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Processes Leading to the Formation of Deep Granitic Shear Zones in the Grenville Front Tectonic Zone, Ontario, Canada

Deborah J. Shulman
University of Maine, deborahjshulman@gmail.com

PROCESSES LEADING TO THE FORMATION OF DEEP GRANITIC SHEAR ZONES IN THE GRENVILLE FRONT TECTONIC ZONE, ONTARIO, CANADA

By

Deborah Joy Shulman

BA, Skidmore College, 2000

BA, University of Vermont, 2004

MS, San Francisco State University, 2011

A DISSERTATION

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Advisory Committee:

Christopher Gerbi, Associate Professor of Earth and Climate Science, Advisor

Nicholas Culshaw, Associate Professor of Earth Sciences, Dalhousie University

Edward Grew, Research Professor of Earth and Climate Science

Scott Johnson, Professor and Director of Earth and Climate Science

Peter Koons, Professor of Earth and Climate Science

Martin Yates, Laboratory Manager and Instructor of Earth and Climate Science

THESIS ACCEPTANCE STATEMENT

On behalf of the Graduate Committee for Deborah Joy Shulman I affirm that this manuscript is the final and accepted dissertation. Signatures of all committee members are on file with the Graduate School at the University of Maine, 42 Stodder Hall, Orono, Maine.

Christopher Gerbi, Associate Professor of the School of Earth and Climate Science Date

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PROCESSES LEADING TO THE FORMATION OF DEEP GRANITIC SHEAR ZONES OF THE GRENVILLE FRONT TECTONIC ZONE, ONTARIO, CANADA

By Deborah Joy Shulman

Dissertation Advisor: Dr. Christopher C. Gerbi

An Abstract of the Dissertation Presented
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The rheology of the deep crust influences the transmission of mantle stresses to the surface as well as the topographic relief of orogenic terrains. Since deformation in the deep crust is often localized in shear zones, we investigate the mechanical processes associated with strain localization to understand the rheology of the deep crust. Strain localizes due to a strength heterogeneity, which can be created by the activation of one or more weakening factors. Studying the mechanical processes and weakening factors that sustain strain localization in the deep crust is becoming increasingly important as geodynamic models become more computationally robust, and therefore more intricate. To research the processes associated with strain localization this study explores ancient shear zones in the denuded core of the Grenville Orogen in Ontario, Canada. This study focuses on a meta-granitoid unit, the Bad River Granite (BRG), of the Grenville Front Tectonic Zone to explore several aspects of strain localization at the m- and km-scale in granitic orogenic crust. The km-scale strain gradients are associated with shear zones along the lithologic boundaries at the BRG's eastern and western edges. Microstructural

and chemical evidence from these gradients show a spatial evolution of the active deformation mechanisms indicating that the shear zone narrowed over time and highlighting the temporal and spatial dynamism associated with shear zone formation. Similar studies of a mylonitic, m-scale shear zone in the BRG show the importance of mass transfer and grain boundary sliding as deformation mechanisms in deep crustal deformation and mylonitization. Lastly, using observations from the km- and m-scale gradients this study also explores six weakening factors to determine whether shear zone formation can be parameterized in a way that allows for prediction of shear zone formation in numerical models. Also, the development of stress heterogeneities at lithologic boundaries is explored through numerical modeling. Results indicate that due to the number of weakening factors and their associated feedbacks, initial variables, and uncertainty in natural conditions shear zone formation is not predictable within reasonable limits. The results presented in this thesis can inform numerical and/or theoretical models as well as other rheologic studies.

This thesis is dedicated
in memory of my father, Dr. Richard Shulman who, just about a month before he passed, asked: "aren't you proud {of yourself}"

And to myself who can now answer: "yes"

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Chapter 1

INTRODUCTION

1.1 Purpose of the study

This study uses observations of natural shear zones to further understanding of how the viscous, granitic crust responds to stress. This research falls under the study of rheology, which attempts to quantify the relationship between stress and strain of materials (Bürgmann & Dresen 2008). Understanding the rheology of the deep crust is important because it can influence the transmission of mantle stresses to the surface and the topography of orogenic terrains. In particular, it is important to investigate the rheology of the granitic deep crust since much of the continental crust is composed of granitoid rock units (Fitz Gerald & Stunitz 1993).

Because deformation in the mid to lower crust is often localized in shear zones it follows that in order to understand the rheology of the deep crust, one must understand the processes associated with strain localization. The term "strain localization" is often used in a variety of manners; here it refers to a measureable amount of strain partitioning at the scale of observation. The importance of the scale of observation is front and center in this definition since strain localization is a process ubiquitous in the lithosphere and across many spatial scales, from microscopic defects in crystal lattices to those that are 10s km wide at plate boundaries. Therefore, deformation may be localized on one scale, yet appear diffuse on another.

Large crustal shear zones are often depicted as extending from the surface through the lower crust and into the mantle, widening with depth (e.g. Teyssier & Tikoff 1998;

Vauchez & Tommasi 2003). In these cases, the rheology of the lower crust can directly influence the ‘communication’ between the mantle and the upper crust. Additionally, numerical models have shown that the strength of the lower crust can influence the topographic relief of orogenic terrains (e.g. Beaumont et al. 2004; Clark et al. 2005; Beaumont et al. 2006; Luth et al. 2010; Vanderhaeghe 2012). Therefore, understanding mid- lower crustal rheology and how shear zones form has a significant impact on our understanding of geodynamic systems.

1.2 Rheology and Rock Strength

Although there are different types of shear zones, those presented in this study represent a spatial distribution of strain such that it increases from the margin toward the core of the shear zone. This strain distribution also indicates that the core of the shear zone is weaker than the margin, therefore there is also a strength gradient represented in the shear zones. Rock strength can be defined in different manners depending on several factors including its rheology.

When discussing the rheology of a material there are three broad categories to describe how a material responds to stress. These rheologies are defined by the relationship between stress and strain or strainrate (Figure 1.1). Elastic rheology describes the stretching and compression of atomic bond lengths and is recoverable (e.g. a slightly stretched rubber band; Figure 1.1a). Plastic rheology describes the unrecoverable breaking of bonds once a yield stress is reached (e.g. a surface fault; Figure 1.1b). Viscous rheology describes the unrecoverable breaking of bonds, but without losing the continuity of a material (e.g. warm taffy; Figure 1.1c). Most materials

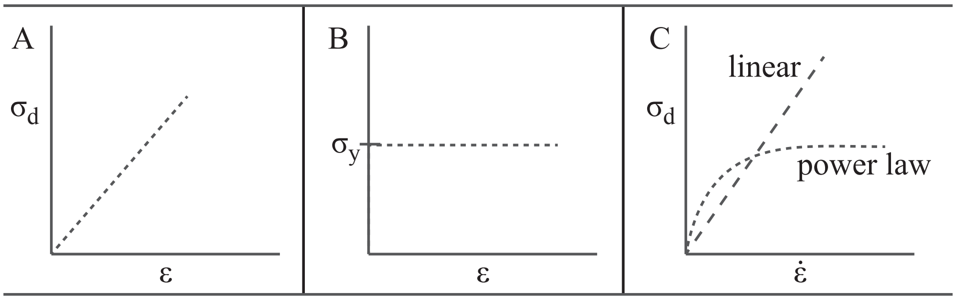


Figure 1.1 Rheologies. A-B graphs of differential stress (σ_d) vs. strain (ε). A. Elastic rheology. Material accommodates strain by stretching and compression atomic bonds. When stress is relieved, all deformation is recovered. B. Plastic rheology. The material is resistant to strain until a yield stress (σ_y) is reached at which point unrecoverable deformation occurs. C. Graph of differential stress vs. strain rate ($\dot{\varepsilon}$). Viscous rheology where material deforms through the breaking of bonds without losing continuity of the material. The relationship between stress and strain rate can be linear or power law.

are best described by a combination of these rheologies. For example, most material has an elastic component (although some are more elastic than others), including all levels of the crust. Therefore, the upper crust is elasto-plastic, such that the strength of the material is based on its yield strength, upon which the rock will fracture. In the mid-crust where the nominal frictional-viscous transition is located, under low stresses and low strain rates, the rock flows viscously, but under high stresses and/or strain rates, the material can fracture. This can be defined as elasto-visco-plastic rheology. With increasing depth higher stresses and strain rates are required to produce fractures and therefore the lower crust's rheology is dominantly elasto-viscous. However, since every level of the crust has an elastic component the upper and lower crust are referred to as plastic and viscous respectively.

Since the deep crust deforms viscously, I define the strength of a material by its effective viscosity, or resistance to flow. This is defined by the relationship between stress and strain rate.

$$\mu = \frac{\sigma}{\dot{\varepsilon}}$$

Where μ is effective viscosity, σ is stress, and $\dot{\varepsilon}$ is strain rate. This relationship can be either linear, as written or have it can have a power-law relationship where a stress exponent (n) is greater than 1 (Figure 1.1c). The strength of a viscous rheology is simply defined by the stress-strain rate relationship $\left(\frac{\sigma}{\dot{\varepsilon}}\right)$. In the case of those materials with a viscous rheology defined by a power-law relationship, the stress-strain rate relationship can evolve over time due to a variety of factors, therefore this relationship must be defined at a moment of time. These factors, which are discussed in Chapter 4, can be categorized as either rock properties (texture, mineralogy, migmatization) or environmental conditions (stress, temperature, fluids). Therefore, the strength of one lithologic unit can be defined by different stress/strain rate curves depending on the spatial distribution of these factors (Figure 1.2). This is especially true for shear zones with a progression in strain from the margin to the core. For example, the core of the shear zone may be finer grained than the margin (e.g. Figure 1.2).

1.3 Deformation in the Deep Crust

In order to understand deep crustal rheology it is important to understand which deformation mechanisms are active within natural shear zones because crustal strength is often quantified by available flow laws, which differ per deformation mechanism. The viscous crust accommodates dynamic strain by three key mechanisms: (1) dislocation creep, (2) mass transfer processes, and (3) grain boundary sliding, sometimes referred to as superplastic flow. These processes accommodate strain at different rates, such that the

total strain rate of a deep crustal shear zone is a sum of the strain rates accommodated by each of these three mechanisms (e.g. Langdon 2006; Warren & Hirth 2006).

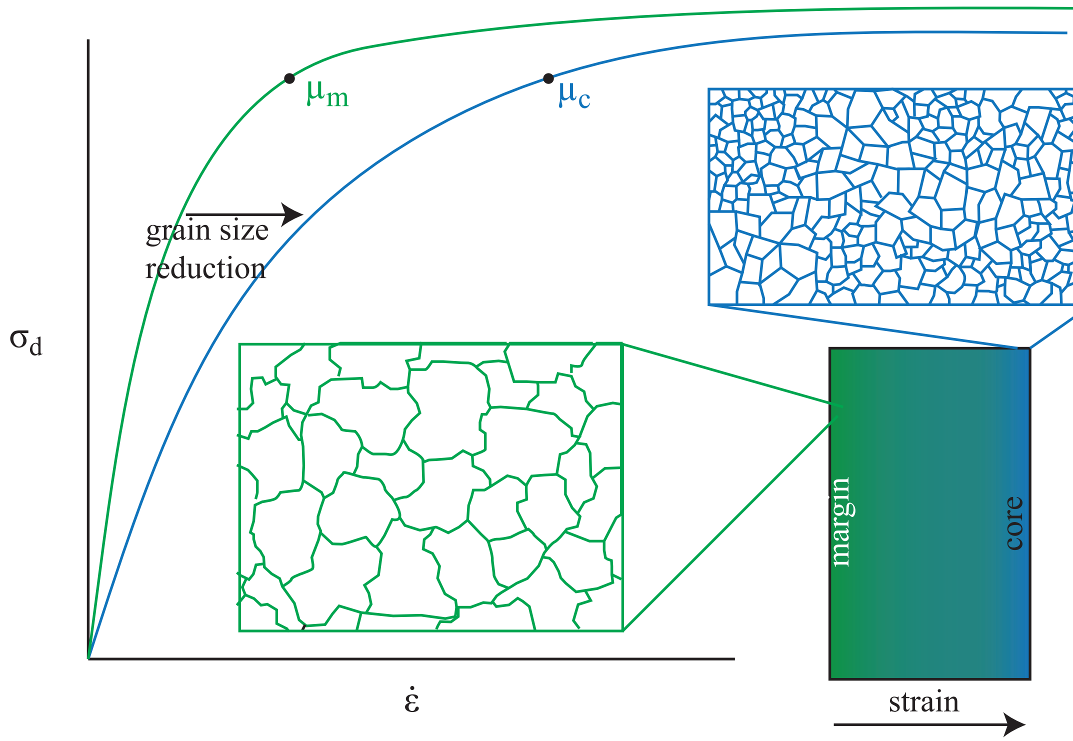


Figure 1.2 Diagram of Power Law Relationship. Diagram of a power law relationship between differential stress (σ_d) and strain rate ($\dot{\varepsilon}$). A rock deforming under viscous conditions by power law creep can have different viscosities based on the spatial distribution of factors that influence a rock's rheology. In this example, at a given stress, a reduction in grain size from the margin to the core of a shear zone creates a spatial variation in the rock's viscosity. Since viscosity is defined by $\sigma_d/\dot{\varepsilon}$, the margin viscosity ($\mu_m$) is greater than the core viscosity (μ_c) and therefore, so is its strength.

1.3.1 Dislocation Creep

Dislocation creep is a grain size insensitive mechanism and includes dislocation glide and climb. The mechanism describes the movement of disparities, or dislocations, in a crystal lattice, which results in recrystallization and/or possibly a change in the shape of grains. The efficiency of dislocation creep at accommodating strain is dependent on temperature and the mineral's properties. For example, dislocation creep can initiate at

~300°C in quartz (M. Stipp et al. 2002) and ~450°C in feldspar (Pryer 1993; Tullis & Yund 1991). The activation of dislocation creep can lead to changes in the shape, size, and orientation of grains through subgrain rotation (SGR) and/or grain boundary migration (GBM), two manners in which minerals can deform depending on temperature and flow stress (Urai et al. 1986; Hirth & Tullis 1992; Dunlap et al. 1997; M. Stipp et al. 2002).

SGR is a mid-grade process where dislocations coalesce to create subgrains (e.g. Poirier & Nicolas 1975; White 1977; Guillope & Poirier 1979). These subgrains are defined by the degree of misorientation. Progressive misorientation can lead to the formation of new grains with a misorientation >10°. SGR leads to grain size reduction and can be identified through undulose extinction and mantled porphyroclasts (e.g. Regime 2 of Hirth & Tullis 1992).

Grain boundary migration is a high temperature process often reported from studies of quartz. It involves the sweeping of dislocations to grain boundaries (e.g. Poirier 1985; Drury & Humphreys 1986). It is often recognized by the presence of strain-free grains (no undulose extinction) with lobate boundaries and a varied grain size (e.g. Regime 3 of Hirth & Tullis 1992). Static grain boundary migration can be identified by a foam-like texture where polygonal grains with straight boundaries form 120° triple points.

1.3.2 Mass Transfer

Mass transfer processes include solution-transfer and diffusion creep. Diffusion creep is accommodated by either Nabarro-Herring creep or Coble creep (intercrystalline

and intracrystalline diffusion, respectively; Herring 1950; Coble 1963). Mass transfer processes are considered grainsize-sensitive mechanisms because a reduction in grain size reduces the length of diffusion and/or solution pathways (Wheeler 1992; Farver & Yund 1995).

The efficiency of solution-transfer is influenced by the amount of pore space and the presence of fluids, either as a fluid phase or a thin film. Pore space is scarce in deep crustal rocks and dilatancy is transient during dynamic recrystallization as grain growth competes with grain size reduction processes (De Bresser et al. 2001; Barreiro et al. 2007). Due to this, solution-transfer is known to be an important deformation mechanism in low-grade conditions. However, evidence for pressure solution at higher grades has been reported (e.g. Rutter & Brodie 1988; den Brok 1998; Farver & Yund 2000). Traditionally, three models for material transport have been proposed for solution-transfer: The thin film model (Weyl 1959; Rutter & Elliott 1976), the island channel model (Raj 1982; Spiers et al. 1990; Cox & Paterson 1991; Lehner 1995), and the Gratz model (Gratz 1991). The thin-film boundary model assumes that grains are separated by a film of water a few nanometers thick. In the island-channel model, grain boundaries are jagged where material from both grains connect to create high stress locations and the spaces in between create a network of channels for the diffusion of dissolved material. The 'islands' and 'channels' are continuously migrating in a steady state manner, but the structure remains the same. The Gratz model uses aspects of the previous two models in that there are static islands with a thin film boundary structure. Micrometer channels are created from microcracking at the grain boundaries and channel networks are developed through etching of the microcracks. The channels are continuously being formed and

their growth is aided by stress corrosion at the crack tips (den Brok 1998). These three methods accommodate strain at different rates. For example at low temperatures (200°C), the island-channel model creates strain rates up to 10 orders of magnitude faster than the other models (J. P. Platt 2015b).

Microstructural evidence for mass transfer processes is summarized in Gower and Simpson (1992) and includes: grain indentation, evidence for fine-scale dissolution and low dislocation densities, grain overgrowths (often leading to a shape preferred orientation (SPO)), and truncation of compositional zoning by indenting grains. Others use the lack of evidence for crystal plasticity (e.g. undulose extinction), a reduction in the strength of a crystallographic preferred orientation as compared to the margin, and the dispersion of phases as evidence for mass transfer processes (e.g. Stünitz & Fitz Gerald 1993).

1.3.3 Grain Boundary Sliding

Grain boundary sliding (GBS) describes the movement of grains past each other and therefore is also thought to be a grain size sensitive mechanism since reduced grain sizes facilitate grain movement. Due to volume constraints in the deep crust, GBS is closely linked to the other deformation processes such as dislocation creep (disGBS; Hirth & Kohlstedt 1995; Hirth & Kohlstedt 2003; Warren et al. 2008) or mass transfer processes (e.g. Tullis et al. 1996, Svahnberg & Piazolo 2013).

Some authors have suggested that mass transfer processes must be accommodated by grain boundary sliding (e.g. Lifshitz 1963; Stevens 1971; Kim & Hiraga 2000) and visa versa (Raj & Ashby 1971; Mori et al. 1998; Langdon 2000; Kim & Hiraga 2000;

Langdon 2006). In a polyphase rock this process (referred to as diffGBS) consists of the nucleation of one phase at the boundary of another phase. The driving forces have often been stated as being chemical potentials (e.g. Stünitz & Tullis 2001), but several studies report evidence for GBS under relatively isochemical conditions. A study by Walderhaug et al. (2006) on sedimentary cement suggested that an electric surface potential difference across mineral interfaces might be a critical driving force in mass transfer. Kristiansen et al. (2011) took this a step further to show that the electrochemical reactions at certain phase boundaries will promote dissolution while others will suppress dissolution depending on several factors including phase, orientation, and surface topology. However, Kruse & Stünitz (1999) discount surface energies as the main thermodynamic driving potential for recrystallization or nucleation, but recognize that it may play an important role in the location of nucleation. If the surface energies of phase boundaries are lower than that of like-phase grain boundaries, then nucleation may favor phase boundaries.

Evidence for GBS is limited, but mass transfer accommodated GBS is a deformation mechanism that efficiently disperses phases (Ashby & Verrall 1973). Several studies have shown evidence that GBS created dispersed textures in two-phase mixing in the tails of porphyroclasts (e.g. Kenkmann & Dresen 1998; J. P. Platt 2015b) or in mylonites (e.g. Behrmann 1985; Kruse & Stünitz 1999; Thomas Kenkmann & Dresen 2002; Halfpenny et al. 2006; Oliot et al. 2014; Czaplińska et al. 2015a). For example, Kruse and Stunitz (1999) show TEM images of nucleated amphibole at plagioclase boundaries and visa versa in an ultramylonite. Therefore, a mixed phase matrix is often used as evidence for GBS.

1.4 Studying the Deep Crust

To understand the role these deformation mechanisms play in strain localization one must study deep crustal shear zones. However, this is not an easy task due to the lower crust's inaccessibility and heterogeneity. There are at least three manners of exploring deep crustal rheology, all of which are valuable and provide unique sets of data that can be used to inform the others.

One way to study mid-lower crustal rheology is through high temperature and pressure deformation experiments conducted in a laboratory and extrapolate to geologic conditions. These studies provide curve fitting equations, or flow laws, that incorporate stress, temperature and grain size. Most flow laws are from experimental deformation studies of monomineralic aggregates and thus are mineral-specific. Therefore, it is generally accepted that they cannot be used to quantify the rheology of polyphase rocks. However, there are a limited number of flow laws from experimental studies on polyphase rocks (e.g. granite, Hansen & Carter 1983; and biotite schist, Shea & Kronenberg 1992). Also, several studies have proposed bulk flow laws for systems with two phases (e.g Hill 1965; Tullis et al. 1991; Dimanov & Dresen 2005), multiple phases (e.g. Ji et al. 2003; Ji 2004), or considering textural parameters (e.g. Handy 1990a; Shaocheng Ji & Pinglao Zhao 1994; Takeda 1998; Ji et al. 2003; Montési 2007; Montési 2013). Although these bulk flow laws provide a base line for quantifying rheology of simple, 2-phase deep crustal systems, observations of natural systems indicate they often include poly-phase units and complexities that cannot be quantified by the available flow laws (e.g. Rutter 1999; Gerbi 2012; Cook et al. 2014; Gerbi et al. 2015).

Another way to try and understand mid-lower crustal rheology is through theory and/or numerical modeling. However, there are at least two obstacles in incorporating lower crustal rheology into geodynamic models: (1) lower crustal rheology is not yet parameterized in a way that can be incorporated into large-scale numerical models and (2) there are still many unknowns about how natural shear zones form.

The results of such experimental, numerical, and theoretical studies provided a wealth of knowledge in terms of crustal rheology. For example, a variety of factors have been shown to influence a rock's strength such as temperature, grain size, the presence of fluids or melt, texture, and morphology. In fact, numerical modeling is used in Chapter 4 to investigate the influence of stress on strain patterns in the lower crust. However, to ensure that numerical models match observations of the natural world it is important to learn from natural shear zones. Therefore, the third way to investigate mid-lower crustal rheology is to research natural, deep crustal shear zones by studying ancient shear zones exposed at the surface today. Through field observations and the use of modern analytical techniques geologists are able to document changes across strain gradients from ancient mid-lower crustal shear zones. The data provide evidence for the processes and mechanisms that lead to shear zone formation and strain localization.

1.5 Study Location

In order to study shear zones of the granitic deep crust I spent several summers collecting data and samples from a granitoid unit in the ancient orogenic terrain of the Grenville Province in Ontario, Canada.

1.5.1 Broad Regional Setting

The Grenville Orogen was formed by a series of mountain building events on the Laurentian margin during the assembly of Rodinia. Grenvillian aged outcrops have been documented from Texas through Labrador (Hynes & Rivers 2010) and the Grenville Front is well mapped in Canada from east of Killarney, Ontario, northeast to the Labrador Sea (Figure 1.3a). The prolonged tectonic history and accumulation of multiple orogenic events are analogous to the processes that form the Himalaya and Tibetan Plateau. The Himalaya provide a unique opportunity to study the interactions among Earth systems from mantle dynamics through orographic systems. However, in order to fully understand such a dynamic system, we must better understand crustal dynamics and therefore, crustal rheology. The present day exposures of what were mid- to lower crustal Grenvillian rocks provide a proxy for similar depths under the present day Himalaya and Tibetan Plateau.

1.5.2 Canadian Exposure

Tollo et al. (2004) describe The Grenville Province of Canada: "The Grenville Province of Canada, represents the classic location for and the longest continuous segment of Late Mesoproterozoic orogenic belts in the world (Wynne-Edwards 1972; Davidson 1995)". The Grenville Orogen of today that is exposed in south eastern Canada has been divided into three tectonic units, (1) the Frontenac-Adirondack Belt is made of supracustal and granitoid rocks and anorthosites that was either a distinctive part of the composite arc belt or an offshore micro-continent (units formed between 1300 – 1130 Ma), (2) the Composite Arc Belt is made of allochthonous volcanic arcs and sedimentary

rocks (formed <1300 Ma), and (3) the pre-Grenvillian Laurentian crust (Grenville Front Tectonic zone) and Laurentian Margin (Central Gneiss Belt) (Figure 1.3b; Rivers et al. 1989; White et al. 2000). The formation of each of these units is part of a long tectonic history, the evidence for which is discontinuous and varies by location. For this reason, there are a number of variations for nomenclature of rocks, units and structures. Even the definition for the "Grenville Orogeny" varies among authors. Similar to Rivers (1997), Gower & Krogh (2002), and Rivers (2008), I reserve the term "Grenville Orogen" for the mountain building events ca. 1090-980 Ma. However, there are several preGrenvillian events that are important in discussing the formation of the Grenville Province and its tectonic units.

Prior to the Grenvillian Orogeny, the eastern Laurentian margin experienced several tectonic periods. The earliest involves the production of juvenile crust during the Mazatzal Orogeny (1.7-1.6 Ga; Whitmeyer and Karlstrom, 2007). Following were a series of accretionary events, the details of which are not agreed upon. For example, according to Rivers & Corrigan (2000), the Pinwarian Orogeny (c.a. 1495-1445 Ma), the earliest regional metamorphic event, is associated with the first arc accretionary event. Others deem the arc accretion of the late Elzevirian (ca. 1350-1190 Ma) was the first (Carr et al. 2000; Tollo et al. 2004). Either way, there was a period of magmatism and arc activity from ~1500 to 1190 Ma accompanied by accretion onto the Laurentian margin before continental collision. This accretion formed the Composite Arc Belt and the Frontenac-Adirondack Belt (Figure 1.3b). There is also evidence for ~1450 plutonism in several domains of the Central Gneiss Belt (Slagstad et al. 2009). Post Elzevirian accretion, the region experienced little to no metamorphism, which has been

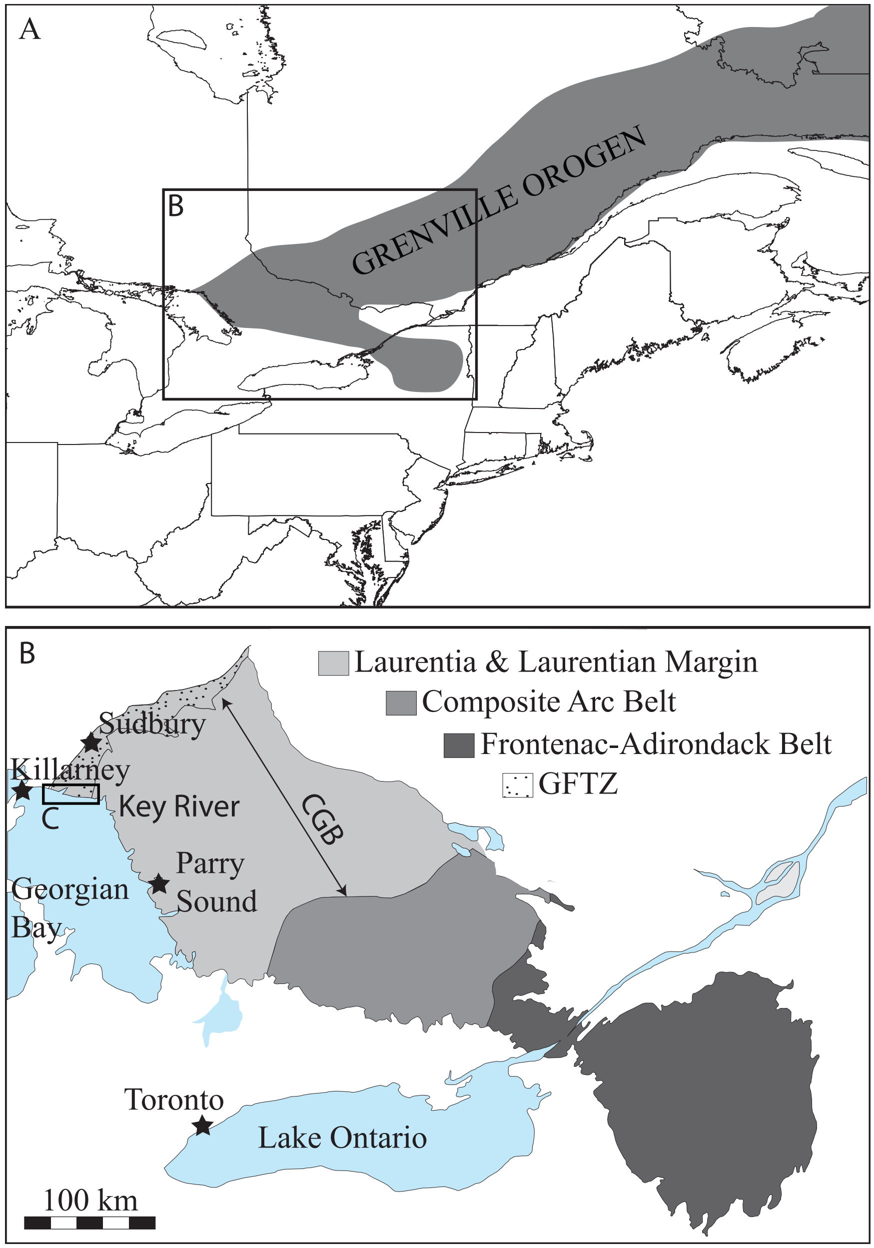


Figure 1.3 Maps of Field Area. A. Extent of Grenville Orogen in Canada and northern New York, USA after Gerbi et al., (2010). B. Tectonic units of the Grenville Orogen in Canada and northern New York, USA after Carr et al., (2000). GFTZ- Grenville Front Tectonic Zone, CGB- Central Gneiss Belt. C. (next page) Local geographic features and rock units mapped in conjunction with this thesis in reference to the Grenville Front.

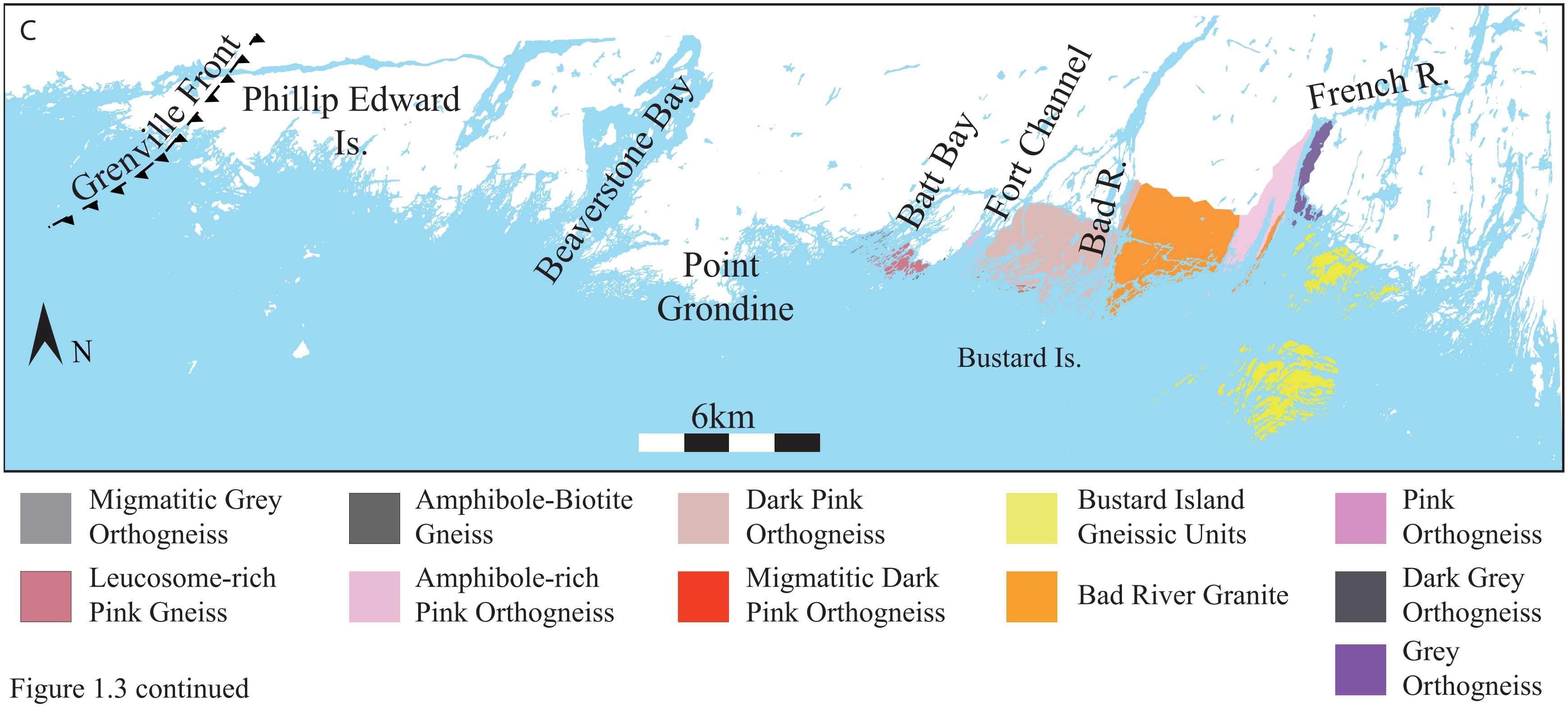


Figure 1.3 continued

suggested to coincide with Midcontinent rifting. Culshaw et al. 1997 mention the possibility of softening by mid-crustal heat. At the least, the end of the rifting and associated volcanism coincides with the onset of the Ottawan orogeny (Cannon 1994; Carr et al. 2000).

The Grenville Orogeny coincides with a change from Andean-type arc collision to Himalayan-type continental collision. The orogeny has been divided into two pulses or sub-orogenies, the Ottawan Pulse from ~1090-1020 Ma and the Rigolet Pulse from ~1000-980 Ma (Moore & Thompson 1980; Rivers et al. 1989). Widespread continental collision began at the beginning of the Ottawan Pulse ca. 1090 Ma (Carr et al. 2000). Northwest directed convergence during the Ottawan is marked by the development of a series of thrust belts that emplaced the previously accreted Composite Arc Belt and Frontenac-Adirondack Belts over Laurentia (Rivers et al. 1989; Carr et al. 2000; Rivers 2008). This resulted in regional amphibolite to granulite grade metamorphism with localized regions of high-pressure metamorphism in what is now the Central Gneiss Belt (Figure 1.3b). This is also proposed to have developed an orogenic plateau similar to the Tibetan Plateau (Jamieson et al. 2007; Rivers 2008). Ottawan metamorphism ceased at ~1020 Ma most likely due to orogenic collapse ~1050-1020 Ma (Rivers 2008). The establishment of a new tectonic regime by 1000 Ma resulted in the advancement of the orogen into its foreland. This coincides with widespread thrusting in what is now the Grenville Front Tectonic Zone (GFTZ; Carr et al., 2000; Rivers, 2008; Jamieson et al., 2010).

1.5.3 The Grenville Front Tectonic Zone

The GFTZ of the Grenville Province extends northwest from western Phillip Edward Island, Ontario, Canada to the Labrador Sea (Figure 1.3a). At its southern end, the front zone width encompasses the area along the north shore of Georgian Bay, from Killarney to the French River outlet (Figure 1.3b). Figure 1.3c shows locations of rock units explored in connection with this study, but this thesis focuses on a granitoid unit dubbed here the Bad River Granite. Two large-scale strain gradients coincide with the lithologic boundaries at the eastern and western edges of the unit, which also coincide with the Bad and French Rivers. As shown in Chapter 3, the Bad River Granite also has a series of smaller, m-scale, shear zones with mylonitic cores, which makes it an ideal location to study granitic rheology across spatial scales.

The most recent geologic maps available of the southern Ontario exposure of the GFTZ were published as part of an examination of the coastal exposure along the north coast of Georgian Bay from Killarney to Key River (~85 km) by Davidson & Bethune (1988). The GFTZ is composed of 1700-1800 Ma granitoids, migmatitic orthogneisses and subordinate paragneisses with varied metamorphic histories. The units were reworked in the Grenville to form a series of SE-dipping mylonitic shear zones with prominent down-dip lineation (Davidson & Bethune 1988; Jamieson et al. 1995). A seismic study conducted in 1986 in southern Ontario revealed large shear zones associated with the GFTZ that dip moderately to the SE while those under the Central Gneiss Belt (CGB) to the east dip moderately and then level out (Figure 1. 4; Green 1988; White et al. 2000). A cross-section including the data collected from the field area studied in this thesis indicates that foliation consistently dips ~55° SE with minimal

variation (Figure 1.4). Metamorphic grade increased from 594±25°C / 6.3±0.4 kbar at the Grenville Front to 747±50°C / 10.8 ±0.8 kbar toward the western border of the GFTZ (Jamieson et al. 1995). A study by Bethune & Davidson (1997) reports similar results of 730±10°C / 6.7±1 kbar from garnet-clinopyroxene pairs in metamorphosed diabase dikes towards the western edge of the GFTZ.

The Grenville Front Tectonic Zone (GFTZ) is the youngest tectonic feature of the Grenville Province. Rivers (2008) suggest that the parautochthonous rocks of the GFTZ underwent a rapid cycle of burial and metamorphism ~1090-1050 Ma and thrust exhumation ~1000 -980 Ma, after which tectonic activity ceased. Jamieson et al. (2010) show that the GFTZ thrust exhumation may have occurred due to gravitational spreading immediately after convergence ceased. Ages of Grenvillian deformation have been reported from U-Pb and $^{40}Ar/^{39}Ar$ analyses from several areas along the GFTZ. Using U-Pb from zircon, apatite, and titanite Corfu & Easton (2000) report penetrative deformation, folding, amphibolite facies metamorphism and extensive migmatization between 995 and 977 Ma in the Street Township area, approximately 100 km north of Killarney along the Grenville Front. Haggart et al. (1993) report a titanite lower intercept age of 978±13 Ma from samples near Killarney. They also report hornblende $^{40}Ar/^{39}Ar$ cooling ages of ~450° at 993-979 Ma, K-feldspar cooling ages of 465-340°C at 990-960 Ma, and muscovite cooling ages of ~320°C at 930 Ma, suggesting a short-lived thermal event followed by rapid exhumation. This supports the models proposed by Rivers (2008) and Jamieson et al. (2010) discussed above. One U-Pb age of study by Davidson & van Breemen (1994) reports a primary zircon age of 1467 +11/-7 for the Bad River Granite (referred to as the King's Island pluton).

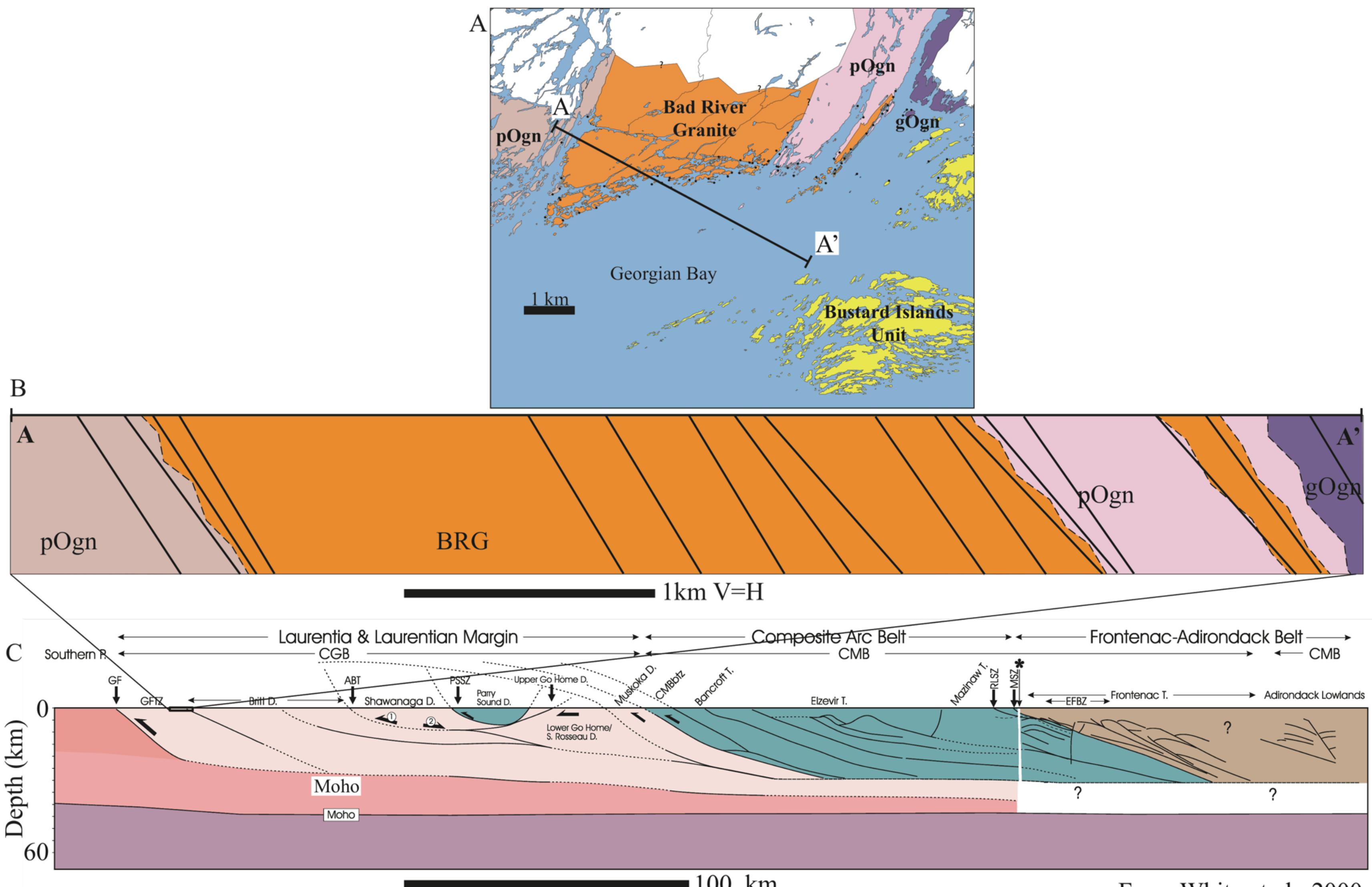


Figure 1.4

From White et al., 2000

1.6 Concluding Remarks

This thesis uses observations from ancient, mid-crustal shear zones of the Grenville Front Tectonic Zone (GFTZ) in Ontario, Canada to explore several aspects of strain localization at the meter and kilometer scale in granitic orogenic crust. The second and third chapters report chemical and microstructural changes across ancient km- and m-scale strain gradients, respectively. The results further our understanding of the processes leading to the formation and propagation of mid-crustal, granitic shear zones. The fourth chapter reviews six weakening mechanisms that can influence a rock's strength and uses the findings from the previous two chapters to analyze whether strain localization can be parameterized in such a way to allow for prediction of shear zone formation in numerical models.

The results presented in this thesis can inform numerical and/or theoretical models as well as other rheologic studies. I hope that my work will also spark more conversation about the complexity of crustal rheology and how this may impact future geodynamic models. Lastly, this thesis provides new geochronological data and detailed mapping of the GFTZ.

Chapter 2

THE TIMING AND ANATOMY OF GRANITIC STRAIN GRADIENTS IN THE GRENVILLE FRONT TECTONIC ZONE, ONTARIO, CANADA

2.1 Chapter Abstract

Observations of physical and chemical changes across strain gradients can provide information about the processes that lead to localization and therefore provide an opportunity to gain a better understanding of crustal rheology. The literature is rich with chemical and microstructural studies of natural shear zones in metapelites and mafic lithologies, but few have described crustal-scale granitic strain gradients despite the fact that granitoid bodies make up much of the orogenic crust. This study reports microstructural and compositional data across two km-scale strain gradients in a granitoid unit in the Grenville Front Tectonic Zone in Ontario, Canada. The high strain regions of both gradients fall on lithologic boundaries with older orthogneisses. Zircon U/Pb ages indicate that the strain gradients in the granite were formed during the Grenville Orogeny and that the unit is monocyclic, providing a simple deformation history. Whole rock analyses reveal some natural heterogeneity exists in major element distribution in the granite and homogeneity in the trace elements, indicating no effect of strain on composition. In contrast, microstructural and mineral chemistry analyses across the two strain gradients indicate some effects of strain: slight changes in mineral compositions, development of crystallographic preferred orientations in quartz, a reduction in recrystallized grain size, and the development of a mixed-phase matrix. However, most of these variations are subtle and occur at different positions across the gradients. The

spatial distribution of the microscale changes suggests a temporal evolution from dislocation creep to diffusion creep accompanying increased localization toward the lithologic boundaries of the unit, consistent with the strain gradients steepening over time.

2.2 Introduction

Evidence for strain localization has been well established in mid- to lower orogenic crust. The size, orientation and distribution of shear zones can affect orogen-scale patterns of heat flow, kinematics, metamorphism, fluid flow, and topographic variance (e.g. Dahlen et al. 1984; Beaumont et al. 2001; Groome et al. 2008; Upton & Craw 2009). They are the roots of surface faults and their strength can influence the communication of mantle stresses to the surface (e.g. Klepeis et al. 2004; Handy et al. 2007; Chatzaras et al. 2015).

These large scale shear zones are both the result and cause of rheologic heterogeneities in the mid- to lower crust. They can form at pre-existing strength heterogeneities (e.g. boundaries of lithotectonic units within an orogenic terrain or pre-existing structures) or they can form within relatively homogenous units. In both scenarios, once formed, the weakened state must persist to continue to localize strain. This is often accommodated by one or more weakening mechanisms such as grain size reduction or the development of a crystallographic preferred orientation (e.g. Poirier 1980; White et al. 1980; Montési & Zuber 2002; Regenauer-Lieb & Yuen 2004). Which factors dominate in the formation of natural shear zones is still not fully understood.

Therefore, it is important to document evidence for such processes in exhumed, natural shear zones.

2.2.1 Previous Studies

Detailed studies of ancient mid- to lower crustal strain gradients in various rock types have been conducted in an attempt to understand deep crustal rheology. Studies on high-grade, lower crustal shear zones are often restricted to mafic or metapelitic shear zones; systems that are susceptible to metamorphic reactions (e.g. Snoke et al. 1999; Racek et al. 2006; Chambers et al. 2009; Marsh et al. 2011). However, there are some studies that report on natural granitic shear zones spanning numerous geographic locations, crustal depths, and answering a variety of research questions.

Some studies are structural investigations that have been conducted on granitic shear zones. These studies may contribute to a tectonic reconstruction at some point in time (e.g. Wegmann et al. 2008) or they may focus on developing methods, such as studies that use local shear zone patterns to derive aspects of the large-scale bulk strain in granitic bodies (e.g. Gapais et al. 1987; Menegon and Pennacchioni 2010).

There are also rheologic studies conducted on granitic shear zones. Some focus on the behavior of felsic minerals, in particular feldspars, at different levels of the crust. For example, studies on granitic shear zones have shown that feldspars can recrystallize by nucleation below 450-500° C (Fitz Gerald and Stunitz, 1993) and granular flow of feldspars is common in low-grade metagranites (Stunitz and Fitz Gerald, 1993). In lower grade rocks, some authors have shown how the reduction of grain size in feldspars by fracturing, neocrystallizaiton along fractures, and myrmekite formation lead to a

switch in deformation mechanism and thus weakened the rock (e.g. Ree et al., 2005; Ishii et al., 2007). Other rheologic studies of granitic shear zones focus on deformation of the rock as a whole, such as determining competency contrasts between different plutonic phases based on shear zone patterns (Belkabir et al. 1998). Some are microstructural studies that determine how granitoids respond to stress under certain conditions. For example, both brittle and viscous processes can take place coevally at greenschist facies conditions (Berthe et al. 1979) and fluid assisted mass transfer can be active between 300-600° C (Kwon et al. 2009).

Another common motivation for rheologic studies of granitic shear zones is to answer the question: why did this shear zone form? The results of such studies vary. Some highlight the importance of pre-existing fabrics on shear zone formation because they can be pathways for fluids (e.g. Segall and Simpson, 1986) or they can be inherited strength heterogeneities on which strain can localize (e.g. Christianson and Pollard, 1997). Others report the significance of rock fabrics and microstructures on shear zone formation (e.g. Schulmann et al., 1996; Martelat et al., 1999) or how the presence of melt can influence shear zone formation (e.g. Marsh et al., 2011). According to several studies the presence of syn-tectonic melt led to granular flow (e.g. Zavada et al., 2007 and Schulmann et al., 2008) or diffusion creep (e.g. Garlick and Gromet, 2004), reducing the strength of the rock. Metamorphic reactions are highlighted in studies by Vauchez et al. (1987) and Oliot et al. (2010) that show continuous recrystallization of feldspars (e.g. myrmekite formation) can lead to shear zone initiation and development. Lastly, many studies highlight the important relationships among several factors, such as reaction

softening and strain (Tsurumi et al., 2003; Kilian et al., 2011) or reaction softening, strain, and fluids (Menegon et al., 2006; Culshaw et al., 2010).

Most of the afore mentioned studies are conducted on small shear zones ranging from mm-cm scale (e.g. Segall and Simpson, 1986; Christiansen & Pollard, 1997; Vauchez et al., 1987, Menegon & Pennacchioni, 2010, Killian et al., 2011) to m-scale (e.g. Schulmann et al., 1996; Belkabir et al., 1998; Tsurumi et al., 2003; Garlick & Gromet, 2004; Kwon, et al., 2009; Oliot, 2010). Those that are studies of km-scale shear zones are most often documenting evidence of processes occurring at greenschist facies conditions (e.g. Berthe et al., 1979; Bozkurt & Park, 1994; Ree et al., 2005; Wegmann et al., 2008). Fewer studies document evidence for processes that lead to lower-crustal, km-scale, granitic shear zones (e.g. Martelat et al., 1999).

This paper reports new geochronological, microstructural, and chemical data across two km-scale strain gradients in a granitic unit at the eastern edge of the Grenville Front Tectonic Zone (GFTZ) in Ontario, Canada. The exposure of these ancient strain gradients provides an opportunity to study mid-crustal, orogenic, km-scale granitic shear zones in detail as well as shed light on the timing of GFTZ tectonics.

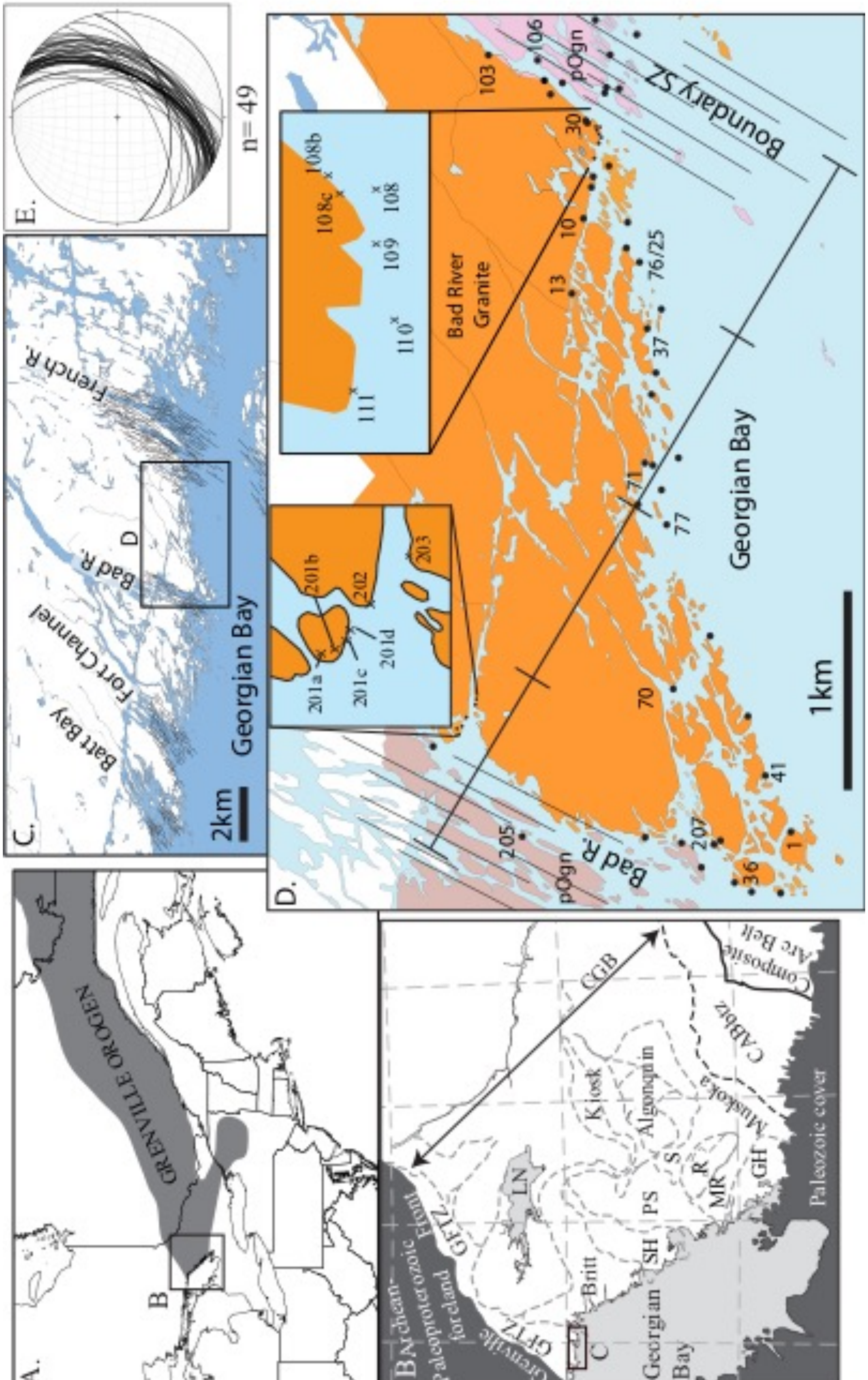
2.3 Geological Setting

The Grenville Orogeny is considered to have been a Himalaya-Tibetan type collision that affected the region from present day Texas through Labrador in North America (Hynes & Rivers 2010). The most continuously exposed package extends for ~2000 km in eastern Canada (Figure 1a). Archean to Paleoproterozoic Laurentian crust was reworked during a sequence of collisional Grenville events from approximately 1100

to 980 Ma (Wynne-Edwards, 1972; Davidson et al. 1982). The Grenville Front Tectonic Zone (GFTZ; Figure 1b) formed during late stages of orogenesis when the orogen migrated northwest into the Laurentian craton due to crustal thickening to the southeast (Jamieson & Beaumont 2011).

The southern extent of the GFTZ in Ontario encompasses the area from Killarney to the French River and crops out along the northern shore of Georgian Bay. This part of the GFTZ is identified by north-northeast oriented lenticular rock units (Hynes & Rivers 2010) separated by strongly foliated, southeast-dipping, migmatitic orthogneisses and subordinate paragneisses with thrust sense kinematic indicators (Davidson & Bethune 1988; Jamieson et al. 1995). Peak metamorphism in this region of the GFTZ increases in grade to the east, having reached amphibolite to granulite facies ca. 1035-980 Ma (Jamieson et al. 1995; Carr et al. 2000 and references therein). The GFTZ had a short burial history most likely due to syn-orogenic erosion causing rapid exhumation along a crustal-scale detachment ramp (Beaumont et al. 1992; Rivers et al. 1993; Jamieson et al. 1995; Jamieson et al. 2010).

The eastern boundary of the GFTZ in southern Ontario is located along the French River outlet to Georgian Bay (Figure 1c). The French River coincides with the Boundary Shear Zone, a major shear zone that separates the GFTZ from the Central Gneiss Belt to the southeast (Jamieson et al. 1995). The parautochthonous Britt domain is pre-Grenvillian Laurentian crust composed of polymetamorphic quartzofeldspathic gneisses (Pinwarian ca. 1450 Ma metamorphism) locally intruded by Pinwarian plutons (van Breeman et al. 1986; Corrigan et al. 1994). Davidson et al. (1982) defined the Britt


A.
GRENVILLE OROGEN
B
B Archean-Paleoproterozoic foreland
Grenville Front
GFTZ
C
Georgian Bay
Britt
SH
PS
LN
MR
GH
R
S
Algonquin
Kiosk
Muskoka
CABbz
Composite Arc Belt
CGB
Paleozoic cover
C.
Batt Bay
Fort Channel
Bad R.
D
French R.
Georgian Bay
2km
D.
pOgn
Bad R.
Bad River Granite
Georgian Bay
Boundary SZ
1km
E.
n=49

domain based on lithologic assemblages, structural style, and metamorphic grade, and determined that it lies within a thrust stack at a deep structural level. Culshaw et al. (1997) identified Britt as "polycyclic", a polyorogenic terrain with major tectono-metamorphism before the Grenville cycle. Culshaw et al. (1994) show that in the southern Britt Domain thrusting was followed by extension as a result of thermal relaxation and fluid ingress. To the west of the Boundary Shear zone there are a series of NE-SW trending, km-scale, thrust-sense shear zones that accommodated the Grenvillian strain in the GFTZ (Davidson & Bethune 1988). A seismic study conducted in 1986 in southern Ontario revealed large reflectors dipping southeast interpreted as the continuation of shear zones mapped at the surface of the GFTZ at depth(Green 1988; White et al. 2000). While those overlying the GFTZ and within the Central Gneiss Belt (CGB) to the southeast dip moderately and then level out.

2.4 Macroscale Field Observations

The western margin of the Boundary Shear Zone is the Bad River Granite, ~5 km wide in map view, that is the focus of this study (Figure 2.1d). The Bad River Granite is also bounded by a km-scale shear zone on its western margin, which coincides with the Bad River outlet to Georgian Bay. Both the western portion of the Boundary Shear Zone and the Bad River Shear Zone cores are within highly deformed pink orthogneisses distinct from the Bad River Granite. Although the bulk of the strain was accommodated in the two bounding gneisses that most likely experienced more than one strain history, strain gradients developed within the granite; evidenced by the development of stronger fabric and the stretching of magmatic enclaves toward the granite's eastern and western

edges. However, strain gradients developed within the granite, evidenced by the development of stronger fabric and the stretching of magmatic enclaves toward the granite's eastern and western edges. These strain gradients provide an opportunity to document chemical and microstructural changes with strain, something that is not possible in the high strain straight gneisses to the east and west. Sample sites were projected to a transect drawn approximately normal to the fabric, such that the least sheared site is located between the two high strain zones on the eastern and western edge of the granite (Figure 2.1d).

2.4.1 Pink Orthogneiss Units

Both units of pink orthogneiss are fine grained and sugary in texture with amphibole rich layers that show a L=S penetrative, planar fabric (Figures 2.2a, b). The western pink orthogneiss is a darker pink and coarser grained than the eastern, although the eastern pink orthogneiss contains some coarse grained pods or layers (Figure 2.2c). Both units record little evidence of internal strain gradients. The units consists of K-feldspar, quartz, and plagioclase with minor amounts of biotite, amphibole.

2.4.2 Bad River Granite

The Bad River Granite contains predominantly plagioclase, K- feldspar, and quartz, with minor amounts of amphibole, biotite, garnet, Fe-Ti oxides, apatite, and zircon. Due to compositional heterogeneity, the unit straddles the boundary between quartz monzonite and granite; for the purposes of this paper we refer to the unit as the Bad River Granite.

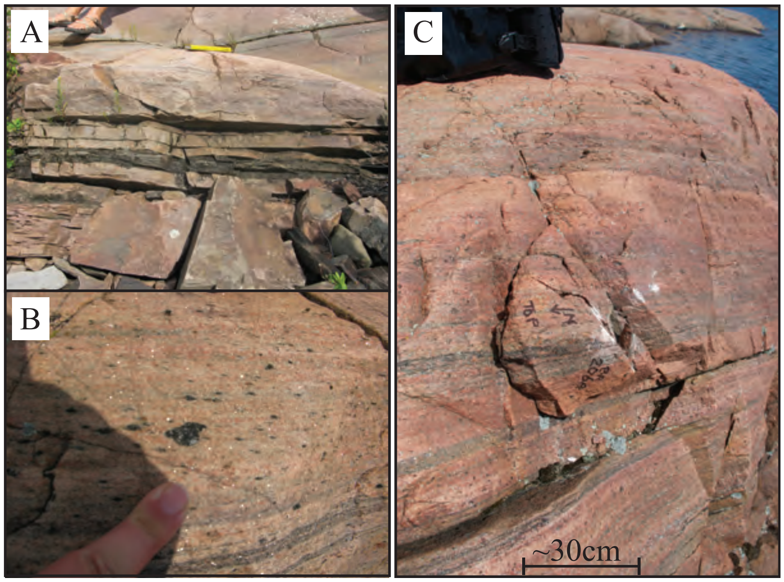


Figure 2.2 Macro-scale Images of Pink Orthogneiss Units. Eastern (A, B) and western (C) pink orthogneiss units that bound the Bad River Granite

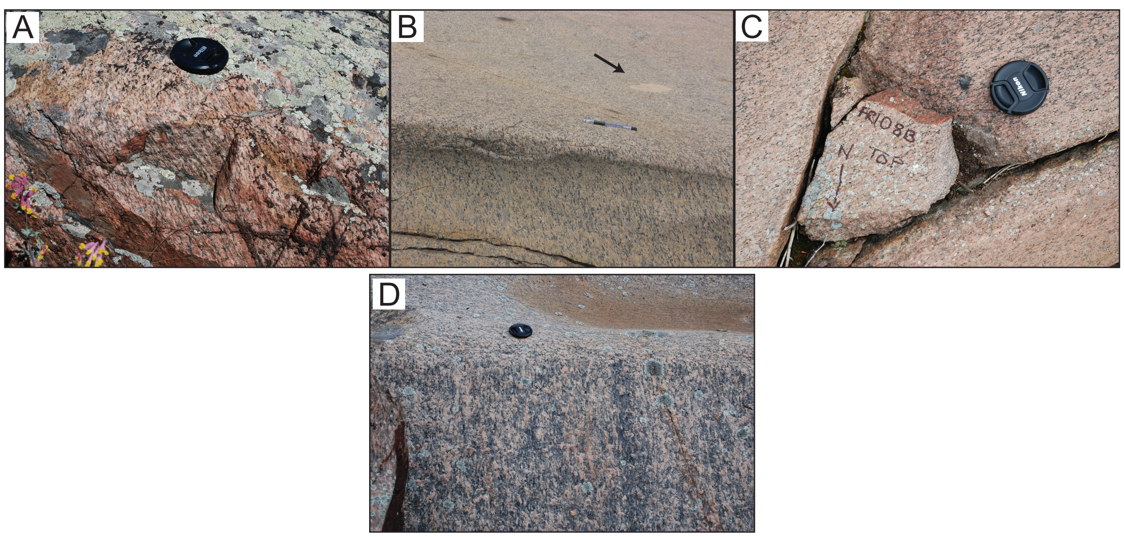


Figure 2.3 Fabric Evolution Across the Transect. A. Strong foliation and lineation of most strained western sample (201a). B. L>S fabric of low-strain site 41. A round xenolith can be seen on the surface (arrow). C. Strong foliation and lineation of the eastern high strain zone. D. Weak lineation and steep rake on the foliation surface of the easternmost site, 103.

A NE-SW striking fabric (Figure 2.1e) transitions from a weak L>S fabric in the least sheared region to a L=S fabric at the boundaries of the unit, where lineation is defined by amphibole and biotite grains and feldspar aggregates (Figure 2.3). In the least

strained portion of the granite, low strain leaves igneous features relatively undeformed, preserving their original aspect ratio in the map view (close to the principal plane of the strain ellipsoid showing the least strain), such as long (>10m) schlieren bands, xenoliths of the pink orthogneisses, and magmatic enclaves (Figure 2.4). The enclaves, which are in places found in groups, are preserved across most of the transect. The fabric strengthens at the boundaries (Figure 2.3a, c), evidenced by grain size reduction and the deformation of all magmatic features including the stretching of enclaves and xenoliths. The regional fabric is cut by pegmatites and grey dikes that vary in orientation as well as by E-W trending fracture sets.

Figure 2.4 Igneous Features Found in the Granite. A. Schlieren at site of sample 76. B. Site 37 schlieren defining two compositional domains. C. Site 41 pocket of enclaves.

Small discrete shear zones (~10 m wide) are scattered across the central and western segments of the transect and dominantly strike ENE-WSW. Their lengths are indeterminate as many of them are found along the coastline and their exposure is partially covered by water, but most can be traced for ~10-20 m and they crosscut the regional fabric. Although most were found in the least sheared areas of the granite

between sites 41 and 13 (see Figure 2.1d), one was found on the southwestern shoreline of the Bad River and another at site 1. None were found east of site 13.

2.4.3 Transformation of Magmatic Enclaves

To provide a semi-quantitative proxy for strain, we measured the aspect ratio of over 1,700 stretched enclaves across the transect (Figure 2.5a). In order to avoid duplicate measurements and reduce bias, we measured the lengths and widths of all enclaves within or immediately adjacent to one- or two- meter squares drawn on the outcrop at each measuring station (Figure 2.5b, c). Exposure on the glacially polished surfaces was not sufficient in the vertical direction to measure three-dimensional aspect ratios. We recognize that this two-dimensional approach incorporates several sources of uncertainty, including: (1) the foliation is moderately-steeply dipping (45-60° SE), thus the outcrop surface is rarely perpendicular to foliation and (2) the surfaces were not always completely flat, such that the error per station may vary. Given the dip, enclave widths are approximately 20-30% narrower than true foliation-normal widths.

We cannot utilize these measurements directly to quantify strain, as explained below, but we can use them to track relative strain across the transect, given several assumptions. (1) As with most strain analysis, we assume the enclaves are passive markers and that the strain is homogenous at each site. (2) We also assume the rheological differences among the enclaves and between the enclaves and the host granite are insignificant. Tobisch & Williams 1998 modeled enclave and granite rheologies based on composition, stress, and strain rate. They found negligible differences between biotite-amphibole rich enclaves and granite host rheologies at granulite to amphibolite

facies temperatures and moderate stresses (~10 MPa) and strain rates (10^{-13} to 10^{-11} s^{-1}).

However, Pearce et al. (2011) showed that mafic dikes are weaker than gneisses under

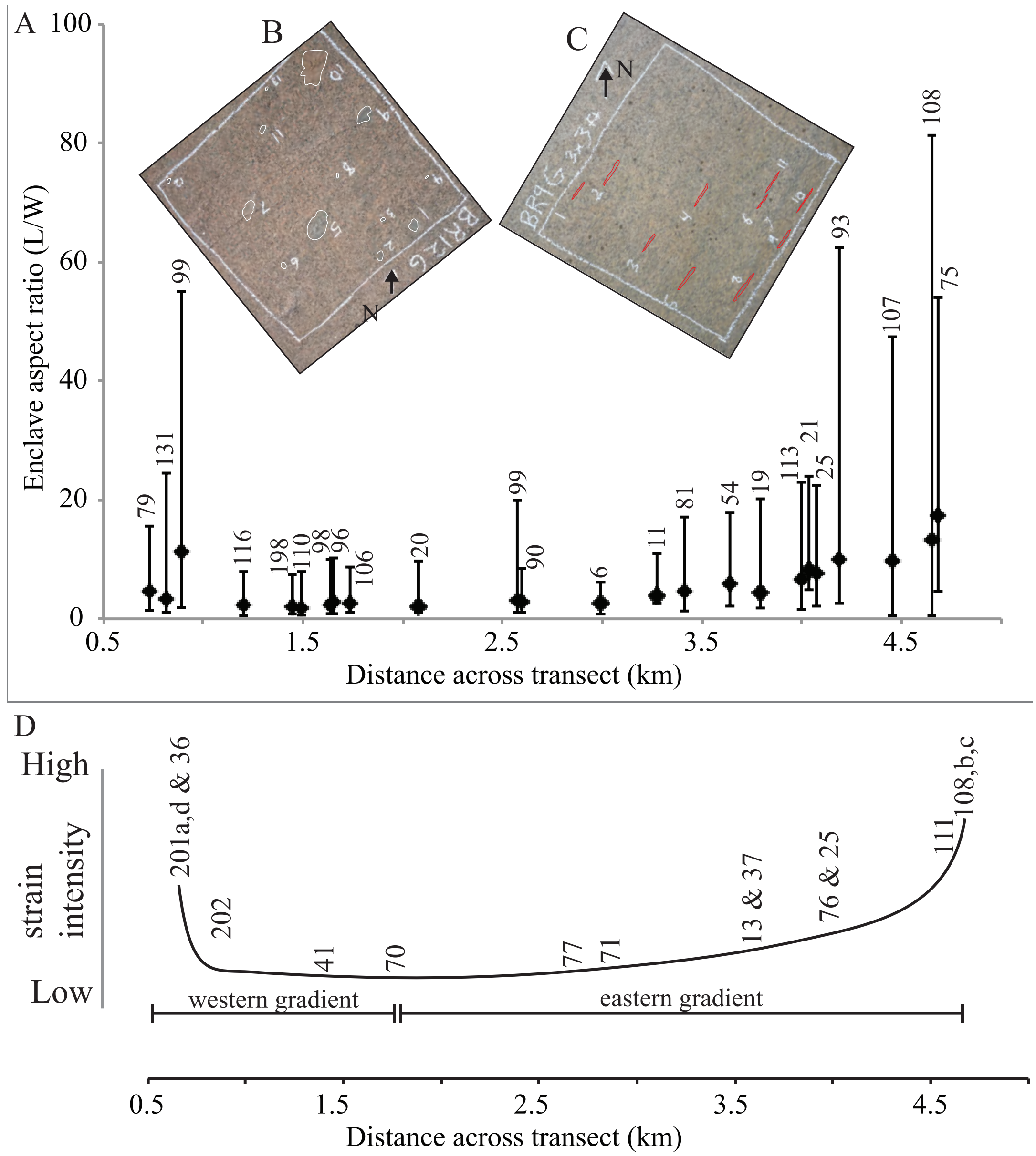


Figure 2.5 Enclave Measurements. A. aspect ratio of enclaves across both transects. Bars represent maximum and minimum aspect ratios at each site; diamonds are the average. The number of enclave measurements per site are shown. B and C. Field photos of measured enclaves in the less sheared and more sheared regions of the granite, respectively. Images are rotated so north is to the top of the page. Enclaves are outlined in white and red. D. Qualitative strain intensity based on aspect ratios of enclaves and degree of foliation development across the Bad River Granite. Site numbers placed at their locations across the transect.

amphibolite facies conditions. If the enclaves were weaker they would deform effectively passively within the granite and therefore track the strain of the unit. If they were stronger, they would represent a strain minimum. (3) Lastly, we assume that the change in aspect ratio across the gradient is due to sub-solidus, tectonically induced strain. It has been reported and modeled that the aspect ratio of enclaves are rarely spherical due to magmatic flow in the chamber and that they tend to increase toward the edge of an intrusion (Davis 1963; Schmeling et al. 1988; Cruden 1990). Paterson et al. (1998) and references within report structural data from five plutons, including the emplacement-related aspect ratios of enclaves located toward the boundaries of the plutons. They report length/width ratios ranging from approximately 1.17 to 13.3. The aspect ratios measured at the edges of the unit in this study (5.43 to 48.07; Appendix A, site 9), suggest that subsolidus strain played the dominant role in changing the aspect ratios of the enclaves. However, if some of the enclave deformation occurred during emplacement, the calculated strain would represent a maximum.

Depending on which assumptions have the most influence, we could consider the stretched enclaves as representing a strain minimum or maximum. Because of the uncertainty surrounding them, we do not make either interpretation, but rather simply use the measurements as a proxy for the relative increase or decrease of strain across the transect.

The map-view aspect ratios of the enclaves (Figure 2.5a) reveal a much more gradual increase in strain towards the eastern margin than towards the western margin, though both margins display smooth rather than sharp transitions. The illustrated strain

pattern in Figure 3d is used as a spatial reference for comparison between the least strained sample (70) and the higher strain samples to the east and west.

Petrographic analyses of three enclaves, one from the less strained area of the granite (sample 12e), and one from each of the most strained sites in the west and east (samples 207 and 30e, respectively), indicate that the enclaves are finer grained and more mafic than the granite (Figure 2.6a). Biotite and amphibole make up ~25-40% of the modes in the enclaves, with varying amounts of garnet. K-feldspar, plagioclase and quartz constitute the rest of the matrix and the phases are well mixed. The boundaries of the enclaves with more amphibole are sharper than those with less. A weak alignment of amphibole is present in the higher strain samples (samples 207 and 30; Figure 2.6a). Undulose extinction and bent Carlsbad twins are observed in the stretched enclave, confirming deformation through solid state recrystallization (Figure 2.6b).

2.5 Methods

2.5.1 Sample Collection

Granitic samples were collected across both strain gradients with more closely spaced sampling toward the boundaries of the unit. The subset of samples described here is representative of the full gradient. Figure 2.1d shows sample sites; numbered sites were chosen for detailed analysis.

2.5.2 U-Pb Geochronology

Methods follow those of Marsh & Culshaw (2014). Zircon were separated from each sample through a standard procedure of crushing, pulverizing, and density and

magnetic separation. Approximately 50 grains were mounted in epoxy and polished to expose grain interiors. Cathodoluminescence images were collected to identify any

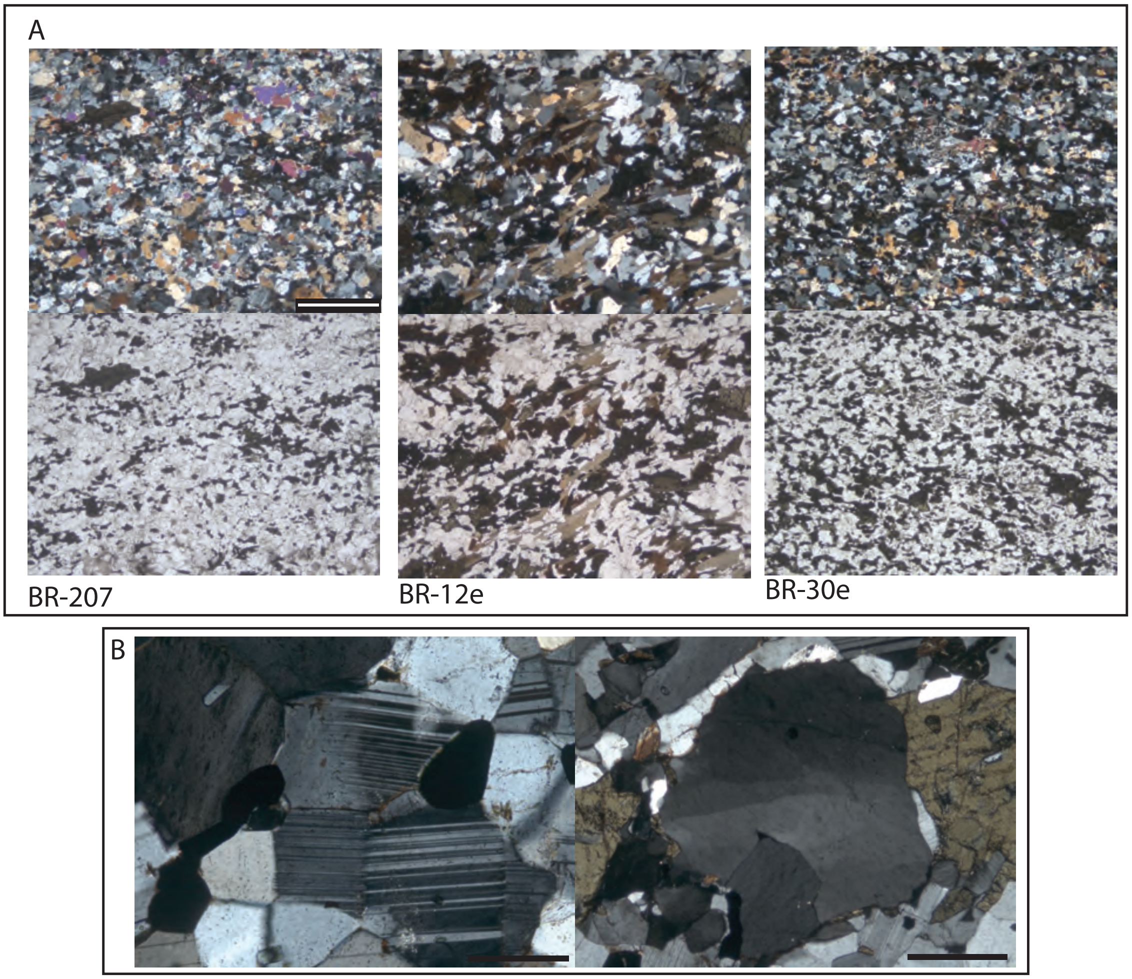


Figure 2.6 Enclave Photomicrographs. A. Top row crossed polarized light, bottom plane polarized light. Images of samples from the western transect (207), less sheared region (12e), and eastern transect (30e). Scale bar is 2mm, all photographs at the same scale. The western and eastern enclaves are finer grained than the less sheared enclave. Most of the enclaves are more biotite- and amphibole-rich than the surrounding granite. B. Photomicrographs showing evidence for solid state deformation as bent plagioclase twins (left, scale bar 200 μm) and undulose extinction in quartz (right, scale bar 500 μm).

internal zoning. An additional ~20 grains from each sample were mounted on tape and analyzed from their exterior (depth profiling). The U-Th-Pb isotopic compositions of the zircon were measured at the University of Texas, Austin, using a Photon Machines 193 nm Analyte G2 excimer laser-ablation system with large volume Helex sample cell,

coupled with a Thermo Scientific Element2 HR-ICP-MS. A spot size of 30 µm was used for polished zircon analyses and one of 50 µm was used for the first round of depth profiling. A laser fluence of 2.24 J/cm^2 and repetition rate of 10Hz was used, with He gas flow of ~0.5 L/s. Ablation times of 35s (for 30 µm spots) and 60s (for 50 µm spots), resulting in ablation depths of ~15 µm and ~30 µm respectively. A spot size of 30 µm was used for the second round of depth profiles due to a mix of spot and profiling analyses. At least 30 seconds of background signal was acquired between each analysis. Signals for masses ^{202}Hg, ^{204}(Pb+Hg), ^{206}Pb, ^{207}Pb, ^{208}Pb, ^{232}Th, and ^{238}U, with ^{235}U was calculated from the measured ^{238}U concentration using the relationship ^{238}U/^{235}U=137.88. The zircon reference standard GJ-1 (Jackson et al. 2004) was analyzed repeatedly before, after, and intermittently during analysis of the unknown specimens so that mass fractionation and instrumental mass bias corrections could be applied. Data reduction was carried out using the VizualAge U-Th-Pb data reduction scheme (Petrus & Kamber 2012) which operates within the Iolite software package (Hellstrom et al. 2008; Paton et al. 2011). A smoothed spline was fit to the sequentially arranged raw count data for background and reference standard measurements, enabling time-resolved background subtraction and corrections for depth-dependent isotopic and elemental fractionation and instrumental drift. The Plešovice zircon (337.13 ± 0.37 Ma, Sláma et al. 2008) was analyzed periodically during each analytical session to verify the accuracy of the analyses, yielding a concordant U-Pb age of 341± 16 (MSWD = 1.7) for 18 of 19 spots.

2.5.3 Whole Rock Analyses

Major, trace, and rare earth elements were measured by Activation Laboratory in Ontario, Canada. Trace elements were analyzed by Inductively Coupled Plasma Mass Spectrometry (ICPMS) and major elements and rare earth elements (REE) were analyzed by lithium metaborate/tetraborate fusion ICPMS. Major elements have detection limits between 0.001 and 0.01%. Trace elements and REEs have detection limits between 0.04 and 30 ppm.

2.5.4 Mineral Chemistries

Mineral chemistries were collected using the Cameca SX100 EPMA with a 15-kV accelerating voltage, 10nA beam current and 5 μm spot size. Reported results are the average of ~10 points/grain. Full analyses can be found in Appendix B.

2.5.5 Electron Backscatter Diffraction (EBSD)

Selected samples were analyzed for crystallographic orientation of quartz using the EDAX/TSL Digiview III camera and OIM Data Collection v.5.3. software on the Tescan Vega II tungsten filament SEM at the University of Maine. SEM and EBSD parameters for each run consisted of a working distance of 25 mm, a tilt of 70°, a beam current of ~10 nA and varying step sizes from 15-25 μm (Appendix C). OIM v. 6.0 software was used to identify minerals by composition (Nowell & Wright 2004) and then index orientations.

A common error associated with EBSD analyses is misindexed crystallographic orientations due to inclusions, the fine-grained nature of the samples, subgrain

boundaries, and microfractures (Prior & Wheeler 2009). Misindexing is identifiable and was corrected during post-processing procedures, which included omission of non-indexed points, a 10° misorientation grain boundary definition, correction of pseudosymmetry (i.e. dauphine twins) and careful grain size partitioning.

2.5.6 Grain Size Analyses

Due to complications from analytical artifacts and perthitic textures, EBSD data were not used to calculate grain sizes. Instead, grain size analyses were conducted on optical photomicrographs of the thin sections using the measurement tool of the QCapture Pro 7 software. Grain sizes of feldspars and quartz were recorded using the maximum diameter of the grain and then binned in 20 μm bins. Histogram envelopes were manually drawn. Porphyroclast measurements were not included in the analyses.

2.6 Microscale Observations in the Bad River Granite

Representative samples from the eastern and western gradients were selected for microscale analyses. Both gradients share the least sheared sample, sample 70 (Figure 2.1d and 2.5d). We compare microstructure, mineral chemistry, and whole rock chemistry across the transect to identify any changes that correlate with strain.

2.6.1 Mineral Analyses

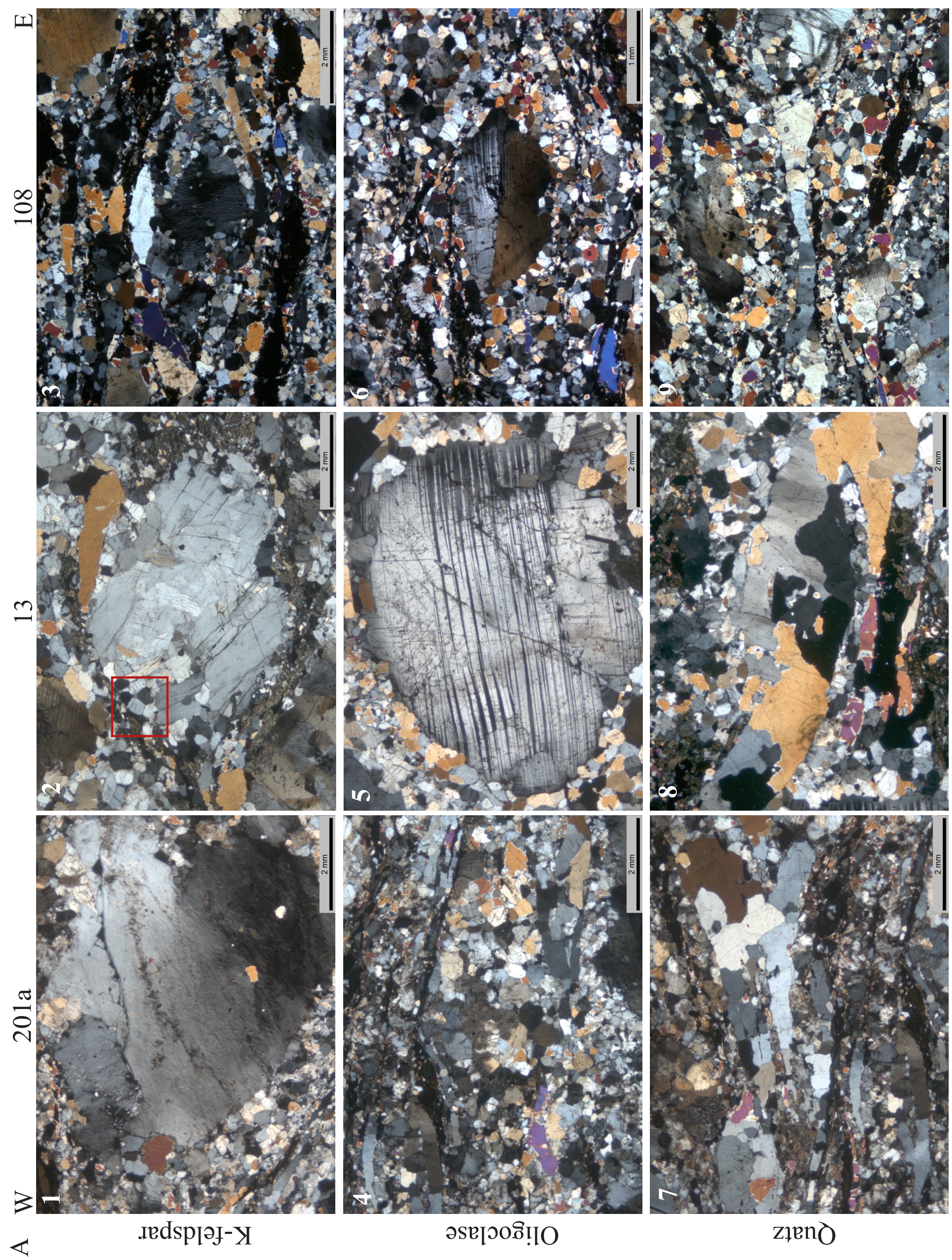
In its least deformed state, the granite unit is megacrystic and consists predominantly of twinned albitic plagioclase, variably perthitic K-feldspar, and mostly ribbon quartz, with varying amounts of, but at most ~15%, amphibole, biotite, Fe-Ti-oxides, garnet, apatite,

and zircon. Some of the biotite and amphibole has evidence of secondary chloritization, especially in the western transect. This section reports the microstructural and/or chemical changes across both gradients. Figure 2.7a is a compilation of photomicrographs of the three most abundant rock-forming minerals across the transect. Figure 2.7b show photomicrographs from sample 103, the easternmost sample collected at the boundary of the Bad River Granite and the pink orthogneiss (Figure 2.1d). Mineral chemistries of plagioclase, amphibole, biotite and garnet were collected (when available) across both gradients (full analyses in Appendix B).

2.6.1.1 Feldspar

Both alkali feldspar and plagioclase exist as mantled porphyroclasts in the least sheared samples (Figure 2.7a). K-feldspar porphyroclasts are perthitic and deformation twins can be seen in plagioclase porphyroclasts. The porphyroclasts of both phases have lobate boundaries and often have aspect ratios with the longest axis parallel to foliation. K-feldspar tartan twinning is rare, but can sometimes be discerned in grains that have less perthite.

The most obvious microstructural change in feldspars across both gradients is the reduction in average grain size (Figure 2.7a; Table 2.1). In the least sheared sample, K-feldspar porphyroclasts are ~6 mm and plagioclase porphyroclast are ~3.5 mm, while recrystallized feldspar grains are ~350 μm. When compared to the least strained sample, 70, there is an increase in the percent of finer grains in the higher strain samples (Figure 2.8a). This complements a reduction in the average grain size of recrystallized feldspar grains from ~400 μm in the lest sheared sample, 70, to ~250 μm in both the westernmost


A
W
E
201a
13
108
K-feldspar
Oligoclase
Quatz

and easternmost samples (201a and 103, respectively; Figure 2.8b). Recrystallized feldspar grains often have straight boundaries and in places form ~120° junctions at like-phase boundaries, creating a foam texture (e.g. Figure 2.7a2). Deformation twins can be seen in some, but not all of the recrystallized plagioclase grains, and the recrystallized K-feldspar grains are variably perthitic (Figure 2.7a).

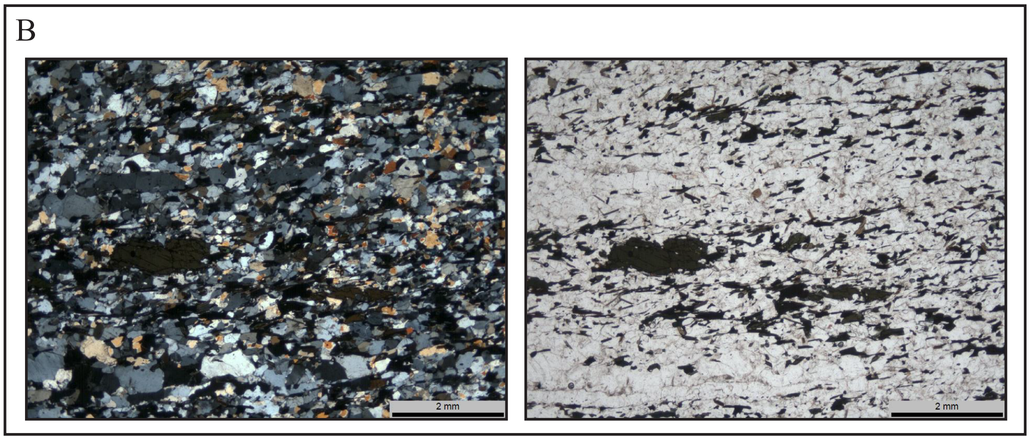


Figure 2.7 Bad River Granite Photomicrographs (con't). B. Photomicrographs taken in crossed (top) and plane (bottom) polarized light of sample 103, the most strained sample taken from the eastern boundary of the Bad River Granite with pink orthogneiss. Compared to the rest of the transect, grain size is reduced and a large proportion of the sample is made of a mixed-phase matrix.

Table 2.1. Grain Size Statistics

	qtz						fsp					
	mean	st dev	min	max	med	count	mean	st dev	min	max	med	count
sample	(μm)	(μm)	(μm)	(μm)	(μm)		(μm)	(μm)	(μm)	(μm)	(μm)	
201	515	477	40	2710	350	183	251	162	30	1070	210	607
202	536	594	40	3580	315	244	273	164	30	840	240	265
70	756	1350	70	8380	280	166	364	192	40	1570	330	415
108	449	412	50	2210	320	112	250	161	40	1820	230	485
103	130	110	20	1340	110	476	205	143	20	910	170	510

Both feldspar phases can be found in loosely-defined augen-shaped pods (Figure 2.7a) wrapped by quartz ribbons, amphibole, biotite, Fe-Ti oxides, and a small modal

amount of garnet (<1%) in the eastern gradient (no garnet was found in the western gradient). In the less sheared samples the augen consist of mantled porphyroclasts, but with increased recrystallization they become aggregates. As strain increases from the low strain samples, the recrystallized grains also create a mixed-phase matrix, blurring the augen shapes. Therefore, the augen shaped clusters are loosely defined in most of the thin sections, but the pods become more defined in higher strained samples (109 & 108; e.g. Figure 2.7a3, 2.7a4). The augen shapes are nearly entirely absent in the easternmost sample (103), as the phases are mostly dispersed throughout the thin section (Figure 2.7b).

We did not measure mineral compositions for the alkali feldspar grains because of their highly perthitic nature. For plagioclase, microprobe analyses were collected from porphyroclasts and recrystallized grains (excluding albitic exsolution from alkali feldspar) in an attempt to document any progression in composition with strain. All of the plagioclase analyses from both gradients plot as oligoclase (Ab_{75}-Ab_{85}), but recrystallized grains are consistently slightly higher in Na-content than adjacent porphyroclasts (Table 2.2; Figure 2.9).

2.6.1.2 Quartz

Quartz throughout both gradients is most often found in polycrystalline ribbons with varying degrees of undulose extinction. In general, the less sheared samples have more irregularly shaped quartz, or ribbons with low aspect ratios, when compared to the higher strain samples (Figures 2.7a & 2.10). However, pockets of relatively thicker quartz pools exist in strain shadows in most samples (e.g. Figure 2.7a7).

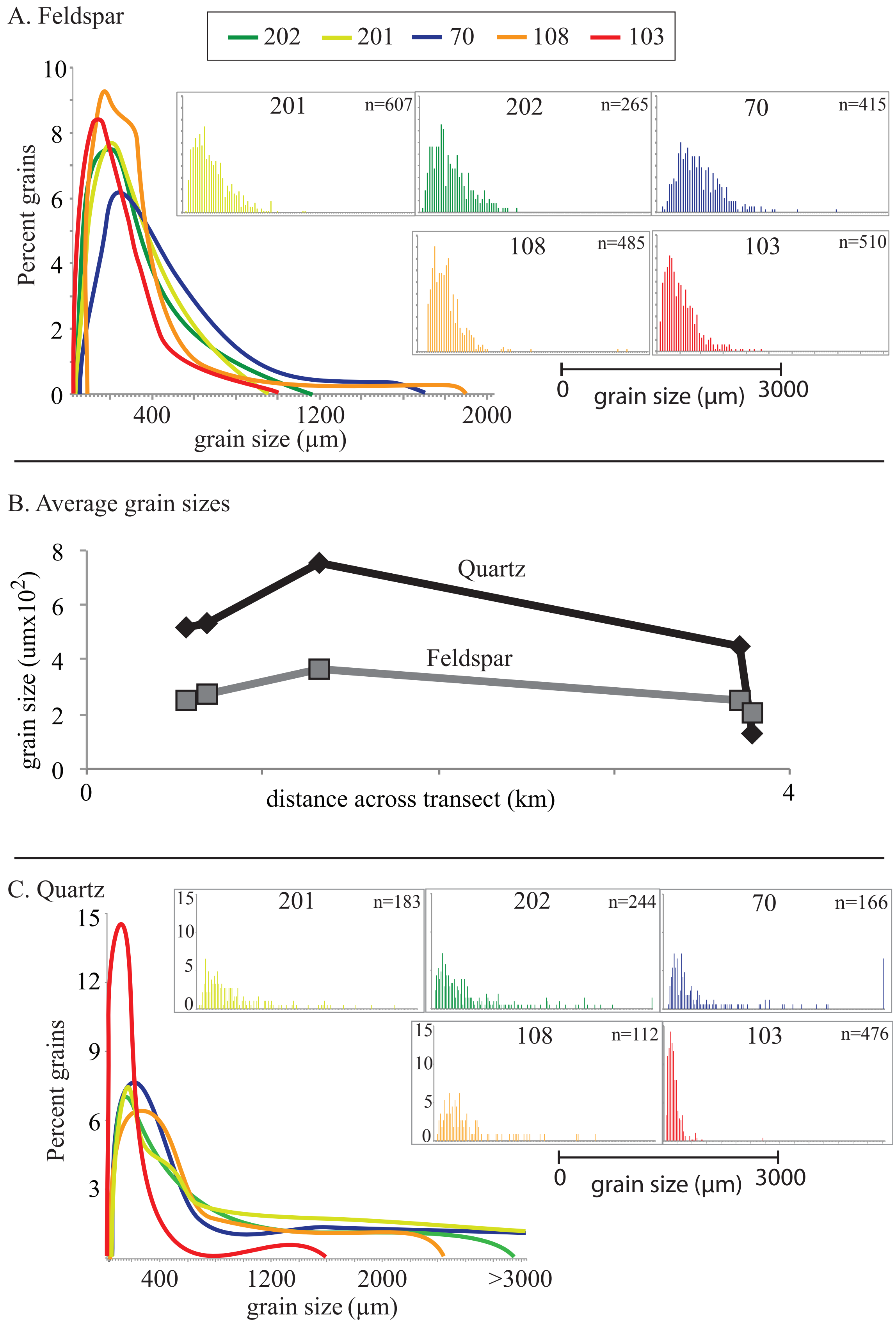

A. Feldspar
202
201
70
108
103
Percent grains
grain size (μm)
201 n=607
202 n=265
70 n=415
108 n=485
103 n=510
0 grain size (μm) 3000
B. Average grain sizes
grain size (umx10^2)
distance across transect (km)
Quartz
Feldspar
C. Quartz
201 n=183
202 n=244
70 n=166
108 n=112
103 n=476
Percent grains
grain size (μm)
>3000

Table 2.2 Representative Plagioclase Compositions

transect	west				east	
Sample #	201d core	201d rim	70 core	70 rim	108 core	108 rim
Analysis #*	5	7	7	5	1.1	2
oxide wt. %						
SiO_2	64.52	63.97	63.80	65.11	61.88	63.38
Al_2O_3	22.65	23.14	22.76	22.29	23.38	22.51
FeO	0.08	0.08	0.06	0.07	0.08	0.08
MnO	0.00	0.00	0.01	0.00	0.01	0.00
MgO	0.00	0.00	0.00	0.00	0.00	0.00
CaO	3.26	3.78	4.01	3.27	4.55	3.61
Na_2O	9.65	9.28	9.03	9.63	8.83	9.56
K_2O	0.24	0.32	0.47	0.16	0.40	0.25
Total	100.38	100.54	100.13	100.52	99.14	99.40
Atoms per formula unit (8 O)						
Si	2.83	2.81	2.82	2.85	2.77	2.82
Al	1.17	1.20	1.18	1.15	1.23	1.18
Fe	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00
Mg	0.00	0.00	0.00	0.00	0.00	0.00
Ca	0.15	0.18	0.19	0.15	0.22	0.17
Na	0.82	0.79	0.77	0.82	0.77	0.82
K	0.01	0.02	0.03	0.01	0.02	0.01
% An	15.51	18.03	19.19	15.66	21.65	17.04

*Analysis numbers correspond to average analyses in Appendix B

The average grain size of quartz decreases from ~800 μm in the least strained sample (70) to ~500 μm in the westernmost sample, 201a, and ~150 μm in the eastern most sample, 103 (Figure 2.8b). The dominant size fraction of quartz grains in most samples is ~200 μm, but there is a slight reduction to ~150 μm in 201a and 103, the western- and easternmost samples and a noticeable increase in number fraction of smaller grains in sample 103 (Figure 2.8c).

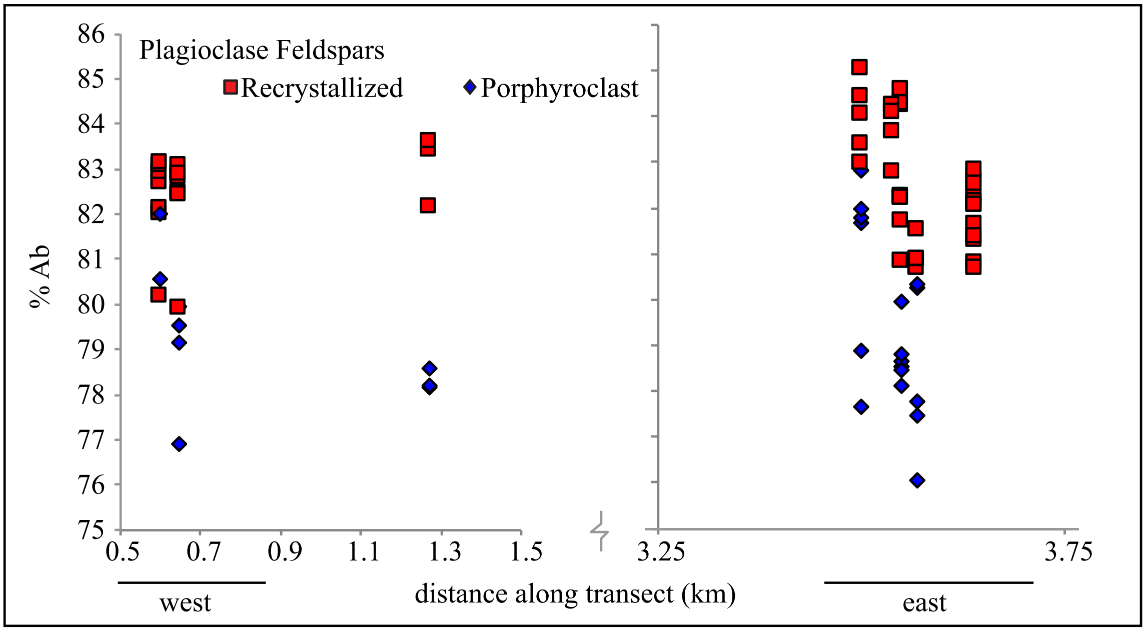
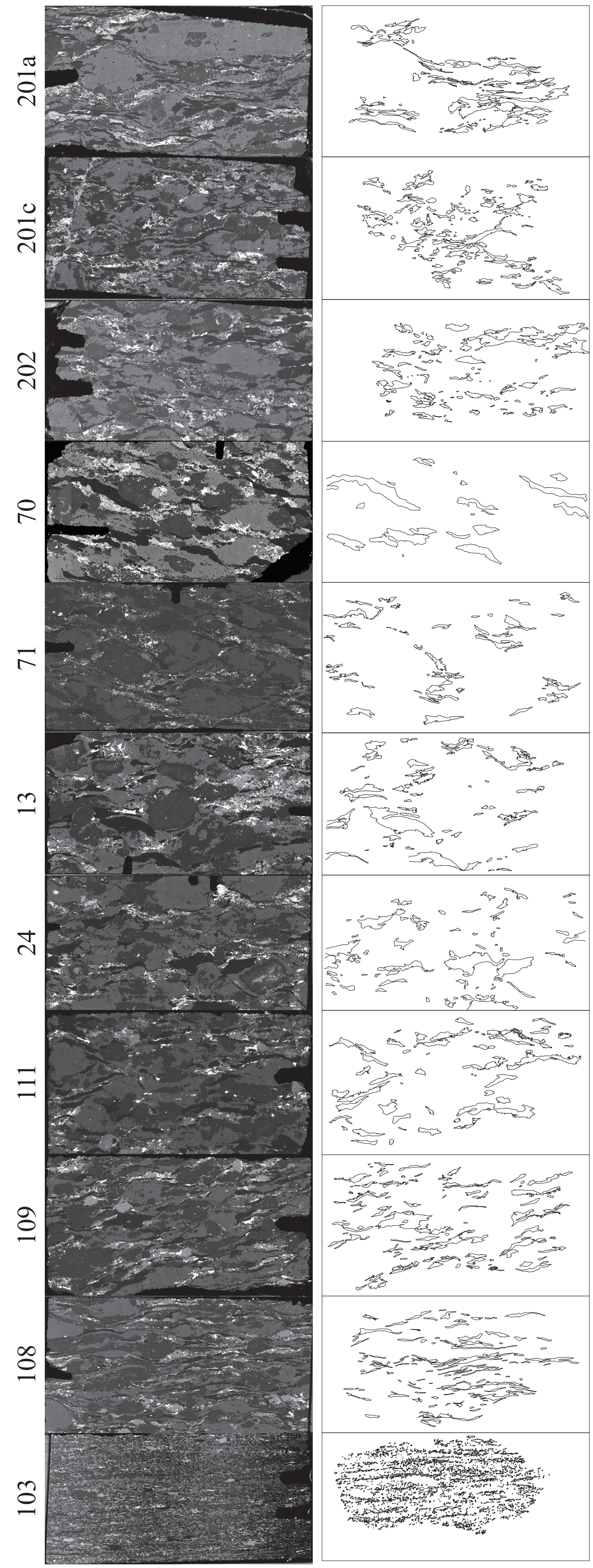
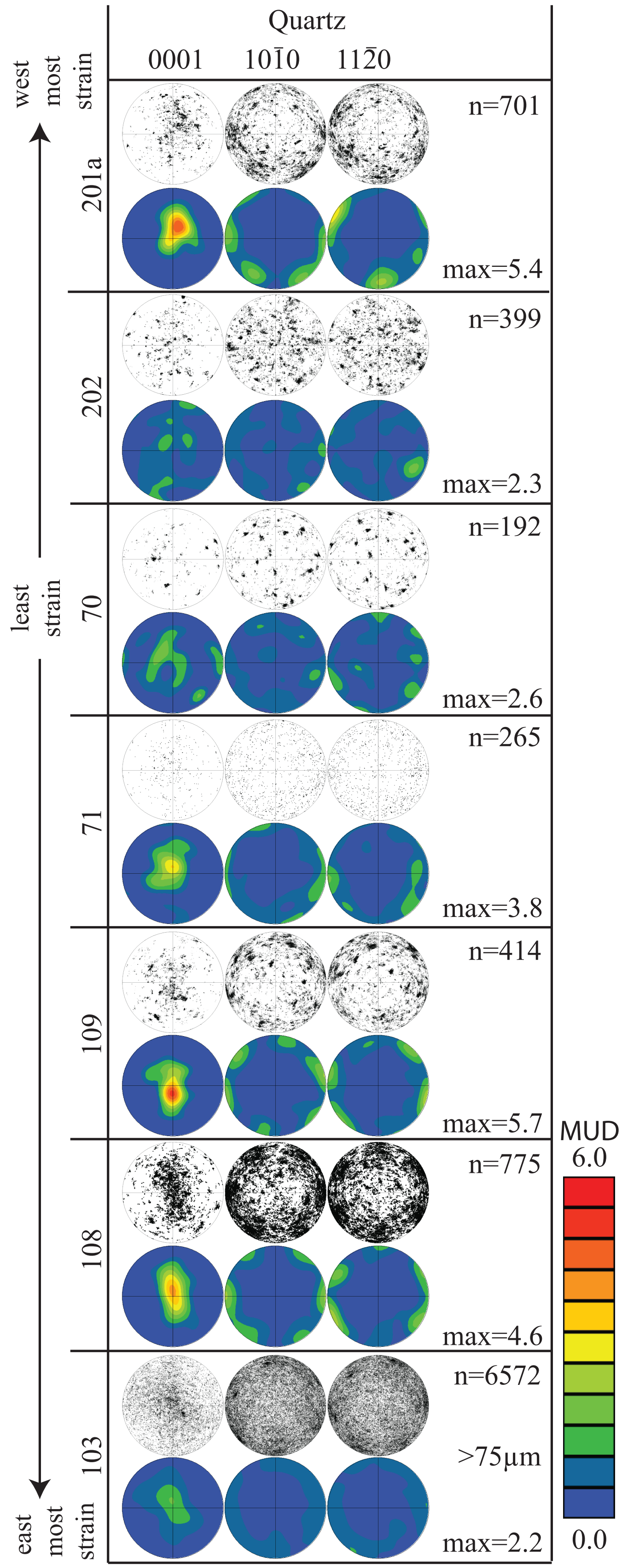


Figure 2.9 Plagioclase Feldspar Compositions. Composition of recrystallized and porphyroclastic plagioclase across the transects. Recrystallized grains are consistently more Na-rich than the porphyroclasts

Crystallographic orientation distribution plots in Figure 2.11 summarize the EBSD data from the recrystallized grains of quartz in each sample analyzed. We report the concentration of crystallographic data (crystallographic preferred orientation; CPO) as multiples of a uniform distribution (MUD). Quartz in the least sheared sample (70) has a low maximum MUD of 2.6 indicating there is a weak CPO. In the western gradient, a stronger CPO does not develop until the most strained sample, 201a, with a maximum MUD of 6.0. In the eastern gradient the CPO strengthens with increasing strain through sample 109 to the east, which has the highest MUD maximum of 5.3. East of sample 109 and into the higher strained samples, the maximum MUD values decrease to 2.2 in the highest strained (sample 103).


201a
201c
202
70
71
13
24
111
109
108
103


Quartz
0001
10$\bar{1}$0
11$\bar{2}$0
west most strain
least strain
east most strain
201a
n=701
max=5.4
202
n=399
max=2.3
70
n=192
max=2.6
71
n=265
max=3.8
109
n=414
max=5.7
108
n=775
max=4.6
103
n=6572
>75µm
max=2.2
MUD
6.0
0.0

2.6.1.3 Biotite

Biotite is found in all samples except westernmost sample (201a) in the western gradient. Across both gradients growth of larger biotite can be seen in the strain shadows of the porphyroclasts. Biotite is found mixed with quartz, amphibole, and Fe-Ti oxides in the regions that wrap the feldspar pods or mantled porphyroclasts and near resorbed garnets. The biotite grains of the western gradient tend to be have lower aspect ratios than those of the eastern gradient. Due to the difficulties in polishing micas and the small modal amount of biotite in the samples, EBSD analyses were not conducted on biotite grains. Biotite analyses across the eastern and western gradients indicate an increase in X_{Mg}, F, and Cl with strain (Figure 2.12; Table 2.3).

2.6.1.4 Amphibole

Amphibole is found in all samples in both gradients with varying amount of chloritization, but in those cases where chloritization was complete, the morphology of the original amphibole can still be discerned. The amphibole morphology, which is similar across both gradients, consists of larger porphyroclasts (~1.5 mm) with trails of smaller grains that have broken off and entrained in the flow of the fabric. Overall, clusters of amphibole clasts become more localized and sinuous with strain, but the change is not monotonic and is more obvious in the western gradient than the eastern. The porphyroclast size does not reduce with strain, but the modal amount of amphibole minimally increases with strain in the eastern gradient. There is no clear trend in amphibole mode with strain in the western gradient. Analyses from the both gradients indicate a slight increase in X_{Mg}, F, and Cl with strain (Figure 2.12; Table 2.4).

Table 2.3 Representative Biotite Compositions

transect	west			east	
Sample #	36	202	70	108	103
Analysis #*	4	2	2	8.2	4
oxide wt. %					
SiO_2	37.72	37.42	36.33	38.06	37.99
TiO_2	3.32	4.31	4.59	4.35	3.16
Al_2O_3	12.97	12.77	12.96	13.21	13.73
FeO	18.17	19.33	21.43	16.15	18.54
MnO	0.09	0.30	0.33	0.19	0.37
MgO	12.80	11.90	10.72	14.06	12.60
CaO	0.01	0.00	0.00	0.00	0.00
Na_2O	0.00	0.10	0.00	0.06	0.07
K_2O	9.72	9.65	9.30	9.46	9.75
BaO	0.13	0.38	0.35	0.42	0.27
V_2O_3	0.00	0.03	0.00	0.04	0.04
Cr_2O_3	0.01	0.00	0.01	0.01	0.00
H_2O**	3.26	3.39	3.60	3.49	3.60
F	2.69	2.24	1.13	2.07	1.56
Cl	0.19	0.13	0.11	0.09	0.10
Total	100.22	101.30	100.53	101.08	101.32
O=F , Cl	1.18	0.97	0.50	0.89	0.68
Total	99.05	100.32	100.03	100.19	100.64
Atoms per formula unit (22 O; Fe=Fe_{tot})					
Si	5.77	5.70	5.60	5.70	5.72
Ti	0.38	0.49	0.53	0.49	0.36
Al	2.34	2.29	2.35	2.33	2.44
Fe	2.32	2.46	2.76	2.02	2.34
Mn	0.01	0.04	0.04	0.02	0.05
Mg	2.92	2.70	2.46	3.14	2.83
Ca	0.00	0.00	0.00	0.00	0.00
Na	5.29	5.75	6.85	5.94	6.43
K	1.90	1.88	1.83	1.81	1.87
Ba	0.01	0.02	0.02	0.02	0.02
V	0.00	0.00	0.00	0.00	0.00
Cr	0.00	0.00	0.00	0.00	0.00
OH	3.32	3.44	3.71	3.48	3.61
F	1.31	1.06	0.55	1.01	0.76
Cl	0.05	0.04	0.03	0.02	0.02
Mg#***	0.56	0.52	0.47	0.61	0.55

*Analysis numbers correspond to average analyses in Appendix B

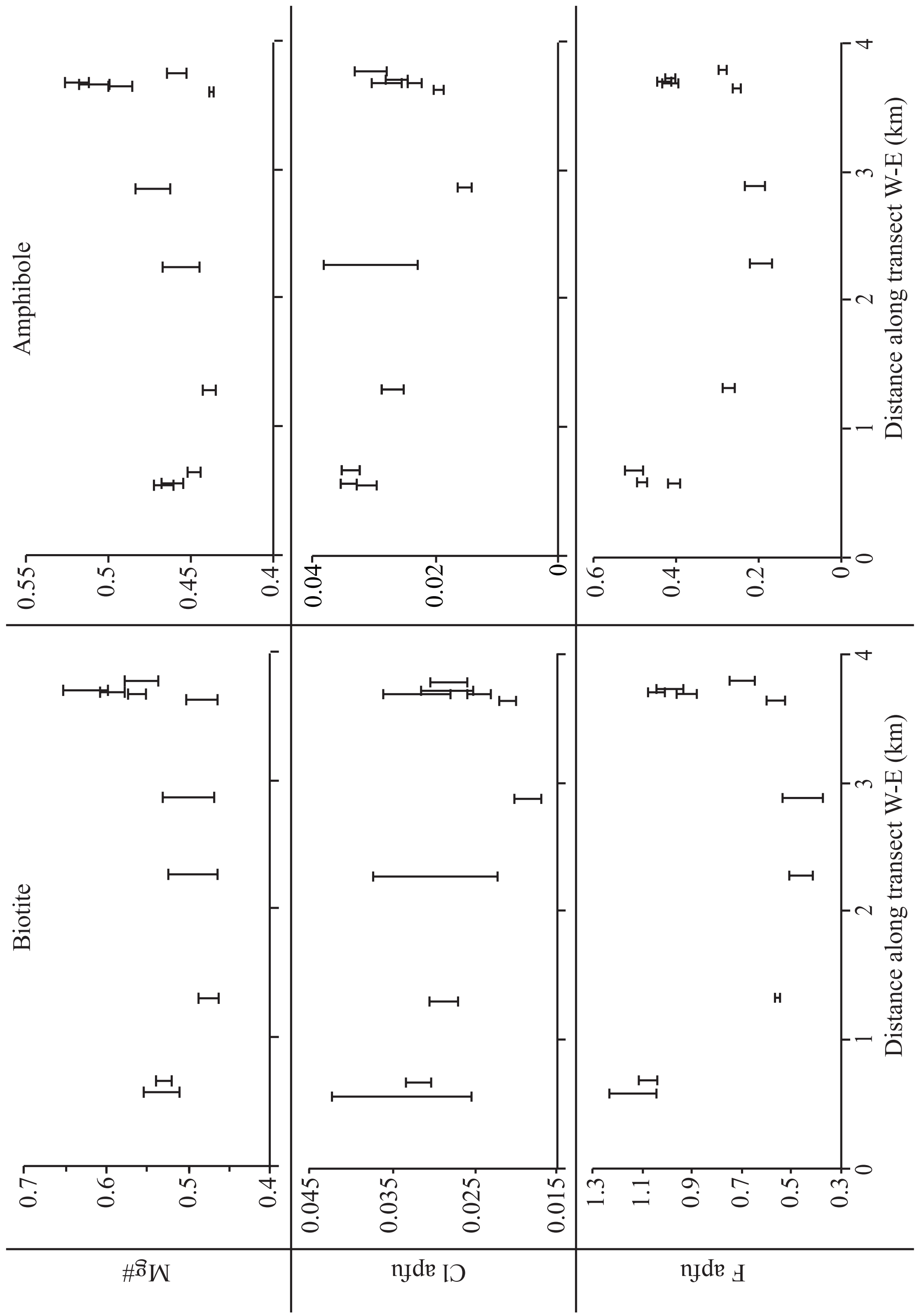
**Calculated as 4-Fl-Cl

***Fe_{tot} used for Mg# calculation

Table 2.4 Representative Amphibole Compositions. Fe^{3+} calculated assuming ∑cations - (Ca + Na + K) = 13 (Droop, 1987)

transect	west		east	
Sample #	201a	70	108	103
Analysis #*	3	3	3	7.2
oxide wt. %				
SiO_2	42.35	41.66	43.13	43.07
TiO_2	1.57	1.95	1.96	2.04
Al_2O_3	10.14	9.93	10.12	10.00
FeO	19.18	20.51	17.57	17.64
MnO	0.75	0.79	0.70	0.67
MgO	9.36	8.82	10.60	10.50
CaO	10.90	10.19	10.63	10.71
Na_2O	1.96	1.80	2.28	2.29
K_2O	1.60	1.41	1.39	1.42
BaO	0.03	0.00	0.02	0.03
V_2O_3	0.04	0.03	0.03	0.02
Cr_2O_3	0.01	0.04	0.00	0.00
H_2O**	1.75	1.80	1.77	1.81
F	0.81	0.54	0.88	0.83
Cl	0.12	0.11	0.11	0.10
Total	100.36	99.43	100.95	100.87
O=F , Cl	0.40	0.27	0.42	0.39
Total	99.96	99.16	100.53	100.47
Atoms per formula unit (23 O; $Fe=Fe_{tot}$)				
Si	6.48	6.46	6.50	6.46
Ti	0.18	0.23	0.22	0.18
Al	1.83	1.81	1.80	1.88
Mn	0.10	0.10	0.09	0.11
Mg	2.14	2.04	2.38	2.08
Fe	2.45	2.66	2.21	2.45
Na	0.58	0.54	0.66	0.56
K	0.31	0.28	0.27	0.30
Ca	1.79	1.69	1.72	1.81
Ba	0.00	0.00	0.00	0.00
V	0.01	0.00	0.00	0.00
Cr	0.00	0.01	0.00	0.00
OH	1.57	1.69	1.55	1.69
F	0.39	0.28	0.42	0.28
Cl	0.03	0.03	0.03	0.03
Total	17.86	17.81	17.85	17.85
Fe^{3+}	0.65	1.05	0.69	0.62
Fe^{2+}	1.80	1.61	1.53	1.83
Mg#	0.54	0.56	0.61	0.53

*Analysis numbers correspond to average analyses in Appendix B
**Calculated from 2-F-Cl



Biotite
Amphibole
Mg#
Cl apfu
F apfu
Distance along transect W-E (km)
Distance along transect W-E (km)

2.6.1.5 Garnet

Garnet is found in only the eastern gradient and not in every sample. The garnet across the eastern gradient is mostly skeletal, likely due to resorption, and typically surrounded by biotite, quartz, Fe-Ti oxides, apatite, and amphibole (Figure 2.13). The amount of remaining garnet seems to decrease with strain so that there is no garnet in sample 103. The least sheared samples have larger fragments of garnet than the higher strained samples, although they are still clearly remnants of larger clasts. Chemical analyses of the garnets from the least sheared sample (70) are $Alm_{56-57}Pyp_{9-11}Grs_{17-18}Sps_{15-17}$ and do not show any significant chemical variation across the eastern gradient (Table 2.5).

2.6.1.6 Accessory Phases

Ilmenite and magnetite are the most abundant oxides found across both gradients. Ilmenite is irregularly shaped and in various stages of alteration. In the western gradient, ilmenite often surrounds rutile and calcite. Magnetite is patchy in backscatter, irregularly shaped, and commonly, but not always, associated with ilmenite. Pyrite is found only in the western gradient (including the least sheared sample, 70), is usually found only adjacent to magnetite or ilmenite, and is most often found as metasomatic reactions or skeletal remnants of grains.

2.6.2 Whole Rock Composition

Whole rock analyses were conducted on the eastern and western edges of the granite (201 and 108) and three samples across the unit (samples 70, 71, 76) (Table 2.6;

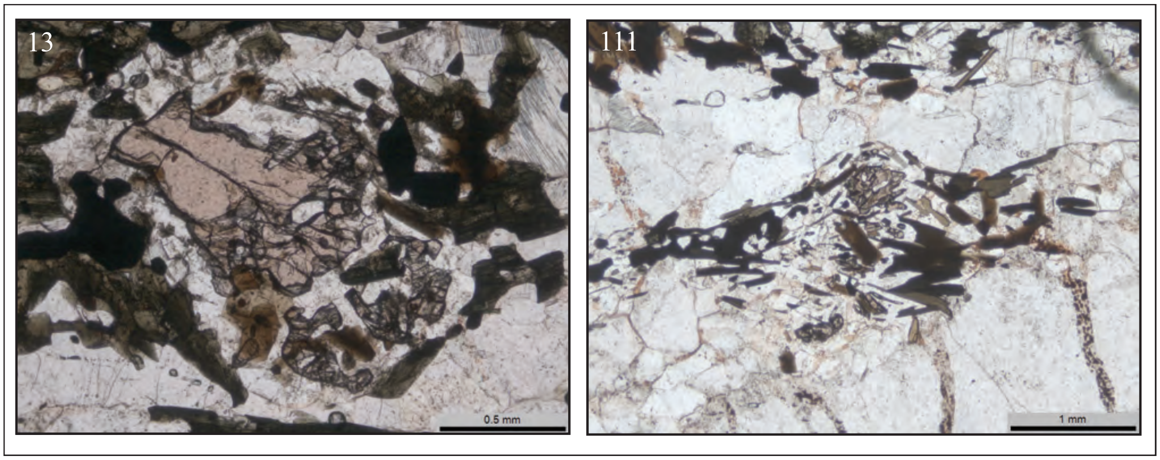


Figure 2.13 Garnet Along the Transect. Representative photomicrographs of garnet from a low strain sample (13) and higher strain sample in the eastern gradient (111).

Figure 2.14). Figure 2.14a depicts the changes in major element oxide weight percent across the transect. K_2O is the only oxide whose concentration correlates with strain across the transect. An isocon diagram (after Grant 1986; Marsh et al., 2011; Figure 2.14b) shows that there is some variation across the transect, with the most significant variation from the lowest strain sample occurring in the westernmost sample, 201a. Samples from the lower strain area of the transect are averaged and plotted with standard deviation error bars. However, the variation among the samples indicates a natural heterogeneity that is indistinguishable from any metasomatism that may have occurred.

Chondrite-normalized REE analyses across both gradients have similar patterns indicating they are of the same rock type with only minor variations due to inherent heterogeneities (Figure 2.14c; CI chondrite from Sun & McDonough 1989).

Table 2.5 Representative Garnet Compositions

transect		east	
Sample #	70	111	108
Analysis #*	1	3	7.2
oxide wt. %			
SiO_2	37.15	36.96	37.61
TiO2	0.07	0.04	0.05
Al_2O_3	20.60	20.49	20.74
FeO	27.12	26.55	25.61
MnO	6.20	7.57	7.45
MgO	2.92	2.58	3.20
CaO	6.08	6.41	5.99
Na_2O	0.00	0.01	0.01
Cr_2O_3	0.00	0.00	0.00
Y_2O_3	0.09	0.11	0.07
Total	100.22	100.71	100.74
Atoms per formula unit (based on 24 oxygens)			
Si	5.94	5.93	5.98
Ti	0.01	0.00	0.01
Al	3.88	3.87	3.89
Fe	3.55	3.56	3.41
Mn	0.94	1.03	1.00
Mg	0.66	0.62	0.76
Ca	1.12	1.10	1.02
Na	0.00	0.00	0.00
Cr	0.00	0.00	0.00
Y	0.00	0.01	0.01
Alm	56.65	56.45	55.02
Prp	10.51	9.77	12.26
Grs	17.82	17.47	16.50
Sps	15.03	16.31	16.22

*Analysis numbers correspond to average analyses in Appendix B

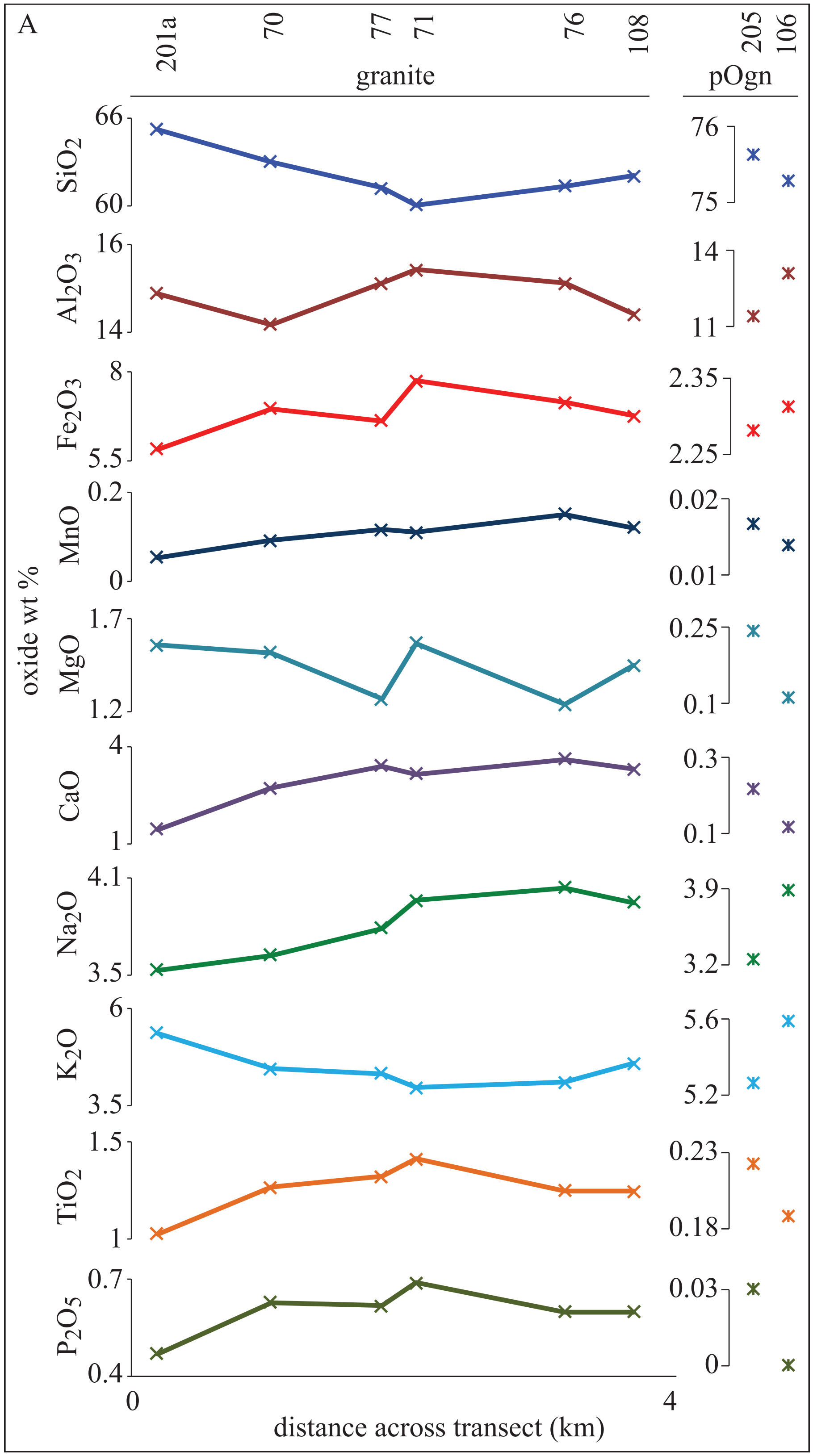
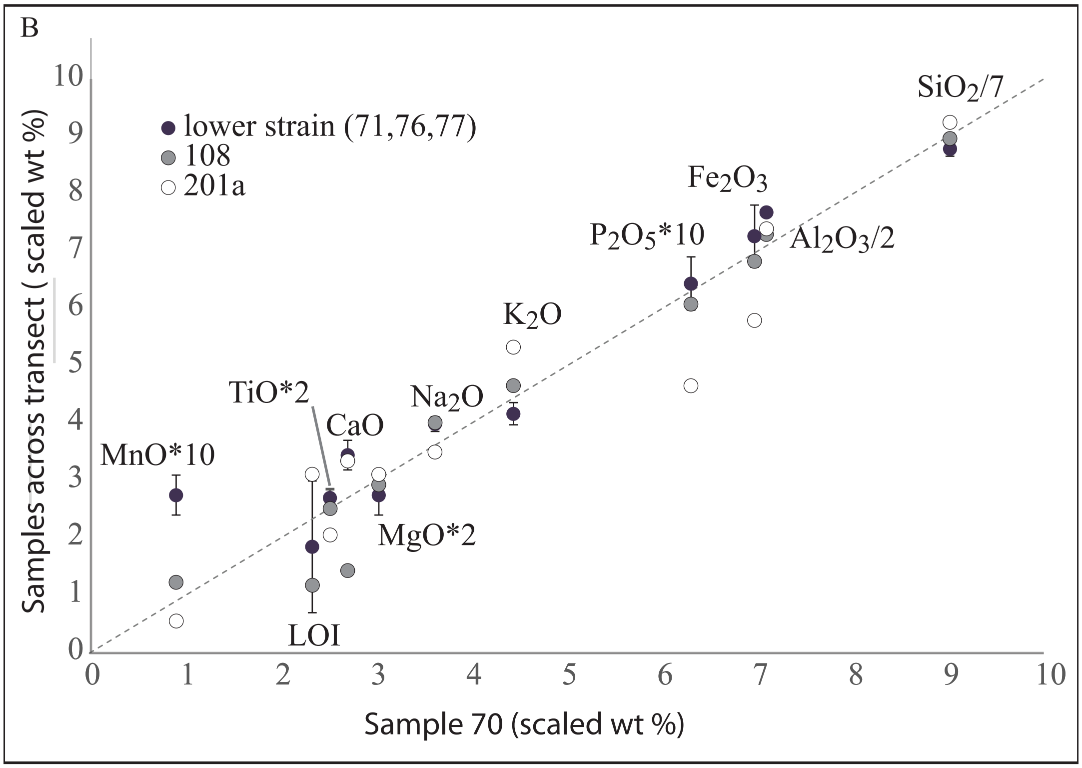
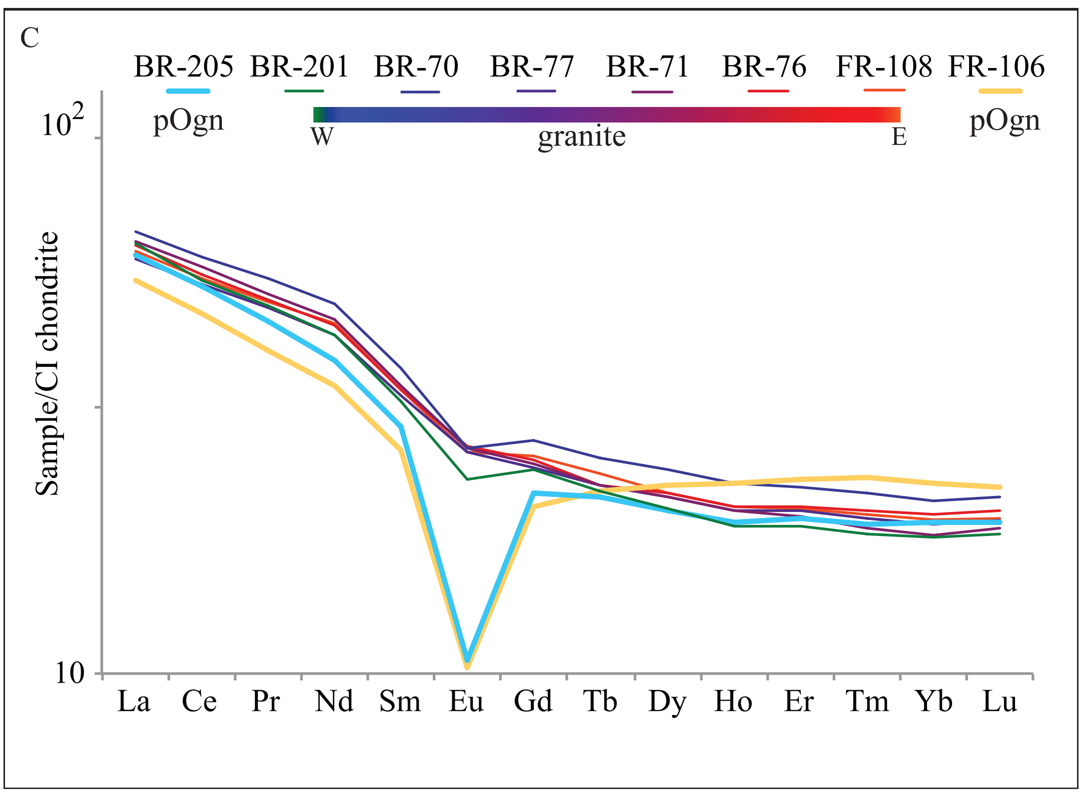


Figure 2.14 Bulk Rock Analysis Results. Major element bulk chemistry weight percent across transects. Sample numbers listed at top.


B
lower strain (71,76,77)
108
201a
Samples across transect (scaled wt %)
Sample 70 (scaled wt %)
SiO2/7
Fe2O3
P2O5*10
Al2O3/2
K2O
Na2O
TiO*2
CaO
MnO*10
MgO*2
LOI


C
BR-205 BR-201 BR-70 BR-77 BR-71 BR-76 FR-108 FR-106
pOgn
W
granite
E
pOgn
Sample/CI chondrite
La Ce Pr Nd Sm Eu Gd Tb Dy Ho Er Tm Yb Lu

2.7 Microscale Observations of the Bounding Pink Orthogneisses

2.7.1 Petrography

The eastern pink orthogneiss, sample 10, consists of mostly recrystallized K-feldspar and quartz with modally less amount of plagioclase, and minor amounts of biotite, amphibole, and opaques (Figure 2.15a). Recrystallized feldspar grain sizes range from ~100 μm to ~2 mm. K-feldspar is the most abundant phase and most grains have tartan twinning and extensive flame perthite. Quartz grains are mostly found as smaller interstitial grains between feldspars, but there are also loosely aggregated quartz ribbons scattered throughout the sample with average grain sizes of ~400 μm. Plagioclase is typically twinned (Figure 2.15b). The amphibole, biotite, and opaques tend to be interstitial and isolated.

The western pink orthogneiss, sample 205, consists of mostly K-feldspar, quartz, and plagioclase with some opaque phases and chlorite that, based on morphology, is most likely altered amphibole (Figure 2.15c). The chlorite and fine grained opaque alteration products tend to be in thin bands that stretch across the length of the thin section with only a few spots of aggregated, slightly larger grains. Feldspar grains range in size from ~100 μm to ~1 mm and K-feldspar grains are perthitic, but not as pervasively as those in sample 106. The thin section of sample 205 has one larger (2.7 mm) K-feldspar grain that may have been an even larger porphyroclast as it is surrounded by recrystallized K-feldspar grains (Figure 2.15d). Quartz grains of the western pink orthogneiss are mostly found in large, disconnected ribbons, with grain sizes of ~300 μm. The aspect ratios of the quartz ribbons are smaller than those of the eastern pink orthogneiss. Interstitial quartz is also found throughout the thin section, mostly surrounded by feldspar grains.

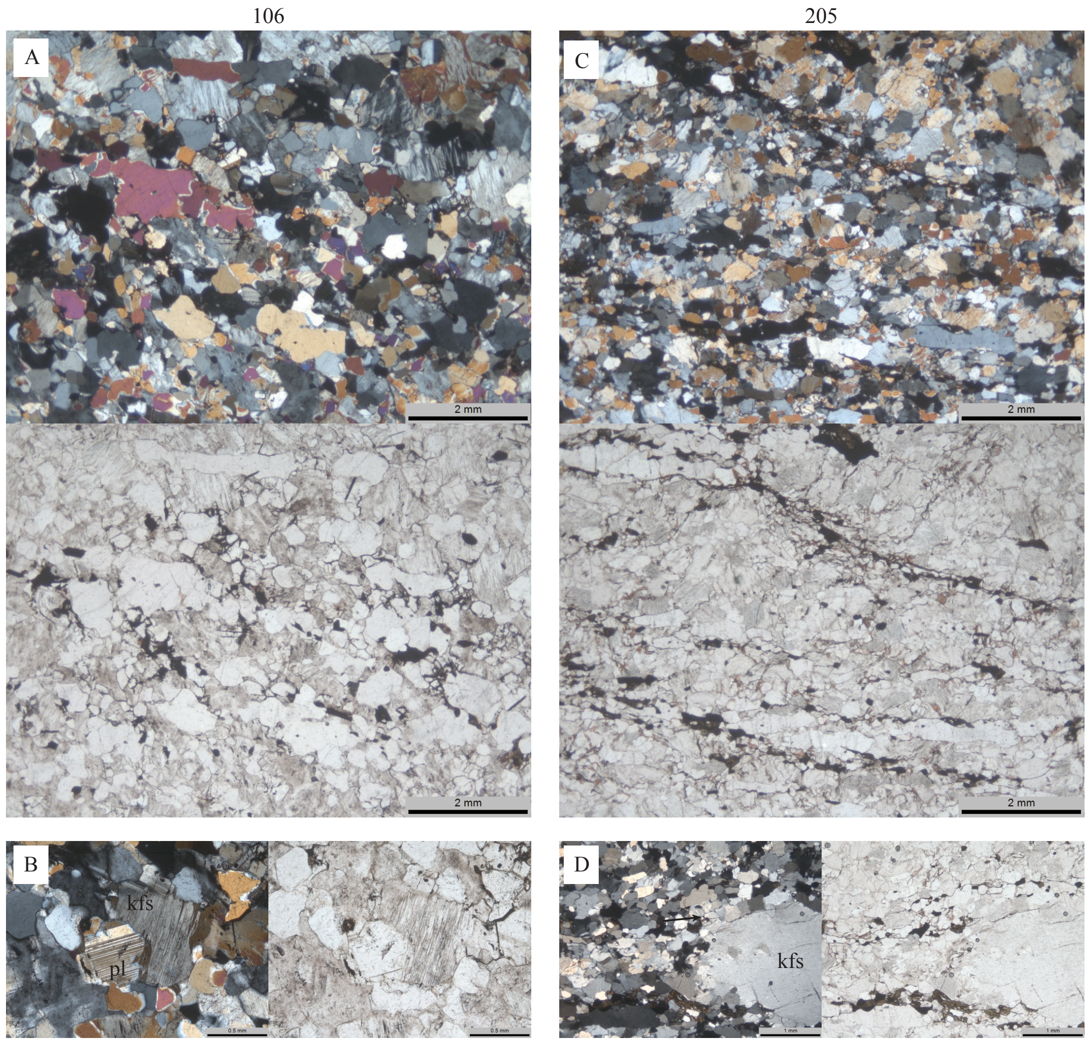


Figure 2.15 Microstructures of the Pink Orthogneisses. A. Typical grain sizes and morphologies of sample 106 of the eastern unit. B. Twinned plagioclase and perthite grains of sample 106. Abbreviations from Whitney and Evans (2010). C. Typical grain sizes and morphologies of sample 205 of the western pink orthogneiss. D. Part of a K-feldspar porphyroclasts mantled by recrystallized grains. Those on the top (arrow) are mostly equant.

2.7.2 Whole Rock Composition

Bulk rock analyses were collected from each pink orthogneiss bounding the granite to the east (sample 106) and west (sample 205) (Table 2.6). The major element results from the western and eastern pink orthogneiss correlate well with each other (Figure 2.14a). They show that Na_2O, SiO_2, and K_2O concentrations are all within the

range of the major element results of the granite, although the western pink orthogneiss (sample 205) has less Na_2O than the least strained sample (70) while the eastern pink orthogneiss has more. In both pink orthogneisses there is a much lower concentration of Fe_2O_3, MgO, TiO_2, MnO, and CaO than in the Bad River Granite.

Chondrite normalized REE analyses of the two pink orthogneisses vary significantly from the Bad River Granite's REE pattern (Figure 2.16). They also show a divergence in the HREE from each other, with the eastern pink orthogneiss having a higher concentration in HREE heavier than terbium. The divergence in patterns may indicate that the pink orthogneisses are different rock types or that they started as the same rock type, intruded by the granite, but their Grenville history created a divergence in REE patterns.

2.8 U-Pb Results

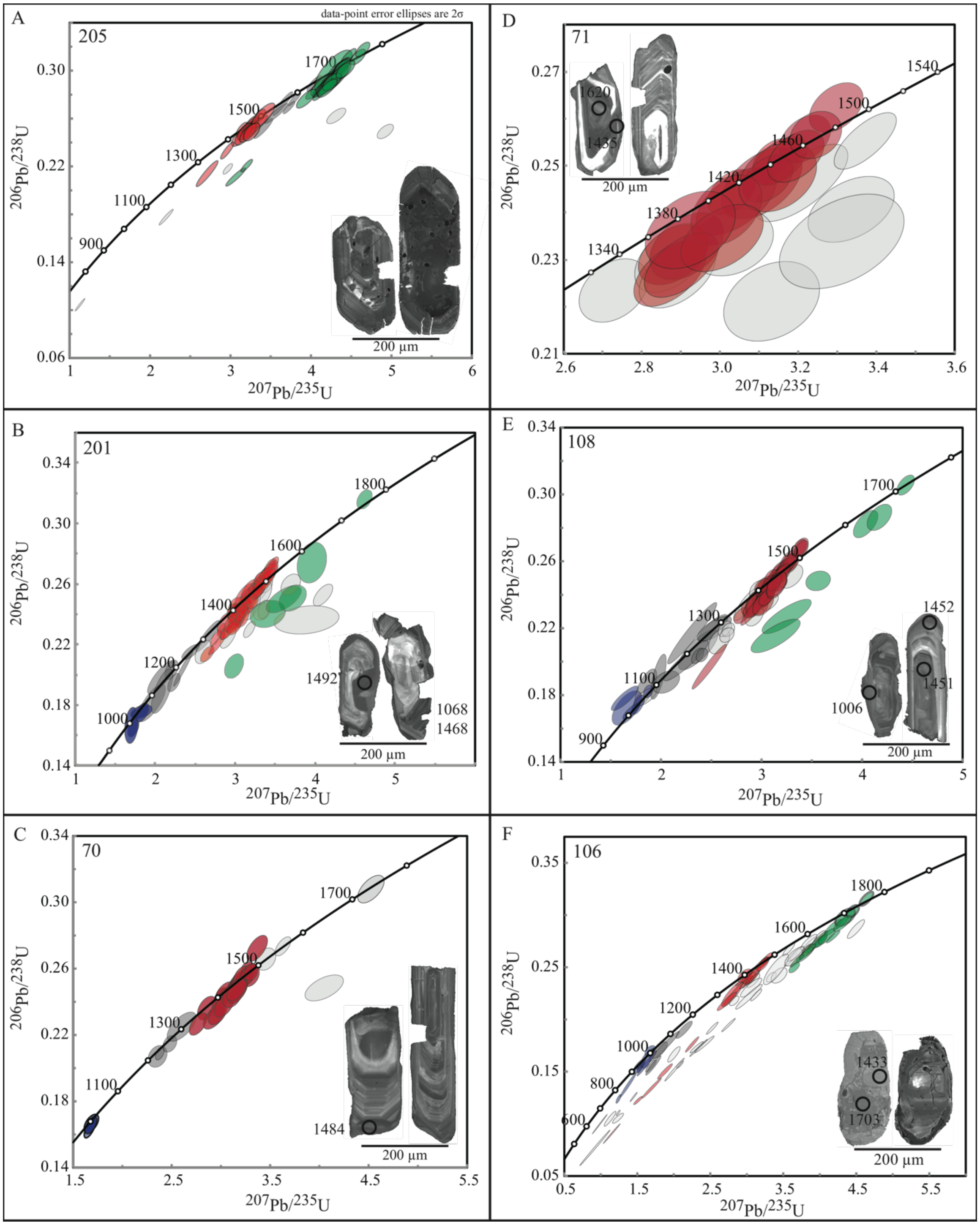
U-Pb analyses were performed on zircon from the middle of the granite unit (samples 70 and 71), each high-strain zone on either end of the granite (samples 108 and 201), and each pink orthogneiss unit to the east and west of the granite (samples 106 and 205) to determine the metamorphic/deformation history of the units and shear zones (Table 2.7; full analyses in Appendix D). U-Pb data were collected from the pink orthogneisses since these units took up most of the strain associated with the granitic strain gradients and could reveal more regional history. Grains between ~150 and ~200 µm were chosen for spot analyses and those greater than ~200 µm were chosen for profiling, since a larger spot size is used for profiling.

Table 2.7 Average $^{207}Pb/^{206}Pb$ Age Per Site

Sample No.	Avg $^{207}Pb/^{206}Pb$ Age	Propagated Error (2σ)	MSWD	n
205	1484.7	5.6	1.6	18
	1719.9	5.8	3.4	26
201	1082	41	0.18	4
	1451.5	8.2	6.3	51
	1723	14	0.65	6
70	1037	32	0.41	2
	1450	11	4.5	26
71	1454.5	6	0.56	16
108	1034	32	1.4	5
	1464.5	4.3	2	51
	1721	19	1.8	6
106	1019	26	5.2	9
	1466.7	8.3	3	19
	1728	12	13	16

Zircons from the Bad River Granite typically have similar morphology and zoning patterns; most have variably elongate cores with different degrees of oscillatory zoning toward the edges (Figure 2.16b-d). The grains commonly have irregular, homogenous, CL- dark rims cutting the cores. A few grains contain CL-dark xenocrystic cores surrounded by oscillatory zoning.

Zircons from the pink orthogneisses (205 and 106) are morphologically distinct from those in the granite, tending to be less elongate and euhedral (Figure 2.16a and e). The grains commonly have metamict cores mantled by homogenous rims, with both zones being CL-dark. However, some grains have rims with oscillatory zoning (Figure 2.16e).



A
205
data-point error ellipses are 2σ
B
201
C
70
D
71
E
108
F
106
200 µm
$^{206}Pb/^{238}U$
$^{207}Pb/^{235}U$

$^{207}Pb/^{206}Pb$ age distributions including all samples, determined from both cross-sectional spot analyses and discrete depth intervals within the profiles, yielded three age groups with maxima at ~1720, ~1460, ~1020 Ma (Figure 16). Analyses excluded from the weighted averages were due to either (1) mixed U-Pb isotopic compositions due to laser sampling of multiple age domains, or (2) significant Pb-loss leading to strongly discordant analyses. In addition, several of the analyses fall along a chord between the age groups (Figure 2.16, dark grey ovals). These analyses most likely indicate partial resetting of the U-Pb in the zircon by the younger event (see Figure 2.17) and we therefore did not include these ages in our calculations. This partial resetting occurred at ~1460 Ma, affecting only the pink orthogneiss, and ~1020 Ma, affecting both the granite and the orthogneiss.

Analyses of epoxy mounted, cross-sectioned zircon were conducted on 86 grains from the 6 sites; 65 on grain cores and 42 on rims. There were few distinctions between cores and rims. Most of the cores within the granite yielded the ~1460 Ma age and some have similarly aged rims (Figure 2.16d), although one rim age from sample 108 yielded an age of 1006 ± 44 Ma to 2σ.

Since all but one of the rims were too thin to be analyzed by cross-sectional analyses, depth profiling was used to determine the ages of outermost rim domains. Depth profile analyses conducted on 119 grains confirmed that there are three distinct age populations recorded by sample 108, and also yield three ages in samples 201 and 106. Results of depth profile analyses from the four granite sites were dominated by a ~1460 Ma age signature ranging from spot ages of 1385 ± 42 Ma to 1494 ± 14 Ma.

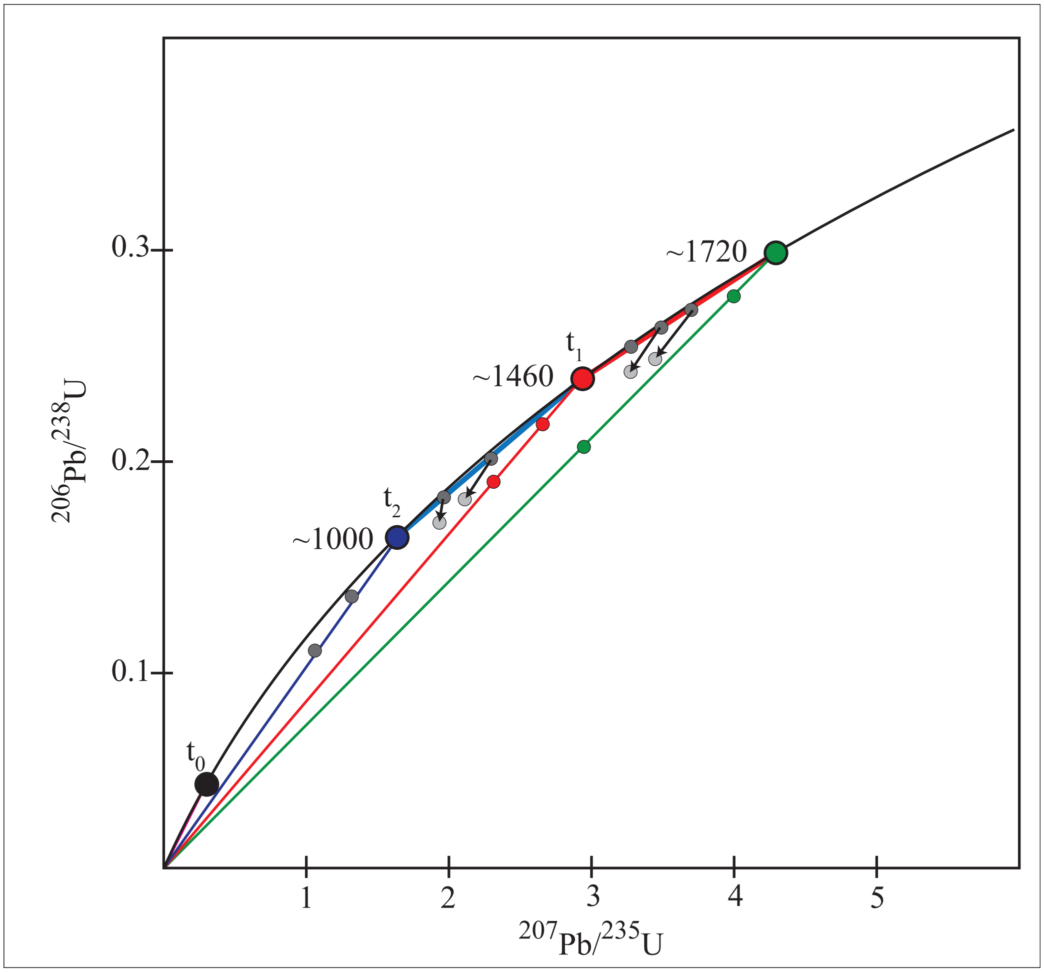


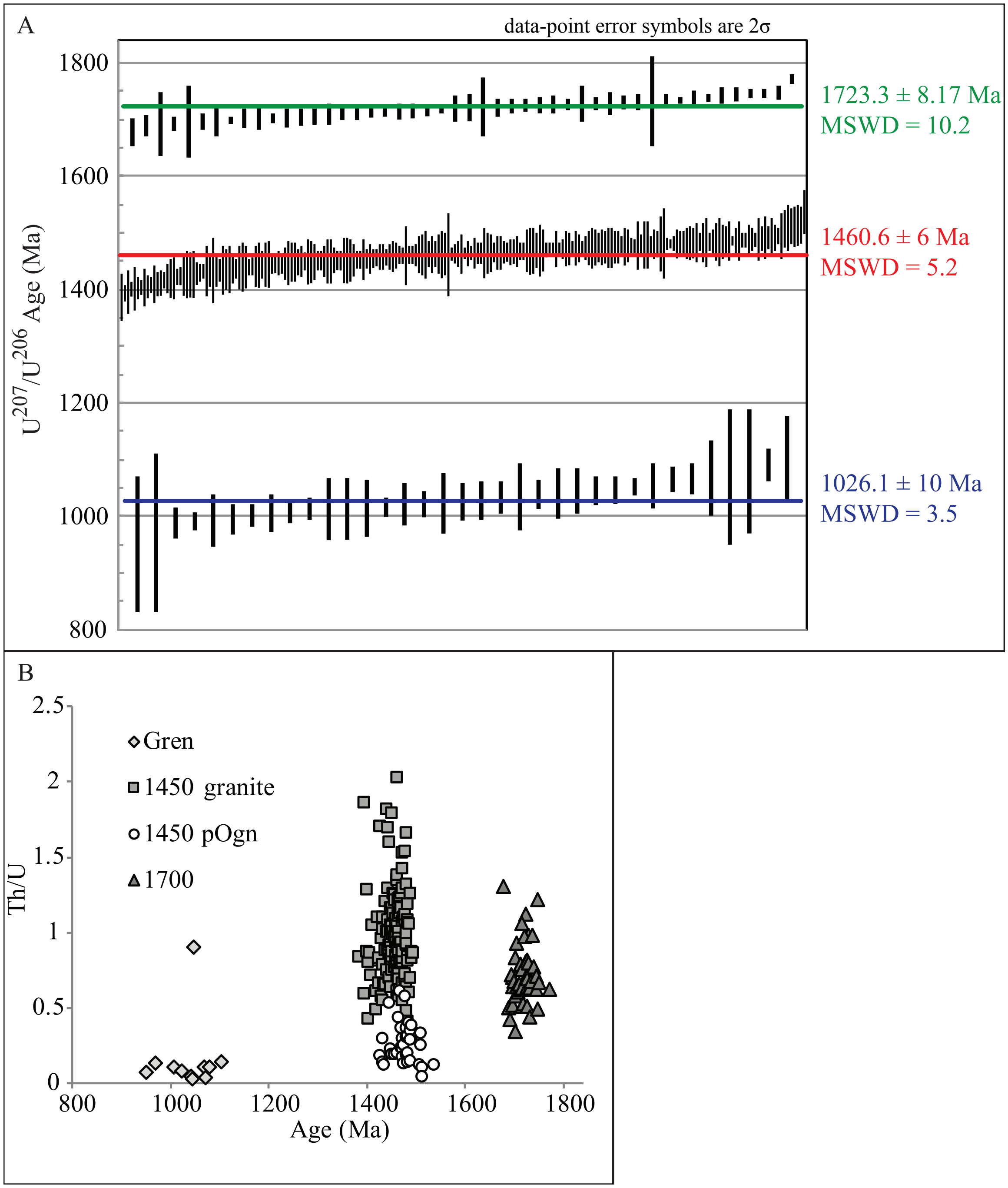
Figure 2.17 Resetting U-Pb Geochronometer in Zircons. Schematic explanation of how partially reset zircons plot on Concordia diagrams. Colored dots represent the major ages reported in this study. Dark grey circles represent ages that have 'travelled' up the Concordia plot after partial resetting between two of the events (e.g. the 1720 Ma age partially reset at 1460 Ma). Light grey dots are zircons that were partially reset a second time during subsequent events forming a new chord between the first or partially reset age and the origin. See text for further explanation. After Faure (1986).

Most of the analyses that resulted in ~1720 Ma ages were from the bounding pink orthogneisses, samples 205 and 106. Some analyses of the granitic samples also yielded older ages ranging from 1670 ± 33 Ma to 2282 ± 14 Ma, but, similar to the cross-sectional analyses, all of these analyses were from the most sheared sites, 201 and 108,

which are found near lithologic contacts and therefore most likely represent xenocrystic cores. Depth profiling did not yield any ages of ~1720 Ma in samples 70 or 71.

Thin rims that vary in width yield Grenville ages in several of the analyses from samples 201 and 108 and two analyses from sample 70 (none in 71). The irregular rims were measured in 6 separate zircons from the three sites and vary in thickness from ~1.5 to ~5 μm (Figure 2.16c). The small integration intervals from these thin rims produced individual ages with high uncertainty, ranging from 950 ± 120 Ma to 1103 ± 73 Ma.

Final ages are reported with 2σ propagated error. Pooled data are quadratically summed with the error from the standard GJ1, which had an error of 0.35% across all analyses. Pooling all the sites together is analytically sound as the data were all collected within two days and the sites were analyzed serially in each run under the same operating conditions. Also, the granite is bounded to each side by the pink orthogneiss units making a cohesive geologic unit on the scale of regional metamorphism. Although there may be some nuances that are lost by pooling the data in such a manner, it is unlikely that they fall outside the uncertainty associated with >1 Ga events. Individual Concordia and weighted average plots for each site can be found in Appendix E. Age populations from all six sites were pooled for weighted averages resulting in ages of 1723 ± 8 Ma, 1461 ± 6 Ma, and 1026 ± 10 Ma (Figure 2.18a). These ages correspond within error with anchored Concordia plots (Appendix E). Th/U ratios for each age population are 0.34-1.3 for ~1720 Ma, 0.41-2.02 for ~1460 Ma, and 0.03-0.90 for ~1020 Ma (Figure 2.18b; Table 2.7). However, the ~1460 Ma Th/U ratios are higher in the granite (0.30-2.02) than those of the pink orthogneiss (0.04-0.61).


A
data-point error symbols are 2σ
U^{207}/U^{206} Age (Ma)
1800
1600
1400
1200
1000
800
1723.3 ± 8.17 Ma
MSWD = 10.2
1460.6 ± 6 Ma
MSWD = 5.2
1026.1 ± 10 Ma
MSWD = 3.5
B
Th/U
2.5
2
1.5
1
0.5
0
Gren
1450 granite
1450 pOgn
1700
800
1000
1200
1400
1600
1800
Age (Ma)

2.9 Summary of Changes Across the Transect

2.9.1 Microstructure

The least strained sample has variably sized K-feldspar and oligoclase porphyroclasts wrapped by elongate quartz, amphibole and/or biotite, and oxides. This morphology does not change much across both gradients because the recrystallized K-feldspar and plagioclase are often found as monophase aggregates in augen shaped pods, similar to the shapes of the porphyroclasts (e.g. Figure 2.7a4). The wrapping regions range in grain size, but most commonly are found in thin, discontinuous, finer grained, mixed phase aggregates wrapping the porphyroclasts or feldspar pods (Figure 2.7). With increased strain feldspars are also found in a matrix of mixed phases (mostly two-feldspar) between porphyroclasts and/or monomineralic pods.

Although the general augen shape morphology of the samples does not change much, there are five textural changes that occur from the least sheared samples to the most across both gradients. (1) Grain size reduction is the most obvious change with strain (Table 2.1). The K-feldspar and plagioclase porphyroclasts become smaller (and eventually disappear in the eastern gradient) reducing from ~5 mm porphyroclasts to ~250 μm. The recrystallized grain size of both feldspars and quartz grains also reduces across both gradients, although the sizes of these recrystallized grains likely experienced some period of static recovery as foam-like textures can be observed (e.g. Figure 2.7a2). (2) Quartz aggregates thin out to a ribbon morphology and become slightly more sinuous (except for sample 103; Figure 2.10). (3) Bands of amphibole generally become more sinuous and continuous, although this is not a rule (except for sample 103). (4) A crystallographic preferred orientation (CPO) develops in quartz in both gradients. In the

eastern gradient, the CPO strengthens (based on MUD maximum values) with strain until the two easternmost, high strain samples (108 and 103) where the quartz CPO weakens. (5) A significant change in morphology is observed in the easternmost sample, 103. The phases are dispersed with only a few small or elongate aggregates remaining and there are more finer-grained quartz grains than the rest of the samples (Figure 2.7b). This is most likely due to a fewer number of ribbons and an increase in individual, finer grains of interstitial quartz.

<u>2.9.2 Composition</u>

Whole rock analyses of rare earth elements indicate that the granite samples from both gradients all have the same REE pattern and therefore confirm that they are of the same approximate igneous phase. Results of major element weight percent from bulk rock chemistry of granite samples indicate some variation, but there are no significant trends that correlate with strain. Furthermore, the variations do not fall outside those reported from other plutons (e.g. Gray et al. 2008) and therefore the variations shown in Figure 2.14a and 2.14b are most likely representative of natural heterogeneities in the granite body (e.g. Figure 2.4b).

The two gradients show little evidence of metamorphic/metasomatic evolution with strain as there is no quantifiable change in modal amounts of amphibole or biotite. However, a slight increase in Mg#, F, and Cl in both amphibole and biotite that correlate well with strain and an increase of Na in recrystallized oligoclase suggests localized element mobility during strain (Figure 2.12). These elemental changes are discernible

when normalized to bulk rock chemistries in the same samples. Also, garnet morphology is generally more skeletal with strain, likely due to increased resorption (Figure 2.14).

2.10 Discussion

2.10.1 Implications of U-Pb Results

The ages reported here complement the results of several previous studies spanning from the Central Gneiss Belt to the Grenville Front (Krogh et al. 1966; Van Breemen & Davidson 1988; Haggart et al. 1993; Corfu & Easton 2000). U-Pb dating of zircons indicate that the pink orthogneisses were emplaced ~1723 Ma. This is a similar age to those reported for the granitoids of the Killarney Complex (1742 ± 1.4 Ma ; Van Breemen & Davidson 1988), Fox Islands (1685-1725) and Grondine Complex (1715 +6/-5 Ma; Davidson et al., 1992). The Th/U ratios reported here support the interpretation that the granite intruded the pink orthogneiss ~1461 Ma, which created metamorphic rims on zircon in the pink orthogneiss and xenocrystic cores found in locations towards the boundaries of the granite. This timing indicates that the granite intrusion was part of a regional magmatic event associated with plutonism and metamorphism of Archean and Paleoproterozoic rocks (van Breeman et al. 1986; Krogh 1994; Fueten & Redmond 1997; Carr et al. 2000 and references therein). The pink orthogneiss units were then again deformed along with the granite toward the end of the Grenville Orogeny at ~1026 Ma. These U-Pb data indicate that the granite is a monocyclic unit within the GFTZ and therefore, any deformation and or metamorphism observed is related to processes associated with the Grenville Orogen.

2.10.2 Deformation Conditions and Mechanisms

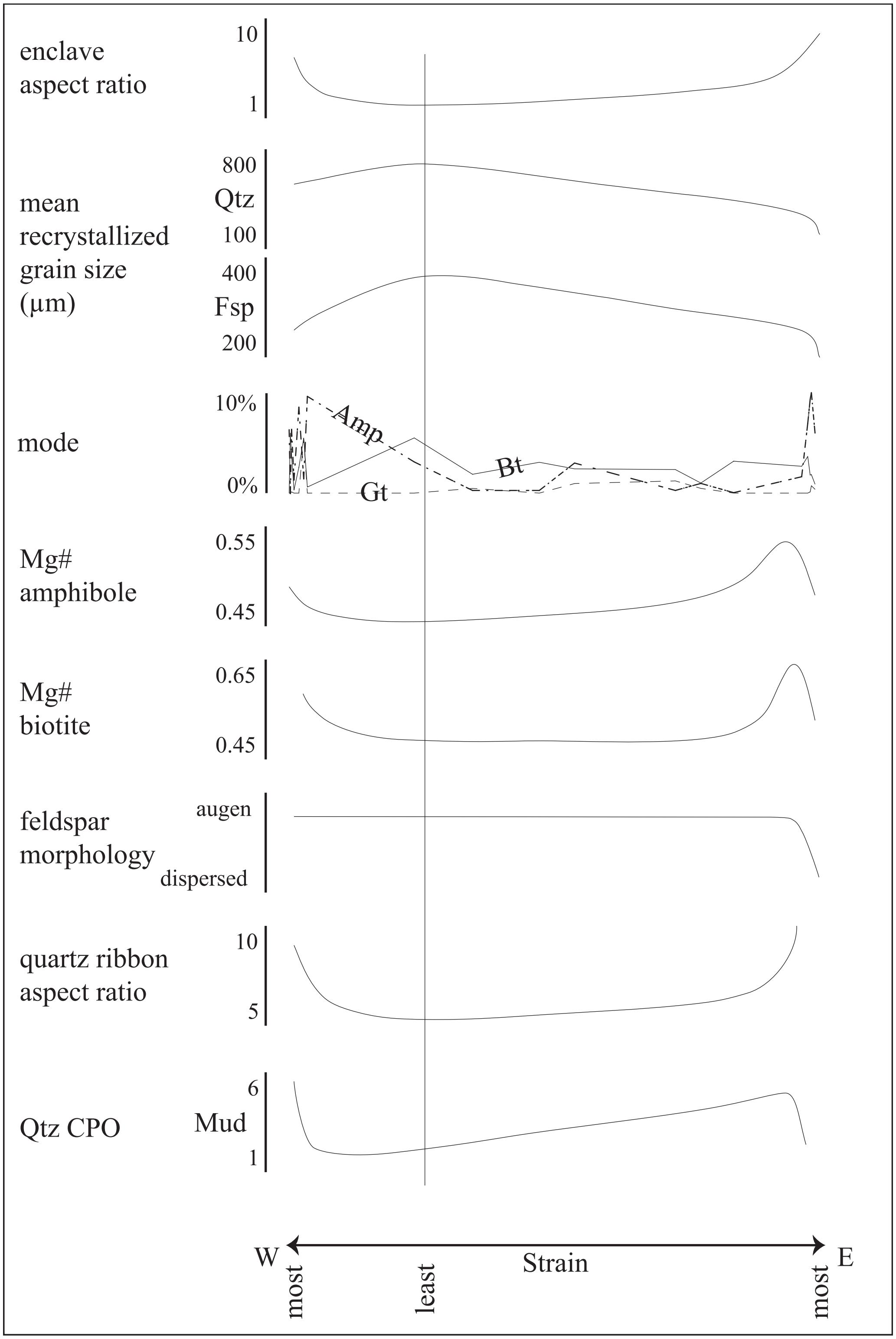
The quartz CPOs indicate that quartz was deforming near the transition from subgrain rotation to grain boundary migration (M. Stipp et al. 2002) suggesting high temperatures where prism <a> slip is most likely the dominant slip system (Schmid & Casey 1986). Furthermore, the development of a ribbon morphology and undulose extinction (Culshaw & Fyson 1984; McLelland 1984; M. Stipp et al. 2002; Toy et al. 2008) are consistent with deformation at amphibolite grade temperatures, which correlates with previously reported ~500-650° deformation temperatures (Jamieson et al. 1995).

Several lines of evidence exist for different deformation mechanisms within the strain gradients of the granite. (1) The presence of subgrains and a CPO in quartz, as well as mantled feldspar porphyroclasts suggests that dislocation creep was active in both strain gradients. (2) The mixed phase matrix that develops in both strain gradients is most clearly observed in the easternmost sample, 103, with a coincident drop in CPO strength and grain size. These are consistent with dislocation- or diffusion-accommodated grain boundary sliding (Ashby & Verrall 1973; Kruse & Stünitz 1999; Kenkmann & Dresen 2002; Warren et al. 2008; Oliot et al. 2014; Czaplińska et al. 2015). (3) Lastly, the correlation of the slight increase in Mg#, F, and Cl in biotite and amphibole with strain is evidence of element mobility, which may indicate that mass transfer processes (i.e. diffusion creep or diffusion-accommodated grain boundary sliding) were active in the higher strained samples. Although the increases in Mg# are slight, they are discernable when normalized to variations in bulk-chemistry across the transect. Furthermore, the increases correlate with a reduction in grain size and therefore an increase in grain

boundary area, which facilitates mass transfer processes (White & White 1981; Behrmann & Mainprice 1987; Warren et al. 2008; Pec et al. 2012). Thus, the data indicate that several deformation processes were active during the life of the shear zone and, potentially more importantly, there is lack of evidence for a single dominant mechanism that accommodated strain in the shear zone.

2.10.3 Correlation Among Microscopic Evidence

Means (1995) proposed three classifications for shear zones: (1) strain hardening or widening shear zones, (2) strain weakening or narrowing shear zones (3) heterogeneous strain rate shear zones that neither widen nor narrow. According to Means (1995) narrowing shear zones provide the most reliable deformation history as the strain gradient provides snap shots through time. Evidence for the deformation mechanisms discussed above occur across different segments of the Bad River Granite transect indicating that strain narrowed over time (Figure 2.19). For example, almost all samples have evidence for dislocation creep through the development of a weak CPO in quartz, but evidence for diffusion creep (increase in Mg#, F, and Cl in biotite and amphibole) is only observed in the higher strain samples (Figure 2.12). Experimental results indicate that a change in deformation mechanism can lead to weakening as each mechanism accommodates strain at different rates. For a given stress and the appropriate grain size, deformation rates are slowest when accommodated by dislocation creep and fastest through mass transfer processes (e.g. Bürgmann & Dresen 2008) and GBS (e.g. Warren & Hirth 2006).



enclave aspect ratio
10
1
mean recrystallized grain size (µm)
800
Qtz
100
400
Fsp
200
mode
10%
0%
Amp
Bt
Gt
Mg# amphibole
0.55
0.45
Mg# biotite
0.65
0.45
feldspar morphology
augen
dispersed
quartz ribbon aspect ratio
10
5
Qtz CPO
6
Mud
1
W
E
Strain
most
least
most

The development of a weak CPO in quartz in the lower strain samples indicates that dislocation creep operated throughout the unit early in shear zone formation (e.g. Figure 15). However, the decrease in average grain sizes and increasingly higher MUD values toward the unit's edges (except for CPO of sample 103) indicate that strain continuously localized over time. As localization continued and strain further reduced grain sizes, diffusion creep initiated once grains were sufficiently reduced. This led to further weakening and localization at the edge of the unit as evidenced by the observations made in sample 103. The spatial distribution of the evidence for each deformation mechanism indicates that the shear zone was weakening and narrowing towards the lithologic boundaries (Type II; Figure 15).

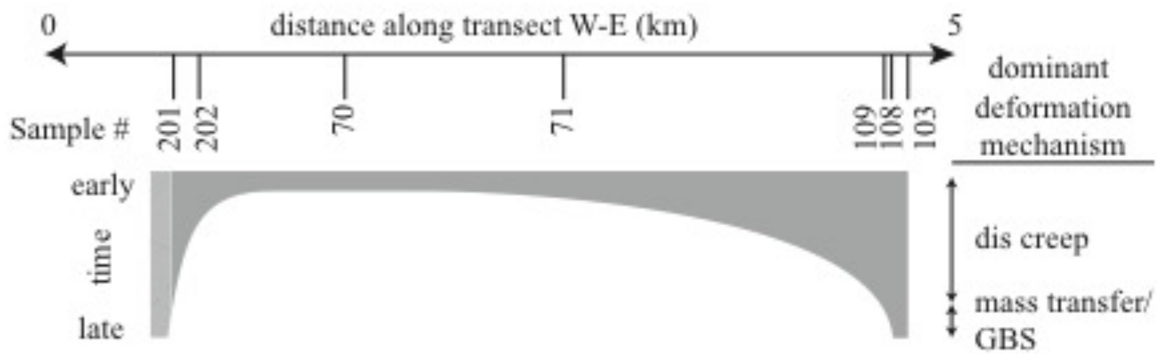


Figure 2.20 Narrowing Shear Zone. Schematic indicating the continued localization of the strain along the Bad River Granite transect. Grey area indicates the parts of the transect that are active from early to late shear zone formation based on data presented. Dotted area in western gradient represents the unobservable portion of the transect under the Bad River, assumed to mimic the easternmost part of the eastern transect.

2.11 Conclusions

The strain gradients of the Bad River Granite provide an opportunity to document evidence for the microstructural and chemical evolution of mid-crustal, orogenic, granitic shear zones and further constrain the timing of the tectonics events within the Grenville Front Tectonic Zone (GFTZ). This is particularly valuable because granitic shear zones are common features of orogenic belts and documentation of microstructural chemical changes across such large-scale shear zones is relatively sparse in the literature.

U-Pb zircon geochronology indicates that the Bad River Granite is a monocyclic unit, bounded by polycyclic pink orthogneiss. It is unclear whether the pink orthogneisses were originally the same unit or not, but they both record a ~1720 Ma crystallization age and a ~1450 Ma metamorphic age associated with the intrusion of the Bad River Granite. The Grenville event, recorded at 1026 ± 10 Ma in the granite and eastern pink orthogneiss, is not recorded in the western pink orthogneiss. However, based on structural data, both shear zones are considered Grenvillian in age.

Across the granite, several deformation mechanisms were active and their spatial distribution require that the shear zones at the margins of the Bad River Granite narrowed with time as a result of an intimate interplay of chemical and mechanical processes. The microstructure-composition-strength feedbacks are likely common within relatively non-reactive, large-scale shear zones but can be obscured in more chemically active shear zones where metamorphic processes may dominate. The evolution of the Bad River Granite strain gradients reveals the spatial and temporal dynamism of the microscale processes that can lead to the formation of km-scale shear zones.

Chapter 3

TEXTURAL EVOLUTION OF M-SCALE STRAIN LOCALIZATION, THE IMPLICATIONS FOR PHASE DISPERSION IN THE MYLONITIC CORE OF SHEAR ZONES.

3.1 Chapter Abstract

The presence of mylonitic zones within a shear zones indicates that significant weakening has occurred. Mylonites are characterized by a fine grained texture and dispersed phase morphology. In order to understand the processes associated with mylonitization of deep granitic crust, we document microstructural and chemical changes across a m-scale shear zone in the exposed deep granitic crust of the Bad River Granite on the eastern boundary of the Grenville Front Tectonic Zone, Ontario, Canada. The transect is texturally defined by the development of a mixed phase matrix, which increases in area with strain. The reduction of average grain size, a change in crystallographic orientation of quartz and a change in morphology from monomineralic aggregates to a mixed phase matrix indicate a switch in dominant deformation mechanism from dislocation creep in the margin to mass transfer accommodated grain boundary sliding (GBS) in the mylonitic core. The presence of mixed phase matrix outside the core implies that this transition was not abrupt and that deformation varies locally on the thin section scale at the edge of the core. Cathodoluminescence microstructures in quartz and an increase in mode of amphibole in the core of the shear zone indicate mylonitization occurred under fluid-present conditions. Thus the data suggest that grain size sensitive processes can operate at grain sizes coarser than the

maximum reported by experimental studies. Lastly, this study shows that mass transfer processes and GBS are important processes in the viscous crust and therefore shear zones are most likely weaker than approximated by the available monomineralic flow laws.

3.2 Introduction

The strength of the lower crust in orogenic terrains impacts large scale geodynamics, a component of which is the transmission of mantle-driven stresses to the surface (Clark & Royden 2000; Clark et al. 2005; Royden 1996; Dayem et al. 2009). Therefore, understanding viscous crustal rheology is an important part of exploring geodynamic systems. Because strain localization plays such a significant role in crustal kinematics, defining mid-lower crustal rheology requires defining the processes that lead to shear zone formation.

Mylonitic crustal shear zones are often represented by a textural evolution from protolith to gneiss to mylonite with increasing strain. This textural evolution begins with a decrease in grain size as porphyroclasts are recrystallized into areas of monomineralic aggregates, forming a gneissic texture. With increased strain localization and grain size reduction, a mixed phase matrix develops. A mylonite is defined when at least 50% of the rock is composed of this mixed phase matrix (Sibson 1977). Shear zones may have mylonitic cores (e.g. Kwon et al. 2009) or several mylonitic bands throughout (e.g. Dutruge & Burg 1997). The textural evolution from gneiss to mylonite is accompanied by a significant grain size reduction and a change in deformation mechanism, both of which have been shown to weaken a rock (Poirier 1980; Tullis & Yund 1985; Hobbs et al. 1990; Hirth & Tullis 1992; Rutter 1999; De Bresser et al. 2001; Platt 2015).

Therefore, the presence of mylonitic zones within a shear zone indicates that significant weakening has occurred.

Numerous studies have documented natural, mylonitic shear zones of various widths from mm-dm (e.g. The Gran Paradiso of the northwestern Alps; Menegon & Pennacchioni 2010), m-hm (e.g., the Tonale mylonite zone; Stipp et al. 2002), and few km-scale (e.g. the Woodroffe mylonite zone; Bell 1973). Although the development of the mixed phase matrix has been shown to be formed in places from metamorphic reactions (Rubie 1983; Brodie & Rutter 1987; Rubie 1990; e.g. Tullis & Yund 1991; Stünitz & Tullis 2001; Garlick & Gromet 2004; Chopin et al. 2012), other studies have reported phase mixing without reaction-induced grain size reduction (e.g. Kruse & Stünitz 1999; Kenkmann & Dresen 2002; Oliot et al. 2014; Platt 2015).

Since mylonitic textures form across rock types and temperature conditions and are associated with significant weakening, it is important to investigate the processes associated with their formation and how these processes influence the bulk rheology of deep-crustal shear zones. Thus, this contribution documents microstructural and chemical changes across a ~30 m wide granitic shear zone with a mylonitic core to discusses the impact of such processes on our understanding and quantification of the rheology of the middle levels of orogenic crust.

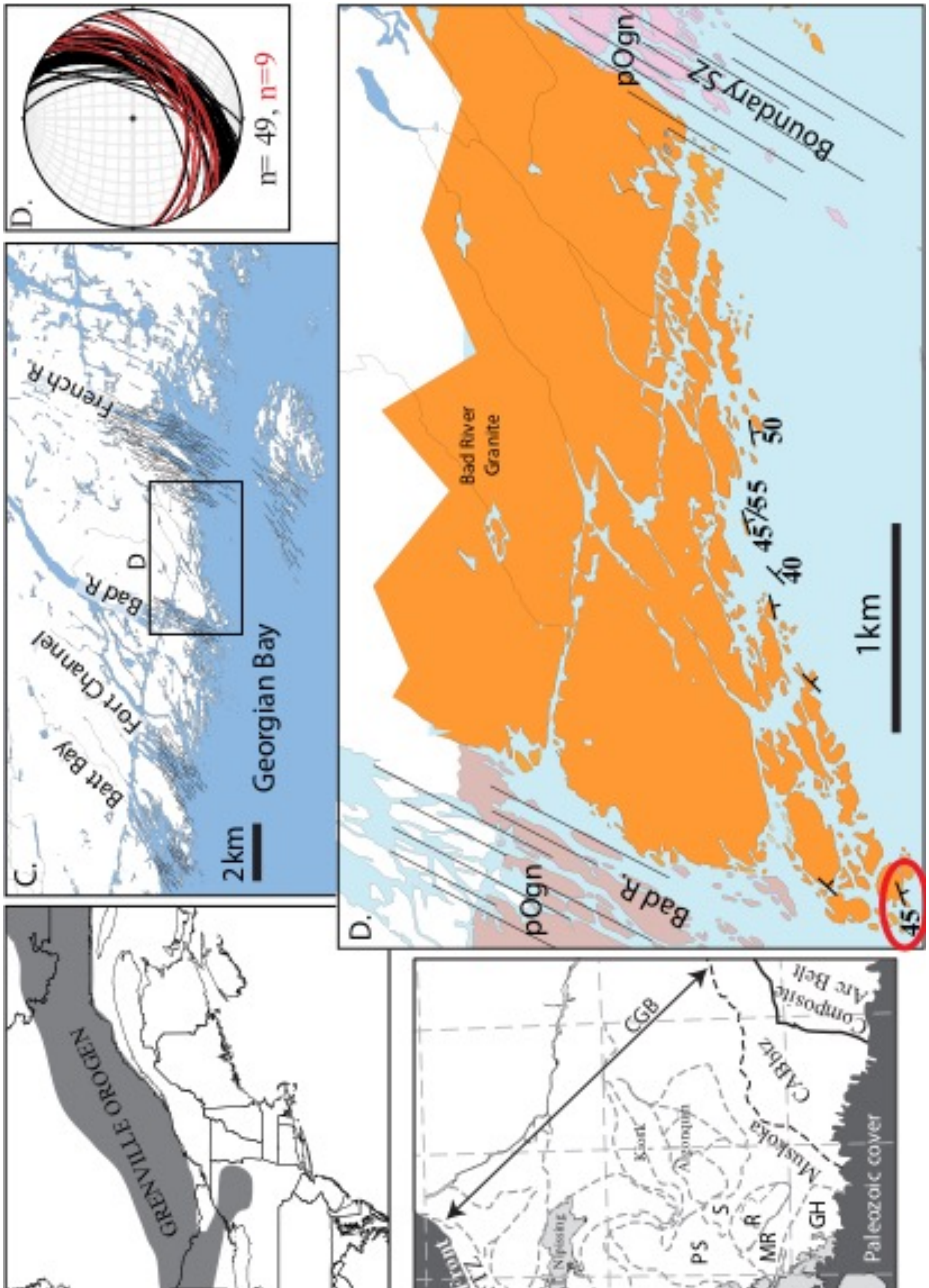
3.3 Deformation Mechanisms

Dynamic strain in the deep crust can be accommodated by three key mechanisms: (1) dislocation creep, (2) mass transfer processes, and (3) grain boundary sliding (GBS), sometimes referred to as superplastic flow. Dislocation creep is a grain size insensitive

mechanism and includes dislocation glide and climb. Mass transfer processes include pressure-solution and diffusion creep and are considered grainsize-sensitive mechanisms because a reduction in grain size reduces the length of diffusion and/or solution pathways (Wheeler 1992; Farver & Yund 1995). GBS describes the movement of grains past each other and therefore is also thought to be a grain size sensitive mechanism since reduced grain sizes facilitate grain movement. Due to volume constraints in the deep crust, GBS must be accommodated by dislocation creep (Hirth & Kohlstedt 1995; Hirth & Kohlstedt 2003; Warren et al. 2008) or mass transfer processes (e.g. Tullis et al. 1996, Svahnberg & Piazolo 2013). Empirical flow laws based on monomineralic deformation experiments have been developed for these deformation mechanisms, but are now generally accepted as limited in applicability since natural systems are often polymineralic and the flow laws for individual minerals cannot be combined to make an effective and accurate aggregate flow law. These deformation mechanisms each accommodate strain at different rates, such that the total strain rate of a viscous-crustal shear zone is a sum of the strain rates accommodated by each of these three mechanisms (e.g. Langdon 2006; Warren & Hirth 2006).

3.4 Geologic Setting

The Grenville Front Tectonic Zone (GFTZ) is the northeastern extent of the Grenville Orogeny, a large collisional orogeny that was active from 1100 to 980 Ma (Hynes & Rivers 2010; Davidson & Bethune 1988). Archean to Paleoproterozoic Laurentian crust was reworked as the orogen migrated northwest into the Larentia craton making the GFTZ is the youngest feature of the orogeny (Figure 3.1). Large shear


A.
GRENVILLE OROGEN
B
C.
Batt Bay
Fort Channel
Bad R.
D
French R.
Georgian Bay
2km
D.
n= 49, n=9
D.
pOgn
Bad R.
Bad River Granite
45
40
45
55
50
1km
pOgn
Boundary SZ
B Archean
Paleoproterozoic foreland
Grenville Front
GFTZ
C
Georgian Bay
Britt
Sh
PS
S
R
MR
GH
Nipissing
Kiosk
Algonquin
Muskoka
CABbz
CGB
Composite Arc Belt
Paleozoic cover

zones associated with the Grenville Front dip moderately to the SE. Peak metamorphism reached amphibolite to granulite facies ca. 1090-1020 Ma (Hynes & Rivers 2010; Davidson & Bethune 1988; Green 1988). The easternmost edge of the GFTZ lies west of the main drainage of the French River and is identified structurally by north-northeast oriented lenticular rock units separated by strongly foliated, southeast-dipping migmatitic orthogneisses and subordinate paragneisses (Davidson & Bethune 1988; Jamieson et al. 1995).

This study focuses on a ~30 m wide shear zone in the Bad River Granite (Figure 3.1). The regional fabric of the Bad River Granite strikes northeast/southwest and generally dips ~45° SE. Smaller shear zones on the 10s of meters scale are scattered throughout Bad River Granite, crosscutting the regional fabric, and particularly well exposed on the shores of Georgian Bay. They vary in strike between 40° and 60° and dip to the SE (Figure 3.1). The shear zone documented in this study is located at the outlet of the Bad River. It is the least altered of the shear zones that were sampled.

The shear zone formed under amphibolite facies conditions and field observations show an abrupt transition from the coarser grained margin to the fine-grained core of the shear zone (~0.5 m wide; Figure 3.2a). We can loosely quantify strain increase toward the core of the shear zone using the aspect ratios of stretched enclaves (Figure 3.3; measurements in Appendix F).

3.5 Results

Samples were collected across strike from the core of the shear zone to the northwest, with the furthest sample being ~32 m across strike from the core (Figure 3.1).

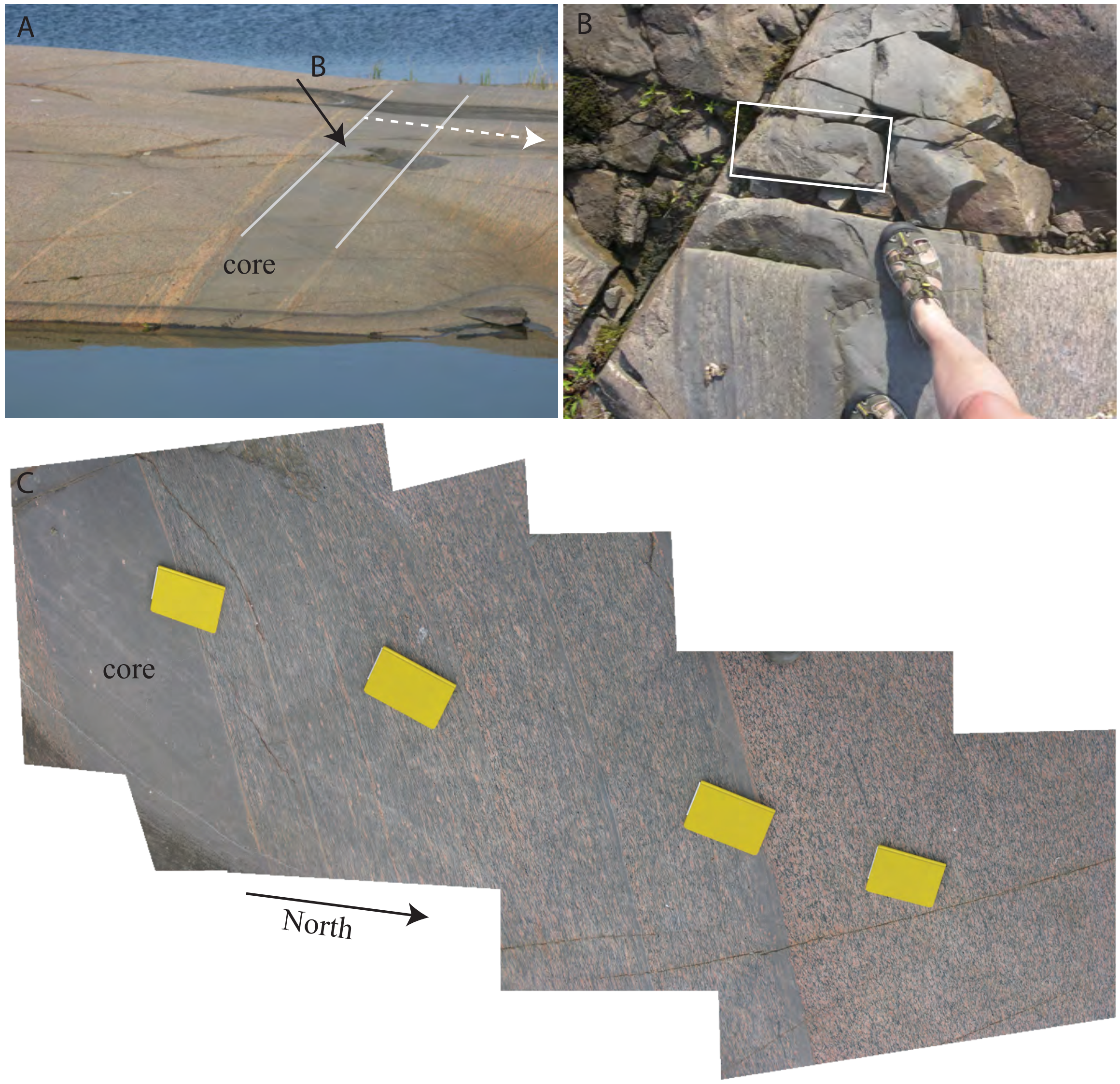


Figure 3.2 Macro-scale Images Of Shear Zone. A. View looking west, mylonitic core is outlined in gray. Black arrow marks location of B. White dashed arrow mark approximate location of C (continues out of frame). B. Core of the shear zone, highlight is sample 14 of core (see Figure 3.4). C. Stitched map of core and margin of the shear zone. Increase in amphibole is seen near the mylonitic zone.

Often sample locations were dictated by where samples could be extracted from the glacial pavement along pre-existing fractures. Thin sections 20, 19, 18, 17, and 16 span most of the transect (Table 3.1). Thin sections 14B9-B1, from here on referred to as B9-

B1, represent a continuous cut from a sample of the core of the shear zone in order to document the transition from core to margin (Figure 3.4).

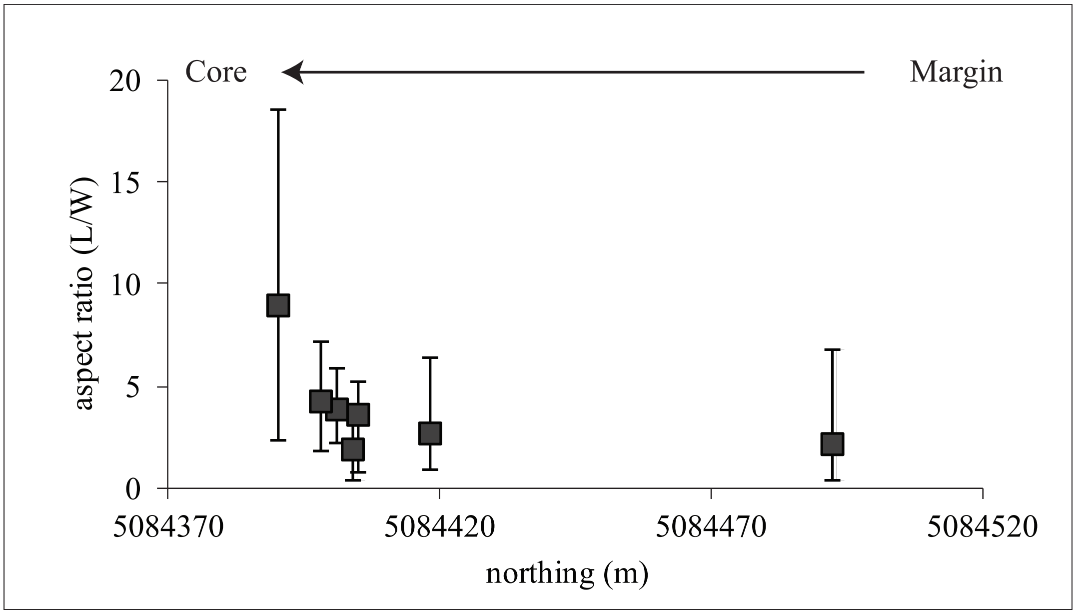


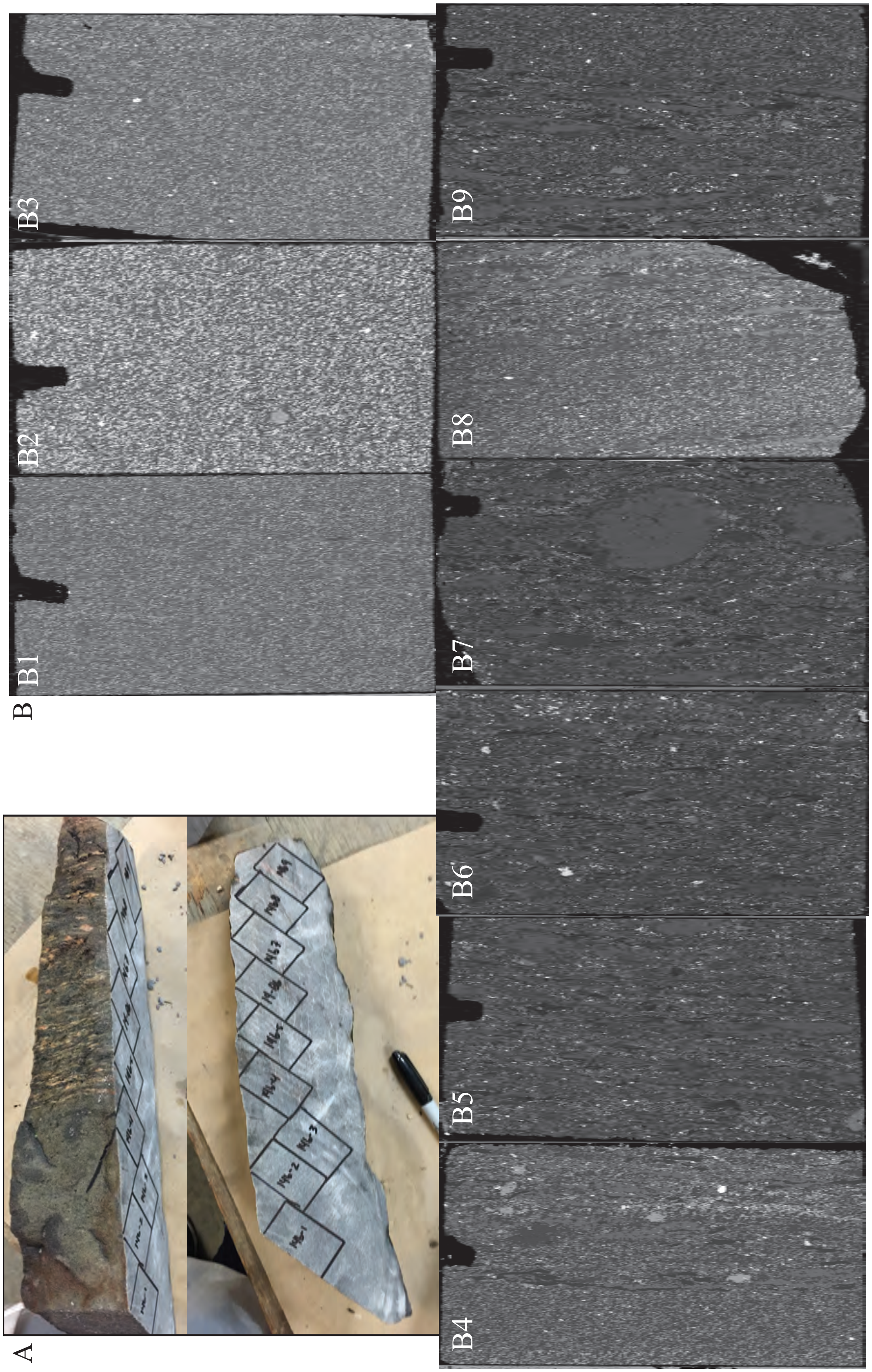
Figure 3.3 Enclave Measurements. Aspect ratio of stretched enclaves across the transect. Boxes are average aspect ratio and error bars are the maximum and minimum aspect ratios of each site. Measurements in Appendix F. Aspect ratios of enclaves increase toward the core of the shear zone.

3.5.1 Petrography

3.5.1.1 Shear Zone Margin (Samples 20-16)

Samples 20 (furthest from the core) to 16 (closest to core) have similar modal mineralogy (Table 3.1). The samples largely consist of oligoclase, microcline, and quartz, with 10-12% of amphibole and biotite, ≤3% Fe- and Ti- oxides, apatite, and trace amounts of zircon, pyrite, titanite, and rutile. Also, samples 20 and 18 have ≤1% calcite and sample 19 has ~2% dolomite. Samples 20-18 have fully chloritized amphibole, but the other samples have only partially chloritized amphibole and biotite.

Although sample 20 is a metagranite, it serves as the least deformed sample and therefore as the base sample for comparison along the transect. Most of the feldspars in

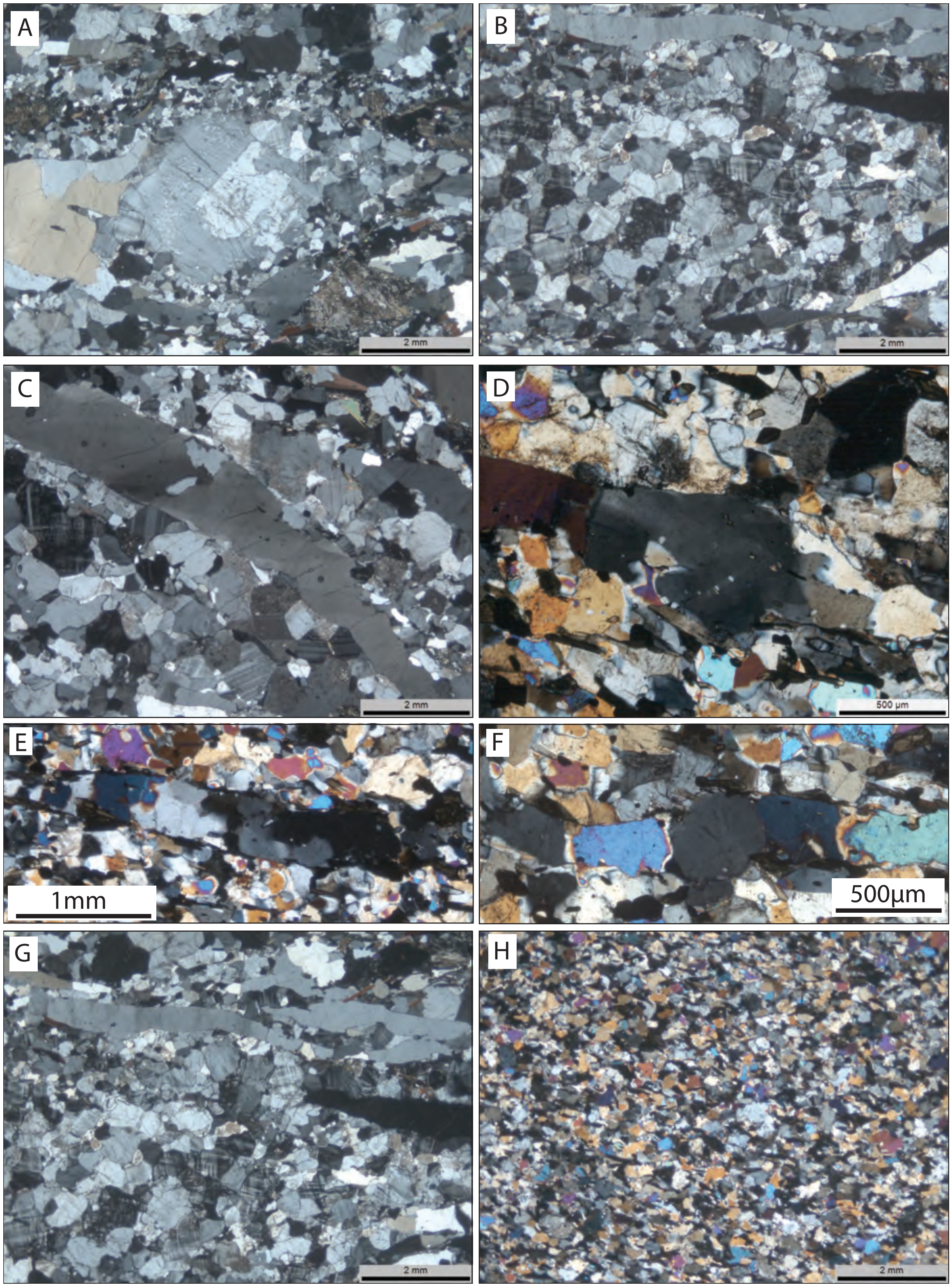

A
B
B1
B2
B3
B4
B5
B6
B7
B8
B9

sample 20 are medium grained aggregates except for one large porphyroclast of K-feldspar mantled by finer grains (Figure 3.5a). The feldspar aggregates form monomineralic, loosely defined augen shapes that are wrapped by large quartz ribbons, with aspect ratios averaging ~6 (Figure 3.5b). Almost all of the microcline exhibits pericline twinning and/or is perthitic. Most quartz grains form ribbons and show undulose extinction (Figure 3.5c), but there is a relatively small amount of interstitial quartz.

Compared to sample 20, samples 19-16 represent a progression in strain with increasing proximity to the core of the shear zone, indicated by a textural evolution. With increased strain, porphyroclasts become smaller and monophase aggregates become more common. By sample 16, the porphyroclasts are non-existent and a mixed phase matrix develops (Figure 3.6). Qualitative observations show that the percentage of K-feldspar grains with pericline twinning decreases with proximity to the core. The K-feldspars are perthitic and pure albite rims can be found along most K-feldspar boundaries in the aggregates and along K-feldspar – oligoclase phase boundaries in the matrix.

3.5.1.2 Shear Zone Core (Samples 14B9-B1)

Samples B9-B1show a progression from the margin of the core (B9) to the inner core (B1; Figure 3.6). The outer core samples (B9-B5) are characterized by loosely defined alternating layers of coarser grained, monomineralic quartz ribbons and feldspar aggregates separated by a finer grained, mixed-phase, matrix (Figure 3.4). In sample B4,


A
B
C
D
E
F
G
H
2 mm
2 mm
2 mm
500 µm
1mm
500µm
2 mm
2 mm

there is a relatively abrupt transition to the mixed phase inner core of the shear zone, in which (samples B3-B1) the unit exhibits a mixed phase matrix (Figure 3.4). The quartz in the mixed phase matrix of the core is often found at triple boundaries. All of the samples in the core indicate an increase in mode of amphibole and oligoclase and a decrease in quartz as compared to samples 16-20 (Table 3.1). However, they are still predominantly made up of oligoclase, microcline and quartz, with modally less amphibole, biotite, Fe-Ti oxides, apatite, and zircon. Amphibole grains are found primarily at phase boundaries (not as inclusions). No pyrite, titanite, rutile, or calcite is found in the core, and chloritized biotite and amphibole is minimal in the core. Some undulose extinction in quartz can be found in the coarser layers within samples B4-B9 (Figure 3.5d), but little to none is observed in samples B1-B3 (Figure 3.5e).

3.5.2 Mineral Chemistries

Mineral chemistries of plagioclase feldspar, K-feldspar, amphibole and biotite were collected using a Cameca SX 100 electron microprobe with a 15-kV accelerating voltage, 10 nA beam current and 5 μm spot size. Several analyses were collected per sample to determine if there is a change in chemistry across the gradient. Due to chloritization in the margin samples, amphibole analyses were only collected from core samples. Results indicate no change in mineral composition with strain (Tables 3.2-3.5; Full analyses in Appendix G). Average compositions for plagioclase and K-feldspar are Ab_{80} and Or_{88}, but the perthitic nature of the K-feldspar and the albite pooling at K-feldspar-oligoclase boundaries indicates that the K-feldspar composition was most likely more albitic prior to exsolution.

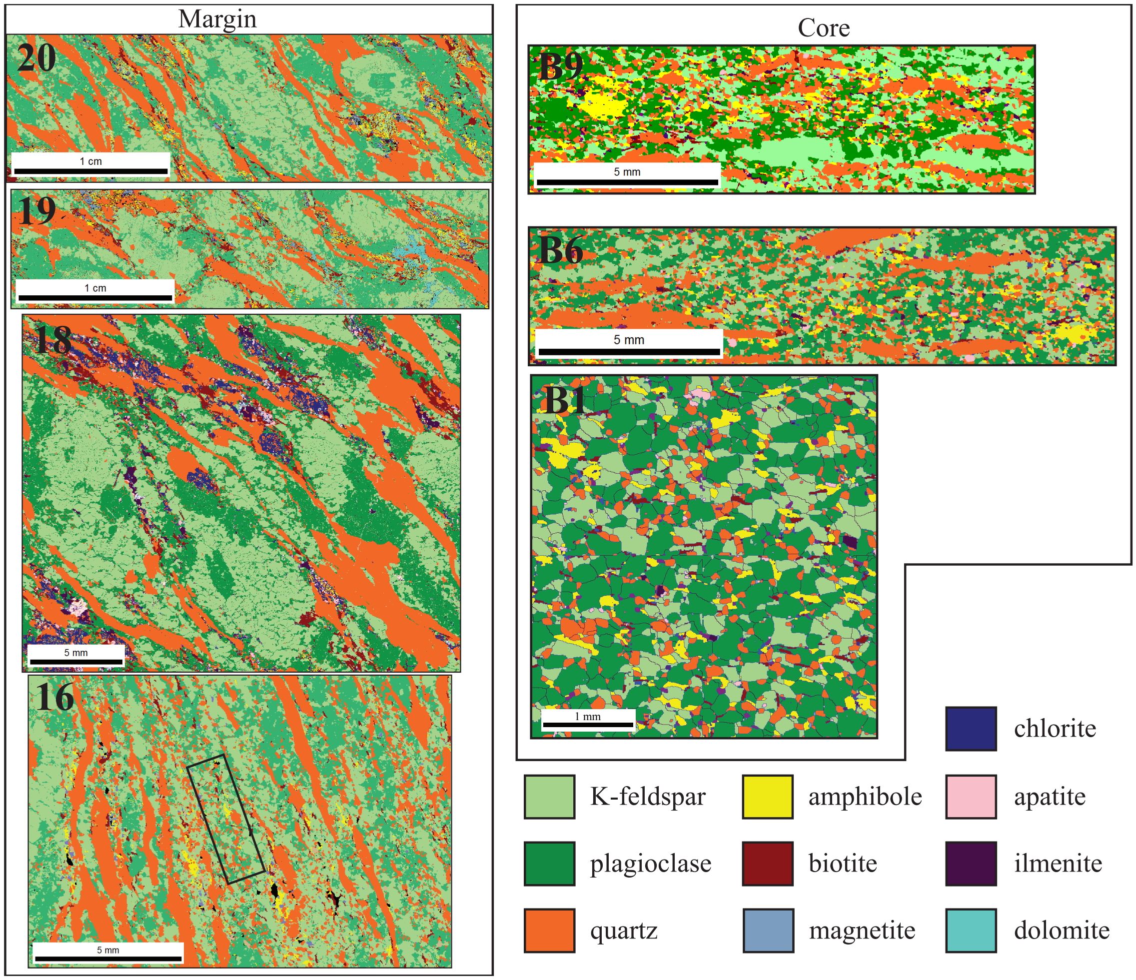


Figure 3.6 Phase Maps. Taken of thin sections perpendicular to foliation and parallel to lineation. Evolution from gneissic to mylonitic texture. Development of mixed phase matrix in sample 16 is highlighted. Grain boundaries are outlined in B1. Note amphibole found along grain boundaries and quartz is often located at triple boundaries.

3.5.3 Crystal Orientations

Electron backscatter diffraction (EBSD) was used to determine quartz crystallographic orientations and the length of like-phase grain boundaries compared to interphase boundaries (from here on referred to as grain boundaries and phase boundaries respectively) among the three dominant phases. The samples were analyzed for crystallographic orientation using the EDAX/TSL Digiview III camera and OIM Data

Table 3.2 Representative Plagioclase Compositions

transect	decreasing strain	--------------------->		
Sample #	B1	B4	16	20
Analysis #*	1.2	1.3	2.1	5
oxide wt. %				
SiO_2	63.89	63.69	63.65	64.28
Al_2O_3	22.87	22.86	22.57	22.45
Na_2O	9.27	9.33	9.30	9.36
K_2O	0.21	0.17	0.24	0.25
CaO	3.91	3.97	3.76	3.58
SrO	0.51	0.51	0.51	0.48
MnO	0.02	0.02	0.00	0.00
FeO	0.20	0.11	0.04	0.05
Total	100.88	100.67	100.07	100.45
Atoms per formula unit (based on 8 oxygens)				
Si	2.81	2.80	2.81	2.83
Al	1.18	1.19	1.18	1.16
Na	0.79	0.80	0.80	0.80
K	0.01	0.01	0.01	0.01
Ca	0.18	0.19	0.18	0.17
Sr	0.02	0.02	0.02	0.02
Mn	0.00	0.00	0.00	0.00
Fe	0.01	0.00	0.00	0.00
% An	18.69	18.87	18.04	17.21

*Analysis numbers correspond to average analyses in Appendix G

Table 3.3 Representative K-feldspar Compositions

transect	decreasing strain	--------------------->		
Sample #	B1	B4	16	20
Analysis #*	1.3	1.1	1	3.2
oxide wt. %				
SiO_2	64.34	64.59	64.38	63.77
Al_2O_3	18.61	18.73	18.73	18.30
Na_2O	1.36	1.26	1.24	0.92
K_2O	14.29	14.67	14.37	15.02
CaO	0.11	0.01	0.06	0.01
SrO	0.54	0.58	0.58	0.55
MnO	0.00	0.00	0.00	0.00
FeO	0.09	0.02	0.04	0.03
Total	99.34	99.86	99.40	98.58
Atoms per formula unit (based on 8 oxygens)				
Si	2.98	2.98	2.98	2.98
Al	1.02	1.02	1.02	1.01
Na	0.12	0.11	0.11	0.08
K	0.84	0.86	0.85	0.90
Ca	0.00	0.00	0.00	0.00
Sr	0.03	0.03	0.03	0.03
Mn	0.00	0.00	0.00	0.00
Fe	0.00	0.00	0.00	0.00
% Or	87.35	88.42	88.17	91.49

*Analysis numbers correspond to average analyses in Appendix G

Table 3.4 Representative Amphibole Compositions. Fe^{3+} calculated assuming ∑cations - (Ca + Na + K) = 13 (Droop, 1987)

transect	decreasing strain	----------------------->		
Sample #	B1	B3	B4	B8
Analysis #*	4.4	4.1	6	3.1
oxide wt. %				
SiO_2	41.47	42.03	41.54	41.73
TiO_2	1.32	1.38	1.52	1.47
Al_2O_3	10.73	10.58	10.62	10.50
FeO	21.18	20.76	20.44	20.35
MnO	0.40	0.47	0.51	0.54
MgO	8.86	8.40	8.54	8.46
CaO	10.14	11.07	10.76	11.11
Na_2O	1.51	1.54	1.96	1.56
K_2O	2.12	1.70	1.68	1.67
BaO	0.00	0.10	0.07	0.02
Cr_2O_3	0.03	0.00	0.00	0.00
H_2O**	1.48	1.58	1.51	1.58
F	0.84	0.64	0.77	0.62
Cl	0.17	0.18	0.19	0.20
Total	100.25	100.43	100.11	99.82
O=F , Cl	0.39	0.31	0.37	0.31
Total	99.85	100.12	99.74	99.51
Atoms per formula unit (23 O; $Fe=Fe_{tot}$)				
Si	6.15	6.18	6.14	6.17
Ti	0.16	0.15	0.17	0.16
Al	1.83	1.83	1.85	1.83
Fe	2.56	2.55	2.53	2.52
Mn	0.05	0.06	0.06	0.07
Mg	1.87	1.84	1.88	1.87
Ca	1.75	1.75	1.70	1.76
Na	0.55	0.44	0.56	0.45
K	0.31	0.32	0.32	0.32
Ba	0.00	0.01	0.00	0.00
Cr	0.01	0.00	0.00	0.00
OH	1.56	1.66	1.59	1.66
F	0.40	0.30	0.36	0.29
Cl	0.04	0.04	0.05	0.05
Fe^{3+}	0.64	0.70	0.71	0.64
Fe^{2+}	1.92	1.86	1.82	1.87
Mg#	0.75	0.73	0.73	0.74

*Analysis numbers correspond to average analyses in Appendix G

** calculated as 2-F-Cl

Table 3.5 Representative Biotite Compositions

transect	decreasing strain	--->				
Sample #	B1	B3	B4	B8	16	20
Analysis #*	3.3	3.3	2.2	5.1	3.1	1
oxide wt. %						
SiO_2	37.60	37.84	37.44	38.99	37.53	37.4
TiO_2	2.93	3.74	3.39	3.13	3.51	3.756
Al_2O_3	13.35	13.15	13.32	13.63	13.38	13.22
FeO	19.98	20.46	19.90	19.19	19.65	19.61
MnO	0.21	0.32	0.31	0.27	0.30	0.37
MgO	12.31	11.23	12.11	11.00	11.92	11.94
CaO	0.05	0.82	0.02	0.03	0.00	0.02
Na_2O	0.10	0.15	0.09	0.10	0.08	0.12
K_2O	9.24	9.00	9.43	9.85	9.61	9.48
BaO	0.34	0.36	0.31	0.45	0.46	0.54
Cr_2O_3	0.05	0.00	0.01	0.01	0.04	0.04
H_2O**	2.95	3.15	2.94	3.03	2.99	2.88
F	1.86	1.51	1.86	1.74	1.76	2.00
Cl	0.14	0.15	0.16	0.15	0.16	0.12
Total	101.09	101.88	101.29	101.57	101.39	101.49
O=F , Cl	0.81	0.67	0.82	0.77	0.78	0.87
Total	100.27	101.21	100.47	100.80	100.61	100.63
Atoms per formula unit (22 O; $Fe=Fe_{tot}$)						
Si	5.72	5.72	5.69	5.68	5.70	5.68
Ti	0.34	0.43	0.39	0.45	0.40	0.43
Al	2.39	2.34	2.39	2.39	2.40	2.37
Fe	2.54	2.59	2.53	2.58	2.50	2.49
Mn	0.03	0.04	0.04	0.04	0.04	0.05
Mg	2.79	2.53	2.74	2.56	2.70	2.71
Ca	0.01	0.13	0.00	0.00	0.00	0.00
Na	0.03	0.04	0.03	0.02	0.02	0.04
K	1.79	1.74	1.83	1.86	1.86	1.84
Ba	0.02	0.02	0.02	0.03	0.03	0.03
Cr	0.01	0.00	0.00	0.00	0.00	0.00
OH	3.07	3.24	3.07	3.13	3.11	3.01
F	0.89	0.72	0.89	0.78	0.845	0.96
Cl	0.04	0.04	0.04	0.04	0.042	0.03
Mg#***	0.52	0.49	0.52	0.50	0.52	0.52

*Analysis numbers correspond to average analyses in Appendix G

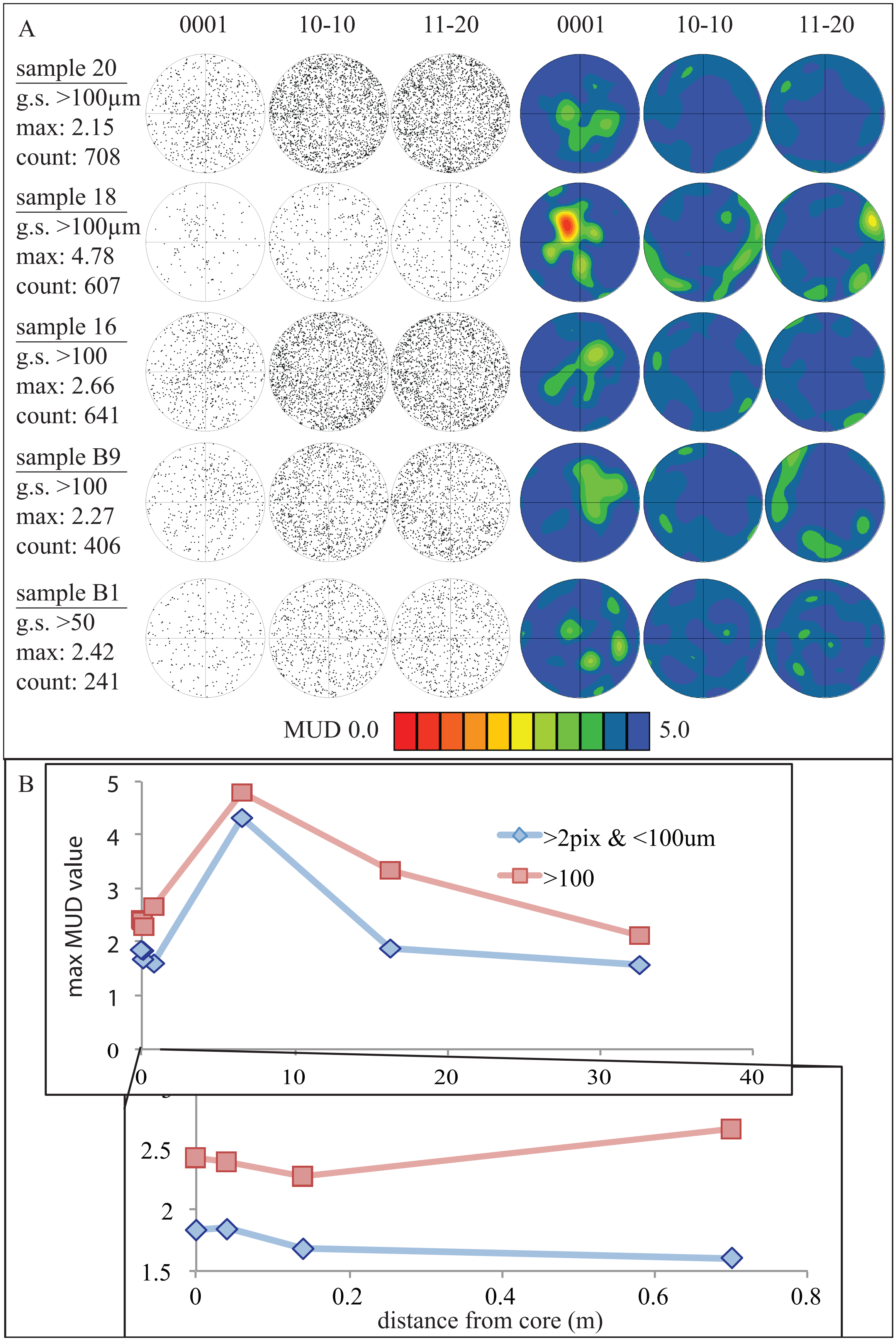
**calculated as 4-F-Cl

***calculated using Fe_{tot}

Collection v.5.3 software on the Tescan Vega II tungsten filament scanning electron microscope (SEM) at the University of Maine. SEM and EBSD parameters for each run consisted of a working distance of 25 mm, a tilt of 70°, a beam current of ~10 nA and varying step sizes from 5-20 μm (Table 3.6). OIM v. 6.0 software was used to identify minerals by composition (Nowell & Wright 2004) and then index orientations.

3.5.3.1 Quartz Crystallographic Orientations

The data used for determination of a crystallographic preferred orientation (CPO) in quartz were minimally cleaned to correct for any misorientations due to analytical error and remove Dauphiné twins. Quartz crystallographic orientations are plotted on equal area plots using OIM Analysis 6 software. All EBSD data are also plotted as contoured, upper hemisphere, equal-area plots of one point per grain using harmonic expansion with 10° Gaussian half-width and a series rank of 10 (out of 34). Figure 7a shows contour plots for samples 20, 18, 16, B9, and B1. Plots include grains greater than 100 μm for all samples except B4 and B1, which include grains greater than 50 μm because they have fewer than 100 grains >100 μm (Table 3.6). The strength of the preferred orientation is determined by the multiples of uniform distribution (MUD) number; all contour plots have the same scale. CPO increases in strength from samples 20 to 18, which has the maximum MUD value of 4.78. MUD reduces from sample 18 to 16 and into the core (Figure 3.7b).



A
0001
10-10
11-20
0001
10-10
11-20
sample 20
g.s. >100µm
max: 2.15
count: 708
sample 18
g.s. >100µm
max: 4.78
count: 607
sample 16
g.s. >100
max: 2.66
count: 641
sample B9
g.s. >100
max: 2.27
count: 406
sample B1
g.s. >50
max: 2.42
count: 241
MUD 0.0
5.0
B
max MUD value
>2pix & <100um
>100
0
10
20
30
40
distance from core (m)

Table 3.6 EBSD Parameters and MUD Values

sample	step size	# grains	maximum MUD
	(μm)		
B1	5	241	2.418
B4	10	291	2.39
B9	10	406	2.269
BR16	15	641	2.663
BR18	15	607	4.775
BR19	15	593	3.344
BR20	20	708	2.122

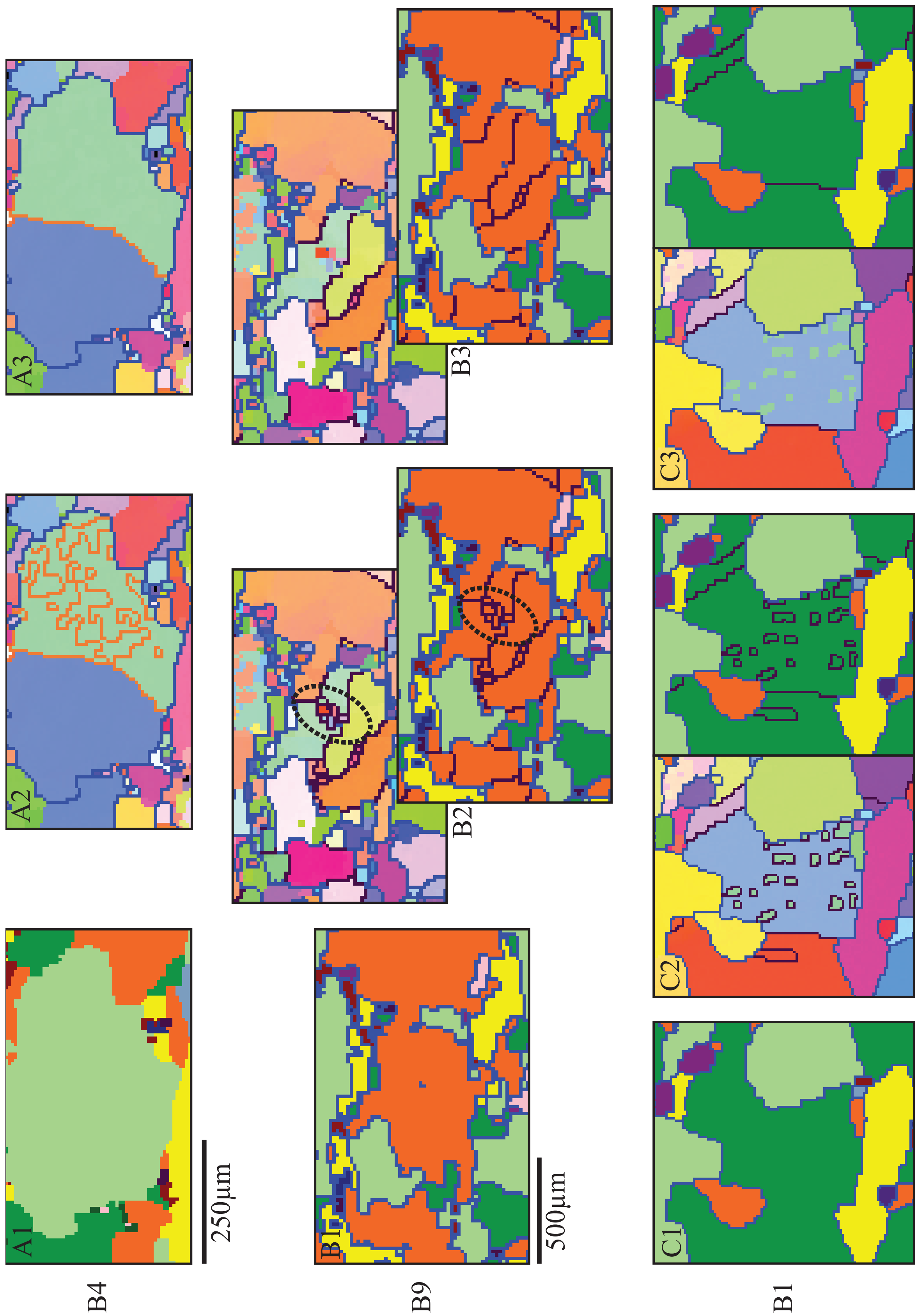
3.5.3.2 Grain Analyses

The calculation of the length of grain and phase boundaries requires cleaning beyond that necessary for CPO determination due to: (1) artifacts from twining and perthitic textures in feldspars, (2) misorientations due to intragranular cracks and/or fluid inclusions, and (3) analytically-derived misorientations of 180°. These errors are not uncommon and are outlined in Prior & Wheeler (2009). They were removed since they add grain boundaries to the calculations, therefore skewing the data. Cleaning procedures were conducted in OIM Analysis 6.1 and Adobe Photoshop 5.1.

Cleaning procedures within Analysis 6.1 included corrections for common twins such as Dauphiné twins in quartz and Carlsbad twinning in oligoclase, pseudosymmetry, and misindexed single pixels. The cleaned maps of grain boundaries for the three main phases (quartz, oligoclase, and K-feldspar) and a phase boundary map of the whole area were created using different colors for grain and phase boundaries. The maps of grain boundaries for the three phases and phase boundaries, a phase map, and an inverse pole figure map of the whole analysis were exported as .tif files.

The magic wand tool of Photoshop 5.1 was used to remove all but the color of the boundaries in the individual grain and phase boundary maps and then all of the maps were overlaid for further clean up (Figure 3.8). The eraser tool (at a size of one pixel) was used to erase any erroneous grain boundaries that were not cleaned by the OIM software. This was an efficient way to clean localized errors and boundaries drawn due to analytical error without manipulating all the data as is done using the clean up options in the OIM software. Often grain boundaries plotted due to analytical error were identified through morphology. These corrections mostly consisted of grains fewer than ~10 pixels that are clustered within phase boundaries of oligoclase and K-feldspar (e.g. Figure 3.8a2 & c2). Once identified, the inverse pole figure map was used to confirm the error, as grain boundaries should correlate with a change of orientation (Figure 3.8a). Some clusters of grain boundaries that had grains <10 pixels and were contained within a phase boundary correlated with cracks and/or fluid inclusions (Figure 3.8c). Although not every grain <10 pixels was confirmed to be an analytical artifact, the preliminary analysis showed a majority of such grains were not real grain boundaries. Other clusters were due to feldspar twinning or perthitic textures (Figure 3.8c). Lastly, in order to keep the boundary analysis to quartz, oligoclase and K-feldspar, all grain boundaries were removed from the other phases (amphibole, biotite, oxides, and accessory phases) as well as phase boundaries between these phases. However, any phase boundary between these phases and quartz, oligoclase or K-feldspar was retained.

Each grain boundary layer and the phase boundary layer were then individually exported from Photoshop as a .bmp and uploaded to ImageJ 1.47j where the pixels were counted by RGB color. The total boundaries reported are a sum of all the grain


B4
A1
250μm
A2
A3
B9
B1
500μm
B2
B3
B1
C1
250μm
C2
C3

boundaries and phase boundaries (Table 3.7). Figure 3.9 is a graph showing the percent of grain boundaries that are also phase boundaries across the gradient from core (B1) to margin (20). The fraction of phase boundaries decreases from sample 20 to 18 and then a sharp increase in the core.

Table 3.7 Phase Boundary Analysis Results

Sample	Albite grain boundaries	K-feldspar grain boundaries	Quartz grain boundaries	Total grain boundaries	Total phase boundaries	Total boundaries	Percent phase
B1	8333	3958	1107	13398	72390	85788	84%
B4	6645.5	6677	2056	15378.5	53490	68869	78%
B9	6174	7854	7411	21439	73457	94896	77%
16	22535	34608	12828	69971	138102	208073	66%
18	12506	14986	3652	31144	53896	85040	63%
20	15163	11516	5778	32457	79199	111656	71%

All boundaries measured by pixels

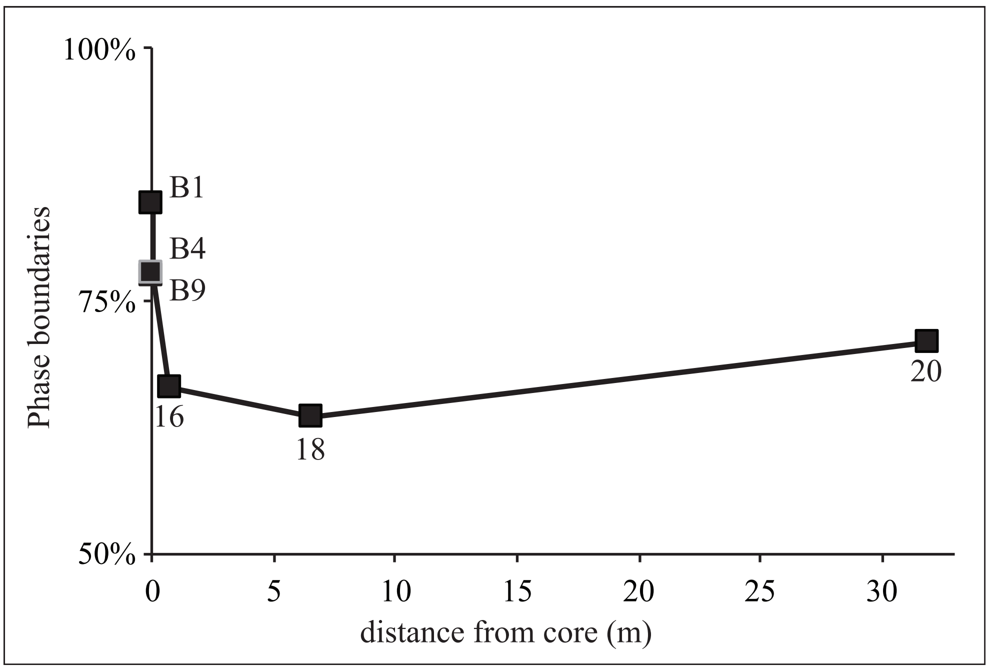


Figure 3.9 Boundary Analysis Results. Graph shows the percent of grain boundaries that are also phase boundaries in samples across the transect. Sample numbers next to data points. Sample B4 highlighted in gray.

3.5.4 Grain Size Analysis

Figure 3.10 shows the transition in mean grain size for quartz, K-feldspar, and oligoclase across the gradient. Grain size analyses do not include porphyroclasts. Minimal clean up was conducted on EBSD maps for quartz grain sizes calculations, which were collected using the grain size feature of OIM Analysis 6. Quartz grain size is reported as equivalent diameter. Due to twinning and exsolution, feldspar grain sizes were determined by measuring the maximum length of each grain in the cleaned EBSD maps used for the boundary analysis. Although we compare quartz and feldspar data across the gradient, we do not compare the grain sizes between phases. The average grain sizes of quartz, K-feldspar and oligoclase in sample 20 are approximately 165 μm, 365 μm, and 345 μm respectively (Table 3.8). The average grain sizes of quartz and oligoclase gradually reduce with strain in the margin and K-feldspar grain sizes do not reduce until sample 16, just outside the core (Figure 3.10). Average grain sizes of quartz, K-feldspar and oligoclase in the core of the shear zones are 55 μm, 130 μm, and 170 μm. Quartz grain shapes evolve from elongate in sample 20 (Figure 3.5g) to sub-equant in sample B1 (Figure 3.5h). Recrystallized K-feldspar and oligoclase remain equant to sub-equant throughout the transect, however grain boundaries become more lobate in the mixed phase matrix.

3.5.5 Cathodoluminescence (CL) Analysis

CL imaging can reveal defects, zoning, and internal microstructures not visible with other imaging techniques (Behr & Frentzel-Beyme 1987; Marshall 1988; Ramseyer & Mullis 1990; Boiron et al. 1992; Götze et al. 2001; Mills 2015). It is widely accepted

that changes in CL intensity are due to either structural defects or chemical impurities, the causes of which have been shown to be produced by variations in trace element composition due to either interactions with aqueous fluids (e.g. Ramseyer & Mullis 1990; Monecke et al. 2002; Götze et al. 2004; van den Kerkhof et al. 2004; Landtwing & Pettke 2005; Lambrecht & Diamond 2014) or changes in pressure and temperature (e.g. Rusk et al. 2006; Spear & Wark 2009). CL intensity is also sensitive to crystal orientation (Ramseyer & Mullis 1990; Walderhaug & Rykkje 2000). We compare CL images from matrix and monomineralic aggregates across the gradient. Images were collected with a Tescan panchromatic (350-650 nm) CL detector on the Tescan Vega XMU SEM.

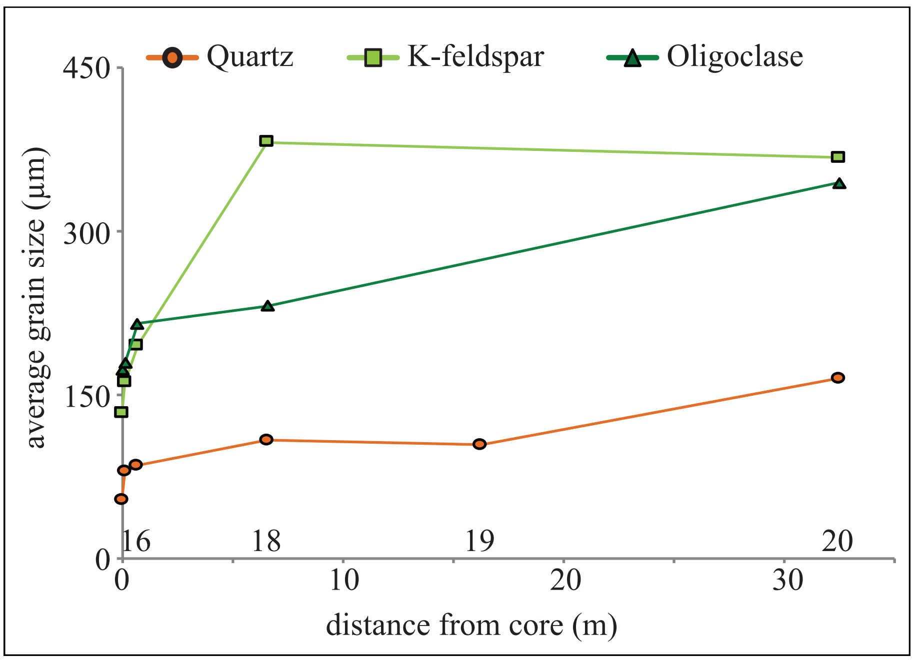


Figure 3.10 Grain Size Analysis Results. Average grain sizes for K-feldspar, oligoclase, and quartz across the transect. Sample numbers of margin under corresponding data points. The two data points closest to the vertical axis in each set for analyses from samples B1 and b9, respectively from left to right. Number of grains per sample listed in Table 3.2.

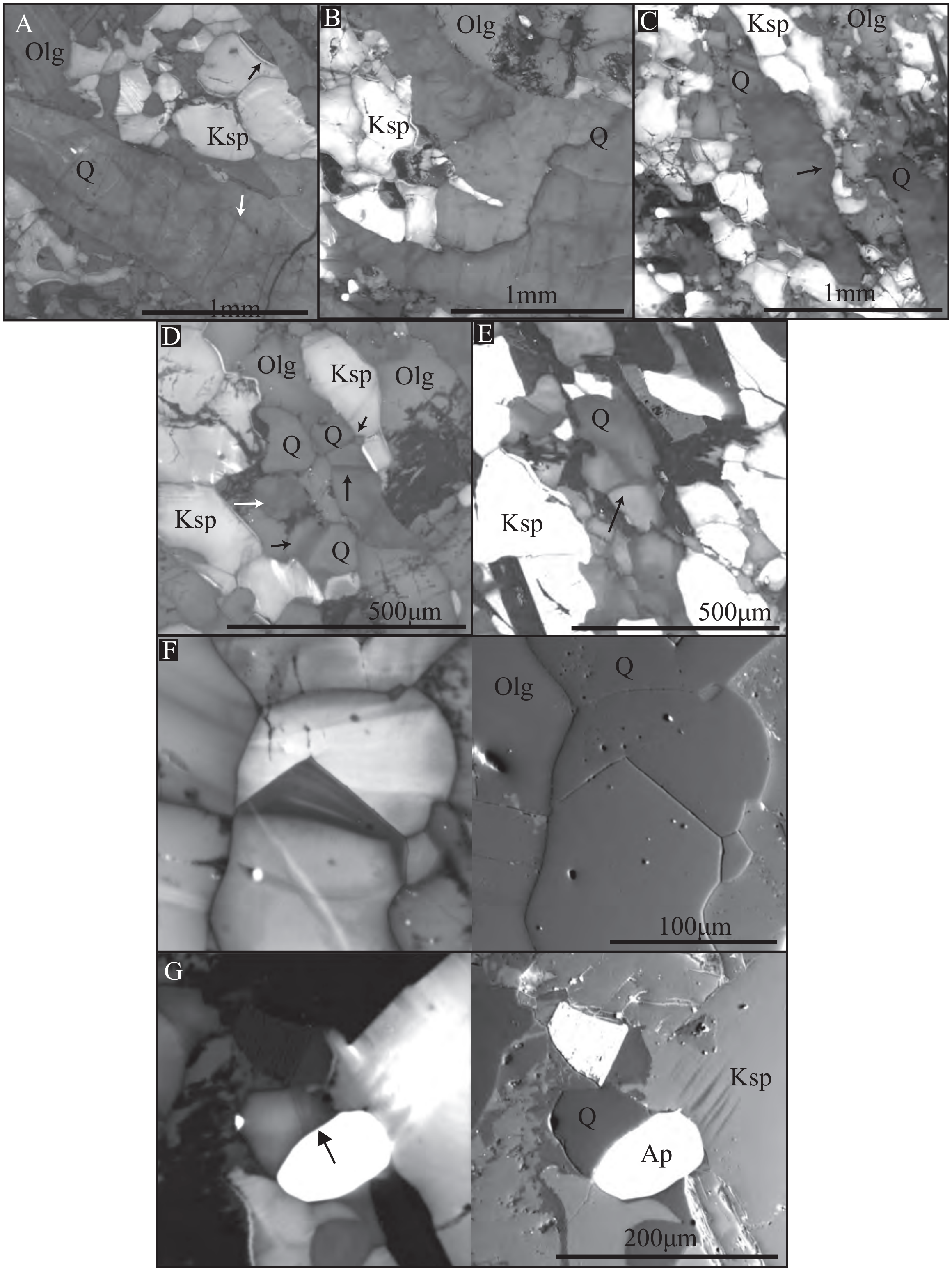
Table 3.8 Average Grain Sizes

	sample	average (μm)	standard deviation (μm)	minimum (μm)	maximum (μm)	count
Quartz*	B1	54.04	33.82	17.84	218.44	510
	B9	79.68	70.25	22.57	1355.70	1641
	16	85.19	86.84	23.94	1398.80	2644
	18	108.54	200.88	29.32	2677.36	595
	19	104.45	138.97	29.32	2232.72	2122
	20	164.80	209.33	31.92	2203.55	1393
K-feldspar	B1	132.82	99.63	9.22	525.95	327
	B9	161.20	108.04	41.57	751.46	385
	16	195.08	146.05	27.39	1082.05	295
	18	381.41	278.00	56.78	2307.64	313
	20	367.00	301.04	56.97	1508.87	590
Oligoclase	B1	172.77	120.83	8.96	581.19	354
	B9	179.27	112.05	20.61	809.64	335
	16	215.40	138.11	25.59	957.83	391
	18	231.50	131.89	36.41	961.77	385
	20	344.13	212.17	89.37	2023.12	325

* Quartz grain sizes are calculated in OIM software as equivalent diameter (see text). Feldspar grain sizes are the maximum length measured under the optical microscope.

3.5.5.1 Monophase Aggregates

The monomineralic aggregates (including quartz ribbons) of samples 20-16 have similar features. Quartz ribbons have a variety of CL-dark features including thin lines (some of which can be seen under the light microscope as dark lines) and irregular mantles of varying thickness (some of which can be seen with backscattered electrons [BSE]; Figure 3.11). Albite-rich rims on plagioclase are mostly limited to boundaries between K-feldspar and oligoclase (e.g. Figure 3.11a). The pericline twinning in K-feldspar is also evident under CL. Similar features are found in the monomineralic


A
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Q
Q
Ksp
500μm
E
Q
Ksp
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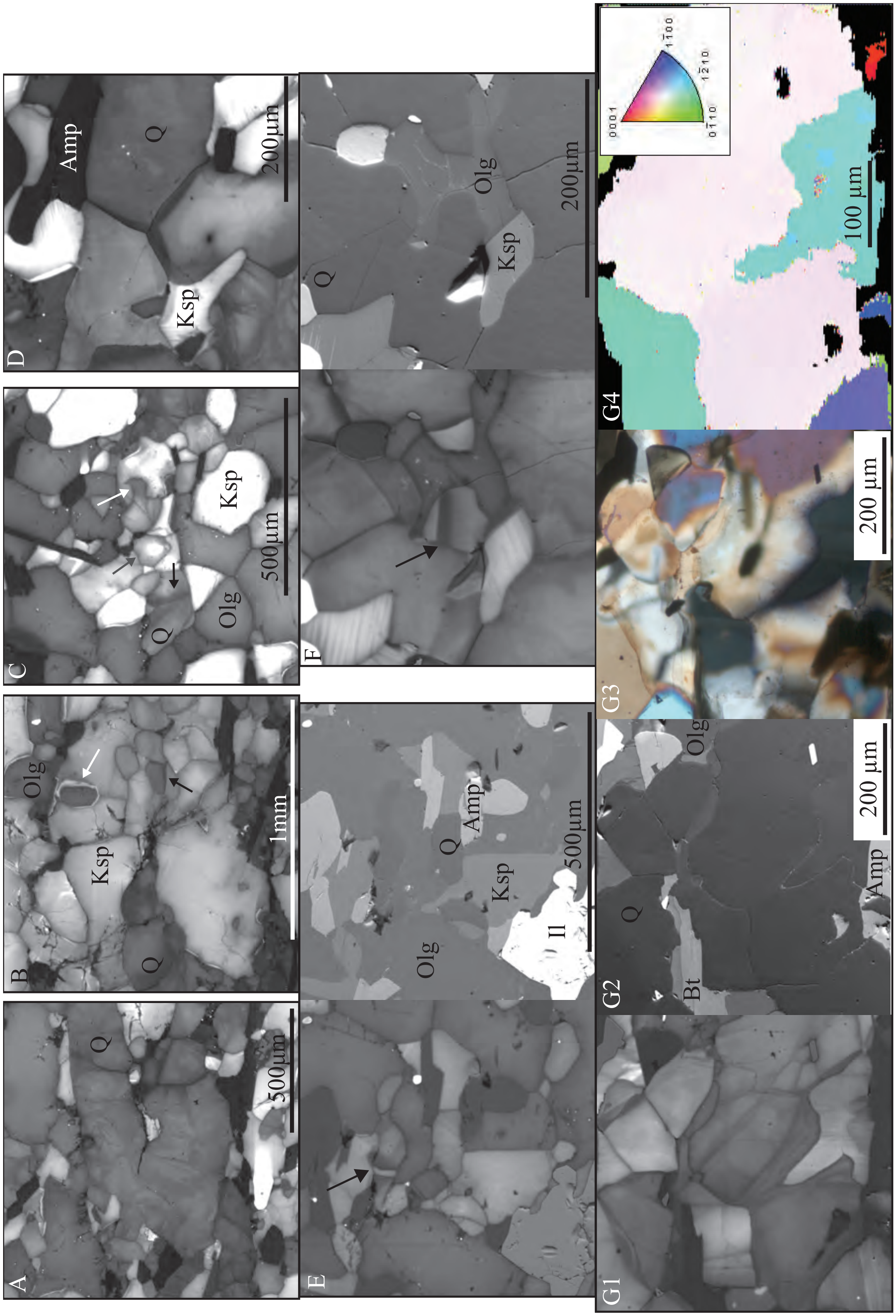
F
Olg
Q
100μm
G
Ksp
Q
Ap
200μm

aggregates of the core samples, except for the pericline twinning as noted in 3.4.1 (Figure 3.12a-b).

3.5.5.2 Mixed Phase Matrix

As the mixed phase matrix develops along the transect, so do the CL features. The differences are most obvious in the matrix, especially in the core samples. However, some differences are observed at the tip of quartz ribbons and in the matrix of sample 16 (Figure 3.11d-g). Within the matrix, fewer quartz grains have the CL-dark thin lines and mantles as observed in the monophase aggregates. Also, several features are only observed in quartz grains found within the matrix: zoning along grain edges (e.g. Figure 3.11f-g & 12c, g); sharp, linear CL bright features cutting across grains (e.g. Figure 3.11d, 3.12e); and both sharp and diffuse CL-dark edge of grains (e.g. Figure 3.11e & 3.12c, d, f). The last of these differs from the mantles seen in the coarser grained aggregates because they are only along one boundary and, although they can either have sharp boundaries or diffuse boundaries, their boundaries are mostly straight. The features discussed were not observed with BSE, under the light microscope, nor with EBSD (Figure 3.12g). Some similar features are found in K-feldspar grains, but they are more common in quartz.


A
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Bt
Olg
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G3
200 μm
G4
100 μm

3.6 Discussion

3.6.1 Mechanisms Associated With Textural Evolution

The textural evolution of the shear zone from gneissic to mylonitic corresponds with the activation of several deformation mechanisms. This section discusses the evidence for each.

3.6.1.1 Dislocation Creep

Several lines of evidence in the major minerals indicate dislocation creep was active in the monmineralic aggreagates across the transect, which are dominantly found in the margin. The shear zone margin is marked by mantled feldspar porphyroclasts indicating deformation by subgrain rotation (White, 1975). Quartz ribbons of the margin have undulose extinction and the samples have CPOs, both indications that dislocation creep was active (e.g. Knipe 1989; Gleason et al. 1993).

3.6.1.2 Mass Transfer

The boundary analysis indicates an increasing fraction of grain boundaries as phase boundaries toward the core of the shear zone. This is direct evidence that a mixed phase matrix developed, which in turn indicates a change in deformation mechanism since dislocation creep does not mix phases on a large scale. A laboratory study of peridotite found that olivine and clinopyroxene mixing can occur through sub-grain rotation, but only within nanometers of the phase boundary (Linckens et al. 2014). In fact, subgrain rotation of porphyroclasts in the shear zone led to a gneissic texture, not a mylonitic one. Therefore, a process other than dislocation creep must have accommodated strain, i.e. mass transfer (e.g. Kenkmann & Dresen 2002; Platt 2015).

Several lines of evidence confirm that fluids were present and/or mass transfer processes were active. (1) CL features of quartz and K-feldspar, (2) grain size reduction, (3) a weakening in the strength of quartz CPO, and (4) an increase in mode of amphibole in the core of the shear zone.

The CL features discussed here are those that are not due to changes in orientation (e.g. Walderhaug & Rykkje 2000), which was confirmed by backscattered electron (BSE), optical microscopy, and/or EBSD imaging (Figure 3.12g). Although the documentation of CL-features from metamorphic quartz is limited in the literature, a few important parallels can be drawn that indicate mass transfer processes were prevalent in the mixed-phase matrix of the samples. The straight, CL-bright, linear features that cut across grains are interpreted to be fractures filled (and potentially widened) by the precipitation of CL-bright quartz (cf. Bignall et al. 2004). Pure quartz produces a CL-darker image than those with more CL-activating trace elements, such as Ti (Rusk et al. 2006; Spear & Wark 2009). This indicates that a trace-element rich fluid facilitated mass transfer processes. The production of the CL-dark quartz along grain boundaries could be due to either diffusion of CL-bright activators out of the quartz (e.g. Boggs et al. 2007) or the nucleation of CL-dark quartz on CL-brighter host grains (e.g. Holness & Watt 2001). The distinction is beyond the scope of this study, but in either scenario, the development of these features indicate that mass transfer processes were active. We interpret the zoned rims of quartz grains to have formed in fluid-present conditions where variations in trace-element availability led to CL zoning as the grain boundary grew (Bergman & Piazolo 2012). The fluctuating availability of trace-elements could be due to fluid pumping during deformation (Sibson et al. 1975; Fusseis et al. 2009). If

electrochemical reactions are a driving force for dissolution and/or nucleation (e.g. Kristiansen et al. 2011) then it may explain why only some grains have CL features and those that do only have them along one edge (e.g. Figure 3.12), indicating that some grains and grain boundaries are more conducive to dissolution and/or nucleation based on their orientation and/or topology.

A reduction in grain size is thought to facilitate a change in deformation mechanism from dislocation creep to mass transfer and or GBS. Although experimental studies report that grain sizes must be sufficiently small for mass transfer processes to dominate, several studies of natural shear zones, including this contribution, have shown evidence for mass transfer processes at grain sizes >100 μm (e.g. Garlick & Gromet 2004 and references therein). The reduction of CPO strength (coinciding with grain size reduction) is also often reported as evidence for a switch in deformation mechanism to mass transfer or GBS processes (Stünitz & Fitz Gerald 1993; Rutter et al. 1994; Prior & Wheeler 1999).

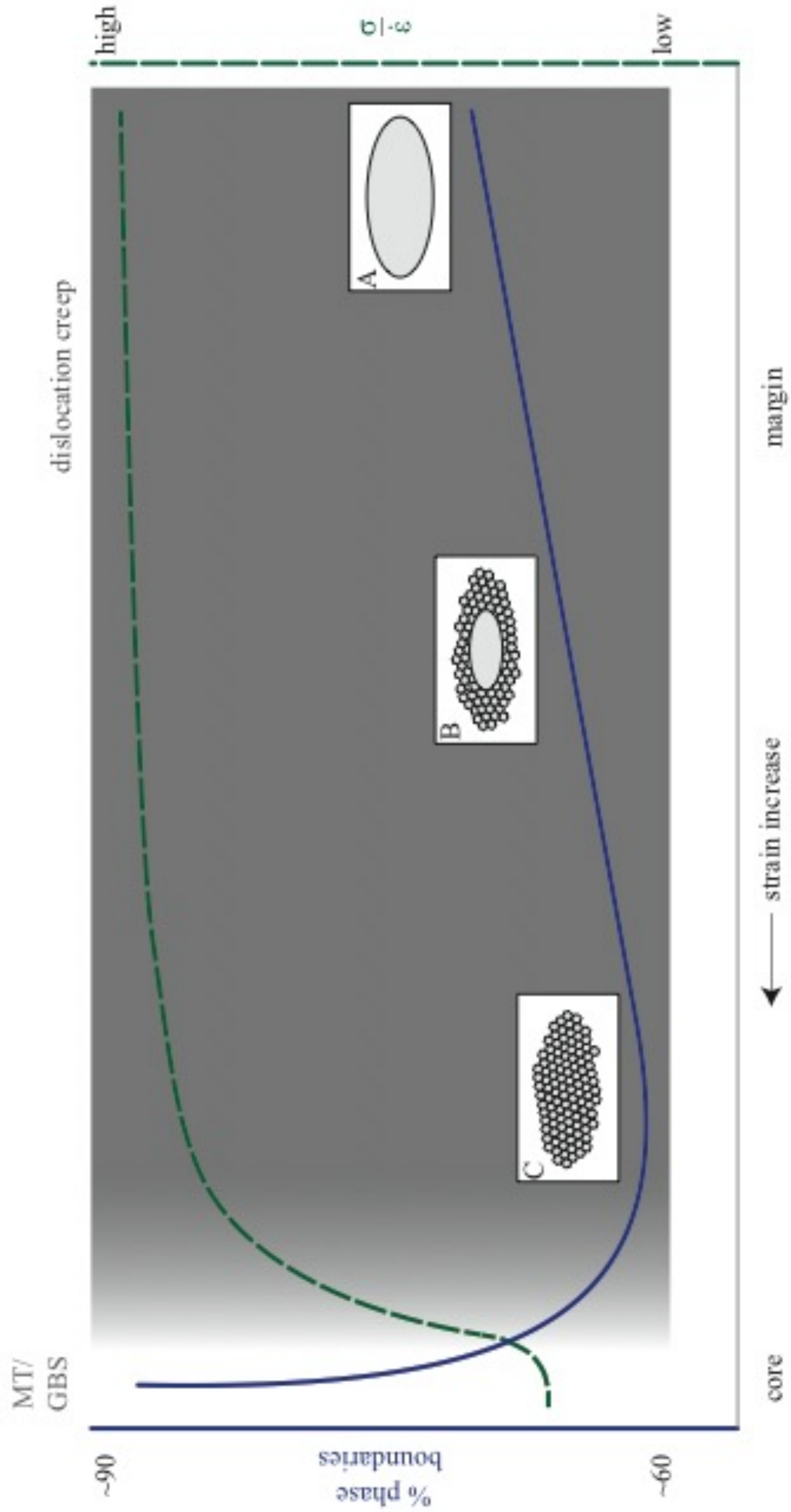
Lastly, in the core of the shear zone the mode of amphibole, a hydrous phase, increases. This does not coincide with a decrease in modes of Fe-Mg minerals from which amphibole could grow (e.g. biotite). This suggests that external fluids pumped through the shear zone providing fluids and elements for amphibole growth. Fluid availability is a key component in considering mass transfer processes as fluids facilitate pressure-solution (e.g. Rutter 1983; Farver & Yund 2000).

3.6.1.3 Grain Boundary Sliding

The switch in dominant texture from that of monomineralic aggregates to dispersed phases indicates the movement of a large volume of material. It is unlikely that dislocation creep is responsible for the phase dispersion since any mixing would only occur within nanometers of the phase boundary (Linckens et al. 2014). Also, subgrain rotation of porphyroclasts in the shear zone led to a texture consisting of aggregated phases, not a dispersed phase texture. Therefore, a process other than dislocation creep must have accommodated strain, i.e. mass transfer and/or nucleation (e.g. Kenkmann & Dresen 2002; Platt 2015). GBS is an efficient method for phase dispersion. The increase in the fraction of grain boundaries that are also phase boundaries in the core of the shear zones and the evidence for fluid-present conditions indicates that the mixed phase matrix was most likely formed from mass transfer assisted GBS. The location of quartz grains at triple boundaries (Figure 3.6 B1) indicates nucleation played a role in phase dispersion, an additional indication that GBS was accommodated through mass transfer processes. This also supports the claim that mass transfer and/or GBS can dominate at grain sizes larger than those reported as a threshold from experimental studies.

3.6.2 Textural Evolution

The progression from protolith to gneiss to mylonite is a textural evolution in grain size, morphology, crystallographic orientation, and zoning. Figure 3.13 depicts our interpretation of rock strength, defined by viscosity, as evidenced by the textural evolution and associated switch in deformation mechanisms.



high
σ/ε̇
low
dislocation creep
A
B
C
margin
strain increase
core
MT/GBS
~90
% phase boundaries
~60

The strongest part of the transect is represented by the least strained sample. Theoretically this could be a coarse-grained igneous protolith (e.g. granite), which is texturally homogenous such that phases and their orientations are random and most grain boundaries are also phase boundaries (Figure 3.13a). However, in the shear zone presented the least strained sample (sample 20) is not a true protolith as some recrystallization has already taken place (e.g. Figure 3.5a-c) and therefore has a lower fraction of phase boundaries than one may expect from a true protolith.

As the rock begins to strain, grain sizes are reduced through dislocation creep and consequent subgrain formation (Figure 3.13b). Gneissification of the protolith often correlates with the progressive recrystallization of porphyroclasts from their rims to their cores. In the studied samples, mantled porphyroclasts (Figure 3.5a) progress to those that are completely recrystallized (Figure 3.5b) reducing the average grain size (Figure 3.10) and weakening the rock. As the grains are grouped into monomineralic, loosely augen-shaped pools the number of grain boundaries between like phases increases (Figure 3.13c), as evidenced by the drop in phase boundaries from sample 20 to sample 18 (Figure 3.9).

As grain sizes continue to reduce the monomineralic pools begin to intermingle and a mixed phase matrix develops (Figure 3.6-16) leading to a relative increase in the number of phase boundaries. As grain size reduces sufficiently a switch in deformation mechanism occurs resulting in an increase in phase boundaries and a reduction in strength along the transect (represented by the gray region of Figure 3.13). The reduction in strength lessens into the outer core of the shear zone. Although the outer core dominantly deforms by mass transfer assisted GBS, there is still a small drop in strength

from the outer core to the inner core due to the presence of some monomineralic aggregates in samples B9-B4 (Figure 3.4). Upon the disappearance of the monomineralic aggregates in the inner core samples (sample B3-B1), there is no further reduction in strength into the inner core.

3.7 Implications

The results indicate that the dominant deformation mechanism vary locally on the thin section scale (cf. Heilbronner & Bruhn 1998; Kruse & Stünitz 1999; Garlick & Gromet 2004). Each deformation mechanism accommodates strain at different rates for a given stress, with mass transfer and GBS being faster than dislocation creep at a sufficiently small grain size (especially under fluid-present conditions; Langdon 2000; Platt 2015). Although it is accepted that deformation in the deep crust is a sum of the strain accommodated by each deformation mechanism, at this point there is no way to know how much strain was accommodated by each mechanism. However, the use of one empirical flow law to describe the rheology of the deep crust disregards the importance of the other processes and should be used judiciously.

Furthermore, the evidence presented here highlight the relationship between texture and dominant deformation mechanism, such that the monomineralic aggregates deformed by dislocation creep and the mixed phase matrix deformed by mass transfer assisted GBS. The results confirms that mass transfer processes and GBS play an important role in mylonitization of deep-crustal granitic rocks, but also that mass transfer processes are active outside a mylonitic core. Although solution-transfer has been reported in some studies (e.g. Rutter & Brodie 1988; den Brok 1998; Farver & Yund

2000), these processes are under-documented as a deformation mechanism in the deep crust (Wheeler 1992) despite their importance and without accounting for them shear zones are most likely weaker than predicted by available flow laws.

3.8 Conclusions

The documentation of microstructural and chemical evolution across a natural mid-crustal, mylonitic shear zone provides insight into the processes that lead to significant weakening in the viscous crust. The data presented here show several changes across the strain gradient. The evolution of grain size, crystallographic orientation, and morphology, the increase in modal percent of amphibole, and the observation of CL features in the core of the shear zone indicate a change in deformation mechanism from dislocation creep in the least strained sample to mass transfer accommodated GBS in the most strained sample under fluid present conditions. On the thin section scale, the quantification of morphology through grain boundary analyses indicates a correlation between the percent of phase boundaries and the type of deformation mechanism such that the ratio of phase to grain boundaries decreases during dislocation creep and increases during mass transfer accommodated GBS.

There are several implications of these findings: (1) The empirically determined minimum grain size for the activation of mass transfer and GBS processes may not be applicable in all real world systems. The data presented here suggest that such processes were active in samples with average grain sizes of >80 μm for quartz and >150 μm for the feldspars. (2) Mass transfer and GBS processes are important in the deep crust and, if activated, can significantly weaken a rock. Since they are often under recognized,

viscous-crustal shear zones are most likely weaker than the available flow laws estimate. (3) Since deformation mechanisms vary from the thin section- to m-scale, the use of a single flow law to describe the bulk strength of the crust over-homogenizes crustal rheology, at least at the m-km scale.

The data presented emphasize the complications in quantifying the strength of deep crustal shear zones. Although available flow laws allow one to approximate rock strength, local heterogeneities lead to varying deformation mechanisms, such that rheology can not be estimated by just one flow law and it is difficult to quantify the amount of strain accommodated by each.

Chapter 4

PARAMETERS LEADING TO STRAIN LOCALIZATION IN THE GRANITIC MID CRUST; CAN WE PREDICT SHEAR ZONE FORMATION?

4.1 Chapter Abstract

The overarching goal of this chapter is to use real-world observations to explore the predictability of shear zone formation in the mid- lower orogenic crust. In order to do this, we first explore six potential weakening mechanisms: the presence of melt, metamorphic reactions, textural evolution (grain size, morphology, and crystallographic preferred orientation), thermal perturbation, fluid infiltration, and stress heterogeneities. In order to understand the potential weakening from stress heterogeneities, preliminary numerical modeling was conducted. Model sets measured the stress patterns around ellipses deformed at $1e^{-14}$ s^{-1} strain rates. Three model sets tested the influence of strength differences, ellipticity, and shear sense on stress patterns at the boundary of the ellipse. Results indicate that strength differences do result in stress gradients and that the curvature of the boundary and the coaxiality of the far-field stress influences the stress pattern. Secondly, we use data from Chapters 2 and 3 to look for evidence of each mechanism in the km- and m- scale shear zones of the Bad River Granite, in the Grenville Front Tectonic Zone, Ontario, Canada. The data indicate that several weakening mechanisms were active at both scales, but not the same ones. The km-scale gradients exist at lithologic boundaries and therefore were most likely affected by stress heterogeneities. The difference in strain gradients may be due to differences in strength between the two bounding units or differences in the boundary curvatures as shown in the

numerical modeling results. There is also evidence for textural evolution and a minor amount of fluid infiltration. The m-scale shear zone does not exist at a lithologic boundary and therefore stress heterogeneity was most likely not a factor. However, there is evidence for textural evolution, fluid infiltration, and metamorphism. In each strain gradient, several positive feedback loops led to shear zone formation and propagation. Lastly, using these data, the environmental and material factors incorporated into the available flow laws do not sufficiently account for the heterogeneity present throughout the viscous portion of the crust. Therefore these flow laws over-homogenize crustal strength. In reality, many variables influence the crust's rheology at all scales and there are still numerous unknowns about many of them (e.g. quantified strength differences due to changes in mineral mode). The number of variables and uncertainty associated with each indicates that shear zone formation has the basic characteristics of a chaotic dynamic system, such that prediction of shear zone formation within an orogenic terrain, is not feasible at this point..

4.2 Introduction

The presence of strain localization in the lower continental crust is well established through seismic reflection tomography studies of tectonically active regions (e.g. Wittlinger 1998; Calvert 2004) and confirmed in observations of the roots of ancient orogens (e.g. Coward 1980; Austrheim & Griffin 1985; Holdsworth & Strachan 1991). Shear zones often bound undeformed blocks of lower crustal material indicating strength heterogeneities in the crust (Martelat et al. 1999; Carreras 2001; Schrank et al. 2008). These strength heterogeneities may be inherent in a laterally heterogeneous crust, where

some lithologic units are weaker than others, or they may form within relatively homogenous units during deformation. The strength heterogeneities either form from (in the latter case) or persist due to (in the former) the activation of one or more weakening mechanisms that locally influence the unit's rheology (Poirier 1980; White et al. 1980; Montési & Zuber 2002; Regenauer-Lieb & Yuen 2004).

Mechanisms that weaken rock, and therefore lead to localization, in the mid- to lower orogenic crust have been explored theoretically, experimentally and through numerical modeling (White et al. 1980; Poirier 1980). Experimental studies have shown that a spatial distribution of weakening mechanisms, such as local changes in temperature, fluid presence, and grain shape and orientation, and grain size result in quantifiable effects on rock strength (Rutter 1974; Mackwell et al. 1998; Tullis & Yund 1985; Kohlstedt et al. 1995 and references therein; Montési & Hirth 2003; Platt & Behr 2011a; Montési 2013). Field observations of natural shear zones show correlations between strain and morphological and textural evolution (e.g. phase distribution; M. Stipp et al. 2002; Johnson et al. 2004; Hunter et al., 2015). This led to numerical modeling of such influences on rock strength (Handy 1990b; Tullis et al. 1991; Bons & Cox 1994; Handy 1994; Treagus 2002; Ji et al. 2003; Takeda & Griera 2006; Montési 2007; Gerbi 2012; Montési 2013; Gerbi et al. 2015). It is now well accepted that in principle, there are many mechanisms that can lead to strain localization in the mid-crust.

Identifying such triggers of shear zone formation and propagation in natural systems is increasingly important as geodynamic models become more computationally robust and researchers are able to model geodynamical systems and their interactions with more detail. One of the questions we explore is whether shear zones can be

parameterized in a way that allows the prediction of shear zone formation and propagation in numerical models. Currently, the rheology of mid- crustal shear zones is defined by empirically derived flow laws based on either power law or linear viscous relationships. These flow laws do not incorporate all of the relevant components of crustal rheology and yet are still too complex to be incorporated into crustal scale numerical models. In order to induce localization some models are able to incorporate a single trigger to allow for the development of localization (e.g. Beaumont et al. 2001; Vauchez et al. 2012; Bercovici & Ricard 2014), but more often shear zones are built into the initial conditions of numerical models. Although theory and experimental results dictate that some mechanisms such as grain size reduction (Tullis & Yund 1985; Braun et al. 1999; De Bresser et al. 2001; Montési & Hirth 2003; White 2004; Raimbourg et al. 2008; Svahnberg & Piazolo 2010; Platt & Behr 2011a) and shear heating (Graham & England 1976; Nabelek et al. 2001; Nabelek et al. 2010; Montési & Zuber 2002; Burg & Schmalholz 2008; Hartz & Podladchikov 2008; Regenauer-Lieb et al. 2008; Crameri & Kaus 2010; Devès et al. 2014; Schmalholz & Duretz 2015) are sufficient to promote localization on their own, a detailed look at nearly any natural shear zone indicates that parameterization of weakening is not usually so simple (e.g. Herwegh et al. 2011; J. P. Platt 2015b).

Using evidence from field based studies of the Bad River Granite (Chapters 2 & 3) and new numerical experiments we explore the physical evidence for weakening mechanisms, the development of feedback systems, and their importance in continued weakening during shear zone propagation in a mid-crustal granitoid. We then use these

data to evaluate if shear zone propagation can be parameterized in a manner that allows for spatial and temporal prediction.

4.3 Potential Weakening Factors

Deformation within the viscous crust is accommodated by one or more of three deformation mechanisms: mass transfer, dislocation creep, and grain boundary sliding. Mass transfer is a term used to describe several processes that involve material moving from one location to another (i.e. diffusion creep and solution transfer). Dislocation creep refers to the development and movement of dislocations as a crystal's lattice accommodates strain. Grain boundary sliding (GBS) refers to grains physically sliding past each other and due to volume constraints in the deep crust, must be accommodated by either diffusion or dislocation creep. Experimental studies of monomineralic aggregates have shown that either diffusion creep or dislocation creep will dominate depending on the stress, strain rate and temperature conditions. Grain boundary sliding and solution transfer are often discounted because they often leave behind little evidence, but their importance in mid-crustal deformation are becoming more recognized (e.g. see Chapter 3).

Empirical flow laws for several minerals and some rocks in the viscous regime relate stress and strain rate using the Arrhenius equation (e.g. Weertman 1955; Carter & Tsenn 1987). A general flow law for diffusion and dislocation creep is $\dot{\varepsilon} = A\sigma^{n} f^{l} d^{-m} e^{\left(\frac{-Q}{RT}\right)}$, (where $\dot{\varepsilon}$- strain rate, A- pre-exponential constant, σ^{n}- stress and stress exponent (>1 for dislocation creep), f^{l}- fugacity and fugacity exponent, d^{-m} grain size and grain size exponent, Q-activation energy, R- gas constant, and T- temperature (e.g. Hirth

et al. 2001). Although a common version of the flow law, this form is not the only option in describing viscous rheology (e.g. Mackwell et al. 1990; Ji & Zhao 1994), but for the purpose of this chapter we use it as a launching point for discussion. The difference between diffusion and dislocation creep lies in the stress exponent, which is empirically determined. Diffusion creep has a stress exponent of 1, while dislocation creep flow laws have stress exponents between 1 and 5. These flow laws were developed to describe deformation of minerals, but have also been used to describe rock rheology (e.g. granite, Hansen & Carter 1983 and biotite schist, Shea & Kronenberg, 1992). One can use the experimentally determined values in this flow law to explore how a material's viscosity (or strength) will respond to a variety of conditions.

There are several hurdles in using these flow laws to approximate the rheology of the lower crust (see Chapter 2). One of the pitfalls of these flow laws is that the rheology is dependent on only 4 variables: stress, strain rate, temperature, and grain size. However, there are many experimental and theoretical papers that discuss the rheological influence of other factors (Bercovici & Karato 2002; Ellis et al. 2001). This section discusses the potential for weakening associated with and how to recognize evidence for each of six factors: presence of melt, metamorphic reactions, textural changes, thermal perturbation, fluids, and a stress heterogeneity. These causes of weakening can be divided into two camps: those due to a change in the rock properties represented by the exponents n, l, and m in the above flow law (i.e. melt, metamorphic reactions, and textural changes) or those due to an external or environmental factor represented by the variables T, f, σ (i.e. thermal perturbation, fluids, and stress heterogeneity).

4.3.1 Rock Properties

4.3.1.1 Melt

The presence of melt has a large effect on strength by lubricating grain boundaries. A small percentage of melt can decrease the strength of a rock by several orders of magnitude (Hollister & Crawford 1986; Rosenberg & Handy 2005). Some numerical models use the theory of melt weakening to incorporate a drop in strength coincident with a temperature threshold in the model (e.g. Beaumont et al. 2006). This weakening has been shown to have the potential for significant tectonic influence, possibly leading to decoupling of the crust and mantle, which in turn has topographic consequences (Royden 1996; Beaumont et al. 2001; Beaumont et al. 2006). Conversely, the expulsion of melt can harden a rock (Handy et al. 2001). It should also be mentioned that melt injection can change the chemical signature of the rock and influence the chemical system especially if the melt was from an external source.

Identifying evidence of melt in ancient rocks is not always a straightforward task, but the clearest sign is the presence of leucosomes. Otherwise, rocks may preserve microscopic evidence of melt in thin section. An atlas of natural and laboratory produced microstructures from partially melted rock has been compiled by Holness et al. (2011) and includes, but isn't limited to the presence of intergranular glass, crystallized melt inclusions, and/or morphologically distinct crystallized intergranular melt pockets.

4.3.1.2 Metamorphic Reactions

The reactions involved with metamorphism can lead to changes in bulk rock rheology through the degradation or growth of weaker or stronger phases (Rubie 1983;

Bell 1991; Stünitz & Tullis 2001; Groome et al. 2006). Several experimental studies have determined the flow laws for several minerals under different conditions including calcite (Schmid et al. 1977; Schmid et al. 1980; Rutter 1974; Rutter 1995; Walker et al. 1990), quartz (Shelton & Tullis 1981; Jaoul et al. 1984; Kronenberg & Tullis 1984; Koch et al. 1989; Hirth & Tullis 1992; Gleason & Tullis 1995; Hirth et al. 2001), feldspars (Shelton & Tullis 1981; Tullis & Yund 1985; Tullis & Yund 1991; Farver & Yund 1995; Dimanov et al. 1999; Rybacki & Dresen 2000; Dimanov 2003; Rybacki & Dresen 2004; Rybacki et al. 2006), biotite (Kronenberg et al. 1990), clinopyroxene (Shelton & Tullis 1981; Kollé & Blacic 1982; Kollé & Blacic 1983; Kirby & Kronenberg 1984; Raterron & Jaoul 1991; Boland & Tullis 1986), and olivine (Carter & Avé Lallemant 1970; Kohlstedt & Goetze 1974; Goetze & Poirier 1978; Evans & Goetze 1979; Karato et al. 1980; Chopra & Paterson 1981; Bystricky & Mackwell 2001; Karato & Jung 2003; Li et al. 2004; Ter Heege et al. 2004). These mineral specific flow laws show the strength differences across minerals. They also show that mineral strengths evolve with temperature (and other factors) such that the strength differences between some minerals drastically reduce and may reverse with temperature. Several field studies of shear zones have attributed strain localization to weakening caused by retrograde metamorphism (Hidas et al. 2013; e.g. Handy & Stunitz 2002; Hobbs et al. 2010 and references therein).

4.3.1.3 Textural Change

The category of textural changes is broad and includes grain size reduction, morphology, and crystallographic preferred orientations.

4.3.1.3.1 Grain Size

Strain induced grain size reduction can be naturally achieved through the nucleation of smaller grains, pinning in polyphase aggregates, and subgrain rotation recrystallization. Often the weakening from grain size reduction is associated with a change in deformation mechanism such that dislocation creep can lead to subgrain rotation and grain size reduction, but once reduced sufficiently, mass transfer dominates and weakening ensues. However, experimental studies on feldspar aggregates by Tullis & Yund (1985) demonstrate that even a small addition (~15%) of finer grains (2-10 μm) to a coarse grained (150-175 μm) matrix can significantly weaken albitic aggregates. Furthermore, several studies have shown evidence for mass transfer processes at larger grain sizes in natural systems (e.g. Chapter 3; Garlick & Gromet 2004), indicating that weakening due to a change in deformation mechanism can occur at coarser grain sizes.

Several studies have argued that grain size is stress and temperature dependent and that rocks respond to stress through a balance between diffusion and dislocation creep hovering around an equilibrium grain size (De Bresser et al. 2001; Montési & Hirth 2003). This equilibrium grain size represents the diameter at which the rate of dislocations reaching the grain boundary balances the production of new dislocations.

Platt & Behr 2011 proposed a flow law named DRX-assisted dislocation creep that incorporates a grain size sensitivity component and plots between the dislocation and diffusion creep fields on deformation mechanism maps, thus providing a range of stresses and grain sizes that correlate with a grain size -sensitive version of dislocation creep (given a strain rate).

4.3.1.3.2 Morphology

The type of phases and their arrangement have long been considered important in determining rock strength (Handy 1990a; Tullis et al. 1991; Bons & Cox 1994; Treagus 2002; Ji et al. 2003; Takeda & Griera 2006; Montési 2007; Gerbi 2012). This phenomenon has been observed naturally (Johnson et al. 2004; Park et al. 2006) and experimentally (Jordan 1987; Ross & Wilks 1996; Holyoke & Tullis 2006). Handy 1990 suggested a transition from load bearing to interconnected weak phase morphologies leads to weakening and localization. However, experimental studies by Tullis et al. (1991) and Gerbi (2015) indicate that a change in morphology itself does not always lead to weakening, but that the morphology can act as a catalyst for other weakening mechanisms such as metamorphic reactions and locally heterogeneous deformation. Results also indicate that geologically significant effects from phase morphology are limited to polyphase rocks whose phases have both significant strength contrasts and significant changes in morphology across the transect (Gerbi et al. 2015).

4.3.1.3.3 Crystallographic Preferred Orientation (CPO)

The development of a crystallographic preferred orientation is often associated with dislocation creep processes, but also depends on the geometry and symmetry of the flow pattern. Crystallographic preferred orientations can lead to weakening as crystal slip systems align, enhancing the anisotropic response of the unit to stress (Griera et al. 2011).

4.3.2 Environmental Perturbations

4.3.2.1 Thermal Perturbation

Temperature has an exponential effect on rock strength in the viscous regime, giving it the potential for being one of the most influential weakening. Increased temperature facilitates the movement of dislocations and therefore intracrystalline deformation. Furthermore, temperature plays a key role in activation energy and can either induce or hinder metamorphism.

The existence and effect of shear heating in the viscous regime of the crust has been debated for some time now. The theory of shear heating derives from the conservation of energy and the laws of physics dictate that a portion of mechanical work converts to heat. Many studies have argued for the importance of shear heating in tectonics (e.g. Brun & Cobbold 1980; Hobbs et al. 1986; Molnar & England 1990; Bai & Dodd 1992; Regenauer-Lieb & Yuen 1998; Regenauer-Lieb & Yuen 2004; Kaus & Podladchikov 2006; Takeuchi & Fialko 2012; Crameri & Kaus 2010; Devès et al. 2014). However, others have argued against shear heating citing a lack thermal anomalies above the San Andreas Fault Zone as evidence (Brune et al. 1969; Lachenbruch & Sass 1980). A recent analytical model by Platt (2015a) shows that shear heating may occur, but only once a shear zone is established and therefore another weakening factor must initiate the shear zone formation. The model results also indicate that shear heating in a mid-crustal shear zone (~5 km wide) may produce up to a 10°C temperature rise, which may lead to some thermal weakening, but that the final gradient (after a few million years) is only a few degrees. Therefore, although shear heating can occur, due to conductive heat loss the temperature gradient is too little to create a strain-rate gradient. The shear heating debate

has by no means been resolved and therefore must be considered as a potential weakening mechanism, yet we recognize that its weakening potential is limited.

Another potential source for temperature changes are magmatic intrusions. The heat from an intrusion conducts into the host rock creating a temperature gradient. The extent of influence depends on a variety of parameters including the host rock lithology (conduction rate), magmatic chemistry (initial temperature and latent heat) and volume (time for crystallization; Nabelek et al. 2012 and references therein). Some plutons have been shown to have formed in several pulses lasting millions of years providing a relatively constant source of heat to the host rock (e.g. Coleman et al. 2004). Metamorphic core complexes can be prime examples of plutonism associated with strain localization (Chéry et al. 1989; Lister & Baldwin 1993).

4.3.2.2 Fluids

Interactions between free fluids and rocks occur in two primary ways: (1) structurally bound fluids can be released or incorporated during metamorphism and/or (2) they can flow along grain boundaries. At lower crustal depths, permeability is controlled by grain boundary geometries and the resulting pore space (Watson & Brenan 1987; Manning & Ingebritsen 1999) and flow is dominated by thermally-driven, or buoyancy-driven, convection. Hydraulic head differences associated with structural features, such as faults and shear zone foliation, drives mid-lower crustal fluid flow (Oliver 1996). Fluids may also be driven by thermal gradients in the mid-lower crust, but flow paths are often limited to structural features that create pathways in otherwise impermeable rocks.

The influence of fluids in the lower crust has both chemical and rheologic consequences, which promotes metamorphism and deformation (Yardley 2009). In fact, evidence for fluid infiltration is mostly chemical, but the presence of fluid inclusions is also a good indication. Rheologically, intergranular fluids can lubricate grain boundaries, facilitating deformation by grain boundary slip (Yardley & Baumgartner 2007) and inducing element mobility and increasing diffusion rates. Also, crystal-entrained fluids, such as those in hydrous retrograde phases, reduces the strength of a mineral allowing it to deform more readily (Austrheim 1987; Boundy et al. 1992; Handy & Stunitz 2002; Rybacki & Dresen 2004).

4.3.2.3 Stress Perturbation

A stress gradient can lead to weakening in two ways. Given the flow law above, higher stresses lead to higher strain rates if nothing else changes. Also, it has been shown that a change in stress can change the other parameters that influence rheology. For example, higher stresses can lead to grain size reduction (Dunlap et al. 1997; Stipp 2003). Although it has long been recognized that strain localization due to stress concentrations occurs at lithologic boundaries (e.g. Platt & Behr 2011; Fitzgerald et al. 2014), it is a difficult mechanism to explore because it does not leave behind chemical or physical evidence. In fact, it is a lack of evidence of other mechanisms that may be the only clue that a stress heterogeneity played a significant role in strain localization. This being said, the development of continental crust creates a complex pattern of lithologic units and therefore rheologic structure, which indicates that stress heterogeneities are ubiquitous throughout the orogenic crust.

Several studies have used numerical models to investigate the stress heterogeneities associated with such lithospheric variation on strain distribution (e.g. Vilotte et al. 1984; England & Houseman 1985; Tommasi et al. 1995; Vauchez et al. 1998). There is a general consensus that strength heterogeneities create stress patterns in the crust, however, there are only a few investigations that explore the extent to which these stress heterogeneities can lead to observed patterns of strain localization. One such study used numerical models based on the Altyn Tagh Shear Zone, which is found between the Tibetan plateau and the Tarim basin; two terrains with different strengths. The models show that although the stress pattern caused by the strength difference did cause localization, an additional weakening mechanism had to be introduced in order to narrow the shear zone to the real world width (Dayem et al. 2009). This indicates that although stress heterogeneity may be an important process during shear zone formation, it could not weaken the rock enough on its own to account for all of the strain accommodated by the shear zone.

4.3.2.3.1 Stress Modeling

All of the aforementioned studies have been designed to model the physics of specific locations on Earth, but it is still unknown why they form or what factors influence the stress patterns. Therefore, to further understand the potential for a stress gradient to form at lithologic boundaries, I used numerical modeling to further understand how geometry and viscosity contrasts influence stress gradients at lithologic boundaries. Using a finite-element implementation of asymptotic expansion homogenization I calculate stress gradients induced at 2D curvi-linear lithologic

boundaries (Cook et al. 2014). Given a user dictated geometry and material viscosity, the MatLab based model relates the stress tensor to the strain rate tensor through a fourth-order viscosity tensor allowing one to explore the effect of geometry/morphology on the distribution of stress and strain rate. The preliminary models presented here explore the distribution of stress at lithologic boundaries through simple, preliminary models.

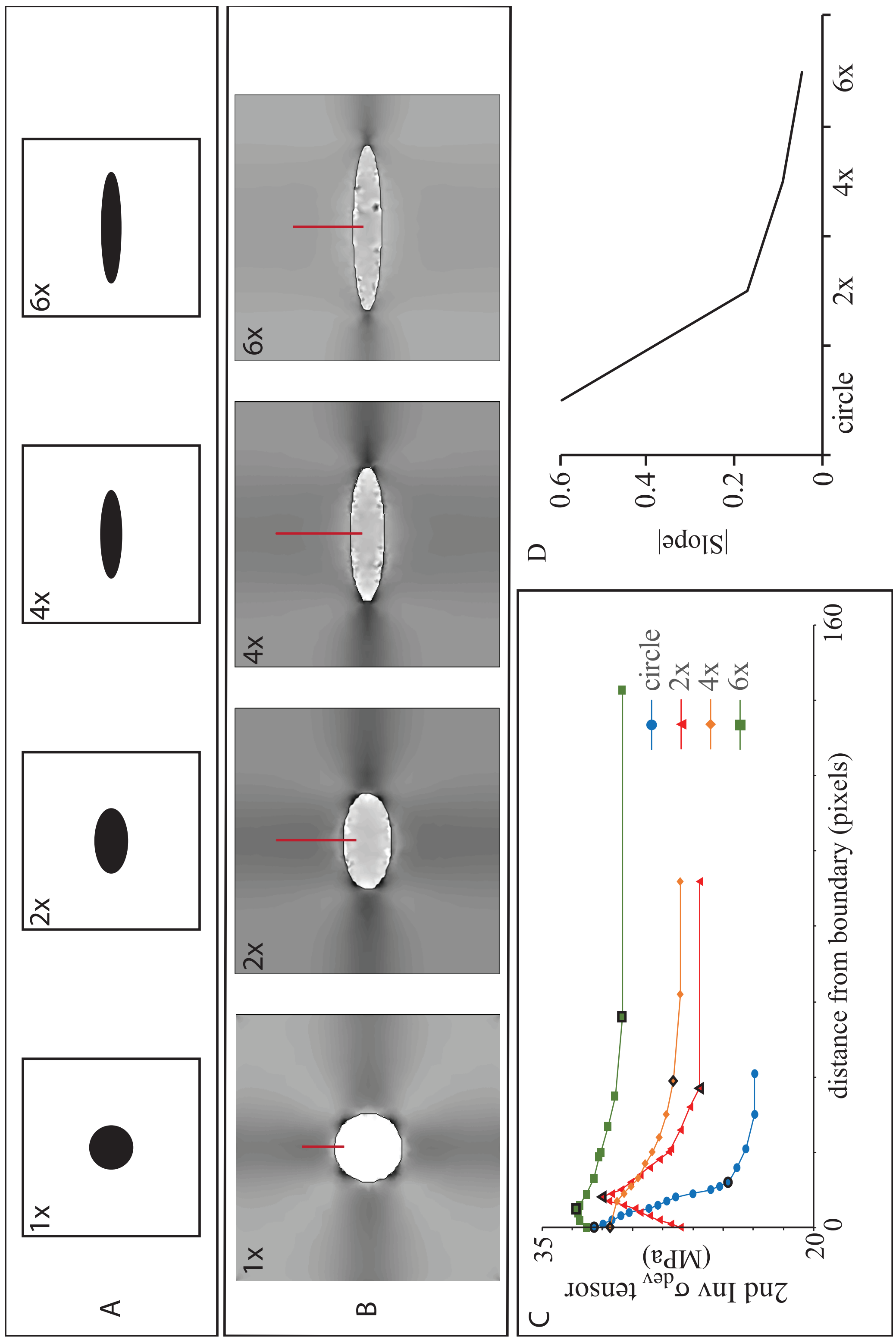
Three models were run to compare how curvature (Model Set A), strength differences (Model Set B), and bulk strain geometry (Model C) influence the stress gradient at a material boundary (Table 4.1). These models are scale independent and simply represent a boundary between two materials. For each run, the results are presented as images shaded for effective stress. The grayscale values were converted to stress using the corresponding scale for each result.

Table 4.1 Model Parameters and Gray Scale

Model Sets*	geometry	matrix viscosity (Pa*s)	shear type	stress scale (Mpa)		slope
				min	max	
A	1x	1.00E-19	simple	9.086	40	-0.194
	2x	1.00E-19	simple	11.438	45	-0.181
	4x	1.00E-19	simple	15.219	40	-0.099
	6x	1.00E-19	simple	8.522	40	-0.045
B	2x	1.00E-18	simple	39.641	80	NA
	2x	1.00E-20	simple	4.025	20	NA
C	2x	1.00E-19	pure	39.641	50	NA

* All runs: ellipse viscosity= 1e-21 Pa*s, Q= 0.00, n= 3 for both phases, strainrate is 1e-14 s-1

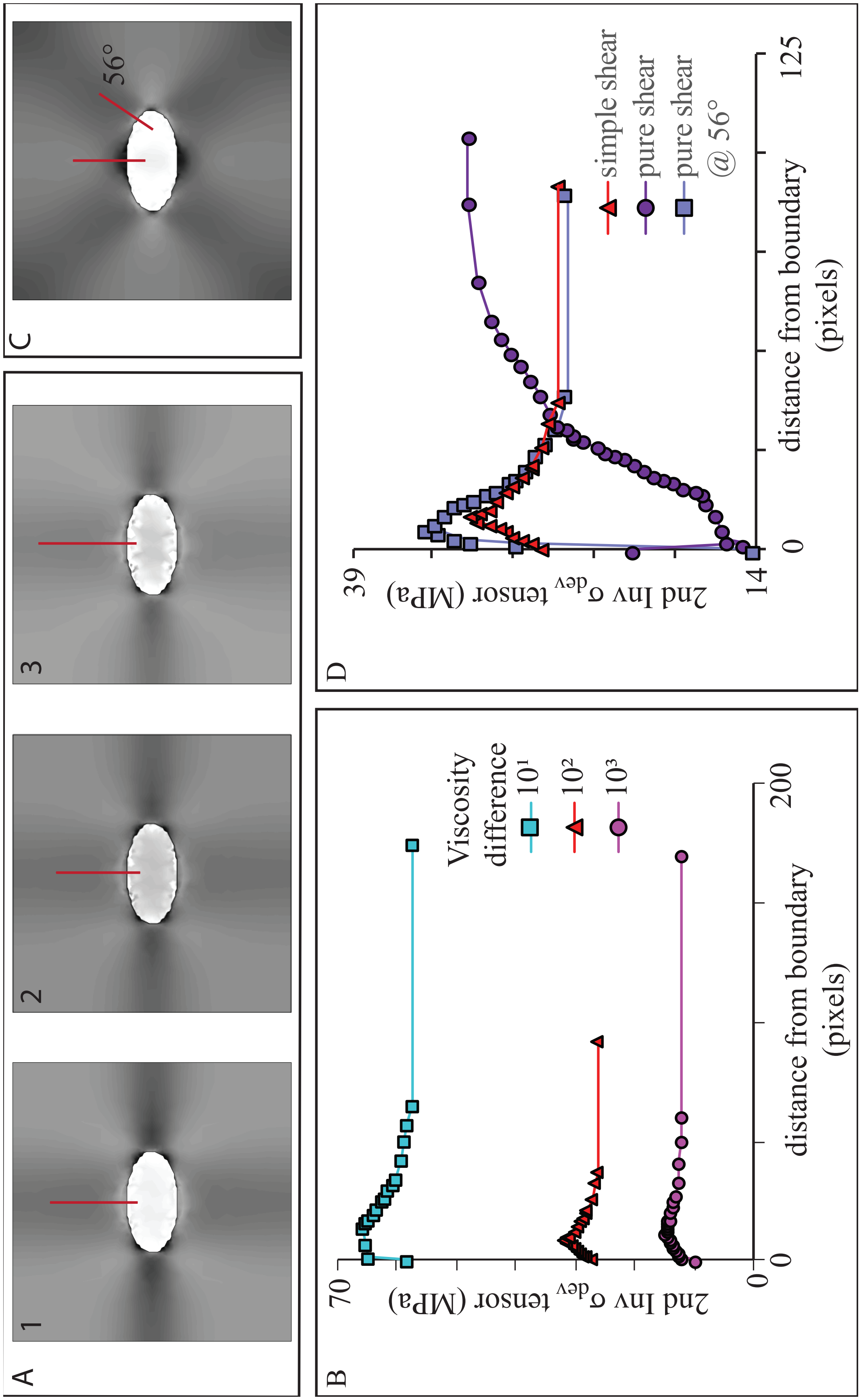
In Model Set A four geometries of the same area were run under simple shear conditions: a circle, and three ellipses with 2x, 4x, and 6x aspect ratios (Figure 4.1a). Each geometry was run with two orders of magnitude difference viscosity between the materials, with the ellipse being stronger. Using ImageJ 1.47j (http://imagej.nih.gov/ij),



A
1x
2x
4x
6x
B
1x
2x
4x
6x
C
2nd Inv σdev tensor (MPa)
35
20
0
160
distance from boundary (pixels)
circle
2x
4x
6x
D
|Slope|
0.6
0.4
0.2
0
circle
2x
4x
6x

gray scale value profiles for each geometry were collected from the image results (Figure 4.1b). Results indicate a correlation between the curvature of the boundary and the stress gradient produced (Figure 4.1c). Although, a sharp increase in stress extending from the boundary in the 2x and 6x geometries indicates some discrepancy among the results. This may be due to modeling artifacts as the digitization of the image creates jagged edges on the ellipses. However, it is curious as to why such effects are absent from the 1x and 4x geometries, indicating they may be real. For the purposes of this chapter, to calculate the stress gradient a spatial range was selected based on the stress values. The maximum stress was used as a starting point even if it didn't coincide with the boundary and the minimum was used for an ending point. The gradient was then calculated as a best fit line in Microsoft Excel for each range. The slope of the stress gradients correlates well with geometry aspect ratios such that less curvature results in a shallower stress gradient (Figure 4.1d; Table 4.1).

The 2x ellipse geometry from Model Set A was also used in Model Set B to test the effect of viscosity differences between the two materials under simple shear conditions. The ellipses always have a viscosity of 10^{-21} Pa s, while the viscosity of the surrounding matrix were weaker by factors of 10^1 (Model B1), 10^2 (Model B2), and 10^3 (Model B3), (Table 4.1). Results indicate that similar stress pattern develops although at different stress values (Figure 4.2a). All three runs resulted in an increase in stress within ~20 pixels of the boundary and a subsequent drop in stress (Figure 4.2b). However, the gradients of the increase at the boundary and subsequent decrease vary with strength. Model B2 resulted in the strongest gradients. Model B1 resulted in a steeper increase in stress than that of B3, but a gentler decrease in stress further from the boundary.


A
1
2
3
C
56°
B
70
0
2nd Inv σdev tensor (MPa)
0
200
distance from boundary
(pixels)
Viscosity
difference
10¹
10²
10³
D
39
14
2nd Inv σdev tensor (MPa)
0
125
distance from boundary
(pixels)
simple shear
pure shear
pure shear
@ 56°

Therefore, based on this limited model, there does not seem to be a systematic correlation between viscosity differences between materials and the stress gradients produced, although viscosity does have an effect. This supports previous studies that show the dependence of the stress field developed in different morphologies on the strength difference between phases across multiple scales (Johnson et al. 2004; Groome et al. 2006; Groome et al. 2008; Jessell et al. 2009; Gerbi et al. 2010; Frieman et al. 2013). The lack of correlation between strength difference and stress pattern could be a result of the modeling artifacts. Further modeling may shed more light, as these are preliminary results.

Lastly, in Model C, the 2x ellipse geometry was run with 2 orders of magnitude difference between the materials under pure shear conditions (Figure 4.2c). When compared to the results for the 2x geometry in Model A (under simple shear), there is a clear difference in the stress gradients produced (Figure 4.2d). As may be expected, the pattern of high-low stress contours has shifted to the 'corners' of the ellipse, thus a transect was also taken at this boundary (at ~56°; Figure 4.2c). At this location, the pattern is similar to that produced under simple shear, although the maximum stress is more than that of the simple shear results (Figure 4.2d). Since many shear zones have components of both pure and simple shear, these results indicate that the amount of each can affect the location and strength of stress gradients at a lithologic boundary.

There are a few conclusions that can be drawn from the results of the preliminary modeling:

1) Assigning a length of 1 km to the longest axis in the ellipses, the stress gradients produced extend for ~200m from the boundary under simple shear conditions.
2) The curvature of the boundary influences the slope of the gradient, such that a higher curvature produces a steeper gradient.
3) The type of stress (pure or simple) influences the stress gradient pattern and where the steeper gradients form.

4.4 Summary of Previous Work

In order to understand the mechanisms that are associated with shear zone formation and propagation, this study refers to data in Chapters 1 and 2, which document microstructural and chemical evolution across km- and m-scale gradients respectively, in the Bad River granite that lies between the Bad and French Rivers at the eastern boundary of the Grenville Front Tectonic Zone (Figure 2.1 and 3.1).

4.4.1 Kilometer-scale Strain Gradients

Two km-scale shear zones bound the Bad River Granite at lithologic boundaries with pink orthogneisses to the east and west (Figure 2.1). Although the bulk of strain of the western and eastern shear zones is accommodated in the pink orthogneiss units, the study focuses on the granite because the unit developed strain gradients against both bounding units, which provides the opportunity to document any changes in the rock that correlate with strain. The aspect ratios of stretched magmatic enclaves indicate a broad

strain gradient in the eastern gradient and a steeper and more complicated gradient to the west.

Figure 2.19 summarizes the results from Chapter 2. Microstructural and chemical analyses indicated few changes with strain across both gradients. No evidence for partial melt was found in the shear zones of the Bad River granite. There is also little evidence for metamorphism in both km-scale gradients. Some modal variation was observed across the gradient due to natural heterogeneities within the granite, but modal amounts of metamorphic minerals such as amphibole and garnet do not correlate with strain and remained less than 10%. Some garnet is replaced by biotite in the eastern gradient, but no garnet was found in the western gradient. However, no correlation between garnet reactions and strain in the eastern gradient was found, indicating that metamorphism did not play a significant role in rock strength or strain localization. Texturally, the strain gradients of the Bad River granite show a correlation between strain and degree of recrystallization and therefore between overall grain size and strain. Average recrystallized grain size reduces with strain, yet grain sizes remain >100 μm in quartz and >250 μm in the feldspars, recognizing that recovery may have taken place and the final grain sizes may not reflect those present during shearing. Morphologically, both km-scale gradients consist of loosely augen shaped mantled porphyroclasts or aggregates (depending on the amount of strain) wrapped by finer grained bands consisting of quartz ribbons, biotite, amphibole, Fe-, Ti-, and Fe-Ti oxides, apatite, zircon, and garnet (in the eastern shear zone). This morphology is consistent across the gradients except in the easternmost sample where the phases are more dispersed and aggregates are found in linear features (e.g. ribbons; Figure 2.7b). Crystallographic preferred orientations were

detected for albite, K-feldspar, quartz, and amphibole, although the first occurrences of a CPO along each transect differs among the phases and the orientations of some of the crystals are oblique to the regional kinematics indicated by macroscale data and reported by previous studies. Due to the mineralogy of the granite, geothermometry techniques were not applicable, so it is unknown if there was a temperature gradient that correlated with strain. However, as mentioned above, there is no evidence for substantive metamorphic change, so any temperature gradient that may have existed was not enough to promote phase assemblage modification. Furthermore, there are no reports of Grenville plutonism in the area that may have created a localized temperature gradient. Although there is no evidence for Grenville age metasomatism, there is evidence of element mobility as the Mg# in biotite and amphibole and the Ab# in oligoclase slightly increases with strain across both km-scale gradients. Therefore, fluids may have been present, but not enough to significantly alter the whole rock chemistry across both gradients. Both km-scale strain gradients are located at lithologic boundaries, although the boundaries may vary in morphology. Also, the pink orthognesses are not exactly the same, but vary slightly in composition.

4.4.2 Meter-scale Shear Zone

There are several m-scale shear zones within the Bad River granite (Figure 3.1c). Their orientations vary but remain slightly oblique to the regional NE-SW fabric (Figure 3.1d). The m-scale shear zone chosen as a focus for this study is located near the mouth of the Bad River. Similar to the km-scale gradients, stretched enclaves were used as a

proxy for strain indicating a gentle strain gradient from N to S, steepening into the mylonitic core (figure 3.3).

There are several similarities between the km- and m-scale shear zones; for example, there was no evidence for melt found in the m-scale shear zone. Also, the textural evolution across the m-scale strain gradient is similar to, but more pronounced than, the km-scale shear zone. The mixed phase matrix develops at the margin of the core and increases in proportion into the core, correlating with a significant reduction in grain size fraction of recrystallized grains. Lastly, a CPO developed in quartz in the margin of the shear zone, strengthened with strain and then reduced in strength in the core of the shear zone, correlating with the development of the mixed phase matrix.

Unlike the km-scale shear zone, an increase in amphibole mode in the core of the shear zone indicates metamorphism took place in the m-scale shear zone. Also, although there was no evidence that mineral composition evolved with strain, the increase in amphibole and presence of various quartz structures visible in cathodoluminescence (CL) indicate that fluids were present and facilitated mass transfer processes. Lastly, a major difference between the km- and m-scale gradients is that the m-scale shear zone did not form at a lithologic boundary.

4.5 Active Mechanisms and Feedbacks

In this section we discuss the evidence for and the potential for interactions among the active weakening mechanisms in the km- and m-scale strain gradients.

4.5.1 Kilometer-scale Strain Gradients

There is no overwhelming evidence that one mechanism was active in either strain gradient from the Bad River Granite, but instead, the evidence indicates that several mechanisms were active to promote strain localization. The fact that both gradients exist at lithologic boundaries suggests that stress heterogeneities may have been a factor in strain localization, especially since the highest strain of both gradients is located at the eastern and western boundaries of the Bad River Granite with pink orthogneiss units.

A potential progression that could explain the km-scale strain localization in the Bad River Granite is that the irregular contact between the granite and the two orthogneisses created stress heterogeneities and strain localization began at the high stress boundaries along the contacts. Once strain began, grain size reduction would be a natural consequence and would further localization. As grain size reduction and strain localization continued, a CPO developed in the recrystallized grains, further weakening the rock and promoting localization. As grain size reduction continued, fluid pathways opened, lubricating grain boundaries and facilitating element mobility. Then, as localization progressed, the element mobility and recrystallization facilitated a morphological change so that the phases became more dispersed, which indicates mass transfer may have become an important process in the most strained rock on the eastern edge of The Bad River Granite.

The results of the numerical models (Figures 4.1 & 4.2) indicate that for a 1 km wide unit (the length of the longest axis in the eliipses of models sets A, B and C), a stress gradient extends for ~200 m from the boundary. The results also indicate that the

geometry of the boundary and the deformation conditions (i.e. pure or simple shear) influence the patterns of stress. These factors could explain the different strain gradients observed in the eastern and western boundaries of the Bad River Granite.

4.5.2 Meter-scale Shear Zone

Similar to the km-scale gradients, there is evidence that several mechanisms led to strain localization in the m-scale gradient. The three key differences are that fluids and metamorphism are factors in the m-scale shear zone and a macro-scale stress heterogeneity is not. The initial heterogeneity that led to shear zone formation is still unknown, but once formed, strain most likely began similarly to the km-scale shear zone with grain-size reduction and development of a CPO. Then, with continued grain size reduction, fluids infiltrated and there was a switch in deformation mechanism in the mylonitic core.

4.5.3 Feedbacks

The concept of positive feedbacks in terms of strain localization is well documented in several geologic fields and there are many in rheology (e.g. Mahan et al. 2011; Skemer et al. 2013). Within the above interpretations of how the km- and m-scale gradients formed are several feedback systems that may have existed (Figure 4.3). For example, as large grains recrystallize through dislocation creep a CPO may develop, which further weakens the rock, localizing strain and thus further reducing grain size through recrystallization, leading to a stronger CPO. Another is an offshoot of the latter, grain size reduction opens fluid pathways by increasing the number of grain boundaries;

fluids further weaken the rock, which leads to more strain localization and further reduction of grain size. Such interactions between various weakening mechanisms most likely leads to sustained strain localization.

4.6 Discussion

The data presented in this thesis show that multiple weakening mechanisms can be active during strain localization. A similar study by Skemer et al. (2013) on peridotites had similar results, indicating that even chemically simpler systems of the crust and mantle involve multiple processes in shear zone formation and propagation. However, current flow laws homogenize the strength of the lower crust, discounting several parameters and feedback systems that lead to rheologic heterogeneity. One of the questions posed is whether shear zone formation can be parameterized such that one can predict where a shear zone will develop and how long localization will be sustained. For example, it is well documented that many orogenic shear zones are found at lithologic boundaries, but not all lithologic boundaries in an orogenic terrain develop shear zones. This is most likely due to several factors, but potentially most importantly, the development of feedback loops. Thus, can we predict whether a shear zone will form and propagate (i.e. will feedback loops develop)?

Chaos theory provides a useful framework for thinking about dynamical systems and their degree of predictability. Chaos theory states that trajectories of simple or deterministic systems, or those that are easily explained by physics and math and whose path is determined by the initial conditions, can quickly become unpredictable. Several factors can lead to chaos, but the most well-known is that small differences in the initial

conditions grow exponentially with time, often referred to as the Butterfly Effect (Lorenz 1975).

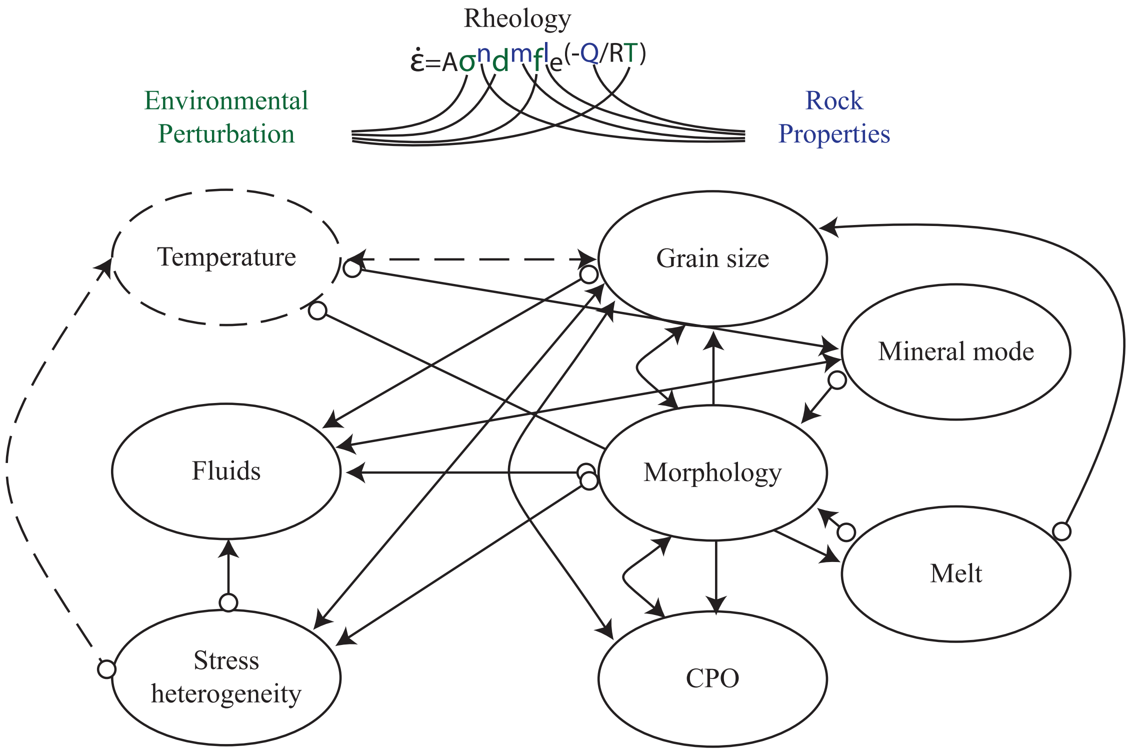


Figure 4.3 Potential Feedback Loops. Each can effect rheology and influence localization. Dotted lines indicate that temperature may play a role through shear heating.

The effects of the various weakening mechanisms discussed in this chapter on rock strength are relatively well understood and mathematically defined, such that each could be a defined parameter of a simple dynamical system. However, there are several obstacles in predicting the path of these parameters. (1) It is virtually impossible to predict whether environmental factors will play a role (stress, temperature, and fluids). For example, fluids played a small role (if any) in the km-scale gradients of the Bad River Granite, but a significant one in the m-scale shear zone, but there is no way to

predict that it would be important in one and not the other. (2) Not all factors will have the same influence in every shear zone. For example, the rheologic influence of metamorphism may be more significant in a mafic shear zone and melt would be more significant in a migmatite. These are details that are easier to parameterize after the fact, but are unknowns when it comes to predicting shear zone formation in orogenic crust. (3) There are too many variables. For example, metamorphism can lead to weakening through the replacement of stronger minerals with weaker ones, but this process in itself leads to more variability. The following is a few examples of potential sources for error in measurements associated with weakening due to metamorphic reactions: the amount of replacement (i.e is there a portion of relict phase remaining), the mode of the metamorphic mineral (i.e. is there enough of the phase to be rheologically significant), and the influence of the phase properties on other factors (morphology, grain size, anisotropy). (4) Lastly, once the mechanisms begin to influence each other and positive feedback loops progress, the system develops the basic characteristics of a chaotic system (Figure 4.3), implying scale independence to shear zone formation such that it follows a power law distribution (similar to earthquakes; Clauset et al. 2009). Recognizing the sensitivity of shear zone formation to minor variation, which is characteristic of chaotic systems, allows us to describe a power law distribution to help constrain model rheologies and thus evaluate their impact on regional orogenic dynamics and kinematics. Future work could quantify this power law relationship and explore whether the distribution will differ based on size and type of orogen.

4.7 Conclusions

Defining the causative mechanisms of mid- lower crustal, orogenic shear zones is becoming more important as numerical models become more robust. The data presented in this thesis confirm that several mechanisms are often active during shear zone formation. We discussed the rheologic importance of melt, morphology, textural changes, temperature perturbations, fluid infiltration, and stress heterogeneities in the viscous regime of the orogenic crust, but are not accounted for in current flow laws. Therefore, if numerical models use the available flow laws, the rheology of the crust would be over homogenized when modelling orogenic processes.

A question posed in this chapter is whether shear zones can be parameterized in a way that allows for the spatial prediction of formation. In order to assess the predictability of mid crustal orogenic shear zones, we refer to microstructural and chemical observations across two km-scale and one m-scale strain gradient in the Bad River Granite (Chapters 1 & 2). These shear zones provide insight into the potential for complexity in shear zone initiation and propagation. The fact that the km-scale strain gradients developed at lithologic boundaries highlights the importance of stress heterogeneities in the initiation of orogenic shear zones. Numerical models presented here show that the geometry and type of shear (pure or simple) influence the stress gradients at the boundary. Thus, the difference in strain gradient between the western and eastern km-scale strain gradients may be due to differences in boundary geometries. In this light, it may be possible to predict that km-scale shear zones will form at lithologic boundaries. Yet, not all lithologic boundaries are shear zones and this thesis shows that

the granite, a relatively simple system in the mid-crust, still has many variables and potentials for feedback loops making it highly sensitive to initial conditions. The characteristics of shear zone formation are similar to those of chaotic systems suggesting that shear zone formation follows a power law distribution, which allows a degree of predictability of the rheologic impact of shear zone formation on the bulk strength of orogenic crust. As more information is collected about ancient, orogenic shear zones, shear zone distribution could be quantified and compared across orogens.

Although the current flow laws must be used judiciously as they often represent a gross approximation, they also provide an estimate for crustal rheology and serve a purpose for geodynamic modeling. Advancements in rheology are on-going and we are learning more and more about how the crust deforms at all levels (e.g. Platt & Behr 2011a). As more knowledge is gained and the associated physics are better understood, so will the flow laws evolve.

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APPENDIX A

Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
BR-13	5085102	502766	4.8	2.1	2.29
	5085102	502766	8	3	2.67
	5085102	502766	4.5	0.6	7.50
	5085102	502766	2.6	1.6	1.63
	5085102	502766	4	1.7	2.35
	5085102	502766	1.6	1.2	1.33
	5085102	502766	2.7	1.6	1.69
	5085102	502766	3.1	2.2	1.41
	5085102	502766	6	3.7	1.62
	5085102	502766	3.2	1.1	2.91
	5085102	502766	7.2	3.7	1.95
	5085102	502766	3.1	1.3	2.38
	5085102	502766	3	1.4	2.14
	5085102	502766	2.2	1.7	1.29
	5085102	502766	2.3	1.3	1.77
	5085102	502766	2	1.2	1.67
	5085102	502766	1.8	1	1.80
	5085102	502766	1.9	1	1.90
	5085102	502766	2.3	2	1.15
	5085102	502766	4.8	2.7	1.78
BR-14	5085311	503637	50	14	3.57
	5085311	503637	4	1.8	2.22
	5085311	503637	5.5	1.7	3.24
	5085311	503637	5	2.5	2.00
	5085311	503637	3	1.2	2.50
	5085311	503637	2.5	1.4	1.79
BR-15	5085463	503909	3.9	1.8	2.17
	5085463	503909	2.1	1.7	1.24
	5085463	503909	3.3	1	3.30
	5085463	503909	11.5	4.6	2.50
	5085463	503909	5	0.8	6.25
	5085463	503909	2.1	1.3	1.62
	5085463	503909	7.8	1.1	7.09
	5085463	503909	3.3	0.9	3.67
	5085463	503909	13.7	1.9	7.21
	5085463	503909	4.9	1.6	3.06
	5085463	503909	9.2	2.7	3.41
BR-16	5085436	504352	11.9	2.7	4.41
	5085436	504352	6	2	3.00
	5085436	504352	6.1	1.4	4.36
	5085436	504352	6.5	1.1	5.91
	5085436	504352	4.9	1.8	2.72
	5085436	504352	7	2.1	3.33
	5085436	504352	5.2	1.3	4.00
	5085436	504352	8.8	1.6	5.50
	5085436	504352	13.1	1.8	7.28
	5085436	504352	6.8	1.6	4.25
	5085436	504352	5.5	1.6	3.44
	5085436	504352	23	3.1	7.42
	5085436	504352	3.7	1	3.70
	5085436	504352	13.5	3.1	4.35
	5085436	504352	4.4	1.8	2.44
	5085436	504352	9	2.3	3.91

APPENDIX A

Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
	5085436	504352	8.5	1.9	4.47
	5085436	504352	2.7	1.1	2.45
	5085436	504352	5.9	1.5	3.93
	5085565	504735	5.8	1.4	4.14
	5085565	504735	5.6	1	5.60
	5085565	504735	7.3	1.1	6.64
	5085565	504735	39.1	3.3	11.85
	5085565	504735	16.4	1.7	9.65
	5085565	504735	6.3	1.5	4.20
	5085565	504735	14.3	1.9	7.53
	5085565	504735	6.5	1.9	3.42
	5085565	504735	7.6	1.2	6.33
BR-17	5085565	504735	6.3	0.9	7.00
	5085565	504735	21.7	1.6	13.56
	5085565	504735	12	2.2	5.45
	5085583	504742	31.4	2.5	12.56
	5085583	504742	9	1.1	8.18
	5085583	504742	10.1	1.5	6.73
	5085583	504742	16	1.4	11.43
	5085583	504742	6.8	0.8	8.50
	5085583	504742	6.4	0.9	7.11
	5085583	504742	7.9	0.5	15.80
	5085583	504742	12.7	2	6.35
BR-17 (cont)	5085583	504742	7.8	0.8	9.75
	5085882	505213	2.5	1	2.50
	5085882	505213	6.3	1.3	4.85
	5085882	505213	3.7	1.1	3.36
	5085882	505213	4.3	1.9	2.26
	5085882	505213	35	4.4	7.95
	5085882	505213	9.7	2	4.85
	5085882	505213	2.8	1.1	2.55
	5085882	505213	4	1.8	2.22
	5085882	505213	3.2	1.1	2.91
	5085882	505213	7.1	1.2	5.92
	5085882	505213	1.9	0.9	2.11
	5085882	505213	4.9	2	2.45
	5085882	505213	8.8	2.1	4.19
	5085882	505213	3.7	1.7	2.18
	5085882	505213	4.3	0.4	10.75
	5085882	505213	3.3	0.5	6.60
	5085882	505213	7.1	1.4	5.07
	5085882	505213	13.2	3.4	3.88
BR-9	5085882	505213	3.5	0.6	5.83
	5085882	505213	9.3	0.5	18.60
	5085882	505213	4.1	1.2	3.42
	5085882	505213	3.2	1	3.20
	5085882	505213	4.2	1.4	3.00
	5085882	505213	3.7	0.9	4.11
	5085882	505213	2.3	0.8	2.88
	5085882	505213	3.3	0.7	4.71
	5085882	505213	6.9	2.2	3.14
	5085882	505213	4.9	1.2	4.08
	5085882	505213	6.7	1.2	5.58

APPENDIX A

Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
BR-9 cont	5085882	505213	3.8	1.2	3.17
	5085882	505213	3.6	1	3.60
	5085882	505213	4.9	0.7	7.00
	5085882	505213	4	1	4.00
	5085882	505213	3.5	0.9	3.89
	5085882	505213	3.4	1.2	2.83
	5085882	505213	4.1	1.3	3.15
	5085882	505213	5.5	1.1	5.00
	5085882	505213	4	1.1	3.64
	5085882	505213	8.1	1.1	7.36
	5085882	505213	4.4	1.5	2.93
	5085882	505213	13.7	1.8	7.61
9A1	5085906	505288	8.7	0.4	21.75
9A2	5085906	505288	13.5	1.0	13.50
9A3	5085906	505288	18.5	1.5	12.33
9A4	5085906	505288	8.0	1.0	8.00
9B1	5085904	505287	13.0	1.0	13.00
9B2	5085904	505287	7.0	0.6	11.67
9B3	5085904	505287	4.0	0.6	6.67
9B4	5085904	505287	6.2	1.5	4.13
9B5	5085904	505287	12.2	1.1	11.09
9B6	5085904	505287	16.2	1.5	10.80
9C2	5085878	505287	49.0	0.8	61.25
9C3	5085878	505287	34.5	1.3	26.54
9C4	5085878	505287	16.3	0.2	81.50
9C5	5085878	505287	11.5	0.5	23.00
9D1	5085886	505303	12.3	0.9	13.67
9D2	5085886	505303	19.7	1.8	10.94
9D3	5085886	505303	55.0	3.0	18.33
9D4	5085886	505303	19.5	1.1	17.73
9D5	5085886	505303	43.5	0.8	54.38
9D6	5085886	505303	10.0	0.4	25.00
9E1	5085881	505270	11.8	1.0	11.80
9E2	5085881	505270	17.0	0.7	24.29
9E3	5085881	505270	16.6	0.8	20.75
9E4	5085881	505270	18.0	0.9	20.00
9F1	5085870	505254	63.5	2.0	31.75
9F2	5085870	505254	13.5	1.8	7.50
9G1	5085925	505251	10.3	0.7	14.71
9G2	5085925	505251	20.3	1.1	18.45
9G3	5085925	505251	9.8	0.7	14.00
9G4	5085925	505251	16.5	0.7	23.57
9G5	5085925	505251	11.1	1.3	8.54
9G6	5085925	505251	10.0	0.9	11.11
9G7	5085925	505251	24.3	1.2	20.25
9G8	5085925	505251	13.1	1.4	9.36
9G9	5085925	505251	11.3	0.8	14.13
9G10	5085925	505251	11.7	0.8	14.63
9G11	5085925	505251	11.0	0.7	15.71
9H1	5085898	505235	27.5	1.1	25.00
9H2	5085898	505235	10.0	0.7	14.29
9H3	5085898	505235	8.6	0.7	12.29
9H4	5085898	505235	16.5	0.9	18.33

APPENDIX A

Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
9I1	5085886	505214	8.9	1.6	5.56
9I2	5085886	505214	6.2	0.7	8.86
9I3	5085886	505214	4.8	1.1	4.36
9I4	5085886	505214	5.0	1.5	3.33
9I5	5085886	505214	4.7	0.5	9.40
9I6	5085886	505214	3.5	1.2	2.92
9I7	5085886	505214	4.5	0.9	5.00
9I8	5085886	505214	7.5	1.3	5.77
9I9	5085886	505214	5.5	1.5	3.67
9J1	5085891	505206	3.2	0.6	5.33
9J2	5085891	505206	4.0	0.5	8.00
9J3	5085891	505206	5.5	0.6	9.17
9J4	5085891	505206	5.5	0.7	7.86
9J5	5085891	505206	9.9	2.2	4.50
9J6	5085891	505206	21.8	3.2	6.81
9J7	5085891	505206	12.0	1.7	7.06
9J8	5085891	505206	4.5	1.8	2.50
9K1	5085898	505193	7.4	2.0	3.70
9K2	5085898	505193	5.9	1.7	3.47
9K3	5085898	505193	8.0	0.7	11.43
9K4	5085898	505193	12.0	1.2	10.00
9K5	5085898	505193	15.2	1.9	8.00
9K6	5085898	505193	20.0	3.0	6.67
9K7	5085898	505193	3.7	0.7	5.29
9L1	5085927	505182	34.5	3.0	11.50
9L2	5085927	505182	16.2	2.0	8.10
9L3	5085927	505182	7.0	0.9	7.78
9L4	5085927	505182	11.3	2.0	5.65
9L5	5085927	505182	6.5	1.9	3.42
9L6	5085927	505182	19.5	1.2	16.25
9M1	5085939	505192	22.5	1.3	17.31
9M2	5085939	505192	7.3	1.3	5.62
9M3	5085939	505192	7.0	1.2	5.83
9M4	5085939	505192	6.0	1.0	6.00
9M5	5085939	505192	8.1	1.7	4.76
9M6	5085939	505192	20.0	1.2	16.67
9M7	5085939	505192	7.8	1.0	7.80
9M8	5085939	505192	13.2	1.4	9.43
9M9	5085939	505192	25.2	2.0	12.60
9N1	5085933	505179	14.0	1.2	11.67
9N2	5085933	505179	6.5	0.7	9.29
9N3	5085933	505179	5.8	0.7	8.29
9N4	5085933	505179	6.7	0.6	11.17
9N5	5085933	505179	9.4	0.8	11.75
9N6	5085933	505179	9.4	1.0	9.40
9N7	5085933	505179	23.5	1.5	15.67
9N8	5085933	505179	11.7	1.0	11.70
9N9	5085933	505179	12.7	0.5	25.40
9N10	5085933	505179	18.6	0.4	46.50
9N11	5085933	505179	22.3	2.4	9.29
9N12	5085933	505179	6.5	0.5	13.00
9N13	5085933	505179	13.0	1.0	13.00
9N14	5085933	505179	11.5	1.2	9.58

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Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
9N15	5085933	505179	20.0	1.5	13.33
9N16	5085933	505179	7.0	1.0	7.00
9N17	5085933	505179	9.2	1.2	7.67
9N18	5085933	505179	19.4	2.5	7.76
9N19	5085933	505179	19.0	1.5	12.67
9N20	5085933	505179	12.9	1.8	7.17
9N21	5085933	505179	6.7	0.8	8.38
9N22	5085933	505179	8.0	0.5	16.00
9N23	5085933	505179	6.7	0.9	7.44
9N24	5085933	505179	13.0	0.9	14.44
9N25	5085933	505179	4.4	0.5	8.80
9N26	5085933	505179	7.0	1.2	5.83
9N27	5085933	505179	6.2	0.6	10.33
10A1	5085975	504926	9.0	2.5	3.60
10A2	5085975	504926	4.5	0.5	9.00
10A3	5085975	504926	2.3	0.5	4.60
10A4	5085975	504926	7.0	0.6	11.67
10A5	5085975	504926	22.5	1.0	22.50
10A6	5085975	504926	5.0	0.5	10.00
10A7	5085975	504926	4.4	0.5	8.80
10A8	5085975	504926	4.2	0.6	7.00
10A9	5085975	504926	5.0	0.6	8.33
10A10	5085975	504926	3.5	0.4	8.75
10A11	5085975	504926	3.5	0.6	5.83
10A12	5085975	504926	7.6	0.6	12.67
10B1	5085966	504941	6.5	1.7	3.82
10B2	5085966	504941	6.2	1.0	6.20
10B3	5085966	504941	3.4	1.0	3.40
10B4	5085966	504941	3.2	0.8	4.00
10B6	5085966	504941	5.0	1.4	3.57
10C1	5085975	504953	13.2	1.9	6.95
10C2	5085975	504953	6.0	2.8	2.14
10C3	5085975	504953	5.7	0.7	8.14
10C4	5085975	504953	4.8	0.7	6.86
10C5	5085975	504953	8.9	0.8	11.13
10C6	5085975	504953	7.6	1.5	5.07
10C7	5085975	504953	4.9	0.6	8.17
36A1	5085675	504835	7.0	1.8	3.89
36A2	5085675	504835	9.0	2.2	4.09
36A4	5085675	504835	22.9	1.2	19.08
36A6	5085675	504835	9.5	1.5	6.33
36A7	5085675	504835	14.0	1.6	8.75
36A8	5085675	504835	7.8	1.9	4.11
36A9	5085675	504835	8.3	1.7	4.88
36A10	5085675	504835	5.9	1.7	3.47
36A11	5085675	504835	7.8	1.5	5.20
36A12	5085675	504835	13.0	1.4	9.29
36A14	5085675	504835	10.5	1.0	10.50
36A15	5085675	504835	7.3	1.5	4.87
36A16	5085675	504835	6.0	0.9	6.67
36A17	5085675	504835	7.0	0.9	7.78
36B1	5085670	504836	13.2	0.9	14.67
36B2	5085670	504836	43.2	3.0	14.40

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Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
36B3	5085670	504836	11.2	3.4	3.29
36B4	5085670	504836	7.3	0.8	9.13
36B5	5085670	504836	8.0	0.7	11.43
36B6	5085670	504836	6.2	0.6	10.33
36B7	5085670	504836	13.2	1.7	7.76
36B8	5085670	504836	6.0	1.2	5.00
36B9	5085670	504836	13.0	1.4	9.29
36B10	5085670	504836	61.0	7.0	8.71
36B11	5085670	504836	7.6	0.9	8.44
36B13	5085670	504836	60.0	9.6	6.25
36B14	5085670	504836	6.2	1.1	5.64
36B15	5085670	504836	10.7	2.3	4.65
36B16	5085670	504836	5.6	2.1	2.67
36C1	5085680	504836	9.8	1.4	7.00
36C2	5085680	504836	6.5	0.6	10.83
36C4	5085680	504836	12.7	2.1	6.05
36C5	5085680	504836	33.0	2.7	12.22
36C6	5085680	504836	15.5	3.9	3.97
36C7	5085680	504836	11.3	3.3	3.42
36C8	5085680	504836	24.5	3.6	6.81
36D1	5085678	504865	10.3	1.8	5.72
36D2	5085678	504865	14.3	1.9	7.53
36D3	5085678	504865	6.2	1.3	4.77
36D4	5085678	504865	5.5	1.3	4.23
36D5	5085678	504865	6.4	1.6	4.00
36D6	5085678	504865	10.0	2.8	3.57
36E1	5085672	504865	5.7	1.3	4.38
36E2	5085672	504865	19.2	2.6	7.38
36E3	5085672	504865	7.5	1.0	7.50
36E4	5085672	504865	8.4	1.0	8.40
36E7	5085672	504865	16.7	0.9	18.56
36F1	5085699	504880	11.0	3.1	3.55
36F2	5085699	504880	7.0	0.9	7.78
36F3	5085699	504880	10.7	0.9	11.89
36F4	5085699	504880	6.0	2.3	2.61
36F5	5085699	504880	7.5	0.9	8.33
36F7	5085699	504880	4.5	1.1	4.09
36F8	5085699	504880	7.7	0.7	11.00
36F9	5085699	504880	6.0	0.9	6.67
36F11	5085699	504880	33.5	2.5	13.40
36G1	5085728	504890	35.5	2.8	12.68
36G2	5085728	504890	10.5	2.0	5.25
36G3	5085728	504890	7.2	1.2	6.00
36G4	5085728	504890	5.5	0.7	7.86
36G5	5085728	504890	10.0	0.6	16.67
36G6	5085728	504890	12.8	0.4	32.00
36G7	5085728	504890	19.1	1.3	14.69
36H1	5085724	504893	16.0	1.0	16.00
36H2	5085724	504893	6.6	0.9	7.33
36H3	5085724	504893	27.0	2.1	12.86
36H4	5085724	504893	6.5	0.6	10.83
36J1	5085692	504905	42.0	2.2	19.09
36J4	5085692	504905	31.0	1.5	20.67

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Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
36J5	5085692	504905	22.5	1.6	14.06
36J6	5085692	504905	25.0	0.4	62.50
36K1	5085687	504904	22.4	1.5	14.93
36K2	5085687	504904	6.1	0.5	12.20
36K3	5085687	504904	7.7	0.6	12.83
36K4	5085687	504904	8.5	0.7	12.14
36K5	5085687	504904	10.5	0.4	26.25
36K6	5085687	504904	15.2	0.9	16.89
36K7	5085687	504904	4.1	0.5	8.20
36K8	5085687	504904	6.5	0.6	10.83
36K9	5085687	504904	6.8	0.3	22.67
36K10	5085687	504904	14.5	2.0	7.25
36K11	5085687	504904	5.0	1.1	4.55
37A1	5085522	504293	29.3	2.4	12.21
37A2	5085522	504293	8.9	1.1	8.09
37A3	5085522	504293	16.3	1.5	10.87
37A4	5085522	504293	9.5	3.0	3.17
37A5	5085522	504293	9.5	1.0	9.50
37B1	5085517	504295	30.0	2.6	11.54
37B2	5085517	504295	6.1	1.9	3.21
37B3	5085517	504295	12.3	4.0	3.08
37B4	5085517	504295	5.5	1.6	3.44
37C1	5085526	504325	6.3	1.1	5.73
37C2	5085526	504325	7.1	1.3	5.46
37C3	5085526	504325	32.0	1.8	17.78
37C4	5085526	504325	8.3	1.3	6.38
37D1	5085577	504315	5.4	1.0	5.40
37D2	5085577	504315	11.2	0.7	16.00
37D3	5085577	504315	6.6	2.1	3.14
37D4	5085577	504315	10.5	3.3	3.18
37D5	5085577	504315	8.6	1.1	7.82
37D6	5085577	504315	6.7	1.9	3.53
37E1	5085577	504320	8.1	1.0	8.10
37E2	5085577	504320	16.7	3.8	4.39
37E3	5085577	504320	7.8	1.7	4.59
37E4	5085577	504320	9.3	1.3	7.15
37E5	5085577	504320	8.3	1.6	5.19
37F1	5085600	504320	15.3	2.0	7.65
37F2	5085600	504320	6.7	0.7	9.57
37F3	5085600	504320	7.9	1.7	4.65
37F4	5085600	504320	12.4	5.2	2.38
37F5	5085600	504320	7.6	1.5	5.07
37G1	5085546	504279	5.0	2.0	2.50
37G2	5085546	504279	5.0	2.0	2.50
37G3	5085546	504279	14.0	2.0	7.00
37G4	5085546	504279	8.5	1.5	5.67
37G5	5085546	504279	5.7	1.5	3.80
37H1	5085537	504280	18.3	3.7	4.95
37H2	5085537	504280	9.1	2.0	4.55
37H3	5085537	504280	4.5	0.6	7.50
37H5	5085537	504280	8.7	2.1	4.14
37H6	5085537	504280	5.1	1.4	3.64
37I1	5085565	504283	6.9	1.3	5.31

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Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
37I2	5085565	504283	12.2	1.4	8.71
37I3	5085565	504283	4.7	1.1	4.27
37I4	5085565	504283	7.0	1.9	3.68
37I5	5085565	504283	7.1	1.2	5.92
37J1	5085567	504315	5.2	1.3	4.00
37J2	5085567	504315	9.1	1.6	5.69
37J3	5085567	504315	5.7	1.1	5.18
37J4	5085567	504315	6.0	1.5	4.00
37J5	5085567	504315	4.0	1.6	2.50
37J6	5085567	504315	6.5	2.2	2.95
37J7	5085567	504315	3.7	0.6	6.17
37J8	5085567	504315	3.0	1.4	2.14
37J9	5085567	504315	5.5	1.8	3.06
1A1	5084594	501473	15.0	2.6	5.77
1A2	5084594	501473	7.9	1.1	7.18
1A3	5084594	501473	5.5	1.0	5.50
1A4	5084594	501473	4.5	1.5	3.00
1A5	5084594	501473	8.2	1.0	8.20
1A6	5084594	501473	7.0	0.7	10.00
1A7	5084594	501473	3.5	1.1	3.18
1A8	5084594	501473	7.1	2.5	2.84
1A9	5084594	501473	11.3	2.6	4.35
1A10	5084594	501473	3.7	0.5	7.40
1A11	5084594	501473	5.5	0.6	9.17
1A12	5084594	501473	9.3	1.3	7.15
1A13	5084594	501473	5.2	0.9	5.78
1A14	5084594	501473	3.5	1.2	2.92
1B1	5084587	501465	3.2	1.2	2.67
1B2	5084587	501465	2.2	2.3	0.96
1B3	5084587	501465	5.4	2.5	2.16
1B4	5084587	501465	1.8	1.3	1.38
1B5	5084587	501465	2.8	1.4	2.00
1B6	5084587	501465	2.8	1.5	1.87
1B7	5084587	501465	7.5	6.6	1.14
1B8	5084587	501465	6.7	3.9	1.72
1B9	5084587	501465	5.8	1.7	3.41
1B10	5084587	501465	12.0	5.5	2.18
1C1	5084585	501467	1.6	1.0	1.60
1C2	5084585	501467	4.6	3.9	1.18
1C3	5084585	501467	16.8	11.0	1.53
1C4	5084585	501467	3.5	1.0	3.50
1C5	5084585	501467	3.4	1.0	3.40
1C6	5084585	501467	2.6	2.0	1.30
1C7	5084585	501467	2.9	0.9	3.22
1C8	5084585	501467	4.3	2.2	1.95
1C9	5084585	501467	6.5	2.8	2.32
1C10	5084585	501467	5.6	1.0	5.60
1C11	5084585	501467	2.5	1.0	2.50
1C12	5084585	501467	5.0	1.0	5.00
1C13	5084585	501467	3.0	0.9	3.33
1C14	5084585	501467	2.4	1.0	2.40
1C15	5084585	501467	9.5	3.5	2.71
1C16	5084585	501467	6.0	5.0	1.20

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Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
1C17	5084585	501467	3.0	1.8	1.67
1C18	5084585	501467	4.7	1.5	3.13
1C19	5084585	501467	3.5	1.0	3.50
1C20	5084585	501467	5.5	2.2	2.50
1D1	5084582	501465	6.5	3.0	2.17
1D2	5084582	501465	4.4	1.0	4.40
1D3	5084582	501465	4.8	1.0	4.80
1D4	5084582	501465	4.5	2.0	2.25
1D5	5084582	501465	2.0	1.0	2.00
1D6	5084582	501465	3.4	2.7	1.26
1D7	5084582	501465	6.9	3.8	1.82
1D8	5084582	501465	3.0	1.0	3.00
1D9	5084582	501465	4.8	4.8	1.00
1D10	5084582	501465	6.6	2.7	2.44
1D11	5084582	501465	2.0	1.5	1.33
1D12	5084582	501465	3.0	1.0	3.00
1D13	5084582	501465	4.5	2.0	2.25
1D14	5084582	501465	6.3	3.5	1.80
1D16	5084582	501465	5.0	2.8	1.79
1D17	5084582	501465	1.8	1.0	1.80
1D18	5084582	501465	4.2	1.5	2.80
1D19	5084582	501465	3.0	2.0	1.50
1D20	5084582	501465	3.0	1.0	3.00
1D21	5084582	501465	5.5	2.0	2.75
1E1	5084611	501474	6.0	2.0	3.00
1E2	5084611	501474	4.5	1.0	4.50
1E3	5084611	501474	6.0	1.5	4.00
1E4	5084611	501474	5.2	2.0	2.60
1E5	5084611	501474	1.3	1.0	1.30
1E6	5084611	501474	3.5	1.0	3.50
1E7	5084611	501474	2.2	0.6	3.67
1E8	5084611	501474	3.6	2.8	1.29
1E9	5084611	501474	3.2	1.2	2.67
1E10	5084611	501474	1.5	1.0	1.50
1E11	5084611	501474	4.4	2.0	2.20
1E12	5084611	501474	6.3	4.0	1.58
1E13	5084611	501474	1.5	1.0	1.50
1E14	5084611	501474	13.5	6.5	2.08
1F1	5084613	501493	9.9	3.4	2.91
1F2	5084613	501493	6.7	3.8	1.76
1F3	5084613	501493	2.7	0.9	3.00
1F4	5084613	501493	5.5	1.2	4.58
1F5	5084613	501493	3.9	1.1	3.55
1F6	5084613	501493	4.1	1.0	4.10
1F7	5084613	501493	4.5	2.8	1.61
1F8	5084613	501493	7.9	2.7	2.93
1F9	5084613	501493	5.8	3.0	1.93
1F10	5084613	501493	7.7	2.5	3.08
1F11	5084613	501493	3.5	1.0	3.50
1F12	5084613	501493	1.2	0.8	1.50
1G1	5084605	501491	9.5	0.8	11.88
1G2	5084605	501491	12.3	0.5	24.60
1G3	5084605	501491	5.8	0.6	9.67

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Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
1G4	5084605	501491	7.7	1.0	7.70
1G5	5084605	501491	7.8	0.7	11.14
1G6	5084605	501491	7.9	1.0	7.90
1G8	5084605	501491	18.6	1.6	11.63
1H1	5084599	501488	5.6	3.8	1.47
1H2	5084599	501488	2.3	0.9	2.56
1H3	5084599	501488	2.0	1.8	1.11
1H4	5084599	501488	4.8	2.0	2.40
1H5	5084599	501488	4.0	3.5	1.14
1H6	5084599	501488	4.2	3.7	1.14
1H8	5084599	501488	3.3	1.4	2.36
1H9	5084599	501488	3.3	1.9	1.74
1H10	5084599	501488	1.9	1.0	1.90
1H12	5084599	501488	2.3	0.8	2.88
1H13	5084599	501488	3.3	1.9	1.74
1H14	5084599	501488	4.5	1.1	4.09
1I1	5084568	501479	5.4	2.5	2.16
1I2	5084568	501479	8.8	2.5	3.52
1I3	5084568	501479	1.9	0.9	2.11
1I4	5084568	501479	3.5	2.0	1.75
1I5	5084568	501479	4.0	2.0	2.00
1I6	5084568	501479	3.0	1.0	3.00
1I7	5084568	501479	5.0	2.2	2.27
1I8	5084568	501479	7.4	1.7	4.35
1I9	5084568	501479	9.2	6.3	1.46
1I10	5084568	501479	3.7	1.7	2.18
1I11	5084568	501479	3.0	1.3	2.31
1I12	5084568	501479	3.8	3.5	1.09
1I13	5084568	501479	4.1	3.9	1.05
1I14	5084568	501479	2.0	1.0	2.00
1I15	5084568	501479	3.9	2.4	1.63
1I16	5084568	501479	4.2	1.3	3.23
1I17	5084568	501479	3.5	2.0	1.75
1I18	5084568	501479	12.1	5.5	2.20
40A1	5084793	501490	13.0	2.7	4.81
40A2	5084793	501490	2.7	0.4	6.75
40A3	5084793	501490	6.5	1.5	4.33
40A4	5084793	501490	7.5	1.8	4.17
40A5	5084793	501490	5.0	1.0	5.00
40A6	5084793	501490	4.0	1.1	3.64
40A7	5084793	501490	12.0	2.8	4.29
40A8	5084793	501490	4.7	1.2	3.92
40A9	5084793	501490	6.9	1.0	6.90
40A10	5084793	501490	5.1	0.8	6.38
40B1	5084793	501492	5.2	1.6	3.25
40B2	5084793	501492	7.6	3.0	2.53
40B3	5084793	501492	4.4	2.0	2.20
40B4	5084793	501492	2.5	1.3	1.92
40B5	5084793	501492	5.0	1.3	3.85
40B6	5084793	501492	5.5	1.5	3.67
40B7	5084793	501492	5.5	1.0	5.50
40B8	5084793	501492	3.7	1.3	2.85
40B9	5084793	501492	4.8	1.2	4.00

APPENDIX A

Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
40B10	5084793	501492	5.0	1.1	4.55
40B11	5084793	501492	6.0	1.4	4.29
40B12	5084793	501492	5.0	1.3	3.85
40B13	5084793	501492	4.5	0.3	15.00
40B14	5084793	501492	4.8	1.4	3.43
40B15	5084793	501492	3.8	0.8	4.75
40B16	5084793	501492	5.4	1.0	5.40
40B17	5084793	501492	9.5	1.9	5.00
40B18	5084793	501492	5.8	2.8	2.07
40B19	5084793	501492	9.9	2.5	3.96
40C1	5084797	501491	8.5	1.3	6.54
40C2	5084797	501491	1.7	0.9	1.89
40C3	5084797	501491	6.5	2.0	3.25
40C5	5084797	501491	5.5	2.2	2.50
40C6	5084797	501491	2.5	0.8	3.13
40C7	5084797	501491	11.0	0.7	15.71
40C8	5084797	501491	6.0	1.7	3.53
40C9	5084797	501491	3.0	0.5	6.00
40C10	5084797	501491	2.8	0.4	7.00
40C11	5084797	501491	3.0	0.6	5.00
40C12	5084797	501491	12.4	2.5	4.96
40C13	5084797	501491	2.5	0.9	2.78
40C14	5084797	501491	3.0	1.0	3.00
40C15	5084797	501491	11.0	2.6	4.23
40D1	5084816	501488	5.2	0.9	5.78
40D2	5084816	501488	6.3	1.7	3.71
40D3	5084816	501488	5.5	1.0	5.50
40D4	5084816	501488	3.9	0.3	13.00
40D5	5084816	501488	2.3	1.3	1.77
40D6	5084816	501488	4.5	1.2	3.75
40D7	5084816	501488	4.5	1.4	3.21
40D8	5084816	501488	5.6	1.6	3.50
40D9	5084816	501488	16.5	5.3	3.11
40D10	5084816	501488	4.5	0.8	5.63
40D11	5084816	501488	6.9	2.3	3.00
40D12	5084816	501488	3.5	0.5	7.00
40E1	5084822	501493	5.9	1.8	3.28
40E2	5084822	501493	10.9	2.8	3.89
40E3	5084822	501493	3.2	0.5	6.40
40E4	5084822	501493	3.2	0.7	4.57
40E5	5084822	501493	3.3	0.8	4.13
40E6	5084822	501493	2.0	0.7	2.86
40E7	5084822	501493	5.9	1.2	4.92
40E8	5084822	501493	2.5	0.7	3.57
40E9	5084822	501493	7.2	1.5	4.80
40E10	5084822	501493	5.0	1.3	3.85
40E11	5084822	501493	4.8	1.2	4.00
40E12	5084822	501493	10.6	2.0	5.30
40E13	5084822	501493	4.0	1.7	2.35
40F1	5084823	501495	5.7	0.7	8.14
40F2	5084823	501495	4.6	1.4	3.29
40F3	5084823	501495	7.0	2.6	2.69
40F4	5084823	501495	4.2	1.1	3.82

APPENDIX A

Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
40F5	5084823	501495	20.6	2.1	9.81
40F6	5084823	501495	4.2	3.0	1.40
40F8	5084823	501495	5.5	0.4	13.75
40F9	5084823	501495	3.0	0.7	4.29
40F10	5084823	501495	7.0	1.8	3.89
12A1	5084510	501780	5.0	4.5	1.11
12A2	5084510	501780	6.4	4.5	1.42
12A3	5084510	501780	7.2	3.5	2.06
12A4	5084510	501780	4.5	1.5	3.00
12A5	5084510	501780	7.5	4.5	1.67
12A6	5084510	501780	4.5	3.5	1.29
12A7a	5084510	501780	5.2	1.5	3.47
12A7b	5084510	501780	1.2	1.3	0.92
12A8	5084510	501780	3.4	1.2	2.83
12B1	5084510	501780	7.4	3.5	2.11
12B2	5084510	501780	8.2	2.0	4.10
12B3	5084510	501780	2.5	0.9	2.78
12B4	5084510	501780	6.2	2.6	2.38
12B5	5084510	501780	1.8	0.5	3.60
12B6	5084510	501780	2.5	0.5	5.00
12B7	5084510	501780	2.8	1.6	1.75
12B8	5084510	501780	2.0	1.7	1.18
12B9	5084510	501780	2.5	2.1	1.19
12B10	5084510	501780	1.7	0.9	1.89
12B11	5084510	501780	0.5	1.1	0.45
12B12	5084510	501780	1.9	1.0	1.90
12B13	5084510	501780	16.7	7.0	2.39
12B14	5084510	501780	12.0	5.0	2.40
12C1	5084519	501776	4.0	2.7	1.48
12C2	5084519	501776	4.0	1.8	2.22
12C3	5084519	501776	11.0	5.8	1.90
12C4	5084519	501776	28.2	8.0	3.53
12C5	5084519	501776	5.3	3.5	1.51
12C6	5084519	501776	7.5	2.3	3.26
12C7	5084519	501776	3.2	1.9	1.68
12D1	5084524	501773	3.4	2.0	1.70
12D2	5084524	501773	2.4	1.9	1.26
12D3	5084524	501773	8.8	1.1	8.00
12D4	5084524	501773	3.0	1.8	1.67
12D5	5084524	501773	1.6	0.7	2.29
12D6	5084524	501773	4.2	1.6	2.63
12D7	5084524	501773	10.5	7.3	1.44
12D8	5084524	501773	1.7	0.7	2.43
12D9	5084524	501773	7.2	4.2	1.71
12D10	5084524	501773	3.3	0.6	5.50
12D11	5084524	501773	2.8	2.7	1.04
12D12	5084524	501773	2.7	2.6	1.04
12E1	5084526	501792	8.7	3.5	2.49
12E2	5084526	501792	2.4	1.7	1.41
12E3	5084526	501792	5.0	2.2	2.27
12E4	5084526	501792	3.5	2.7	1.30
12E5	5084526	501792	3.7	3.0	1.23
12E6	5084526	501792	2.3	1.5	1.53

APPENDIX A

Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
12E7	5084526	501792	3.0	1.0	3.00
12E8	5084526	501792	8.3	3.5	2.37
12E9	5084526	501792	2.0	1.8	1.11
12E10	5084526	501792	2.0	1.0	2.00
12E11	5084526	501792	4.2	2.1	2.00
12E12	5084526	501792	3.5	2.0	1.75
12E13	5084526	501792	8.1	3.5	2.31
12E14	5084526	501792	8.7	4.2	2.07
12E15	5084526	501792	5.3	2.7	1.96
12F1	5084521	501764	2.6	1.4	1.86
12F2	5084521	501764	6.3	5.2	1.21
12F3	5084521	501764	2.0	1.3	1.54
12F4	5084521	501764	2.1	1.1	1.91
12F5a	5084521	501764	38.0	16.7	2.28
12F5b	5084521	501764	5.3	2.8	1.89
12G1	5084525	501707	6.1	4.7	1.30
12G2	5084525	501707	4.5	2.0	2.25
12G3	5084525	501707	2.4	1.2	2.00
12G4	5084525	501707	2.4	0.7	3.43
12G5	5084525	501707	14.0	7.4	1.89
12G6	5084525	501707	3.3	2.0	1.65
12G7	5084525	501707	8.5	4.0	2.13
12G8	5084525	501707	3.2	1.1	2.91
12G9	5084525	501707	7.9	4.6	1.72
12G10	5084525	501707	14.7	8.5	1.73
12G11	5084525	501707	4.0	1.6	2.50
12G12	5084525	501707	2.9	1.8	1.61
12G13	5084525	501707	1.7	1.2	1.42
12H1	5084501	501758	4.5	1.6	2.81
12H2	5084501	501758	4.3	1.8	2.39
12H3	5084501	501758	2.4	1.0	2.40
12H4	5084501	501758	17.3	9.0	1.92
12H5	5084501	501758	9.7	2.7	3.59
12H6	5084501	501758	6.2	2.3	2.70
12H7	5084501	501758	3.2	2.5	1.28
12H8	5084501	501758	4.7	3.0	1.57
12H9	5084501	501758	6.2	1.5	4.13
12H10	5084501	501758	14.5	6.0	2.42
12H11	5084501	501758	3.0	1.5	2.00
12H12	5084501	501758	2.9	1.9	1.53
12H13	5084501	501758	9.8	2.5	3.92
12H14	5084501	501758	2.3	1.5	1.53
12I1	5084497	501758	9.6	2.8	3.43
12I2	5084497	501758	1.7	0.6	2.83
12I3	5084497	501758	2.5	1.0	2.50
12I4	5084497	501758	6.7	2.3	2.91
12I5	5084497	501758	8.4	4.0	2.10
12I6	5084497	501758	5.3	3.3	1.61
12I7	5084497	501758	2.7	1.6	1.69
12I8	5084497	501758	2.0	1.0	2.00
12J1	5084489	501461	10.4	3.2	3.25
12J2	5084489	501461	2.3	1.5	1.53
12J4	5084489	501461	3.7	1.0	3.70

APPENDIX A

Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
12J5	5084489	501461	3.2	1.8	1.78
12J6	5084489	501461	13.0	9.5	1.37
12J7	5084489	501461	4.5	1.5	3.00
12J8	5084489	501461	3.5	1.8	1.94
12J9	5084489	501461	2.0	1.5	1.33
12J10	5084489	501461	1.7	1.0	1.70
12J12	5084489	501461	7.0	2.5	2.80
12J13	5084489	501461	2.3	0.8	2.88
12J14	5084489	501461	3.2	1.5	2.13
12J15	5084489	501461	2.5	1.2	2.08
12J16	5084489	501461	3.4	0.7	4.86
12J17	5084489	501461	2.6	1.2	2.17
12J18	5084489	501461	2.0	0.7	2.86
41A1	5084683	502058	3.0	2.3	1.30
41A2	5084683	502058	9.9	7.0	1.41
41A3	5084683	502058	2.4	2.0	1.20
41A4	5084683	502058	12.1	3.5	3.46
41A5	5084683	502058	3.3	2.0	1.65
41A6	5084683	502058	2.8	2.5	1.12
41A7	5084683	502058	3.0	3.3	0.91
41A8	5084683	502058	1.3	1.2	1.08
41A9	5084683	502058	1.7	1.5	1.13
41A10	5084683	502058	2.3	1.5	1.53
41A11	5084683	502058	1.7	1.1	1.55
41A12	5084683	502058	1.5	0.9	1.67
41A13	5084683	502058	5.8	3.2	1.81
41A14	5084683	502058	5.9	2.4	2.46
41B1	5084718	502036	1.8	1.0	1.80
41B2	5084718	502036	5.9	2.5	2.36
41B3	5084718	502036	3.7	2.5	1.48
41B4	5084718	502036	1.7	1.4	1.21
41B5	5084718	502036	1.5	1.7	0.88
41B6	5084718	502036	3.0	2.0	1.50
41B7	5084718	502036	3.5	2.2	1.59
41B8	5084718	502036	6.0	2.5	2.40
41B9	5084718	502036	7.7	6.5	1.18
41B10	5084718	502036	12.0	4.7	2.55
41B11	5084718	502036	27.2	12.5	2.18
41C1	5084719	502037	3.7	3.5	1.06
41C2	5084719	502037	2.4	1.0	2.40
41C3	5084719	502037	3.5	1.0	3.50
41C4	5084719	502037	2.3	2.0	1.15
41C5	5084719	502037	3.5	1.9	1.84
41C6	5084719	502037	5.0	3.0	1.67
41C7	5084719	502037	2.8	2.8	1.00
41C8	5084719	502037	6.4	3.4	1.88
41C9	5084719	502037	4.0	2.4	1.67
41C10	5084719	502037	3.8	3.3	1.15
41C11	5084719	502037	13.0	9.0	1.44
41C12	5084719	502037	3.0	2.8	1.07
41C13	5084719	502037	2.5	1.3	1.92
41C14	5084719	502037	4.3	1.9	2.26
41C15	5084719	502037	2.0	0.9	2.22

APPENDIX A

Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
41C16	5084719	502037	5.0	4.8	1.04
41C17	5084719	502037	6.2	3.0	2.07
41C18	5084719	502037	2.5	1.0	2.50
41C19	5084719	502037	4.1	2.1	1.95
41D1	5084729	502047	17.6	9.2	1.91
41D2	5084729	502047	4.0	2.6	1.54
41D3	5084729	502047	2.2	2.0	1.10
41D4	5084729	502047	4.6	3.3	1.39
41D5	5084729	502047	15.9	8.5	1.87
41D6	5084729	502047	6.5	1.8	3.61
41D8	5084729	502047	2.5	1.2	2.08
41D9	5084729	502047	3.0	1.4	2.14
41F1	5084916	502068	5.5	3.5	1.57
41F2	5084916	502068	4.7	3.0	1.57
41F3	5084916	502068	1.6	1.3	1.23
41F4	5084916	502068	3.1	0.5	6.20
41F5	5084916	502068	8.5	5.6	1.52
41F6	5084916	502068	6.5	5.0	1.30
41F7	5084916	502068	13.0	4.6	2.83
41F8	5084916	502068	13.2	4.7	2.81
41F9	5084916	502068	2.5	1.6	1.56
41F10	5084916	502068	8.0	3.8	2.11
41F11	5084916	502068	2.8	1.8	1.56
41F12	5084916	502068	2.2	1.7	1.29
41G1	5084716	502073	2.5	0.7	3.57
41G2	5084716	502073	14.2	5.3	2.68
41G3	5084716	502073	3.4	0.7	4.86
41G4	5084716	502073	21.1	7.8	2.71
41G5	5084716	502073	16.0	9.8	1.63
41G6	5084716	502073	2.2	0.9	2.44
41G7	5084716	502073	9.6	4.0	2.40
41G8	5084716	502073	5.8	2.1	2.76
41G9	5084716	502073	12.5	1.7	7.35
41H1	5084716	502077	3.2	1.4	2.29
41H2	5084716	502077	5.3	3.3	1.61
41H2b	5084716	502077	3.5	4.5	0.78
41H3	5084716	502077	4.3	3.3	1.30
41H4	5084716	502077	3.9	1.7	2.29
41H5	5084716	502077	3.2	2.0	1.60
41H6	5084716	502077	7.2	3.3	2.18
41H7	5084716	502077	2.7	1.4	1.93
41H8	5084716	502077	2.5	2.5	1.00
41H9	5084716	502077	3.9	2.5	1.56
41H10	5084716	502077	2.6	1.7	1.53
41H11	5084716	502077	4.8	3.0	1.60
41H12	5084716	502077	10.2	5.7	1.79
41H13	5084716	502077	8.0	1.8	4.44
42A1	5084784	502126	4.3	1.8	2.39
42A2	5084784	502126	2.0	2.0	1.00
42A3	5084784	502126	5.0	1.8	2.78
42A4	5084784	502126	9.0	6.5	1.38
42A5	5084784	502126	3.5	2.0	1.75
42A6	5084784	502126	1.7	1.0	1.70

APPENDIX A

Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
42A7	5084784	502126	2.0	1.3	1.54
42A8	5084784	502126	7.0	6.6	1.06
42A9	5084784	502126	4.0	0.5	8.00
42A10	5084784	502126	3.4	2.0	1.70
42A11	5084784	502126	2.4	1.2	2.00
42B1	5084785	502126	4.4	1.2	3.67
42B2	5084785	502126	2.2	0.8	2.75
42B3	5084785	502126	4.2	1.7	2.47
42B4	5084785	502126	6.9	3.2	2.16
42B5	5084785	502126	4.1	1.9	2.16
42B6	5084785	502126	3.1	3.0	1.03
42B7	5084785	502126	5.0	3.0	1.67
42B8	5084785	502126	4.0	2.1	1.90
42B9	5084785	502126	7.8	2.8	2.79
42B10	5084785	502126	7.6	3.5	2.17
42B11	5084785	502126	2.9	2.0	1.45
42B12	5084785	502126	3.8	1.2	3.17
42B13	5084785	502126	2.6	1.0	2.60
42C1	5084775	502146	4.0	2.8	1.43
42C2	5084775	502146	5.3	6.0	0.88
42C3	5084775	502146	1.8	1.8	1.00
42C4	5084775	502146	3.4	2.4	1.42
42C5	5084775	502146	3.0	2.2	1.36
42C6	5084775	502146	2.7	1.6	1.69
42C7	5084775	502146	9.3	2.9	3.21
42C8	5084775	502146	1.8	1.7	1.06
42C9	5084775	502146	4.5	2.2	2.05
42C10	5084775	502146	2.8	1.6	1.75
42C11	5084775	502146	1.0	1.6	0.63
42C12	5084775	502146	2.8	1.5	1.87
42C13	5084775	502146	3.0	2.6	1.15
42D1	5084775	502146	3.0	2.2	1.36
42D2	5084775	502146	5.0	4.0	1.25
42D3	5084775	502146	7.0	3.0	2.33
42D4	5084775	502146	2.5	1.0	2.50
42D5	5084775	502146	2.7	1.0	2.70
42D6	5084775	502146	5.8	3.0	1.93
42D7	5084775	502146	9.3	2.3	4.04
42D8	5084775	502146	4.0	1.1	3.64
42D9	5084775	502146	6.1	2.2	2.77
42D10	5084775	502146	3.9	2.5	1.56
42E1	5084773	502177	4.5	2.5	1.80
42E2	5084773	502177	4.3	2.0	2.15
42E3	5084773	502177	3.5	2.2	1.59
42E4	5084773	502177	5.9	4.2	1.40
42E5	5084773	502177	5.3	4.0	1.33
42E6	5084773	502177	1.5	1.5	1.00
42E7	5084773	502177	2.0	1.9	1.05
42E8	5084773	502177	2.7	1.5	1.80
42E9	5084773	502177	5.6	3.7	1.51
42E10	5084773	502177	5.3	3.4	1.56
42E11	5084773	502177	2.3	2.0	1.15
42E12	5084773	502177	2.8	1.7	1.65

APPENDIX A

Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
42E13a	5084773	502177	4.5	2.9	1.55
42E14b	5084773	502177	4.2	2.8	1.50
42E14	5084773	502177	3.4	1.8	1.89
42F1	5084773	502141	7.2	5.5	1.31
42F2	5084773	502141	3.0	1.8	1.67
42F3	5084773	502141	5.0	3.2	1.56
42F4	5084773	502141	1.9	1.0	1.90
42F5	5084773	502141	2.1	1.2	1.75
42F6	5084773	502141	2.6	2.5	1.04
42F7	5084773	502141	2.1	1.8	1.17
42F8	5084773	502141	2.6	1.5	1.73
42F9	5084773	502141	3.8	1.8	2.11
42F10	5084773	502141	3.0	2.2	1.36
42F11	5084773	502141	4.2	2.6	1.62
42G1	5084772	502171	1.8	1.0	1.80
42G2	5084772	502171	4.1	1.3	3.15
42G3	5084772	502171	4.0	3.4	1.18
42G4	5084772	502171	8.4	3.0	2.80
42G5	5084772	502171	3.0	1.9	1.58
42G6	5084772	502171	2.6	1.3	2.00
42G7	5084772	502171	5.3	2.2	2.41
42G8	5084772	502171	4.0	3.0	1.33
42G9	5084772	502171	2.2	0.8	2.75
42G10	5084772	502171	4.4	3.0	1.47
42G11	5084772	502171	1.5	1.2	1.25
42G12	5084772	502171	3.6	3.0	1.20
42G13	5084772	502171	2.9	2.3	1.26
42H1	5084776	502170	5.4	3.0	1.80
42H2	5084776	502170	5.0	2.3	2.17
42H3	5084776	502170	3.1	2.4	1.29
42H4	5084776	502170	1.0	1.0	1.00
42H5	5084776	502170	3.0	2.0	1.50
42H6	5084776	502170	2.2	0.7	3.14
42H7	5084776	502170	1.5	0.7	2.14
42H8	5084776	502170	11.0	6.5	1.69
42H9	5084776	502170	3.1	2.1	1.48
42H10	5084776	502170	2.7	1.7	1.59
42H11	5084776	502170	5.3	1.7	3.12
42H12	5084776	502170	2.9	1.7	1.71
42H13	5084776	502170	3.0	2.7	1.11
42H14	5084776	502170	6.5	4.0	1.63
42I1	5084776	502172	3.6	1.5	2.40
42I2	5084776	502172	1.3	0.7	1.86
42I3	5084776	502172	6.8	1.9	3.58
42I4	5084776	502172	1.7	1.5	1.13
42I5	5084776	502172	2.0	1.4	1.43
42I6	5084776	502172	6.2	2.0	3.10
42I7	5084776	502172	3.4	2.7	1.26
42I8	5084776	502172	1.5	0.7	2.14
42I9	5084776	502172	2.2	1.4	1.57
42I10	5084776	502172	5.1	2.3	2.22
43A1	5084775	502225	3.7	2.0	1.85
43A2	5084775	502225	1.5	0.7	2.14

APPENDIX A

Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
43A3	5084775	502225	6.2	3.8	1.63
43A4	5084775	502225	4.6	2.3	2.00
43A5	5084775	502225	2.0	1.5	1.33
43A6	5084775	502225	5.0	3.2	1.56
43A7	5084775	502225	7.7	3.5	2.20
43A8	5084775	502225	4.7	1.6	2.94
43A9	5084775	502225	4.9	2.7	1.81
43A10	5084775	502225	1.6	1.6	1.00
43A11	5084775	502225	3.9	2.7	1.44
43B1	5084775	502225	5.7	3.0	1.90
43B2	5084775	502225	5.4	4.0	1.35
43B3	5084775	502225	2.7	1.5	1.80
43B4	5084775	502225	1.6	1.0	1.60
43B5	5084775	502225	3.7	2.1	1.76
43B6	5084775	502225	2.0	1.2	1.67
43B7	5084775	502225	1.3	1.5	0.87
43B8	5084775	502225	3.3	1.3	2.54
43B9	5084775	502225	1.7	0.8	2.13
43B10	5084775	502225	1.0	0.7	1.43
43B11	5084775	502225	2.5	1.6	1.56
43B12	5084775	502225	4.5	4.0	1.13
43B13	5084775	502225	3.3	2.6	1.27
43B14	5084775	502225	1.9	1.0	1.90
43B15	5084775	502225	1.3	0.8	1.63
43C1	5084974	502229	3.0	1.1	2.73
43C2	5084974	502229	3.2	2.0	1.60
43C3	5084974	502229	7.4	2.7	2.74
43C4	5084974	502229	4.4	1.0	4.40
43C5	5084974	502229	1.5	0.8	1.88
43C6	5084974	502229	6.5	2.7	2.41
43C7	5084974	502229	9.5	4.0	2.38
43C8	5084974	502229	3.2	2.0	1.60
43C9	5084974	502229	2.0	0.7	2.86
43C10	5084974	502229	7.0	3.0	2.33
43C11	5084974	502229	2.7	2.0	1.35
43C12	5084974	502229	4.2	2.4	1.75
43C13	5084974	502229	2.0	0.8	2.50
43C14	5084974	502229	1.2	1.1	1.09
43C15	5084974	502229	4.2	0.9	4.67
43D1	5084780	502227	1.0	1.0	1.00
43D2	5084780	502227	7.0	1.0	7.00
43D3	5084780	502227	7.0	1.1	6.36
43D4	5084780	502227	4.5	3.0	1.50
43D5	5084780	502227	5.0	4.5	1.11
43D6	5084780	502227	3.5	3.3	1.06
43D7	5084780	502227	4.5	3.0	1.50
43D8	5084780	502227	11.5	2.0	5.75
43E1	5084777	502243	5.5	4.5	1.22
43E2	5084777	502243	3.5	1.0	3.50
43E3	5084777	502243	8.5	6.7	1.27
43E4	5084777	502243	5.0	4.0	1.25
43E5	5084777	502243	1.5	1.0	1.50
43E6	5084777	502243	2.0	1.5	1.33

APPENDIX A

Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
43E7	5084777	502243	1.5	1.0	1.50
43E8	5084777	502243	2.0	1.5	1.33
43E9	5084777	502243	9.5	6.5	1.46
43E10	5084777	502243	2.5	1.0	2.50
43E11	5084777	502243	3.2	2.5	1.28
43F1	5084788	502246	4.2	1.0	4.20
43F2	5084788	502246	12.7	8.0	1.59
43F3	5084788	502246	3.5	2.0	1.75
43F4	5084788	502246	5.6	3.0	1.87
43F5	5084788	502246	4.7	4.5	1.04
43F6	5084788	502246	10.0	4.0	2.50
43F7	5084788	502246	3.0	2.0	1.50
43F8	5084788	502246	5.3	2.0	2.65
43F9	5084788	502246	7.5	1.5	5.00
43F10	5084788	502246	3.0	1.0	3.00
43F11	5084788	502246	4.0	2.5	1.60
43F12	5084788	502246	7.5	3.2	2.34
43F13	5084788	502246	3.5	2.0	1.75
43F14	5084788	502246	2.2	0.8	2.75
43F15	5084788	502246	1.2	0.6	2.00
43F16	5084788	502246	4.5	1.2	3.75
43F17	5084788	502246	5.0	2.9	1.72
43G1	5084788	502258	3.0	1.0	3.00
43G2	5084788	502258	4.0	3.2	1.25
43G3	5084788	502258	4.5	1.5	3.00
43G4	5084788	502258	3.5	1.2	2.92
43G5	5084788	502258	13.0	5.5	2.36
43G6	5084788	502258	5.2	2.0	2.60
43G7	5084788	502258	2.5	1.5	1.67
43H1	5084776	502255	3.0	0.3	10.00
43H2	5084776	502255	3.2	1.0	3.20
43H3	5084776	502255	2.2	0.3	7.33
43H4	5084776	502255	3.0	2.6	1.15
43H5	5084776	502255	2.5	2.0	1.25
43H6	5084776	502255	13.7	8.2	1.67
43H8	5084776	502255	3.0	2.5	1.20
43H9	5084776	502255	2.0	1.0	2.00
43H10	5084776	502255	1.5	1.2	1.25
43H11	5084776	502255	1.7	1.3	1.31
43H12	5084776	502255	25.4	10.0	2.54
43H13	5084776	502255	6.2	2.0	3.10
43H14	5084776	502255	12.0	4.5	2.67
44A1	5084808	502327	2.1	1.0	2.10
44A2	5084808	502327	2.0	1.0	2.00
44A3	5084808	502327	4.2	0.5	8.40
44A4	5084808	502327	11.7	4.2	2.79
44A5	5084808	502327	5.5	1.4	3.93
44A6	5084808	502327	4.5	3.4	1.32
44A7	5084808	502327	4.0	3.2	1.25
44A8	5084808	502327	2.5	1.5	1.67
44A9	5084808	502327	3.0	1.0	3.00
44A10	5084808	502327	1.5	1.0	1.50
44A11	5084808	502327	2.0	0.7	2.86

APPENDIX A

Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
44A12	5084808	502327	3.6	2.8	1.29
44A13	5084808	502327	1.7	0.6	2.83
44A14	5084808	502327	3.0	1.4	2.14
44A15	5084808	502327	3.5	1.5	2.33
44A16	5084808	502327	5.0	1.0	5.00
44A17	5084808	502327	4.9	2.0	2.45
44A18	5084808	502327	1.5	0.8	1.88
44A19	5084808	502327	4.0	0.5	8.00
44A20	5084808	502327	4.0	1.5	2.67
44A21	5084808	502327	3.5	1.5	2.33
44B1	5084807	502330	5.4	2.0	2.70
44B2	5084807	502330	4.6	2.0	2.30
44B3	5084807	502330	3.4	1.2	2.83
44B4	5084807	502330	3.5	1.5	2.33
44B5	5084807	502330	4.0	2.0	2.00
44B6	5084807	502330	2.0	1.5	1.33
44B7	5084807	502330	3.5	2.0	1.75
44B8	5084807	502330	7.5	1.5	5.00
44B9	5084807	502330	6.2	2.6	2.38
44B10	5084807	502330	3.2	2.4	1.33
44C1	5084805	502338	3.2	1.5	2.13
44C2	5084805	502338	5.4	2.0	2.70
44C3	5084805	502338	9.7	4.0	2.43
44C4	5084805	502338	1.5	1.2	1.25
44C5	5084805	502338	6.5	1.8	3.61
44C6	5084805	502338	4.3	1.8	2.39
44C7	5084805	502338	9.5	3.0	3.17
44C8	5084805	502338	2.0	1.0	2.00
44C9	5084805	502338	4.5	4.0	1.13
44C10	5084805	502338	5.0	1.8	2.78
44C11	5084805	502338	1.0	0.6	1.67
44C12	5084805	502338	5.0	2.5	2.00
44D1	5084801	502335	15.5	4.3	3.60
44D2	5084801	502335	3.0	0.9	3.33
44D3	5084801	502335	2.0	1.3	1.54
44D4	5084801	502335	3.3	1.7	1.94
44D5	5084801	502335	1.8	1.1	1.64
44D6	5084801	502335	2.8	1.4	2.00
44D7	5084801	502335	2.7	1.0	2.70
44D8	5084801	502335	5.8	1.4	4.14
44D9	5084801	502335	1.8	1.1	1.64
44D10	5084801	502335	2.0	0.6	3.33
44D11	5084801	502335	1.6	1.5	1.07
44D12	5084801	502335	4.7	3.5	1.34
44D13	5084801	502335	2.5	0.8	3.13
44D14	5084801	502335	3.0	1.8	1.67
44D15	5084801	502335	3.5	2.8	1.25
44E1	5084814	502339	13.0	5.0	2.60
44E2	5084814	502339	8.5	4.4	1.93
44E3	5084814	502339	4.0	3.8	1.05
44E4	5084814	502339	3.8	3.8	1.00
44E5	5084814	502339	2.2	0.5	4.40
44E6	5084814	502339	1.6	0.7	2.29

APPENDIX A

Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
44E7	5084814	502339	4.3	2.2	1.95
44E8	5084814	502339	6.3	3.4	1.85
44E9	5084814	502339	3.9	2.4	1.63
44F1	5084814	502348	4.2	1.4	3.00
44F2	5084814	502348	10.5	1.2	8.75
44F3	5084814	502348	10.0	2.5	4.00
44F4	5084814	502348	3.9	1.7	2.29
44F5	5084814	502348	7.2	2.2	3.27
44F6	5084814	502348	10.0	3.3	3.03
44F7	5084814	502348	2.3	1.1	2.09
44F8	5084814	502348	6.3	4.3	1.47
44F9	5084814	502348	4.2	3.2	1.31
44F10	5084814	502348	9.1	2.9	3.14
44F11	5084814	502348	1.5	1.0	1.50
44F12	5084814	502348	2.8	2.0	1.40
44F13	5084814	502348	13.9	3.4	4.09
44F14	5084814	502348	16.0	6.7	2.39
44F15	5084814	502348	4.7	4.1	1.15
44G1	5084813	502354	3.3	1.2	2.75
44G2	5084813	502354	2.3	0.8	2.88
44G3	5084813	502354	12.0	8.0	1.50
44G4	5084813	502354	3.5	1.8	1.94
44G5	5084813	502354	5.8	3.0	1.93
44G6	5084813	502354	12.0	11.7	1.03
44G7	5084813	502354	5.0	2.1	2.38
44G8	5084813	502354	3.8	2.9	1.31
44G9	5084813	502354	3.5	2.3	1.52
44G10	5084813	502354	7.9	2.0	3.95
44G11	5084813	502354	8.4	1.2	7.00
44H1	5084819	502358	7.8	5.8	1.34
44H2	5084819	502358	1.9	1.2	1.58
44H3	5084819	502358	11.3	2.8	4.04
44H4	5084819	502358	6.1	3.7	1.65
44H5	5084819	502358	1.9	1.4	1.36
44H6	5084819	502358	2.0	1.8	1.11
44H7	5084819	502358	7.8	3.0	2.60
44H8	5084819	502358	9.5	3.9	2.44
44H9	5084819	502358	3.9	3.0	1.30
44H10	5084819	502358	5.7	3.7	1.54
44H11	5084819	502358	5.8	2.9	2.00
44H12	5084819	502358	6.1	2.3	2.65
44H13	5084819	502358	4.5	2.2	2.05
45A1	5085389	503309	1.2	1.2	1.00
45A2	5085389	503309	1.2	0.5	2.40
45A3	5085389	503309	4.0	2.9	1.38
45A4	5085389	503309	4.0	1.0	4.00
45A5	5085389	503309	1.5	0.6	2.50
45B1	5085389	503310	1.2	1.0	1.20
45B2	5085389	503310	2.6	2.0	1.30
45B3	5085389	503310	5.2	2.6	2.00
45B4	5085389	503310	3.0	1.4	2.14
45C1	5085389	503310	6.0	0.8	7.50
45C2	5085389	503310	4.5	0.5	9.00

APPENDIX A

Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
45C3	5085389	503310	6.0	2.5	2.40
45C4	5085389	503310	3.5	1.0	3.50
45C5	5085389	503310	5.0	4.0	1.25
45C6	5085389	503310	5.0	1.8	2.78
45C7	5085389	503310	3.5	1.0	3.50
45C8	5085389	503310	4.7	1.0	4.70
45C9	5085389	503310	3.0	1.0	3.00
45C10	5085389	503310	2.5	1.0	2.50
45D1	5085389	503309	6.7	0.7	9.57
45D3	5085389	503309	2.0	1.0	2.00
45D4	5085389	503309	1.5	1.0	1.50
45D5	5085389	503309	2.0	1.0	2.00
45D6	5085389	503309	2.0	1.5	1.33
45D7	5085389	503309	2.5	2.5	1.00
45D8	5085389	503309	2.0	0.3	6.67
45D9	5085389	503309	6.7	4.0	1.68
45D10	5085389	503309	4.0	0.2	20.00
45E1	5085390	503309	3.0	1.0	3.00
45E2	5085390	503309	4.0	0.9	4.44
45E3	5085390	503309	2.0	2.0	1.00
45E4	5085390	503309	3.8	1.2	3.17
45E5	5085390	503309	1.8	1.1	1.64
45E6	5085390	503309	4.6	2.3	2.00
45E7	5085390	503309	3.2	1.2	2.67
45E8	5085390	503309	3.6	1.7	2.12
45E9	5085390	503309	3.8	1.7	2.24
45E10	5085390	503309	2.9	1.5	1.93
45E12	5085390	503309	2.5	2.2	1.14
45F1	5085392	503309	10.8	5.5	1.96
45F2	5085392	503309	4.8	2.0	2.40
45F3	5085392	503309	3.9	1.7	2.29
45F4	5085392	503309	1.6	0.7	2.29
45F5	5085392	503309	2.7	1.9	1.42
45F6	5085392	503309	9.0	1.0	9.00
45F7	5085392	503309	3.6	1.8	2.00
45F8	5085392	503309	2.9	0.8	3.63
45F9	5085392	503309	2.2	1.9	1.16
45F10	5085392	503309	4.6	2.3	2.00
45F11	5085392	503309	2.5	1.0	2.50
45Fb1	5085415	503331	2.2	1.1	2.00
45Fb2	5085415	503331	2.9	1.5	1.93
45Fb3	5085415	503331	8.6	5.7	1.51
45Fb4	5085415	503331	2.3	2.0	1.15
45Fb5	5085415	503331	3.5	1.7	2.06
45Fb6	5085415	503331	2.3	1.7	1.35
45Fb7	5085415	503331	1.9	1.5	1.27
45Fb8	5085415	503331	17.6	2.0	8.80
45Fb9	5085415	503331	13.0	2.0	6.50
45G1	5085430	503357	3.9	0.9	4.33
45G2	5085430	503357	6.6	2.0	3.30
45G3	5085430	503357	11.0	1.2	9.17
45G4	5085430	503357	1.5	0.9	1.67
45G5	5085430	503357	6.9	3.4	2.03

APPENDIX A

Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
45G6	5085430	503357	5.5	2.2	2.50
45G7	5085430	503357	2.6	1.8	1.44
45G8	5085430	503357	2.2	1.3	1.69
45G9	5085430	503357	3.4	1.0	3.40
45G10	5085430	503357	2.0	1.0	2.00
45G11	5085430	503357	1.7	1.1	1.55
45G12	5085430	503357	2.1	1.2	1.75
45G13	5085430	503357	4.5	2.2	2.05
45H1	5085455	503381	3.1	1.9	1.63
45H2	5085455	503381	2.5	1.5	1.67
45H3	5085455	503381	3.3	1.6	2.06
45H4	5085455	503381	2.0	1.5	1.33
45H5	5085455	503381	4.0	0.8	5.00
45H7	5085455	503381	2.6	2.3	1.13
45H8	5085455	503381	2.9	1.7	1.71
45H9	5085455	503381	2.8	1.7	1.65
45H10	5085455	503381	1.7	1.5	1.13
45I1	5085470	503381	4.0	1.0	4.00
45I2	5085470	503381	9.0	3.5	2.57
45I3	5085470	503381	5.5	2.0	2.75
45I5	5085470	503381	6.0	1.5	4.00
45I6	5085470	503381	3.0	1.3	2.31
45J1	5085477	503398	3.5	1.0	3.50
45J2	5085477	503398	2.0	1.0	2.00
45J3	5085477	503398	6.0	1.0	6.00
45J4	5085477	503398	3.5	0.7	5.00
45J5	5085477	503398	2.0	0.4	5.00
45J6	5085477	503398	4.0	2.0	2.00
45J7	5085477	503398	5.2	2.0	2.60
45J8	5085477	503398	5.0	2.4	2.08
45J9	5085477	503398	11.0	4.0	2.75
46A1	5085475	504087	5.0	1.0	5.00
46A2	5085475	504087	2.0	0.5	4.00
46A3	5085475	504087	4.0	0.7	5.71
46A4	5085475	504087	8.5	1.8	4.72
46A6	5085475	504087	3.0	0.6	5.00
46A7	5085475	504087	5.5	0.4	13.75
46A8	5085475	504087	6.0	0.5	12.00
46A9	5085475	504087	7.0	1.5	4.67
46A10	5085475	504087	3.0	0.4	7.50
46A11	5085475	504087	8.6	0.5	17.20
46A12	5085475	504087	3.5	1.2	2.92
46B1	5085497	504063	2.0	1.0	2.00
46B2	5085497	504063	2.0	0.6	3.33
46B3	5085497	504063	14.0	4.0	3.50
46B4	5085497	504063	4.0	0.5	8.00
46B5	5085497	504063	2.5	1.0	2.50
46B6	5085497	504063	4.5	1.0	4.50
46B8	5085497	504063	3.0	0.5	6.00
46C1	5085497	504085	8.9	1.3	6.85
46C2	5085497	504085	3.0	0.6	5.00
46C3	5085497	504085	3.0	1.0	3.00
46C4	5085497	504085	3.6	1.3	2.77

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Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
46C5	5085497	504085	3.7	2.0	1.85
46C6	5085497	504085	3.4	0.6	5.67
46C7	5085497	504085	4.2	1.8	2.33
46C8	5085497	504085	4.0	1.0	4.00
46D1	5085502	504110	2.0	0.8	2.50
46D2	5085502	504110	4.0	1.2	3.33
46D3	5085502	504110	2.4	0.8	3.00
46D4	5085502	504110	3.0	0.5	6.00
46D5	5085502	504110	6.7	1.0	6.70
46E1	5085502	504111	11.0	2.5	4.40
46E2	5085502	504111	13.5	2.6	5.19
46E3	5085502	504111	1.3	0.5	2.60
46E4	5085502	504111	2.0	0.5	4.00
46E5	5085502	504111	3.5	1.0	3.50
46E6	5085502	504111	3.0	1.5	2.00
46E7	5085502	504111	5.0	1.0	5.00
46F1	5085504	504111	12.0	4.0	3.00
46F2	5085504	504111	8.0	1.6	5.00
46F3	5085504	504111	5.0	2.2	2.27
46F4	5085504	504111	2.6	0.6	4.33
46F5	5085504	504111	4.4	1.0	4.40
46F6	5085504	504111	3.8	0.9	4.22
46F8	5085504	504111	2.9	0.5	5.80
46G1	5085504	504123	7.2	1.8	4.00
46G2	5085504	504123	4.0	1.8	2.22
46G3	5085504	504123	2.2	1.0	2.20
46G4	5085504	504123	3.0	0.5	6.00
46G5	5085504	504123	4.9	1.2	4.08
46G6	5085504	504123	2.5	0.9	2.78
46G7	5085504	504123	2.5	0.6	4.17
46G8	5085504	504123	8.5	1.6	5.31
46G9	5085504	504123	5.5	0.7	7.86
46G10	5085504	504123	3.5	1.5	2.33
46G11	5085504	504123	10.5	1.0	10.50
46H1	5085511	504122	4.2	1.9	2.21
46H2	5085511	504122	2.9	1.2	2.42
46H3	5085511	504122	5.5	3.0	1.83
46H4	5085511	504122	4.5	0.7	6.43
46H5	5085511	504122	3.2	1.0	3.20
46H6	5085511	504122	6.0	0.7	8.57
46J	5085545	504060	4.0	1.2	3.33
46J	5085545	504060	1.5	0.5	3.00
46J	5085545	504060	22.6	7.7	2.94
46J	5085545	504060	6.0	1.0	6.00
46J	5085545	504060	3.0	1.2	2.50
46K1	5085569	504130	2.0	0.8	2.50
46K2	5085569	504130	3.5	1.6	2.19
46K3	5085569	504130	15.5	6.6	2.35
46K4	5085569	504130	5.6	1.2	4.67
46K5	5085569	504130	2.1	1.6	1.31
46L1	5085548	504173	3.5	1.8	1.94
46L2	5085548	504173	2.9	0.8	3.63
46L3	5085548	504173	7.1	1.3	5.46

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Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
46L4	5085548	504173	2.8	1.0	2.80
46L5	5085548	504173	5.3	1.0	5.30
46L6	5085548	504173	3.9	0.5	7.80
48A1	5085622	503409	2.6	2.0	1.30
48A2	5085622	503409	3.0	2.0	1.50
48A3	5085622	503409	7.0	1.2	5.83
48A4	5085622	503409	2.0	1.0	2.00
48A5	5085622	503409	3.2	0.6	5.33
48A6	5085622	503409	6.0	0.7	8.57
48B1	5085617	503401	6.0	3.8	1.58
48B2	5085617	503401	5.6	2.7	2.07
48B3	5085617	503401	2.1	1.0	2.10
48B4	5085617	503401	7.5	1.5	5.00
48B6	5085617	503401	2.0	0.8	2.50
48B7	5085617	503401	7.0	3.5	2.00
48C1	5085620	503391	4.0	1.0	4.00
48C2	5085620	503391	2.5	1.5	1.67
48C3	5085620	503391	3.0	1.2	2.50
48C4	5085620	503391	3.2	0.5	6.40
48C5	5085620	503391	2.5	0.5	5.00
48C6	5085620	503391	3.0	1.0	3.00
48D1	5085618	503382	5.0	2.0	2.50
48D2	5085618	503382	5.0	1.8	2.78
48D3	5085618	503382	4.5	3.0	1.50
48D4	5085618	503382	2.0	0.6	3.33
48D5	5085618	503382	3.0	1.0	3.00
48E1	5085638	503404	2.0	0.5	4.00
48E3a	5085638	503404	7.5	4.7	1.60
48E3b	5085638	503404	3.0	0.5	6.00
48E4	5085638	503404	2.0	0.5	4.00
48E5	5085638	503404	11.0	3.0	3.67
48F1	5085640	503418	2.0	1.2	1.67
48F2	5085640	503418	4.0	3.5	1.14
48F3	5085640	503418	4.0	1.4	2.86
48F4	5085640	503418	6.0	3.6	1.67
48F5	5085640	503418	6.0	2.6	2.31
48F7	5085640	503418	2.5	1.0	2.50
48G1	5085618	503419	3.5	1.5	2.33
48G2	5085618	503419	1.5	1.0	1.50
48G3	5085618	503419	4.5	1.5	3.00
48G4a	5085618	503419	4.0	0.6	6.67
48G4b	5085618	503419	6.0	3.0	2.00
48G6	5085618	503419	2.2	0.7	3.14
48H1	5085608	503429	2.5	1.0	2.50
48H2	5085608	503429	3.0	1.9	1.58
48H3	5085608	503429	1.5	1.5	1.00
48H4	5085608	503429	7.0	1.0	7.00
48I1a	5085613	503480	4.7	1.4	3.36
48I1b	5085613	503480	16.0	7.5	2.13
48I2	5085613	503480	2.0	1.6	1.25
48I3	5085613	503480	3.6	0.7	5.14
48I4	5085613	503480	5.5	4.5	1.22
48J1	5085626	503486	3.2	1.5	2.13

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Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
48J3	5085626	503486	1.1	1.0	1.10
48J4	5085626	503486	1.5	0.6	2.50
48J5	5085626	503486	3.5	1.0	3.50
48J6	5085626	503486	2.0	1.3	1.54
48J7	5085626	503486	3.7	2.1	1.76
48J8	5085626	503486	4.6	1.5	3.07
48K1	5085641	503492	6.0	1.5	4.00
48K3	5085641	503492	3.3	0.9	3.67
48K5	5085641	503492	2.5	1.0	2.50
48K6	5085641	503492	3.0	0.8	3.75
48K7	5085641	503492	4.0	2.0	2.00
48K8	5085641	503492	4.2	0.8	5.25
48L1	5085616	503483	5.1	0.7	7.29
48L2	5085616	503483	1.1	0.9	1.22
48L3	5085616	503483	5.3	2.2	2.41
48L4	5085616	503483	1.4	1.0	1.40
48L5	5085616	503483	2.5	1.5	1.67
48L7	5085616	503483	3.0	0.6	5.00
48L8	5085616	503483	2.0	0.6	3.33
48L10	5085616	503483	2.0	1.2	1.67
48L11	5085616	503483	2.1	2.0	1.05
48M1	5085612	503482	4.0	1.7	2.35
48M2	5085612	503482	3.0	2.4	1.25
48M3	5085612	503482	2.3	1.2	1.92
48M4	5085612	503482	2.5	1.0	2.50
48M5	5085612	503482	1.6	0.7	2.29
48M6	5085612	503482	2.7	0.5	5.40
48M7	5085612	503482	1.6	1.0	1.60
48M8	5085612	503482	4.2	1.0	4.20
48M9	5085612	503482	4.5	1.3	3.46
48M10	5085612	503482	2.0	1.2	1.67
49A1	5085599	504924	8.5	0.9	9.44
49A2	5085599	504924	6.0	0.9	6.67
49A3	5085599	504924	5.1	0.8	6.38
49A4	5085599	504924	9.0	3.8	2.37
49A5	5085599	504924	2.0	0.5	4.00
49A6	5085599	504924	2.0	0.4	5.00
49A7	5085599	504924	5.5	0.5	11.00
49A8	5085599	504924	6.1	1.9	3.21
49A9	5085599	504924	2.5	0.9	2.78
49A10	5085599	504924	3.0	0.6	5.00
49A11	5085599	504924	2.5	0.9	2.78
49A12	5085599	504924	4.3	1.0	4.30
49B1	5085603	504627	2.0	0.4	5.00
49B2	5085603	504627	5.4	2.0	2.70
49B3	5085603	504627	4.3	0.6	7.17
49B4	5085603	504627	3.0	1.0	3.00
49B5	5085603	504627	4.6	1.5	3.07
49B6	5085603	504627	3.6	1.2	3.00
49B7	5085603	504627	2.0	0.7	2.86
49C1	5085613	504620	3.5	0.4	8.75
49C2	5085613	504620	8.0	1.0	8.00
49C3	5085613	504620	2.0	0.3	6.67

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Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
49C4	5085613	504620	2.0	1.0	2.00
49C5	5085613	504620	2.0	0.5	4.00
49C6	5085613	504620	3.6	1.0	3.60
49C7	5085613	504620	4.5	0.9	5.00
49C8	5085613	504620	4.0	0.7	5.71
49C10	5085613	504620	3.5	0.7	5.00
49D1	5085649	504609	2.5	0.7	3.57
49D2	5085649	504609	5.0	1.0	5.00
49D3	5085649	504609	6.6	1.0	6.60
49D4	5085649	504609	3.0	1.0	3.00
49D5	5085649	504609	9.0	1.0	9.00
49D6	5085649	504609	2.0	0.5	4.00
49D7	5085649	504609	4.0	1.0	4.00
49D8	5085649	504609	7.0	3.4	2.06
49D9	5085649	504609	3.6	0.7	5.14
49D11	5085649	504609	8.8	3.0	2.93
49D12	5085649	504609	10.5	0.5	21.00
49E1	5085651	504608	11.5	0.5	23.00
49E2	5085651	504608	5.3	0.6	8.83
49E3	5085651	504608	2.0	0.6	3.33
49E4	5085651	504608	2.0	0.7	2.86
49E5	5085651	504608	3.0	1.5	2.00
49E6	5085651	504608	5.0	0.5	10.00
49E7	5085651	504608	4.0	0.3	13.33
49G1	5085685	504603	6.5	1.2	5.42
49G2	5085685	504603	7.9	1.7	4.65
49G3	5085685	504603	5.0	0.7	7.14
49G5	5085685	504603	3.5	1.0	3.50
49G6	5085685	504603	7.0	0.6	11.67
49G7	5085685	504603	4.0	0.6	6.67
49G8	5085685	504603	5.0	0.5	10.00
49G9	5085685	504603	6.5	0.6	10.83
49H1	5085666	504559	6.0	0.5	12.00
49H2	5085666	504559	2.0	1.0	2.00
49H3	5085666	504559	6.0	1.5	4.00
49H4	5085666	504559	10.0	2.0	5.00
49H5	5085666	504559	6.5	1.0	6.50
49H6	5085666	504559	8.5	0.5	17.00
49H7	5085666	504559	4.4	1.0	4.40
49H8	5085666	504559	7.0	0.5	14.00
49I1	5085660	504554	6.0	0.5	12.00
49I2	5085660	504554	2.0	1.0	2.00
49I3	5085660	504554	6.0	1.5	4.00
49I4	5085660	504554	10.0	2.0	5.00
49I5	5085660	504554	6.5	1.0	6.50
49I6	5085660	504554	8.5	0.5	17.00
49I7	5085660	504554	4.4	1.0	4.40
49I8	5085660	504554	7.0	0.5	14.00
49J1	5085642	504522	9.5	2.0	4.75
49J2	5085642	504522	17.5	2.8	6.25
49J3	5085642	504522	3.2	0.5	6.40
49J4	5085642	504522	10.0	0.6	16.67
49J5	5085642	504522	8.7	2.6	3.35

APPENDIX A

Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
49K1	5085636	504510	10.0	1.7	5.88
49K2	5085636	504510	4.7	0.5	9.40
49K3	5085636	504510	5.5	1.5	3.67
49K4	5085636	504510	17.2	2.0	8.60
49K6	5085636	504510	6.0	0.7	8.57
49K7	5085636	504510	9.5	2.0	4.75
49K8	5085636	504510	4.5	1.0	4.50
49L1	5085666	504514	4.5	0.5	9.00
49L2	5085666	504514	5.0	1.7	2.94
49L3	5085666	504514	4.5	1.6	2.81
49L4	5085666	504514	8.0	1.6	5.00
49L5	5085666	504514	5.2	1.7	3.06
49L6	5085666	504514	1.5	1.0	1.50
49L7	5085666	504514	6.5	1.0	6.50
49L8	5085666	504514	2.5	1.0	2.50
49L9	5085666	504514	19.0	2.0	9.50
49L10	5085666	504514	31.0	2.5	12.40
49M1	5085684	504478	3.5	1.0	3.50
49M2	5085684	504478	6.0	0.5	12.00
49M3	5085684	504478	5.0	0.5	10.00
49M4	5085684	504478	14.0	1.5	9.33
49M5	5085684	504478	2.5	1.0	2.50
49M6	5085684	504478	9.5	0.7	13.57
49M7	5085684	504478	4.5	2.4	1.88
49M8	5085684	504478	9.5	0.5	19.00
49M9	5085684	504478	6.0	1.2	5.00
49N1	5085678	504470	3.0	1.0	3.00
49N2	5085678	504470	3.0	0.5	6.00
49N3	5085678	504470	9.0	1.0	9.00
49N4	5085678	504470	8.5	2.5	3.40
49N5	5085678	504470	14.5	1.0	14.50
49N6	5085678	504470	2.6	0.3	8.67
49N7	5085678	504470	6.0	1.0	6.00
50A1	5085804	505094	4.0	1.0	4.00
50A2	5085804	505094	39.0	3.0	13.00
50A3	5085804	505094	11.0	3.0	3.67
50A4	5085804	505094	3.5	0.5	7.00
50A5	5085804	505094	6.0	5.0	1.20
50A6	5085804	505094	9.5	0.5	19.00
50A7	5085804	505094	8.0	1.0	8.00
50A8	5085804	505094	12.0	0.5	24.00
50A9	5085804	505094	13.0	1.5	8.67
50A10	5085804	505094	15.0	1.5	10.00
50A11	5085804	505094	9.5	1.5	6.33
50A13	5085804	505094	7.0	8.0	0.88
50A14	5085804	505094	9.5	1.5	6.33
50A15	5085804	505094	7.0	0.6	11.67
50A16	5085804	505094	7.5	0.8	9.38
50B1	5085810	505094	8.0	1.0	8.00
50B2	5085810	505094	12.5	1.0	12.50
50B4	5085810	505094	5.6	2.0	2.80
50B5	5085810	505094	10.0	0.5	20.00
50B6	5085810	505094	12.5	1.5	8.33

APPENDIX A

Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
50B7	5085810	505094	9.5	0.2	47.50
50B8	5085810	505094	3.5	0.5	7.00
50B9	5085810	505094	12.0	0.5	24.00
50B10	5085810	505094	8.0	1.2	6.67
50B11	5085810	505094	8.5	0.5	17.00
50C1	5085802	505091	6.0	0.6	10.00
50C2	5085802	505091	9.5	0.6	15.83
50C3	5085802	505091	8.5	0.5	17.00
50C4	5085802	505091	8.5	0.5	17.00
50C5	5085802	505091	3.5	0.4	8.75
50C6	5085802	505091	12.6	0.5	25.20
50C7	5085802	505091	6.5	0.4	16.25
50C8	5085802	505091	19.5	1.2	16.25
50C9	5085802	505091	5.7	0.5	11.40
50C10	5085802	505091	21.0	2.0	10.50
50D1	5085790	505086	38.0	2.8	13.57
50D2	5085790	505086	3.5	0.4	8.75
50D3	5085790	505086	5.5	0.5	11.00
50D4	5085790	505086	4.0	0.5	8.00
50D5	5085790	505086	11.5	1.0	11.50
50D6	5085790	505086	22.0	1.5	14.67
50D7	5085790	505086	3.0	0.7	4.29
50D8	5085790	505086	12.0	0.9	13.33
50D9	5085790	505086	3.0	0.5	6.00
50D10	5085790	505086	12.5	1.0	12.50
50D11	5085790	505086	2.5	0.5	5.00
50D12	5085790	505086	4.0	0.6	6.67
50D13	5085790	505086	13.0	1.4	9.29
50F1	5085770	505087	14.0	1.6	8.75
50F2	5085770	505087	2.5	0.3	8.33
50F3	5085770	505087	8.5	1.6	5.31
50F4	5085770	505087	6.5	0.5	13.00
50F6	5085770	505087	7.5	0.5	15.00
50F7	5085770	505087	11.0	1.5	7.33
50F8	5085770	505087	2.0	1.1	1.82
50F9	5085770	505087	3.5	0.8	4.38
50G1	5085757	505093	14.0	2.5	5.60
50G2	5085757	505093	4.0	0.5	8.00
50G3	5085757	505093	6.0	2.0	3.00
50G4	5085757	505093	2.5	0.5	5.00
50G5	5085757	505093	3.5	0.4	8.75
50G6	5085757	505093	3.5	0.6	5.83
50G7	5085757	505093	3.5	0.5	7.00
50G8	5085757	505093	2.0	1.0	2.00
50G9	5085757	505093	3.0	0.5	6.00
50G10	5085757	505093	4.2	0.4	10.50
50G11	5085757	505093	5.5	1.5	3.67
50G12	5085757	505093	3.6	0.4	9.00
50G13	5085757	505093	2.5	0.5	5.00
50G14	5085757	505093	9.2	2.0	4.60
50G15	5085757	505093	2.5	0.5	5.00
50G16	5085757	505093	5.5	1.0	5.50
50G17	5085757	505093	4.2	2.0	2.10

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Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
50G18	5085757	505093	2.0	0.3	6.67
50G19	5085757	505093	4.0	1.2	3.33
50G20	5085757	505093	3.5	0.5	7.00
50H1	5085746	505089	11.0	2.0	5.50
50H2	5085746	505089	1.5	3.4	0.44
50H3	5085746	505089	6.5	0.5	13.00
50H4	5085746	505089	20.0	2.8	7.14
50H5	5085746	505089	12.5	1.5	8.33
50H6	5085746	505089	3.4	0.6	5.67
50H7	5085746	505089	6.6	1.0	6.60
50H8	5085746	505089	4.0	0.5	8.00
50H9	5085746	505089	2.1	0.5	4.20
50H10	5085746	505089	25.5	5.0	5.10
50H11	5085746	505089	9.0	1.0	9.00
50H12	5085746	505089	3.8	0.8	4.75
50H13	5085746	505089	14.4	2.4	6.00
50H14	5085746	505089	11.0	3.0	3.67
50H15	5085746	505089	4.0	0.7	5.71
50H16	5085746	505089	6.0	1.5	4.00
50I1	5085724	505098	4.5	0.5	9.00
50I2	5085724	505098	22.0	1.0	22.00
50I3	5085724	505098	14.0	0.5	28.00
50I4	5085724	505098	3.5	0.5	7.00
50I5	5085724	505098	2.5	0.5	5.00
50I6	5085724	505098	8.5	2.0	4.25
50I7	5085724	505098	5.0	0.5	10.00
50I8	5085724	505098	15.5	0.5	31.00
50I10	5085724	505098	7.0	0.7	10.00
50I11	5085724	505098	11.0	1.0	11.00
50I12	5085724	505098	21.0	0.6	35.00
51A1	5080227	505454	22.0	0.6	36.67
51B1	5086229	505454	10.0	0.6	16.67
51C1	5086229	505454	10.0	0.5	20.00
51D1	5086233	505449	9.0	0.6	15.00
51E1	5086235	505447	30.0	1.0	30.00
51F1	5086235	505447	15.5	1.0	15.50
51G1	5086232	505445	31.0	1.6	19.38
51H1	5086230	505444	11.0	0.6	18.33
51H2	5086230	505444	7.0	0.6	11.67
51H3	5086230	505444	10.0	1.0	10.00
51H4	5086230	505444	27.0	0.5	54.00
51H5	5086230	505444	10.0	0.5	20.00
51H6	5086230	505444	5.5	0.5	11.00
51H7	5086230	505444	8.0	0.5	16.00
51I1	5086228	505444	14.5	0.9	16.11
51I2	5086228	505444	32.5	0.8	40.63
51I3	5086228	505444	12.5	0.6	20.83
51I4	5086228	505444	10.0	0.5	20.00
51I5	5086228	505444	22.0	0.7	31.43
51I6	5086228	505444	31.2	2.5	12.48
51I7	5086228	505444	4.5	0.5	9.00
51J1	5086227	505444	13.0	0.6	21.67
51J2	5086227	505444	15.0	1.0	15.00

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Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
51J3	5086227	505444	10.0	0.5	20.00
51J4	5086227	505444	14.0	1.0	14.00
51J5	5086227	505444	3.7	0.2	18.50
51J6	5086227	505444	12.0	0.7	17.14
51J7	5086227	505444	13.0	0.4	32.50
51J8	5086227	505444	5.5	0.6	9.17
51K1	5086222	505446	10.0	0.5	20.00
51L1	5086224	505446	7.5	0.3	25.00
51L2	5086224	505446	5.5	0.4	13.75
51L3	5086224	505446	6.5	0.5	13.00
51M1	5086226	505450	33.5	1.9	17.63
51M2	5086226	505450	14.0	0.5	28.00
51M3	5086226	505450	4.0	0.6	6.67
51M4	5086226	505450	10.5	1.5	7.00
51M5	5086226	505450	10.0	1.0	10.00
51M6	5086226	505450	17.5	0.7	25.00
51M7	5086226	505450	10.5	0.4	26.25
51N1	5086209	505434	19.0	0.4	47.50
51N2	5086209	505434	3.0	0.5	6.00
51N3	5086209	505434	6.0	0.4	15.00
51N4	5086209	505434	14.5	1.0	14.50
51N5	5086209	505434	10.2	0.7	14.57
51N6	5086209	505434	2.5	0.4	6.25
51N7	5086209	505434	8.5	0.5	17.00
51N8	5086209	505434	7.0	0.3	23.33
51N9	5086209	505434	5.0	0.5	10.00
51N10	5086209	505434	16.0	1.3	12.31
51O1	5086212	505431	5.4	0.3	18.00
51O2	5086212	505431	56.5	4.5	12.56
51O3	5086212	505431	11.0	0.7	15.71
51O4	5086212	505431	15.5	0.5	31.00
51O5	5086212	505431	6.0	0.6	10.00
51P1	5086205	505428	8.5	0.3	28.33
51P2	5086205	505428	8.5	0.3	28.33
51P3	5086205	505428	4.5	0.3	15.00
51P4	5086205	505428	6.5	0.4	16.25
51P5	5086205	505428	6.5	0.5	13.00
51P6	5086205	505428	15.0	1.2	12.50
51P7	5086205	505428	6.0	1.3	4.62
51P8	5086205	505428	9.0	1.0	9.00
51P9	5086205	505428	9.5	0.5	19.00
51Q1	5086203	505429	14.5	1.0	14.50
51Q2	5086203	505429	4.5	0.4	11.25
51Q3	5086203	505429	17.1	2.0	8.55
51Q4	5086203	505429	4.3	0.3	14.33
51Q5	5086203	505429	19.0	1.1	17.27
51Q6	5086203	505429	25.3	1.9	13.32
51Q7	5086203	505429	7.0	1.5	4.67
51R1	5086206	505422	7.2	0.6	12.00
51R2	5086206	505422	14.1	1.9	7.42
51R3	5086206	505422	24.0	1.5	16.00
51R4	5086206	505422	8.2	1.2	6.83
90A3	5085076	501718	13.4	0.6	22.33

APPENDIX A

Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
90A4	5085076	501718	14.5	0.5	29.00
90A5	5085076	501718	40.7	2.0	20.35
90A6	5085076	501718	11.4	0.6	19.00
90B1	5085073	501717	5.7	1.9	3.00
90B2	5085073	501717	5.1	0.6	8.50
90B3	5085073	501717	4.9	1.0	4.90
90B6	5085073	501717	12.8	0.6	21.33
90C1	5085081	501723	14.5	0.8	18.13
90C2	5085081	501723	8.7	0.5	17.40
90C3	5085081	501723	32.3	1.2	26.92
90C4	5085081	501723	3.8	0.3	12.67
90C5	5085081	501723	6.2	1.0	6.20
90C6	5085081	501723	26.4	1.2	22.00
90D1	5085081	501723	7.6	0.4	19.00
90D2	5085081	501723	22.0	0.4	55.00
90D3	5085081	501723	8.1	0.7	11.57
90E1	5085080	501742	9.8	1.6	6.13
90E2	5085080	501742	11.9	1.8	6.61
90E3	5085080	501742	10.5	1.1	9.55
90E4	5085080	501742	5.0	1.2	4.17
90E5	5085080	501742	6.1	1.3	4.69
90E6	5085080	501742	36.5	2.0	18.25
90E8	5085080	501742	6.3	0.6	10.50
90E9	5085080	501742	16.1	3.6	4.47
90E10	5085080	501742	7.3	1.8	4.06
90E11	5085080	501742	8.1	1.6	5.06
90E12	5085080	501742	9.2	0.9	10.22
90F1	5085083	501742	9.2	1.9	4.84
90F2	5085083	501742	2.8	1.5	1.87
90F3	5085083	501742	3.7	1.5	2.47
90F4	5085083	501742	10.4	2.7	3.85
90F5	5085083	501742	4.6	1.0	4.60
90F7	5085083	501742	4.7	1.0	4.70
90F8	5085083	501742	8.0	1.2	6.67
90G1	5085079	501742	10.2	0.5	20.40
90G2	5085079	501742	5.9	1.2	4.92
90G3	5085079	501742	3.6	0.7	5.14
90G4	5085079	501742	18.4	1.0	18.40
90G5	5085079	501742	8.2	0.8	10.25
90H1	5085024	501683	12.50	1.5	8.33
90H2	5085024	501683	14.70	1.6	9.19
90H3	5085024	501683	12.0	1.3	9.23
90H4	5085024	501683	7.2	0.5	14.40
90H5	5085024	501683	3.8	0.8	4.75
90H6	5085024	501683	3.3	0.7	4.71
90H7	5085024	501683	45.8	2.7	16.96
90I1	5085020	501683	8.8	1.3	6.77
90I3	5085020	501683	12.9	1.2	10.75
90I4	5085020	501683	21.1	1.5	14.07
90J1	5085020	501682	17.0	1.4	12.14
90J2	5085020	501682	8.5	1.0	8.50
90J3	5085020	501682	43.0	2.0	21.50
90J4	5085020	501682	17.0	0.6	28.33

APPENDIX A

Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
90J5	5085020	501682	27.0	2.2	12.27
90J6	5085020	501682	6.8	0.6	11.33
90J7	5085020	501682	16.2	1.3	12.46
90K1	5085026	501682	36.2	4.3	8.42
90K2	5085026	501682	4.0	1.1	3.64
90K3	5085026	501682	14.1	1.2	11.75
90K4	5085026	501682	10.5	2.5	4.20
90K5	5085026	501682	7.1	0.9	7.89
90K6	5085026	501682	2.8	0.5	5.60
90K7	5085026	501682	22.4	1.0	22.40
90K8	5085026	501682	5.8	0.5	11.60
90K9	5085026	501682	5.6	0.5	11.20
90K10	5085026	501682	15.0	1.6	9.38
90L1	5085028	501682	8.5	0.6	14.17
90L2	5085028	501682	5.0	0.5	10.00
90L3	5085028	501682	4.2	0.7	6.00
90L4	5085028	501682	15.8	2.7	5.85
90L5	5085028	501682	4.3	0.7	6.14
90L6	5085028	501682	6.0	0.5	12.00
90L7	5085028	501682	5.8	0.6	9.67
90L8	5085028	501682	12.0	0.7	17.14
90L9	5085028	501682	10.5	1.0	10.50
90L10	5085028	501682	12.0	1.2	10.00
90L11	5085028	501682	8.8	1.1	8.00
90L12	5085028	501682	6.7	0.8	8.38
90M1	5085031	501683	11.9	1.0	11.90
90M2	5085031	501683	5.5	1.1	5.00
90M4	5085031	501683	5.7	1.0	5.70
90M5	5085031	501683	7.3	0.8	9.13
90M6	5085031	501683	3.7	0.5	7.40
90M7	5085031	501683	5.6	0.5	11.20
90M8	5085031	501683	9.9	1.0	9.90
90M9	5085031	501683	12.7	1.9	6.68
90M10	5085031	501683	5.7	0.7	8.14
90M11	5085031	501683	5.0	0.6	8.33
91A1	5085347	502489	1.6	1.1	1.45
91A3	5085347	502489	3.3	1.9	1.74
91A4	5085347	502489	2.0	1.2	1.67
91A5	5085347	502489	13.4	5.5	2.44
91A6	5085347	502489	17.5	5.8	3.02
91A7	5085347	502489	2.5	2.3	1.09
91A8	5085347	502489	2.5	0.7	3.57
91B1	5085348	502493	6.0	0.9	6.67
91B2	5085348	502493	5.0	3.1	1.61
91B3	5085348	502493	6.7	4.4	1.52
91B4	5085348	502493	2.6	0.7	3.71
91B5	5085348	502493	3.1	0.9	3.44
91B6	5085348	502493	2.5	0.7	3.57
91B7	5085348	502493	3.1	1.9	1.63
91B8	5085348	502493	2.0	1.3	1.54
91B9	5085348	502493	4.5	4.6	0.98
91C1	5085347	502495	2.5	1.9	1.32
91C2	5085347	502495	4.3	2.9	1.48

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Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
91C3	5085347	502495	4.9	1.5	3.27
91C4	5085347	502495	3.9	0.6	6.50
91C5	5085347	502495	16.6	4.2	3.95
91C6	5085347	502495	7.2	2.5	2.88
91C7	5085347	502495	1.7	1.7	1.00
91C8	5085347	502495	3.3	2.5	1.32
91D1	5085345	502496	4.2	2.1	2.00
91D2	5085345	502496	5.1	2.7	1.89
91D3	5085345	502496	4.5	3.0	1.50
91D4	5085345	502496	4.1	0.8	5.13
91D5	5085345	502496	5.0	2.1	2.38
91D6	5085345	502496	2.9	1.1	2.64
91D7	5085345	502496	2.8	1.3	2.15
91D8	5085345	502496	3.0	2.2	1.36
91E1	5085343	502496	5.0	2.8	1.79
91E2	5085343	502496	3.1	1.3	2.38
91E3	5085343	502496	2.5	2.0	1.25
91E4	5085343	502496	2.0	1.4	1.43
91E5	5085343	502496	3.2	2.2	1.45
91E6	5085343	502496	12.0	6.0	2.00
91E7	5085343	502496	19.5	7.6	2.57
91E8	5085343	502496	5.3	3.7	1.43
91F1	5085323	502510	20.0	2.8	7.14
91F2	5085323	502510	3.5	1.3	2.69
91F3	5085323	502510	15.0	4.0	3.75
91F4	5085323	502510	2.8	0.5	5.60
91F6	5085323	502510	4.4	1.0	4.40
91F7	5085323	502510	4.0	2.8	1.43
91F8	5085323	502510	8.9	1.7	5.24
91F9	5085323	502510	8.9	3.2	2.78
91F10	5085323	502510	12.5	2.9	4.31
91F11	5085323	502510	3.3	0.5	6.60
91F12	5085323	502510	2.8	1.0	2.80
91F13	5085323	502510	5.1	1.4	3.64
91F14	5085323	502510	4.0	1.1	3.64
91F15	5085323	502510	3.7	1.0	3.70
91G1	5085317	502509	7.1	0.7	10.14
91G2	5085317	502509	8.3	3.7	2.24
91G3	5085317	502509	4.0	1.8	2.22
91G4	5085317	502509	7.9	2.1	3.76
91G5	5085317	502509	8.0	1.3	6.15
91G6	5085317	502509	3.2	1.4	2.29
91G7	5085317	502509	5.0	2.0	2.50
91G8	5085317	502509	9.7	1.8	5.39
91G9	5085317	502509	6.8	1.8	3.78
91G10	5085317	502509	5.5	2.2	2.50
91G11	5085317	502509	5.7	0.8	7.13
91G12	5085317	502509	3.9	2.0	1.95
91H1	5085321	502517	2.9	1.8	1.61
91H2	5085321	502517	5.3	3.1	1.71
91H3	5085321	502517	12.2	2.5	4.88
91H4	5085321	502517	6.3	2.2	2.86
91H5	5085321	502517	14.5	2.7	5.37

APPENDIX A

Table A1: Km-scale Gradients Enclave Measurements

ID	northing	easting	length	width	aspect ratio (l/w)
91H6	5085321	502517	4.4	1.2	3.67
91H8	5085321	502517	3.1	1.7	1.82
91H9	5085321	502517	4.4	1.8	2.44
91H10	5085321	502517	4.5	2.5	1.80
91H11	5085321	502517	1.4	1.6	0.88
91H12	5085321	502517	3.5	3.3	1.06
91H13	5085321	502517	4.5	1.0	4.50
91H14	5085321	502517	3.0	1.8	1.67
91I1	5085294	502513	2.7	1.1	2.45
91I2	5085294	502513	2.2	1.7	1.29
91I3	5085294	502513	2.2	0.7	3.14
91I4	5085294	502513	4.0	1.0	4.00
91I5	5085294	502513	3.7	1.2	3.08
91I6	5085294	502513	3.3	2.5	1.32
91I7	5085294	502513	6.5	3.8	1.71
91I8	5085294	502513	3.2	2.0	1.60
91I9	5085294	502513	3.5	2.0	1.75
91I10	5085294	502513	3.3	1.7	1.94
91I11	5085294	502513	1.3	1.5	0.87
91I12	5085294	502513	4.5	1.5	3.00
91I13	5085294	502513	5.6	3.0	1.87
91I14	5085294	502513	3.2	2.0	1.60

APPENDIX B
MINERAL CHEMISTRIES FROM KM-SCALE GRADIENTS

Table B1: Plagioclase Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
BR-201d									
201d_plag_1									
1 / 1 .	9.67	0.30	0.01	3.34	0.02	0.09	22.44	64.66	100.54
1 / 2 .	9.55	0.27	0.00	3.25	-0.01	0.07	22.70	64.69	100.52
1 / 3 .	9.61	0.30	0.01	3.39	0.02	0.11	22.53	64.42	100.39
1 / 4 .	9.70	0.27	0.00	3.29	-0.02	0.07	22.32	64.38	100.03
1 / 5 .	9.67	0.31	0.00	3.29	-0.01	0.12	22.63	64.40	100.43
1 / 6 .	9.59	0.30	0.00	3.28	-0.02	0.07	22.72	64.35	100.32
1 / 7 .	9.63	0.32	0.00	3.25	0.03	0.08	22.49	64.29	100.09
1 / 8 .	9.62	0.27	-0.02	3.26	0.00	0.09	22.51	64.40	100.14
1 / 9 .	9.56	0.31	0.01	3.29	-0.01	0.08	22.52	64.70	100.46
1 / 10 .	9.67	0.31	-0.01	3.35	0.01	0.11	22.52	64.60	100.57
Avg 201d_plag_1	9.63	0.29	0.00	3.30	0.00	0.09	22.54	64.49	100.34
201d_plag_2									
1 / 1 .	9.51	0.25	-0.01	3.53	0.00	0.05	23.05	64.37	100.77
1 / 2 .	9.51	0.24	-0.02	3.58	0.00	0.11	22.67	64.14	100.24
1 / 3 .	9.45	0.22	0.00	3.58	0.01	0.07	22.90	63.97	100.20
1 / 4 .	9.54	0.26	-0.01	3.52	0.02	0.09	22.80	64.06	100.29
1 / 5 .	9.61	0.25	-0.01	3.52	0.00	0.06	23.14	63.91	100.49
1 / 6 .	9.55	0.26	-0.02	3.49	0.02	0.08	22.80	64.10	100.30
1 / 7 . *	9.70	0.24	-0.02	3.50	0.01	0.10	23.09	64.43	101.07
1 / 8 .	9.67	0.29	0.01	3.43	0.00	0.09	22.84	64.04	100.36
1 / 9 .	9.56	0.27	-0.02	3.40	0.03	0.06	22.87	64.27	100.46
1 / 10 .	9.66	0.27	0.00	3.40	-0.01	0.08	22.79	64.47	100.68
Avg 201d_plag_2	9.56	0.26	-0.01	3.50	0.01	0.08	22.87	64.15	100.41
201d_plag_3									
1 / 1 .	9.62	0.34	0.00	3.21	0.00	0.05	22.63	64.24	100.09
1 / 2 .	9.70	0.32	0.01	3.11	0.00	0.08	22.34	64.04	99.60

Table B1: Plagioclase Chemistries
* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
1 / 3 .	9.69	0.33	0.01	3.18	0.00	0.07	22.72	64.27	100.28
1 / 4 .	9.66	0.33	0.00	3.19	-0.01	0.10	22.47	64.40	100.15
1 / 5 .	9.63	0.33	0.01	3.26	0.01	0.08	22.20	64.61	100.11
1 / 6 .	9.57	0.32	0.00	3.14	0.00	0.08	22.47	64.76	100.35
1 / 7 .	9.62	0.36	0.00	3.15	0.00	0.08	22.60	64.48	100.29
1 / 8 .	9.70	0.33	0.00	3.28	-0.01	0.10	22.58	64.41	100.39
1 / 9 .	9.65	0.32	0.00	3.19	0.00	0.11	22.31	64.43	100.01
1 / 10 .	9.55	0.34	0.02	3.28	0.00	0.11	22.45	64.38	100.14
Avg 201d_plag_3	9.64	0.33	0.00	3.20	0.00	0.09	22.48	64.40	100.14
201d_plag_4									
1 / 1 .	9.52	0.31	0.00	3.41	0.00	0.10	23.00	64.47	100.82
1 / 2 .	9.51	0.30	0.01	3.50	0.01	0.07	22.87	64.07	100.33
1 / 3 .	9.49	0.28	0.00	3.45	0.00	0.09	23.00	64.07	100.37
1 / 4 .	9.63	0.27	0.00	3.48	-0.03	0.11	22.77	64.27	100.52
1 / 5 .	9.50	0.28	-0.02	3.47	0.00	0.09	22.97	64.24	100.56
1 / 6 .	9.57	0.27	-0.01	3.49	0.00	0.12	23.05	64.20	100.71
1 / 7 .	9.51	0.27	0.01	3.52	-0.01	0.11	23.15	64.27	100.83
1 / 8 .	9.62	0.25	0.00	3.42	0.01	0.11	22.83	64.46	100.70
1 / 9 .	9.48	0.36	-0.01	3.36	0.01	0.11	22.94	64.27	100.54
1 / 10 .	9.49	0.24	0.00	3.39	-0.01	0.07	22.69	64.37	100.26
Avg 201d_plag_4	9.53	0.28	0.00	3.45	0.00	0.10	22.93	64.27	100.56
201d_plag_5									
1 / 1 .	9.80	0.24	0.00	3.16	0.00	0.14	22.40	64.62	100.37
1 / 2 .	9.73	0.24	-0.01	3.18	0.01	0.09	22.75	64.65	100.65
1 / 3 .	9.75	0.23	0.01	3.11	0.00	0.09	22.48	65.01	100.67
1 / 4 .	9.59	0.24	-0.02	3.21	-0.02	0.04	22.45	64.40	99.93
1 / 5 .	9.72	0.26	-0.01	3.23	-0.01	0.11	22.74	64.52	100.57
1 / 6 .	9.61	0.24	0.01	3.30	-0.02	0.05	22.73	64.40	100.33
1 / 7 .	9.51	0.24	0.00	3.35	-0.02	0.05	22.72	64.89	100.77
1 / 8 .	9.55	0.24	-0.01	3.38	-0.01	0.12	22.52	64.19	100.01

Table B1: Plagioclase Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
1 / 9 .	9.69	0.24	0.00	3.33	0.01	0.06	22.63	64.18	100.16
1 / 10 .	9.53	0.24	0.00	3.33	-0.02	0.08	23.02	64.29	100.49
Avg 201d_plag_5	9.65	0.24	0.00	3.26	-0.01	0.08	22.65	64.52	100.38
201d_plag_6									
1 / 1 .	9.54	0.14	-0.01	3.53	0.01	0.05	23.07	64.19	100.52
1 / 2 .	9.71	0.16	-0.01	3.56	0.01	0.11	22.87	64.21	100.63
1 / 3 . *	9.65	0.17	0.00	3.55	-0.03	0.12	23.02	64.52	101.02
1 / 4 .	9.48	0.19	0.00	3.52	0.00	0.08	22.83	64.35	100.45
1 / 5 .	9.59	0.18	-0.02	3.55	-0.04	0.09	22.79	64.22	100.41
1 / 6 .	9.62	0.21	0.00	3.58	0.02	0.12	22.79	64.54	100.87
1 / 7 .	9.67	0.21	0.00	3.56	-0.02	0.11	22.61	64.14	100.30
1 / 8 .	9.66	0.20	0.00	3.54	0.00	0.15	22.81	64.29	100.65
1 / 9 .	9.50	0.23	-0.01	3.58	-0.01	0.17	22.94	64.32	100.74
1 / 10 .	9.63	0.23	-0.01	3.52	0.00	0.11	22.87	64.45	100.83
Avg 201d_plag_6	9.60	0.19	-0.01	3.55	0.00	0.11	22.84	64.30	100.59
201d_plag_7									
1 / 1 .	9.24	0.33	0.00	3.81	-0.01	0.08	23.20	63.97	100.63
1 / 2 .	9.23	0.34	0.00	3.79	-0.04	0.08	23.19	64.05	100.67
1 / 3 .	9.31	0.33	0.00	3.74	-0.02	0.06	23.21	63.92	100.57
1 / 4 .	9.26	0.31	-0.01	3.76	-0.02	0.08	23.08	64.13	100.63
1 / 5 .	9.21	0.33	-0.01	3.84	-0.03	0.09	23.02	64.08	100.57
1 / 6 . *	9.30	0.32	-0.02	3.85	0.01	0.11	23.10	64.58	101.27
1 / 7 . *	9.24	0.32	-0.01	3.85	0.01	0.13	23.26	64.14	100.97
1 / 8 .	9.29	0.30	-0.01	3.79	0.00	0.08	23.28	64.01	100.75
1 / 9 .	9.35	0.33	-0.02	3.72	0.00	0.09	23.08	63.72	100.29
1 / 10 .	9.32	0.29	0.01	3.76	0.03	0.07	23.03	63.86	100.36
201d_plag_7	9.28	0.32	-0.01	3.78	-0.01	0.08	23.14	63.97	100.54
201d_plag_8									
1 / 1 .	9.34	0.30	-0.01	3.74	0.02	0.09	22.81	63.73	100.02

Table B1: Plagioclase Chemistries
* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
1 / 2 .	9.32	0.27	0.01	3.82	-0.03	0.10	22.92	63.96	100.41
1 / 3 .	9.26	0.29	0.01	3.78	0.00	0.10	23.05	63.44	99.93
1 / 4 .	9.32	0.30	-0.02	3.75	0.01	0.11	22.88	63.58	99.95
1 / 5 .	9.23	0.31	0.01	3.72	0.00	0.08	22.85	63.50	99.69
1 / 6 .	9.30	0.27	-0.01	3.73	-0.03	0.04	22.88	63.35	99.57
1 / 7 .	9.30	0.28	0.01	3.68	0.03	0.07	22.86	63.59	99.84
1 / 8 .	9.36	0.26	0.00	3.79	-0.04	0.11	22.85	63.61	99.98
1 / 9 .	9.37	0.28	0.00	3.65	-0.01	0.11	22.69	63.80	99.89
1 / 10 .	9.37	0.26	-0.01	3.70	0.03	0.05	22.77	63.72	99.91
Avg 201d_plag_8	9.32	0.28	0.00	3.74	0.00	0.08	22.86	63.63	99.90
201d_plag_9									
1 / 1 .	9.63	0.24	0.01	3.30	-0.02	0.07	22.49	64.35	100.10
1 / 2 .	9.65	0.26	-0.01	3.31	0.00	0.10	22.50	64.11	99.94
1 / 3 .	9.61	0.23	0.00	3.24	0.01	0.08	22.46	64.41	100.04
1 / 4 .	9.70	0.29	0.00	3.26	-0.01	0.10	22.68	64.24	100.27
1 / 5 .	9.69	0.25	-0.01	3.25	-0.02	0.13	22.55	64.31	100.18
1 / 6 .	9.63	0.24	0.01	3.18	0.01	0.10	22.49	64.80	100.46
1 / 7 .	9.63	0.28	0.01	3.17	0.00	0.11	22.43	64.59	100.22
1 / 8 .	9.56	0.29	-0.01	3.20	0.00	0.06	22.58	64.19	99.88
1 / 9 .	9.52	0.30	0.01	3.22	-0.04	0.12	22.37	63.94	99.48
1 / 10 .	9.63	0.25	-0.01	3.24	0.03	0.08	22.55	64.31	100.09
Avg 201d_plag_9	9.62	0.26	0.00	3.24	0.00	0.09	22.51	64.33	100.05
BR-202									
202_plag_1									
1 / 1 .	9.09	0.32	0.00	3.87	-0.02	0.05	23.59	63.55	100.47
1 / 2 .	9.18	0.30	0.01	3.88	-0.02	0.03	23.07	63.81	100.27
1 / 3 .	9.19	0.30	0.00	3.94	0.00	0.07	23.43	63.80	100.74
1 / 4 .	9.28	0.32	-0.01	3.88	0.00	0.11	23.31	63.99	100.89
1 / 5 .	9.17	0.31	0.02	3.95	0.03	0.10	23.46	63.81	100.85

Table B1: Plagioclase Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
1 / 6 .	9.27	0.34	0.00	3.89	0.03	0.12	23.12	63.88	100.65
1 / 7 .	9.17	0.34	0.00	3.90	0.01	0.08	23.31	63.96	100.77
1 / 8 .	9.16	0.31	0.00	3.93	-0.01	0.08	23.01	63.82	100.32
1 / 9 .	9.17	0.33	0.00	3.94	-0.03	0.05	23.29	63.28	100.06
1 / 10 .	9.29	0.32	0.00	3.91	0.02	0.09	23.25	64.00	100.88
Avg 202_plag_1	9.20	0.32	0.00	3.91	0.00	0.08	23.28	63.79	100.58
202_plag_2									
1 / 1 .	9.63	0.32	0.01	3.25	0.02	0.06	22.65	64.46	100.41
1 / 2 .	9.71	0.32	-0.01	3.19	-0.01	0.11	22.64	64.79	100.76
1 / 3 .	9.63	0.35	0.01	3.31	0.01	0.08	22.60	64.80	100.80
1 / 4 .	9.58	0.36	0.00	3.30	0.01	0.12	22.63	64.72	100.71
1 / 5 .	9.52	0.34	-0.01	3.33	-0.01	0.07	22.59	64.50	100.35
1 / 6 .	9.58	0.31	0.00	3.31	-0.02	0.07	22.93	64.36	100.56
1 / 7 .	9.63	0.33	0.00	3.35	-0.02	0.06	22.85	64.48	100.71
1 / 8 .	9.65	0.32	0.00	3.39	0.01	0.08	22.79	64.34	100.58
1 / 9 .	9.63	0.30	0.01	3.39	-0.01	0.07	22.69	64.65	100.74
1 / 10 .	9.63	0.25	-0.02	3.37	0.00	0.05	22.61	64.43	100.34
Avg 202_plag_2	9.62	0.32	0.00	3.32	0.00	0.08	22.70	64.55	100.58
202_plag_3									
1 / 1 .	8.85	0.37	0.01	4.38	0.01	0.12	23.66	63.03	100.43
1 / 2 .	8.92	0.40	-0.01	4.42	-0.04	0.12	23.60	62.75	100.21
1 / 3 .	8.82	0.42	0.01	4.36	0.02	0.06	23.44	62.84	99.96
1 / 4 .	8.94	0.39	-0.01	4.37	0.01	0.07	23.61	62.90	100.28
1 / 5 .	8.89	0.40	-0.01	4.34	0.00	0.09	23.66	63.16	100.54
1 / 6 .	8.91	0.40	0.00	4.31	-0.03	0.13	23.32	62.93	100.00
1 / 7 .	8.91	0.39	0.00	4.34	0.03	0.16	23.36	63.14	100.32
1 / 8 .	8.84	0.41	-0.02	4.33	0.03	0.10	23.51	63.03	100.26
1 / 9 .	8.90	0.41	0.00	4.29	-0.01	0.08	23.47	62.83	99.97
1 / 10 .	8.84	0.39	0.00	4.39	-0.01	0.05	23.53	63.00	100.20
Avg 202_plag_3	8.88	0.40	0.00	4.35	0.00	0.10	23.52	62.96	100.20

Table B1: Plagioclase Chemistries
* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
202_plag_4	Wt% Oxide								
Formula									
1 / 1 .	9.14	0.39	0.01	4.01	0.01	0.08	23.41	63.34	100.39
1 / 2 .	9.08	0.38	0.00	4.00	-0.01	0.08	22.99	63.57	100.09
1 / 3 .	9.13	0.37	0.00	3.97	0.01	0.09	23.17	63.77	100.52
1 / 4 .	9.20	0.36	0.00	3.92	0.01	0.10	23.09	64.02	100.70
1 / 5 .	9.26	0.38	-0.01	3.86	0.01	0.06	23.02	64.12	100.71
1 / 6 .	9.22	0.34	-0.01	3.79	0.01	0.07	22.94	63.67	100.04
1 / 7 .	9.33	0.36	0.01	3.71	-0.03	0.06	22.93	64.03	100.43
1 / 8 .	9.36	0.35	0.01	3.58	0.01	0.12	22.76	64.04	100.24
1 / 9 .	9.41	0.32	0.00	3.53	0.01	0.07	22.83	64.11	100.30
1 / 10 .	9.39	0.29	0.00	3.55	0.02	0.07	22.67	64.32	100.31
Avg 202_plag_4	9.25	0.35	0.00	3.79	0.01	0.08	22.98	63.90	100.37
202_plag_5									
1 / 1 .	9.57	0.33	-0.01	3.22	0.00	0.10	22.55	64.50	100.27
1 / 2 .	9.68	0.36	0.00	3.22	0.01	0.11	22.70	64.78	100.86
1 / 3 .	9.66	0.35	-0.02	3.19	0.01	0.09	22.56	64.85	100.71
1 / 4 .	9.72	0.36	-0.02	3.13	0.01	0.11	22.69	64.90	100.93
1 / 5 .	9.70	0.36	-0.01	3.18	0.00	0.04	22.48	64.63	100.39
1 / 6 .	9.66	0.36	0.00	3.13	-0.02	0.08	22.30	64.66	100.19
1 / 7 .	9.70	0.34	0.00	3.12	0.03	0.03	22.36	65.07	100.64
1 / 8 .	9.60	0.35	0.02	3.15	0.01	0.11	22.40	64.56	100.20
1 / 9 .	9.77	0.33	0.01	3.15	-0.01	0.11	22.55	64.74	100.67
1 / 10 .	9.66	0.35	0.00	3.09	-0.01	0.10	22.51	65.02	100.74
Avg 202_plag_5	9.67	0.35	0.00	3.16	0.00	0.09	22.51	64.77	100.55
202_plag_6									
1 / 1 .	9.72	0.18	0.00	3.37	-0.02	0.05	22.53	64.65	100.51
1 / 2 .	9.73	0.17	-0.01	3.28	0.00	0.10	22.71	64.60	100.59
1 / 3 .	9.75	0.18	0.00	3.28	0.02	0.05	22.62	64.54	100.44

Table B1: Plagioclase Chemistries
* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
1 / 4 .	9.80	0.20	-0.01	3.31	0.00	0.06	22.36	64.39	100.12
1 / 5 .	9.75	0.19	-0.01	3.34	0.01	0.09	22.64	64.54	100.57
1 / 6 .	9.81	0.20	-0.01	3.32	0.00	0.02	22.46	64.58	100.40
1 / 7 .	9.71	0.19	-0.01	3.33	0.01	0.07	22.60	64.08	99.97
1 / 8 .	9.73	0.21	0.00	3.39	0.02	0.06	22.73	64.60	100.74
1 / 9 .	9.64	0.17	-0.02	3.46	0.02	0.08	22.56	64.38	100.31
1 / 10 .	9.35	1.05	-0.01	3.13	-0.03	0.09	22.53	64.55	100.68
Avg 202_plag_6	9.70	0.28	-0.01	3.32	0.01	0.07	22.57	64.49	100.42
202_plag_7									
1 / 1 .	9.27	0.39	0.00	3.83	0.01	0.08	22.95	63.81	100.34
1 / 2 .	9.20	0.42	-0.01	3.87	-0.01	0.08	23.02	63.72	100.31
1 / 3 .	9.23	0.38	0.00	3.89	-0.02	0.13	23.07	63.52	100.23
1 / 4 .	9.17	0.44	-0.01	3.86	0.00	0.10	23.15	63.34	100.06
1 / 5 .	9.21	0.44	0.00	3.86	0.00	0.13	23.08	63.73	100.45
1 / 6 .	9.13	0.44	0.00	3.92	-0.01	0.11	23.17	63.80	100.57
1 / 7 .	9.13	0.41	0.00	3.94	0.00	0.10	23.05	63.53	100.16
1 / 8 .	9.25	0.40	0.01	3.94	-0.02	0.10	22.99	63.37	100.05
1 / 9 .	9.28	0.36	-0.01	3.91	0.00	0.13	23.17	63.53	100.37
1 / 10 .	9.10	0.35	-0.01	4.00	0.03	0.17	23.10	63.45	100.21
Avg 202_plag_7	9.20	0.40	0.00	3.90	0.00	0.11	23.07	63.58	100.26
202_plag_8									
1 / 1 .	9.54	0.23	0.00	3.43	0.03	0.13	22.78	64.61	100.74
1 / 2 .	9.49	0.22	0.00	3.49	0.02	0.08	22.75	64.40	100.45
1 / 3 .	9.58	0.23	0.01	3.41	0.01	0.07	22.38	64.59	100.28
1 / 4 .	9.65	0.24	-0.01	3.36	0.01	0.10	22.63	64.28	100.25
1 / 5 .	9.71	0.21	-0.01	3.26	0.00	0.09	22.67	64.43	100.36
1 / 6 .	9.73	0.21	0.01	3.28	0.00	0.07	22.37	64.36	100.04
1 / 7 .	9.61	0.22	-0.01	3.26	-0.03	0.11	22.56	64.36	100.11
1 / 8 .	9.63	0.23	0.00	3.30	-0.02	0.07	22.54	64.54	100.31
1 / 9 .	9.63	0.20	0.00	3.31	-0.01	0.11	22.62	64.68	100.54

Table B1: Plagioclase Chemistries
* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
1 / 10 .	9.73	0.17	0.00	3.34	-0.03	0.06	22.52	64.63	100.45
Avg 202_plag_8	9.63	0.21	0.00	3.34	0.00	0.09	22.58	64.49	100.34
202_plag_9									
1 / 1 .	9.19	0.38	0.00	3.79	0.02	0.04	22.85	63.39	99.65
1 / 2 .	9.19	0.36	-0.01	3.83	0.04	0.05	22.79	63.18	99.44
1 / 3 .	9.25	0.34	0.00	3.79	-0.02	0.09	22.77	63.29	99.54
1 / 4 .	9.31	0.36	-0.01	3.74	0.02	0.06	23.00	63.67	100.15
1 / 5 .	9.21	0.39	-0.03	3.80	0.01	0.08	22.85	63.22	99.56
1 / 6 .	9.30	0.37	-0.01	3.78	0.02	0.09	22.69	63.22	99.47
1 / 7 .	9.36	0.35	-0.01	3.75	0.01	0.09	22.77	63.44	99.77
1 / 8 .	9.19	0.39	0.00	3.73	0.01	0.04	22.83	63.62	99.81
1 / 9 .	9.30	0.38	-0.01	3.75	-0.01	0.06	23.02	63.82	100.34
1 / 10 .	9.21	0.37	0.00	3.68	0.00	0.06	22.78	63.83	99.95
Avg 202_plag_9	9.25	0.37	-0.01	3.76	0.01	0.07	22.84	63.47	99.76
202_plag_10									
1 / 1 .	9.59	0.26	0.00	3.30	-0.03	0.08	22.59	64.26	100.09
1 / 2 .	9.51	0.29	-0.01	3.36	0.00	0.08	22.79	64.67	100.70
1 / 3 .	9.57	0.28	0.01	3.39	0.02	0.05	22.58	64.61	100.51
1 / 4 .	9.56	0.29	0.00	3.35	-0.04	0.06	22.60	64.20	100.06
1 / 5 .	9.62	0.26	0.00	3.32	0.00	0.05	22.80	64.47	100.53
1 / 6 .	9.50	0.27	-0.01	3.41	-0.01	0.09	22.77	64.12	100.14
1 / 7 .	9.65	0.27	0.00	3.36	0.00	0.10	22.77	64.57	100.72
1 / 8 .	9.69	0.27	-0.02	3.43	0.05	0.09	22.49	64.11	100.13
1 / 9 .	9.44	0.25	0.00	3.40	0.02	0.06	22.42	64.40	100.01
1 / 10 .	9.54	0.25	0.00	3.44	0.00	0.10	22.47	64.42	100.21
Avg 202_plag_10	9.57	0.27	0.00	3.38	0.00	0.08	22.63	64.38	100.30
BR-70									
70_plag_4									
1 / 1 .	8.47	0.38	-0.03	4.96	-0.03	0.12	23.77	62.30	100.00

Table B1: Plagioclase Chemistries
* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
1 / 2 .	8.54	0.38	-0.01	4.96	-0.02	0.05	23.66	62.37	99.96
1 / 3 .	8.65	0.37	0.00	4.90	0.01	0.11	23.77	62.16	99.96
1 / 4 .	8.56	0.35	0.01	4.83	0.01	0.05	23.67	62.15	99.63
1 / 5 .	8.52	0.38	-0.01	4.84	-0.01	-0.01	23.60	62.29	99.63
1 / 6 .	8.55	0.36	0.00	4.80	0.01	0.10	23.66	62.31	99.79
1 / 7 .	8.49	0.37	0.00	4.86	0.00	0.09	23.54	62.32	99.67
1 / 8 .	8.59	0.39	-0.01	4.79	0.02	0.08	23.41	62.64	99.91
1 / 9 .	8.63	0.39	-0.01	4.84	0.00	0.08	23.66	63.13	100.72
1 / 10 .	8.61	0.37	0.00	4.82	-0.03	0.01	23.44	62.49	99.75
Avg 70_plag_4	8.56	0.37	-0.01	4.86	0.00	0.07	23.62	62.42	99.89
70_plag_5									
1 / 1 .	9.66	0.23	-0.01	3.25	0.01	0.10	22.18	64.76	100.18
1 / 2 .	9.58	0.23	-0.01	3.30	0.00	0.06	22.40	65.17	100.75
1 / 3 .	9.79	0.14	0.00	3.25	-0.02	0.04	22.34	65.14	100.70
1 / 4 .	9.60	0.12	0.00	3.36	0.00	0.08	22.53	65.07	100.75
1 / 5 .	9.63	0.12	-0.01	3.25	0.02	0.05	22.23	65.15	100.45
1 / 6 .	9.58	0.12	-0.01	3.33	-0.02	0.06	22.30	65.31	100.71
1 / 7 .	9.50	0.19	0.01	3.27	0.02	0.09	22.33	65.49	100.92
1 / 8 .	9.55	0.19	0.00	3.26	0.01	0.04	22.28	65.24	100.57
1 / 9 .	9.59	0.12	-0.01	3.29	-0.01	0.09	22.34	64.99	100.41
1 / 10 .	9.83	0.14	0.01	3.14	-0.01	0.04	21.98	64.79	99.93
Avg 70_plag_5	9.63	0.16	0.00	3.27	0.00	0.07	22.29	65.11	100.52
70_plag_6									
1 / 1 .	9.06	0.44	0.00	3.91	-0.01	0.12	22.78	64.12	100.45
1 / 2 .	9.15	0.44	0.01	3.90	0.00	0.07	22.87	63.77	100.22
1 / 3 .	9.14	0.47	0.00	3.91	0.00	0.04	22.75	64.07	100.38
1 / 4 .	9.11	0.46	0.00	3.86	0.00	0.17	22.78	64.11	100.48
1 / 5 .	9.02	0.46	-0.02	3.87	0.02	0.10	22.94	63.82	100.23
1 / 6 .	9.11	0.47	0.00	3.95	-0.01	0.08	22.70	64.02	100.33
1 / 7 .	9.04	0.46	0.00	3.90	-0.06	0.10	22.68	64.21	100.39

Table B1: Plagioclase Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
1 / 8 .	9.09	0.48	0.00	4.00	0.00	0.08	22.69	64.12	100.46
1 / 9 .	9.01	0.46	0.01	4.01	-0.01	0.10	22.98	64.02	100.59
1 / 10 .	9.03	0.46	0.00	3.98	0.01	0.12	22.77	64.32	100.68
Avg 70_plag_6	9.08	0.46	0.00	3.93	-0.01	0.10	22.79	64.06	100.41
70_plag_7									
1 / 1 .	9.01	0.46	0.00	4.02	0.00	0.09	22.83	64.00	100.40
1 / 2 .	9.04	0.45	-0.02	4.06	0.04	0.06	22.67	63.85	100.18
1 / 3 .	9.11	0.48	0.00	4.00	-0.01	0.06	22.82	64.08	100.54
1 / 4 .	9.03	0.44	0.00	4.08	0.00	0.08	22.87	63.56	100.06
1 / 5 .	9.01	0.48	-0.01	3.99	0.02	0.07	22.86	63.74	100.17
1 / 6 .	8.94	0.47	-0.01	4.01	0.02	0.06	22.66	63.63	99.79
1 / 7 .	9.08	0.46	0.00	4.00	0.00	0.05	22.77	63.69	100.05
1 / 8 .	8.98	0.47	0.00	3.99	-0.01	0.01	22.79	63.75	99.99
1 / 9 .	9.02	0.49	0.00	3.99	0.03	0.08	22.53	63.95	100.09
1 / 10 .	9.10	0.48	-0.01	3.99	0.00	0.03	22.80	63.72	100.11
Avg 70_plag_7	9.03	0.47	0.00	4.01	0.01	0.06	22.76	63.80	100.13
70_plag_8									
1 / 1 .	9.55	0.43	0.01	3.19	0.01	0.08	22.18	64.54	100.00
1 / 2 .	9.51	0.41	0.00	3.27	-0.03	0.09	22.18	64.37	99.83
1 / 3 .	9.56	0.38	0.01	3.06	0.00	0.10	22.13	64.87	100.11
1 / 4 .	9.47	0.40	0.00	3.23	0.02	0.05	22.18	64.94	100.29
1 / 5 .	9.58	0.42	-0.01	3.27	-0.01	0.12	22.12	64.90	100.41
1 / 6 .	9.53	0.39	-0.02	3.30	-0.02	0.07	22.33	64.43	100.04
1 / 7 .	9.50	0.40	0.01	3.31	0.00	0.05	22.40	64.60	100.26
1 / 8 .	9.57	0.39	-0.02	3.37	0.03	0.11	22.24	64.39	100.10
1 / 9 .	9.49	0.38	-0.01	3.38	0.00	0.08	22.28	64.13	99.75
1 / 10 .	9.45	0.35	-0.01	3.40	0.03	0.09	22.49	64.64	100.46
Avg 70_plag_8	9.52	0.40	0.00	3.28	0.00	0.08	22.25	64.58	100.11
70_plag_9									

Table B1: Plagioclase Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
1 / 1 .	9.02	0.35	-0.01	4.08	0.01	0.04	23.19	63.57	100.25
1 / 2 .	9.03	0.35	0.00	4.14	-0.01	0.12	23.16	63.40	100.20
1 / 3 .	9.11	0.37	-0.01	4.15	0.01	0.05	22.88	63.30	99.88
1 / 4 .	9.12	0.36	-0.01	4.12	-0.01	0.08	22.97	63.89	100.54
1 / 5 .	8.96	0.37	-0.01	4.11	-0.01	0.03	22.94	63.50	99.92
1 / 6 .	9.05	0.35	0.00	4.04	0.02	0.09	23.00	63.50	100.05
1 / 7 .	9.02	0.35	-0.01	4.11	-0.02	0.09	23.22	63.58	100.37
1 / 8 .	9.05	0.40	-0.01	4.13	-0.03	0.10	22.96	63.56	100.21
1 / 9 .	9.04	0.38	-0.02	4.19	0.00	0.06	22.97	63.20	99.83
1 / 10 .	8.91	0.42	-0.01	4.15	-0.04	0.05	22.92	63.36	99.82
Avg 70_plag_9	9.03	0.37	-0.01	4.12	-0.01	0.07	23.02	63.49	100.08
70_plag_10									
1 / 1 .	9.60	0.38	0.00	3.05	0.06	0.07	22.09	65.27	100.53
1 / 2 .	9.63	0.40	0.00	3.05	-0.01	0.05	22.10	65.10	100.33
1 / 3 .	9.67	0.34	0.01	3.07	-0.01	0.07	22.02	65.10	100.28
1 / 4 .	9.74	0.43	-0.01	2.99	0.05	0.04	22.20	65.12	100.57
1 / 5 .	9.61	0.39	-0.01	3.03	-0.02	0.07	21.96	65.14	100.21
1 / 6 .	9.79	0.34	-0.01	3.03	0.06	0.08	22.07	64.94	100.30
1 / 7 .	9.75	0.33	-0.02	3.08	0.02	0.09	22.03	64.83	100.14
1 / 8 .	9.66	0.34	0.00	3.10	-0.03	0.08	21.97	64.80	99.95
1 / 9 .	9.74	0.27	0.00	3.09	-0.01	0.04	22.12	64.93	100.20
1 / 10 .	9.75	0.35	-0.01	3.12	0.02	0.02	22.21	64.68	100.16
Avg 70_plag_10.1	9.69	0.36	0.00	3.06	0.01	0.06	22.08	64.99	100.25
2 / 1 .	9.68	0.31	0.00	3.08	0.01	0.05	22.14	65.26	100.54
2 / 2 .	9.70	0.38	-0.02	3.04	0.01	0.04	22.05	65.22	100.44
2 / 3 .	9.63	0.39	0.00	3.11	-0.03	0.08	22.06	64.90	100.17
2 / 4 .	9.71	0.37	-0.01	3.06	-0.02	0.04	21.94	65.24	100.36
2 / 5 .	9.66	0.34	-0.01	3.00	-0.03	0.08	22.12	64.97	100.16
2 / 6 .	9.78	0.37	0.01	3.02	-0.02	0.05	21.98	65.25	100.46
2 / 7 .	9.72	0.36	0.00	3.00	0.01	0.07	21.89	65.40	100.46

Table B1: Plagioclase Chemistries
* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
2 / 8 .	9.61	0.34	-0.01	2.98	0.01	0.07	22.01	65.46	100.47
2 / 9 .	9.68	0.34	-0.01	2.99	-0.01	0.08	21.99	65.23	100.32
2 / 10 .	9.84	0.29	-0.01	3.06	0.02	0.03	22.03	65.13	100.40
Avg 70_plag_10.2	9.70	0.35	-0.01	3.03	-0.01	0.06	22.02	65.21	100.36
FR-111									
111_plag_1									
1 / 1 .	9.68	0.31	0.00	3.03	0.00	0.10	22.16	64.05	99.33
1 / 2 .	9.73	0.34	-0.01	3.08	-0.02	0.09	22.23	64.04	99.52
1 / 3 .	9.60	0.33	0.01	3.03	0.00	0.07	22.24	64.67	99.96
1 / 4 .	9.58	0.34	0.00	3.10	0.00	0.08	22.21	64.26	99.58
1 / 5 .	9.67	0.33	-0.01	3.07	0.01	0.07	22.16	64.55	99.87
1 / 6 .	9.73	0.35	-0.01	3.14	0.01	0.08	22.11	64.54	99.96
1 / 7 .	9.64	0.34	0.01	3.08	0.03	0.12	22.26	64.15	99.63
1 / 8 .	9.63	0.35	0.00	3.08	0.01	0.04	22.12	64.55	99.79
1 / 9 .	9.73	0.35	-0.02	3.06	0.02	0.08	22.24	64.45	99.93
1/10.	9.66	0.34	0.01	3.06	0.00	0.08	21.92	64.57	99.63
Avg 111_plag_1.1	9.67	0.34	0.00	3.07	0.01	0.08	22.16	64.38	99.71
2 / 1 .	9.53	0.31	-0.01	3.31	-0.01	0.11	22.36	64.00	99.61
2 / 2 .	9.56	0.32	-0.01	3.31	-0.02	0.06	22.27	64.16	99.68
2 / 3 .	9.63	0.32	0.00	3.27	0.02	0.08	22.43	64.34	100.08
2 / 4 .	9.53	0.31	0.00	3.32	0.00	0.06	22.24	64.05	99.52
2 / 5 .	9.65	0.31	0.00	3.30	0.05	0.11	22.45	64.13	100.00
2 / 6 .	9.63	0.27	0.00	3.21	0.00	0.09	22.30	64.24	99.75
2 / 7 .	9.60	0.28	0.00	3.31	0.02	0.07	22.41	64.35	100.04
2 / 8 .	9.69	0.29	-0.01	3.28	0.02	0.15	22.30	64.06	99.79
2 / 9 .	9.68	0.27	-0.02	3.23	0.01	0.08	22.21	64.32	99.80
2 / 10 .	9.73	0.26	0.00	3.10	-0.02	0.07	22.23	64.67	100.06
Avg 111_plag_1.2	9.62	0.29	0.00	3.26	0.01	0.09	22.32	64.23	99.82
111_plag_2									

Table B1: Plagioclase Chemistries
* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
1 / 1 .	9.71	0.17	0.00	3.19	0.04	0.04	22.50	64.12	99.77
1 / 2 .	9.67	0.16	-0.01	3.13	0.02	0.07	22.09	64.39	99.52
1 / 3 .	9.70	0.19	-0.01	3.09	-0.04	0.11	22.08	64.14	99.31
1 / 4 .	9.76	0.16	0.00	3.04	-0.01	0.07	22.33	64.55	99.91
1 / 5 .	9.90	0.17	0.02	3.00	0.01	0.07	22.03	64.25	99.45
1 / 6 .	9.80	0.19	0.01	2.96	0.01	0.08	22.10	64.07	99.23
1 / 7 .	9.86	0.21	0.00	3.01	0.02	0.09	22.24	64.28	99.73
1 / 8 .	9.84	0.20	0.01	3.02	0.01	0.11	22.07	64.21	99.48
1 / 9 .	9.90	0.22	0.00	3.06	0.01	0.09	22.20	64.35	99.83
1 / 10 .	9.78	0.20	0.00	2.95	0.02	0.10	21.96	64.28	99.29
Avg 111_plag_2.2	9.79	0.19	0.00	3.04	0.01	0.08	22.16	64.27	99.54
111_plag_3									
1 / 1 .	9.56	0.48	0.00	3.32	-0.03	0.10	22.14	63.47	99.07
1 / 2 .	9.58	0.50	0.01	3.30	0.02	0.06	22.32	63.94	99.73
1 / 3 .	9.49	0.51	0.00	3.42	-0.01	0.12	22.25	63.33	99.10
1 / 4 .	9.55	0.49	0.00	3.35	-0.01	0.09	22.40	63.60	99.49
1 / 5 .	9.47	0.44	0.00	3.37	0.00	0.06	22.31	63.61	99.26
1 / 6 .	9.38	0.48	0.00	3.28	0.00	0.08	22.18	63.66	99.06
1 / 7 .	9.56	0.46	0.00	3.36	0.01	0.12	22.25	63.79	99.55
1 / 8 .	9.35	0.47	0.00	3.35	0.01	0.08	22.24	63.80	99.31
1 / 9 .	9.42	0.49	0.00	3.43	0.00	0.11	22.47	63.73	99.66
1 / 10 .	9.39	0.49	-0.01	3.41	0.02	0.10	22.52	63.47	99.40
Avg 111_plag_3.1	9.47	0.48	0.00	3.36	0.00	0.09	22.31	63.64	99.36
2 / 1 .	9.18	0.46	0.01	3.79	0.00	0.08	22.68	63.23	99.44
2 / 2 .	9.16	0.48	0.00	3.77	0.00	0.08	22.84	62.90	99.22
2 / 3 .	9.22	0.46	0.00	3.76	0.02	0.12	22.70	63.30	99.58
2 / 4 .	9.22	0.45	-0.02	3.71	0.02	0.07	22.55	63.13	99.15
2 / 5 .	9.24	0.46	0.01	3.75	0.01	0.10	22.61	63.42	99.60
2 / 6 .	9.19	0.47	-0.01	3.69	0.01	0.09	22.54	63.54	99.54
2 / 7 .	9.24	0.47	0.00	3.80	0.01	0.04	22.83	63.53	99.92

Table B1: Plagioclase Chemistries
* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
2 / 8 .	9.27	0.48	0.00	3.65	0.01	0.10	22.63	63.18	99.33
2 / 9 .	9.17	0.45	0.01	3.67	-0.04	0.07	22.52	63.14	99.03
2 / 10 .	9.19	0.47	0.00	3.66	0.00	0.08	22.63	63.40	99.43
Avg 111_plag_3.2	9.21	0.47	0.00	3.73	0.01	0.08	22.65	63.28	99.42
111_plag_4									
1 / 1 .	9.83	0.27	0.00	2.86	-0.04	0.07	22.16	64.63	99.82
1 / 2 .	9.87	0.25	0.01	2.92	0.01	0.13	22.08	64.45	99.73
1 / 3 .	9.91	0.25	-0.01	3.02	0.00	0.06	22.00	64.65	99.90
1 / 4 .	9.92	0.27	-0.01	2.99	0.02	0.07	22.06	64.50	99.84
1 / 5 .	9.79	0.32	-0.01	3.02	0.00	0.10	22.16	64.40	99.80
1 / 6 .	9.80	0.26	0.00	3.12	0.03	0.08	22.03	64.37	99.69
1 / 7 .	9.73	0.31	-0.01	3.10	0.01	0.05	22.00	64.22	99.43
1 / 8 .	9.67	0.34	0.01	3.10	0.01	0.07	22.20	64.34	99.74
1 / 9 .	9.79	0.26	0.00	3.13	0.00	0.09	22.13	64.24	99.66
1 / 10 .	9.61	0.32	0.01	3.20	0.00	0.07	22.28	64.05	99.54
Avg 111_plag_4.1	9.79	0.29	0.00	3.05	0.01	0.08	22.11	64.39	99.71
2 / 1 .	9.80	0.19	0.00	3.18	0.01	0.09	22.23	63.98	99.48
2 / 2 .	9.69	0.21	0.00	3.10	-0.01	0.09	22.14	64.23	99.46
2 / 3 .	9.86	0.22	-0.01	3.03	0.00	0.08	22.16	64.08	99.42
2 / 4 .	9.82	0.21	0.00	3.02	0.01	0.05	22.36	64.27	99.75
2 / 5 .	9.81	0.22	-0.02	3.09	0.00	0.10	22.41	63.89	99.51
2 / 6 .	9.79	0.18	-0.01	3.09	0.03	0.04	22.07	64.11	99.32
2 / 7 .	9.82	0.20	0.00	3.10	-0.01	0.06	22.01	63.79	98.98
2 / 8 .	9.85	0.26	0.00	3.11	-0.02	0.09	21.93	64.01	99.26
2 / 9 . *	9.81	0.21	0.00	3.09	-0.01	0.04	22.03	63.80	98.99
2 / 10 .	9.82	0.18	0.02	3.10	0.03	0.06	22.09	63.97	99.27
Avg 111_plag_4.2	9.81	0.21	0.00	3.09	0.00	0.07	22.16	64.04	99.38
111_plag_5									
1 / 1 .	9.61	0.29	-0.01	3.31	-0.01	0.09	22.22	63.57	99.09

Table B1: Plagioclase Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
1 / 2 .	9.66	0.31	0.01	3.33	0.00	0.09	22.49	63.94	99.83
1 / 3 .	9.64	0.27	0.00	3.37	0.01	0.08	22.51	63.95	99.83
1 / 4 .	9.56	0.27	0.00	3.27	-0.02	0.05	22.29	63.59	99.04
1 / 5 .	9.67	0.26	0.00	3.34	-0.01	0.07	22.42	63.80	99.57
1 / 6 .	9.64	0.28	-0.01	3.35	0.02	0.09	22.33	63.65	99.37
1 / 7 .	9.56	0.27	0.00	3.27	0.01	0.05	22.31	63.83	99.29
1 / 8 .	9.60	0.26	-0.01	3.32	0.02	0.11	22.31	64.11	99.72
1 / 9 .	9.64	0.27	-0.02	3.13	0.01	0.11	22.42	64.04	99.62
1 / 10 .	9.53	0.26	0.01	3.35	0.00	0.10	22.45	63.82	99.51
2 / 1 .	9.40	0.31	0.01	3.56	0.00	0.09	22.20	63.83	99.40
2 / 2 .	9.44	0.32	-0.01	3.51	0.00	0.10	22.66	63.82	99.86
2 / 3 .	9.51	0.33	-0.01	3.60	0.03	0.01	22.78	63.83	100.09
2 / 4 .	9.28	0.33	0.00	3.58	-0.05	0.11	22.51	63.52	99.33
2 / 5 .	9.31	0.34	-0.02	3.58	0.04	0.09	22.75	63.63	99.74
2 / 6 .	9.47	0.31	0.01	3.59	0.02	0.06	22.37	63.69	99.54
2 / 7 .	9.43	0.30	0.00	3.58	0.00	0.06	22.67	63.85	99.90
2 / 8 .	9.36	0.31	-0.03	3.56	-0.02	0.02	22.39	63.77	99.41
2 / 9 .	9.48	0.34	-0.01	3.56	-0.04	0.05	22.50	63.77	99.70
2 / 10 .	9.53	0.28	0.01	3.57	0.02	0.06	22.52	63.48	99.46
Avg 111_plag_5	9.52	0.30	0.00	3.44	0.00	0.07	22.45	63.77	99.55
111_plag_6									
1 / 1 .	9.55	0.46	0.00	3.22	-0.02	0.11	22.23	63.57	99.14
1 / 2 .	9.55	0.50	0.00	3.21	0.02	0.14	22.22	63.76	99.39
1 / 3 .	9.43	0.46	0.00	3.32	0.01	0.11	22.26	63.45	99.04
1 / 4 .	9.41	0.50	-0.02	3.28	0.03	0.09	21.99	63.71	99.00
1 / 5 .	9.52	0.50	-0.01	3.27	0.02	0.09	22.32	63.59	99.32
1 / 6 . *	9.42	0.48	0.00	3.31	0.01	0.11	22.09	63.59	99.00
1 / 7 .	9.44	0.46	0.00	3.34	0.01	0.07	22.28	63.71	99.31
1 / 8 .	9.35	0.46	0.01	3.28	-0.01	0.10	22.03	63.82	99.04
1 / 9 .	9.41	0.48	0.00	3.35	0.04	0.09	22.04	63.64	99.05
1 / 10 .	9.47	0.49	-0.01	3.28	-0.03	0.11	22.24	63.58	99.16

Table B1: Plagioclase Chemistries
* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
2 / 1 .	9.46	0.47	-0.01	3.25	0.00	0.08	22.33	63.51	99.10
2 / 2 . *	9.44	0.47	0.00	3.26	0.04	0.09	22.11	63.44	98.85
2 / 3 .	9.45	0.46	0.00	3.25	0.04	0.11	22.09	63.66	99.07
2 / 4 . *	9.45	0.48	0.00	3.27	0.00	0.11	22.21	63.38	98.90
2 / 5 . *	9.43	0.47	0.01	3.32	0.02	0.07	22.26	63.41	98.98
2 / 6 .	9.48	0.41	0.00	3.28	0.02	0.07	22.42	63.44	99.13
2 / 7 .	9.43	0.46	-0.01	3.31	0.00	0.12	22.22	63.53	99.07
2 / 8 . *	9.43	0.48	0.01	3.23	0.02	0.07	22.00	62.97	98.21
2 / 9 .	9.50	0.48	-0.01	3.37	0.01	0.10	22.36	63.57	99.38
2 / 10 . *	9.41	0.48	-0.01	3.31	0.01	0.13	22.01	63.39	98.73
Avg 111_plag_6	9.46	0.47	0.00	3.29	0.01	0.10	22.22	63.61	99.15
111_plag_7									
1 / 1 .	9.79	0.25	-0.01	2.89	0.01	0.06	21.81	64.37	99.19
1 / 2 .	9.84	0.27	0.00	2.88	-0.02	0.12	21.94	64.32	99.37
1 / 3 .	9.87	0.30	0.00	2.89	-0.01	0.11	21.94	64.44	99.56
1 / 4 .	9.84	0.26	-0.01	2.91	0.02	0.10	21.84	64.23	99.19
1 / 5 .	9.85	0.26	0.01	2.81	0.02	0.08	21.72	64.27	99.02
1 / 6 .	9.93	0.27	0.00	2.86	0.00	0.10	21.96	64.30	99.41
1 / 7 .	9.78	0.26	0.00	2.88	-0.03	0.06	22.12	64.54	99.63
1 / 8 .	10.01	0.25	-0.01	2.84	0.00	0.12	21.99	64.04	99.26
1 / 9 .	9.82	0.28	0.00	2.76	0.03	0.08	21.84	64.44	99.24
1 / 10 .	9.83	0.25	0.00	2.72	-0.01	0.08	21.94	64.77	99.60
1 / 11 .	9.96	0.25	0.00	2.79	-0.05	0.08	21.49	64.39	98.96
1 / 12 .	9.94	0.25	0.00	2.84	0.00	0.11	22.03	64.47	99.64
1 / 13 .	9.95	0.21	0.01	2.82	0.00	0.11	22.02	64.21	99.33
1 / 14 .	9.93	0.24	0.00	2.86	0.01	0.12	21.75	64.26	99.18
1 / 15 .	10.00	0.20	0.00	2.84	0.00	0.07	21.93	64.21	99.25
Avg 111_plag_7	9.89	0.25	0.00	2.84	0.00	0.09	21.89	64.35	99.31
111_plag_8									
1 / 1 . *	8.89	0.39	0.00	4.26	0.00	0.10	22.92	61.79	98.37

Table B1: Plagioclase Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
1 / 2 . *	8.93	0.36	0.00	4.34	0.04	0.09	23.01	61.94	98.70
1 / 3 .	9.10	0.40	0.01	4.18	-0.01	0.10	23.17	62.40	99.36
1 / 4 . *	8.99	0.38	-0.01	4.26	0.02	0.05	22.72	62.41	98.84
1 / 5 .	9.03	0.40	-0.01	4.14	-0.05	0.07	22.88	62.56	99.08
1 / 6 .	8.93	0.39	0.00	4.21	0.02	0.06	23.00	62.46	99.07
1 / 7 .	8.95	0.36	0.00	4.25	0.03	0.10	23.03	62.41	99.14
1 / 8 . *	8.92	0.36	-0.01	4.18	0.00	0.10	22.98	62.28	98.83
1 / 9 .	9.02	0.40	-0.01	4.36	0.00	0.08	22.95	62.26	99.07
1 / 10 . *	8.97	0.38	0.00	4.30	0.01	0.07	22.98	62.22	98.94
Avg 111_plag_8	9.01	0.39	0.00	4.23	0.00	0.08	23.01	62.42	99.13
111_plag_9									
1 / 1 .	9.73	0.26	-0.01	3.18	0.00	0.11	22.22	63.77	99.27
1 / 2 .	9.63	0.29	0.01	3.26	-0.02	0.09	22.15	63.67	99.11
1 / 3 . *	9.60	0.27	-0.01	3.27	-0.01	0.09	22.08	63.56	98.89
1 / 4 . *	9.59	0.32	0.00	3.25	-0.05	0.04	22.09	63.70	99.00
1 / 5 .	9.59	0.28	0.00	3.22	0.01	0.10	22.34	63.67	99.21
1 / 6 . *	9.61	0.25	-0.01	3.19	-0.02	0.11	21.83	63.66	98.65
1 / 7 . *	9.62	0.26	0.00	3.17	0.00	0.06	22.08	63.43	98.62
1 / 8 . *	9.66	0.26	0.00	3.17	0.01	0.07	22.15	63.38	98.71
1 / 9 .	9.69	0.28	0.00	3.12	0.01	0.09	22.24	63.71	99.14
1 / 10 .	9.63	0.24	-0.01	3.18	0.03	0.07	22.08	63.87	99.09
2 / 1 . *	9.59	0.29	0.00	3.31	0.01	0.10	22.11	63.31	98.73
2 / 2 . *	9.54	0.43	0.00	3.29	0.02	0.11	22.13	63.32	98.83
2 / 3 .	9.58	0.34	0.00	3.28	0.01	0.06	22.29	63.78	99.34
2 / 4 . *	9.63	0.35	-0.01	3.28	0.00	0.10	22.13	63.30	98.80
2 / 5 . *	9.65	0.33	-0.02	3.34	0.00	0.11	22.08	63.23	98.74
2 / 6 . *	9.59	0.34	0.00	3.31	0.02	0.10	22.17	63.00	98.53
2 / 7 . *	9.52	0.31	0.00	3.26	0.00	0.09	22.10	63.01	98.29
2 / 8 . *	9.67	0.27	0.00	3.26	-0.01	0.06	22.21	63.25	98.72
2 / 9 .	9.60	0.29	-0.02	3.33	-0.01	0.07	22.41	63.73	99.44
2 / 10 .	9.59	0.30	0.00	3.32	0.01	0.11	22.22	63.66	99.21

Table B1: Plagioclase Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
Avg 111_plag_9	9.63	0.29	0.00	3.24	0.01	0.09	22.24	63.73	99.22
111_plag_10									
1 / 1 .	9.05	0.44	0.00	3.95	-0.01	0.04	22.75	62.93	99.17
1 / 2 .	9.16	0.42	0.00	3.89	0.00	0.09	22.69	62.96	99.22
1 / 3 .	9.21	0.42	0.00	3.98	-0.02	0.05	22.77	63.40	99.84
1 / 4 .	9.05	0.43	0.00	4.00	-0.03	0.07	22.99	63.00	99.55
1 / 5 .	9.12	0.41	0.00	3.90	0.02	0.06	22.52	63.16	99.19
1 / 6 .	9.15	0.42	-0.01	3.91	-0.02	0.07	22.62	63.21	99.38
1 / 7 .	9.05	0.41	-0.02	3.83	-0.01	0.05	22.78	62.98	99.10
1 / 8 .	9.14	0.40	-0.02	3.93	-0.02	0.09	22.61	62.96	99.13
1 / 9 . *	8.99	0.46	0.00	3.94	0.03	0.07	22.91	62.42	98.82
1 / 10 .	9.08	0.43	-0.01	3.83	0.03	0.05	22.70	62.99	99.10
Avg 111_plag_10	9.11	0.42	-0.01	3.91	-0.01	0.06	22.71	63.07	99.28
FR-109									
109 plag_6									
1 / 1 .	9.46	0.23	0.00	3.34	0.00	0.07	22.48	64.01	99.59
1 / 2 .	9.48	0.26	-0.01	3.29	0.01	0.06	22.45	63.51	99.06
1 / 3 . *	9.28	0.26	0.00	3.26	0.01	0.12	22.21	63.54	98.69
1 / 4 .	9.50	0.27	0.00	3.24	0.01	0.10	22.38	63.85	99.35
1 / 5 .	9.56	0.28	0.00	3.21	0.03	0.11	22.54	63.77	99.49
1 / 6 . *	9.46	0.27	-0.01	3.19	-0.02	0.02	22.17	63.56	98.68
1 / 7 .	9.40	0.26	0.00	3.19	0.00	0.06	22.51	63.68	99.09
1 / 8 .	9.39	0.28	-0.01	3.19	0.02	0.04	22.49	63.70	99.12
1 / 9 . *	9.40	0.29	-0.01	3.17	0.01	0.07	22.28	63.73	98.96
1 / 10 .	9.43	0.29	-0.02	3.24	-0.01	0.06	22.35	63.94	99.31
Avg 109 plag_6	9.46	0.27	-0.01	3.24	0.01	0.07	22.46	63.78	99.28
109 plag_7									
3 / 1 . *	9.58	0.19	-0.01	3.12	0.01	0.04	22.20	63.60	98.72
3 / 2 . *	9.54	0.16	0.00	3.07	0.01	0.10	22.02	63.51	98.40

Table B1: Plagioclase Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
3 / 3 . *	9.51	0.16	-0.01	3.04	-0.03	0.04	21.95	63.75	98.46
3 / 4 . *	9.64	0.19	0.00	3.05	-0.02	0.05	22.11	63.59	98.64
3 / 5 . *	9.69	0.18	0.01	2.93	-0.03	0.06	22.13	63.96	98.96
3 / 6 . *	9.59	0.18	0.01	3.01	0.02	0.06	21.99	63.96	98.82
3 / 7 .	9.69	0.20	0.00	3.07	0.00	0.03	22.34	63.86	99.19
3 / 8 .	9.66	0.17	0.01	3.06	0.02	0.04	22.17	64.13	99.26
3 / 9 .	9.70	0.15	-0.01	3.04	-0.03	0.07	22.40	63.95	99.31
3 / 10 .	9.72	0.13	-0.01	3.20	0.01	0.03	22.24	64.11	99.43
Avg 109 plag_7	9.69	0.16	0.00	3.09	0.00	0.04	22.29	64.01	99.29
109 plag_10									
2 / 1 .	9.52	0.17	0.00	3.13	-0.01	0.06	22.13	64.20	99.22
2 / 2 .	9.59	0.18	-0.01	3.15	-0.01	0.14	22.25	64.11	99.44
2 / 3 .	9.65	0.17	0.00	3.24	-0.02	0.07	22.32	63.96	99.41
2 / 4 .	9.54	0.21	-0.01	3.26	-0.01	0.12	22.16	64.27	99.57
2 / 5 . *	9.55	0.20	0.00	3.13	0.00	0.09	22.19	63.73	98.88
2 / 6 .	9.44	0.19	0.01	3.18	0.00	0.08	22.17	64.21	99.27
2 / 7 .	9.61	0.20	0.01	3.10	0.02	0.16	22.38	64.24	99.71
2 / 8 .	9.50	0.21	0.00	3.14	0.01	0.05	22.22	63.91	99.04
2 / 9 .	9.55	0.19	-0.01	2.96	-0.01	0.08	22.13	64.24	99.15
2 / 10 .	9.56	0.21	0.00	3.15	0.03	0.06	22.21	64.26	99.50
Avg 109 plag_10.2	9.55	0.19	0.00	3.15	0.00	0.09	22.22	64.16	99.35
3 / 1 . *	9.53	0.18	-0.01	3.17	0.02	0.08	22.18	63.71	98.88
3 / 2 . *	9.52	0.18	-0.01	3.15	-0.02	0.06	21.99	64.09	98.99
3 / 3 .	9.64	0.19	0.00	3.13	0.01	0.10	22.03	64.10	99.22
3 / 4 . *	9.64	0.20	0.01	3.12	0.00	0.07	21.93	63.78	98.76
3 / 5 .	9.63	0.19	-0.01	3.02	-0.02	0.09	22.02	64.47	99.42
3 / 6 . *	9.60	0.20	0.02	3.00	-0.01	0.06	21.80	64.03	98.71
3 / 7 . *	9.52	0.22	0.00	3.06	0.01	0.08	21.95	63.83	98.67
3 / 8 .	9.60	0.17	0.00	3.08	0.00	0.04	22.05	64.21	99.15
3 / 9 .	9.71	0.17	-0.01	3.14	0.03	0.08	22.07	63.94	99.14

Table B1: Plagioclase Chemistries
* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
3 / 10 .	9.67	0.14	0.01	3.11	0.01	0.10	21.97	64.13	99.15
Avg 109 plag_10.3	9.65	0.17	0.00	3.10	0.01	0.08	22.03	64.17	99.21
FR-108c									
108c plag_1.1									
1 / 1 .	9.09	0.40	-0.01	3.78	-0.01	0.10	22.51	63.57	99.45
1 / 2 .	9.23	0.34	-0.01	3.64	-0.01	0.06	22.42	63.36	99.05
1 / 3 . *	9.18	0.35	-0.02	3.66	0.00	0.06	22.56	62.95	98.77
1 / 4 . *	9.33	0.38	0.00	3.65	0.04	0.05	22.35	63.01	98.81
1 / 5 .	9.28	0.26	-0.01	3.72	-0.02	0.10	22.62	63.23	99.22
1 / 6 .	9.25	0.38	0.00	3.65	-0.02	0.03	22.58	63.28	99.17
1 / 7 . *	9.19	0.42	-0.01	3.59	0.03	0.02	22.49	63.20	98.93
1 / 8 .	9.29	0.39	0.00	3.72	0.03	0.07	22.66	62.90	99.05
1 / 9 .	9.15	0.46	0.00	3.68	-0.02	0.09	22.70	63.35	99.43
1 / 10 .	9.13	0.46	0.00	3.80	0.00	0.10	22.75	62.98	99.21
Avg 108c plag_1.1	9.20	0.39	-0.01	3.71	-0.01	0.08	22.61	63.24	99.21
2 / 1 .	8.84	0.41	0.00	4.10	0.00	0.07	22.93	62.72	99.07
2 / 2 . *	8.85	0.38	0.00	4.12	-0.01	0.06	22.81	62.53	98.74
2 / 3 . *	8.86	0.39	-0.01	4.07	0.03	0.06	22.77	62.46	98.63
2 / 4 . *	8.87	0.40	0.00	4.07	0.02	0.07	22.83	62.69	98.96
2 / 5 .	8.98	0.39	-0.01	3.99	0.00	0.06	23.07	62.65	99.14
2 / 6 .	8.87	0.38	0.00	4.10	-0.01	0.08	23.35	62.74	99.52
2 / 7 .	9.04	0.40	0.00	4.06	0.00	0.12	22.98	62.67	99.27
2 / 8 .	8.92	0.40	0.02	4.09	0.01	0.04	23.05	62.89	99.42
2 / 9 .	9.02	0.36	0.02	4.11	-0.03	0.08	22.94	62.70	99.23
2 / 10 .	8.94	0.33	0.00	4.12	0.03	0.06	23.04	62.91	99.42
108c plag_1.2	8.94	0.38	0.00	4.08	0.00	0.07	23.05	62.75	99.29
108c plag_2									
1 / 1 .	9.80	0.27	0.00	3.04	-0.02	0.13	22.10	64.40	99.74
1 / 2 .	9.86	0.16	0.01	3.01	-0.02	0.07	21.83	64.56	99.48

Table B1: Plagioclase Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
1 / 3 .	9.78	0.20	0.01	3.14	-0.01	0.07	22.11	64.20	99.52
1 / 4 .	9.60	0.15	-0.01	3.64	0.02	0.11	22.82	64.22	100.57
1 / 5 .	7.51	3.07	0.00	3.19	-0.06	0.09	22.05	63.19	99.11
1 / 6 .	9.12	0.24	-0.01	4.24	0.00	0.08	23.13	62.88	99.71
1 / 7 .	9.21	0.28	0.00	3.96	0.03	0.07	23.01	63.03	99.59
1 / 8 .	9.17	0.27	0.00	3.87	0.02	0.07	22.86	63.71	99.97
1 / 9 .	9.26	0.24	0.00	3.79	0.02	0.05	22.74	63.35	99.44
1 / 10 .	9.18	0.29	0.00	3.77	-0.03	0.06	22.72	63.35	99.36
Avg 108c plag_2.1	9.25	0.52	0.00	3.56	0.00	0.08	22.54	63.69	99.63
2 / 1 .	9.62	0.17	0.01	3.15	0.02	0.03	22.40	64.29	99.69
2 / 2 .	9.81	0.16	0.00	3.09	-0.04	0.09	21.98	64.38	99.50
2 / 3 .	9.77	0.19	0.00	3.10	0.00	0.11	22.10	64.21	99.48
2 / 4 .	9.64	0.17	0.01	3.04	0.03	0.03	22.00	64.26	99.18
2 / 5 .	9.77	0.17	-0.01	3.07	-0.01	0.12	22.12	64.28	99.54
2 / 6 .	9.81	0.21	-0.01	3.08	0.00	0.08	22.04	63.89	99.10
2 / 7 .	9.80	0.17	0.01	3.05	0.00	0.08	22.27	64.23	99.61
2 / 8 .	9.75	0.19	0.00	3.14	0.01	0.04	22.33	64.62	100.07
2 / 9 .	9.76	0.19	0.00	3.03	0.02	0.08	22.13	64.12	99.34
2 / 10 .	9.70	0.20	0.00	3.05	0.00	0.08	22.14	64.38	99.55
Avg 108c plag_2.2	9.74	0.18	0.00	3.08	0.00	0.07	22.15	64.27	99.50
108c plag_3									
1 / 1 .	9.68	0.23	-0.01	3.39	0.00	0.08	22.57	64.25	100.20
1 / 2 .	9.60	0.23	-0.01	3.42	0.02	0.01	22.37	64.17	99.82
1 / 3 .	9.68	0.25	0.00	3.31	-0.02	0.01	22.42	64.34	100.00
1 / 4 .	9.62	0.23	0.01	3.36	-0.02	0.09	22.49	64.41	100.20
1 / 5 .	8.98	1.31	0.00	3.12	0.00	0.06	21.89	64.14	99.50
1 / 6 .	9.57	0.30	0.00	3.30	0.00	0.04	22.56	64.35	100.13
1 / 7 .	9.64	0.30	-0.01	3.29	0.01	0.05	22.38	64.36	100.04
1 / 8 .	9.52	0.31	0.01	3.35	0.01	0.04	22.38	64.61	100.23
1 / 9 .	9.64	0.32	0.02	3.38	0.00	0.12	22.62	64.40	100.50

Table B1: Plagioclase Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
1 / 10 .	9.48	0.31	-0.01	3.39	-0.02	0.06	22.59	64.04	99.87
2 / 1 .	9.56	0.27	0.01	3.32	0.00	0.03	22.44	64.55	100.18
2 / 2 .	9.68	0.27	0.00	3.27	0.00	0.09	22.32	64.72	100.36
2 / 3 .	9.59	0.30	0.00	3.23	0.01	0.10	22.55	64.36	100.15
2 / 4 .	9.62	0.32	-0.01	3.28	0.02	0.11	22.59	64.47	100.40
2 / 5 .	9.59	0.30	0.01	3.29	0.02	0.08	22.35	64.47	100.12
2 / 6 .	9.67	0.29	0.00	3.28	-0.01	0.04	22.26	64.20	99.74
2 / 7 .	9.61	0.28	0.00	3.28	-0.03	0.08	22.57	64.45	100.28
2 / 8 .	9.66	0.27	0.00	3.33	0.00	0.06	22.47	64.46	100.26
2 / 9 .	9.59	0.29	-0.01	3.32	0.03	0.12	22.44	64.57	100.35
2 / 10 .	9.74	0.21	0.00	3.28	-0.03	0.08	22.47	64.24	100.01
3 / 1 . *	9.35	0.31	-0.01	3.44	-0.01	0.04	22.13	63.21	98.47
3 / 2 .	9.47	0.31	0.00	3.42	0.01	0.07	22.40	64.10	99.77
3 / 3 .	9.49	0.32	0.01	3.42	0.00	0.07	22.45	64.23	99.98
3 / 4 .	9.43	0.30	0.00	3.54	0.02	0.08	22.59	64.27	100.23
3 / 5 .	9.48	0.28	-0.01	3.43	0.01	0.06	22.32	63.91	99.49
3 / 6 .	9.52	0.31	0.01	3.38	0.01	0.07	22.46	64.23	99.97
3 / 7 .	9.32	0.32	-0.01	3.52	0.00	0.07	22.50	64.12	99.86
3 / 8 .	9.52	0.30	-0.01	3.40	0.02	0.05	22.31	63.72	99.30
3 / 9 .	9.50	0.29	0.00	3.45	0.03	0.04	22.28	63.83	99.43
3 / 10 .	9.60	0.26	0.00	3.41	0.02	0.04	22.39	63.83	99.54
Avg 108c plag_3	9.55	0.32	0.00	3.35	0.00	0.07	22.43	64.27	99.99
108c plag_4									
1 / 1 .	9.15	0.33	-0.02	3.91	0.01	0.04	23.08	63.40	99.92
1 / 2 .	9.13	0.36	-0.02	3.97	-0.01	0.11	22.94	63.47	99.98
1 / 3 .	9.05	0.33	-0.01	4.13	0.00	0.06	23.06	63.29	99.92
1 / 4 .	9.08	0.33	0.00	4.01	-0.02	0.08	23.00	63.07	99.58
1 / 5 .	9.11	0.35	0.00	4.08	0.01	0.06	23.15	63.19	99.95
1 / 6 .	9.19	0.36	0.00	4.03	0.02	0.06	23.09	63.37	100.11
1 / 7 .	9.17	0.35	0.00	4.04	0.04	0.09	23.24	63.44	100.39
1 / 8 .	9.25	0.29	0.00	4.05	0.03	0.10	23.19	63.60	100.51

Table B1: Plagioclase Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
1 / 9 .	9.10	0.33	-0.01	4.05	-0.02	0.04	22.98	63.32	99.82
1 / 10 .	9.14	0.33	-0.01	3.96	-0.03	0.07	23.10	63.24	99.84
2 / 1 .	9.02	0.35	-0.01	4.21	0.05	0.08	23.10	63.29	100.11
2 / 2 .	9.07	0.29	0.01	4.18	-0.04	0.08	22.90	63.40	99.93
2 / 3 .	9.08	0.35	-0.01	4.17	0.00	0.03	23.08	62.92	99.64
2 / 4 .	9.13	0.36	0.00	4.15	0.01	0.03	23.05	63.24	99.98
2 / 5 .	9.02	0.33	0.00	4.12	-0.02	0.58	22.94	63.01	100.01
2 / 6 .	9.03	0.36	-0.02	4.19	0.01	0.06	23.24	63.33	100.22
2 / 7 .	9.09	0.27	0.00	4.20	0.02	0.04	23.29	63.20	100.11
2 / 8 .	8.98	0.33	-0.01	4.23	0.00	0.09	23.29	63.23	100.14
2 / 9 .	8.98	0.34	-0.01	4.16	0.03	0.06	23.16	63.30	100.03
2 / 10 .	9.07	0.33	0.00	4.20	-0.01	0.07	23.08	63.55	100.30
Avg 108c plag_4	9.09	0.33	-0.01	4.10	0.00	0.09	23.10	63.29	100.01
108c plag_5									
1 / 1 .	9.44	0.25	-0.01	3.68	0.00	0.08	22.81	63.96	100.22
1 / 2 .	9.38	0.34	-0.01	3.70	0.00	0.04	22.74	63.59	99.79
1 / 3 .	9.30	0.33	0.00	3.73	-0.02	0.02	22.72	64.00	100.10
1 / 4 .	9.28	0.31	-0.01	3.67	0.00	0.06	22.58	63.68	99.58
1 / 5 .	9.43	0.31	0.00	3.59	-0.02	0.07	22.78	63.74	99.92
1 / 6 .	9.32	0.32	-0.01	3.56	0.00	0.07	22.77	64.09	100.14
1 / 7 .	9.41	0.31	0.01	3.62	0.03	0.07	22.56	63.85	99.86
1 / 8 .	9.31	0.34	0.00	3.63	-0.03	0.04	22.81	63.79	99.92
1 / 9 .	9.34	0.32	0.01	3.63	0.00	0.07	22.72	64.09	100.18
1 / 10 .	9.30	0.30	0.00	3.57	0.02	0.08	22.59	64.11	99.97
Avg 108c plag_5.1	9.35	0.31	0.00	3.64	0.00	0.06	22.71	63.89	99.96
2 / 1 .	9.11	0.35	0.00	4.01	-0.01	0.07	22.90	63.18	99.62
2 / 2 .	9.15	0.37	0.00	3.97	-0.01	0.04	23.01	63.58	100.11
2 / 3 .	9.13	0.36	0.00	4.03	-0.01	0.06	23.02	63.30	99.90
2 / 4 .	9.15	0.36	0.00	3.98	0.01	0.08	23.00	63.35	99.93
2 / 5 .	9.17	0.35	0.00	4.07	-0.02	0.03	23.01	63.62	100.24

Table B1: Plagioclase Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
2 / 6 .	9.03	0.52	0.01	3.96	0.01	0.04	23.15	62.76	99.49
2 / 7 .	9.07	0.35	0.00	4.09	0.03	0.08	23.01	63.11	99.73
2 / 8 .	9.13	0.34	0.01	4.01	0.00	0.04	23.07	63.07	99.66
2 / 9 .	9.09	0.38	-0.01	4.09	-0.03	0.10	22.97	63.65	100.27
2 / 10 .	9.02	0.35	0.00	4.07	-0.01	0.07	22.91	63.62	100.05
Avg 108c plag_5.2	9.11	0.37	0.00	4.03	-0.01	0.06	23.00	63.32	99.89
108c plag_6									
1 / 1 .	8.71	0.38	0.01	4.37	0.02	0.12	23.23	62.73	99.58
1 / 2 .	8.96	0.42	-0.01	4.20	-0.01	0.11	23.39	62.86	99.95
1 / 3 .	8.93	0.37	-0.01	4.01	-0.02	0.07	23.00	63.61	99.99
1 / 4 .	9.28	0.30	0.00	3.80	-0.02	0.08	22.78	63.64	99.88
1 / 5 .	11.61	0.14	0.00	0.21	-0.03	0.03	20.03	68.59	100.61
1 / 6 .	0.00	0.00	0.00	0.00	0.06	-0.03	0.02	100.81	100.89
1 / 7 .	0.00	0.00	0.00	0.01	-0.04	0.02	-0.01	100.22	100.25
1 / 8 .	0.00	0.01	0.00	-0.01	0.02	0.01	-0.01	100.58	100.62
1 / 9 .	0.00	0.00	-0.01	0.00	-0.01	0.01	0.04	99.67	99.72
1 / 10 .	0.09	0.01	0.01	0.01	0.02	-0.02	0.01	100.70	100.84
2 / 1 .	8.77	0.38	-0.02	4.39	0.02	0.04	23.23	62.92	99.74
2 / 2 .	8.87	0.36	-0.01	4.33	0.00	0.08	23.43	62.94	100.01
2 / 3 .	8.98	0.38	0.01	4.40	0.02	0.03	23.53	62.51	99.85
2 / 4 .	8.89	0.38	0.00	4.33	0.01	0.08	23.37	62.61	99.66
2 / 5 .	8.75	0.38	-0.01	4.39	0.02	0.08	23.30	62.82	99.74
2 / 6 .	8.74	0.39	0.01	4.33	0.00	0.08	23.49	63.02	100.05
2 / 7 .	8.97	0.38	-0.01	4.29	0.01	0.10	23.31	63.08	100.14
2 / 8 .	8.86	0.39	-0.01	4.27	0.01	0.05	23.37	62.94	99.90
2 / 9 .	8.84	0.41	-0.01	4.23	0.00	0.07	23.22	62.83	99.60
2 / 10 .	8.91	0.39	0.00	4.13	0.00	0.03	23.13	63.12	99.71
Avg 108c plag_6	6.81	0.27	0.00	2.98	0.00	0.05	17.29	72.61	100.02
108c plag_7									
1 / 1 .	9.76	0.23	0.00	2.96	0.03	0.13	22.20	64.70	100.01

Table B1: Plagioclase Chemistries
* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
1 / 2 .	9.86	0.25	-0.01	2.98	0.04	0.11	22.37	64.65	100.26
1 / 3 .	9.72	0.24	-0.01	2.96	0.00	0.06	22.01	64.44	99.42
1 / 4 .	9.79	0.21	0.00	2.94	0.01	0.12	22.11	64.46	99.64
1 / 5 .	9.85	0.22	-0.01	2.96	-0.01	0.11	22.01	64.49	99.65
Avg 108c plag_7.1	9.80	0.23	-0.01	2.96	0.02	0.10	22.14	64.55	99.79
2 / 1 .	9.86	0.23	0.01	2.89	-0.01	0.11	22.14	64.52	99.76
2 / 2 .	9.81	0.20	0.00	2.90	-0.03	0.07	22.19	64.71	99.87
2 / 3 .	9.76	0.31	0.02	2.88	-0.02	0.08	22.13	64.25	99.44
2 / 4 .	9.44	0.67	0.05	2.72	0.00	0.15	21.97	64.09	99.09
2 / 5 .	9.63	0.22	-0.01	3.07	0.00	0.05	22.17	64.56	99.71
2 / 6 .	9.79	0.23	-0.01	3.01	0.02	0.12	21.98	64.30	99.45
2 / 7 .	9.70	0.23	-0.03	2.97	0.00	0.09	22.36	64.46	99.81
2 / 8 .	9.76	0.24	0.00	3.01	-0.02	0.06	22.33	64.28	99.68
2 / 9 .	9.71	0.21	-0.01	3.05	0.00	0.05	22.34	64.41	99.77
2 / 10 .	9.79	0.20	-0.01	3.04	0.04	0.06	22.33	64.59	100.05
Avg 108c plag_7.2	9.73	0.27	0.00	2.95	0.00	0.08	22.19	64.42	99.65
108c plag_8									
1 / 1 .	9.31	0.32	0.00	3.53	0.00	0.08	22.63	63.40	99.27
1 / 2 .	9.36	0.30	0.00	3.56	-0.01	0.07	22.70	63.69	99.68
1 / 3 .	9.21	0.33	0.01	3.49	0.00	0.06	22.53	63.63	99.25
1 / 4 .	9.36	0.32	-0.01	3.50	0.02	0.07	22.51	63.72	99.50
1 / 5 .	9.35	0.33	0.00	3.47	0.00	0.07	22.58	64.08	99.89
1 / 6 .	9.42	0.30	-0.01	3.44	0.02	0.11	22.51	63.81	99.60
1 / 7 .	9.53	0.29	-0.01	3.42	0.00	0.04	22.56	63.85	99.70
1 / 8 .	9.47	0.28	0.00	3.55	0.02	0.11	22.56	64.31	100.31
1 / 9 .	9.35	0.27	0.01	3.41	0.00	0.07	22.44	64.15	99.72
1 / 10 .	9.37	0.26	-0.01	3.48	0.01	0.05	22.62	63.85	99.64
2 / 1 .	9.50	0.24	0.01	3.38	0.02	0.09	22.46	63.90	99.59
2 / 2 .	9.58	0.23	0.01	3.34	0.01	0.04	22.51	64.12	99.84
2 / 3 .	9.36	0.26	0.01	3.38	0.01	0.08	22.44	63.90	99.46

Table B1: Plagioclase Chemistries
* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
2 / 4 .	9.42	0.26	0.00	3.33	-0.01	0.11	22.62	63.67	99.42
2 / 5 .	9.48	0.29	-0.01	3.32	-0.01	0.07	22.41	63.94	99.51
2 / 6 .	9.46	0.27	0.01	3.28	-0.01	0.07	22.44	63.63	99.16
2 / 7 .	9.50	0.28	0.00	3.34	0.00	0.07	22.33	64.19	99.72
2 / 8 .	9.55	0.29	0.00	3.23	-0.02	0.08	22.51	63.97	99.63
2 / 9 .	9.56	0.30	0.00	3.30	0.02	0.08	22.30	63.88	99.43
2 / 10 .	9.43	0.27	0.00	3.33	0.03	0.06	22.46	63.71	99.30
3 / 1 .	9.52	0.18	-0.01	3.42	0.01	0.08	22.55	64.15	99.92
3 / 2 .	9.52	0.17	-0.02	3.44	0.00	0.11	22.47	64.60	100.31
3 / 3 .	9.65	0.19	0.00	3.33	0.01	0.07	22.39	64.21	99.86
3 / 4 .	9.61	0.17	0.02	3.48	-0.01	0.04	22.36	63.97	99.64
3 / 5 .	9.52	0.17	-0.01	3.38	0.02	0.09	22.52	64.50	100.21
3 / 6 .	9.65	0.19	-0.01	3.42	0.01	0.12	22.43	63.88	99.69
3 / 7 .	9.49	0.17	0.00	3.39	-0.03	0.06	22.49	64.42	100.01
3 / 8 .	9.54	0.18	-0.02	3.46	-0.01	0.05	22.55	64.34	100.12
3 / 9 .	9.61	0.17	0.01	3.46	0.00	0.06	22.45	64.40	100.16
3 / 10 .	9.52	0.16	-0.01	3.51	-0.02	0.06	22.47	64.17	99.89
Avg 108c plag_8	9.47	0.25	0.00	3.41	0.00	0.07	22.49	64.00	99.71
108c plag_9									
1 / 1 .	9.31	0.32	0.00	3.53	0.00	0.08	22.63	63.40	99.27
1 / 2 .	9.36	0.30	0.00	3.56	-0.01	0.07	22.70	63.69	99.68
1 / 3 .	9.21	0.33	0.01	3.49	0.00	0.06	22.53	63.63	99.25
1 / 4 .	9.36	0.32	-0.01	3.50	0.02	0.07	22.51	63.72	99.50
1 / 5 .	9.35	0.33	0.00	3.47	0.00	0.07	22.58	64.08	99.89
1 / 6 .	9.42	0.30	-0.01	3.44	0.02	0.11	22.51	63.81	99.60
1 / 7 .	9.53	0.29	-0.01	3.42	0.00	0.04	22.56	63.85	99.70
1 / 8 .	9.47	0.28	0.00	3.55	0.02	0.11	22.56	64.31	100.31
1 / 9 .	9.35	0.27	0.01	3.41	0.00	0.07	22.44	64.15	99.72
1 / 10 .	9.37	0.26	-0.01	3.48	0.01	0.05	22.62	63.85	99.64
2 / 1 .	9.50	0.24	0.01	3.38	0.02	0.09	22.46	63.90	99.59
2 / 2 .	9.58	0.23	0.01	3.34	0.01	0.04	22.51	64.12	99.84

Table B1: Plagioclase Chemistries
* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
2 / 3 .	9.36	0.26	0.01	3.38	0.01	0.08	22.44	63.90	99.46
2 / 4 .	9.42	0.26	0.00	3.33	-0.01	0.11	22.62	63.67	99.42
2 / 5 .	9.48	0.29	-0.01	3.32	-0.01	0.07	22.41	63.94	99.51
2 / 6 .	9.46	0.27	0.01	3.28	-0.01	0.07	22.44	63.63	99.16
2 / 7 .	9.50	0.28	0.00	3.34	0.00	0.07	22.33	64.19	99.72
2 / 8 .	9.55	0.29	0.00	3.23	-0.02	0.08	22.51	63.97	99.63
2 / 9 .	9.56	0.30	0.00	3.30	0.02	0.08	22.30	63.88	99.43
2 / 10 .	9.43	0.27	0.00	3.33	0.03	0.06	22.46	63.71	99.30
3 / 1 .	9.52	0.18	-0.01	3.42	0.01	0.08	22.55	64.15	99.92
3 / 2 .	9.52	0.17	-0.02	3.44	0.00	0.11	22.47	64.60	100.31
3 / 3 .	9.65	0.19	0.00	3.33	0.01	0.07	22.39	64.21	99.86
3 / 4 .	9.61	0.17	0.02	3.48	-0.01	0.04	22.36	63.97	99.64
3 / 5 .	9.52	0.17	-0.01	3.38	0.02	0.09	22.52	64.50	100.21
3 / 6 .	9.65	0.19	-0.01	3.42	0.01	0.12	22.43	63.88	99.69
3 / 7 .	9.49	0.17	0.00	3.39	-0.03	0.06	22.49	64.42	100.01
3 / 8 .	9.54	0.18	-0.02	3.46	-0.01	0.05	22.55	64.34	100.12
3 / 9 .	9.61	0.17	0.01	3.46	0.00	0.06	22.45	64.40	100.16
3 / 10 .	9.52	0.16	-0.01	3.51	-0.02	0.06	22.47	64.17	99.89
Avg 108c plag_9	9.47	0.25	0.00	3.41	0.00	0.07	22.49	64.00	99.71
108c plag_10									
1 / 1 .	9.03	0.39	0.00	4.15	0.02	0.08	23.15	62.93	99.74
1 / 2 .	8.97	0.38	-0.01	4.16	-0.03	0.08	23.25	62.75	99.59
1 / 3 .	8.98	0.36	0.01	4.16	-0.01	0.50	23.14	62.70	99.84
1 / 4 .	8.79	0.35	0.01	4.14	0.02	0.09	23.34	63.15	99.89
1 / 5 .	8.84	0.39	-0.01	4.22	-0.01	0.07	23.22	63.23	99.97
2 / 1 .	8.90	0.36	0.00	4.19	0.03	0.09	23.48	63.22	100.27
2 / 2 .	8.97	0.31	0.00	4.19	-0.02	0.05	23.19	63.12	99.82
2 / 3 .	8.96	0.29	0.03	4.19	-0.01	0.11	23.20	63.06	99.85
2 / 4 . *	8.21	0.57	1.85	3.28	0.01	1.38	21.77	61.55	98.61
2 / 5 .	9.06	0.21	0.01	4.14	-0.01	0.07	23.26	63.35	100.09
2 / 6 .	9.14	0.18	0.00	4.16	-0.01	0.12	23.32	63.32	100.24

Table B1: Plagioclase Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
2 / 7 .	9.21	0.13	0.01	4.06	0.02	0.11	23.06	63.02	99.61
2 / 8 .	9.28	0.13	-0.01	4.02	0.01	0.12	23.01	63.17	99.73
2 / 9 .	9.05	0.35	0.03	3.96	-0.01	0.20	23.24	63.15	99.98
2 / 10 .	9.19	0.25	0.02	4.07	-0.03	0.19	23.11	62.79	99.61
Avg 108c plag10.1	9.03	0.29	0.01	4.13	0.00	0.13	23.21	63.07	99.86
3 / 1 .	9.28	0.26	0.00	3.58	0.01	0.10	22.86	63.71	99.80
3 / 2 .	9.45	0.24	0.01	3.52	0.03	0.09	22.62	64.38	100.35
3 / 3 .	9.43	0.25	-0.01	3.51	0.00	0.08	22.54	64.12	99.94
3 / 4 .	9.36	0.25	-0.01	3.49	0.01	0.09	22.64	64.01	99.84
3 / 5 .	9.45	0.24	-0.01	3.47	0.00	0.08	22.59	63.95	99.78
3 / 6 .	9.39	0.28	0.00	3.55	-0.02	0.06	22.58	63.99	99.84
3 / 7 .	9.36	0.23	0.00	3.62	-0.01	0.07	22.43	63.97	99.68
3 / 8 .	9.41	0.23	-0.01	3.59	0.01	0.07	22.89	64.05	100.25
3 / 9 .	9.38	0.23	0.00	3.57	-0.02	0.08	22.64	63.93	99.84
3 / 10 .	9.50	0.20	-0.01	3.56	-0.01	0.05	22.65	63.94	99.90
4 / 1 .	9.38	0.21	0.00	3.49	0.01	0.08	22.79	63.93	99.89
4 / 2 .	9.36	0.20	0.00	3.59	-0.02	0.05	22.62	64.07	99.89
4 / 3 .	9.40	0.21	-0.01	3.49	-0.01	0.05	22.76	64.27	100.17
4 / 4 .	9.47	0.22	0.00	3.59	-0.03	0.02	22.55	64.13	99.99
4 / 5 .	9.31	0.24	-0.01	3.54	0.03	0.06	22.69	64.01	99.88
4 / 6 .	9.47	0.25	-0.01	3.56	0.01	0.07	22.77	63.95	100.08
4 / 7 .	9.44	0.21	0.00	3.56	-0.02	0.06	22.75	63.79	99.82
4 / 8 .	9.43	0.22	0.00	3.62	0.02	0.05	22.57	63.86	99.77
4 / 9 .	9.34	0.21	0.00	3.51	0.01	0.04	22.63	64.18	99.92
4 / 10 .	9.39	0.22	-0.01	3.56	0.02	0.05	22.61	64.16	100.00
4 / 11 .	9.42	0.20	-0.01	3.51	0.03	0.10	22.58	64.04	99.87
4 / 12 .	9.49	0.21	0.00	3.58	0.00	0.08	22.62	64.30	100.28
4 / 13 .	9.41	0.17	-0.01	3.51	0.00	0.07	22.50	64.33	100.00
4 / 14 .	9.43	0.17	0.00	3.46	-0.02	0.07	22.86	64.15	100.15
4 / 15 .	9.49	0.15	0.01	3.54	-0.02	0.09	22.78	64.14	100.18
Avg 108c plag10.2	9.41	0.22	0.00	3.54	0.00	0.07	22.66	64.05	99.95

Table B1: Plagioclase Chemistries
* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
FR-108									
108_plag_1.1									
1 / 1 .	8.97	0.43	0.01	4.44	0.00	0.08	23.31	62.00	99.26
1 / 2 . *	8.85	0.43	0.01	4.52	-0.03	0.10	23.02	61.80	98.73
1 / 3 . *	8.76	0.42	-0.01	4.46	0.04	0.13	22.99	61.67	98.46
1 / 4 .	8.82	0.37	0.00	4.44	0.03	0.11	23.29	61.93	99.00
1 / 5 .	8.79	0.40	0.00	4.60	0.02	0.06	23.31	61.96	99.14
1 / 6 .	8.77	0.44	0.00	4.60	0.02	0.08	23.31	61.84	99.07
1 / 7 .	8.77	0.41	-0.01	4.55	0.02	0.06	23.49	62.02	99.33
1 / 8 . *	8.76	0.45	-0.01	4.70	-0.01	0.08	23.38	61.59	98.96
1 / 9 . *	8.61	0.42	0.00	4.68	0.00	0.07	23.23	61.50	98.50
1 / 10 .	8.87	0.37	0.00	4.67	-0.01	0.06	23.56	61.54	99.08
Avg 108_plag_1.1	8.83	0.40	0.00	4.55	0.01	0.08	23.38	61.88	99.14
2 / 1 .	9.00	0.47	0.00	4.13	-0.02	0.07	22.86	62.59	99.11
2 / 2 .	8.93	0.41	0.00	4.12	-0.02	0.07	22.89	62.69	99.10
2 / 3 .	8.97	0.45	0.00	4.24	-0.01	0.07	22.82	62.60	99.16
2 / 4 .	8.87	0.48	-0.02	4.18	-0.01	0.03	22.85	62.63	99.04
2 / 5 .	8.96	0.46	-0.01	4.19	0.03	0.05	22.85	62.60	99.13
2 / 6 .	8.97	0.48	0.00	4.19	-0.01	0.09	22.93	62.17	98.82
2 / 7 .	9.00	0.46	-0.01	4.20	-0.02	0.09	22.90	62.39	99.04
2 / 8 .	9.07	0.44	0.00	4.17	0.04	0.07	23.09	63.04	99.92
2 / 9 .	8.96	0.45	-0.01	4.21	0.01	0.08	23.04	62.54	99.27
2 / 10 .	9.00	0.41	0.01	4.25	0.01	0.11	22.88	62.43	99.08
Avg 108_plag_1.2	8.97	0.45	0.00	4.19	0.00	0.07	22.91	62.57	99.15
108_plag_2									
1 / 1 .	9.51	0.23	-0.01	3.57	0.04	0.07	22.36	63.88	99.65
1 / 2 .	9.59	0.23	0.00	3.62	0.00	0.11	22.37	63.24	99.16
1 / 3 .	9.60	0.27	-0.01	3.66	-0.01	0.07	22.70	62.84	99.13
1 / 4 .	9.53	0.28	0.00	3.61	-0.02	0.08	22.64	63.56	99.70

Table B1: Plagioclase Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
1 / 5 . *	9.50	0.25	-0.01	3.29	0.00	0.08	22.22	63.36	98.68
1 / 6 . *	9.07	0.64	0.04	3.51	0.03	0.13	22.52	62.58	98.52
1 / 7 . *	9.46	0.22	0.00	3.71	0.01	0.11	22.28	62.95	98.73
1 / 8 . *	9.56	0.14	-0.01	3.59	0.00	0.10	22.56	62.65	98.60
1 / 9 . *	9.52	0.18	0.00	3.70	-0.04	0.07	22.23	62.96	98.67
1 / 10 .	9.43	0.22	-0.01	3.55	-0.01	0.09	22.31	62.60	98.21
Avg 108_plag_2	9.56	0.25	-0.01	3.61	0.00	0.08	22.51	63.38	99.40
108_plag_3									
1 / 1 .	9.27	0.33	0.01	3.83	0.00	0.10	22.39	63.25	99.18
1 / 2 .	9.24	0.33	0.00	3.79	-0.03	0.05	22.60	63.15	99.17
1 / 3 . *	9.34	0.33	0.00	3.76	0.05	0.06	22.05	62.91	98.49
1 / 4 .	9.23	0.35	-0.01	3.79	0.01	0.11	22.60	63.45	99.54
1 / 5 .	9.30	0.34	0.00	3.61	-0.01	0.09	22.41	63.36	99.10
1 / 6 . *	9.33	0.36	-0.01	3.73	0.00	0.09	22.21	63.11	98.83
1 / 7 . *	9.32	0.36	0.02	3.75	0.00	0.06	22.55	62.88	98.94
1 / 8 .	9.35	0.36	0.01	3.76	0.04	0.06	22.51	62.97	99.04
1 / 9 .	9.49	0.31	0.00	3.49	0.00	0.11	22.29	63.43	99.13
1 / 10 .	9.29	0.31	0.01	3.97	-0.01	0.12	22.52	63.06	99.27
Avg 108_plag_3.1	9.31	0.33	0.00	3.75	0.00	0.09	22.48	63.24	99.19
2 / 1 .	9.10	0.35	0.00	4.26	-0.02	0.14	23.03	62.48	99.36
2 / 2 . *	8.94	0.44	-0.01	4.33	-0.02	0.07	22.67	62.16	98.61
2 / 3 .	9.18	0.37	0.00	4.30	0.03	0.07	23.05	62.38	99.38
2 / 4 . *	9.01	0.35	0.00	4.21	0.02	0.07	22.94	62.38	98.99
2 / 5 .	9.02	0.33	0.00	4.28	0.03	0.08	23.00	62.47	99.21
2 / 6 .	9.05	0.36	-0.01	4.28	0.02	0.07	23.13	62.60	99.51
2 / 7 .	9.06	0.35	-0.01	4.24	0.01	0.05	22.88	62.61	99.20
2 / 8 .	9.06	0.35	0.01	4.33	0.02	0.01	23.13	62.36	99.28
2 / 9 . *	9.15	0.35	0.00	4.34	-0.01	0.13	22.93	61.77	98.67
2 / 10 . *	9.04	0.37	-0.01	4.22	-0.01	0.34	22.87	62.07	98.92
Avg 108_plag_3.2	9.08	0.35	0.00	4.28	0.01	0.07	23.04	62.48	99.31

Table B1: Plagioclase Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
108_plag_4									
1 / 1 . *	9.45	0.26	-0.01	3.61	0.00	0.08	22.40	63.13	98.94
1 / 2 .	9.51	0.28	-0.01	3.69	0.01	0.08	22.49	62.96	99.02
1 / 3 .	9.50	0.31	0.00	3.63	0.02	0.02	22.26	63.34	99.07
1 / 4 .	9.36	0.34	-0.01	3.68	0.01	0.10	22.34	63.46	99.29
1 / 5 .	9.40	0.34	-0.01	3.66	-0.01	0.09	22.54	63.10	99.13
1 / 6 .	9.30	0.35	0.00	3.71	-0.01	0.08	22.68	63.50	99.63
1 / 7 . *	9.31	0.37	0.00	3.61	-0.01	0.04	22.22	62.62	98.17
1 / 8 .	9.38	0.35	-0.01	3.70	0.01	0.05	22.49	63.19	99.18
1 / 9 .	9.40	0.35	0.00	3.65	0.02	0.10	22.46	63.18	99.16
1 / 10 .	9.47	0.34	0.00	3.76	0.03	0.08	22.40	63.42	99.49
Avg 108_plag_4.1	9.41	0.33	-0.01	3.68	0.01	0.07	22.46	63.27	99.24
2 / 1 . *	9.41	0.35	0.00	3.68	0.00	0.14	22.36	62.94	98.89
2 / 2 . *	9.35	0.36	-0.01	3.68	-0.07	0.12	22.37	63.00	98.88
2 / 3 . *	9.31	0.37	-0.01	3.64	-0.01	0.08	22.42	62.73	98.55
2 / 4 .	9.39	0.38	-0.01	3.63	-0.01	0.10	22.46	63.17	99.12
2 / 5 .	9.52	0.36	0.00	3.48	-0.01	0.10	22.49	63.58	99.54
2 / 6 .	9.56	0.36	0.00	3.59	0.02	0.06	22.37	63.21	99.17
2 / 7 .	9.38	0.37	-0.02	3.68	0.00	0.12	22.22	63.25	99.01
2 / 8 . *	9.39	0.35	0.00	3.63	0.00	0.08	22.47	63.05	98.97
2 / 9 . *	9.35	0.30	0.00	3.68	0.00	0.17	22.51	62.89	98.90
2 / 10 .	9.43	0.24	0.00	3.85	0.00	0.14	22.45	63.14	99.25
Avg 108_plag_4.2	9.46	0.34	-0.01	3.64	0.00	0.10	22.40	63.27	99.21
108_plag_5									
1 / 1 .	9.00	0.29	0.01	4.26	0.01	0.12	23.10	62.47	99.26
1 / 2 .	9.02	0.35	0.06	4.23	0.00	0.22	22.77	62.55	99.21
1 / 3 .	9.09	0.31	-0.01	4.12	0.01	0.13	22.89	62.60	99.17
1 / 4 . *	2.63	2.46	0.08	1.05	0.01	33.57	10.54	29.61	79.96
1 / 5 .	9.54	0.27	-0.01	3.52	0.00	0.07	22.38	63.74	99.51

Table B1: Plagioclase Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
1 / 6 .	9.50	0.31	0.00	3.47	0.02	0.06	22.34	63.81	99.51
1 / 7 .	9.58	0.25	0.00	3.44	0.01	0.04	22.36	63.74	99.41
1 / 8 .	9.53	0.25	0.01	3.45	0.01	0.12	22.28	63.52	99.16
1 / 9 .	8.94	0.95	0.03	3.11	0.00	0.23	22.36	63.50	99.11
1 / 10 .	9.45	0.21	-0.01	3.63	-0.01	0.06	22.36	63.57	99.28
Avg 108_plag_5.1	9.29	0.35	0.01	3.69	0.00	0.12	22.54	63.28	99.28
2 / 1 .	9.67	0.36	-0.01	3.39	0.00	0.09	22.19	63.48	99.19
2 / 2 . *	9.43	0.36	0.00	3.42	-0.01	0.10	22.02	63.56	98.88
2 / 3 .	9.48	0.37	-0.02	3.55	-0.01	0.05	22.15	63.52	99.13
2 / 4 . *	9.45	0.35	0.01	3.40	0.00	0.10	22.24	63.43	98.97
2 / 5 . *	9.63	0.36	0.00	3.47	0.02	0.09	22.18	63.25	98.99
2 / 6 .	9.47	0.35	0.01	3.52	0.01	0.06	22.45	63.51	99.37
2 / 7 . *	9.49	0.37	0.00	3.60	0.02	0.07	22.17	63.22	98.93
2 / 8 . *	9.41	0.36	0.00	3.62	0.03	0.07	22.23	63.02	98.76
2 / 9 .	9.39	0.41	0.00	3.70	0.03	0.09	22.36	63.36	99.33
2 / 10 .	9.31	0.41	0.00	3.81	0.00	0.06	22.52	63.23	99.33
Avg 108_plag_5.2	9.46	0.38	0.00	3.59	0.00	0.07	22.33	63.42	99.26
FR-103									
103_plag_1									
1 / 1 .	9.49	0.31	0.00	3.52	0.00	0.11	22.57	64.52	100.52
1 / 2 .	9.51	0.30	0.01	3.55	0.04	0.10	22.64	64.30	100.45
1 / 3 .	9.49	0.31	-0.02	3.50	-0.01	0.13	22.74	64.56	100.73
1 / 4 .	9.50	0.31	-0.01	3.55	0.01	0.10	22.49	64.20	100.15
1 / 5 .	9.44	0.32	0.01	3.59	-0.02	0.13	22.67	64.33	100.49
1 / 6 .	9.47	0.32	0.02	3.52	0.05	0.08	22.57	64.33	100.36
1 / 7 .	9.51	0.36	0.00	3.60	0.00	0.06	22.47	64.15	100.16
1 / 8 .	9.40	0.29	-0.01	3.58	0.00	0.13	22.57	64.18	100.16
1 / 9 .	9.39	0.30	-0.01	3.62	-0.02	0.08	22.46	64.21	100.06
1 / 10 .	9.37	0.30	-0.02	3.62	0.03	0.12	22.74	64.29	100.45

Table B1: Plagioclase Chemistries
* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
Avg 103_plag_1	9.46	0.31	0.00	3.57	0.01	0.10	22.59	64.31	100.34
103_plag_2									
1 / 1 .	9.44	0.25	0.01	3.63	0.00	0.11	22.72	63.92	100.09
1 / 2 .	9.64	0.24	0.00	3.75	0.02	0.06	22.75	63.76	100.21
1 / 3 .	9.53	0.23	0.00	3.76	-0.02	0.09	22.87	64.32	100.80
1 / 4 .	9.49	0.27	0.00	3.71	0.00	0.09	22.86	64.31	100.72
1 / 5 .	9.47	0.24	-0.01	3.76	0.03	0.08	22.70	63.94	100.23
1 / 6 .	9.41	0.22	-0.01	3.78	-0.01	0.04	22.80	63.98	100.24
1 / 7 .	9.43	0.23	-0.01	3.92	0.02	0.05	22.79	63.87	100.32
1 / 8 .	9.50	0.21	0.02	3.84	-0.02	0.05	23.15	63.70	100.46
1 / 9 .	9.35	0.20	0.00	3.92	-0.02	0.09	22.78	63.86	100.21
1 / 10 .	9.36	0.16	-0.01	3.93	0.03	0.04	22.86	63.84	100.23
Avg 103_plag_2	9.46	0.22	0.00	3.80	0.00	0.07	22.83	63.95	100.34
103_plag_3									
1 / 1 . *	9.65	0.30	-0.01	3.48	-0.03	0.08	22.76	64.81	101.08
1 / 2 .	9.68	0.28	-0.01	3.32	0.01	0.08	22.73	64.27	100.37
1 / 3 .	9.62	0.29	0.00	3.48	0.01	0.09	22.39	64.69	100.57
1 / 4 .	9.55	0.27	0.00	3.42	-0.02	0.11	22.39	64.75	100.48
1 / 5 .	9.62	0.28	-0.02	3.41	-0.02	0.09	22.53	64.65	100.58
1 / 6 .	9.58	0.28	-0.01	3.38	0.01	0.13	22.54	64.81	100.74
1 / 7 .	9.55	0.28	-0.01	3.41	0.00	0.10	22.43	64.39	100.15
1 / 8 .	9.56	0.29	-0.01	3.35	-0.01	0.05	22.51	64.50	100.26
1 / 9 .	9.54	0.25	-0.02	3.40	-0.03	0.11	22.37	64.27	99.94
1 / 10 .	9.52	0.25	-0.01	3.48	0.01	0.05	22.62	64.72	100.66
Avg 103_plag_3	9.59	0.27	-0.01	3.41	-0.01	0.09	22.53	64.59	100.46
103_plag_4									
1 / 1 .	9.42	0.21	-0.02	3.88	-0.01	0.14	22.92	64.00	100.56
1 / 2 .	9.31	0.22	0.00	3.82	-0.02	0.12	22.99	63.98	100.43
1 / 3 .	9.36	0.21	0.00	3.84	-0.02	0.12	22.95	63.70	100.19

Table B1: Plagioclase Chemistries
* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
1 / 4 .	9.44	0.21	-0.01	3.81	0.05	0.15	22.87	64.09	100.61
1 / 5 .	9.43	0.23	0.00	3.83	-0.01	0.11	22.88	64.08	100.55
1 / 6 .	9.33	0.20	-0.01	3.83	0.03	0.10	22.81	63.69	100.00
1 / 7 .	9.43	0.20	0.01	3.75	-0.03	0.15	23.03	63.90	100.48
1 / 8 .	9.46	0.19	0.00	3.82	-0.01	0.17	22.95	63.82	100.41
1 / 9 .	9.37	0.15	-0.01	3.87	-0.02	0.13	22.77	63.93	100.23
1 / 10 .	9.45	0.15	0.00	3.92	0.00	0.17	22.98	64.06	100.72
Avg 103_plag_4	9.40	0.20	0.00	3.84	0.00	0.14	22.91	63.93	100.40
103_plag_5									
1 / 1 .	9.38	0.20	0.01	3.83	0.02	0.09	23.02	63.74	100.29
1 / 2 .	9.50	0.25	-0.01	3.69	0.04	0.12	22.63	64.41	100.64
1 / 3 .	9.53	0.24	-0.01	3.56	-0.02	0.12	22.63	64.23	100.30
1 / 4 .	9.62	0.27	0.00	3.46	0.01	0.11	22.24	64.41	100.13
1 / 5 .	9.55	0.26	-0.01	3.42	0.01	0.11	22.58	63.95	99.88
1 / 6 .	9.56	0.27	0.01	3.43	-0.01	0.13	22.40	64.24	100.03
1 / 7 .	9.58	0.27	-0.02	3.55	0.01	0.09	22.60	64.17	100.27
1 / 8 .	9.45	0.25	0.00	3.53	-0.02	0.09	22.72	64.34	100.38
1 / 9 .	9.48	0.25	0.00	3.62	0.03	0.11	22.70	64.16	100.35
1 / 10 .	9.49	0.22	0.00	3.66	0.02	0.11	22.58	63.65	99.73
Avg 103_plag_5.1	9.51	0.25	0.00	3.58	0.01	0.11	22.61	64.13	100.19
2 / 1 .	9.54	0.24	0.01	3.47	-0.01	0.08	22.52	63.54	99.40
2 / 2 .	9.66	0.25	0.00	3.51	0.00	0.07	22.63	63.64	99.77
2 / 3 .	9.56	0.25	0.00	3.53	0.02	0.10	22.46	63.57	99.47
2 / 4 .	9.59	0.24	0.01	3.46	-0.04	0.08	22.39	63.72	99.51
2 / 5 .	9.50	0.27	0.01	3.44	0.02	0.07	22.45	63.37	99.12
2 / 6 .	9.57	0.26	-0.01	3.45	-0.01	0.07	22.51	63.48	99.35
2 / 7 .	9.55	0.25	-0.01	3.44	-0.01	0.08	22.39	63.75	99.45
2 / 8 .	9.47	0.25	-0.01	3.43	0.03	0.06	22.38	63.44	99.06
2 / 9 .	9.54	0.26	-0.01	3.41	0.00	0.11	22.28	63.42	99.02
2 / 10 .	9.65	0.26	0.00	3.42	0.00	0.11	22.45	63.37	99.26

Table B1: Plagioclase Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
Avg 103_plag_5.2	9.56	0.25	0.00	3.46	0.00	0.08	22.45	63.53	99.33
103_plag_6									
2 / 1 .	9.62	0.16	0.00	3.18	-0.03	0.06	22.39	63.84	99.26
2 / 2 .	9.78	0.17	-0.01	3.25	0.02	0.06	22.43	63.84	99.55
2 / 3 .	9.68	0.33	0.00	3.22	-0.03	0.06	22.56	63.56	99.41
2 / 4 .	9.57	0.37	0.00	3.25	-0.02	0.07	22.40	63.65	99.30
2 / 5 .	9.62	0.17	-0.01	3.34	0.01	0.05	22.50	63.68	99.38
2 / 6 .	9.57	0.30	0.15	3.19	-0.01	0.25	22.21	63.33	99.00
2 / 7 .	9.43	0.24	0.26	3.28	0.04	0.45	22.27	63.08	99.06
2 / 8 . *	8.91	0.86	0.28	3.05	-0.01	0.09	22.41	62.95	98.55
2 / 9 .	9.36	0.18	0.00	3.45	0.00	0.09	22.65	63.45	99.20
2 / 10 .	9.04	0.88	-0.01	3.09	-0.03	0.10	22.94	62.23	98.28
Avg 103_plag_6.2	9.52	0.31	0.04	3.25	-0.01	0.13	22.48	63.41	99.14
103_plag_6.1_2									
1 / 1 .	9.39	0.16	0.01	3.66	0.02	0.06	22.81	63.40	99.51
1 / 2 .	9.40	0.16	0.00	3.65	-0.01	0.04	22.75	63.85	99.85
1 / 3 .	9.50	0.15	0.00	3.53	0.05	0.04	22.69	63.86	99.82
1 / 4 .	9.42	0.16	-0.01	3.53	-0.01	0.02	22.74	63.75	99.62
1 / 5 .	9.44	0.16	-0.01	3.58	0.01	0.02	22.92	63.81	99.94
1 / 6 .	9.54	0.16	0.02	3.50	-0.02	0.05	22.80	63.70	99.76
1 / 7 .	9.47	0.17	-0.01	3.51	-0.01	0.06	22.82	63.61	99.63
1 / 8 .	9.47	0.18	-0.02	3.49	-0.02	0.09	22.79	63.55	99.56
1 / 9 .	9.43	0.15	0.00	3.53	-0.01	0.09	22.82	63.68	99.70
1 / 10 .	9.41	0.25	-0.01	3.37	-0.01	0.02	22.62	63.61	99.28
Avg 103_plag_6.1_2	9.45	0.17	0.00	3.54	0.00	0.05	22.78	63.68	99.65
103_plag_7_2									
1 / 1 .	9.53	0.23	0.00	3.39	-0.01	0.08	22.50	64.10	99.84
1 / 2 .	9.60	0.25	-0.01	3.35	0.00	0.07	22.61	64.15	100.02
1 / 3 .	9.55	0.27	0.00	3.34	0.02	0.10	22.36	64.35	100.00

Table B1: Plagioclase Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
1 / 4 .	9.54	0.27	-0.02	3.24	0.00	0.11	22.55	64.24	99.96
1 / 5 .	9.56	0.27	0.01	3.31	0.01	0.09	22.61	64.15	100.01
1 / 6 .	9.52	0.30	0.01	3.30	0.00	0.07	22.66	64.67	100.54
1 / 7 .	9.49	0.28	0.01	3.30	-0.01	0.08	22.61	64.16	99.93
1 / 8 .	9.44	0.28	-0.01	3.29	-0.01	0.10	22.61	64.19	99.91
1 / 9 .	9.54	0.27	-0.01	3.21	0.02	0.07	22.48	64.26	99.86
1 / 10 .	9.50	0.29	-0.01	3.32	0.00	0.06	22.58	64.19	99.94
Avg 103_plag_7_2	9.53	0.27	0.00	3.31	0.00	0.08	22.56	64.25	99.99
103_plag_8_2									
1 / 1 .	9.57	0.18	-0.01	3.32	0.03	0.11	22.55	64.42	100.17
1 / 2 .	9.64	0.21	-0.01	3.34	0.02	0.13	22.87	64.33	100.54
1 / 3 .	9.62	0.20	0.00	3.32	-0.02	0.08	22.46	64.61	100.31
1 / 4 .	9.56	0.23	-0.01	3.29	0.02	0.09	22.48	64.79	100.46
1 / 5 .	9.59	0.23	-0.01	3.33	-0.02	0.05	22.54	64.63	100.37
1 / 6 .	9.60	0.23	-0.01	3.30	-0.03	0.09	22.61	64.13	99.96
1 / 7 .	9.56	0.26	0.01	3.29	0.02	0.04	22.77	64.45	100.39
1 / 8 .	9.58	0.26	-0.01	3.36	0.00	0.07	22.41	64.59	100.26
1 / 9 .	9.49	0.28	-0.01	3.28	0.01	0.08	22.67	64.51	100.32
1 / 10 .	9.53	0.25	0.00	3.34	0.04	0.12	22.50	64.44	100.22
Avg 103_plag_8_2	9.57	0.23	-0.01	3.32	0.01	0.08	22.58	64.49	100.29
103_plag_9_2									
1 / 1 .	9.59	0.23	-0.01	3.45	-0.01	0.09	22.58	64.39	100.33
1 / 2 .	9.55	0.26	-0.02	3.44	0.02	0.10	22.47	64.31	100.13
1 / 3 .	9.64	0.24	-0.02	3.35	-0.02	0.10	22.68	64.47	100.49
1 / 4 .	9.53	0.27	0.00	3.32	-0.03	0.11	22.62	64.61	100.46
1 / 5 .	9.64	0.26	0.01	3.43	-0.02	0.03	22.60	64.39	100.37
1 / 6 .	9.53	0.25	0.00	3.32	-0.02	0.11	22.58	64.51	100.31
1 / 7 .	9.56	0.25	-0.01	3.34	0.02	0.08	22.45	64.33	100.03
1 / 8 .	9.60	0.25	0.00	3.32	-0.01	0.10	22.59	64.51	100.37
1 / 9 .	9.64	0.24	-0.01	3.44	-0.02	0.07	22.62	64.51	100.52

Table B1: Plagioclase Chemistries
* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	K_2O	MgO	CaO	MnO	FeO	Al_2O_3	SiO_2	Total
1 / 10 .	9.63	0.22	-0.01	3.45	0.00	0.11	22.66	63.97	100.05
Avg 103_plag_9_2	9.59	0.25	-0.01	3.39	-0.01	0.09	22.59	64.40	100.28
103_plag_10_2									
1 / 1 .	9.44	0.21	-0.01	3.65	0.02	0.10	22.74	64.31	100.45
1 / 2 .	9.52	0.21	0.00	3.65	0.01	0.10	22.84	63.74	100.07
1 / 3 .	9.49	0.22	0.00	3.69	-0.01	0.06	22.91	63.90	100.26
1 / 4 .	9.48	0.21	-0.02	3.67	0.00	0.13	22.73	64.18	100.41
1 / 5 .	9.42	0.20	-0.01	3.62	0.01	0.16	22.76	63.96	100.13
1 / 6 .	9.49	0.19	0.00	3.69	-0.02	0.09	22.87	64.01	100.36
1 / 7 .	9.31	0.23	-0.01	3.62	0.00	0.10	22.76	64.08	100.10
1 / 8 .	9.47	0.20	0.00	3.65	0.04	0.15	22.88	64.32	100.70
1 / 9 .	9.40	0.20	0.00	3.64	0.01	0.11	22.99	63.67	100.02
1 / 10 .	9.34	0.18	0.00	3.72	0.00	0.13	22.92	63.90	100.19
Avg 103_plag10_2	9.44	0.21	-0.01	3.66	0.01	0.11	22.84	64.01	100.26

APPENDIX B
MINERAL CHEMISTRIES FROM KM-SCALE GRADIENTS

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
36																		
BR-36 bt 1																		
1 / 1 .	2.45	0.13	2.65	0.02	9.72	13.68	-0.01	0.24	16.96	0.32	13.31	--	0.05	37.54	3.53	100.61	1.06	99.55
1 / 2 .	2.37	0.12	2.71	0.04	9.81	13.58	0.00	0.28	17.28	0.35	13.27	--	0.01	37.64	3.62	101.09	1.03	100.07
1 / 3 .	2.42	0.12	2.68	0.05	9.68	13.55	0.00	0.28	17.19	0.31	13.38	--	0.02	37.54	3.57	100.80	1.05	99.75
1 / 4 .	2.55	0.12	2.61	0.05	9.70	13.63	0.00	0.28	16.81	0.34	13.39	--	0.00	37.85	3.46	100.83	1.10	99.72
1 / 5 .	2.46	0.12	2.63	0.01	9.64	13.69	0.01	0.26	16.72	0.49	13.24	--	0.03	37.38	3.50	100.19	1.06	99.12
1 / 6 .	2.43	0.10	2.67	0.09	9.74	13.69	0.01	0.28	16.67	0.37	13.47	--	-0.02	37.57	3.37	100.46	1.05	99.41
1 / 7 .	2.42	0.12	2.66	0.01	9.70	13.61	-0.01	0.26	16.62	0.37	13.30	--	0.03	37.58	3.52	100.20	1.04	99.16
1 / 8 .	2.48	0.13	2.63	0.07	9.68	13.55	0.00	0.30	17.03	0.30	13.08	--	-0.01	37.55	3.59	100.38	1.07	99.31
1 / 9 .	2.41	0.11	2.70	0.02	9.69	13.85	0.00	0.27	16.78	0.34	13.26	--	0.01	37.89	3.47	100.78	1.04	99.74
1 / 10 .	2.36	0.11	2.68	0.01	9.58	13.38	0.00	0.27	17.72	0.32	13.19	--	0.03	37.20	3.46	100.31	1.02	99.29
Avg 36 bt 1	2.44	0.12	2.66	0.04	9.69	13.62	0.00	0.27	16.98	0.35	13.29	--	0.02	37.57	3.51	100.56	1.05	99.50
BR-36 bt 2																		
1 / 1 .	2.20	0.11	2.73	-0.03	9.58	12.13	0.00	0.36	19.53	0.40	12.63	--	-0.02	36.97	3.81	100.45	0.95	99.50
1 / 2 .	2.21	0.12	2.74	0.02	9.46	12.27	-0.01	0.30	19.48	0.36	12.68	--	-0.02	37.21	3.74	100.59	0.96	99.64
1 / 3 .	2.19	0.12	2.74	-0.03	9.46	12.17	0.00	0.31	19.56	0.42	12.76	--	-0.01	36.94	3.82	100.49	0.95	99.54
1 / 4 .	2.25	0.13	2.70	-0.06	9.47	12.16	0.00	0.37	19.48	0.43	12.77	--	-0.01	36.90	3.77	100.43	0.98	99.45
1 / 5 .	2.14	0.13	2.76	-0.03	9.44	12.18	0.00	0.32	19.69	0.46	12.79	--	0.03	36.96	3.68	100.58	0.93	99.65
1 / 6 .	2.10	0.11	2.81	-0.03	9.52	12.18	-0.01	0.30	19.66	0.43	12.89	--	0.02	37.23	3.73	100.98	0.91	100.07
1 / 7 .	2.22	0.11	2.73	-0.03	9.44	12.01	-0.03	0.31	19.55	0.45	12.87	--	0.01	37.04	3.76	100.48	0.96	99.52
1 / 8 .	2.12	0.12	2.75	-0.02	9.42	12.01	0.00	0.30	19.30	0.31	12.76	--	0.00	36.80	3.77	99.66	0.92	98.75
1 / 9 .	2.19	0.12	2.73	-0.05	9.49	12.11	0.00	0.28	19.45	0.41	12.73	--	0.01	37.07	3.75	100.35	0.95	99.39
1 / 10 .	2.11	0.12	2.77	-0.01	9.46	12.14	0.00	0.31	19.32	0.46	12.79	--	0.01	37.02	3.73	100.26	0.91	99.34
Avg 36 bt 2	2.17	0.12	2.75	-0.03	9.47	12.14	-0.01	0.32	19.50	0.41	12.77	--	0.00	37.01	3.76	100.39	0.94	99.44
BR-36 bt 2																		
1 / 1 .	2.38	0.12	2.62	0.00	9.45	12.54	-0.01	0.40	17.88	0.57	13.03	--	-0.03	36.94	3.68	99.60	1.03	98.57

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 2 .	2.29	0.11	2.70	-0.07	9.41	12.67	-0.02	0.31	18.10	0.33	12.92	--	-0.04	37.33	3.70	99.87	0.99	98.88
1 / 3 .	2.17	0.11	2.74	-0.01	9.46	12.56	-0.01	0.35	18.19	0.44	12.93	--	-0.02	37.07	3.70	99.72	0.94	98.78
1 / 4 .	2.21	0.11	2.70	0.02	9.42	12.57	-0.01	0.35	18.13	0.52	12.91	--	-0.04	36.71	3.65	99.29	0.95	98.34
1 / 5 .	2.19	0.12	2.71	-0.07	9.57	12.64	0.00	0.35	18.11	0.35	12.70	--	-0.09	36.97	3.65	99.38	0.95	98.43
1 / 6 .	2.15	0.11	2.74	0.00	9.53	12.56	-0.01	0.36	17.91	0.39	12.67	--	-0.05	37.07	3.78	99.27	0.93	98.34
1 / 7 .	2.18	0.10	2.74	0.03	9.39	12.56	-0.01	0.31	18.04	0.42	12.86	--	-0.06	37.22	3.63	99.49	0.94	98.55
1 / 8 .	2.27	0.11	2.69	-0.04	9.43	12.58	-0.01	0.35	18.30	0.33	12.79	--	-0.06	37.06	3.71	99.62	0.98	98.64
1 / 9 .	2.19	0.10	2.73	-0.06	9.47	12.49	-0.01	0.40	18.26	0.37	12.80	--	-0.05	37.15	3.73	99.69	0.95	98.74
1 / 10 .	2.21	0.11	2.73	-0.07	9.52	12.53	-0.01	0.34	18.39	0.41	12.87	--	0.02	37.12	3.89	100.15	0.96	99.19
Avg 36 bt 2	2.22	0.11	2.71	-0.03	9.47	12.57	-0.01	0.35	18.13	0.41	12.85	--	-0.04	37.06	3.71	99.52	0.96	98.56
BR-36 bt 3																		
1 / 1 .	2.38	0.12	2.62	0.00	9.45	12.54	-0.01	0.40	17.88	0.57	13.03	--	-0.03	36.94	3.68	99.60	1.03	98.57
1 / 2 .	2.29	0.11	2.70	-0.07	9.41	12.67	-0.02	0.31	18.10	0.33	12.92	--	-0.04	37.33	3.70	99.87	0.99	98.88
1 / 3 .	2.17	0.11	2.74	-0.01	9.46	12.56	-0.01	0.35	18.19	0.44	12.93	--	-0.02	37.07	3.70	99.72	0.94	98.78
1 / 4 .	2.21	0.11	2.70	0.02	9.42	12.57	-0.01	0.35	18.13	0.52	12.91	--	-0.04	36.71	3.65	99.29	0.95	98.34
1 / 5 .	2.19	0.12	2.71	-0.07	9.57	12.64	0.00	0.35	18.11	0.35	12.70	--	-0.09	36.97	3.65	99.38	0.95	98.43
1 / 6 .	2.15	0.11	2.74	0.00	9.53	12.56	-0.01	0.36	17.91	0.39	12.67	--	-0.05	37.07	3.78	99.27	0.93	98.34
1 / 7 .	2.18	0.10	2.74	0.03	9.39	12.56	-0.01	0.31	18.04	0.42	12.86	--	-0.06	37.22	3.63	99.49	0.94	98.55
1 / 8 .	2.27	0.11	2.69	-0.04	9.43	12.58	-0.01	0.35	18.30	0.33	12.79	--	-0.06	37.06	3.71	99.62	0.98	98.64
1 / 9 .	2.19	0.10	2.73	-0.06	9.47	12.49	-0.01	0.40	18.26	0.37	12.80	--	-0.05	37.15	3.73	99.69	0.95	98.74
1 / 10 .	2.21	0.11	2.73	-0.07	9.52	12.53	-0.01	0.34	18.39	0.41	12.87	--	0.02	37.12	3.89	100.15	0.96	99.19
Avg 36 bt 3	2.22	0.11	2.71	-0.03	9.47	12.57	-0.01	0.35	18.13	0.41	12.85	--	-0.04	37.06	3.71	99.52	0.96	98.56
BR-36 bt 4																		
1 / 1 .	2.58	0.24	2.52	-0.10	9.74	12.53	0.00	0.07	17.84	0.13	13.19	--	0.01	37.79	3.39	100.03	1.14	98.89
1 / 2 .	2.60	0.21	2.51	0.00	9.77	12.47	0.00	0.09	18.38	0.17	12.97	--	0.01	37.54	3.46	100.19	1.14	99.05
1 / 3 .	2.67	0.21	2.48	-0.04	9.58	12.65	0.01	0.10	18.35	0.10	12.96	--	0.02	37.56	3.52	100.21	1.17	99.04
1 / 4 .	2.65	0.19	2.51	-0.09	9.78	12.81	0.01	0.10	18.27	0.08	13.00	--	0.04	37.68	3.52	100.64	1.16	99.48
1 / 5 .	2.61	0.16	2.51	-0.08	9.31	12.58	0.03	0.13	19.03	0.12	12.92	--	-0.02	37.42	3.23	100.06	1.14	98.92
1 / 6 .	2.75	0.17	2.45	-0.03	9.82	12.82	0.00	0.12	17.94	0.17	12.94	--	0.03	37.65	3.31	100.18	1.20	98.98
1 / 7 .	2.64	0.19	2.52	-0.06	9.73	12.86	0.00	0.06	17.97	0.14	13.05	--	-0.01	37.90	3.29	100.35	1.15	99.20

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 8 .	2.68	0.20	2.49	-0.03	9.84	13.02	0.00	0.10	18.14	0.14	12.96	--	0.00	37.77	3.15	100.50	1.17	99.32
1 / 9 .	2.86	0.19	2.39	-0.08	9.84	13.08	0.00	0.08	17.93	0.12	12.88	--	-0.02	37.91	3.12	100.41	1.25	99.16
1 / 10 .	2.83	0.18	2.42	-0.07	9.82	13.16	0.00	0.04	17.87	0.09	12.80	--	0.00	37.93	3.17	100.31	1.23	99.08
Avg 36 bt 4	2.69	0.19	2.48	-0.06	9.72	12.80	0.01	0.09	18.17	0.13	12.97	--	0.01	37.72	3.32	100.22	1.18	99.05
BR-36 bt 5																		
1 / 1 .	2.32	0.12	2.68	0.04	9.58	12.27	0.00	0.23	19.19	0.42	12.91	--	0.01	37.02	3.90	100.69	1.01	99.68
1 / 2 .	2.42	0.12	2.60	-0.05	9.56	11.97	0.00	0.27	18.98	0.36	12.85	--	0.01	36.92	3.78	99.83	1.05	98.78
1 / 3 .	2.22	0.12	2.72	-0.04	9.57	12.22	-0.01	0.27	19.33	0.46	12.73	--	-0.01	36.96	3.86	100.45	0.96	99.49
1 / 4 .	2.33	0.12	2.66	0.04	9.45	12.21	-0.01	0.22	19.17	0.40	12.84	--	0.01	37.02	3.79	100.27	1.01	99.26
1 / 5 .	2.28	0.12	2.68	-0.02	9.55	12.14	0.00	0.29	19.25	0.31	12.81	--	-0.01	37.01	3.70	100.15	0.99	99.16
1 / 6 .	2.33	0.14	2.66	0.00	9.49	12.10	-0.01	0.31	19.21	0.49	12.94	--	-0.02	36.94	3.88	100.49	1.01	99.47
1 / 7 .	2.32	0.12	2.67	-0.06	9.50	12.10	-0.01	0.32	19.58	0.43	12.77	--	0.00	37.01	3.87	100.71	1.00	99.70
1 / 8 .	2.21	0.12	2.72	-0.01	9.59	12.09	-0.01	0.24	19.54	0.48	12.73	--	0.00	36.89	3.93	100.53	0.96	99.58
1 / 9 .	2.25	0.13	2.69	0.02	9.69	11.99	0.00	0.27	19.25	0.40	12.74	--	-0.01	36.90	3.87	100.21	0.98	99.23
1 / 10 .	2.23	0.13	2.72	-0.01	9.53	12.09	-0.01	0.32	19.15	0.52	12.96	--	0.00	37.03	3.82	100.50	0.97	99.54
Avg 36 bt 5	2.29	0.12	2.68	-0.01	9.55	12.12	-0.01	0.27	19.27	0.43	12.83	--	0.00	36.97	3.84	100.35	0.99	99.36
BR-202																		
202_bt_1																		
1 / 1 . *	2.29	0.13	2.75	0.10	9.79	12.53	0.01	0.27	19.50	0.24	12.86	0.01	0.01	37.74	3.81	102.03	0.99	101.04
1 / 2 . *	2.43	0.11	2.68	0.10	9.88	12.65	0.00	0.27	19.47	0.32	12.78	0.04	0.00	37.64	3.83	102.20	1.05	101.15
1 / 3 .	2.22	0.13	2.77	0.09	9.84	12.46	-0.02	0.24	19.49	0.28	12.82	0.07	0.01	37.64	3.58	101.65	0.97	100.68
1 / 4 . *	2.38	0.09	2.71	0.09	9.84	12.47	0.00	0.28	19.66	0.39	12.92	0.03	-0.03	37.61	3.78	102.24	1.02	101.21
1 / 5 .	2.02	0.10	2.87	0.12	8.55	12.47	0.03	0.28	20.97	0.37	13.15	0.04	0.04	36.82	3.56	101.39	0.87	100.51
1 / 6 . *	2.29	0.12	2.75	0.09	9.84	12.40	0.00	0.30	19.44	0.36	12.92	0.04	0.02	37.86	3.75	102.19	0.99	101.20
1 / 7 . *	2.22	0.13	2.78	0.10	9.77	12.32	-0.01	0.24	19.81	0.33	12.85	0.09	0.01	37.61	3.94	102.19	0.96	101.22
1 / 8 . *	2.32	0.13	2.74	0.08	9.82	12.31	0.01	0.28	19.54	0.35	13.02	0.06	0.03	37.60	3.97	102.27	1.01	101.26
1 / 9 .	2.25	0.14	2.75	0.09	9.75	12.42	0.01	0.28	19.63	0.35	12.91	0.02	-0.03	37.50	3.65	101.74	0.98	100.76
1 / 10 .	2.25	0.12	2.75	0.08	9.75	12.33	0.02	0.32	19.29	0.31	12.89	0.08	-0.04	37.48	3.85	101.51	0.97	100.54
Avg 202_bt1	2.19	0.12	2.78	0.10	9.47	12.42	0.01	0.28	19.85	0.33	12.94	0.05	0.00	37.36	3.66	101.55	0.95	100.60

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
202_bt_2																		
1 / 1 .	2.24	0.13	2.74	0.12	9.57	11.85	-0.01	0.30	19.29	0.28	12.68	0.08	-0.01	37.57	4.04	100.89	0.97	99.92
1 / 2 .	2.26	0.15	2.72	0.14	9.55	11.88	0.00	0.27	19.18	0.32	12.64	0.04	-0.04	37.39	4.42	100.96	0.98	99.97
1 / 3 .	2.24	0.13	2.75	0.09	9.67	11.97	0.01	0.33	19.50	0.28	12.76	0.01	0.03	37.53	4.33	101.64	0.98	100.66
1 / 4 .	2.20	0.12	2.76	0.10	9.61	11.77	0.00	0.28	19.45	0.54	12.92	0.06	-0.01	37.24	4.33	101.39	0.95	100.44
1 / 5 .	2.17	0.14	2.78	0.14	9.67	11.86	0.01	0.31	19.26	0.51	12.80	0.04	-0.01	37.48	4.14	101.31	0.94	100.37
1 / 6 . *	2.23	0.15	2.78	0.11	9.76	12.00	-0.01	0.36	19.82	0.34	12.90	0.05	0.03	37.54	4.41	102.49	0.97	101.51
1 / 7 .	2.22	0.13	2.76	0.10	9.75	11.89	0.00	0.31	19.34	0.40	12.75	0.05	-0.01	37.54	4.28	101.53	0.97	100.57
1 / 8 .	2.17	0.15	2.79	0.08	9.68	11.97	0.01	0.30	19.43	0.53	12.76	0.01	-0.02	37.50	4.38	101.76	0.95	100.81
1 / 9 .	2.34	0.14	2.69	0.08	9.72	11.94	0.00	0.27	19.29	0.20	12.84	0.00	0.04	37.29	4.38	101.23	1.02	100.21
1 / 10 .	2.33	0.12	2.69	0.08	9.68	11.91	0.00	0.31	19.19	0.33	12.73	-0.02	0.04	37.24	4.45	101.10	1.01	100.10
Avg 202_bt2	2.24	0.13	2.74	0.10	9.65	11.90	0.00	0.30	19.33	0.38	12.77	0.03	0.00	37.42	4.31	101.30	0.97	100.32
202_bt_3																		
1 / 1 .	2.17	0.13	2.75	0.13	9.28	12.26	0.01	0.34	18.50	0.24	12.67	0.06	0.03	37.29	4.04	99.90	0.94	98.96
1 / 2 .	2.25	0.10	2.73	0.14	9.37	12.46	-0.02	0.32	18.63	0.30	12.56	0.06	-0.02	37.48	3.87	100.26	0.97	99.29
1 / 3 .	2.40	0.13	2.64	0.16	9.46	12.38	-0.01	0.35	18.36	0.22	12.64	0.05	-0.01	37.28	4.16	100.23	1.04	99.19
1 / 4 .	2.35	0.12	2.66	0.14	9.46	12.22	0.01	0.30	18.57	0.42	12.74	0.08	0.00	37.16	4.10	100.31	1.02	99.29
1 / 5 .	2.25	0.11	2.71	0.12	9.28	12.29	0.01	0.32	18.34	0.46	12.81	0.03	0.00	37.24	3.85	99.81	0.97	98.84
1 / 6 .	2.21	0.10	2.76	0.13	9.33	12.39	0.00	0.35	18.53	0.40	12.82	0.01	0.00	37.50	4.04	100.58	0.95	99.63
1 / 7 .	2.21	0.13	2.73	0.09	9.32	12.39	0.01	0.30	18.29	0.61	12.78	0.06	0.00	37.25	4.05	100.21	0.96	99.25
1 / 8 .	2.27	0.12	2.70	0.14	9.45	12.32	0.00	0.29	18.01	0.29	12.65	0.01	-0.05	37.35	4.07	99.64	0.98	98.66
1 / 9 .	2.22	0.11	2.76	0.15	9.31	12.56	0.02	0.28	18.69	0.42	12.80	0.03	0.01	37.37	4.11	100.84	0.96	99.88
1 / 10 .	2.29	0.11	2.72	0.13	9.45	12.61	0.00	0.35	18.26	0.39	12.82	0.09	0.04	37.25	4.18	100.69	0.99	99.71
Avg 202_bt3	2.26	0.12	2.71	0.13	9.37	12.39	0.00	0.32	18.42	0.38	12.73	0.05	0.00	37.32	4.05	100.24	0.98	99.26
202_bt_4																		
1 / 1 .	2.17	0.12	2.79	0.15	9.40	11.96	0.01	0.26	18.33	0.45	13.19	0.05	0.01	37.57	4.23	100.68	0.94	99.74
1 / 2 .	2.16	0.12	2.79	0.14	9.33	11.89	0.01	0.26	18.61	0.53	13.22	-0.01	0.00	37.43	4.31	100.81	0.94	99.88
1 / 3 .	2.30	0.12	2.73	0.13	9.37	12.01	0.01	0.34	18.51	0.35	13.21	0.04	0.01	37.61	4.30	101.02	1.00	100.03
1 / 4 .	2.14	0.13	2.82	0.17	9.32	11.92	0.01	0.29	18.61	0.38	13.28	0.03	0.00	37.66	4.39	101.15	0.93	100.22

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 5 .	2.07	0.12	2.84	0.17	9.36	11.89	0.02	0.32	18.53	0.43	13.27	0.07	0.01	37.53	4.25	100.88	0.90	99.98
1 / 6 .	2.02	0.11	2.86	0.15	9.45	11.82	0.00	0.28	18.73	0.54	13.20	0.05	0.00	37.37	4.25	100.84	0.88	99.96
1 / 7 .	2.17	0.12	2.79	0.16	9.29	11.59	0.02	0.28	18.87	0.47	13.14	0.08	0.05	37.53	4.44	100.99	0.94	100.05
1 / 8 .	2.03	0.10	2.86	0.16	9.20	11.71	0.02	0.27	18.65	0.45	13.23	0.08	0.00	37.38	4.56	100.71	0.88	99.83
1 / 9 .	2.16	0.12	2.79	0.16	9.26	11.81	0.00	0.26	18.59	0.55	13.31	0.04	-0.06	37.45	4.30	100.82	0.94	99.88
1 / 10 .	2.09	0.11	2.83	0.14	9.34	11.71	0.01	0.34	18.56	0.43	13.18	0.05	0.02	37.48	4.43	100.74	0.91	99.84
Avg 202bt4.1	2.13	0.12	2.81	0.15	9.33	11.83	0.01	0.29	18.60	0.46	13.22	0.05	0.00	37.50	4.35	100.86	0.92	99.93
2 / 1 .	2.03	0.13	2.88	0.13	9.65	11.89	0.01	0.30	18.47	0.35	13.34	0.06	0.03	37.60	4.48	101.35	0.88	100.47
2 / 2 .	2.07	0.10	2.86	0.06	9.71	12.08	0.00	0.33	18.58	0.35	13.20	0.02	-0.02	37.59	4.37	101.32	0.89	100.43
2 / 3 . *	2.08	0.11	2.88	0.10	9.77	11.99	0.01	0.31	18.78	0.32	13.30	0.07	0.00	37.86	4.44	102.02	0.90	101.11
2 / 4 . *	1.99	0.11	2.92	0.11	9.70	11.86	-0.01	0.28	18.91	0.46	13.23	0.08	-0.02	37.66	4.70	102.00	0.86	101.14
2 / 5 . *	1.96	0.12	2.93	0.13	9.65	11.73	0.01	0.31	18.88	0.49	13.26	0.05	0.03	37.69	4.63	101.87	0.85	101.02
2 / 6 .	2.02	0.12	2.88	0.10	9.68	11.67	0.00	0.29	18.95	0.41	13.20	0.02	0.03	37.58	4.62	101.57	0.88	100.70
2 / 7 .	2.11	0.13	2.83	0.10	9.79	11.88	0.02	0.33	18.58	0.33	13.16	0.07	0.00	37.45	4.62	101.40	0.92	100.49
2 / 8 .	2.08	0.13	2.86	0.11	9.76	11.74	0.00	0.27	18.78	0.39	13.18	0.04	-0.01	37.61	4.86	101.81	0.90	100.91
2 / 9 .	2.03	0.12	2.89	0.14	9.73	11.81	0.00	0.30	18.94	0.42	13.11	0.01	-0.01	37.56	4.79	101.83	0.88	100.95
2 / 10 .	2.11	0.12	2.85	0.13	9.70	11.73	0.00	0.30	18.83	0.39	13.20	0.07	-0.03	37.51	4.84	101.77	0.92	100.86
Avg 202bt4.2	2.06	0.12	2.87	0.11	9.72	11.83	0.00	0.30	18.73	0.38	13.20	0.04	0.00	37.56	4.65	101.57	0.90	100.68
202_bt_5																		
1 / 1 . *	2.52	0.11	2.63	0.09	9.70	12.23	0.00	0.31	19.66	0.46	12.88	0.04	-0.04	37.50	4.14	102.26	1.09	101.17
1 / 2 . *	2.36	0.11	2.72	0.06	9.83	12.10	0.01	0.30	19.45	0.31	12.83	0.03	-0.03	37.85	4.11	102.08	1.02	101.06
1 / 3 . *	2.30	0.14	2.74	0.05	9.82	12.05	0.01	0.29	19.70	0.32	12.88	0.03	-0.02	37.63	4.19	102.16	1.00	101.16
1 / 4 .	2.51	0.12	2.63	0.06	9.77	12.10	0.00	0.30	19.50	0.31	12.88	0.06	0.04	37.76	4.02	102.07	1.09	100.99
1 / 5 .	2.20	0.12	2.78	0.11	9.25	11.96	0.01	0.28	19.95	0.37	12.93	0.03	-0.01	37.69	3.95	101.64	0.95	100.69
1 / 6 . *	2.34	0.13	2.72	0.06	9.80	12.01	-0.02	0.35	19.63	0.34	12.86	0.06	0.00	37.64	4.28	102.24	1.01	101.23
1 / 7 .	2.42	0.12	2.67	0.04	9.63	11.97	0.01	0.37	19.86	0.34	12.81	0.02	0.04	37.53	4.19	102.02	1.05	100.98
1 / 8 . *	2.34	0.10	2.74	0.07	9.94	11.81	0.00	0.28	19.84	0.43	12.79	0.03	0.07	37.78	4.35	102.55	1.01	101.54
1 / 9 . *	2.34	0.14	2.72	0.07	9.86	11.79	0.00	0.30	20.18	0.38	12.79	0.01	-0.02	37.47	4.41	102.45	1.02	101.44
1 / 10 .	2.19	0.11	2.78	0.08	9.70	11.70	0.00	0.32	19.89	0.39	12.68	0.06	0.00	37.26	4.46	101.62	0.95	100.67
Avg 202_bt5	2.33	0.12	2.72	0.07	9.59	11.93	0.01	0.32	19.80	0.35	12.83	0.04	0.02	37.56	4.16	101.84	1.01	100.83

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
202_bt_6																		
1 / 1 .	2.11	0.12	2.79	0.09	9.68	11.64	0.02	0.33	19.55	0.40	12.66	0.06	0.00	37.19	4.38	101.04	0.92	100.12
1 / 2 .	2.08	0.13	2.82	0.11	9.67	11.73	0.01	0.31	19.93	0.50	12.69	0.04	-0.01	37.23	4.35	101.59	0.91	100.68
1 / 3 .	2.14	0.13	2.78	0.10	9.81	11.69	0.00	0.35	19.85	0.45	12.71	0.04	-0.04	37.17	4.16	101.38	0.93	100.44
1 / 4 .	2.05	0.14	2.83	0.09	9.75	11.71	0.00	0.33	20.08	0.43	12.74	0.17	0.02	36.95	4.31	101.58	0.89	100.69
1 / 5 .	2.15	0.12	2.78	0.10	9.66	11.67	0.01	0.42	19.75	0.40	12.80	0.01	-0.01	37.32	4.05	101.24	0.93	100.31
1 / 6 . *	2.28	0.11	2.75	0.11	9.92	11.75	0.01	0.39	19.96	0.42	12.86	0.04	-0.02	37.33	4.43	102.36	0.99	101.38
1 / 7 .	2.17	0.12	2.78	0.10	9.61	11.70	-0.01	0.31	19.99	0.32	12.71	-0.01	0.01	37.25	4.31	101.38	0.94	100.44
1 / 8 .	2.24	0.11	2.75	0.08	9.75	11.80	0.00	0.35	19.96	0.43	12.73	-0.02	0.02	37.28	4.14	101.63	0.97	100.67
1 / 9 .	2.20	0.11	2.77	0.09	9.72	11.81	0.00	0.37	19.76	0.45	12.79	0.03	0.01	37.30	4.24	101.66	0.95	100.71
1 / 10 .	2.22	0.12	2.75	0.10	9.79	11.75	-0.02	0.35	19.85	0.39	12.76	0.06	0.05	37.16	4.04	101.38	0.96	100.42
Avg 202_bt6	2.15	0.12	2.78	0.09	9.72	11.72	0.00	0.35	19.86	0.42	12.73	0.04	0.00	37.21	4.22	101.42	0.93	100.49
202_bt_8																		
1 / 1 .	2.19	0.12	2.76	0.11	9.57	12.03	0.00	0.30	19.12	0.22	12.93	0.02	-0.02	37.31	4.14	100.84	0.95	99.89
1 / 2 . *	2.16	0.12	2.82	0.08	9.64	12.11	0.01	0.31	19.67	0.40	13.08	0.03	-0.01	37.32	4.35	102.08	0.94	101.15
1 / 3 .	2.06	0.14	2.83	0.13	9.57	12.06	0.00	0.30	19.72	0.26	12.92	0.03	-0.02	37.22	4.07	101.32	0.90	100.42
1 / 4 .	2.10	0.13	2.81	0.12	9.61	12.03	0.00	0.29	19.34	0.24	12.88	0.09	0.00	37.38	4.00	101.03	0.91	100.12
1 / 5 .	2.33	0.13	2.71	0.09	9.58	12.03	-0.01	0.30	19.32	0.53	12.92	0.05	0.03	37.48	4.13	101.62	1.01	100.61
1 / 6 .	2.11	0.13	2.80	0.12	9.53	12.05	-0.01	0.30	19.45	0.39	12.82	0.06	-0.04	37.32	4.02	101.11	0.92	100.20
1 / 7 .	2.27	0.12	2.75	0.15	9.52	12.00	-0.01	0.28	19.65	0.27	12.94	0.04	0.01	37.48	4.15	101.63	0.98	100.65
1 / 8 .	2.18	0.12	2.79	0.08	9.62	12.01	-0.01	0.28	19.25	0.33	12.94	0.04	0.01	37.55	4.19	101.39	0.95	100.44
1 / 9 .	2.31	0.12	2.70	0.14	9.56	11.91	0.01	0.34	19.29	0.30	13.04	0.04	0.01	37.17	3.97	100.92	1.00	99.92
1 / 10 .	2.23	0.14	2.75	0.12	9.57	11.96	0.00	0.32	19.21	0.58	13.10	-0.03	0.00	37.20	4.31	101.49	0.97	100.52
Avg 202_bt8	2.20	0.13	2.77	0.12	9.57	12.01	0.00	0.30	19.37	0.35	12.94	0.04	0.00	37.35	4.11	101.25	0.95	100.29
202_bt_9																		
1 / 1 .	2.41	0.11	2.66	0.12	9.53	12.38	0.02	0.35	18.83	0.43	13.00	-0.01	0.02	37.38	3.90	101.16	1.04	100.12
1 / 2 .	2.34	0.13	2.70	0.10	9.49	12.34	0.02	0.37	18.61	0.53	12.93	0.00	-0.03	37.70	4.05	101.30	1.02	100.29
1 / 3 .	2.26	0.13	2.73	0.10	9.52	12.28	0.00	0.28	18.75	0.40	13.03	0.05	-0.02	37.40	3.92	100.84	0.98	99.86
1 / 4 .	2.33	0.10	2.72	0.10	9.70	12.28	0.02	0.32	18.80	0.32	13.00	0.04	0.03	37.47	4.07	101.30	1.00	100.29

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 5 .	2.33	0.12	2.69	0.12	9.44	12.17	0.05	0.29	18.58	0.61	12.92	0.08	0.03	37.61	3.80	100.83	1.01	99.83
1 / 6 .	2.15	0.11	2.82	0.13	9.67	12.34	0.01	0.31	19.11	0.53	13.00	-0.01	0.04	37.35	4.24	101.79	0.93	100.86
1 / 7 .	2.34	0.11	2.71	0.10	9.55	12.26	0.00	0.36	18.73	0.50	13.12	0.04	-0.03	37.53	4.12	101.47	1.01	100.46
1 / 8 .	2.26	0.13	2.74	0.10	9.74	12.28	-0.01	0.38	18.90	0.57	12.92	0.02	0.02	37.50	3.95	101.53	0.98	100.55
1 / 9 .	2.30	0.13	2.72	0.11	9.57	12.31	0.00	0.32	18.89	0.46	12.91	0.01	-0.01	37.47	3.96	101.16	1.00	100.17
1 / 10 . *	2.32	0.11	2.74	0.07	9.75	12.36	0.01	0.32	19.20	0.43	13.11	0.02	-0.01	37.56	4.08	102.08	1.00	101.07
Avg 202 bt9	2.30	0.12	2.72	0.11	9.58	12.29	0.01	0.33	18.80	0.48	12.98	0.02	0.00	37.49	4.00	101.25	1.00	100.26
202_bt_10																		
1 / 1 . *	2.25	0.10	2.78	0.07	9.79	12.18	-0.02	0.37	19.52	0.28	12.76	0.01	0.00	37.89	4.12	102.11	0.97	101.14
1 / 2 .	2.32	0.13	2.69	0.09	9.59	12.10	-0.01	0.35	18.93	0.29	12.69	0.04	0.01	37.43	4.05	100.69	1.01	99.68
1 / 3 .	2.24	0.12	2.76	0.09	9.65	12.12	0.00	0.35	19.18	0.34	12.80	0.02	-0.02	37.52	4.22	101.39	0.97	100.43
1 / 4 .	2.14	0.12	2.81	0.15	9.64	12.08	0.00	0.35	19.02	0.45	12.78	0.03	-0.06	37.81	4.09	101.47	0.93	100.55
1 / 5 .	2.20	0.12	2.76	0.13	9.56	11.97	-0.01	0.36	19.54	0.27	12.81	0.06	-0.01	37.40	3.95	101.14	0.96	100.18
1 / 6 .	2.31	0.11	2.72	0.12	9.73	11.96	0.01	0.36	19.18	0.38	12.75	0.13	-0.01	37.60	4.15	101.50	1.00	100.50
1 / 7 .	2.24	0.11	2.71	0.13	9.53	11.81	-0.02	0.32	19.17	0.44	12.66	0.05	0.01	37.08	4.23	100.49	0.97	99.52
1 / 8 .	2.12	0.11	2.82	0.11	9.55	11.95	-0.02	0.38	19.35	0.45	12.76	0.00	0.06	37.50	4.35	101.51	0.92	100.60
1 / 9 .	2.24	0.13	2.76	0.09	9.67	11.98	0.00	0.35	19.29	0.39	12.74	0.04	0.05	37.57	4.35	101.66	0.97	100.68
1 / 10 .	2.26	0.11	2.74	0.13	9.59	12.05	0.02	0.36	19.36	0.29	12.57	0.06	0.00	37.36	4.32	101.22	0.98	100.25
Avg 202bt10	2.23	0.12	2.75	0.11	9.61	12.00	0.00	0.35	19.22	0.37	12.73	0.05	0.00	37.47	4.19	101.21	0.97	100.25
BR-70 bt 1																		
1 / 1 .	1.13	0.11	3.31	0.01	9.30	11.33	-0.01	0.33	20.25	0.40	13.18	--	-0.02	36.63	4.65	100.63	0.50	100.13
1 / 2 . *	1.19	0.12	3.18	0.06	9.06	10.81	0.05	0.29	20.11	0.36	12.81	--	0.00	36.13	4.15	98.31	0.53	97.78
1 / 3 .	1.11	0.10	3.32	0.00	9.13	11.34	0.02	0.30	20.34	0.28	13.24	--	0.01	37.13	4.13	100.45	0.49	99.96
1 / 4 . *	0.16	0.02	7.18	0.21	1.87	1.99	0.02	0.03	2.77	0.07	3.11	--	-0.05	126.51	0.88	144.84	0.07	144.77
1 / 5 . *	1.18	0.12	3.18	0.03	9.10	10.81	0.01	0.29	20.28	0.31	12.78	--	0.00	35.98	4.32	98.41	0.53	97.88
1 / 6 . *	0.96	0.12	3.39	0.09	8.18	9.18	0.16	0.27	18.61	0.29	11.02	--	-0.01	41.60	3.94	97.82	0.43	97.39
1 / 7 .	1.08	0.10	3.34	0.00	9.36	11.18	0.00	0.34	20.22	0.30	13.22	--	-0.02	37.21	4.28	100.63	0.48	100.15
1 / 8 .	1.18	0.11	3.22	0.00	9.45	10.96	0.01	0.32	19.79	0.29	13.04	--	0.02	36.28	4.54	99.22	0.52	98.69
1 / 9 .	1.05	0.10	3.34	-0.03	9.43	11.15	0.00	0.33	20.28	0.42	13.06	--	-0.01	36.85	4.46	100.49	0.46	100.02

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 10 .	1.21	0.11	3.22	-0.05	9.32	10.97	-0.02	0.31	20.12	0.24	13.05	--	-0.05	36.60	4.35	99.50	0.53	98.97
Avg 70 bt 1	1.13	0.11	3.29	-0.01	9.33	11.16	0.00	0.32	20.17	0.32	13.13	--	-0.01	36.78	4.40	100.15	0.50	99.65
BR-70 bt 2																		
1 / 1 .	1.16	0.11	3.28	-0.07	9.45	10.96	0.00	0.30	21.33	0.36	12.99	--	-0.01	36.48	4.59	101.01	0.51	100.49
1 / 2 .	1.13	0.11	3.29	-0.07	9.41	10.81	0.00	0.32	21.38	0.36	12.91	--	0.02	36.45	4.61	100.81	0.50	100.31
1 / 3 .	1.18	0.12	3.24	-0.08	9.47	10.74	-0.02	0.34	21.07	0.34	12.94	--	0.03	36.29	4.61	100.36	0.52	99.84
1 / 4 .	1.13	0.10	3.27	-0.02	9.28	10.70	0.01	0.32	21.16	0.36	12.85	--	0.03	36.36	4.62	100.19	0.50	99.69
1 / 5 .	1.12	0.09	3.31	-0.07	9.16	10.82	-0.02	0.35	21.71	0.32	13.20	--	-0.01	36.52	4.48	101.08	0.49	100.59
1 / 6 .	1.08	0.12	3.29	-0.06	9.23	10.64	0.00	0.33	21.45	0.30	13.00	--	0.02	36.35	4.56	100.37	0.48	99.89
1 / 7 .	1.07	0.12	3.29	-0.05	8.98	10.73	0.01	0.31	21.62	0.39	12.92	--	0.00	36.23	4.42	100.10	0.47	99.62
1 / 8 .	1.17	0.10	3.27	-0.03	9.34	10.57	-0.01	0.34	21.50	0.23	13.00	--	0.01	36.41	4.66	100.59	0.51	100.08
1 / 9 .	1.09	0.10	3.30	-0.07	9.40	10.67	-0.01	0.36	21.65	0.42	13.00	--	0.01	36.18	4.62	100.80	0.48	100.32
1 / 10 .	1.13	0.11	3.25	-0.05	9.26	10.57	0.02	0.29	21.46	0.37	12.75	--	0.01	36.03	4.75	100.00	0.50	99.50
Avg 70 bt 2	1.13	0.11	3.28	-0.06	9.30	10.72	0.00	0.33	21.43	0.35	12.96	--	0.01	36.33	4.59	100.53	0.50	100.03
BR-70 bt 3																		
1 / 1 .	1.16	0.11	3.28	-0.07	9.45	10.96	0.00	0.30	21.33	0.36	12.99	--	-0.01	36.48	4.59	101.01	0.51	100.49
1 / 2 .	1.13	0.11	3.29	-0.07	9.41	10.81	0.00	0.32	21.38	0.36	12.91	--	0.02	36.45	4.61	100.81	0.50	100.31
1 / 3 .	1.18	0.12	3.24	-0.08	9.47	10.74	-0.02	0.34	21.07	0.34	12.94	--	0.03	36.29	4.61	100.36	0.52	99.84
1 / 4 .	1.13	0.10	3.27	-0.02	9.28	10.70	0.01	0.32	21.16	0.36	12.85	--	0.03	36.36	4.62	100.19	0.50	99.69
1 / 5 .	1.12	0.09	3.31	-0.07	9.16	10.82	-0.02	0.35	21.71	0.32	13.20	--	-0.01	36.52	4.48	101.08	0.49	100.59
1 / 6 .	1.08	0.12	3.29	-0.06	9.23	10.64	0.00	0.33	21.45	0.30	13.00	--	0.02	36.35	4.56	100.37	0.48	99.89
1 / 7 .	1.07	0.12	3.29	-0.05	8.98	10.73	0.01	0.31	21.62	0.39	12.92	--	0.00	36.23	4.42	100.10	0.47	99.62
1 / 8 .	1.17	0.10	3.27	-0.03	9.34	10.57	-0.01	0.34	21.50	0.23	13.00	--	0.01	36.41	4.66	100.59	0.51	100.08
1 / 9 .	1.09	0.10	3.30	-0.07	9.40	10.67	-0.01	0.36	21.65	0.42	13.00	--	0.01	36.18	4.62	100.80	0.48	100.32
1 / 10 .	1.13	0.11	3.25	-0.05	9.26	10.57	0.02	0.29	21.46	0.37	12.75	--	0.01	36.03	4.75	100.00	0.50	99.50
Avg 70 bt 3	1.13	0.11	3.28	-0.06	9.30	10.72	0.00	0.33	21.43	0.35	12.96	0.00	0.01	36.33	4.59	100.53	0.50	100.03
BR-70 bt 5																		
1 / 1 .	1.15	0.10	3.24	-0.01	9.42	10.75	0.01	0.25	21.30	0.37	12.90	--	-0.02	35.97	4.55	100.03	0.51	99.52
1 / 2 .	1.11	0.11	3.24	0.01	9.43	10.61	0.00	0.22	21.20	0.33	12.83	--	-0.06	35.93	4.48	99.51	0.49	99.01

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 3 .	1.13	0.13	3.24	0.02	9.53	10.60	0.01	0.23	21.40	0.38	12.81	--	-0.01	35.80	4.68	99.94	0.50	99.44
1 / 4 .	1.15	0.11	3.23	-0.04	9.50	10.63	-0.01	0.27	21.32	0.37	12.79	--	0.02	35.82	4.64	99.86	0.51	99.35
1 / 5 .	1.14	0.11	3.24	-0.03	9.48	10.61	0.01	0.23	21.34	0.37	12.99	--	-0.06	35.87	4.59	100.00	0.50	99.50
1 / 6 . *	1.05	0.12	3.20	0.07	9.27	10.27	0.00	0.22	20.65	0.49	12.54	--	0.01	35.33	4.50	97.73	0.47	97.26
1 / 7 .	1.12	0.09	3.25	-0.01	9.48	10.62	0.00	0.21	21.31	0.41	12.86	--	-0.02	35.85	4.67	99.89	0.49	99.40
1 / 8 .	1.16	0.11	3.24	-0.01	9.40	10.69	-0.01	0.23	21.62	0.46	12.93	--	-0.02	35.94	4.62	100.39	0.51	99.88
1 / 9 .	1.09	0.10	3.26	-0.03	9.53	10.55	0.00	0.18	21.51	0.50	12.98	--	-0.03	35.74	4.51	99.95	0.48	99.47
1 / 10 .	1.14	0.11	3.25	-0.04	9.40	10.64	0.00	0.13	21.52	0.43	12.87	--	0.00	36.00	4.59	100.07	0.50	99.57
Avg 70 bt 5	1.13	0.11	3.24	-0.02	9.46	10.63	0.00	0.22	21.39	0.40	12.88	0.00	-0.02	35.88	4.59	99.96	0.50	99.46
BR-70 bt 6																		
1 / 1 .	1.18	0.11	3.23	-0.06	8.89	10.66	0.04	0.23	21.42	0.30	12.90	--	0.01	36.32	4.50	99.80	0.52	99.28
1 / 2 .	1.16	0.12	3.25	-0.05	9.06	10.72	0.04	0.32	21.59	0.36	12.94	--	0.03	36.34	4.47	100.40	0.52	99.88
1 / 3 .	1.23	0.13	3.22	-0.05	9.26	10.83	0.02	0.27	21.23	0.39	13.12	--	0.03	36.26	4.49	100.50	0.55	99.95
1 / 4 .	1.21	0.12	3.24	-0.09	9.25	10.65	0.02	0.28	21.33	0.43	12.97	--	0.03	36.59	4.45	100.56	0.53	100.03
1 / 5 .	1.19	0.12	3.24	-0.06	9.13	10.70	0.03	0.27	21.25	0.33	13.08	--	0.00	36.38	4.52	100.24	0.53	99.71
1 / 6 .	1.15	0.13	3.25	-0.04	9.12	10.77	0.06	0.27	21.48	0.32	12.82	--	0.00	36.34	4.44	100.16	0.51	99.64
1 / 7 .	1.21	0.10	3.23	-0.05	8.92	10.53	0.06	0.32	21.57	0.37	12.97	--	0.04	36.44	4.43	100.18	0.53	99.65
1 / 8 .	1.16	0.12	3.24	0.02	9.08	10.57	0.04	0.25	21.07	0.33	12.93	--	0.04	36.41	4.49	99.75	0.52	99.23
1 / 9 .	1.17	0.14	3.22	-0.03	8.94	10.66	0.06	0.33	21.57	0.35	12.85	--	0.02	36.16	4.43	99.90	0.52	99.38
1 / 10 .	1.15	0.13	3.26	-0.06	9.04	10.59	0.04	0.27	21.61	0.32	12.94	--	0.03	36.58	4.47	100.43	0.51	99.92
Avg 70 bt 6	1.18	0.12	3.24	-0.05	9.07	10.67	0.04	0.28	21.41	0.35	12.95	0.00	0.02	36.38	4.47	100.19	0.52	99.67

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BR-71 bt 1	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 .	0.78	0.08	3.43	-0.08	9.22	10.73	0.09	0.22	20.63	0.50	13.21	--	-0.03	35.87	4.61	99.37	0.35	99.02
1 / 2 . *	0.87	0.11	3.37	-0.05	9.14	10.72	0.07	0.22	20.12	0.50	13.11	--	-0.06	35.80	4.79	98.82	0.39	98.43
1 / 3 .	0.86	0.11	3.42	-0.08	9.45	10.68	0.03	0.19	20.89	0.54	13.30	--	0.00	36.10	4.81	100.40	0.39	100.01
1 / 4 . *	0.99	0.11	3.31	0.05	8.77	10.59	0.15	0.22	20.37	0.48	13.11	--	-0.02	36.00	4.81	98.97	0.44	98.53
1 / 5 .	0.85	0.08	3.42	-0.06	9.45	10.59	0.04	0.17	20.67	0.71	13.48	--	0.02	35.88	4.84	100.21	0.38	99.83
1 / 6 .	0.83	0.10	3.42	-0.07	9.40	10.68	0.02	0.21	20.62	0.62	13.18	--	-0.04	35.94	5.00	100.01	0.37	99.64

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 7 .	0.84	0.09	3.40	-0.01	9.42	10.58	0.00	0.22	20.64	0.61	13.32	--	0.00	35.66	4.78	99.55	0.37	99.18
1 / 8 .	0.88	0.10	3.40	-0.07	9.36	10.66	0.02	0.17	20.65	0.53	13.32	--	-0.02	35.96	4.87	99.92	0.39	99.53
1 / 9 .	0.84	0.11	3.41	-0.08	9.48	10.62	0.00	0.21	20.72	0.65	13.28	--	-0.01	35.86	4.92	100.12	0.38	99.74
1 / 10 .	0.86	0.10	3.40	-0.06	9.52	10.68	0.01	0.21	20.59	0.48	13.21	--	0.00	35.90	4.94	99.92	0.38	99.53
Avg 71 bt 1	0.84	0.10	3.41	-0.06	9.41	10.65	0.03	0.20	20.68	0.58	13.29	0.00	-0.01	35.90	4.85	99.94	0.38	99.56
BR-71 bt 2																		
1 / 1 .	0.99	0.10	3.34	0.01	9.58	11.41	0.01	0.16	19.83	0.41	13.14	--	0.01	36.18	4.54	99.72	0.44	99.27
1 / 2 .	0.75	0.10	3.47	-0.03	9.60	11.27	-0.01	0.17	20.02	0.48	13.26	--	-0.03	36.06	4.62	99.80	0.34	99.46
1 / 3 .	0.88	0.11	3.39	0.02	9.56	11.20	-0.01	0.20	19.87	0.46	13.24	--	-0.01	36.08	4.53	99.53	0.40	99.13
1 / 4 .	0.59	0.10	3.56	0.00	9.50	11.20	0.01	0.18	20.14	0.46	13.37	--	-0.01	36.12	4.65	99.87	0.27	99.60
1 / 5 .	0.68	0.10	3.49	-0.04	9.53	11.12	0.02	0.14	20.16	0.52	13.23	--	0.02	35.92	4.54	99.46	0.31	99.15
1 / 6 .	0.79	0.11	3.43	0.02	9.33	11.14	0.02	0.17	20.34	0.47	13.21	--	0.03	35.97	4.46	99.50	0.36	99.14
1 / 7 .	0.92	0.10	3.35	0.01	9.40	11.21	0.06	0.16	19.98	0.40	13.12	--	0.00	35.91	4.38	98.99	0.41	98.58
1 / 8 .	1.02	0.11	3.32	-0.03	9.34	11.31	0.06	0.18	20.04	0.44	13.17	--	0.02	36.14	4.53	99.68	0.45	99.23
1 / 9 .	1.00	0.11	3.34	0.00	9.50	11.19	0.04	0.16	20.26	0.57	13.20	--	0.00	36.15	4.56	100.07	0.45	99.62
1 / 10 .	0.95	0.11	3.37	0.02	9.56	11.38	0.06	0.13	20.44	0.37	13.13	--	0.01	36.03	4.57	100.13	0.43	99.70
Avg 71 bt 2	0.86	0.11	3.41	0.00	9.49	11.24	0.03	0.17	20.11	0.46	13.21	0.00	0.00	36.06	4.54	99.68	0.39	99.29
BR-71 bt 3																		
1 / 1 . *	0.88	0.08	3.36	-0.03	9.43	10.15	0.01	0.17	20.94	0.41	12.91	--	-0.03	35.73	4.97	99.05	0.39	98.66
1 / 2 .	0.92	0.08	3.38	-0.03	9.43	10.13	0.00	0.14	21.64	0.57	13.02	--	-0.06	36.10	5.03	100.44	0.41	100.04
1 / 3 .	0.93	0.08	3.36	-0.04	9.35	10.09	0.01	0.19	21.63	0.54	12.89	--	-0.02	35.80	5.15	100.03	0.41	99.62
1 / 4 .	0.87	0.10	3.40	-0.04	9.44	10.11	0.00	0.19	21.86	0.52	12.97	--	-0.03	35.97	5.11	100.54	0.39	100.16
1 / 5 .	0.93	0.07	3.35	-0.04	9.05	10.13	0.02	0.16	21.83	0.52	13.06	--	-0.01	35.64	4.94	99.71	0.41	99.30
1 / 6 .	0.84	0.07	3.41	-0.08	9.38	10.04	0.01	0.21	22.11	0.51	13.01	--	-0.01	35.73	5.11	100.44	0.37	100.07
1 / 7 .	0.86	0.10	3.38	-0.05	9.46	10.09	0.01	0.20	21.60	0.50	12.94	--	-0.01	35.75	5.06	99.96	0.38	99.58
1 / 8 .	0.95	0.08	3.33	-0.08	9.44	10.11	0.00	0.18	21.52	0.50	12.97	--	-0.04	35.72	4.97	99.80	0.42	99.38
1 / 9 .	0.90	0.09	3.37	-0.03	9.35	10.27	0.00	0.18	21.37	0.43	13.02	--	0.01	35.83	4.89	99.73	0.40	99.34
1 / 10 .	0.90	0.07	3.38	-0.05	9.40	10.08	0.01	0.19	21.68	0.36	13.02	--	-0.01	35.82	5.07	99.98	0.39	99.58
Avg 71 bt 3	0.90	0.08	3.37	-0.05	9.37	10.12	0.01	0.18	21.69	0.49	12.99	0.00	-0.02	35.82	5.04	100.07	0.40	99.67

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
BR-71 bt 4																		
1 / 1 .	1.11	0.12	3.32	-0.06	9.58	11.98	0.00	0.15	18.63	0.52	13.66	--	-0.02	36.58	4.66	100.30	0.49	99.81
1 / 2 .	1.16	0.14	3.30	-0.04	9.58	11.95	0.02	0.19	18.46	0.68	13.70	--	-0.02	36.61	4.74	100.52	0.52	100.00
1 / 3 . *	1.07	0.11	3.31	-0.01	9.45	11.83	0.01	0.18	18.31	0.63	13.55	--	-0.01	36.32	4.66	99.44	0.48	98.96
1 / 4 .	1.14	0.12	3.29	0.03	9.46	11.93	0.01	0.20	18.34	0.62	13.65	--	-0.03	36.44	4.70	99.94	0.51	99.44
1 / 5 .	1.14	0.14	3.30	0.01	9.59	12.08	0.01	0.14	18.48	0.68	13.70	--	-0.02	36.29	4.77	100.33	0.51	99.82
1 / 6 .	1.01	0.12	3.38	-0.05	9.35	12.07	0.02	0.20	18.68	0.69	13.75	--	-0.02	36.55	4.69	100.53	0.45	100.07
1 / 7 .	1.06	0.14	3.35	-0.02	9.57	12.06	0.00	0.15	18.49	0.76	13.92	--	0.00	36.37	4.75	100.63	0.48	100.16
1 / 8 .	1.04	0.12	3.35	-0.01	9.15	11.99	0.01	0.18	18.41	0.61	13.78	--	-0.01	36.47	4.68	99.79	0.46	99.32
1 / 9 .	1.08	0.14	3.33	-0.02	9.57	11.98	0.00	0.19	18.07	0.68	13.74	--	-0.04	36.42	4.96	100.17	0.49	99.68
1 / 10 .	1.09	0.14	3.35	-0.05	9.62	11.89	0.01	0.22	18.61	0.50	13.90	--	-0.03	36.51	5.10	100.92	0.49	100.43
Avg 71 bt 4	1.09	0.13	3.33	-0.02	9.50	11.99	0.01	0.18	18.46	0.64	13.76	0.00	-0.02	36.47	4.78	100.35	0.49	99.86
BR-71 bt 5																		
1 / 1 .	1.01	0.17	3.34	0.04	9.46	10.95	-0.01	0.18	20.20	0.48	13.41	--	-0.05	36.32	4.78	100.35	0.46	99.89
1 / 2 .	0.97	0.13	3.36	-0.02	9.48	10.91	0.01	0.17	19.82	0.37	13.40	--	0.00	36.36	4.83	99.81	0.44	99.38
1 / 3 .	1.00	0.18	3.32	0.00	9.53	10.80	0.00	0.21	19.88	0.51	13.42	--	-0.02	36.24	4.76	99.85	0.46	99.39
1 / 4 .	1.03	0.13	3.31	-0.01	9.41	10.74	-0.02	0.18	19.86	0.53	13.52	--	-0.02	36.18	4.78	99.69	0.46	99.23
1 / 5 .	1.01	0.15	3.33	-0.02	9.49	10.90	0.00	0.15	19.97	0.51	13.45	--	-0.02	36.28	4.81	100.06	0.46	99.60
1 / 6 .	0.97	0.15	3.34	-0.01	9.53	10.88	0.00	0.17	20.05	0.48	13.36	--	-0.05	36.15	4.80	99.87	0.44	99.43
1 / 7 .	0.94	0.16	3.36	-0.02	9.40	10.71	0.00	0.17	20.25	0.67	13.47	--	-0.02	36.34	4.74	100.22	0.43	99.79
1 / 8 .	0.90	0.15	3.39	0.06	9.52	10.81	-0.01	0.17	20.17	0.53	13.57	--	-0.02	36.21	4.77	100.25	0.41	99.84
1 / 9 .	0.99	0.16	3.36	0.00	9.52	10.76	0.00	0.17	20.22	0.49	13.63	--	-0.01	36.38	4.86	100.55	0.45	100.10
1 / 10 .	1.00	0.16	3.33	0.02	9.53	10.75	0.00	0.13	20.36	0.42	13.56	--	-0.01	36.21	4.75	100.21	0.46	99.76
Avg 71 bt 5	0.98	0.15	3.34	0.00	9.49	10.82	0.00	0.17	20.08	0.50	13.48	0.00	-0.02	36.27	4.79	100.09	0.45	99.64

BR-13																		
BR-13 bt 1	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 . *	1.06	0.08	3.29	0.04	9.12	12.48	0.02	0.15	19.15	0.40	13.80	--	-0.01	36.05	2.96	98.62	0.46	98.16
1 / 2 .	1.17	0.09	3.27	0.07	9.22	12.58	0.02	0.19	19.03	0.37	13.73	--	-0.01	36.49	3.28	99.52	0.51	99.01
1 / 3 .	1.18	0.07	3.29	0.07	9.65	12.59	0.06	0.13	18.92	0.57	13.75	--	0.02	36.73	3.09	100.11	0.51	99.60

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 4 .	1.15	0.08	3.28	0.05	9.40	12.55	0.00	0.12	19.23	0.41	13.77	--	-0.01	36.68	2.87	99.59	0.50	99.09
1 / 5 . *	1.14	0.06	3.27	0.05	9.02	12.53	0.02	0.11	19.18	0.36	13.76	--	0.01	36.14	3.14	98.78	0.49	98.29
1 / 6 . *	1.20	0.06	3.24	0.07	9.16	12.64	0.08	0.11	18.63	0.39	13.70	--	-0.01	36.31	3.11	98.70	0.52	98.18
1 / 7 . *	1.22	0.07	3.22	0.06	9.30	12.47	0.08	0.14	18.49	0.42	13.69	--	0.01	36.43	3.04	98.62	0.53	98.09
1 / 8 .	1.14	0.07	3.29	0.06	9.46	12.67	0.01	0.10	18.91	0.44	13.72	--	0.01	36.59	3.08	99.55	0.49	99.06
1 / 9 . *	1.22	0.09	3.22	0.05	9.44	12.52	0.06	0.15	18.54	0.48	13.60	--	0.00	36.45	3.11	98.92	0.53	98.39
1 / 10 .*	1.10	0.06	3.28	0.06	9.45	12.52	0.06	0.11	18.56	0.41	13.67	--	0.02	36.25	3.04	98.59	0.48	98.11
Avg 13 bt 1	1.16	0.08	3.28	0.06	9.43	12.60	0.02	0.14	19.02	0.45	13.74	0.00	0.00	36.62	3.08	99.69	0.50	99.19
BR-13 bt 3																		
1 / 1 .	0.76	0.07	3.49	0.03	9.23	10.65	0.04	0.25	20.06	0.41	13.44	--	-0.02	36.67	4.81	99.91	0.34	99.57
1 / 2 .	0.79	0.05	3.47	0.02	9.40	10.66	0.00	0.25	20.52	0.46	13.45	--	0.00	36.44	4.50	100.02	0.34	99.68
1 / 3 .	0.82	0.06	3.46	0.04	9.22	10.69	0.02	0.18	20.54	0.52	13.48	--	-0.03	36.42	4.69	100.14	0.36	99.78
1 / 4 . *	0.80	0.07	3.42	0.04	9.30	10.29	0.03	0.21	20.59	0.61	13.07	--	0.02	36.10	4.64	99.20	0.35	98.85
1 / 5 . *	0.84	0.07	3.38	0.06	9.26	10.17	0.06	0.24	20.22	0.66	13.13	--	0.01	35.93	4.63	98.67	0.37	98.30
1 / 6 .	0.86	0.07	3.41	0.07	9.21	10.55	0.05	0.26	20.25	0.56	13.30	--	-0.02	36.18	4.70	99.46	0.37	99.09
1 / 7 . *	0.85	0.05	3.39	0.03	9.15	10.52	0.02	0.21	20.25	0.46	13.08	--	0.01	36.10	4.58	98.72	0.37	98.35
1 / 8 .	0.84	0.06	3.43	0.04	9.27	10.58	0.03	0.26	20.29	0.52	13.35	--	0.01	36.35	4.67	99.70	0.37	99.33
1 / 9 .	0.91	0.07	3.40	0.05	9.40	10.62	0.02	0.28	20.42	0.62	13.48	--	0.01	36.37	4.44	100.08	0.40	99.68
1 / 10 .	0.91	0.06	3.41	0.04	9.28	10.68	0.02	0.25	20.13	0.54	13.51	--	0.00	36.51	4.71	100.05	0.40	99.65
Avg 13 bt 3	0.84	0.06	3.44	0.04	9.29	10.63	0.03	0.25	20.32	0.52	13.43	0.00	-0.01	36.42	4.65	99.91	0.37	99.54
BR-13 bt 4																		
1 / 1 .	0.82	0.05	3.43	0.02	9.44	10.34	0.01	0.29	20.23	0.55	13.33	--	0.03	35.95	4.99	99.49	0.36	99.14
1 / 2 .	0.76	0.07	3.46	0.02	9.50	10.41	0.02	0.25	20.51	0.56	13.40	--	-0.01	35.95	5.00	99.91	0.34	99.57
1 / 3 . *	0.77	0.07	3.36	0.08	9.14	10.07	0.07	0.28	19.95	0.61	13.12	--	0.00	35.13	4.73	97.38	0.34	97.04
1 / 4 .	0.83	0.06	3.43	0.01	9.49	10.40	0.00	0.25	20.64	0.52	13.36	--	0.01	35.97	5.00	99.98	0.36	99.61
1 / 5 . *	0.77	0.07	3.34	0.03	6.83	10.38	0.09	0.32	22.64	0.46	13.79	--	0.03	33.90	4.30	96.96	0.34	96.61
1 / 6 .	0.77	0.07	3.45	0.03	9.50	10.36	0.02	0.29	20.27	0.57	13.41	--	-0.01	35.84	4.91	99.47	0.34	99.13
1 / 7 .	0.82	0.06	3.43	0.04	9.35	10.28	0.01	0.28	20.50	0.53	13.41	--	0.03	36.02	4.91	99.67	0.36	99.31
1 / 8 .	0.75	0.07	3.46	0.05	9.42	10.31	0.05	0.24	20.73	0.56	13.42	--	0.03	35.75	5.05	99.90	0.33	99.56
1 / 9 .	0.76	0.07	3.49	0.03	9.45	10.34	0.01	0.28	20.82	0.64	13.53	--	0.03	36.08	5.05	100.57	0.34	100.23

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 10 .	0.82	0.07	3.44	0.03	9.46	10.36	0.01	0.31	20.85	0.57	13.41	--	0.01	35.90	4.97	100.21	0.36	99.85
Avg 13 bt 4	0.79	0.07	3.45	0.03	9.45	10.35	0.02	0.27	20.57	0.56	13.41	0.00	0.02	35.93	4.99	99.90	0.35	99.55
BR-13 bt 5																		
1 / 1 . *	0.92	0.07	3.36	0.07	9.16	10.95	0.00	0.21	19.54	0.40	13.37	--	0.00	36.05	4.40	98.50	0.40	98.10
1 / 2 .	0.88	0.08	3.42	0.06	9.38	11.08	0.01	0.18	20.27	0.51	13.62	--	0.01	36.41	4.28	100.20	0.39	99.81
1 / 3 .	0.95	0.08	3.38	0.06	9.16	11.03	0.03	0.19	20.06	0.48	13.58	--	-0.02	36.35	4.49	99.85	0.42	99.43
1 / 4 .	0.93	0.06	3.39	0.10	9.26	10.87	0.01	0.20	20.11	0.53	13.58	--	-0.01	36.25	4.52	99.83	0.41	99.42
1 / 5 .	0.82	0.08	3.45	0.06	9.25	11.08	0.01	0.20	20.08	0.54	13.53	--	0.00	36.17	4.68	99.94	0.36	99.58
1 / 6 .	0.89	0.07	3.41	0.08	9.34	11.02	0.01	0.16	20.01	0.49	13.58	--	0.00	36.26	4.46	99.76	0.39	99.37
1 / 7 .	0.87	0.08	3.41	0.08	9.36	11.05	0.02	0.18	20.04	0.44	13.48	--	0.00	36.18	4.31	99.51	0.38	99.12
1 / 8 .	0.91	0.07	3.39	0.11	9.23	10.97	0.01	0.21	20.03	0.53	13.49	--	0.04	36.03	4.64	99.65	0.40	99.25
1 / 9 .	0.85	0.08	3.42	0.08	9.18	11.08	0.03	0.21	19.84	0.59	13.58	--	0.00	36.21	4.32	99.46	0.38	99.08
1 / 10 . *	0.90	0.08	3.38	0.08	9.31	11.07	0.00	0.18	19.99	0.41	13.50	--	0.00	35.93	4.26	99.07	0.40	98.67
Avg 13 bt 5	0.89	0.08	3.41	0.08	9.27	11.02	0.02	0.19	20.06	0.51	13.56	0.00	0.00	36.23	4.46	99.78	0.39	99.38

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111_bt_1	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 .	1.13	0.09	3.31	0.11	9.11	10.88	0.00	0.30	21.30	0.22	12.88	0.00	0.02	36.93	4.50	100.78	0.50	100.28
1 / 2 .	1.18	0.07	3.25	0.07	9.03	10.86	0.00	0.24	20.57	0.29	12.75	0.08	0.03	36.61	4.47	99.48	0.51	98.97
1 / 3 .	1.30	0.08	3.18	0.10	9.08	10.82	-0.01	0.23	20.89	0.28	12.69	0.04	0.03	36.52	4.46	99.69	0.57	99.13
1 / 4 .	1.24	0.10	3.22	0.08	8.92	10.75	-0.02	0.25	20.88	0.46	12.81	0.00	-0.04	36.71	4.60	100.02	0.54	99.48
1 / 5 .	1.18	0.08	3.25	0.08	8.93	10.62	-0.01	0.27	20.80	0.30	12.89	0.08	-0.04	36.72	4.49	99.68	0.51	99.16
1 / 6 .	1.20	0.09	3.24	0.07	8.91	10.74	0.01	0.25	20.89	0.56	12.86	0.06	0.00	36.62	4.54	100.04	0.53	99.52
1 / 7 .	1.14	0.09	3.29	0.10	8.79	10.71	0.01	0.25	20.70	0.38	12.95	0.07	-0.06	36.89	4.64	100.00	0.50	99.50
1 / 8 .	1.15	0.08	3.26	0.08	8.88	10.63	0.01	0.22	20.55	0.45	12.79	0.00	0.01	36.77	4.61	99.49	0.50	98.99
1 / 9 .	1.16	0.07	3.26	0.08	8.82	10.73	0.00	0.26	20.68	0.41	12.84	0.02	0.02	36.78	4.44	99.56	0.50	99.05
1 / 10 .	1.23	0.07	3.23	0.11	8.82	10.62	-0.02	0.31	20.66	0.39	12.79	0.09	0.01	36.82	4.59	99.75	0.54	99.22
Avg 111_bt1	1.19	0.08	3.25	0.09	8.93	10.74	0.00	0.26	20.79	0.37	12.82	0.04	0.00	36.74	4.53	99.83	0.52	99.31

111_bt_2

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 1 .	1.06	0.08	3.36	0.11	9.60	10.57	-0.01	0.29	20.90	0.37	12.97	0.05	-0.03	37.30	4.60	101.27	0.46	100.81
1 / 2 . *	1.15	0.08	3.33	0.09	9.64	10.46	0.00	0.31	21.19	0.27	13.15	0.11	-0.02	37.39	4.52	101.71	0.50	101.21
1 / 3 .	1.09	0.08	3.35	0.10	9.52	10.51	-0.02	0.33	21.15	0.41	12.99	0.01	0.02	37.21	4.70	101.47	0.48	100.99
1 / 4 . *	0.99	0.06	3.42	0.09	9.42	10.59	0.01	0.36	21.43	0.41	13.00	0.01	0.03	37.18	4.82	101.82	0.43	101.39
1 / 5 . *	1.12	0.08	3.34	0.09	9.74	10.53	-0.01	0.35	21.03	0.24	13.10	0.03	-0.01	37.19	4.69	101.53	0.49	101.04
1 / 6 .	1.05	0.07	3.34	0.11	9.45	10.46	0.00	0.28	20.82	0.16	12.92	0.09	0.02	37.03	4.46	100.25	0.46	99.79
1 / 7 .	1.03	0.08	3.36	0.09	9.37	10.48	0.00	0.32	21.13	0.33	12.85	0.03	-0.05	37.18	4.40	100.65	0.45	100.20
1 / 8 . *	1.01	0.06	3.40	0.10	9.50	10.62	-0.01	0.35	21.26	0.43	12.99	0.03	-0.02	37.31	4.57	101.63	0.44	101.19
1 / 9 . *	1.04	0.07	3.40	0.10	9.37	10.49	0.00	0.32	21.28	0.35	13.27	0.10	-0.02	37.09	4.89	101.76	0.45	101.31
1 / 10 .	1.04	0.07	3.38	0.09	9.52	10.62	-0.01	0.30	21.11	0.43	12.95	-0.02	0.01	37.20	4.64	101.36	0.45	100.91
Avg 111bt2.1	1.05	0.08	3.36	0.10	9.49	10.53	-0.01	0.30	21.02	0.34	12.94	0.03	-0.01	37.18	4.56	100.98	0.46	100.51
2 / 1 .	1.07	0.08	3.36	0.07	9.48	10.62	0.01	0.28	20.81	0.40	13.03	0.01	0.03	37.27	4.58	101.09	0.47	100.62
2 / 2 .	1.10	0.09	3.33	0.08	9.58	10.53	0.01	0.29	21.25	0.41	12.93	0.07	-0.02	37.01	4.65	101.32	0.48	100.84
2 / 3 . *	1.14	0.08	2.58	0.10	9.41	10.84	-0.01	0.32	20.94	0.51	13.33	0.08	0.00	23.10	4.62	87.07	0.50	86.57
2 / 4 .	1.14	0.07	3.31	0.10	9.47	10.53	0.00	0.29	21.29	0.43	12.97	0.05	0.02	37.00	4.52	101.19	0.50	100.69
2 / 5 .	1.06	0.08	3.33	0.08	9.32	10.49	0.03	0.28	21.16	0.18	12.80	0.03	-0.02	36.84	4.73	100.41	0.46	99.95
2 / 6 .	1.12	0.07	3.29	0.09	9.33	10.48	0.00	0.27	20.85	0.28	12.71	0.09	-0.03	36.94	4.56	100.09	0.49	99.60
2 / 7 .	1.08	0.09	3.34	0.12	9.50	10.66	-0.01	0.30	21.00	0.23	12.84	0.02	0.01	37.05	4.68	100.93	0.47	100.46
2 / 8 .	1.09	0.08	3.31	0.08	9.43	10.47	0.00	0.28	21.02	0.31	12.76	0.03	-0.07	36.81	4.82	100.50	0.48	100.02
2 / 9 .	1.11	0.06	3.31	0.06	9.38	10.49	0.02	0.34	20.72	0.28	12.74	-0.02	0.05	36.90	4.81	100.29	0.48	99.81
2 / 10 .	0.98	0.06	3.36	0.08	9.34	10.51	-0.02	0.33	21.04	0.30	12.76	0.03	0.04	36.75	4.52	100.12	0.43	99.69
Avg 111bt2.2	1.08	0.08	3.33	0.09	9.43	10.53	0.00	0.30	21.02	0.31	12.84	0.03	0.00	36.95	4.65	100.64	0.47	100.17
3 / 1 .	1.07	0.09	3.29	0.16	9.06	10.44	-0.01	0.25	20.68	0.52	12.79	0.06	-0.06	36.53	4.71	99.65	0.47	99.18
3 / 2 .	1.08	0.10	3.28	0.11	9.01	10.52	0.03	0.26	20.93	0.66	12.78	0.03	-0.01	36.55	4.42	99.75	0.48	99.27
3 / 3 .	1.05	0.09	3.29	0.12	9.01	10.43	0.01	0.33	20.96	0.52	12.81	0.06	0.01	36.07	4.91	99.67	0.46	99.21
3 / 4 .	1.19	0.08	3.24	0.12	9.01	10.47	0.01	0.31	20.85	0.42	12.81	0.09	0.07	36.38	4.86	99.91	0.52	99.39
3 / 5 .	1.16	0.08	3.22	0.11	8.98	10.41	-0.01	0.30	20.56	0.43	12.72	0.08	0.00	36.21	4.82	99.09	0.51	98.58
3 / 6 .	1.09	0.08	3.28	0.10	8.92	10.38	0.03	0.33	21.19	0.54	12.75	-0.01	-0.05	36.53	4.51	99.73	0.48	99.25
3 / 7 .	1.04	0.09	3.29	0.14	8.82	10.36	-0.02	0.31	20.57	0.48	12.72	-0.01	0.00	36.38	4.94	99.15	0.46	98.69
3 / 8 .	1.09	0.08	3.28	0.14	8.88	10.46	0.02	0.26	21.13	0.45	12.63	0.01	-0.04	36.42	4.85	99.69	0.48	99.21

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
3 / 9 .	0.98	0.09	3.32	0.12	8.78	10.47	0.01	0.32	20.78	0.42	12.69	0.05	0.04	36.41	4.54	99.01	0.43	98.58
3 / 10 .	1.06	0.08	3.26	0.14	8.73	10.49	-0.01	0.32	20.66	0.40	12.66	0.03	0.05	36.00	4.60	98.47	0.46	98.01
Avg 111bt2.3	1.08	0.09	3.28	0.13	8.92	10.44	0.01	0.30	20.83	0.48	12.73	0.04	0.00	36.35	4.72	99.39	0.47	98.91
111_bt_3	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 . *	1.07	0.08	3.37	0.06	9.34	10.52	-0.01	0.31	21.81	0.42	13.01	0.09	-0.06	37.16	4.74	101.98	0.47	101.51
1 / 2 .	1.12	0.09	3.33	0.11	9.45	10.38	-0.02	0.28	21.42	0.17	13.05	-0.02	-0.01	37.12	4.76	101.28	0.49	100.79
1 / 3 .	1.04	0.08	3.38	0.09	9.46	10.41	0.00	0.24	21.29	0.30	13.11	0.06	0.04	37.28	4.63	101.41	0.46	100.95
1 / 4 .	1.19	0.08	3.29	0.11	9.42	10.45	0.00	0.28	21.47	0.35	13.03	0.06	0.00	37.09	4.52	101.35	0.52	100.83
1 / 5 . *	1.19	0.08	3.30	0.05	9.38	10.45	0.01	0.24	21.85	0.40	13.09	0.07	-0.01	37.23	4.43	101.76	0.52	101.24
1 / 6 .	1.16	0.07	3.31	0.11	9.44	10.44	-0.01	0.28	21.33	0.40	13.02	0.12	0.00	37.16	4.56	101.40	0.51	100.89
1 / 7 . *	1.23	0.07	3.29	0.13	9.36	10.45	0.00	0.33	21.66	0.32	13.14	0.05	0.01	37.29	4.43	101.77	0.53	101.24
1 / 8 .	1.14	0.08	3.33	0.12	9.40	10.49	0.02	0.29	21.17	0.44	13.04	0.04	-0.01	37.20	4.65	101.39	0.50	100.90
1 / 9 . *	1.10	0.08	3.36	0.12	9.43	10.50	-0.01	0.25	21.63	0.36	13.03	0.11	0.00	37.23	4.77	101.98	0.48	101.50
1 / 10 . *	1.19	0.08	3.31	0.10	9.49	10.38	-0.01	0.30	21.49	0.41	13.03	0.08	0.02	37.25	4.74	101.89	0.52	101.37
Avg 111bt3.1	1.13	0.08	3.33	0.11	9.43	10.43	0.00	0.27	21.34	0.33	13.05	0.05	0.00	37.17	4.62	101.35	0.49	100.86
2 / 1 .	1.11	0.08	3.31	0.11	9.31	10.44	0.00	0.21	21.51	0.36	12.98	0.01	0.02	36.92	4.37	100.75	0.48	100.26
2 / 2 .	1.07	0.08	3.34	0.11	9.43	10.50	0.03	0.29	21.35	0.37	12.95	0.07	-0.02	37.06	4.33	100.98	0.47	100.51
2 / 3 . *	1.11	0.08	3.34	0.11	9.36	10.49	0.00	0.22	21.61	0.48	13.10	-0.01	0.02	37.02	4.64	101.58	0.49	101.10
2 / 4 .	1.13	0.09	3.31	0.13	9.39	10.45	0.00	0.25	21.45	0.36	12.95	0.04	0.00	37.07	4.36	100.99	0.50	100.50
2 / 5 .	1.12	0.07	3.32	0.10	9.49	10.56	0.01	0.24	21.49	0.32	13.01	0.02	0.01	37.03	4.32	101.11	0.49	100.62
2 / 6 .	1.15	0.07	3.30	0.11	9.35	10.49	0.00	0.21	21.44	0.35	12.94	0.09	0.00	37.11	4.31	100.94	0.50	100.44
2 / 7 .	1.18	0.09	3.30	0.10	9.42	10.50	0.00	0.23	21.48	0.45	12.97	0.05	0.01	37.25	4.57	101.60	0.52	101.08
2 / 8 .	1.24	0.07	3.27	0.11	9.54	10.55	-0.01	0.27	21.29	0.36	13.12	0.04	0.00	37.18	4.40	101.43	0.54	100.89
2 / 9 .	1.16	0.09	3.30	0.11	9.40	10.54	0.00	0.25	21.48	0.39	13.02	0.01	-0.01	37.09	4.47	101.31	0.51	100.80
2 / 10 .	1.16	0.07	3.26	0.11	9.34	10.38	0.03	0.21	21.15	0.53	12.95	0.04	0.01	36.82	4.20	100.27	0.51	99.76
Avg 111bt3.2	1.15	0.08	3.30	0.11	9.41	10.49	0.01	0.24	21.40	0.39	12.99	0.04	0.00	37.06	4.37	101.03	0.50	100.53
111_bt_4																		
1 / 1 .	1.08	0.09	3.31	0.11	9.08	10.34	-0.01	0.31	20.94	0.35	12.71	0.03	-0.01	36.78	4.95	100.07	0.47	99.60
1 / 2 .	1.15	0.09	3.27	0.12	9.06	10.31	0.01	0.25	20.96	0.41	12.84	0.08	0.01	36.90	4.53	99.98	0.50	99.48

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 3 .	1.05	0.09	3.32	0.12	9.12	10.37	0.01	0.33	20.81	0.26	12.76	0.07	0.00	36.71	4.99	100.00	0.46	99.54
1 / 4 .	1.19	0.08	3.24	0.11	9.18	10.44	-0.01	0.31	20.55	0.57	12.82	0.02	-0.05	36.73	4.69	99.95	0.52	99.42
1 / 5 .	1.07	0.09	3.34	0.11	9.19	10.48	-0.01	0.23	20.90	0.31	12.95	0.08	-0.01	37.04	4.81	100.61	0.47	100.14
1 / 6 .	1.04	0.07	3.32	0.12	9.09	10.30	-0.01	0.33	20.69	0.41	12.80	0.02	0.05	36.60	4.80	99.64	0.45	99.19
1 / 7 .	1.10	0.10	3.29	0.15	9.15	10.36	0.01	0.28	20.90	0.42	12.71	0.07	-0.03	36.70	4.78	100.02	0.48	99.53
1 / 8 .	1.04	0.07	3.36	0.11	9.28	10.45	-0.01	0.34	20.90	0.67	12.87	0.07	0.01	37.11	4.76	101.05	0.46	100.59
1 / 9 .	1.13	0.08	3.32	0.12	9.10	10.52	-0.01	0.30	21.16	0.41	12.95	0.10	-0.02	37.02	4.72	100.92	0.49	100.43
1 / 10 .	1.15	0.07	3.30	0.08	9.23	10.57	0.00	0.30	21.08	0.38	12.72	0.11	0.06	37.04	4.65	100.74	0.50	100.24
Avg 111bt4.1	1.10	0.08	3.31	0.11	9.15	10.41	0.00	0.30	20.89	0.42	12.81	0.06	0.00	36.86	4.77	100.28	0.48	99.80
2 / 1 .	1.20	0.09	3.25	0.06	9.20	10.46	0.01	0.31	20.63	0.21	12.80	0.04	-0.03	37.10	4.63	100.00	0.53	99.47
2 / 2 .	1.10	0.07	3.30	0.10	9.23	10.34	-0.01	0.31	20.79	0.30	12.79	0.06	0.00	36.83	4.71	99.91	0.48	99.43
2 / 3 .	1.20	0.09	3.26	0.10	9.29	10.48	0.02	0.32	20.69	0.37	12.78	-0.01	0.05	36.89	4.92	100.46	0.52	99.94
2 / 4 .	1.15	0.09	3.29	0.06	9.18	10.46	0.01	0.34	20.92	0.34	12.88	0.02	-0.02	36.95	4.75	100.45	0.50	99.94
2 / 5 .	1.00	0.07	3.34	0.11	9.22	10.37	0.00	0.38	20.48	0.43	12.80	0.09	0.02	36.76	4.72	99.80	0.44	99.36
2 / 6 .	1.11	0.07	3.32	0.10	9.16	10.49	-0.01	0.31	20.87	0.43	12.78	0.01	-0.01	37.08	4.82	100.55	0.48	100.07
2 / 7 .	1.08	0.09	3.32	0.10	9.16	10.52	0.01	0.30	20.47	0.30	12.81	0.07	0.01	37.12	4.62	99.98	0.47	99.51
2 / 8 .	1.18	0.08	3.28	0.10	9.20	10.55	0.01	0.33	20.86	0.50	12.87	0.08	-0.06	36.94	4.67	100.65	0.51	100.13
2 / 9 .	1.17	0.08	3.27	0.12	9.14	10.42	0.00	0.30	20.65	0.24	12.81	0.03	-0.01	37.23	4.59	100.06	0.51	99.55
2 / 10 .	1.07	0.07	3.34	0.11	9.23	10.44	0.00	0.33	20.69	0.27	13.01	-0.03	0.01	36.98	4.77	100.31	0.46	99.84
Avg 111bt4.2	1.12	0.08	3.30	0.10	9.20	10.45	0.00	0.32	20.71	0.34	12.83	0.04	0.00	36.99	4.72	100.20	0.49	99.70
3 / 1 .	1.10	0.10	3.32	0.07	9.34	11.43	0.03	0.21	19.91	0.33	13.05	0.08	0.00	37.28	3.98	100.23	0.49	99.75
3 / 2 .	1.24	0.07	3.25	0.04	9.51	11.29	0.00	0.19	19.88	0.42	13.04	0.08	0.02	37.08	4.20	100.31	0.54	99.77
3 / 3 .	1.18	0.09	3.30	0.08	9.40	11.40	0.03	0.17	20.03	0.28	13.21	0.04	-0.03	37.29	4.21	100.68	0.52	100.17
3 / 4 .	1.21	0.08	3.26	0.07	9.41	11.25	0.02	0.25	19.95	0.32	13.13	0.05	0.00	37.18	3.97	100.16	0.53	99.64
3 / 5 .	1.26	0.08	3.22	0.07	9.27	11.30	0.02	0.24	19.72	0.23	13.03	0.09	0.02	37.02	4.12	99.70	0.55	99.15
3 / 6 .	1.25	0.07	3.25	0.08	9.38	11.36	0.02	0.23	20.08	0.38	13.14	0.13	0.02	37.00	4.13	100.52	0.54	99.98
3 / 7 .	1.27	0.07	3.25	0.07	9.51	11.41	0.00	0.20	20.02	0.25	13.11	0.06	0.03	37.27	4.01	100.53	0.55	99.98
3 / 8 .	1.11	0.09	3.30	0.09	9.30	11.30	0.02	0.22	19.65	0.23	12.99	0.04	-0.03	37.17	4.15	99.66	0.49	99.17
3 / 9 .	1.28	0.06	3.24	0.05	9.45	11.44	0.02	0.19	20.14	0.20	13.12	0.11	0.01	37.13	3.98	100.41	0.55	99.85
3 / 10 .	1.34	0.09	3.21	0.08	9.42	11.50	0.03	0.21	19.92	0.25	13.03	0.08	-0.03	37.23	4.16	100.55	0.58	99.96

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
Avg 111bt4.3	1.23	0.08	3.26	0.07	9.40	11.37	0.02	0.21	19.93	0.29	13.08	0.08	0.00	37.17	4.09	100.27	0.53	99.73
111_bt_5																		
1 / 1 .	1.24	0.07	3.31	0.13	9.36	11.57	-0.01	0.21	19.98	0.32	13.22	0.07	-0.01	37.63	4.28	101.39	0.54	100.85
1 / 2 . *	1.23	0.08	3.33	0.14	9.41	11.74	0.00	0.23	20.19	0.25	13.22	0.09	0.00	37.80	4.34	102.05	0.53	101.51
1 / 3 .	1.18	0.09	3.32	0.13	9.27	11.54	-0.01	0.22	20.08	0.45	13.18	0.08	0.01	37.47	4.34	101.37	0.52	100.85
1 / 4 . *	1.20	0.09	3.32	0.12	9.24	11.54	-0.01	0.25	20.14	0.32	13.04	0.09	0.00	37.71	4.48	101.54	0.53	101.01
1 / 5 .	1.32	0.09	3.25	0.13	9.24	11.59	0.00	0.23	20.12	0.36	13.21	0.09	-0.02	37.47	4.36	101.47	0.58	100.89
1 / 6 .	1.44	0.08	3.20	0.13	9.40	11.66	0.00	0.23	19.91	0.33	13.17	0.01	0.00	37.62	4.33	101.52	0.63	100.90
1 / 7 .	1.17	0.09	3.32	0.12	9.27	11.50	0.03	0.20	19.77	0.44	13.08	0.01	-0.03	37.61	4.22	100.83	0.51	100.31
Avg 111bt5.1	1.27	0.08	3.28	0.13	9.31	11.57	0.00	0.22	19.97	0.38	13.17	0.05	-0.01	37.56	4.31	101.30	0.55	100.74
2 / 1 .	1.33	0.07	3.24	0.14	9.39	11.73	0.00	0.23	19.60	0.37	13.18	-0.01	0.01	37.55	4.12	100.96	0.58	100.38
2 / 2 .	1.33	0.08	3.24	0.14	9.29	11.74	0.00	0.18	19.63	0.29	13.23	0.05	0.05	37.25	4.38	100.89	0.58	100.31
2 / 3 . *	1.33	0.08	3.27	0.12	9.35	11.91	0.01	0.16	19.68	0.42	13.38	0.06	0.01	37.68	4.20	101.66	0.58	101.08
2 / 4 .	1.31	0.08	3.26	0.09	9.33	11.77	0.00	0.25	19.55	0.46	13.22	-0.01	0.00	37.60	4.13	101.04	0.57	100.47
2 / 5 .	1.34	0.07	3.26	0.09	9.38	11.93	-0.01	0.17	19.63	0.35	13.30	0.03	0.00	37.76	4.04	101.36	0.58	100.78
2 / 6 .	1.21	0.08	3.32	0.11	9.42	11.87	0.00	0.22	19.61	0.55	13.23	0.00	0.02	37.60	4.14	101.39	0.53	100.86
2 / 7 .	1.38	0.08	3.23	0.11	9.37	11.76	0.00	0.21	19.50	0.34	13.33	0.08	0.01	37.64	4.26	101.31	0.60	100.71
Avg 111bt5.2	1.32	0.08	3.26	0.11	9.36	11.80	0.00	0.21	19.59	0.39	13.25	0.02	0.02	37.57	4.18	101.15	0.57	100.58
111_bt_6																		
1 / 1 .	1.17	0.06	3.30	0.11	9.26	10.18	-0.02	0.29	21.81	0.24	12.85	0.06	0.00	37.37	4.52	101.24	0.51	100.73
1 / 2 . *	1.08	0.10	3.36	0.08	9.33	10.24	0.00	0.27	21.90	0.34	13.05	0.03	0.02	37.43	4.41	101.64	0.48	101.16
1 / 3 . *	1.19	0.09	3.33	0.08	9.29	10.30	0.01	0.29	22.04	0.40	12.99	0.10	0.06	37.67	4.51	102.33	0.52	101.81
1 / 4 .	1.06	0.08	3.34	0.08	9.25	10.27	0.01	0.22	22.03	0.34	12.89	0.05	-0.02	37.06	4.40	101.11	0.47	100.64
1 / 5 .	1.01	0.07	3.38	0.07	9.30	10.29	0.00	0.26	22.09	0.33	12.89	0.02	-0.01	37.22	4.44	101.39	0.44	100.95
1 / 6 .	1.14	0.10	3.31	0.08	9.30	10.22	0.02	0.31	21.71	0.29	12.92	0.11	0.02	37.22	4.63	101.38	0.50	100.88
1 / 7 .	1.06	0.09	3.34	0.07	9.31	10.19	0.01	0.27	21.71	0.37	12.87	0.09	0.02	37.27	4.35	101.04	0.47	100.57
1 / 8 .	1.04	0.11	3.36	0.10	9.26	10.23	0.00	0.27	21.83	0.41	12.96	0.05	-0.05	37.23	4.42	101.27	0.46	100.81
1 / 9 . *	1.16	0.09	3.31	0.11	9.34	10.21	0.00	0.27	22.04	0.33	12.92	0.07	-0.02	37.29	4.49	101.65	0.51	101.14
1 / 10 .	1.07	0.10	3.34	0.09	9.27	10.17	0.00	0.24	22.08	0.53	12.97	0.01	0.05	37.13	4.41	101.45	0.47	100.98

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
Avg 111bt_6	1.08	0.09	3.34	0.08	9.28	10.22	0.01	0.27	21.89	0.36	12.91	0.06	0.00	37.21	4.45	101.25	0.47	100.78
111_bt_7																		
1 / 1 .	1.26	0.08	1.24	0.09	9.38	10.74	-0.02	0.33	20.67	0.43	13.18	0.06	-0.02	37.17	4.44	99.07	0.55	98.53
1 / 2 .	1.07	0.09	1.35	0.10	9.37	10.85	-0.02	0.34	21.32	0.49	13.08	0.07	0.00	37.57	4.55	100.24	0.47	99.77
1 / 3 .	1.12	0.07	1.31	0.07	9.38	10.65	0.01	0.34	20.66	0.40	13.18	0.10	0.00	37.35	4.49	99.12	0.49	98.64
1 / 4 .	1.01	0.10	1.37	0.09	9.30	10.73	-0.01	0.34	20.89	0.32	13.15	0.04	-0.03	37.44	4.71	99.47	0.45	99.03
1 / 5 .	1.16	0.09	1.30	0.10	9.28	10.81	0.00	0.34	20.81	0.39	13.21	0.01	-0.04	37.29	4.90	99.69	0.51	99.18
1 / 6 .	1.19	0.08	1.28	0.08	9.36	10.86	0.01	0.31	20.78	0.48	13.11	0.03	-0.01	37.55	4.50	99.61	0.52	99.09
1 / 7 .	1.06	0.08	1.33	0.10	9.17	10.95	-0.01	0.30	20.76	0.31	12.95	-0.03	0.02	37.27	4.38	98.68	0.46	98.22
1 / 8 .	1.23	0.08	1.27	0.14	9.42	10.90	-0.01	0.29	20.73	0.38	13.24	-0.01	0.04	37.62	4.52	99.85	0.54	99.32
1 / 9 . *	1.00	0.10	1.36	0.08	8.55	11.15	-0.01	0.27	20.45	0.21	13.00	0.07	0.02	36.88	5.18	98.32	0.44	97.88
1 / 10 .	1.08	0.07	1.34	0.07	9.05	10.86	0.00	0.37	20.70	0.24	13.12	0.05	-0.01	37.86	4.36	99.18	0.47	98.71
1 / 11 .	1.19	0.07	1.28	0.09	9.45	10.93	-0.01	0.31	20.87	0.22	13.02	-0.01	0.00	37.61	4.41	99.48	0.52	98.96
1 / 12 .	1.11	0.07	1.33	0.10	9.31	10.86	-0.01	0.31	20.95	0.43	13.05	-0.01	0.00	37.36	4.77	99.64	0.48	99.16
1 / 13 .	1.14	0.07	1.31	0.10	9.32	10.81	-0.02	0.29	21.07	0.28	13.05	-0.02	-0.04	37.40	4.51	99.34	0.49	98.85
1 / 14 .	1.19	0.09	1.27	0.09	9.20	10.77	-0.03	0.40	20.46	0.43	13.04	0.06	-0.01	37.48	4.58	99.06	0.52	98.54
1 / 15 .	1.30	0.08	1.22	0.10	9.22	10.83	0.00	0.30	20.64	0.28	13.13	0.07	0.07	37.43	4.53	99.21	0.57	98.65
Avg 111bt_7	1.15	0.08	1.30	0.09	9.30	10.83	-0.01	0.33	20.81	0.36	13.11	0.03	0.00	37.46	4.55	99.38	0.50	98.87
111_bt_8																		
1 / 1 .	1.08	0.08	3.34	0.10	9.40	10.61	0.02	0.22	20.45	0.41	12.99	0.03	-0.07	37.40	4.31	100.43	0.47	99.96
1 / 2 .	1.17	0.06	3.31	0.15	9.26	10.81	0.02	0.23	20.76	0.54	13.07	0.02	0.02	37.20	4.36	100.98	0.51	100.47
1 / 3 .	1.08	0.08	3.34	0.14	9.33	10.81	-0.01	0.27	20.79	0.33	13.02	0.03	-0.01	37.14	4.43	100.79	0.47	100.32
1 / 4 .	1.21	0.07	3.29	0.14	9.33	10.74	0.01	0.25	20.72	0.39	12.95	0.03	-0.03	37.48	4.41	101.02	0.53	100.49
1 / 5 .	1.14	0.07	3.34	0.09	9.32	10.88	0.00	0.28	20.86	0.40	13.14	0.06	-0.02	37.43	4.42	101.42	0.49	100.93
1 / 6 .	1.13	0.08	3.31	0.18	9.17	10.74	0.02	0.29	20.95	0.36	12.85	0.16	0.00	37.17	4.31	100.72	0.49	100.23
1 / 7 .	1.18	0.07	3.31	0.09	9.38	10.84	0.00	0.24	20.93	0.28	13.01	0.05	0.01	37.32	4.42	101.13	0.51	100.62
1 / 8 .	1.20	0.07	3.28	0.11	9.20	10.76	0.01	0.26	20.74	0.28	12.86	0.08	0.01	37.30	4.50	100.66	0.52	100.13
1 / 9 .	1.08	0.09	3.35	0.18	9.14	10.74	0.02	0.30	20.62	0.30	12.94	0.05	-0.01	37.38	4.65	100.86	0.48	100.38
1 / 10 .	1.03	0.07	3.37	0.14	9.25	10.65	0.02	0.29	20.56	0.29	13.08	-0.01	0.06	37.14	4.57	100.52	0.45	100.07
Avg 111bt_8	1.13	0.07	3.32	0.13	9.28	10.76	0.01	0.26	20.74	0.36	12.99	0.05	0.00	37.29	4.44	100.84	0.49	100.34

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
111_bt_9																		
1 / 1 .	1.13	0.09	3.30	0.10	9.19	11.23	0.02	0.25	19.37	0.32	13.39	-0.02	0.01	37.16	3.97	99.52	0.49	99.02
1 / 2 .	1.26	0.10	3.26	0.09	9.32	11.35	0.01	0.21	19.31	0.32	13.42	0.05	-0.06	37.48	4.25	100.44	0.55	99.89
1 / 3 .	1.15	0.09	3.31	0.09	9.18	11.29	0.01	0.16	19.60	0.30	13.51	0.06	-0.01	37.18	4.23	100.16	0.50	99.65
1 / 4 .	1.24	0.08	3.31	0.08	9.33	11.48	0.01	0.22	19.82	0.45	13.59	0.04	-0.03	37.54	4.28	101.47	0.54	100.93
1 / 5 .	1.15	0.08	3.32	0.08	9.27	11.43	0.01	0.21	19.31	0.45	13.52	0.03	-0.04	37.31	4.26	100.43	0.50	99.93
1 / 6 .	1.16	0.08	3.35	0.07	9.44	11.46	0.02	0.28	19.59	0.45	13.47	0.05	0.04	37.77	4.22	101.45	0.51	100.95
1 / 7 .	1.15	0.08	3.35	0.08	9.42	11.42	0.01	0.25	19.53	0.41	13.66	0.03	-0.02	37.69	4.08	101.15	0.50	100.65
1 / 8 .	1.26	0.08	3.28	0.07	9.28	11.32	0.01	0.26	19.22	0.30	13.63	0.05	-0.02	37.57	4.23	100.57	0.55	100.02
1 / 9 .	1.14	0.08	3.33	0.11	9.36	11.25	0.00	0.23	19.35	0.33	13.48	0.04	0.03	37.42	4.26	100.41	0.50	99.92
1 / 10 .	1.09	0.09	3.34	0.09	9.18	11.44	0.02	0.20	19.35	0.03	13.47	0.04	0.02	37.18	4.27	99.80	0.48	99.32
Avg 111bt_9	1.17	0.08	3.32	0.09	9.30	11.37	0.01	0.23	19.45	0.34	13.51	0.04	-0.01	37.43	4.20	100.52	0.51	100.01
109																		
109_bt_1.3																		
3 / 1 .	1.70	0.09	3.07	0.11	9.76	12.18	0.00	0.31	19.00	0.41	12.98	0.03	0.06	37.73	4.30	101.73	0.74	100.99
3 / 2 . *	1.87	0.11	2.99	0.12	9.70	12.25	0.00	0.27	18.78	0.40	12.99	0.03	-0.03	38.02	4.42	101.96	0.81	101.14
3 / 3 .	1.76	0.10	3.02	0.09	9.67	12.27	0.00	0.25	18.66	0.29	12.94	0.08	0.03	37.65	4.34	101.15	0.76	100.39
3 / 4 . *	1.82	0.10	3.01	0.11	9.80	12.08	0.00	0.27	19.01	0.64	12.98	0.03	-0.02	37.83	4.43	102.13	0.79	101.34
3 / 5 . *	1.81	0.11	3.02	0.09	9.49	12.28	-0.01	0.28	18.90	0.37	13.05	0.04	-0.02	37.91	4.50	101.84	0.79	101.06
3 / 6 . *	1.79	0.08	3.04	0.11	9.61	12.26	-0.02	0.31	18.82	0.60	13.03	0.08	0.03	37.93	4.24	101.92	0.77	101.14
3 / 7 .	1.85	0.08	2.98	0.12	9.60	12.08	-0.01	0.36	18.86	0.50	12.95	0.06	0.01	37.78	4.28	101.51	0.80	100.71
3 / 8 .	1.90	0.11	2.94	0.13	9.67	12.20	-0.02	0.25	18.80	0.40	13.01	0.04	-0.01	37.33	4.33	101.11	0.82	100.28
3 / 9 .	1.83	0.11	2.99	0.09	9.56	12.18	0.00	0.25	18.52	0.44	13.16	0.07	0.02	37.74	4.26	101.22	0.80	100.43
3 / 10 .	1.94	0.10	2.93	0.11	9.58	12.24	0.01	0.24	18.93	0.39	12.96	0.06	0.02	37.66	4.25	101.43	0.84	100.59
Avg 109bt1.3	1.83	0.10	2.99	0.11	9.64	12.19	0.00	0.28	18.80	0.41	13.00	0.06	0.02	37.65	4.29	101.35	0.79	100.56
109_bt_1.4																		
4 / 1 .	1.87	0.11	2.96	0.10	9.65	12.18	-0.01	0.27	18.87	0.31	12.95	0.07	-0.01	37.59	4.42	101.33	0.81	100.52
4 / 2 .	1.98	0.11	2.89	0.11	9.53	12.04	0.01	0.24	18.78	0.33	12.86	0.06	0.00	37.62	4.44	101.02	0.86	100.16

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
4 / 3 .	1.79	0.11	3.01	0.12	9.58	12.22	-0.01	0.24	18.67	0.35	12.95	0.10	-0.02	37.78	4.40	101.32	0.78	100.54
4 / 4 .	1.86	0.11	2.97	0.11	9.54	12.17	0.00	0.28	18.62	0.37	13.01	0.09	-0.03	37.60	4.45	101.18	0.81	100.38
4 / 5 .	1.93	0.09	2.95	0.09	9.58	12.16	0.00	0.27	18.96	0.40	13.02	-0.02	0.00	37.73	4.41	101.59	0.83	100.75
4 / 6 .	1.91	0.10	2.94	0.14	9.50	12.13	-0.01	0.21	18.60	0.41	12.91	0.06	0.02	37.72	4.45	101.09	0.83	100.26
4 / 7 .	1.80	0.12	3.00	0.21	9.56	12.30	0.03	0.27	18.87	0.27	12.96	0.03	0.03	37.63	4.32	101.41	0.79	100.62
4 / 8 .	1.83	0.10	2.96	0.11	9.51	12.16	0.00	0.24	18.62	0.45	12.88	0.03	-0.05	37.60	4.09	100.58	0.79	99.79
4 / 9 .	1.84	0.11	2.98	0.11	9.48	12.16	0.01	0.27	18.68	0.39	12.93	0.03	0.00	37.75	4.44	101.19	0.80	100.39
4 / 10 .	1.89	0.10	2.97	0.13	9.58	12.27	0.02	0.29	18.77	0.35	12.89	0.05	-0.03	37.80	4.45	101.55	0.82	100.73
Avg 109bt1.4	1.87	0.11	2.96	0.12	9.55	12.18	0.00	0.26	18.74	0.36	12.94	0.05	-0.01	37.68	4.39	101.20	0.81	100.39
109 bt 5																		
1 / 1 .	1.85	0.15	2.91	0.08	9.47	11.88	0.00	0.35	18.26	0.49	12.87	0.07	0.01	37.13	4.44	99.96	0.81	99.15
1 / 2 .	1.74	0.14	2.95	0.06	9.46	11.83	0.01	0.37	18.78	0.36	12.86	0.05	0.03	36.62	4.57	99.83	0.77	99.07
1 / 3 .	1.76	0.12	2.97	0.08	9.67	11.91	0.00	0.26	18.66	0.38	12.86	0.01	0.00	37.06	4.34	100.08	0.77	99.31
1 / 4 .	1.70	0.13	2.98	0.10	9.33	11.79	0.03	0.34	18.51	0.58	12.99	0.06	0.00	36.75	4.33	99.62	0.74	98.88
1 / 5 .	1.69	0.12	2.95	0.10	9.35	11.77	0.00	0.30	18.48	0.52	12.82	0.06	0.00	36.45	4.39	99.01	0.74	98.27
1 / 6 .	1.62	0.14	3.00	0.10	9.40	11.86	0.00	0.34	18.46	0.50	12.70	0.05	-0.01	36.71	4.38	99.25	0.71	98.53
1 / 7 .	1.77	0.13	2.94	0.08	9.51	12.00	0.00	0.31	18.47	0.56	12.76	-0.01	0.03	36.96	4.30	99.81	0.78	99.04
1 / 8 .	1.80	0.11	2.92	0.11	9.36	11.77	0.02	0.35	18.56	0.47	12.79	-0.05	0.06	36.76	4.39	99.47	0.78	98.69
1 / 9 .	1.68	0.13	2.99	0.16	9.45	11.68	0.00	0.35	18.72	0.46	12.76	-0.01	-0.02	36.82	4.55	99.74	0.74	99.00
1 / 10 .	1.74	0.13	2.94	0.12	9.31	11.67	0.01	0.31	18.53	0.64	12.84	0.03	-0.03	36.66	4.34	99.28	0.76	98.52
Avg 109 bt 5	1.74	0.13	2.95	0.10	9.43	11.82	0.01	0.33	18.54	0.50	12.82	0.03	0.01	36.79	4.40	99.59	0.76	98.83
109 bt 6																		
1 / 1 .	1.88	0.15	2.97	0.16	9.41	12.50	0.00	0.27	18.35	0.36	13.05	0.01	0.07	38.04	4.31	101.54	0.82	100.71
1 / 2 .	1.89	0.11	2.92	0.16	9.36	12.27	0.01	0.32	18.39	0.43	12.83	0.06	0.01	37.54	4.14	100.46	0.82	99.64
1 / 3 .	1.89	0.13	2.94	0.14	9.24	12.43	0.01	0.25	18.26	0.43	13.01	0.07	0.03	37.59	4.30	100.73	0.83	99.90
1 / 4 .	1.88	0.14	2.89	0.17	9.28	12.11	0.01	0.28	18.08	0.36	12.78	0.05	-0.01	37.30	4.08	99.39	0.82	98.57
1 / 5 .	1.89	0.11	2.91	0.15	9.36	12.10	0.00	0.25	17.94	0.42	12.89	0.02	0.03	37.61	3.99	99.67	0.82	98.85
1 / 6 .	1.85	0.13	2.92	0.13	9.18	12.23	0.01	0.27	18.12	0.41	12.81	0.01	0.03	37.39	4.07	99.55	0.81	98.75
1 / 7 .	1.93	0.13	2.85	0.15	9.23	12.17	0.01	0.29	17.68	0.42	12.88	-0.02	-0.02	37.00	4.27	99.01	0.84	98.16
1 / 8 .	2.08	0.14	2.84	0.16	9.49	12.51	0.01	0.28	18.36	0.22	12.92	0.02	0.06	37.87	3.89	100.86	0.91	99.95

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 9 .	1.92	0.20	2.89	0.45	9.40	12.29	0.04	0.25	18.10	0.25	12.80	0.01	0.07	37.47	4.27	100.38	0.85	99.52
1 / 10 .	2.05	0.13	2.85	0.13	9.41	12.43	0.03	0.27	17.86	0.29	12.85	0.10	-0.01	37.75	4.26	100.42	0.89	99.52
Avg 109 bt 6	1.93	0.14	2.90	0.18	9.34	12.30	0.01	0.27	18.11	0.36	12.88	0.03	0.03	37.55	4.16	100.20	0.84	99.35
109 bt 7																		
1 / 1 .	1.90	0.11	2.97	0.12	9.63	12.54	0.02	0.33	18.02	0.40	13.15	0.10	0.00	37.93	4.27	101.49	0.82	100.66
1 / 2 .	1.87	0.10	3.00	0.10	9.63	12.57	0.00	0.34	18.59	0.36	13.08	0.01	-0.02	38.01	4.19	101.85	0.81	101.04
1 / 3 .	2.00	0.11	2.91	0.09	9.71	12.51	0.01	0.35	17.86	0.39	13.06	0.06	-0.03	37.93	4.26	101.25	0.87	100.39
1 / 4 .	2.06	0.11	2.90	0.08	9.58	12.52	0.00	0.34	18.21	0.44	13.05	0.02	-0.04	38.17	4.23	101.70	0.89	100.81
1 / 5 .	1.99	0.12	2.93	0.12	9.75	12.55	0.00	0.31	18.29	0.37	13.08	0.06	0.03	38.08	4.27	101.96	0.87	101.09
1 / 6 .	1.98	0.13	2.92	0.09	9.77	12.55	-0.01	0.28	18.40	0.49	13.13	0.03	0.03	37.84	4.12	101.76	0.86	100.90
1 / 7 .	1.92	0.13	2.95	0.06	9.56	12.44	0.02	0.36	18.44	0.48	12.97	0.04	0.03	37.93	4.27	101.60	0.84	100.76
1 / 8 .	1.97	0.11	2.94	0.09	9.65	12.49	0.00	0.28	18.25	0.36	13.06	0.09	-0.01	38.07	4.31	101.68	0.85	100.83
1 / 9 .	1.97	0.11	2.92	0.10	9.65	12.51	0.02	0.29	18.41	0.27	13.04	0.06	-0.01	37.83	4.10	101.26	0.86	100.41
1 / 10 .	1.98	0.14	2.92	0.06	9.77	12.47	0.01	0.32	18.26	0.41	13.08	0.06	-0.08	38.02	4.21	101.72	0.87	100.85
Avg 109 bt 7	1.96	0.12	2.94	0.09	9.67	12.51	0.01	0.32	18.27	0.40	13.07	0.05	-0.01	37.98	4.22	101.60	0.85	100.75
109 bt 8																		
1 / 1 .	1.94	0.15	2.93	0.08	9.59	12.87	0.01	0.30	18.04	0.22	13.17	0.05	0.02	38.01	3.67	101.03	0.85	100.18
1 / 2 .	1.92	0.12	2.96	0.10	9.62	12.85	0.00	0.32	17.75	0.25	13.16	-0.01	0.02	38.27	3.84	101.18	0.83	100.34
1 / 3 .	2.07	0.13	2.91	0.12	9.63	13.12	0.01	0.31	17.95	0.30	13.25	0.09	0.02	38.34	3.98	102.22	0.90	101.32
1 / 4 .	2.02	0.12	2.83	0.10	9.42	12.65	0.05	0.27	17.34	0.32	12.82	0.06	0.05	37.62	3.74	99.41	0.88	98.53
1 / 5 .	2.02	0.14	2.85	0.12	9.70	12.64	0.04	0.23	18.08	0.15	12.82	0.05	0.03	37.60	3.82	100.29	0.88	99.41
1 / 6 .	2.03	0.14	2.86	0.08	9.63	12.61	0.01	0.26	17.97	0.29	13.01	0.08	-0.04	37.79	3.85	100.62	0.89	99.73
1 / 7 .	1.96	0.14	2.93	0.09	9.66	12.85	-0.01	0.28	18.04	0.33	13.00	0.00	0.01	37.98	4.16	101.43	0.86	100.57
1 / 8 .	1.88	0.10	2.94	0.11	9.51	12.50	0.02	0.30	18.20	0.47	12.96	0.01	-0.04	37.51	4.00	100.52	0.82	99.71
1 / 9 .	1.82	0.14	3.01	0.16	9.51	12.67	0.02	0.33	18.18	0.34	13.09	0.06	-0.01	38.05	4.06	101.43	0.80	100.63
1 / 10 .	1.94	0.13	2.95	0.10	9.62	12.68	0.02	0.28	18.41	0.41	13.25	0.06	0.00	38.07	3.86	101.76	0.85	100.92
Avg 109 bt 8	1.96	0.13	2.92	0.11	9.59	12.74	0.02	0.29	18.00	0.31	13.05	0.04	0.01	37.92	3.90	100.98	0.86	100.12
109 bt 9																		
1 / 1 .	2.05	0.16	2.87	0.23	9.67	12.90	0.01	0.30	17.35	0.22	13.52	0.03	-0.01	37.85	3.73	100.87	0.90	99.97

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 2 .	1.97	0.16	2.91	0.29	9.59	12.68	0.03	0.26	17.66	0.47	13.47	0.07	-0.02	37.71	3.97	101.24	0.87	100.37
1 / 3 .	1.94	0.15	2.88	0.25	9.45	12.40	0.07	0.31	17.43	0.40	13.14	0.09	0.02	37.66	3.68	99.88	0.85	99.03
1 / 4 .	1.93	0.15	2.92	0.12	9.50	12.63	0.07	0.28	17.93	0.32	13.41	0.01	-0.05	37.62	3.86	100.76	0.85	99.91
1 / 5 .	2.01	0.14	2.89	0.11	9.48	12.66	0.02	0.26	17.82	0.36	13.34	0.02	0.01	37.87	3.79	100.77	0.88	99.89
1 / 6 .	1.92	0.14	2.88	0.11	9.49	12.53	0.00	0.28	17.41	0.40	13.15	0.03	0.01	37.30	3.86	99.52	0.84	98.67
1 / 7 .	1.83	0.11	2.99	0.12	9.74	12.66	-0.02	0.28	17.87	0.24	13.22	0.07	0.01	37.75	4.02	100.91	0.80	100.12
1 / 8 .	1.85	0.14	2.95	0.12	9.56	12.55	0.02	0.28	17.83	0.29	13.31	0.06	0.01	37.34	4.09	100.40	0.81	99.59
1 / 9 .	1.98	0.12	2.93	0.11	9.68	12.72	0.00	0.34	18.19	0.27	13.44	0.00	0.00	37.90	3.95	101.63	0.86	100.77
1 / 10 .	1.95	0.12	2.90	0.13	9.61	12.64	0.00	0.31	17.55	0.39	13.23	0.04	-0.03	37.64	3.90	100.43	0.85	99.58
Avg 109 bt 9	1.94	0.14	2.91	0.16	9.58	12.64	0.02	0.29	17.70	0.34	13.32	0.04	-0.01	37.67	3.88	100.63	0.85	99.78

FR-108c

108c bt1	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 .	2.25	0.10	2.79	0.09	10.27	14.34	0.02	0.22	16.68	0.48	13.04	-0.01	-0.03	37.49	3.66	101.43	0.97	100.46
1 / 2 .	2.27	0.07	2.79	0.07	10.34	14.28	0.00	0.18	16.84	0.21	12.97	0.03	0.03	37.48	4.05	101.61	0.97	100.64
1 / 3 .	2.18	0.09	2.82	0.06	10.34	14.27	-0.01	0.14	16.98	0.38	13.08	0.03	0.00	37.32	3.72	101.43	0.94	100.49
1 / 4 .	2.24	0.09	2.80	0.07	10.38	14.19	0.01	0.21	16.87	0.38	12.92	0.01	-0.02	37.63	3.74	101.53	0.96	100.57
1 / 5 .	2.18	0.09	2.81	0.06	10.45	14.13	0.01	0.17	16.44	0.31	12.93	0.03	0.01	37.37	3.86	100.85	0.94	99.91
1 / 6 .	2.30	0.08	2.76	0.06	10.27	14.27	0.02	0.14	16.61	0.40	12.91	-0.04	0.01	37.52	3.77	101.12	0.98	100.13
1 / 7 .	2.14	0.09	2.79	0.08	9.85	13.84	0.02	0.18	17.88	0.29	12.92	0.08	0.00	36.68	3.59	100.44	0.92	99.52
1 / 8 .	2.09	0.10	2.82	0.07	9.60	13.75	0.06	0.19	18.23	0.15	12.95	-0.07	-0.01	36.88	3.52	100.38	0.90	99.48
1 / 9 .	2.24	0.09	2.78	0.07	10.07	14.20	0.07	0.25	16.88	0.22	12.94	0.03	0.00	37.31	3.74	100.87	0.96	99.90
1 / 10 .	2.31	0.07	2.73	0.06	10.42	14.14	0.01	0.15	16.55	0.25	12.82	0.01	0.01	37.34	3.60	100.46	0.99	99.47
Avg 108c bt1	2.22	0.09	2.79	0.07	10.20	14.14	0.02	0.18	17.00	0.31	12.95	0.01	0.00	37.30	3.72	100.99	0.95	100.04
108c bt2																		
1 / 1 .	2.39	0.11	2.73	0.05	10.52	15.33	0.00	0.21	14.72	0.39	13.82	0.03	-0.02	37.61	3.17	101.08	1.03	100.05
1 / 2 .	2.32	0.10	2.77	0.05	10.43	15.19	-0.02	0.16	14.87	0.27	13.71	0.01	-0.01	37.60	3.52	100.99	1.00	99.99
1 / 3 .	2.27	0.10	2.78	0.08	10.34	14.94	0.01	0.21	15.21	0.45	13.64	0.03	0.02	37.42	3.38	100.86	0.98	99.88
1 / 4 .	2.32	0.12	2.75	0.06	10.28	14.73	-0.01	0.23	15.24	0.31	13.62	0.04	0.00	37.46	3.48	100.64	1.00	99.64
1 / 5 .	2.28	0.10	2.77	0.07	10.51	14.62	0.00	0.20	15.51	0.40	13.43	0.02	-0.03	37.42	3.53	100.86	0.98	99.87

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 6 .	2.25	0.09	2.78	0.10	10.31	14.58	0.00	0.18	15.88	0.32	13.29	0.01	0.02	37.33	3.76	100.91	0.97	99.94
1 / 7 .	2.13	0.12	2.84	0.07	10.22	14.34	0.00	0.19	16.10	0.39	13.46	0.02	-0.01	37.30	3.83	101.02	0.92	100.09
1 / 8 .	2.02	0.10	2.89	0.10	10.12	14.14	-0.01	0.23	16.15	0.44	13.31	-0.02	0.00	37.20	3.90	100.61	0.87	99.73
1 / 9 .	2.14	0.12	2.85	0.07	10.25	14.18	-0.04	0.23	16.28	0.64	13.29	-0.01	-0.03	37.43	4.01	101.48	0.93	100.55
1 / 10 .	2.04	0.09	2.88	0.10	10.11	13.86	-0.02	0.22	16.84	0.54	13.31	0.03	0.00	37.06	3.96	101.05	0.88	100.18
Avg 108c bt2	2.22	0.10	2.80	0.07	10.31	14.59	-0.01	0.21	15.68	0.42	13.49	0.01	-0.01	37.38	3.65	100.93	0.96	99.97
108c bt3																		
1 / 1 .	1.96	0.08	2.91	0.06	10.15	13.64	0.02	0.27	17.09	0.35	13.13	0.08	-0.02	36.89	4.11	100.74	0.84	99.89
1 / 2 .	2.01	0.08	2.87	0.08	10.26	13.37	0.04	0.28	16.74	0.25	13.07	0.02	0.01	37.06	4.10	100.25	0.87	99.38
1 / 3 .	2.08	0.09	2.85	0.09	10.30	13.55	0.01	0.28	17.26	0.43	13.19	-0.01	-0.03	36.97	4.00	101.10	0.90	100.20
1 / 4 .	2.07	0.11	2.86	0.10	10.15	13.51	0.01	0.29	16.95	0.49	13.24	0.11	-0.02	37.11	3.98	100.95	0.89	100.06
1 / 5 .	2.08	0.11	2.85	0.10	10.12	13.52	0.02	0.24	17.08	0.42	13.22	0.03	-0.01	36.87	4.39	101.04	0.90	100.14
1 / 6 .	2.04	0.10	2.87	0.11	10.16	13.35	0.00	0.29	17.49	0.54	13.21	0.04	0.01	36.88	4.10	101.19	0.88	100.31
1 / 7 .	2.05	0.07	2.87	0.11	10.31	13.44	0.02	0.31	17.11	0.40	13.06	0.06	0.00	37.11	4.04	100.97	0.88	100.09
1 / 8 .	2.20	0.10	2.79	0.11	10.14	13.44	-0.01	0.26	17.20	0.30	13.22	0.03	0.00	37.08	4.17	101.02	0.95	100.08
1 / 9 .	2.06	0.08	2.87	0.11	10.19	13.53	0.02	0.34	17.08	0.44	13.18	0.05	0.06	36.98	4.25	101.23	0.89	100.34
1 / 10 .	2.09	0.10	2.85	0.10	10.28	13.47	0.01	0.24	17.39	0.41	13.16	-0.01	0.06	36.91	4.14	101.20	0.90	100.30
Avg 108c bt3	2.06	0.09	2.86	0.10	10.21	13.48	0.01	0.28	17.14	0.40	13.17	0.04	0.01	36.98	4.13	100.96	0.89	100.07
108c bt4																		
1 / 1 .	2.18	0.10	2.77	0.11	10.11	13.79	0.00	0.25	16.38	0.42	13.07	0.04	0.03	36.49	4.29	100.05	0.94	99.11
1 / 2 .	2.06	0.08	2.84	0.11	10.15	13.94	0.03	0.23	16.30	0.45	13.07	0.03	0.00	36.68	4.13	100.08	0.89	99.19
1 / 3 .	2.10	0.09	2.82	0.10	10.10	13.80	0.04	0.24	16.22	0.42	13.14	0.00	0.04	36.80	4.11	100.03	0.91	99.13
1 / 4 .	2.05	0.10	2.83	0.08	10.13	13.80	0.02	0.24	16.27	0.36	13.02	0.05	0.07	36.42	4.35	99.79	0.88	98.90
1 / 5 .	2.00	0.09	2.88	0.14	10.20	13.80	0.01	0.22	16.41	0.56	13.15	0.05	-0.01	36.67	4.23	100.40	0.86	99.54
1 / 6 .	2.03	0.11	2.81	0.12	10.10	13.74	0.01	0.25	16.37	0.34	13.07	0.03	-0.01	36.32	4.02	99.34	0.88	98.46
1 / 7 .	2.23	0.10	2.77	0.10	10.08	13.97	-0.02	0.27	16.10	0.49	13.25	0.08	0.03	37.01	4.17	100.63	0.96	99.67
1 / 8 .	2.12	0.10	2.83	0.09	10.08	14.17	0.02	0.24	15.72	0.64	13.11	0.10	0.02	37.16	4.10	100.50	0.92	99.59
1 / 9 .	2.27	0.07	2.72	0.11	10.17	13.99	0.03	0.23	15.81	0.37	13.07	-0.02	0.04	36.75	4.04	99.67	0.97	98.69
1 / 10 .	2.08	0.10	2.84	0.09	10.16	14.12	0.02	0.25	16.09	0.49	13.10	0.00	0.00	36.79	4.20	100.33	0.90	99.43
Avg 108c bt4	2.11	0.09	2.81	0.10	10.13	13.92	0.02	0.24	16.17	0.45	13.11	0.04	0.02	36.71	4.16	100.07	0.91	99.16

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
108c bt5																		
1 / 1 .	2.06	0.09	2.85	0.09	10.29	13.43	0.02	0.22	17.20	0.32	13.14	0.08	0.01	36.81	4.19	100.80	0.89	99.91
1 / 2 .	2.14	0.09	2.83	0.13	10.32	13.49	-0.01	0.21	17.14	0.26	13.19	0.09	0.00	37.12	4.20	101.20	0.92	100.27
1 / 3 .	2.15	0.09	2.81	0.09	10.33	13.50	-0.01	0.20	17.06	0.46	13.09	0.05	0.03	37.03	4.09	100.98	0.93	100.05
1 / 4 .	2.20	0.10	2.79	0.07	10.21	13.49	-0.02	0.22	17.22	0.34	13.14	0.02	-0.02	37.14	4.25	101.19	0.95	100.24
1 / 5 .	2.01	0.11	2.86	0.10	9.98	13.22	0.03	0.25	17.13	0.57	13.22	0.03	-0.02	36.80	4.13	100.43	0.87	99.56
1 / 6 .	2.09	0.10	2.82	0.11	10.12	13.33	0.01	0.21	17.22	0.55	13.09	0.00	-0.04	36.89	4.09	100.65	0.90	99.75
1 / 7 .	2.13	0.09	2.81	0.07	10.20	13.40	-0.02	0.18	17.02	0.37	13.25	0.07	-0.02	36.79	4.06	100.43	0.92	99.52
1 / 8 .	2.02	0.09	2.87	0.10	10.27	13.40	0.01	0.20	17.33	0.46	13.20	0.00	0.01	36.86	4.15	100.98	0.87	100.11
1 / 9 .	2.11	0.10	2.83	0.07	10.34	13.43	-0.02	0.18	17.29	0.37	13.24	0.01	0.01	37.03	4.05	101.08	0.91	100.17
1 / 10 .	2.10	0.08	2.83	0.11	10.19	13.32	-0.01	0.24	17.26	0.38	13.21	0.02	0.03	36.89	4.11	100.77	0.90	99.87
Avg 108c bt5	2.10	0.10	2.83	0.09	10.23	13.40	0.00	0.21	17.19	0.41	13.18	0.04	0.00	36.94	4.13	100.83	0.91	99.93
108c bt6																		
1 / 1 .	2.12	0.09	2.84	0.07	10.25	13.52	-0.01	0.16	16.84	0.44	13.19	0.03	0.06	36.97	4.36	100.93	0.91	100.02
1 / 2 .	2.26	0.10	2.75	0.10	10.14	13.51	-0.02	0.19	16.86	0.54	13.20	-0.01	-0.01	36.96	4.31	100.92	0.97	99.95
1 / 3 .	2.28	0.09	2.77	0.09	10.29	13.58	-0.01	0.16	16.98	0.41	13.13	0.07	-0.01	37.23	4.39	101.47	0.98	100.49
1 / 4 .	2.21	0.10	2.80	0.09	10.34	13.56	0.01	0.16	17.08	0.39	13.26	0.07	0.02	37.15	4.23	101.47	0.95	100.52
1 / 5 .	2.34	0.08	2.74	0.10	10.23	13.60	0.00	0.15	17.16	0.41	13.30	0.08	0.04	37.07	4.20	101.51	1.00	100.51
1 / 6 .	2.21	0.09	2.81	0.09	10.38	13.45	-0.01	0.18	17.18	0.44	13.30	0.03	0.03	37.11	4.37	101.66	0.95	100.71
1 / 7 .	2.12	0.11	2.83	0.08	10.30	13.39	0.00	0.23	17.22	0.61	13.08	0.06	0.05	37.16	4.24	101.50	0.92	100.58
1 / 8 .	2.29	0.09	2.77	0.08	10.33	13.74	0.00	0.19	17.01	0.35	12.98	0.01	0.00	37.34	4.31	101.49	0.98	100.50
1 / 9 .	2.27	0.09	2.76	0.09	10.37	13.61	0.00	0.21	16.99	0.42	13.05	0.08	-0.15	37.15	4.17	101.26	0.98	100.28
1 / 10 .	2.17	0.10	2.81	0.10	10.43	13.41	-0.02	0.22	17.19	0.39	13.10	0.06	0.01	37.03	4.28	101.31	0.94	100.37
Avg 108cbt6.1	2.23	0.09	2.79	0.09	10.31	13.54	-0.01	0.18	17.05	0.44	13.16	0.05	0.00	37.12	4.29	101.33	0.96	100.37
2 / 1 .	2.16	0.11	2.82	0.11	10.32	13.32	-0.02	0.20	17.51	0.49	13.21	0.03	0.00	37.21	4.15	101.65	0.93	100.72
2 / 2 .	2.20	0.09	2.78	0.06	10.14	13.04	0.00	0.17	17.55	0.38	13.08	0.06	0.00	37.10	4.06	100.70	0.95	99.75
2 / 3 .	2.31	0.08	2.76	0.08	10.37	13.46	-0.01	0.18	17.13	0.43	13.18	0.04	0.02	37.40	4.12	101.54	0.99	100.55
2 / 4 .	2.17	0.09	2.82	0.08	10.39	13.44	-0.01	0.21	17.17	0.56	13.19	0.06	-0.01	37.11	4.29	101.58	0.94	100.64
2 / 5 .	2.18	0.08	2.80	0.08	10.27	13.27	0.00	0.19	17.00	0.36	13.10	0.09	0.11	36.97	4.29	100.77	0.93	99.84

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
2 / 6 .	2.20	0.10	2.77	0.06	10.36	13.32	0.01	0.22	17.05	0.28	13.07	0.08	-0.06	36.97	4.03	100.52	0.95	99.57
2 / 7 .	2.18	0.09	2.80	0.07	10.38	13.36	0.00	0.13	16.96	0.65	13.16	0.03	-0.01	36.97	4.37	101.16	0.94	100.22
2 / 8 .	2.15	0.09	2.79	0.06	10.22	13.36	0.01	0.13	17.04	0.36	13.01	0.11	-0.02	36.93	4.09	100.35	0.92	99.43
2 / 9 .	2.26	0.09	2.76	0.09	10.25	13.42	0.00	0.16	17.29	0.47	12.98	0.05	0.01	37.12	4.26	101.21	0.97	100.24
2 / 10 .	2.23	0.08	2.79	0.09	10.33	13.39	-0.01	0.13	17.11	0.41	13.06	-0.02	0.03	37.17	4.50	101.31	0.96	100.35
Avg 108cbt6.2	2.20	0.09	2.79	0.08	10.30	13.34	0.00	0.17	17.18	0.44	13.10	0.05	0.01	37.09	4.22	101.06	0.95	100.12
108c bt7																		
1 / 1 .	2.15	0.09	2.83	0.10	10.10	13.42	-0.01	0.20	16.15	0.47	13.89	0.03	0.00	37.25	3.90	100.58	0.92	99.66
1 / 2 .	2.19	0.09	2.78	0.12	10.13	13.24	-0.01	0.24	16.01	0.49	13.78	0.06	-0.01	37.10	3.83	100.06	0.94	99.12
1 / 3 .	2.16	0.10	2.79	0.11	10.14	13.11	0.02	0.22	16.30	0.37	13.70	0.04	0.03	37.08	3.89	100.08	0.93	99.15
1 / 4 .	2.04	0.10	2.84	0.09	10.10	13.14	0.00	0.28	16.23	0.41	13.68	-0.01	0.05	36.86	4.05	99.89	0.88	99.01
1 / 5 .	2.07	0.10	2.84	0.14	10.13	13.09	0.00	0.23	16.42	0.48	13.59	0.03	0.00	36.99	4.24	100.35	0.90	99.45
1 / 6 .	2.12	0.12	2.79	0.09	10.13	12.99	0.01	0.24	16.55	0.42	13.48	0.07	0.00	36.88	4.03	99.96	0.92	99.03
1 / 7 .	2.15	0.10	2.80	0.09	10.08	13.04	0.00	0.21	16.76	0.45	13.58	0.04	0.01	36.98	4.08	100.37	0.93	99.44
1 / 8 .	2.21	0.10	2.77	0.10	10.06	13.12	-0.01	0.28	16.54	0.50	13.62	0.05	-0.01	37.05	3.95	100.34	0.95	99.39
1 / 9 .	2.18	0.09	2.78	0.09	10.09	13.09	0.00	0.23	16.50	0.40	13.42	0.03	-0.05	37.11	4.21	100.23	0.94	99.29
1 / 10 .	2.17	0.10	2.79	0.13	10.08	13.10	0.02	0.26	16.62	0.44	13.51	0.04	-0.03	37.09	4.17	100.52	0.94	99.59
Avg 108cbt7.1	2.15	0.10	2.80	0.11	10.10	13.13	0.00	0.24	16.41	0.44	13.62	0.04	0.00	37.04	4.04	100.22	0.93	99.30
2 / 1 .	2.07	0.09	2.83	0.05	10.14	12.93	0.00	0.22	17.38	0.46	12.99	0.05	0.00	36.77	4.49	100.48	0.89	99.59
2 / 2 .	2.02	0.09	2.88	0.09	10.21	12.83	-0.03	0.18	17.65	0.56	13.06	0.06	0.04	36.86	4.71	101.24	0.87	100.37
2 / 3 .	2.01	0.09	2.88	0.08	10.19	12.96	-0.03	0.15	17.58	0.48	13.14	0.03	0.02	36.76	4.72	101.11	0.87	100.24
2 / 4 .	2.10	0.08	2.81	0.10	10.14	12.91	-0.02	0.17	17.23	0.63	13.01	0.01	-0.01	36.53	4.60	100.33	0.90	99.42
2 / 5 .	2.04	0.09	2.85	0.09	10.20	12.96	0.00	0.18	17.34	0.50	12.91	0.04	0.04	36.86	4.48	100.59	0.88	99.71
2 / 6 .	2.11	0.09	2.80	0.06	10.15	12.93	0.00	0.21	17.27	0.55	12.82	0.04	0.00	36.77	4.62	100.44	0.91	99.53
2 / 7 .	1.89	0.08	2.94	0.11	10.25	12.82	0.00	0.21	17.31	0.44	13.08	0.00	0.03	36.74	4.73	100.63	0.81	99.81
2 / 8 .	1.97	0.07	2.89	0.10	10.13	12.74	0.01	0.21	17.26	0.51	13.08	-0.03	-0.01	36.79	4.74	100.50	0.85	99.65
2 / 9 .	2.01	0.08	2.87	0.12	10.06	12.65	-0.04	0.22	17.27	0.53	13.11	0.05	0.06	36.83	4.69	100.55	0.86	99.69
2 / 10 .	1.94	0.08	2.92	0.12	10.14	12.49	-0.02	0.13	17.45	0.39	13.11	0.03	0.00	36.88	5.09	100.77	0.84	99.93
Avg 108cbt7.2	2.02	0.09	2.87	0.09	10.16	12.82	-0.01	0.19	17.37	0.50	13.03	0.03	0.02	36.78	4.69	100.64	0.87	99.77

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
FR-108c bt8	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 .	2.28	0.08	2.71	0.16	9.92	13.51	-0.01	0.23	17.16	0.44	12.99	0.05	-0.03	36.58	3.85	99.96	0.98	98.98
1 / 2 .	2.20	0.11	2.74	0.10	9.88	13.56	-0.01	0.21	16.86	0.32	12.89	0.03	0.02	36.75	3.99	99.65	0.95	98.70
1 / 3 .	2.09	0.09	2.82	0.11	10.06	13.65	-0.01	0.22	16.97	0.59	13.11	0.00	0.00	36.92	3.68	100.31	0.90	99.41
1 / 4 .	2.22	0.10	2.73	0.17	9.75	13.36	-0.01	0.28	17.11	0.34	12.97	0.02	0.01	36.59	4.03	99.67	0.96	98.72
1 / 5 .	2.18	0.10	2.78	0.14	10.02	13.52	-0.01	0.26	17.42	0.37	13.00	0.06	-0.01	36.80	4.13	100.78	0.94	99.84
1 / 6 .	2.14	0.09	2.77	0.15	9.80	13.32	-0.01	0.23	17.16	0.59	12.97	0.03	0.04	36.67	3.87	99.83	0.92	98.91
1 / 7 .	2.05	0.10	2.80	0.13	9.86	13.36	0.00	0.22	16.70	0.45	12.85	0.04	-0.02	36.78	3.78	99.13	0.88	98.25
1 / 8 .	2.15	0.10	2.80	0.12	9.96	13.53	0.00	0.19	17.17	0.48	12.95	0.05	0.00	36.87	4.12	100.50	0.93	99.57
1 / 9 .	2.14	0.09	2.78	0.15	9.95	13.47	0.00	0.22	17.00	0.42	12.92	0.04	-0.01	36.81	3.89	99.87	0.92	98.95
1 / 10 .	2.06	0.10	2.82	0.15	9.93	13.42	0.00	0.25	17.14	0.49	12.96	0.02	0.01	36.62	4.02	99.98	0.89	99.09
Avg 108 bt8.1	2.15	0.09	2.77	0.14	9.91	13.47	-0.01	0.23	17.07	0.45	12.96	0.03	0.00	36.74	3.94	99.95	0.93	99.03
2 / 1 .	2.23	0.10	2.72	0.11	9.76	13.61	0.01	0.25	16.91	0.44	12.91	0.02	0.02	36.79	3.63	99.50	0.96	98.54
2 / 2 .	2.11	0.09	2.76	0.14	9.87	13.37	-0.01	0.27	16.53	0.49	12.86	-0.02	0.00	36.59	3.80	98.89	0.91	97.98
2 / 3 .	2.15	0.08	2.75	0.13	9.79	13.47	-0.01	0.24	16.65	0.36	12.88	-0.01	-0.01	36.66	3.85	99.00	0.92	98.08
2 / 4 .	2.13	0.10	2.77	0.12	9.77	13.48	0.00	0.21	16.88	0.49	12.96	0.06	0.02	36.64	3.82	99.46	0.92	98.54
2 / 5 .	2.08	0.09	2.81	0.11	9.92	13.43	-0.02	0.18	16.91	0.39	12.97	0.04	-0.03	36.84	3.79	99.55	0.89	98.65
2 / 6 .	2.08	0.09	2.84	0.12	10.06	13.68	0.03	0.18	17.07	0.54	13.10	0.04	0.02	36.86	4.03	100.73	0.89	99.84
2 / 7 .	2.16	0.10	2.78	0.11	10.07	13.60	0.01	0.26	16.98	0.35	12.93	-0.04	0.04	37.05	3.77	100.21	0.93	99.28
2 / 8 .	2.21	0.11	2.74	0.13	9.97	13.53	-0.01	0.24	16.78	0.33	12.97	0.06	-0.04	37.04	3.62	99.73	0.96	98.78
2 / 9 .	2.13	0.09	2.79	0.14	9.90	13.53	0.01	0.21	16.95	0.46	12.97	0.09	-0.04	36.99	3.64	99.90	0.92	98.98
2 / 10 .	2.22	0.10	2.73	0.12	9.86	13.72	0.00	0.27	16.54	0.32	12.87	0.07	-0.02	36.80	3.99	99.61	0.96	98.65
Avg 108cbt8.2	2.15	0.09	2.77	0.12	9.90	13.54	0.00	0.23	16.82	0.42	12.94	0.03	-0.01	36.83	3.79	99.63	0.93	98.70
108																		
108_bt_1	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 .	2.04	0.10	2.87	0.07	9.19	12.82	-0.01	0.19	17.50	0.31	12.96	0.01	0.02	37.55	4.61	100.24	0.88	99.36
1 / 2 .	1.77	0.10	3.00	0.07	9.20	12.79	0.00	0.17	17.70	0.55	12.89	-0.01	0.00	37.51	4.53	100.27	0.77	99.50
1 / 3 .	1.85	0.10	2.97	0.08	9.10	12.73	-0.01	0.15	17.64	0.48	13.06	0.01	0.06	37.39	4.72	100.34	0.80	99.54
1 / 4 .	1.77	0.11	3.00	0.08	9.21	12.75	0.00	0.22	17.58	0.44	13.02	0.06	0.04	37.49	4.50	100.29	0.77	99.52

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 5 .	1.84	0.12	2.98	0.06	9.21	12.69	-0.01	0.21	18.15	0.47	12.97	0.02	0.04	37.44	4.82	101.05	0.80	100.24
1 / 6 .	1.87	0.10	2.99	0.06	9.22	12.82	0.00	0.23	17.88	0.76	12.94	0.07	-0.03	37.81	4.76	101.49	0.81	100.68
1 / 7 .	1.74	0.10	3.05	0.08	9.17	12.79	0.00	0.21	18.07	0.53	12.95	0.09	-0.04	37.63	4.63	101.04	0.75	100.29
Avg 108bt1.1	1.84	0.11	2.98	0.07	9.19	12.77	-0.01	0.20	17.79	0.51	12.97	0.04	0.01	37.55	4.65	100.66	0.80	99.86
2 / 1 .	1.97	0.10	2.94	0.06	9.36	12.73	0.00	0.23	18.03	0.45	12.96	0.05	-0.01	37.76	4.73	101.35	0.85	100.50
2 / 2 . *	2.00	0.09	2.94	0.05	9.30	12.86	-0.01	0.27	18.31	0.54	12.95	0.08	-0.04	37.75	4.84	101.98	0.86	101.12
2 / 3 .	1.87	0.09	2.99	0.09	9.15	12.68	-0.02	0.17	18.41	0.56	12.99	0.03	0.02	37.78	4.73	101.58	0.81	100.77
2 / 4 .	1.99	0.09	2.93	0.07	9.22	12.81	-0.01	0.20	18.11	0.53	13.02	0.06	0.00	37.84	4.69	101.58	0.86	100.72
2 / 5 . *	1.86	0.11	3.01	0.07	9.22	12.83	-0.03	0.25	18.35	0.91	13.07	0.03	0.07	37.66	4.82	102.25	0.81	101.44
2 / 6 .	2.04	0.13	2.88	0.09	9.29	12.79	-0.01	0.19	17.96	0.59	12.98	0.07	0.03	37.62	4.47	101.11	0.89	100.23
2 / 7 .	1.79	0.10	3.02	0.05	9.41	12.78	0.00	0.21	17.94	0.50	13.04	0.04	0.04	37.89	4.31	101.13	0.78	100.35
2 / 8 .	1.92	0.11	2.97	0.09	9.34	12.94	-0.01	0.22	18.13	0.21	12.99	-0.04	0.00	37.89	4.72	101.55	0.83	100.71
2 / 9 .	1.98	0.10	2.93	0.07	9.31	12.85	-0.02	0.22	17.96	0.41	12.94	0.04	0.02	37.80	4.67	101.28	0.86	100.42
2 / 10 .	1.92	0.10	2.96	0.06	9.30	12.80	0.00	0.26	17.78	0.52	13.00	0.08	0.01	37.84	4.67	101.31	0.83	100.48
Avg 108bt1.2	1.94	0.10	2.95	0.07	9.30	12.80	-0.01	0.21	18.04	0.47	12.99	0.04	0.01	37.80	4.62	101.34	0.84	100.51
108_bt_2																		
1 / 1 .	2.00	0.12	2.92	0.19	9.04	13.66	0.06	0.23	16.69	0.51	13.30	0.06	0.01	37.65	4.43	100.88	0.87	100.02
1 / 2 .	1.94	0.10	2.95	0.17	9.14	13.63	0.06	0.23	16.80	0.61	13.37	0.01	-0.05	37.51	4.36	100.88	0.84	100.04
1 / 3 .	1.99	0.11	2.91	0.17	9.04	13.66	0.08	0.19	16.74	0.52	13.32	0.05	-0.01	37.58	4.18	100.55	0.86	99.68
1 / 4 .	1.91	0.12	2.98	0.18	9.27	13.68	0.05	0.26	16.75	0.50	13.46	-0.02	-0.03	37.76	4.44	101.36	0.83	100.53
1 / 5 .	1.99	0.11	2.92	0.21	9.03	13.63	0.06	0.21	16.89	0.69	13.38	0.00	0.00	37.61	4.30	101.04	0.86	100.17
1 / 6 .	2.07	0.13	2.89	0.21	9.10	13.63	0.05	0.23	16.86	0.55	13.49	-0.10	-0.02	37.88	4.16	101.25	0.90	100.35
1 / 7 .	1.95	0.11	2.95	0.19	9.13	13.53	0.10	0.25	16.71	0.64	13.50	0.03	0.02	37.68	4.18	100.98	0.85	100.13
1 / 8 .	1.99	0.12	2.93	0.14	9.11	13.77	0.12	0.25	16.82	0.54	13.34	0.03	-0.02	37.69	4.31	101.16	0.87	100.29
1 / 9 .	1.93	0.12	2.98	0.20	8.97	13.84	0.15	0.23	16.64	0.49	13.41	0.06	0.03	37.99	4.14	101.18	0.84	100.34
1 / 10 .	2.08	0.10	2.89	0.17	9.08	13.78	0.14	0.22	16.38	0.53	13.42	0.03	0.02	37.84	4.22	100.92	0.90	100.02
Avg 108_bt2	1.99	0.11	2.93	0.18	9.09	13.68	0.09	0.23	16.73	0.56	13.40	0.02	0.00	37.72	4.27	100.99	0.86	100.13
108_bt_3																		
1 / 1 .	2.29	0.11	2.85	0.10	9.16	14.74	0.07	0.17	15.02	0.43	13.43	0.10	-0.03	39.13	4.21	101.81	0.99	100.82

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 2 .	2.15	0.12	2.89	0.09	9.17	14.78	0.06	0.21	14.94	0.26	13.49	0.08	0.03	38.45	4.16	100.88	0.93	99.95
1 / 3 .	2.19	0.12	2.84	0.17	8.94	14.52	0.09	0.16	15.00	0.29	13.50	0.08	-0.01	38.13	4.07	100.10	0.95	99.15
1 / 4 .	2.14	0.10	2.89	0.08	9.19	14.73	0.06	0.21	15.11	0.25	13.46	0.02	0.03	38.34	4.09	100.68	0.92	99.76
1 / 5 .	2.11	0.11	2.91	0.09	9.47	14.74	0.05	0.21	15.18	0.20	13.39	0.00	-0.04	38.34	4.20	100.99	0.91	100.08
1 / 6 .	2.21	0.12	2.86	0.08	9.40	14.71	0.05	0.18	15.50	0.43	13.30	0.06	0.00	38.41	4.07	101.37	0.96	100.41
1 / 7 .	2.28	0.11	2.83	0.09	9.26	14.84	0.05	0.15	15.50	0.26	13.45	-0.01	0.02	38.50	4.11	101.45	0.99	100.47
1 / 8 .	2.23	0.10	2.83	0.08	9.10	14.56	0.07	0.11	15.65	0.25	13.37	0.02	-0.01	38.16	4.20	100.74	0.96	99.78
1 / 9 .	2.20	0.11	2.86	0.11	9.14	14.64	0.06	0.16	15.70	0.33	13.51	0.04	0.04	38.23	4.05	101.17	0.95	100.22
1 / 10 .	2.24	0.10	2.83	0.12	8.75	14.96	0.07	0.17	15.86	0.36	13.56	0.01	0.04	37.98	3.78	100.84	0.97	99.87
Avg 108_bt3	2.20	0.11	2.86	0.10	9.16	14.72	0.06	0.17	15.35	0.31	13.44	0.04	0.01	38.37	4.10	100.99	0.95	100.04
108_bt_4																		
1 / 1 .	1.96	0.13	2.93	0.11	9.18	12.77	0.02	0.09	17.89	0.54	13.39	0.04	0.04	37.78	4.28	101.14	0.86	100.28
1 / 2 .	1.94	0.12	2.96	0.10	9.21	12.88	0.02	0.06	18.08	0.60	13.35	0.00	0.03	37.92	4.45	101.73	0.84	100.88
1 / 3 .	1.89	0.13	2.98	0.12	9.24	12.99	0.03	0.16	17.79	0.48	13.20	0.07	0.02	37.85	4.44	101.39	0.83	100.57
1 / 4 .	1.97	0.13	2.94	0.13	9.18	13.11	0.03	0.14	17.85	0.56	13.18	0.05	0.01	38.13	4.19	101.61	0.86	100.75
1 / 5 .	1.94	0.12	2.95	0.12	9.10	13.06	0.04	0.15	18.07	0.51	13.07	0.04	0.03	37.91	4.29	101.40	0.85	100.56
1 / 6 .	1.89	0.15	2.97	0.11	9.10	13.01	0.03	0.17	17.96	0.65	13.17	0.04	0.02	38.00	4.13	101.39	0.83	100.56
1 / 7 .	1.88	0.14	2.98	0.12	9.05	12.95	0.03	0.14	18.15	0.72	13.24	0.04	-0.02	37.85	4.20	101.47	0.82	100.65
1 / 8 .	1.94	0.13	2.95	0.13	9.05	13.04	0.03	0.12	18.10	0.68	13.33	0.03	0.00	37.76	4.32	101.61	0.85	100.76
1 / 9 .	2.00	0.13	2.91	0.10	9.12	13.08	0.04	0.14	17.88	0.54	13.29	-0.01	0.01	37.81	4.11	101.15	0.87	100.28
1 / 10 .	2.01	0.19	2.89	0.29	9.03	13.14	0.05	0.12	17.66	0.50	13.21	0.01	0.04	37.82	4.02	100.99	0.89	100.10
Avg 108_bt4	1.94	0.14	2.95	0.13	9.13	13.00	0.03	0.13	17.94	0.58	13.24	0.03	0.02	37.88	4.24	101.38	0.85	100.54
108_bt_5																		
1 / 1 .	2.00	0.11	2.91	0.12	9.34	13.14	0.00	0.19	17.25	0.56	13.46	-0.05	0.01	37.45	4.47	101.01	0.87	100.15
1 / 2 .	1.98	0.10	2.94	0.11	9.35	13.21	-0.01	0.17	17.33	0.65	13.48	-0.03	0.00	37.59	4.49	101.40	0.86	100.54
1 / 3 .	1.95	0.10	2.95	0.10	9.30	13.19	0.00	0.23	17.32	0.76	13.49	0.09	-0.05	37.54	4.41	101.43	0.84	100.59
1 / 4 .	2.00	0.11	2.93	0.13	9.33	13.28	0.00	0.20	17.06	0.72	13.42	-0.01	0.04	37.77	4.47	101.47	0.87	100.60
1 / 5 .	1.92	0.11	2.96	0.10	9.33	13.20	-0.01	0.20	16.85	0.44	13.41	0.06	-0.03	37.65	4.51	100.73	0.83	99.90
1 / 6 .	1.92	0.15	2.95	0.20	9.41	13.22	0.00	0.17	17.01	0.70	13.40	0.06	-0.02	37.53	4.50	101.22	0.84	100.38
1 / 7 .	2.01	0.12	2.93	0.09	9.31	13.39	0.01	0.14	17.18	0.59	13.51	0.03	-0.05	37.82	4.50	101.62	0.87	100.75

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 8 .	2.00	0.11	2.91	0.11	9.37	13.30	0.00	0.19	16.92	0.58	13.35	0.06	-0.02	37.61	4.31	100.82	0.86	99.95
1 / 9 .	2.10	0.10	2.87	0.12	9.31	13.25	0.00	0.18	17.10	0.53	13.38	0.04	0.03	37.57	4.56	101.15	0.91	100.25
1 / 10 . *	1.94	0.12	2.98	0.14	9.41	13.33	0.00	0.20	17.12	0.67	13.61	0.06	0.00	37.67	4.63	101.88	0.84	101.04
Avg 108_bt5	1.99	0.11	2.93	0.12	9.34	13.24	0.00	0.19	17.11	0.61	13.43	0.03	-0.01	37.61	4.47	101.17	0.86	100.31
108_bt_6																		
1 / 1 .	2.05	0.11	2.96	0.06	9.38	14.71	0.01	0.23	15.33	0.62	13.89	0.11	0.04	38.34	3.91	101.74	0.89	100.85
1 / 2 .	2.36	0.11	2.79	0.06	9.42	14.50	-0.01	0.22	15.46	0.58	13.74	0.01	0.02	38.38	4.06	101.70	1.02	100.68
1 / 3 .	2.14	0.11	2.89	0.09	9.39	14.33	0.00	0.21	15.62	0.48	13.77	0.01	-0.01	38.42	3.93	101.40	0.93	100.47
1 / 4 .	2.02	0.13	2.95	0.10	9.46	14.28	0.00	0.21	15.63	0.37	13.62	0.01	0.00	38.36	4.21	101.35	0.88	100.47
1 / 5 .	2.17	0.13	2.88	0.06	9.52	14.11	0.03	0.16	15.79	0.45	13.69	0.00	0.02	38.33	4.33	101.67	0.94	100.73
1 / 6 .	2.10	0.12	2.90	0.07	9.50	14.09	0.01	0.25	15.68	0.55	13.68	0.08	0.00	38.34	3.90	101.28	0.91	100.37
1 / 7 .	2.09	0.12	2.90	0.06	9.37	14.03	0.00	0.25	15.87	0.42	13.68	0.01	0.00	38.10	4.27	101.17	0.91	100.26
1 / 8 .	1.99	0.10	2.96	0.06	9.44	14.12	0.00	0.23	16.09	0.44	13.63	-0.02	-0.01	38.07	4.23	101.37	0.86	100.51
1 / 9 .	2.13	0.12	2.89	0.07	9.49	14.04	0.01	0.27	15.87	0.40	13.58	0.03	0.02	38.21	4.26	101.38	0.93	100.45
1 / 10 .	2.19	0.16	2.84	0.05	9.44	14.15	0.01	0.24	15.87	0.50	13.50	0.02	0.00	38.24	4.24	101.48	0.96	100.52
Avg 108_bt6	2.13	0.12	2.90	0.07	9.44	14.24	0.01	0.23	15.72	0.48	13.68	0.03	0.01	38.28	4.13	101.45	0.92	100.53
108_bt_7																		
1 / 1 .	2.09	0.12	2.88	0.09	9.47	13.90	0.00	0.20	16.45	0.51	13.23	0.03	0.00	37.97	4.30	101.24	0.91	100.33
1 / 2 .	2.03	0.11	2.93	0.08	9.46	13.88	0.02	0.13	16.43	0.42	13.17	0.00	0.01	38.08	4.46	101.19	0.88	100.31
1 / 3 .	2.02	0.12	2.93	0.08	9.48	13.96	0.01	0.19	16.29	0.68	13.22	0.02	-0.01	38.11	4.30	101.42	0.88	100.54
1 / 4 .	2.17	0.10	2.87	0.09	9.47	13.94	0.02	0.23	16.50	0.54	13.32	0.01	0.02	38.04	4.37	101.68	0.93	100.74
1 / 5 .	2.19	0.09	2.86	0.07	9.48	13.90	0.00	0.20	16.32	0.65	13.31	0.04	0.03	38.09	4.40	101.62	0.94	100.68
1 / 6 . *	2.14	0.10	2.89	0.07	9.47	13.97	0.02	0.26	16.49	0.56	13.45	0.04	-0.03	38.10	4.39	101.94	0.93	101.02
1 / 7 . *	2.18	0.10	2.88	0.06	9.59	14.05	0.01	0.22	16.65	0.47	13.31	0.03	0.01	38.23	4.31	102.10	0.94	101.16
1 / 8 .	2.24	0.08	2.84	0.05	9.57	14.10	0.00	0.19	16.32	0.50	13.26	0.00	-0.06	38.02	4.60	101.78	0.96	100.81
1 / 9 . *	2.21	0.13	2.86	0.06	9.55	14.02	0.01	0.23	16.30	0.43	13.28	0.03	0.05	38.27	4.55	101.97	0.96	101.01
1 / 10 .	2.16	0.12	2.87	0.06	9.56	14.01	0.01	0.20	16.59	0.44	13.23	0.02	0.04	38.13	4.26	101.69	0.94	100.76
Avg 108_bt7	2.13	0.11	2.88	0.07	9.50	13.96	0.01	0.19	16.41	0.53	13.25	0.02	0.00	38.06	4.38	101.51	0.92	100.59
108_bt_8																		

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 1 .	2.12	0.10	2.91	0.06	9.37	14.73	0.09	0.19	15.28	0.32	13.40	0.06	0.02	38.32	4.31	101.27	0.91	100.36
1 / 2 .	2.18	0.11	2.87	0.10	9.41	14.80	0.05	0.13	15.19	0.39	13.28	0.00	0.03	38.36	4.27	101.19	0.95	100.24
1 / 3 .	2.12	0.10	2.90	0.12	9.56	14.60	0.05	0.20	15.27	0.33	13.33	0.01	-0.02	38.30	4.20	101.08	0.91	100.17
1 / 4 .	2.05	0.10	2.94	0.10	9.51	14.64	0.02	0.17	15.58	0.33	13.35	0.05	0.00	38.35	4.09	101.27	0.89	100.38
1 / 5 .	2.16	0.09	2.88	0.12	9.43	14.59	0.04	0.17	15.57	0.33	13.35	-0.01	0.02	38.07	4.40	101.20	0.93	100.28
1 / 6 .	1.98	0.11	2.98	0.12	9.43	14.69	0.03	0.17	15.67	0.52	13.41	0.02	0.00	38.31	4.17	101.61	0.86	100.76
1 / 7 .	2.06	0.09	2.92	0.10	9.43	14.48	0.02	0.19	15.44	0.22	13.30	0.05	0.00	38.26	4.14	100.72	0.89	99.83
1 / 8 .	2.01	0.09	2.97	0.13	9.30	14.57	0.06	0.18	15.52	0.55	13.40	0.03	0.01	38.37	4.27	101.48	0.87	100.61
1 / 9 .	2.11	0.09	2.90	0.15	9.29	14.48	0.05	0.21	15.40	0.40	13.40	0.04	-0.02	38.24	4.21	100.97	0.91	100.06
1 / 10 .	2.24	0.10	2.86	0.13	9.47	14.70	0.07	0.18	15.56	0.33	13.40	0.03	0.00	38.31	4.45	101.85	0.97	100.88
Avg 108_bt_8.1	2.10	0.10	2.91	0.11	9.42	14.63	0.05	0.18	15.45	0.37	13.36	0.03	0.00	38.29	4.25	101.26	0.91	100.35
2 / 1 .	2.14	0.09	2.89	0.04	9.42	14.30	-0.01	0.16	15.94	0.30	13.20	0.08	0.03	38.29	4.22	101.12	0.92	100.20
2 / 2 .	2.18	0.11	2.87	0.05	9.44	14.19	-0.01	0.19	15.91	0.38	13.22	0.11	-0.08	38.36	4.50	101.51	0.94	100.56
2 / 3 .	2.21	0.09	2.84	0.04	9.46	14.03	0.00	0.19	16.24	0.39	13.22	0.00	-0.02	37.96	4.46	101.11	0.95	100.16
2 / 4 .	2.15	0.09	2.87	0.08	9.39	14.11	-0.02	0.17	16.14	0.30	13.32	0.02	0.05	37.94	4.41	101.05	0.93	100.12
2 / 5 .	2.01	0.09	2.93	0.04	9.44	14.08	-0.01	0.18	16.01	0.50	13.15	0.02	0.01	38.09	4.20	100.74	0.87	99.87
2 / 6 .	2.00	0.10	2.94	0.08	9.50	13.94	0.00	0.16	16.01	0.56	13.27	0.07	0.05	37.90	4.44	101.01	0.86	100.15
2 / 7 .	2.02	0.10	2.92	0.07	9.42	14.00	-0.01	0.20	16.33	0.40	13.14	0.01	0.02	38.02	4.21	100.87	0.87	99.99
2 / 8 .	2.03	0.10	2.93	0.08	9.52	13.90	0.01	0.19	16.25	0.50	13.21	0.02	-0.04	38.14	4.28	101.15	0.88	100.28
2 / 9 .	1.98	0.08	2.95	0.07	9.51	13.99	-0.01	0.22	16.37	0.45	13.16	0.04	0.03	37.81	4.40	101.08	0.85	100.23
2 / 10 .	2.03	0.08	2.95	0.07	9.45	14.09	0.00	0.21	16.28	0.39	13.24	0.01	0.04	38.12	4.43	101.38	0.87	100.51
Avg 108bt8.2	2.07	0.09	2.91	0.06	9.46	14.06	0.00	0.19	16.15	0.42	13.21	0.04	0.01	38.06	4.35	101.08	0.89	100.19
108_bt_9																		
1 / 1 .	2.02	0.10	2.93	0.21	9.21	14.27	0.05	0.25	15.53	0.44	13.41	0.01	-0.04	38.03	4.21	100.66	0.87	99.79
1 / 2 .	2.12	0.10	2.87	0.22	9.17	14.22	0.10	0.18	15.45	0.34	13.29	0.00	-0.03	38.07	4.22	100.35	0.91	99.44
1 / 3 .	2.08	0.09	2.92	0.20	9.21	14.35	0.05	0.16	15.49	0.48	13.37	0.03	-0.01	38.16	4.37	100.93	0.90	100.04
1 / 4 .	2.00	0.09	2.93	0.18	9.17	14.10	0.08	0.16	15.42	0.39	13.38	0.01	0.02	38.12	4.14	100.19	0.86	99.32
1 / 5 .	2.11	0.10	2.93	0.20	9.26	14.32	0.06	0.18	15.77	0.30	13.46	0.10	-0.03	38.35	4.58	101.73	0.91	100.81
1 / 6 .	2.12	0.10	2.88	0.20	9.19	14.28	0.05	0.20	15.40	0.39	13.43	0.03	-0.01	38.04	4.33	100.65	0.92	99.73
1 / 7 .	2.05	0.10	2.93	0.20	9.11	14.33	0.03	0.21	15.52	0.43	13.30	0.06	0.02	38.19	4.38	100.85	0.89	99.96

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 8 .	2.02	0.09	2.96	0.18	9.11	14.20	0.04	0.19	15.77	0.31	13.43	0.02	0.01	38.45	4.27	101.04	0.87	100.17
1 / 9 .	2.05	0.11	2.90	0.23	9.12	14.22	0.03	0.20	15.48	0.33	13.32	0.05	-0.02	37.95	4.21	100.21	0.89	99.32
1 / 10 .	2.00	0.10	2.94	0.18	9.13	14.18	0.05	0.16	15.76	0.44	13.29	0.03	-0.01	38.09	4.20	100.55	0.87	99.68
Avg 108_bt9	2.06	0.10	2.92	0.20	9.17	14.25	0.05	0.19	15.56	0.38	13.37	0.03	-0.01	38.14	4.29	100.70	0.89	99.81

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103_bt_1	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 .	1.29	0.13	3.20	0.14	9.17	11.95	0.04	0.41	18.65	0.21	13.32	0.06	-0.02	37.55	2.98	99.10	0.57	98.53
1 / 2 .	1.43	0.10	3.16	0.09	9.32	12.08	0.03	0.37	18.76	0.28	13.50	0.02	0.00	37.61	3.16	99.90	0.62	99.28
1 / 3 .	1.39	0.09	3.19	0.11	9.44	12.11	0.02	0.40	18.81	0.19	13.46	0.00	0.00	37.59	3.31	100.11	0.61	99.51
1 / 4 .	1.40	0.11	3.19	0.11	9.46	12.14	0.04	0.45	18.67	0.42	13.67	0.01	0.01	37.64	3.34	100.66	0.62	100.04
1 / 5 .	1.43	0.10	3.17	0.08	9.50	12.13	0.02	0.45	18.67	0.32	13.70	0.08	0.00	37.71	3.01	100.37	0.63	99.74
1 / 6 .	1.40	0.11	3.17	0.11	9.47	12.12	0.01	0.38	18.87	0.19	13.52	0.05	-0.05	37.55	3.09	100.03	0.62	99.42
1 / 7 .	1.46	0.10	3.15	0.13	9.43	12.03	0.02	0.39	18.80	0.38	13.68	0.01	0.01	37.59	3.09	100.27	0.64	99.63
1 / 8 .	1.35	0.13	3.17	0.12	9.32	11.90	0.05	0.37	18.63	0.29	13.67	0.03	0.01	37.24	3.12	99.41	0.60	98.82
1 / 9 .	1.49	0.10	3.14	0.05	9.54	11.97	0.02	0.43	18.59	0.32	13.76	0.04	0.05	37.68	3.02	100.19	0.65	99.54
1 / 10 .	1.45	0.11	3.17	0.09	9.58	12.22	0.00	0.39	18.46	0.26	13.80	0.06	-0.02	37.67	3.19	100.44	0.63	99.81
Avg 103_bt1	1.41	0.11	3.17	0.10	9.42	12.06	0.02	0.40	18.69	0.29	13.61	0.04	0.00	37.58	3.13	100.04	0.62	99.42
103_bt_2																		
1 / 1 .	1.26	0.10	3.26	0.07	9.47	10.94	0.00	0.32	20.18	0.36	13.77	0.05	0.00	37.43	3.72	100.92	0.55	100.37
1 / 2 .	1.21	0.09	3.30	0.07	9.39	11.08	0.01	0.32	20.35	0.24	13.88	0.04	0.02	37.27	3.92	101.20	0.53	100.66
1 / 3 .	1.19	0.11	3.30	0.04	9.31	10.97	0.00	0.41	20.27	0.43	13.78	0.12	0.01	37.32	3.88	101.13	0.52	100.61
1 / 4 .	1.17	0.10	3.29	0.07	9.35	10.98	0.00	0.38	20.24	0.31	13.64	0.05	-0.02	37.15	3.90	100.63	0.52	100.11
1 / 5 . *	1.14	0.12	3.34	0.08	9.39	11.06	0.00	0.39	20.57	0.47	13.72	0.02	-0.01	37.39	4.00	101.69	0.51	101.18
1 / 6 .	1.17	0.13	3.28	0.09	9.49	10.94	0.02	0.41	19.88	0.39	13.60	0.03	-0.01	36.99	4.02	100.42	0.52	99.90
1 / 7 .	1.29	0.12	3.23	0.05	9.41	10.91	0.02	0.29	19.96	0.41	13.51	0.01	0.01	37.49	3.89	100.60	0.57	100.03
1 / 8 .	1.36	0.11	3.20	0.09	9.48	10.89	0.05	0.36	19.74	0.40	13.54	0.01	0.04	37.51	3.76	100.55	0.60	99.96
1 / 9 .	1.16	0.11	3.32	0.07	9.62	11.15	0.00	0.34	19.86	0.31	13.67	0.01	0.02	37.45	3.89	100.97	0.51	100.45
1 / 10 .	1.39	0.13	3.17	0.08	9.54	10.99	0.02	0.37	19.67	0.40	13.55	0.06	0.03	37.24	3.95	100.56	0.61	99.95
Avg 103_bt2	1.24	0.11	3.27	0.07	9.44	10.99	0.01	0.36	20.07	0.37	13.67	0.04	0.01	37.32	3.89	100.87	0.54	100.33

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
103_bt_3																		
1 / 1 .	1.30	0.08	3.26	0.05	9.52	11.21	0.00	0.45	19.70	0.44	13.60	0.10	-0.03	37.47	4.05	101.22	0.56	100.66
1 / 2 .	1.34	0.09	3.21	0.06	9.53	11.16	-0.01	0.50	19.94	0.33	13.43	0.03	0.02	37.32	3.87	100.82	0.58	100.24
1 / 3 .	1.28	0.10	3.23	0.07	9.68	11.11	0.01	0.52	19.68	0.29	13.32	0.02	-0.01	37.44	3.86	100.62	0.56	100.06
1 / 4 .	1.28	0.10	3.24	0.05	9.60	11.05	0.00	0.47	19.89	0.33	13.45	0.06	0.04	37.35	3.84	100.75	0.56	100.19
1 / 5 .	1.23	0.09	3.29	0.07	9.65	11.17	-0.01	0.49	19.75	0.28	13.43	0.05	-0.01	37.65	3.87	101.00	0.54	100.46
1 / 6 .	1.24	0.10	3.28	0.07	9.54	11.18	0.00	0.44	19.59	0.42	13.62	0.09	0.00	37.64	3.89	101.10	0.55	100.55
1 / 7 . *	1.29	0.10	3.27	0.04	9.58	11.24	0.00	0.51	20.03	0.46	13.43	0.04	0.03	37.67	3.88	101.57	0.57	101.01
1 / 8 .	1.32	0.09	3.21	0.05	9.66	11.11	-0.01	0.49	19.64	0.39	13.45	0.01	-0.03	37.36	3.79	100.59	0.58	100.01
1 / 9 .	1.27	0.12	3.25	0.07	9.68	11.18	-0.01	0.49	19.94	0.37	13.42	0.06	0.03	37.34	3.88	101.11	0.56	100.55
1 / 10 .	1.32	0.10	3.25	0.07	9.64	11.10	-0.01	0.49	19.72	0.34	13.60	0.06	0.02	37.63	3.95	101.28	0.58	100.70
Avg 103_bt3	1.29	0.10	3.25	0.06	9.61	11.14	0.00	0.48	19.76	0.35	13.48	0.05	0.00	37.47	3.89	100.93	0.56	100.37
103_bt_4																		
1 / 1 .	1.61	0.09	3.13	0.06	9.76	12.70	0.00	0.38	18.56	0.15	13.80	0.07	0.02	38.03	3.13	101.50	0.70	100.80
1 / 2 .	1.44	0.10	3.21	0.08	9.75	12.66	-0.03	0.31	18.47	0.27	13.77	0.04	0.04	38.15	3.02	101.32	0.63	100.69
1 / 3 .	1.50	0.10	3.16	0.06	9.77	12.59	0.00	0.35	18.51	0.28	13.70	0.07	-0.02	37.79	3.05	100.93	0.65	100.28
1 / 4 .	1.59	0.09	3.14	0.07	9.82	12.65	0.00	0.33	18.62	0.37	13.72	0.03	-0.02	38.02	3.11	101.56	0.69	100.87
1 / 5 .	1.58	0.10	3.13	0.07	9.74	12.58	-0.01	0.39	18.43	0.35	13.81	0.09	-0.07	37.85	3.13	101.25	0.69	100.56
1 / 6 .	1.69	0.09	3.09	0.06	9.76	12.61	0.01	0.38	18.46	0.20	13.74	0.02	0.01	38.13	3.18	101.43	0.73	100.70
1 / 7 .	1.47	0.09	3.19	0.10	9.65	12.58	0.00	0.39	18.61	0.24	13.69	0.05	-0.02	37.93	3.23	101.22	0.64	100.58
1 / 8 . *	1.49	0.08	3.21	0.06	9.71	12.56	-0.03	0.38	18.73	0.38	13.83	0.00	0.01	38.15	3.23	101.83	0.65	101.18
1 / 9 .	1.61	0.09	3.13	0.09	9.75	12.62	0.00	0.39	18.39	0.27	13.69	0.00	-0.03	38.09	3.36	101.49	0.70	100.80
1 / 10 .	1.57	0.10	3.13	0.06	9.74	12.43	-0.01	0.37	18.78	0.33	13.65	-0.02	0.04	37.94	3.22	101.37	0.69	100.69
Avg 103_bt4	1.56	0.10	3.15	0.07	9.75	12.60	-0.01	0.37	18.54	0.27	13.73	0.04	-0.01	37.99	3.16	101.32	0.68	100.64
103_bt_5																		
1 / 1 .	1.39	0.11	3.22	0.06	9.80	12.03	-0.01	0.48	18.61	0.19	13.74	0.05	0.05	37.66	3.81	101.20	0.61	100.59
1 / 2 .	1.36	0.09	3.23	0.06	9.82	12.00	0.00	0.51	19.01	0.22	13.58	0.02	-0.01	37.59	3.69	101.19	0.59	100.59
1 / 3 .	1.40	0.10	3.21	0.06	9.77	11.91	0.00	0.44	18.94	0.22	13.59	0.04	0.01	37.80	3.59	101.08	0.61	100.47
1 / 4 .	1.35	0.10	3.23	0.05	9.78	11.98	-0.01	0.51	18.67	0.21	13.51	0.01	-0.02	37.66	3.64	100.71	0.59	100.11

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 5 .	1.27	0.11	3.27	0.09	9.91	12.00	0.00	0.44	18.73	0.27	13.53	0.04	0.00	37.67	3.70	101.02	0.56	100.47
1 / 6 .	1.35	0.09	3.23	0.05	9.79	12.01	0.00	0.47	18.69	0.15	13.59	-0.03	0.00	37.72	3.54	100.68	0.59	100.09
1 / 7 .	1.37	0.08	3.23	0.07	9.80	11.98	-0.01	0.51	18.88	0.24	13.76	0.02	0.07	37.53	3.59	101.12	0.59	100.53
1 / 8 .	1.30	0.11	3.26	0.06	9.77	11.99	-0.02	0.51	18.76	0.14	13.70	0.06	0.03	37.64	3.55	100.87	0.57	100.30
1 / 9 .	1.34	0.12	3.23	0.05	9.78	11.94	-0.01	0.53	19.28	0.24	13.73	-0.01	0.01	37.38	3.73	101.35	0.59	100.76
1 / 10 .	1.24	0.10	3.28	0.11	9.74	11.83	-0.01	0.49	18.93	0.21	13.73	0.00	0.04	37.29	3.75	100.73	0.54	100.18
Avg 103_bt5	1.34	0.10	3.24	0.07	9.80	11.97	-0.01	0.49	18.85	0.21	13.65	0.02	0.02	37.59	3.66	100.98	0.59	100.39
103_bt_6																		
1 / 1 .	1.43	0.13	3.22	0.08	9.59	12.60	0.00	0.44	17.99	0.30	13.87	-0.02	-0.04	38.10	3.43	101.16	0.63	100.53
1 / 2 .	1.50	0.11	3.16	0.07	9.70	12.44	-0.01	0.49	18.23	0.37	13.77	0.01	-0.01	37.95	3.16	100.97	0.66	100.31
1 / 3 .	1.49	0.11	3.15	0.09	9.75	12.44	0.00	0.42	18.14	0.37	13.73	0.06	-0.02	37.68	3.19	100.62	0.65	99.97
1 / 4 .	1.49	0.12	3.16	0.05	9.72	12.45	0.00	0.36	18.14	0.35	13.81	0.02	0.04	37.86	3.29	100.85	0.66	100.20
1 / 5 .	1.50	0.11	3.17	0.10	9.65	12.37	-0.01	0.48	18.19	0.29	13.88	0.01	0.03	37.84	3.35	100.97	0.66	100.32
1 / 6 .	1.50	0.13	3.14	0.08	9.67	12.25	0.00	0.42	18.05	0.23	13.63	0.05	0.02	37.78	3.49	100.46	0.66	99.80
1 / 7 .	1.45	0.12	3.20	0.06	9.78	12.40	-0.01	0.38	18.34	0.36	13.88	0.06	0.04	37.97	3.24	101.31	0.64	100.67
1 / 8 .	1.48	0.12	3.17	0.07	9.72	12.31	-0.01	0.44	18.08	0.38	13.85	0.03	-0.03	37.77	3.42	100.83	0.65	100.18
1 / 9 .	1.54	0.12	3.14	0.07	9.69	12.46	-0.01	0.44	18.26	0.34	13.83	0.13	0.00	37.63	3.49	101.13	0.67	100.45
1 / 10 .	1.52	0.12	3.15	0.06	9.67	12.42	-0.01	0.39	18.34	0.38	13.72	0.05	-0.01	37.82	3.40	101.04	0.67	100.37
Avg 103_bt6	1.49	0.12	3.17	0.07	9.69	12.41	-0.01	0.43	18.18	0.34	13.80	0.04	0.00	37.84	3.35	100.91	0.65	100.26
103_bt_7																		
1 / 1 .	1.40	0.11	3.21	0.12	9.76	12.36	-0.01	0.31	18.47	0.34	13.76	0.00	0.01	37.79	3.26	100.91	0.62	100.30
1 / 2 .	1.51	0.10	3.15	0.08	9.76	12.32	-0.02	0.35	18.54	0.34	13.68	0.01	0.00	37.72	3.21	100.78	0.66	100.12
1 / 3 .	1.54	0.12	3.12	0.06	9.60	12.37	0.00	0.33	18.93	0.46	13.61	0.04	0.00	37.70	3.07	100.95	0.68	100.28
1 / 4 .	1.37	0.11	3.21	0.06	9.83	12.25	0.00	0.30	18.70	0.35	13.70	0.07	0.01	37.66	3.07	100.70	0.60	100.10
1 / 5 .	1.36	0.13	3.22	0.09	9.78	12.35	0.00	0.32	18.82	0.40	13.66	0.01	-0.02	37.69	3.05	100.89	0.60	100.29
1 / 6 .	1.38	0.11	3.21	0.08	9.72	12.12	0.00	0.37	18.67	0.47	13.83	0.00	0.00	37.69	3.30	100.96	0.61	100.35
1 / 7 .	1.51	0.10	3.14	0.06	9.73	12.21	-0.02	0.37	18.63	0.26	13.72	0.10	-0.03	37.60	3.25	100.67	0.66	100.02
1 / 8 .	1.48	0.11	3.15	0.06	9.72	12.31	-0.01	0.34	18.72	0.33	13.81	0.04	-0.03	37.59	3.04	100.70	0.65	100.06
1 / 9 .	1.46	0.10	3.15	0.09	9.73	12.14	0.00	0.36	18.78	0.35	13.69	0.07	0.05	37.40	3.17	100.55	0.64	99.91
1 / 10 .	1.53	0.11	3.13	0.06	9.65	12.28	0.01	0.44	18.60	0.40	13.68	0.05	0.03	37.65	3.14	100.78	0.67	100.11

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
Avg 103_bt7	1.45	0.11	3.17	0.08	9.73	12.27	0.00	0.35	18.69	0.37	13.72	0.04	0.00	37.65	3.16	100.78	0.64	100.14
103_bt_8																		
1 / 1 .	1.53	0.12	3.13	0.05	9.64	12.34	0.00	0.46	18.53	0.22	13.59	0.00	-0.03	37.69	3.36	100.67	0.67	100.00
1 / 2 .	1.50	0.12	3.14	0.05	9.73	12.22	0.00	0.43	18.27	0.26	13.75	0.03	0.02	37.77	3.22	100.50	0.66	99.84
1 / 3 .	1.43	0.11	3.21	0.08	9.77	12.37	-0.02	0.52	18.47	0.34	13.59	0.00	0.00	38.05	3.33	101.27	0.63	100.64
1 / 4 .	1.45	0.12	3.18	0.07	9.77	12.16	-0.01	0.49	18.50	0.36	13.69	0.03	-0.01	37.92	3.24	100.98	0.63	100.34
1 / 5 .	1.55	0.13	3.13	0.05	9.73	12.36	0.01	0.45	18.52	0.31	13.64	-0.03	-0.01	37.93	3.28	101.10	0.68	100.42
1 / 6 .	1.52	0.13	3.13	0.06	9.83	12.39	-0.01	0.48	18.13	0.39	13.67	-0.01	-0.01	37.82	3.07	100.61	0.67	99.94
1 / 7 .	1.51	0.12	3.15	0.06	9.82	12.22	0.00	0.43	18.35	0.40	13.61	0.01	0.03	37.84	3.37	100.90	0.66	100.24
1 / 8 .	1.45	0.11	3.20	0.06	9.84	12.34	0.00	0.48	18.32	0.26	13.75	0.00	0.01	37.92	3.48	101.22	0.63	100.59
1 / 9 .	1.60	0.11	3.10	0.05	9.71	12.36	0.01	0.49	18.36	0.36	13.59	-0.06	0.01	37.83	3.30	100.90	0.70	100.20
1 / 10 .	1.40	0.10	3.21	0.04	9.70	12.23	0.01	0.45	18.21	0.38	13.57	0.05	-0.05	37.94	3.39	100.67	0.61	100.06
Avg 103_bt8	1.49	0.11	3.16	0.06	9.75	12.30	0.00	0.47	18.37	0.33	13.64	0.00	0.00	37.87	3.30	100.85	0.65	100.20
103_bt_9																		
1 / 1 .	1.46	0.12	3.17	0.09	9.74	12.40	0.01	0.46	18.04	0.32	13.57	0.01	0.00	37.88	3.35	100.62	0.64	99.98
1 / 2 .	1.51	0.10	3.15	0.08	9.78	12.36	-0.01	0.45	18.30	0.40	13.67	0.07	0.00	37.73	3.36	100.96	0.66	100.30
1 / 3 .	1.44	0.11	3.21	0.05	9.80	12.34	0.01	0.47	18.34	0.37	13.71	0.02	0.04	37.99	3.54	101.43	0.63	100.80
1 / 4 .	1.47	0.11	3.17	0.06	9.63	12.36	0.00	0.41	18.46	0.30	13.65	0.03	0.00	37.69	3.56	100.90	0.64	100.25
1 / 5 .	1.64	0.13	3.08	0.09	9.74	12.28	0.00	0.48	18.07	0.45	13.66	0.05	0.04	37.68	3.61	100.99	0.72	100.27
1 / 6 .	1.50	0.11	3.15	0.10	9.71	12.33	0.01	0.51	18.19	0.50	13.68	0.05	-0.01	37.69	3.41	100.94	0.66	100.28
1 / 7 .	1.61	0.12	3.11	0.12	9.70	12.38	0.01	0.47	18.19	0.34	13.78	-0.03	-0.01	37.81	3.48	101.10	0.71	100.40
1 / 8 .	1.37	0.13	3.23	0.11	9.72	12.42	0.00	0.46	18.26	0.67	13.81	0.06	-0.02	37.58	3.62	101.46	0.60	100.85
1 / 9 .	1.50	0.11	3.17	0.08	9.73	12.42	0.00	0.55	18.25	0.50	13.76	0.06	0.01	37.70	3.58	101.42	0.66	100.76
1 / 10 .	1.28	0.11	3.27	0.08	9.77	12.44	0.01	0.45	18.04	0.50	13.66	0.01	0.00	37.68	3.58	100.88	0.57	100.31
Avg 103_bt9	1.48	0.11	3.17	0.09	9.73	12.37	0.00	0.47	18.21	0.43	13.70	0.03	0.00	37.74	3.51	101.06	0.65	100.41
103_bt_10																		
1 / 1 .	1.49	0.12	3.16	0.11	9.86	12.66	0.01	0.41	17.69	0.24	13.79	0.03	0.03	37.68	3.39	100.68	0.66	100.02
1 / 2 .	1.58	0.11	3.13	0.10	9.79	12.63	-0.01	0.45	17.78	0.33	13.90	0.05	0.03	37.93	3.33	101.15	0.69	100.46
1 / 3 .	1.57	0.10	3.14	0.05	9.80	12.59	0.01	0.42	17.86	0.36	13.71	0.06	-0.01	38.07	3.33	101.09	0.68	100.40

Table B2: Biotite Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 4 .	1.68	0.12	3.07	0.05	9.64	12.64	0.00	0.44	18.03	0.21	13.63	0.05	0.03	37.98	3.31	100.88	0.74	100.15
1 / 5 .	1.45	0.10	3.17	0.04	9.15	12.57	-0.01	0.39	18.69	0.19	13.98	0.04	0.00	37.44	3.14	100.34	0.63	99.71
1 / 6 .	1.35	0.09	3.21	0.06	8.50	12.33	0.00	0.45	19.88	0.27	13.99	0.07	-0.03	36.88	3.11	100.19	0.59	99.60
1 / 7 .	1.52	0.10	3.14	0.09	9.56	12.75	0.01	0.39	17.62	0.30	13.78	-0.02	-0.05	37.70	3.41	100.39	0.66	99.72
1 / 8 .	1.61	0.09	3.12	0.10	9.75	12.58	-0.01	0.42	17.69	0.28	13.91	0.03	0.01	38.04	3.33	100.95	0.70	100.26
1 / 9 .	1.46	0.10	3.20	0.04	9.83	12.63	-0.01	0.39	17.71	0.39	13.91	0.09	-0.01	38.01	3.33	101.09	0.64	100.45
1 / 10 .	1.45	0.11	3.20	0.08	9.76	12.63	0.00	0.46	17.99	0.34	13.75	0.05	0.00	38.02	3.29	101.14	0.63	100.50
Avg 103_bt10	1.52	0.10	3.16	0.07	9.56	12.60	0.00	0.42	18.09	0.29	13.83	0.04	0.00	37.78	3.30	100.77	0.66	100.11

APPENDIX B
MINERAL CHEMISTRIES FROM KM-SCALE GRADIENTS

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
BR-201a																		
201a_amph_1																		
1 / 1 .	0.87	0.12	1.50	2.09	1.66	9.46	10.76	0.73	19.10	0.08	10.27	0.01	-0.01	42.15	1.79	100.60	0.39	100.21
1 / 2 .	0.81	0.14	1.53	2.10	1.61	9.37	10.86	0.78	19.26	-0.02	10.18	0.02	0.02	42.30	1.76	100.72	0.37	100.34
1 / 3 .	0.83	0.12	1.53	2.08	1.59	9.37	10.94	0.79	19.19	0.07	10.11	0.01	0.03	42.52	1.67	100.85	0.37	100.48
1 / 4 .	0.81	0.12	1.53	2.01	1.62	9.38	10.64	0.69	19.35	-0.02	10.13	0.05	-0.02	42.23	1.81	100.35	0.37	99.98
1 / 5 .	0.84	0.12	1.51	2.06	1.70	9.30	10.78	0.75	19.24	0.06	10.11	0.09	-0.03	42.04	1.75	100.34	0.38	99.96
1 / 6 .	0.83	0.12	1.51	2.09	1.63	9.20	10.73	0.79	19.30	0.06	10.19	0.01	-0.02	42.10	1.83	100.40	0.38	100.02
1 / 7 .	0.84	0.12	1.52	2.07	1.64	9.36	10.80	0.75	19.36	-0.06	10.19	0.03	0.00	42.26	1.76	100.70	0.38	100.32
1 / 8 .	0.80	0.12	1.53	2.03	1.65	9.26	10.87	0.79	19.27	-0.01	10.13	0.01	0.02	42.26	1.65	100.40	0.36	100.04
1 / 9 .	0.75	0.12	1.55	2.11	1.63	9.32	10.85	0.79	19.28	0.05	10.04	0.03	-0.02	42.12	1.55	100.19	0.35	99.85
1 / 10 .	0.82	0.10	1.52	2.02	1.63	9.40	10.91	0.74	19.11	-0.08	10.07	-0.01	0.04	42.21	1.66	100.24	0.37	99.87
Avg 201a_amph1	0.82	0.12	1.52	2.07	1.64	9.34	10.81	0.76	19.25	0.01	10.14	0.02	0.00	42.22	1.72	100.45	0.37	100.08
201a_amph_2																		
1 / 1 .	0.84	0.13	1.52	2.03	1.59	9.54	10.89	0.78	19.36	-0.07	10.20	0.06	-0.02	42.47	1.61	101.02	0.38	100.64
1 / 2 .	0.92	0.13	1.47	2.02	1.59	9.59	10.88	0.77	18.96	-0.10	10.06	0.05	0.01	42.39	1.41	100.25	0.42	99.83
1 / 3 .	0.92	0.12	1.48	2.05	1.56	9.54	10.90	0.73	18.83	0.11	10.05	-0.02	0.06	42.62	1.50	100.44	0.41	100.03
1 / 4 .	0.89	0.11	1.50	1.96	1.63	9.58	10.81	0.83	18.92	0.22	10.14	0.01	-0.01	42.56	1.55	100.70	0.40	100.30
1 / 5 .	0.89	0.12	1.49	2.02	1.64	9.46	10.87	0.72	19.31	0.04	10.21	0.05	0.00	42.27	1.50	100.59	0.40	100.19
1 / 6 .	0.92	0.13	1.47	2.01	1.60	9.42	10.80	0.74	19.15	0.02	10.23	0.03	0.03	42.35	1.50	100.38	0.42	99.96
1 / 7 .	0.83	0.14	1.51	2.04	1.62	9.44	10.84	0.79	19.07	-0.03	10.13	0.03	0.00	42.54	1.42	100.41	0.38	100.03
1 / 8 .	0.87	0.12	1.50	1.99	1.58	9.48	10.63	0.73	18.96	-0.02	10.14	0.08	0.02	42.70	1.44	100.24	0.39	99.85
1 / 9 .	0.90	0.12	1.48	2.01	1.61	9.64	10.81	0.80	18.87	0.04	10.14	0.03	-0.04	42.31	1.56	100.32	0.41	99.91
1 / 10 .	0.90	0.12	1.49	2.04	1.60	9.53	10.92	0.76	19.02	-0.06	10.06	0.07	0.03	42.55	1.44	100.52	0.40	100.11
Avg 201a_amph2	0.89	0.12	1.49	2.02	1.60	9.52	10.83	0.76	19.05	0.01	10.14	0.04	0.01	42.48	1.49	100.45	0.40	100.05
201a_amph_3																		
1 / 1 .	0.77	0.12	1.55	1.94	1.61	9.46	10.82	0.72	19.00	0.19	10.08	0.04	0.00	42.46	1.66	100.43	0.35	100.07

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 2 .	0.89	0.13	1.49	1.96	1.59	9.55	10.88	0.77	19.01	-0.04	10.11	0.04	0.02	42.57	1.47	100.47	0.40	100.07
1 / 3 .	0.95	0.11	1.46	1.93	1.60	9.39	10.97	0.70	19.16	0.04	10.04	0.04	-0.03	42.43	1.57	100.40	0.42	99.98
1 / 4 .	0.73	0.13	1.57	1.98	1.59	9.30	10.97	0.75	19.32	0.14	10.12	0.02	-0.03	42.62	1.59	100.82	0.34	100.48
1 / 5 .	0.86	0.11	1.50	1.93	1.62	9.28	10.82	0.81	19.13	0.09	10.13	0.04	0.04	42.13	1.49	99.97	0.39	99.59
1 / 6 .	0.79	0.12	1.54	1.94	1.63	9.34	11.08	0.70	19.49	-0.04	10.18	0.08	0.01	42.26	1.60	100.75	0.36	100.39
1 / 7 .	0.74	0.13	1.56	1.97	1.62	9.33	10.89	0.77	19.15	-0.01	10.19	0.08	0.01	42.23	1.63	100.30	0.34	99.96
1 / 8 .	0.78	0.13	1.54	1.97	1.59	9.31	10.75	0.71	19.27	0.05	10.19	0.02	0.02	42.39	1.49	100.22	0.36	99.86
1 / 9 .	0.83	0.12	1.51	1.99	1.59	9.29	10.90	0.76	19.19	-0.02	10.15	0.05	-0.03	42.25	1.49	100.11	0.38	99.73
1 / 10 .	0.82	0.11	1.53	1.98	1.58	9.36	10.92	0.75	19.09	-0.05	10.24	0.04	0.09	42.14	1.69	100.34	0.37	99.98
Avg 201a_amph3	0.81	0.12	1.52	1.96	1.60	9.36	10.90	0.75	19.18	0.03	10.14	0.04	0.01	42.35	1.57	100.36	0.37	99.99
201a_amph_4																		
1 / 1 .	0.88	0.11	1.51	2.12	1.61	9.53	10.57	0.84	18.93	0.10	9.95	0.02	0.04	43.02	1.74	100.99	0.40	100.59
1 / 2 .	0.90	0.12	1.49	2.25	1.59	9.46	10.62	0.85	19.24	0.11	9.97	0.03	-0.03	42.74	1.80	101.17	0.41	100.76
1 / 3 .	0.92	0.10	1.49	2.23	1.55	9.46	10.84	0.83	19.06	0.01	9.95	-0.01	0.04	42.75	1.75	100.98	0.41	100.57
1 / 4 .	0.89	0.12	1.50	2.15	1.60	9.49	10.71	0.83	19.21	-0.05	9.90	-0.05	0.02	42.88	1.62	100.93	0.40	100.53
1 / 5 .	0.89	0.11	1.50	2.21	1.57	9.51	10.65	0.80	18.92	-0.05	9.99	0.06	0.01	42.77	1.64	100.65	0.40	100.25
1 / 6 .	0.85	0.09	1.53	2.22	1.59	9.36	10.64	0.86	18.97	0.08	9.96	0.01	0.00	43.07	1.83	101.06	0.38	100.68
1 / 7 .	0.87	0.09	1.50	2.20	1.59	9.34	10.56	0.79	18.95	0.05	9.88	0.05	0.05	42.58	1.68	100.19	0.39	99.80
1 / 8 .	0.85	0.12	1.52	2.22	1.55	9.32	10.60	0.85	19.29	0.13	9.99	0.08	-0.03	42.75	1.68	100.93	0.38	100.55
1 / 9 .	0.90	0.12	1.49	2.21	1.56	9.38	10.63	0.77	19.16	-0.01	10.00	0.01	0.07	42.62	1.63	100.55	0.40	100.15
1 / 10 .	0.90	0.11	1.50	2.24	1.59	9.43	10.69	0.79	19.14	-0.05	9.95	0.01	-0.04	42.73	1.75	100.82	0.40	100.42
Avg 201a_amph4	0.88	0.11	1.50	2.21	1.58	9.43	10.65	0.82	19.09	0.03	9.95	0.02	0.01	42.79	1.71	100.79	0.40	100.40
201a_amph_5																		
1 / 1 .	0.72	0.13	1.56	2.11	1.65	9.06	10.65	0.71	19.43	0.04	10.11	-0.04	0.01	42.05	1.69	99.91	0.33	99.58
1 / 2 .	0.82	0.11	1.51	2.11	1.64	9.15	10.69	0.73	19.71	0.03	10.17	0.08	0.01	41.73	1.64	100.14	0.37	99.78
1 / 3 .	0.76	0.11	1.54	2.05	1.65	8.98	10.73	0.78	19.59	0.02	10.19	0.04	0.00	41.95	1.68	100.07	0.34	99.72
1 / 4 .	0.89	0.13	1.47	2.11	1.59	9.08	10.66	0.81	19.46	-0.08	10.13	0.02	0.03	41.75	1.75	99.88	0.40	99.48
1 / 5 .	0.89	0.11	1.47	2.04	1.60	9.03	10.58	0.75	19.86	0.07	10.13	0.01	0.02	41.89	1.62	100.08	0.40	99.68
1 / 6 .	0.79	0.12	1.53	2.06	1.61	9.07	10.94	0.71	19.96	0.00	10.14	-0.01	-0.01	41.98	1.66	100.57	0.36	100.21
1 / 7 .	0.85	0.11	1.50	2.10	1.61	9.05	10.74	0.77	19.69	-0.04	10.20	0.03	0.00	41.94	1.67	100.27	0.38	99.89

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 8 .	0.78	0.10	1.54	2.16	1.63	9.06	10.82	0.70	19.99	0.04	10.09	0.04	0.00	41.86	1.70	100.52	0.35	100.17
1 / 9 .	0.78	0.13	1.53	2.06	1.62	9.12	10.63	0.70	19.48	0.05	10.19	0.03	0.00	41.90	1.71	99.94	0.36	99.58
1 / 10 .	0.78	0.13	1.53	2.12	1.65	9.09	10.79	0.74	19.79	0.00	10.16	0.08	-0.02	41.80	1.72	100.40	0.36	100.04
Avg 201a_amph5	0.80	0.12	1.52	2.09	1.63	9.07	10.72	0.74	19.70	0.01	10.15	0.03	0.00	41.89	1.69	100.16	0.37	99.79
201a_amph_6																		
1 / 1 .	0.72	0.12	1.57	2.12	1.64	9.17	10.80	0.79	19.29	-0.12	10.29	0.05	0.03	42.10	1.69	100.38	0.33	100.05
1 / 2 .	0.73	0.13	1.56	2.10	1.61	9.22	10.69	0.74	19.30	-0.09	10.22	0.05	0.01	42.03	1.84	100.22	0.34	99.88
1 / 3 .	0.82	0.10	1.53	2.16	1.63	9.14	10.74	0.75	19.54	0.05	10.17	0.05	-0.02	41.95	1.96	100.58	0.37	100.22
1 / 4 .	0.81	0.14	1.52	2.11	1.63	9.16	10.85	0.81	19.42	-0.02	10.25	-0.01	0.01	42.01	1.84	100.56	0.37	100.19
1 / 5 .	0.84	0.13	1.50	2.11	1.65	9.27	10.83	0.73	19.36	0.12	10.13	0.06	-0.02	41.67	1.84	100.24	0.38	99.86
1 / 6 .	0.78	0.12	1.53	2.14	1.62	9.17	10.78	0.71	19.49	0.07	10.14	-0.02	0.02	41.78	1.86	100.20	0.36	99.85
1 / 7 .	0.74	0.11	1.55	2.12	1.59	9.37	10.68	0.78	19.27	-0.11	10.07	0.01	-0.03	42.01	1.77	100.09	0.34	99.75
1 / 8 .	0.77	0.11	1.55	2.10	1.61	9.32	10.65	0.69	19.40	-0.07	10.16	-0.05	-0.03	42.20	1.83	100.39	0.35	100.04
1 / 9 .	0.85	0.13	1.50	2.05	1.59	9.17	10.78	0.75	19.33	0.09	10.12	0.06	0.02	42.11	1.79	100.34	0.38	99.96
1 / 10 .	0.80	0.14	1.52	2.06	1.64	9.32	10.68	0.71	19.31	-0.08	10.04	0.06	0.02	42.26	1.77	100.35	0.37	99.97
Avg 201a_amph_6	0.79	0.12	1.53	2.11	1.62	9.23	10.75	0.75	19.37	-0.02	10.16	0.03	0.00	42.01	1.82	100.27	0.36	99.91
201a_amph_7																		
1 / 1 .	0.84	0.11	1.51	2.13	1.54	9.55	10.55	0.84	18.96	-0.04	9.76	0.01	-0.03	42.59	1.55	99.96	0.38	99.58
1 / 2 .	0.80	0.11	1.54	2.16	1.56	9.48	10.75	0.80	19.04	0.01	9.81	-0.01	0.00	42.52	1.70	100.27	0.36	99.91
1 / 3 .	0.86	0.11	1.50	2.16	1.57	9.46	10.62	0.78	18.95	0.01	9.82	0.02	0.04	42.39	1.67	99.96	0.39	99.57
1 / 4 .	0.88	0.11	1.49	2.16	1.55	9.49	10.65	0.73	18.97	0.07	9.76	0.03	-0.01	42.64	1.53	100.08	0.40	99.68
1 / 5 .	0.78	0.11	1.54	2.15	1.57	9.52	10.64	0.76	19.19	0.06	9.88	0.03	0.06	42.48	1.52	100.28	0.36	99.93
1 / 6 .	0.89	0.11	1.49	2.10	1.59	9.54	10.57	0.88	19.36	0.09	9.85	0.01	0.01	42.56	1.60	100.64	0.40	100.24
1 / 7 .	0.89	0.12	1.49	2.16	1.58	9.50	10.51	0.82	19.21	-0.06	9.83	0.01	-0.01	42.47	1.73	100.32	0.40	99.92
1 / 8 .	0.81	0.11	1.53	2.11	1.60	9.40	10.67	0.80	19.22	0.06	9.92	-0.04	-0.01	42.53	1.68	100.44	0.37	100.07
1 / 9 .	0.86	0.13	1.50	2.09	1.61	9.24	10.83	0.83	19.21	0.02	10.04	-0.01	-0.02	42.30	1.74	100.40	0.39	100.01
1 / 10 .	0.79	0.11	1.53	2.08	1.63	9.42	10.86	0.72	19.25	-0.10	10.15	0.02	0.00	42.06	1.62	100.25	0.36	99.89
Avg 201a_amph_7	0.84	0.11	1.51	2.13	1.58	9.46	10.67	0.79	19.14	0.01	9.88	0.01	0.00	42.46	1.63	100.23	0.38	99.85
201a_amph_8																		

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 1 .	0.83	0.12	1.51	2.15	1.62	9.43	10.81	0.78	19.32	0.01	10.03	0.04	-0.02	42.06	1.61	100.31	0.38	99.94
1 / 2 .	0.90	0.12	1.47	2.11	1.63	9.49	10.80	0.77	19.15	0.03	9.98	0.04	-0.03	41.90	1.80	100.21	0.41	99.80
1 / 3 .	0.84	0.11	1.51	2.09	1.59	9.32	10.81	0.82	19.29	0.12	9.94	0.03	0.00	42.19	1.72	100.37	0.38	99.99
1 / 4 .	0.81	0.12	1.52	2.15	1.63	9.46	10.58	0.88	19.44	0.00	10.06	0.03	-0.01	41.84	1.84	100.37	0.37	100.00
1 / 5 .	0.91	0.10	1.47	2.10	1.59	9.38	10.63	0.88	18.94	0.00	9.89	0.04	-0.05	42.18	1.71	99.82	0.40	99.42
1 / 6 .	0.87	0.10	1.50	2.14	1.60	9.45	10.80	0.81	19.13	0.06	9.89	-0.02	-0.04	42.30	1.65	100.28	0.39	99.90
1 / 7 .	0.91	0.10	1.47	2.13	1.58	9.41	10.62	0.75	19.10	-0.08	9.84	0.01	-0.03	42.02	1.80	99.74	0.41	99.33
1 / 8 .	0.83	0.11	1.51	2.10	1.56	9.53	10.73	0.86	18.89	0.06	9.75	0.09	-0.03	42.22	1.71	99.95	0.37	99.57
1 / 9 .	0.84	0.11	1.52	2.06	1.52	9.70	10.66	0.81	18.96	-0.01	9.60	0.08	0.01	42.62	1.65	100.11	0.38	99.73
1 / 10 .	0.87	0.10	1.50	2.04	1.51	9.67	10.63	0.76	18.71	0.05	9.38	0.02	0.02	42.85	1.79	99.92	0.39	99.53
Avg 201a_amph_8	0.86	0.11	1.50	2.11	1.58	9.48	10.71	0.81	19.09	0.02	9.84	0.04	-0.02	42.22	1.73	100.07	0.39	99.69
201a_amph_9																		
1 / 1 .	0.82	0.12	1.51	2.05	1.60	9.42	10.77	0.67	19.35	0.11	10.05	0.01	0.00	41.82	1.62	99.92	0.37	99.55
1 / 2 .	0.81	0.12	1.51	2.03	1.58	9.38	10.71	0.73	19.38	-0.01	10.08	0.02	-0.03	42.01	1.55	99.90	0.37	99.53
1 / 3 .	0.71	0.13	1.55	2.02	1.61	9.33	10.71	0.65	19.45	-0.04	10.05	0.02	0.03	41.81	1.53	99.61	0.33	99.28
1 / 4 .	0.81	0.12	1.52	2.07	1.59	9.32	10.88	0.69	19.52	0.20	10.04	0.01	0.00	41.98	1.53	100.27	0.37	99.90
1 / 5 .	0.84	0.13	1.50	2.07	1.59	9.20	10.97	0.67	19.38	0.04	10.07	0.01	-0.05	42.12	1.50	100.08	0.38	99.70
1 / 6 .	0.87	0.10	1.49	2.05	1.58	9.34	10.70	0.69	19.51	0.05	10.12	0.16	-0.03	41.91	1.53	100.09	0.39	99.71
1 / 7 .	0.91	0.14	1.46	2.04	1.62	9.18	10.82	0.70	19.31	-0.01	10.09	0.02	0.02	41.99	1.58	99.89	0.41	99.47
1 / 8 .	0.86	0.13	1.48	1.97	1.58	9.32	10.74	0.71	19.51	-0.04	9.98	0.08	0.01	41.96	1.52	99.86	0.39	99.47
1 / 9 . *	0.87	0.11	1.47	2.01	1.56	9.37	10.86	0.69	19.16	0.03	9.90	0.04	-0.01	41.71	1.52	99.29	0.39	98.90
1 / 10 .	0.93	0.12	1.46	1.91	1.54	9.33	10.87	0.69	19.40	0.00	9.93	0.01	-0.06	42.17	1.60	99.94	0.42	99.52
Avg 201a_amph_9	0.84	0.12	1.50	2.02	1.58	9.32	10.80	0.69	19.40	0.03	10.03	0.04	-0.01	41.95	1.55	99.86	0.38	99.48
201a_amph_10																		
1 / 1 .	0.79	0.14	1.53	2.12	1.59	9.29	10.72	0.77	19.46	0.04	10.15	0.08	0.03	42.21	1.51	100.40	0.36	100.04
1 / 2 .	0.84	0.11	1.51	2.10	1.65	9.29	10.80	0.75	19.58	0.01	10.20	0.04	0.02	41.92	1.64	100.47	0.38	100.10
1 / 3 .	0.84	0.12	1.51	2.20	1.62	9.38	10.69	0.82	19.70	0.04	10.15	0.02	0.03	42.16	1.42	100.71	0.38	100.33
1 / 4 .	0.94	0.14	1.46	2.12	1.61	9.26	10.75	0.81	19.44	0.06	10.18	0.06	0.00	42.15	1.58	100.56	0.43	100.14
1 / 5 .	0.89	0.13	1.47	2.13	1.65	9.27	10.74	0.74	19.34	-0.03	10.21	0.07	-0.06	41.93	1.70	100.28	0.41	99.87
1 / 6 .	0.84	0.13	1.50	2.16	1.62	9.23	10.67	0.75	19.27	0.03	10.14	0.08	0.07	41.99	1.60	100.06	0.38	99.68

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 7 .	0.82	0.12	1.52	2.11	1.64	9.27	10.85	0.74	19.58	0.00	10.22	0.02	0.00	41.84	1.74	100.47	0.37	100.10
1 / 8 .	0.86	0.14	1.48	2.13	1.58	9.10	10.74	0.73	19.40	-0.12	10.18	0.03	0.08	41.96	1.60	100.04	0.40	99.64
1 / 9 .	0.82	0.13	1.51	2.11	1.66	9.33	10.59	0.75	19.70	-0.11	10.21	0.01	0.03	41.88	1.69	100.43	0.37	100.06
1 / 10 .	0.77	0.12	1.54	2.14	1.57	9.32	10.75	0.80	19.57	-0.04	10.05	0.06	-0.02	42.09	1.59	100.37	0.35	100.02
Avg 201a_amph10	0.84	0.13	1.50	2.13	1.62	9.27	10.73	0.77	19.50	-0.01	10.17	0.05	0.02	42.01	1.61	100.34	0.38	99.96
BR-36																		
36 amph 1																		
1 / 1 .	1.11	0.14	1.35	2.09	1.55	9.22	10.66	0.80	19.42	0.08	10.04	0.05	0.01	42.05	1.31	99.88	0.50	99.38
1 / 2 .	1.02	0.14	1.38	1.94	1.42	9.48	9.70	0.70	20.07	0.04	10.36	0.02	-0.02	41.03	1.38	98.66	0.46	98.20
1 / 3 .	1.04	0.12	1.39	2.14	1.62	9.30	10.56	0.71	19.64	0.11	10.07	0.06	0.00	41.52	1.61	99.87	0.46	99.41
1 / 4 .	1.01	0.14	1.40	2.14	1.58	9.21	10.55	0.78	19.43	0.00	10.17	-0.01	-0.02	41.74	1.54	99.69	0.46	99.24
1 / 5 . *	1.03	0.13	1.37	2.08	1.55	8.92	10.27	0.76	19.43	0.08	10.06	0.09	0.01	41.12	1.46	98.36	0.46	97.90
1 / 6 .	1.03	0.12	1.39	2.13	1.56	9.13	10.53	0.75	19.31	0.00	10.03	0.08	0.04	41.62	1.59	99.33	0.46	98.87
1 / 7 .	1.01	0.13	1.40	2.13	1.60	9.21	10.59	0.74	19.35	0.12	10.01	0.08	0.02	41.68	1.64	99.71	0.45	99.26
1 / 8 .	1.03	0.13	1.39	2.16	1.58	9.22	10.70	0.82	19.39	0.03	10.04	0.06	-0.01	41.60	1.57	99.72	0.46	99.26
1 / 9 .	1.02	0.13	1.40	2.14	1.59	9.12	10.58	0.77	19.58	0.03	10.02	0.12	0.00	41.59	1.71	99.81	0.46	99.35
1 / 10 .	1.01	0.13	1.40	2.15	1.61	9.12	10.53	0.83	19.44	-0.03	10.00	0.08	0.01	41.77	1.66	99.74	0.46	99.29
Avg 36 amph 1	1.03	0.13	1.39	2.11	1.57	9.22	10.49	0.77	19.51	0.04	10.08	0.06	0.00	41.62	1.56	99.59	0.46	99.13
36 amph 2																		
1 / 1 .	0.90	0.14	1.45	2.04	1.62	9.20	10.71	0.71	19.14	0.12	10.16	0.02	-0.01	41.67	1.40	99.27	0.41	98.86
1 / 2 .	1.02	0.15	1.40	2.08	1.62	9.26	10.56	0.68	19.64	0.08	10.26	0.06	0.01	41.65	1.46	99.93	0.46	99.47
1 / 3 .	1.01	0.14	1.40	2.10	1.63	9.14	10.69	0.75	19.15	0.10	10.28	0.01	0.00	41.51	1.46	99.36	0.46	98.90
1 / 4 .	1.01	0.14	1.40	2.11	1.63	9.21	10.53	0.73	19.73	0.02	10.22	0.08	-0.02	41.52	1.43	99.78	0.46	99.32
1 / 5 .	0.94	0.12	1.43	2.17	1.63	9.22	10.53	0.72	19.47	0.12	10.22	0.09	0.02	41.47	1.35	99.49	0.42	99.07
1 / 6 .	0.99	0.14	1.41	2.14	1.63	9.15	10.50	0.68	19.67	0.07	10.36	0.09	-0.01	41.68	1.34	99.86	0.45	99.41
1 / 7 .	0.96	0.13	1.41	2.11	1.61	9.12	10.58	0.65	19.26	0.05	10.18	0.10	0.02	41.42	1.30	98.93	0.43	98.50
1 / 8 .	0.97	0.14	1.42	2.10	1.61	9.21	10.61	0.70	19.35	0.15	10.34	0.06	-0.02	41.54	1.35	99.54	0.44	99.10
1 / 9 .	0.97	0.13	1.42	2.09	1.62	9.25	10.72	0.73	19.54	0.07	10.24	0.07	0.01	41.43	1.14	99.43	0.44	98.99
1 / 10 .	1.00	0.12	1.41	2.05	1.60	9.24	10.54	0.69	19.30	0.07	10.34	0.01	0.00	41.66	1.24	99.26	0.45	98.82

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
Avg 36 amph 2	0.98	0.14	1.42	2.10	1.62	9.20	10.60	0.70	19.43	0.09	10.26	0.06	0.00	41.56	1.35	99.48	0.44	99.04
BR-36 amph 3																		
1 / 1 .	0.93	0.13	1.44	2.28	1.63	9.10	10.44	0.80	19.35	0.09	10.19	0.03	-0.02	41.48	1.63	99.52	0.42	99.10
1 / 2 .	1.01	0.12	1.40	2.23	1.60	9.09	10.44	0.79	19.20	0.03	10.22	0.07	-0.01	41.32	1.72	99.24	0.45	98.78
1 / 3 .	0.97	0.11	1.43	2.25	1.60	9.10	10.44	0.79	19.41	0.06	10.23	0.07	-0.03	41.58	1.60	99.66	0.43	99.23
1 / 4 .	0.97	0.11	1.43	2.25	1.65	9.19	10.41	0.74	19.49	0.01	10.15	0.06	-0.04	41.62	1.66	99.74	0.43	99.31
1 / 5 .	1.04	0.11	1.39	2.24	1.52	9.21	10.46	0.77	19.52	0.03	10.06	0.02	-0.04	41.47	1.63	99.47	0.46	99.00
1 / 6 .	1.03	0.10	1.40	2.23	1.59	9.20	10.45	0.78	19.10	0.04	10.04	0.03	-0.03	41.51	1.77	99.26	0.46	98.81
1 / 7 .	0.96	0.14	1.43	2.16	1.57	9.27	10.47	0.79	19.39	0.05	10.20	0.06	-0.01	41.58	1.63	99.68	0.44	99.25
1 / 8 .	1.01	0.13	1.41	2.17	1.60	9.14	10.52	0.78	19.49	0.07	10.15	0.04	-0.02	41.80	1.60	99.91	0.46	99.45
1 / 9 .	1.04	0.12	1.40	2.19	1.59	9.11	10.54	0.74	19.45	0.03	10.23	0.04	-0.01	41.70	1.66	99.85	0.46	99.38
1 / 10 .	1.02	0.13	1.39	2.12	1.60	9.14	10.48	0.77	19.41	-0.01	10.18	0.09	-0.07	41.54	1.50	99.36	0.46	98.91
Avg 36 amph 3.1	1.00	0.12	1.41	2.21	1.60	9.16	10.47	0.78	19.38	0.04	10.17	0.05	-0.03	41.56	1.64	99.54	0.45	99.09
2 / 1 .	1.01	0.12	1.39	2.11	1.61	9.18	10.54	0.71	19.34	0.08	10.22	0.01	-0.02	41.32	1.51	99.16	0.45	98.71
2 / 2 .	0.94	0.12	1.43	2.15	1.61	9.18	10.47	0.68	19.05	0.04	9.96	0.02	-0.02	41.41	1.64	98.68	0.42	98.26
2 / 3 .	0.93	0.13	1.41	2.10	1.61	9.07	10.49	0.68	19.33	0.03	9.86	0.03	-0.01	40.95	1.48	98.10	0.42	97.68
2 / 4 .	0.95	0.14	1.42	2.12	1.61	9.24	10.50	0.74	19.54	0.08	9.94	0.02	0.01	41.33	1.54	99.18	0.43	98.75
2 / 5 .	1.03	0.13	1.38	1.97	1.57	9.31	10.53	0.72	19.12	0.05	10.00	0.04	0.03	41.49	1.39	98.76	0.46	98.30
2 / 6 .	0.95	0.12	1.42	2.15	1.59	9.18	10.49	0.71	19.34	0.00	10.09	0.08	-0.01	41.21	1.54	98.85	0.43	98.42
2 / 7 .	0.90	0.14	1.44	2.10	1.62	9.12	10.43	0.69	19.49	0.01	10.11	0.06	-0.04	41.18	1.56	98.85	0.41	98.44
2 / 8 .	1.00	0.12	1.40	2.14	1.63	9.06	10.55	0.71	19.37	0.09	10.10	0.04	-0.01	41.27	1.59	99.08	0.45	98.63
2 / 9 .	0.99	0.13	1.40	2.07	1.56	9.18	10.61	0.73	19.43	0.05	10.04	0.04	-0.02	41.44	1.51	99.17	0.45	98.73
2 / 10 .	0.89	0.14	1.46	1.83	1.57	9.49	10.58	0.78	19.11	0.08	9.79	0.05	0.02	42.02	1.52	99.34	0.41	98.93
Avg 36 amph 3.2	0.96	0.13	1.42	2.07	1.60	9.20	10.52	0.72	19.31	0.05	10.01	0.04	-0.01	41.36	1.53	98.91	0.43	98.47
36 amph 4																		
1 / 1 .	0.97	0.13	1.42	2.19	1.57	9.30	10.50	0.80	18.86	0.03	10.06	0.03	-0.01	41.55	1.57	98.97	0.44	98.53
1 / 2 .	0.96	0.13	1.43	2.14	1.63	9.23	10.42	0.78	19.24	0.03	10.16	0.03	0.00	41.78	1.64	99.60	0.43	99.17
1 / 3 .	0.95	0.13	1.44	2.19	1.66	9.32	10.53	0.79	19.29	0.06	10.18	0.00	-0.01	41.62	1.64	99.78	0.43	99.35
1 / 4 .	0.99	0.12	1.42	2.21	1.56	9.34	10.57	0.77	19.05	0.04	10.13	0.05	-0.02	41.62	1.46	99.30	0.44	98.86

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 5 .	1.05	0.12	1.39	2.13	1.58	9.42	10.47	0.81	18.94	-0.05	10.14	0.06	-0.02	41.85	1.44	99.39	0.47	98.92
1 / 6 .	0.96	0.13	1.43	2.16	1.63	9.34	10.59	0.72	19.03	-0.01	10.13	0.06	0.04	41.82	1.48	99.51	0.43	99.08
1 / 7 .	1.02	0.14	1.40	2.04	1.56	9.37	10.51	0.77	19.00	0.04	10.03	0.06	0.00	41.80	1.58	99.30	0.46	98.84
1 / 8 .	1.08	0.13	1.36	2.09	1.61	9.32	10.50	0.77	19.00	-0.03	10.14	0.04	0.00	41.80	1.49	99.33	0.49	98.85
1 / 9 .	1.02	0.15	1.40	2.16	1.66	9.23	10.50	0.74	19.26	-0.01	10.26	0.05	-0.02	41.93	1.56	99.92	0.46	99.46
1 / 10 .	0.94	0.12	1.44	2.21	1.61	9.34	10.53	0.68	18.94	0.12	10.12	0.00	0.03	41.85	1.54	99.49	0.42	99.07
Avg 36 amph 4	0.99	0.13	1.41	2.15	1.61	9.32	10.51	0.76	19.06	0.02	10.14	0.04	0.00	41.76	1.54	99.45	0.45	99.00
36 amph 5																		
1 / 1 .	0.94	0.14	1.43	1.98	1.58	9.17	10.66	0.65	19.56	0.03	10.02	0.03	0.01	41.77	1.30	99.26	0.43	98.84
1 / 2 .	0.97	0.13	1.42	2.05	1.60	9.30	10.62	0.71	19.72	0.02	10.00	0.08	0.02	41.58	1.27	99.49	0.44	99.05
1 / 3 .	0.99	0.13	1.40	2.03	1.57	9.25	10.56	0.65	19.86	0.02	9.90	0.03	0.00	41.40	1.36	99.14	0.45	98.69
1 / 4 . *	0.91	0.13	1.42	1.78	1.46	10.07	9.25	0.60	20.42	0.03	10.51	0.04	0.00	40.40	1.23	98.24	0.41	97.83
1 / 5 .	0.94	0.13	1.43	2.09	1.61	9.19	10.58	0.71	19.64	0.00	10.03	-0.01	0.00	41.64	1.43	99.43	0.43	99.01
1 / 6 .	0.98	0.13	1.41	2.10	1.59	9.24	10.52	0.72	19.55	0.04	10.10	0.01	0.00	41.46	1.42	99.25	0.44	98.81
1 / 7 .	1.02	0.12	1.40	2.13	1.62	9.27	10.68	0.69	19.75	0.00	10.04	0.05	0.02	41.40	1.48	99.68	0.46	99.22
1 / 8 .	1.03	0.13	1.38	2.11	1.58	9.16	10.50	0.73	19.67	0.10	9.94	0.01	-0.03	41.39	1.50	99.23	0.46	98.76
1 / 9 .	0.84	0.13	1.48	2.08	1.59	9.16	10.51	0.75	19.58	-0.04	10.03	0.02	-0.02	41.52	1.54	99.21	0.38	98.83
1 / 10 .	0.97	0.12	1.42	2.07	1.53	9.22	10.57	0.75	19.15	0.00	10.09	0.07	-0.01	41.62	1.51	99.10	0.44	98.66
Avg 36 amph 5	0.96	0.13	1.42	2.07	1.59	9.22	10.58	0.71	19.61	0.02	10.02	0.03	0.00	41.53	1.42	99.30	0.44	98.86

BR-202

202_amph_1	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 .	0.98	0.15	1.43	2.27	1.60	9.04	10.71	0.83	19.81	0.00	10.20	0.03	-0.03	42.06	1.58	100.70	0.45	100.26
1 / 2 .	1.01	0.15	1.42	2.29	1.61	8.98	10.64	0.83	19.92	0.11	10.28	0.04	0.03	41.91	1.67	100.87	0.46	100.41
1 / 3 .	0.97	0.13	1.44	2.33	1.66	9.00	10.79	0.79	19.78	-0.05	10.28	0.00	0.00	41.73	1.73	100.64	0.44	100.20
1 / 4 .	1.02	0.13	1.41	2.33	1.61	9.00	10.52	0.81	19.96	0.05	10.32	0.02	0.00	41.75	1.72	100.65	0.46	100.18
1 / 5 .	0.97	0.13	1.45	2.29	1.65	9.03	10.65	0.78	20.03	0.01	10.33	0.02	0.00	41.90	1.68	100.91	0.44	100.48
1 / 6 .	1.07	0.15	1.39	2.35	1.63	8.99	10.71	0.72	19.85	0.07	10.46	0.06	0.01	41.77	1.71	100.93	0.49	100.44
1 / 7 .	1.05	0.14	1.40	2.33	1.64	8.97	10.58	0.76	20.02	-0.04	10.29	-0.02	-0.03	41.92	1.62	100.73	0.47	100.26
1 / 8 .	1.13	0.14	1.36	2.35	1.64	8.99	10.66	0.81	19.70	0.05	10.41	0.05	-0.03	41.85	1.49	100.64	0.51	100.13

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 9 .	1.14	0.15	1.34	2.35	1.58	8.81	10.65	0.83	19.80	0.02	10.34	0.02	-0.03	41.86	1.56	100.47	0.51	99.95
1 / 10 .	1.01	0.13	1.41	2.33	1.68	8.92	10.59	0.78	19.88	-0.02	10.36	0.05	0.04	41.67	1.72	100.58	0.46	100.12
Avg 202_amph_1	1.04	0.14	1.40	2.32	1.63	8.97	10.65	0.79	19.88	0.02	10.33	0.03	0.00	41.84	1.65	100.69	0.47	100.22
202_amph_2	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 .	1.03	0.13	1.41	2.32	1.56	8.85	10.70	0.75	19.73	0.07	10.27	0.03	0.06	41.78	1.89	100.58	0.46	100.12
1 / 2 .	0.99	0.13	1.44	2.37	1.62	9.02	10.69	0.83	19.80	-0.06	10.27	0.05	-0.01	41.99	1.83	101.03	0.45	100.59
1 / 3 .	1.02	0.14	1.41	2.35	1.68	8.94	10.59	0.79	19.76	0.06	10.28	0.07	0.04	41.74	1.90	100.77	0.46	100.31
1 / 4 .	0.87	0.12	1.50	2.33	1.65	8.92	10.64	0.80	20.07	0.09	10.32	0.05	-0.01	41.86	1.75	100.95	0.39	100.56
1 / 5 .	0.94	0.15	1.44	2.37	1.67	8.87	10.67	0.71	19.81	0.03	10.21	0.06	0.02	41.56	1.88	100.40	0.43	99.97
1 / 6 .	1.03	0.15	1.41	2.35	1.64	8.89	10.66	0.75	20.22	0.08	10.31	-0.01	0.02	41.88	1.93	101.31	0.47	100.85
1 / 7 .	1.00	0.14	1.42	2.37	1.69	8.81	10.58	0.78	20.04	-0.10	10.34	-0.02	0.01	41.73	2.03	100.96	0.46	100.50
1 / 8 .	0.88	0.14	1.48	2.39	1.69	8.72	10.53	0.73	19.91	0.03	10.39	0.02	0.03	41.77	1.88	100.58	0.40	100.18
1 / 9 .	0.99	0.15	1.42	2.42	1.67	8.85	10.61	0.76	19.61	0.04	10.27	0.02	0.03	41.64	1.98	100.47	0.45	100.02
1 / 10 .	0.89	0.13	1.48	2.37	1.61	8.76	10.71	0.81	20.00	0.05	10.31	0.04	-0.05	41.72	2.04	100.92	0.40	100.51
Avg 202_amph_2	0.96	0.14	1.44	2.36	1.65	8.86	10.64	0.77	19.90	0.03	10.30	0.03	0.01	41.77	1.91	100.77	0.44	100.34
202_amph_3	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 .	1.10	0.13	1.37	2.40	1.60	8.95	10.51	0.85	20.00	0.00	10.12	0.04	-0.04	41.81	1.82	100.70	0.49	100.21
1 / 2 .	1.15	0.13	1.35	2.42	1.66	8.90	10.47	0.79	19.98	0.03	10.22	0.05	0.00	41.83	1.70	100.68	0.51	100.17
1 / 3 .	1.08	0.09	1.39	2.37	1.69	8.80	10.61	0.87	19.88	0.05	10.24	-0.02	-0.03	41.76	1.88	100.72	0.47	100.24
1 / 4 .	1.04	0.11	1.41	2.40	1.65	8.84	10.48	0.84	20.09	0.01	10.37	0.08	0.02	41.64	1.79	100.77	0.46	100.31
1 / 5 .	1.06	0.13	1.38	2.40	1.65	8.80	10.56	0.76	19.67	-0.01	10.33	0.05	-0.02	41.42	1.77	99.98	0.47	99.50
1 / 6 .	0.99	0.13	1.43	2.39	1.68	8.85	10.54	0.84	20.32	0.03	10.31	0.04	0.02	41.47	1.88	100.93	0.44	100.48
1 / 7 .	1.14	0.13	1.35	2.43	1.66	8.81	10.46	0.84	19.93	0.17	10.24	0.06	-0.01	41.54	1.78	100.53	0.51	100.02
1 / 8 .	1.11	0.14	1.37	2.36	1.64	8.80	10.66	0.83	20.01	0.04	10.41	0.05	-0.01	41.75	1.94	101.10	0.50	100.61
1 / 9 .	1.09	0.13	1.38	2.38	1.61	8.94	10.58	0.78	20.07	0.01	10.30	0.05	-0.03	41.72	1.68	100.73	0.49	100.24
1 / 10 .	1.09	0.15	1.38	2.40	1.63	8.83	10.63	0.81	20.10	0.04	10.32	0.05	-0.01	41.90	1.88	101.21	0.49	100.72
Avg 202_amph_3	1.08	0.13	1.38	2.40	1.65	8.85	10.55	0.82	20.01	0.04	10.29	0.05	-0.01	41.68	1.81	100.72	0.49	100.23
202_amph_4	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 .	1.04	0.12	1.41	2.31	1.65	9.07	10.69	0.90	19.74	0.03	10.26	0.04	-0.03	42.05	1.76	101.09	0.47	100.62

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 2 .	1.07	0.13	1.38	2.26	1.63	9.04	10.69	0.78	19.42	-0.08	10.33	-0.05	0.03	41.81	1.58	100.18	0.48	99.70
1 / 3 .	1.07	0.13	1.39	2.27	1.60	9.18	10.80	0.81	19.71	0.00	10.29	0.04	-0.03	41.82	1.77	100.89	0.48	100.41
1 / 4 .	1.13	0.14	1.36	2.31	1.66	9.08	10.63	0.84	19.56	0.00	10.42	-0.01	-0.01	41.85	1.77	100.75	0.51	100.25
1 / 5 .	1.00	0.13	1.43	2.33	1.61	9.05	10.83	0.76	19.78	0.06	10.33	0.04	-0.03	41.82	1.76	100.93	0.45	100.48
1 / 6 .	1.00	0.12	1.43	2.37	1.57	9.06	10.75	0.79	19.59	-0.02	10.45	0.05	0.02	41.88	1.70	100.78	0.45	100.33
1 / 7 .	1.09	0.14	1.38	2.31	1.65	8.99	10.71	0.82	19.74	0.02	10.44	-0.04	0.02	41.69	1.76	100.74	0.49	100.25
1 / 8 .	0.99	0.14	1.43	2.32	1.63	9.07	10.74	0.72	19.72	0.05	10.34	0.01	-0.01	41.70	1.77	100.65	0.45	100.20
1 / 9 .	1.01	0.14	1.42	2.33	1.64	9.05	10.71	0.90	19.55	0.11	10.38	0.03	0.04	41.85	1.63	100.79	0.46	100.34
1 / 10 .	1.06	0.12	1.40	2.35	1.62	9.01	10.69	0.83	19.87	0.03	10.28	0.01	0.00	41.94	1.70	100.90	0.48	100.42
Avg 202_amph_4	1.05	0.13	1.40	2.32	1.63	9.06	10.72	0.82	19.67	0.02	10.35	0.01	0.00	41.84	1.72	100.74	0.47	100.27
202_amph_5	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 . *	1.14	0.12	1.37	2.43	1.61	9.05	10.55	0.78	19.97	0.11	10.37	0.02	0.00	42.09	1.86	101.48	0.51	100.97
1 / 2 .	0.93	0.12	1.46	2.43	1.63	9.07	10.68	0.79	19.75	-0.13	10.30	0.03	0.01	41.84	1.73	100.78	0.42	100.36
1 / 3 .	1.09	0.11	1.39	2.46	1.63	8.96	10.50	0.80	19.67	-0.08	10.29	0.01	-0.03	42.10	1.69	100.69	0.48	100.21
1 / 4 .	1.11	0.12	1.37	2.40	1.60	9.04	10.49	0.82	19.88	0.06	10.09	0.05	0.05	41.93	1.83	100.86	0.50	100.36
1 / 5 .	1.10	0.14	1.39	2.46	1.62	9.01	10.51	0.86	19.70	0.11	10.41	0.03	-0.03	42.21	1.87	101.43	0.50	100.94
1 / 6 .	1.20	0.11	1.33	2.43	1.59	8.93	10.61	0.77	19.68	0.00	10.24	0.02	0.06	42.00	1.80	100.77	0.53	100.24
1 / 7 .	0.96	0.12	1.46	2.47	1.65	9.13	10.48	0.84	19.78	0.01	10.38	0.04	0.00	42.15	1.76	101.23	0.43	100.80
1 / 8 .	1.02	0.13	1.42	2.45	1.63	9.08	10.52	0.76	19.73	0.07	10.35	0.00	-0.01	42.03	1.75	100.94	0.46	100.48
1 / 9 .	1.05	0.12	1.41	2.47	1.63	9.00	10.39	0.83	20.27	-0.04	10.25	0.04	0.04	41.83	1.84	101.17	0.47	100.70
1 / 10 .	1.08	0.13	1.39	2.52	1.63	9.01	10.44	0.78	19.67	0.04	10.27	-0.02	0.02	41.99	1.81	100.79	0.48	100.30
Avg 202_amph_5.1	1.06	0.12	1.40	2.46	1.62	9.03	10.51	0.81	19.79	0.01	10.29	0.02	0.01	42.01	1.79	100.92	0.47	100.45
2 / 1 .	1.01	0.12	1.43	2.43	1.57	9.08	10.62	0.82	19.55	0.02	10.27	0.00	0.05	41.95	1.91	100.81	0.45	100.36
2 / 2 .	1.08	0.14	1.39	2.48	1.61	9.09	10.56	0.81	19.91	-0.09	10.35	0.07	-0.03	42.06	1.77	101.30	0.49	100.81
2 / 3 .	1.07	0.11	1.41	2.41	1.58	9.05	10.47	0.88	19.76	-0.09	10.38	0.01	-0.02	42.18	1.81	101.12	0.48	100.64
2 / 4 .	1.08	0.15	1.39	2.41	1.63	9.03	10.57	0.76	19.71	0.03	10.33	0.05	-0.01	42.20	1.72	101.04	0.49	100.55
2 / 5 . *	1.02	0.14	1.38	2.41	1.57	8.89	10.25	0.81	19.28	0.07	10.18	0.02	-0.07	41.33	1.68	99.04	0.46	98.57
2 / 6 .	1.07	0.13	1.40	2.40	1.59	9.08	10.60	0.74	19.63	-0.02	10.44	0.04	0.07	42.07	1.73	101.01	0.48	100.53
2 / 7 .	1.21	0.12	1.33	2.44	1.62	9.08	10.64	0.80	19.57	0.07	10.23	0.06	0.03	41.95	1.74	100.90	0.54	100.36
2 / 8 .	1.06	0.13	1.39	2.39	1.65	9.03	10.48	0.76	19.40	0.03	10.34	0.05	0.01	42.04	1.70	100.46	0.48	99.98

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
2 / 9 .	1.24	0.12	1.31	2.43	1.65	9.08	10.57	0.79	19.90	0.02	10.32	0.03	-0.01	41.92	1.67	101.05	0.55	100.50
2 / 10 .	1.08	0.13	1.40	2.39	1.65	9.04	10.60	0.77	19.84	0.02	10.30	0.06	0.01	42.13	1.73	101.16	0.48	100.68
Avg 202_amph_5.2	1.10	0.13	1.38	2.42	1.62	9.06	10.57	0.79	19.70	0.00	10.33	0.04	0.01	42.05	1.75	100.95	0.49	100.46
202_amph_6	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 .	1.01	0.13	1.42	2.32	1.65	8.88	10.70	0.79	19.97	-0.11	10.38	0.10	-0.02	41.73	1.85	100.93	0.45	100.48
1 / 2 .	0.94	0.14	1.45	2.30	1.63	8.86	10.74	0.82	19.76	0.05	10.35	0.09	0.02	41.85	1.86	100.87	0.43	100.44
1 / 3 .	0.94	0.13	1.46	2.36	1.62	8.85	10.74	0.69	19.72	-0.09	10.28	0.03	-0.02	41.95	1.83	100.61	0.43	100.18
1 / 4 .	1.13	0.11	1.37	2.35	1.63	8.82	10.59	0.78	19.96	0.08	10.39	0.04	0.02	41.72	1.87	100.85	0.50	100.35
1 / 5 .	1.00	0.12	1.43	2.35	1.63	8.95	10.67	0.81	19.97	0.00	10.37	0.10	0.00	41.95	1.68	101.02	0.45	100.57
1 / 6 .	1.10	0.15	1.37	2.36	1.58	8.97	10.77	0.77	19.89	-0.02	10.36	0.04	-0.04	41.86	1.86	101.09	0.50	100.59
1 / 7 .	0.99	0.12	1.43	2.33	1.63	8.91	10.68	0.76	20.04	0.02	10.28	0.06	0.00	41.69	2.01	100.97	0.45	100.52
1 / 8 .	1.02	0.15	1.41	2.37	1.62	8.85	10.67	0.72	19.90	0.07	10.32	0.04	0.02	41.77	1.97	100.90	0.47	100.44
1 / 9 .	0.93	0.12	1.47	2.32	1.61	8.87	10.62	0.76	20.04	0.06	10.33	0.06	-0.02	41.90	1.79	100.86	0.42	100.44
1 / 10 .	1.01	0.15	1.42	2.37	1.61	8.93	10.58	0.77	20.20	0.13	10.35	0.03	-0.04	41.78	1.97	101.31	0.46	100.86
Avg 202_amph_6	1.01	0.13	1.42	2.34	1.62	8.89	10.68	0.77	19.94	0.02	10.34	0.06	-0.01	41.82	1.87	100.91	0.45	100.45
202_amph_7	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 .	0.99	0.14	1.42	2.29	1.66	8.84	10.65	0.74	19.77	-0.11	10.06	0.02	-0.01	41.86	1.86	100.30	0.45	99.86
1 / 2 .	1.02	0.11	1.42	2.31	1.59	8.80	10.47	0.81	19.95	0.03	10.12	0.10	-0.04	42.13	1.76	100.62	0.45	100.16
1 / 3 .	0.93	0.12	1.46	2.30	1.60	8.90	10.67	0.76	19.97	-0.03	10.02	-0.01	-0.01	41.90	1.87	100.49	0.42	100.07
1 / 4 .	1.05	0.13	1.40	2.23	1.60	8.82	10.73	0.74	20.05	0.07	10.10	0.00	0.00	42.06	1.85	100.84	0.47	100.36
1 / 5 .	1.08	0.12	1.39	2.36	1.57	8.89	10.66	0.76	20.17	-0.06	9.95	0.05	0.03	42.19	1.76	100.99	0.48	100.51
1 / 6 .	1.00	0.14	1.43	2.28	1.61	8.75	10.63	0.79	19.92	-0.07	10.02	0.06	0.03	42.24	1.81	100.69	0.45	100.24
1 / 7 .	1.05	0.12	1.40	2.32	1.63	8.85	10.58	0.84	19.98	0.01	10.06	0.02	-0.02	42.00	1.72	100.59	0.47	100.12
1 / 8 .	0.93	0.13	1.46	2.28	1.57	8.86	10.59	0.76	20.05	0.02	10.04	0.03	-0.01	42.05	1.90	100.68	0.42	100.26
1 / 9 .	1.01	0.13	1.41	2.30	1.61	8.82	10.65	0.82	19.85	-0.08	10.12	-0.01	-0.02	41.98	1.78	100.48	0.46	100.02
1 / 10 .	0.94	0.15	1.45	2.26	1.64	8.83	10.68	0.75	20.11	0.03	10.08	0.00	-0.06	42.16	1.86	100.94	0.43	100.51
Avg 202_amph_7	1.00	0.13	1.42	2.29	1.61	8.84	10.63	0.78	19.98	-0.02	10.06	0.03	-0.01	42.06	1.82	100.61	0.45	100.16
202_amph_8	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 .	1.16	0.15	1.35	2.31	1.62	9.04	10.76	0.79	19.62	0.02	10.22	0.11	0.00	42.21	1.70	101.06	0.52	100.54

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 2 .	1.08	0.13	1.39	2.30	1.59	9.04	10.74	0.75	19.90	0.03	10.25	0.01	-0.02	42.04	1.69	100.95	0.48	100.46
1 / 3 . *	0.95	0.14	1.46	2.32	1.61	9.04	10.75	0.80	20.23	0.02	10.25	0.04	-0.01	42.19	1.79	101.59	0.43	101.16
1 / 4 .	1.09	0.13	1.38	2.27	1.64	8.82	10.72	0.85	19.82	-0.02	10.19	-0.01	0.01	41.76	1.93	100.62	0.49	100.14
1 / 5 .	1.05	0.11	1.41	2.23	1.58	8.97	10.77	0.84	20.10	-0.04	10.17	0.10	0.00	41.94	1.78	101.06	0.47	100.60
1 / 6 .	0.97	0.13	1.45	2.19	1.57	8.96	10.86	0.74	19.80	0.01	10.20	0.05	0.00	42.17	1.85	100.95	0.44	100.51
1 / 7 .	1.16	0.11	1.36	2.17	1.57	9.03	10.73	0.75	19.99	-0.03	10.23	0.01	-0.03	42.15	1.79	101.03	0.51	100.52
1 / 8 .	0.99	0.13	1.44	2.24	1.60	9.11	10.77	0.81	19.80	-0.03	10.20	0.08	0.01	42.06	1.84	101.06	0.45	100.61
1 / 9 .	1.04	0.12	1.42	2.25	1.56	9.11	10.79	0.76	19.78	-0.01	10.25	0.06	0.01	42.27	1.88	101.31	0.47	100.84
1 / 10 .	0.99	0.12	1.44	2.22	1.65	8.98	10.78	0.80	19.81	-0.02	10.21	0.01	0.01	42.17	1.78	100.98	0.44	100.53
Avg 202_amph_8	1.06	0.13	1.40	2.24	1.60	9.01	10.77	0.79	19.85	-0.01	10.21	0.05	0.00	42.08	1.80	100.98	0.47	100.51
202_amph_9	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 .	1.03	0.14	1.40	2.33	1.65	9.09	10.50	0.86	19.49	0.08	10.49	0.04	0.02	41.69	1.74	100.56	0.47	100.09
1 / 2 .	1.22	0.12	1.32	2.36	1.61	8.92	10.65	0.81	19.73	0.01	10.31	0.06	-0.03	41.74	1.82	100.68	0.54	100.14
1 / 3 .	1.13	0.14	1.35	2.43	1.64	8.95	10.55	0.75	19.38	-0.03	10.37	0.01	0.03	41.77	1.84	100.33	0.51	99.82
1 / 4 .	1.02	0.15	1.41	2.26	1.67	8.96	10.69	0.82	19.29	0.05	10.35	0.01	0.05	42.14	1.69	100.55	0.46	100.09
1 / 5 .	1.10	0.12	1.38	2.32	1.64	9.04	10.68	0.77	19.76	0.07	10.34	0.02	0.00	41.67	1.78	100.69	0.49	100.20
1 / 6 .	1.08	0.13	1.39	2.34	1.66	9.05	10.69	0.86	19.46	0.08	10.44	0.05	-0.01	41.90	1.69	100.82	0.48	100.33
1 / 7 .	1.21	0.13	1.32	2.34	1.64	8.92	10.64	0.75	19.51	-0.01	10.38	-0.03	0.04	41.86	1.77	100.52	0.54	99.98
1 / 8 .	1.10	0.12	1.38	2.32	1.63	9.08	10.74	0.80	19.45	0.00	10.43	0.04	-0.02	41.86	1.64	100.61	0.49	100.12
1 / 9 .	1.03	0.10	1.42	2.35	1.66	9.04	10.71	0.79	19.62	0.02	10.41	0.07	-0.02	41.98	1.75	100.97	0.46	100.52
1 / 10 .	1.11	0.15	1.37	2.34	1.62	9.13	10.67	0.86	19.33	0.04	10.37	0.03	0.02	41.91	1.68	100.63	0.50	100.13
Avg 202_amph_9	1.10	0.13	1.37	2.34	1.64	9.02	10.65	0.81	19.50	0.03	10.39	0.03	0.01	41.85	1.74	100.62	0.49	100.13
202_amph_10	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 .	0.98	0.13	1.45	2.35	1.61	9.03	10.62	0.79	19.98	-0.03	10.24	0.01	-0.06	42.09	1.94	101.22	0.44	100.78
1 / 2 .	0.97	0.12	1.44	2.36	1.58	8.95	10.59	0.78	20.23	0.18	10.13	-0.01	0.04	41.70	2.02	101.08	0.44	100.65
1 / 3 .	0.83	0.11	1.52	2.39	1.60	8.89	10.53	0.79	19.92	0.06	10.10	0.07	0.02	41.96	1.92	100.70	0.37	100.33
1 / 4 .	1.05	0.12	1.40	2.41	1.60	8.93	10.58	0.79	19.79	-0.08	10.13	0.08	-0.01	41.89	1.97	100.75	0.47	100.28
1 / 5 .	1.04	0.12	1.41	2.38	1.58	8.88	10.53	0.79	19.88	0.04	10.19	0.03	0.00	42.05	1.90	100.83	0.47	100.37
1 / 6 .	1.01	0.12	1.42	2.41	1.62	8.93	10.54	0.79	19.77	0.01	10.10	0.06	-0.03	41.88	1.89	100.55	0.45	100.09
1 / 7 .	1.04	0.12	1.41	2.41	1.59	8.93	10.58	0.86	19.69	-0.03	10.11	0.07	-0.02	41.89	1.92	100.63	0.46	100.17

Table B3: Amphibole Chemistries
* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 8 .	1.11	0.11	1.38	2.44	1.60	9.00	10.44	0.81	19.84	0.03	10.06	0.05	0.05	42.20	1.97	101.09	0.49	100.59
1 / 9 .	1.00	0.12	1.43	2.43	1.63	8.96	10.57	0.77	19.75	0.06	10.14	0.08	-0.01	42.05	1.98	100.98	0.45	100.53
1 / 10 .	1.07	0.12	1.39	2.37	1.59	8.90	10.65	0.76	19.61	0.10	10.11	0.02	-0.01	41.89	1.91	100.48	0.48	100.00
Avg 202_amph_10	1.01	0.12	1.42	2.40	1.60	8.94	10.56	0.79	19.85	0.03	10.13	0.04	0.00	41.96	1.94	100.80	0.45	100.35
BR-70																		
70 amph 1																		
1 / 1 .	0.59	0.10	1.61	1.84	1.43	8.86	10.07	0.73	20.00	0.01	10.03	-0.02	0.02	41.72	1.90	98.91	0.27	98.64
1 / 2 .	0.52	0.11	1.64	1.84	1.42	8.87	10.15	0.70	19.89	0.02	10.03	0.03	0.00	41.56	1.80	98.58	0.24	98.33
1 / 3 .	0.56	0.09	1.62	1.81	1.39	8.87	10.22	0.74	20.20	-0.01	9.85	0.04	0.02	41.59	1.89	98.90	0.26	98.64
1 / 4 .	0.56	0.09	1.64	1.87	1.36	9.06	10.21	0.72	20.01	0.02	9.79	0.02	-0.01	42.10	1.84	99.27	0.26	99.01
1 / 5 .	0.57	0.10	1.62	1.82	1.34	8.96	10.31	0.76	19.92	-0.04	9.83	0.02	0.00	41.86	1.70	98.82	0.26	98.56
1 / 6 .	0.54	0.09	1.64	1.81	1.36	8.97	10.15	0.78	20.03	0.01	9.81	0.04	0.01	41.98	1.68	98.90	0.25	98.65
1 / 7 .	0.59	0.10	1.60	1.83	1.37	8.93	10.08	0.80	19.94	-0.01	9.95	-0.01	0.01	41.72	1.64	98.54	0.27	98.27
1 / 8 .	0.57	0.10	1.63	1.84	1.37	8.89	10.18	0.72	20.22	0.08	9.96	0.02	0.04	41.81	1.79	99.20	0.26	98.93
1 / 9 .	0.66	0.10	1.58	1.85	1.43	8.96	10.18	0.74	20.01	0.03	9.97	0.02	0.00	41.58	1.82	98.92	0.30	98.62
1 / 10 .	0.54	0.08	1.64	1.85	1.39	8.98	10.04	0.74	20.13	0.04	9.90	0.03	0.01	41.83	1.81	99.01	0.25	98.77
Avg 70 amph 1	0.57	0.10	1.62	1.84	1.39	8.94	10.16	0.74	20.04	0.02	9.91	0.02	0.01	41.78	1.79	98.91	0.26	98.64
70 amph 2																		
1 / 1 .	0.48	0.09	1.68	2.12	1.40	8.66	10.33	0.76	20.24	-0.02	10.25	0.05	-0.01	41.84	1.80	99.68	0.22	99.46
1 / 2 .	0.51	0.10	1.66	2.15	1.40	8.68	10.27	0.79	20.37	0.07	10.27	0.01	0.04	41.62	1.92	99.85	0.24	99.62
1 / 3 .	0.52	0.10	1.65	2.16	1.43	8.58	10.31	0.81	20.08	0.03	10.22	0.00	0.05	41.52	1.80	99.27	0.24	99.03
1 / 4 .	0.49	0.12	1.67	2.19	1.43	8.67	10.41	0.77	20.34	0.06	10.25	0.07	0.02	41.47	1.99	99.94	0.23	99.71
1 / 5 .	0.51	0.11	1.66	2.15	1.40	8.59	10.32	0.78	20.01	0.09	10.34	0.08	0.02	41.44	2.06	99.55	0.24	99.31
1 / 6 .	0.63	0.10	1.60	2.17	1.41	8.62	10.26	0.75	20.11	0.00	10.31	0.03	0.01	41.48	1.93	99.40	0.29	99.11
1 / 7 .	0.50	0.10	1.66	2.16	1.43	8.65	10.26	0.83	20.02	-0.02	10.25	0.04	0.02	41.52	1.74	99.17	0.23	98.94
1 / 8 .	0.57	0.12	1.63	2.07	1.38	8.69	10.53	0.78	20.17	0.02	10.14	0.02	0.04	41.63	1.84	99.62	0.27	99.36
1 / 9 .	0.58	0.10	1.63	2.09	1.36	8.85	10.41	0.74	20.24	0.06	10.23	0.03	0.03	41.74	1.91	100.01	0.27	99.74
1 / 10 .	0.51	0.11	1.66	2.08	1.30	8.91	10.38	0.83	19.92	0.03	9.92	0.03	0.03	42.05	1.89	99.66	0.24	99.42
Avg 70 amph 2	0.53	0.11	1.65	2.13	1.39	8.69	10.35	0.78	20.15	0.03	10.22	0.04	0.03	41.63	1.89	99.62	0.25	99.37

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
70 amph 3																		
1 / 1 . *	0.53	0.11	1.64	1.78	1.37	8.78	10.07	0.78	20.30	-0.02	9.79	0.04	0.05	41.81	1.90	98.94	0.25	98.70
1 / 2 . *	0.44	0.10	1.69	1.75	1.34	8.97	10.20	0.77	20.18	-0.10	9.71	0.02	0.06	41.98	1.77	98.97	0.21	98.77
1 / 3 .	0.54	0.09	1.65	1.76	1.39	9.00	10.29	0.74	20.42	-0.01	9.76	0.06	0.05	41.91	1.81	99.48	0.25	99.24
1 / 4 .	0.56	0.10	1.64	1.80	1.38	8.87	10.11	0.81	20.38	0.04	9.84	0.04	0.02	41.92	1.97	99.50	0.26	99.24
1 / 5 .	0.51	0.11	1.65	1.79	1.41	8.83	10.12	0.79	20.46	0.02	9.92	0.04	0.07	41.69	1.94	99.36	0.24	99.12
1 / 6 .	0.50	0.10	1.66	1.83	1.43	8.80	10.13	0.75	20.47	0.02	10.00	-0.01	0.04	41.58	1.92	99.23	0.23	99.00
1 / 7 .	0.48	0.11	1.67	1.78	1.39	8.77	10.21	0.79	20.44	-0.03	9.99	0.07	0.02	41.52	2.14	99.37	0.23	99.14
1 / 8 .	0.58	0.11	1.62	1.80	1.44	8.78	10.34	0.84	20.37	0.00	9.99	0.03	0.02	41.62	1.81	99.35	0.27	99.09
1 / 9 .	0.56	0.11	1.63	1.83	1.41	8.74	10.12	0.82	20.67	0.04	9.94	0.01	0.04	41.58	1.95	99.44	0.26	99.19
1 / 10 .	0.56	0.11	1.63	1.82	1.42	8.75	10.20	0.78	20.90	-0.05	10.00	0.02	0.07	41.48	2.09	99.83	0.26	99.57
Avg 70 amph 3	0.54	0.11	1.64	1.80	1.41	8.82	10.19	0.79	20.51	0.00	9.93	0.03	0.04	41.66	1.95	99.43	0.25	99.18
70 amph 4																		
1 / 1 . *	0.57	0.10	1.62	1.81	1.36	8.87	9.87	0.79	20.42	0.05	10.01	0.12	-0.02	41.50	1.95	99.02	0.26	98.76
1 / 2 .	0.51	0.10	1.66	1.84	1.40	8.78	10.20	0.77	20.84	0.06	10.14	0.11	-0.02	41.53	1.99	99.94	0.24	99.70
1 / 3 .	0.58	0.09	1.62	1.86	1.48	8.66	10.21	0.75	20.71	0.05	10.10	0.06	-0.04	41.46	1.93	99.56	0.26	99.30
1 / 4 .	0.62	0.10	1.61	1.79	1.45	8.72	10.19	0.75	20.44	0.12	10.14	0.11	0.00	41.65	1.94	99.61	0.28	99.33
1 / 5 .	0.54	0.11	1.64	1.80	1.43	8.87	10.17	0.72	20.38	0.00	10.03	0.10	-0.01	41.68	1.89	99.37	0.25	99.11
1 / 6 .	0.59	0.08	1.63	1.77	1.38	8.81	10.24	0.73	20.43	-0.03	10.02	0.05	-0.03	41.86	2.02	99.60	0.27	99.34
1 / 7 .	0.60	0.09	1.63	1.82	1.37	8.96	10.14	0.76	20.56	0.00	10.03	0.07	-0.03	41.92	1.85	99.77	0.27	99.50
1 / 8 .	0.55	0.08	1.64	1.78	1.37	9.08	10.07	0.79	20.22	0.04	9.76	0.10	0.03	42.05	1.74	99.30	0.25	99.05
1 / 9 .	0.53	0.09	1.65	1.83	1.46	8.83	10.21	0.73	20.54	0.09	10.01	0.10	-0.01	41.70	1.82	99.59	0.24	99.35
1 / 10 .	0.61	0.10	1.60	1.82	1.47	8.81	10.35	0.71	20.39	0.08	10.11	0.06	0.02	41.59	1.78	99.48	0.28	99.20
Avg 70 amph 4	0.57	0.09	1.63	1.81	1.42	8.84	10.20	0.75	20.50	0.05	10.04	0.08	-0.01	41.72	1.88	99.57	0.26	99.31
70 amph 5																		
1 / 1 . *	0.59	0.10	1.61	1.79	1.37	8.80	10.16	0.73	20.39	0.05	9.79	0.07	0.01	41.89	1.79	99.15	0.27	98.88
1 / 2 . *	0.62	0.12	1.59	1.79	1.42	8.93	10.29	0.79	20.23	-0.01	10.09	0.02	-0.02	41.49	1.86	99.24	0.29	98.95
1 / 3 . *	0.63	0.12	1.59	1.76	1.36	8.78	10.44	0.72	20.02	0.01	10.19	0.04	-0.02	41.48	1.96	99.09	0.29	98.80
1 / 4 .	0.58	0.11	1.62	1.81	1.43	8.86	10.26	0.73	20.42	0.05	10.22	0.07	0.00	41.46	1.84	99.46	0.27	99.19

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 5 .	0.65	0.12	1.58	1.81	1.40	8.84	10.34	0.69	20.38	-0.01	10.08	0.06	0.00	41.63	1.89	99.47	0.30	99.17
1 / 6 .	0.58	0.09	1.62	1.79	1.37	8.88	10.41	0.74	20.54	0.05	10.10	0.07	0.01	41.34	1.80	99.39	0.27	99.12
1 / 7 .	0.63	0.10	1.60	1.82	1.42	8.76	10.23	0.76	20.65	0.03	10.11	0.10	0.00	41.45	1.85	99.49	0.29	99.21
1 / 8 .	0.63	0.09	1.60	1.79	1.38	8.76	10.35	0.83	20.61	-0.01	10.19	0.08	0.01	41.53	1.78	99.64	0.29	99.35
1 / 9 .	0.59	0.10	1.61	1.79	1.42	8.74	10.32	0.76	20.67	0.05	10.19	0.04	0.01	41.34	1.80	99.41	0.27	99.14
1 / 10 .	0.63	0.10	1.60	1.80	1.42	8.74	10.22	0.80	20.65	0.12	10.19	0.07	-0.01	41.59	1.79	99.72	0.29	99.43
Avg 70 amph 5	0.61	0.10	1.60	1.80	1.41	8.80	10.30	0.76	20.56	0.04	10.15	0.07	0.00	41.48	1.82	99.51	0.28	99.23
70 amph 6																		
1 / 1 . *	0.54	0.10	1.64	1.83	1.41	8.95	10.16	0.66	20.03	0.07	9.91	0.10	-0.02	41.89	1.76	99.06	0.25	98.81
1 / 2 .	0.54	0.11	1.64	1.80	1.40	8.98	10.27	0.70	20.38	0.02	9.97	-0.02	-0.01	42.01	1.69	99.50	0.25	99.25
1 / 3 . *	0.58	0.12	1.61	1.83	1.38	8.98	10.28	0.76	19.97	0.07	9.95	0.00	0.04	41.56	1.72	98.84	0.27	98.57
1 / 4 . *	0.56	0.11	1.63	1.83	1.32	9.01	10.19	0.76	20.10	-0.04	9.91	0.03	0.00	41.81	1.84	99.09	0.26	98.83
1 / 5 .	0.52	0.13	1.65	1.83	1.42	8.88	10.24	0.79	20.21	0.00	9.88	0.05	-0.02	41.79	1.90	99.28	0.25	99.03
1 / 6 . *	0.55	0.13	1.63	1.86	1.37	9.02	10.23	0.78	20.13	0.00	9.92	0.02	0.00	41.76	1.66	99.05	0.26	98.79
1 / 7 . *	0.61	0.11	1.60	1.85	1.39	8.91	10.32	0.77	20.05	0.04	9.91	0.09	-0.03	41.72	1.74	99.12	0.28	98.84
1 / 8 . *	0.62	0.11	1.59	1.81	1.35	8.93	10.24	0.81	19.97	0.10	9.95	0.07	-0.01	41.79	1.65	99.00	0.29	98.71
1 / 9 . *	0.53	0.12	1.64	1.79	1.39	9.05	10.16	0.79	19.85	-0.02	10.02	0.00	0.02	41.78	1.82	98.98	0.25	98.73
1 / 10 .	0.57	0.10	1.63	1.88	1.34	8.92	10.24	0.79	20.11	0.03	9.92	0.05	-0.02	42.01	1.84	99.43	0.26	99.17
Avg 70 amph 6	0.54	0.11	1.64	1.84	1.39	8.93	10.25	0.76	20.23	0.02	9.92	0.03	-0.02	41.94	1.81	99.39	0.26	99.12

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71 amph 1	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 .	0.45	0.10	1.69	2.12	1.47	8.89	10.26	0.62	19.98	-0.03	10.50	0.05	0.00	41.39	1.89	99.40	0.21	99.19
1 / 2 .	0.44	0.08	1.69	2.05	1.48	8.92	10.34	0.61	19.70	0.01	10.43	0.05	0.00	41.28	1.88	98.96	0.20	98.75
1 / 3 .	0.44	0.09	1.68	2.07	1.44	8.86	10.29	0.55	19.51	-0.11	10.34	0.02	-0.01	41.45	1.83	98.57	0.21	98.36
1 / 4 .	0.43	0.09	1.68	2.03	1.44	8.75	10.21	0.57	19.49	-0.05	10.17	0.05	-0.02	41.27	1.98	98.17	0.20	97.97
1 / 5 .	0.41	0.10	1.70	2.07	1.46	8.93	10.42	0.58	19.51	0.00	10.34	0.04	-0.02	41.27	2.14	98.97	0.20	98.77
1 / 6 .	0.31	0.09	1.75	2.08	1.47	8.92	10.34	0.56	19.56	0.04	10.28	0.01	-0.02	41.32	2.00	98.72	0.15	98.57
1 / 7 . *	0.41	0.10	1.66	1.83	1.42	8.46	9.83	0.50	18.59	0.06	10.13	-0.01	0.00	41.27	1.92	96.18	0.20	95.99
1 / 8 .	0.36	0.08	1.73	2.03	1.48	8.89	10.41	0.56	19.49	0.02	10.34	0.04	0.05	41.43	1.88	98.78	0.17	98.61

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 9 .	0.36	0.09	1.73	2.01	1.41	8.95	10.30	0.61	19.55	-0.08	10.25	0.02	-0.01	41.45	1.90	98.64	0.17	98.47
1 / 10 .	0.36	0.09	1.73	1.95	1.40	8.98	10.42	0.55	19.51	0.03	10.18	0.06	-0.03	41.50	2.04	98.80	0.17	98.63
Avg 71 amph 1	0.40	0.09	1.71	2.05	1.45	8.90	10.33	0.58	19.59	-0.02	10.31	0.04	-0.01	41.37	1.95	98.78	0.19	98.59
71 amph 2																		
1 / 1 .	0.41	0.09	1.71	1.95	1.43	8.92	10.57	0.56	19.35	-0.01	10.42	0.01	0.01	41.74	2.02	99.20	0.20	99.00
1 / 2 .	0.39	0.08	1.73	2.01	1.40	8.88	10.58	0.55	19.30	0.02	10.45	0.01	0.03	41.67	1.98	99.07	0.18	98.89
1 / 3 .	0.40	0.10	1.72	2.02	1.41	8.83	10.48	0.55	20.01	-0.06	10.33	0.02	0.01	41.58	2.11	99.57	0.19	99.38
1 / 4 .	0.34	0.10	1.75	2.02	1.41	8.98	10.50	0.50	19.58	0.05	10.38	-0.02	0.04	41.64	1.93	99.22	0.17	99.05
1 / 5 .	0.46	0.08	1.70	2.04	1.46	8.97	10.44	0.52	19.52	0.05	10.45	0.00	0.03	41.77	1.95	99.45	0.21	99.24
1 / 6 .	0.45	0.08	1.69	2.01	1.50	8.86	10.44	0.54	19.69	0.06	10.18	-0.02	0.02	41.56	1.83	98.90	0.21	98.69
1 / 7 .	0.45	0.10	1.70	2.08	1.43	9.05	10.38	0.58	19.97	0.13	10.40	0.00	0.02	41.69	1.89	99.86	0.21	99.65
1 / 8 .	0.42	0.08	1.71	2.03	1.43	9.08	10.45	0.57	19.73	-0.01	10.25	0.05	0.00	41.58	2.01	99.39	0.20	99.20
1 / 9 .	0.47	0.09	1.68	2.04	1.41	9.02	10.50	0.59	19.72	0.01	10.26	0.06	0.04	41.60	1.91	99.39	0.22	99.17
1 / 10 .	0.40	0.09	1.72	2.09	1.39	9.12	10.47	0.49	19.49	0.00	10.41	0.00	0.04	41.65	1.74	99.10	0.19	98.91
Avg 71 amph 2	0.42	0.09	1.71	2.03	1.43	8.97	10.48	0.55	19.64	0.02	10.35	0.01	0.02	41.65	1.94	99.32	0.20	99.12
71 amph 3																		
1 / 1 .	0.36	0.09	1.74	2.02	1.36	8.93	10.50	0.57	19.39	0.03	10.28	0.03	0.04	41.90	1.84	99.09	0.17	98.92
1 / 2 .	0.31	0.09	1.76	2.03	1.40	8.90	10.53	0.61	19.38	0.06	10.13	-0.01	0.03	41.73	2.02	98.96	0.15	98.81
1 / 3 .	0.30	0.10	1.77	2.07	1.44	8.98	10.55	0.56	19.49	-0.01	10.30	0.02	0.03	41.62	2.03	99.28	0.15	99.13
1 / 4 .	0.34	0.10	1.75	2.08	1.43	8.87	10.49	0.56	19.53	0.09	10.21	0.04	0.06	41.67	2.15	99.37	0.16	99.21
1 / 5 .	0.31	0.10	1.77	2.02	1.46	8.96	10.48	0.49	19.83	0.03	10.40	0.00	0.01	41.75	1.96	99.55	0.15	99.40
1 / 6 .	0.23	0.11	1.79	1.99	1.40	8.84	10.49	0.51	19.52	0.05	10.25	0.04	0.02	41.50	1.96	98.70	0.12	98.58
1 / 7 .	0.35	0.10	1.73	2.02	1.44	8.86	10.34	0.49	19.59	0.00	10.23	-0.04	0.00	41.48	1.91	98.55	0.17	98.38
1 / 8 .	0.30	0.10	1.75	2.05	1.43	8.92	10.43	0.54	19.52	-0.06	10.22	-0.02	0.01	41.51	1.89	98.67	0.15	98.52
1 / 9 .	0.33	0.11	1.74	2.03	1.45	8.99	10.33	0.55	19.60	0.05	10.29	0.02	-0.01	41.48	2.08	99.03	0.16	98.87
1 / 10 .	0.35	0.08	1.74	2.02	1.43	8.86	10.47	0.58	19.63	0.12	10.07	0.03	0.04	41.49	1.94	98.84	0.16	98.68
Avg 71 amph 3	0.32	0.10	1.75	2.03	1.42	8.91	10.46	0.55	19.55	0.04	10.24	0.01	0.02	41.61	1.98	99.00	0.15	98.85
71 amph 4																		
1 / 1 .	0.36	0.12	1.73	2.02	1.39	8.84	10.47	0.62	19.56	0.01	10.26	0.01	0.04	41.73	1.86	99.01	0.18	98.84

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 2 .	0.42	0.12	1.70	2.00	1.41	8.83	10.41	0.65	19.70	0.00	10.28	-0.01	0.00	41.52	2.02	99.03	0.20	98.83
1 / 3 .	0.34	0.10	1.73	2.11	1.38	8.68	10.36	0.59	19.37	0.03	10.35	0.05	-0.02	41.54	1.96	98.59	0.17	98.42
1 / 4 .	0.40	0.13	1.70	2.02	1.42	8.77	10.27	0.58	19.77	0.06	10.32	0.00	0.02	41.40	1.93	98.78	0.20	98.58
1 / 5 .	0.36	0.13	1.72	2.00	1.47	8.70	10.28	0.60	19.62	0.06	10.38	0.03	-0.02	41.60	2.07	99.02	0.18	98.84
1 / 6 .	0.35	0.13	1.73	2.06	1.41	8.69	10.26	0.60	20.00	-0.02	10.34	0.06	0.00	41.41	2.13	99.16	0.18	98.99
1 / 7 .	0.33	0.12	1.75	2.03	1.47	8.78	10.36	0.61	19.65	0.03	10.26	0.03	0.00	41.71	2.05	99.17	0.16	99.01
1 / 8 .	0.33	0.11	1.75	2.00	1.40	8.83	10.36	0.63	19.93	0.02	10.23	0.04	0.00	41.51	2.10	99.24	0.16	99.07
1 / 9 .	0.36	0.12	1.72	2.01	1.42	8.75	10.61	0.63	19.74	0.00	10.28	0.03	0.00	41.43	2.11	99.22	0.18	99.04
1 / 10 .	0.43	0.10	1.69	1.96	1.41	8.73	10.56	0.59	19.44	0.04	10.11	0.01	-0.01	41.34	2.02	98.43	0.20	98.23
Avg 71 amph 4	0.37	0.12	1.72	2.02	1.42	8.76	10.39	0.61	19.68	0.02	10.28	0.03	0.00	41.52	2.03	98.97	0.18	98.79
71 amph 5																		
1 / 1 .	0.50	0.15	1.65	2.01	1.45	9.16	10.42	0.71	19.03	-0.05	10.28	0.07	0.00	41.67	1.99	99.09	0.24	98.85
1 / 2 .	0.52	0.14	1.64	2.01	1.41	9.21	10.47	0.61	19.03	0.05	10.13	0.07	0.06	41.77	1.74	98.83	0.25	98.58
1 / 3 .	0.51	0.16	1.65	2.01	1.47	9.17	10.43	0.58	19.22	0.05	10.16	0.05	0.05	41.82	1.81	99.13	0.25	98.88
1 / 4 .	0.47	0.16	1.67	2.05	1.45	9.18	10.51	0.59	19.43	0.09	10.31	0.08	0.02	41.70	1.98	99.67	0.24	99.44
1 / 5 .	0.45	0.14	1.68	2.03	1.45	9.14	10.57	0.60	19.37	-0.05	10.33	0.04	-0.02	41.55	1.88	99.22	0.22	99.00
1 / 6 .	0.40	0.13	1.73	2.05	1.48	9.20	10.49	0.62	19.49	-0.01	10.26	0.05	0.04	42.18	1.87	100.00	0.20	99.80
1 / 7 .	0.40	0.14	1.70	2.00	1.42	9.11	10.53	0.60	19.11	0.07	10.12	0.03	0.03	41.84	1.87	98.98	0.20	98.78
1 / 8 .	0.35	0.13	1.74	2.00	1.45	9.12	10.49	0.61	19.20	-0.01	10.24	0.07	0.02	41.88	1.96	99.25	0.18	99.07
1 / 9 .	0.54	0.16	1.63	1.92	1.45	9.22	10.58	0.57	19.25	0.06	10.37	0.08	0.03	41.80	1.78	99.44	0.27	99.17
1 / 10 .	0.45	0.14	1.68	1.90	1.42	9.12	10.53	0.58	19.25	-0.04	10.22	0.05	0.05	41.71	1.93	99.01	0.22	98.79
Avg 71 amph 5.1	0.46	0.15	1.68	2.00	1.45	9.16	10.50	0.61	19.24	0.02	10.24	0.06	0.03	41.79	1.88	99.26	0.23	99.04
2 / 1 .	0.39	0.17	1.69	1.97	1.39	9.03	10.41	0.61	18.71	0.06	10.31	0.02	0.04	41.56	2.10	98.46	0.20	98.25
2 / 2 .	0.39	0.15	1.71	2.03	1.41	9.22	10.40	0.62	18.89	0.04	10.36	0.03	0.05	41.47	2.16	98.94	0.20	98.75
2 / 3 .	0.44	0.17	1.67	2.02	1.44	9.22	10.37	0.59	18.73	-0.07	10.27	0.09	0.02	41.56	2.18	98.77	0.22	98.55
2 / 4 .	0.51	0.15	1.65	2.08	1.45	9.33	10.35	0.59	18.92	-0.03	10.41	0.06	0.05	41.74	1.94	99.24	0.25	98.99
2 / 5 .	0.48	0.15	1.66	1.95	1.38	9.34	10.43	0.58	18.96	-0.03	10.25	0.03	0.01	41.88	1.77	98.86	0.24	98.62
2 / 6 .	0.47	0.15	1.67	1.96	1.42	9.55	10.45	0.62	18.91	0.05	10.24	0.07	-0.01	41.90	1.86	99.33	0.23	99.09
2 / 7 .	0.47	0.16	1.67	2.00	1.34	9.54	10.39	0.56	18.77	0.04	10.15	0.05	0.01	42.11	1.81	99.06	0.23	98.83
2 / 8 .	0.45	0.16	1.67	1.95	1.39	9.53	10.42	0.60	18.67	-0.03	10.13	0.01	0.03	41.88	1.85	98.75	0.23	98.53

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
2 / 9 .	0.47	0.16	1.68	1.96	1.41	9.70	10.59	0.59	18.65	0.15	10.07	0.07	0.00	42.24	1.62	99.34	0.23	99.11
2 / 10 .	0.50	0.15	1.66	1.95	1.38	9.64	10.55	0.62	18.60	-0.02	10.24	0.05	0.04	42.11	1.70	99.19	0.24	98.95
Avg 71 amph 5.2	0.46	0.16	1.67	1.99	1.40	9.41	10.44	0.60	18.78	0.02	10.24	0.05	0.02	41.85	1.90	98.99	0.23	98.77
BR-13																		
13 amph 1	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 .	0.47	0.04	1.73	1.80	1.26	9.66	10.76	0.60	18.33	0.04	10.27	-0.19	0.00	43.05	1.65	99.65	0.21	99.45
1 / 2 .	0.53	0.05	1.69	1.79	1.30	9.65	10.75	0.63	18.59	0.02	10.31	-0.23	0.01	42.65	1.71	99.67	0.24	99.44
1 / 3 .	0.50	0.05	1.70	1.86	1.29	9.50	10.84	0.68	18.42	-0.05	10.38	-0.16	0.03	42.47	1.65	99.34	0.22	99.12
1 / 4 .	0.50	0.04	1.71	1.88	1.30	9.69	10.76	0.70	18.68	0.01	10.37	-0.18	-0.01	42.72	1.57	99.92	0.22	99.70
1 / 5 .	0.53	0.05	1.69	1.85	1.26	9.69	10.86	0.67	18.51	0.06	10.32	-0.22	0.03	42.85	1.53	99.91	0.23	99.68
1 / 6 .	0.45	0.05	1.73	1.80	1.26	9.86	10.64	0.67	18.45	0.08	10.27	-0.21	0.01	42.98	1.40	99.65	0.20	99.45
1 / 7 .	0.54	0.06	1.68	1.85	1.27	9.95	10.60	0.67	18.47	0.15	10.17	-0.20	0.02	42.93	1.50	99.87	0.24	99.63
1 / 8 .	0.48	0.05	1.72	1.69	1.22	10.01	10.66	0.68	18.43	0.00	10.01	-0.18	0.03	43.51	1.23	99.72	0.21	99.51
1 / 9 .	0.47	0.06	1.73	1.68	1.24	10.22	10.81	0.71	18.55	-0.01	9.65	-0.15	-0.04	43.71	1.21	100.04	0.21	99.83
1 / 10 .	0.55	0.07	1.67	1.77	1.32	9.96	10.76	0.64	18.56	0.08	10.12	-0.20	-0.02	42.93	1.24	99.68	0.25	99.43
Avg 13 amph 1	0.50	0.05	1.71	1.80	1.27	9.82	10.74	0.67	18.50	0.04	10.19	-0.19	0.01	42.98	1.47	99.75	0.22	99.52
13 amph 2	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 .	0.41	0.06	1.74	1.89	1.39	9.30	10.63	0.64	18.98	0.11	10.47	-0.22	0.01	42.11	1.61	99.36	0.18	99.17
1 / 2 .	0.34	0.06	1.76	1.90	1.43	9.15	10.61	0.65	18.95	0.02	10.63	-0.24	0.00	42.01	1.71	99.21	0.16	99.06
1 / 3 .	0.36	0.06	1.75	1.92	1.39	9.14	10.70	0.64	19.00	0.02	10.60	-0.27	0.02	41.97	1.77	99.35	0.17	99.18
1 / 4 . *	0.35	0.05	1.75	1.98	1.40	9.10	10.48	0.66	19.02	0.06	10.65	-0.18	0.02	41.64	1.67	98.84	0.16	98.68
1 / 5 . *	0.39	0.06	1.73	1.94	1.36	9.03	10.42	0.74	18.81	0.12	10.58	-0.23	0.03	41.97	1.72	98.92	0.18	98.74
1 / 6 . *	0.37	0.07	1.74	1.97	1.41	9.07	10.53	0.66	19.05	0.04	10.67	-0.27	0.03	41.63	1.61	98.86	0.17	98.69
1 / 7 . *	0.40	0.06	1.72	1.94	1.38	9.08	10.50	0.71	18.82	0.04	10.62	-0.20	-0.01	41.58	1.72	98.56	0.18	98.38
1 / 8 .	0.40	0.05	1.74	1.96	1.38	9.05	10.61	0.69	19.19	0.04	10.67	-0.24	0.00	41.91	1.75	99.43	0.18	99.25
1 / 9 . *	0.46	0.05	1.70	1.98	1.39	9.06	10.49	0.67	18.83	0.12	10.62	-0.21	0.02	41.78	1.65	98.84	0.20	98.64
1 / 10 . *	0.39	0.05	1.74	1.96	1.41	9.08	10.51	0.68	18.85	0.08	10.65	-0.27	0.01	41.76	1.76	98.93	0.17	98.75
Avg 13 amph 2	0.38	0.06	1.75	1.92	1.40	9.16	10.64	0.66	19.03	0.05	10.59	-0.24	0.01	42.00	1.71	99.34	0.17	99.17

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
13 amph 3	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 .	0.41	0.05	1.74	1.96	1.45	9.10	10.46	0.65	18.85	0.06	10.62	-0.26	0.05	41.99	2.12	99.50	0.18	99.32
1 / 2 .	0.49	0.07	1.69	1.99	1.44	9.15	10.48	0.65	18.94	-0.01	10.59	-0.28	0.02	41.93	1.99	99.43	0.22	99.21
1 / 3 .	0.39	0.06	1.74	1.94	1.45	9.09	10.63	0.69	18.78	0.09	10.49	-0.28	0.03	41.97	2.03	99.39	0.18	99.21
1 / 4 .	0.42	0.06	1.72	1.98	1.44	9.24	10.44	0.65	18.83	-0.03	10.44	-0.25	0.01	41.90	2.10	99.23	0.19	99.04
1 / 5 .	0.37	0.07	1.75	1.97	1.39	9.16	10.46	0.64	19.09	0.08	10.46	-0.26	0.04	41.90	1.88	99.25	0.17	99.08
1 / 6 . *	0.38	0.05	1.74	1.96	1.41	9.18	10.61	0.68	18.82	0.10	10.34	-0.26	0.04	41.84	1.92	99.06	0.17	98.89
1 / 7 .	0.42	0.06	1.73	1.98	1.44	9.27	10.54	0.65	18.53	0.09	10.38	-0.24	0.03	42.18	1.95	99.25	0.19	99.06
1 / 8 . *	0.37	0.06	1.75	1.93	1.39	9.27	10.64	0.70	18.69	0.05	10.26	-0.26	0.03	41.92	2.01	99.06	0.17	98.89
1 / 9 .	0.44	0.06	1.72	1.93	1.36	9.26	10.52	0.63	19.14	0.00	10.25	-0.24	0.02	42.26	1.88	99.48	0.20	99.29
1 / 10 . *	0.43	0.06	1.72	1.91	1.43	9.32	10.44	0.71	18.82	0.03	10.41	-0.22	0.03	41.99	1.83	99.11	0.20	98.92
Avg 13 amph 3	0.42	0.06	1.73	1.96	1.42	9.18	10.50	0.65	18.88	0.04	10.46	-0.26	0.03	42.02	1.99	99.36	0.19	99.17
13 amph 4	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 . *	0.44	0.06	1.71	2.01	1.44	9.33	10.36	0.65	18.83	0.00	10.43	-0.29	-0.03	41.95	1.88	99.10	0.20	98.90
1 / 2 . *	0.45	0.05	1.71	2.10	1.43	9.27	10.41	0.68	18.34	0.02	10.52	-0.31	0.02	41.77	1.98	98.74	0.20	98.54
1 / 3 .	0.50	0.06	1.69	2.04	1.48	9.33	10.49	0.67	18.65	-0.02	10.39	-0.29	-0.01	42.08	1.85	99.23	0.22	99.01
1 / 4 .	0.42	0.06	1.74	2.06	1.46	9.36	10.51	0.72	18.61	0.02	10.43	-0.30	0.02	42.27	2.06	99.74	0.19	99.55
1 / 5 .	0.39	0.05	1.75	2.03	1.45	9.38	10.42	0.72	18.85	0.08	10.45	-0.33	0.01	42.08	1.91	99.57	0.17	99.40
1 / 6 .	0.48	0.06	1.70	2.06	1.44	9.43	10.42	0.73	18.71	-0.03	10.58	-0.34	0.03	41.78	1.97	99.39	0.22	99.18
1 / 7 .	0.38	0.05	1.75	2.05	1.46	9.28	10.54	0.69	18.46	0.01	10.45	-0.26	-0.01	42.16	1.98	99.27	0.17	99.09
1 / 8 .	0.46	0.07	1.71	2.10	1.43	9.33	10.47	0.68	18.77	0.02	10.39	-0.31	-0.01	42.08	2.04	99.54	0.21	99.33
1 / 9 .	0.40	0.06	1.74	2.01	1.44	9.32	10.56	0.69	18.87	0.05	10.43	-0.31	0.00	41.91	1.87	99.35	0.18	99.17
1 / 10 . *	0.43	0.05	1.72	2.03	1.50	9.23	10.61	0.59	18.66	0.03	10.54	-0.31	-0.01	41.88	1.86	99.12	0.19	98.93
Avg 13 amph 4	0.43	0.06	1.73	2.05	1.45	9.35	10.49	0.70	18.70	0.02	10.45	-0.31	0.00	42.05	1.95	99.44	0.19	99.25
FR-111																		
111_amph_1																		
1 / 1 .	0.47	0.06	1.71	2.22	1.40	8.63	10.37	0.80	20.06	-0.07	9.95	0.03	0.01	42.57	1.94	100.23	0.21	100.02
1 / 2 .	0.53	0.07	1.69	2.25	1.41	8.66	10.46	0.71	20.46	0.02	10.00	0.04	0.01	42.60	1.92	100.83	0.24	100.59
1 / 3 .	0.59	0.07	1.65	2.23	1.42	8.70	10.42	0.74	20.14	0.00	9.90	0.01	0.05	42.70	1.80	100.43	0.27	100.16

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 4 .	0.50	0.08	1.69	2.23	1.41	8.61	10.46	0.80	19.82	-0.01	9.91	0.03	0.00	42.65	2.09	100.28	0.23	100.06
1 / 5 .	0.51	0.06	1.70	2.26	1.43	8.71	10.37	0.64	20.08	0.11	9.87	0.05	0.04	42.75	2.06	100.64	0.23	100.41
1 / 6 .	0.52	0.07	1.68	2.22	1.42	8.68	10.33	0.79	19.97	-0.03	10.03	0.03	0.01	42.54	2.06	100.37	0.24	100.13
1 / 7 .	0.47	0.08	1.71	2.19	1.44	8.72	10.50	0.72	20.08	-0.12	9.97	0.05	-0.01	42.67	1.99	100.59	0.22	100.37
1 / 8 .	0.43	0.08	1.72	2.18	1.43	8.70	10.38	0.82	20.09	0.03	10.00	0.04	-0.02	42.50	2.05	100.45	0.20	100.25
1 / 9 .	0.46	0.07	1.71	2.18	1.37	8.73	10.35	0.71	20.27	0.13	9.94	0.00	-0.04	42.55	2.06	100.54	0.21	100.33
1 / 10 .	0.52	0.07	1.69	2.24	1.41	8.78	10.50	0.70	20.37	0.04	9.86	0.02	-0.02	42.69	1.94	100.83	0.23	100.59
2 / 1 .	0.55	0.08	1.66	2.15	1.44	8.61	10.43	0.73	19.94	0.03	9.91	0.02	-0.05	42.67	1.94	100.17	0.25	99.92
2 / 2 .	0.46	0.05	1.72	2.13	1.42	8.74	10.39	0.83	20.10	-0.11	9.93	0.04	0.00	42.83	1.80	100.43	0.21	100.23
2 / 3 .	0.45	0.07	1.72	2.19	1.40	8.69	10.24	0.75	20.15	0.03	9.87	0.06	-0.01	42.57	1.96	100.14	0.20	99.94
2 / 4 .	0.50	0.08	1.68	2.18	1.39	8.68	10.32	0.75	19.80	0.14	9.92	0.04	0.04	42.39	1.87	99.77	0.23	99.54
2 / 5 .	0.55	0.07	1.66	2.18	1.39	8.67	10.47	0.74	20.05	0.04	9.88	0.07	-0.02	42.48	1.92	100.17	0.25	99.92
2 / 6 .	0.51	0.07	1.68	2.21	1.39	8.63	10.16	0.76	20.09	-0.05	9.95	0.02	-0.02	42.70	1.97	100.14	0.23	99.91
2 / 7 .	0.48	0.08	1.71	2.18	1.40	8.74	10.41	0.73	20.28	0.00	9.96	0.02	0.04	42.74	1.88	100.65	0.22	100.43
2 / 8 .	0.50	0.05	1.70	2.09	1.37	8.73	10.32	0.77	20.30	0.11	9.95	0.10	-0.03	42.67	2.11	100.75	0.22	100.53
2 / 9 .	0.51	0.08	1.69	2.15	1.39	8.73	10.41	0.76	20.17	0.01	9.91	0.04	-0.03	42.64	1.93	100.42	0.23	100.18
2 / 10 .	0.57	0.06	1.67	2.15	1.39	8.65	10.49	0.76	20.07	-0.20	9.97	-0.01	0.01	42.82	1.90	100.50	0.25	100.25
3 / 1 .	0.45	0.09	1.72	2.18	1.41	8.73	10.42	0.73	20.35	0.04	9.91	0.02	0.02	42.71	1.89	100.66	0.21	100.45
3 / 2 .	0.47	0.08	1.70	2.13	1.42	8.68	10.38	0.78	19.92	0.04	9.90	0.01	0.02	42.71	1.82	100.07	0.22	99.85
3 / 3 .	0.50	0.07	1.69	2.14	1.43	8.55	10.50	0.74	20.19	0.05	9.97	0.03	-0.02	42.39	1.94	100.19	0.22	99.96
3 / 4 .	0.52	0.07	1.68	2.14	1.44	8.70	10.68	0.70	20.18	-0.04	9.82	0.06	-0.04	42.62	1.91	100.53	0.24	100.30
3 / 5 .	0.46	0.06	1.71	2.14	1.44	8.77	10.49	0.66	20.17	0.14	9.83	0.01	0.00	42.56	1.88	100.34	0.21	100.13
3 / 6 .	0.55	0.08	1.66	2.11	1.42	8.83	10.38	0.74	20.28	0.06	9.85	-0.01	-0.06	42.46	1.82	100.24	0.25	99.99
3 / 7 .	0.49	0.06	1.70	2.15	1.39	8.74	10.43	0.78	20.20	0.01	9.89	0.02	0.01	42.72	1.95	100.54	0.22	100.32
3 / 8 .	0.58	0.05	1.66	2.09	1.38	8.72	10.46	0.77	19.98	-0.01	9.84	-0.08	-0.03	42.84	1.83	100.20	0.26	99.94
3 / 9 .	0.43	0.07	1.73	2.05	1.44	8.73	10.49	0.73	20.08	-0.10	9.96	0.02	0.00	42.61	1.86	100.20	0.20	100.00
3 / 10 .	0.50	0.07	1.69	2.06	1.41	8.81	10.68	0.69	20.06	0.05	9.83	0.09	-0.04	42.59	1.67	100.19	0.23	99.96
Avg 111_amph_1	0.50	0.07	1.69	2.17	1.41	8.70	10.42	0.74	20.12	0.01	9.92	0.03	-0.01	42.63	1.92	100.34	0.23	100.11
111_amph_2																		
1 / 1 .	0.54	0.07	1.67	2.28	1.47	8.74	10.34	0.69	20.41	-0.01	9.95	0.03	0.01	42.44	2.01	100.67	0.24	100.42

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 2 .	0.59	0.08	1.65	2.24	1.51	8.74	10.35	0.66	20.04	-0.15	10.05	0.06	-0.01	42.65	2.07	100.70	0.27	100.43
1 / 3 .	0.54	0.07	1.68	2.25	1.49	8.86	10.28	0.68	20.33	0.03	10.04	0.03	0.03	42.66	1.91	100.89	0.24	100.64
1 / 4 .	0.58	0.09	1.66	2.24	1.44	8.78	10.24	0.69	20.25	-0.05	10.08	-0.02	-0.04	42.54	2.07	100.66	0.26	100.40
1 / 5 .	0.66	0.07	1.62	2.21	1.47	8.77	10.44	0.68	20.14	0.03	10.04	0.03	-0.03	42.61	2.08	100.86	0.29	100.57
1 / 6 .	0.53	0.09	1.68	2.23	1.48	8.72	10.35	0.72	20.61	0.02	10.12	0.05	0.00	42.40	2.08	101.08	0.24	100.83
1 / 7 .	0.54	0.07	1.68	2.24	1.51	8.75	10.36	0.71	20.28	0.06	10.22	0.05	0.05	42.45	1.92	100.88	0.24	100.63
1 / 8 .	0.57	0.08	1.66	2.24	1.46	8.74	10.24	0.72	20.13	0.12	10.12	0.08	0.01	42.51	2.05	100.74	0.26	100.48
1 / 9 .	0.45	0.09	1.72	2.24	1.47	8.75	10.31	0.68	20.21	-0.03	10.13	0.00	-0.03	42.68	1.83	100.56	0.21	100.35
1 / 10 .	0.60	0.08	1.65	2.23	1.49	8.71	10.30	0.67	19.99	0.01	10.02	0.04	0.00	42.67	2.01	100.46	0.27	100.19
2 / 1 .	0.54	0.08	1.67	2.19	1.40	8.81	10.38	0.69	19.72	-0.05	9.98	0.09	-0.02	42.57	2.15	100.26	0.25	100.01
2 / 2 .	0.54	0.07	1.68	2.14	1.41	8.84	10.43	0.68	20.40	0.00	10.05	0.06	-0.01	42.41	1.98	100.69	0.24	100.45
2 / 3 .	0.51	0.08	1.70	2.22	1.42	8.82	10.35	0.68	20.16	-0.02	9.99	0.03	0.06	42.68	1.90	100.59	0.23	100.36
2 / 4 .	0.55	0.07	1.67	2.19	1.39	8.79	10.27	0.68	20.17	0.05	10.07	0.02	0.00	42.66	1.93	100.51	0.25	100.26
2 / 5 .	0.57	0.07	1.66	2.20	1.44	8.79	10.62	0.73	19.96	0.03	10.14	0.05	-0.01	42.48	1.94	100.69	0.26	100.43
2 / 6 .	0.53	0.08	1.68	2.21	1.44	8.85	10.43	0.76	19.99	0.04	10.08	-0.02	0.09	42.52	1.92	100.62	0.24	100.38
2 / 7 .	0.55	0.07	1.68	2.20	1.46	8.90	10.42	0.68	20.01	-0.03	10.18	0.03	0.03	42.50	1.99	100.70	0.25	100.45
2 / 8 .	0.51	0.07	1.70	2.23	1.43	8.81	10.31	0.64	20.16	-0.01	10.20	-0.02	-0.06	42.60	1.97	100.62	0.23	100.39
2 / 9 .	0.65	0.07	1.63	2.22	1.38	8.81	10.30	0.67	19.92	-0.01	10.13	0.06	0.03	42.70	2.11	100.68	0.29	100.39
2 / 10 .	0.64	0.07	1.63	2.22	1.39	8.79	10.35	0.66	20.12	-0.01	10.16	-0.04	-0.10	42.72	1.96	100.71	0.29	100.43
3 / 1 .	0.51	0.07	1.69	2.21	1.43	8.72	10.37	0.65	20.31	-0.11	10.01	0.01	0.03	42.51	2.01	100.53	0.23	100.30
3 / 2 .	0.57	0.07	1.67	2.25	1.39	8.80	10.32	0.74	20.26	0.02	9.95	0.04	0.04	42.77	1.94	100.84	0.25	100.59
3 / 3 .	0.53	0.07	1.68	2.22	1.43	8.76	10.28	0.70	20.27	0.00	10.04	0.02	0.03	42.78	1.94	100.78	0.24	100.53
3 / 4 .	0.52	0.10	1.68	2.31	1.39	8.75	10.41	0.71	20.18	0.17	9.99	0.07	0.03	42.53	2.09	100.94	0.24	100.70
3 / 5 .	0.61	0.09	1.64	2.30	1.43	8.88	10.29	0.73	20.23	-0.02	9.98	0.05	-0.02	42.68	1.98	100.90	0.28	100.62
3 / 6 .	0.63	0.07	1.63	2.25	1.44	8.75	10.41	0.65	20.12	-0.01	9.97	0.01	-0.04	42.51	1.90	100.34	0.28	100.06
3 / 7 .	0.48	0.08	1.70	2.26	1.40	8.74	10.37	0.80	20.22	-0.02	9.86	0.04	0.01	42.63	1.88	100.48	0.22	100.25
3 / 8 .	0.51	0.07	1.70	2.24	1.43	8.77	10.48	0.70	20.60	0.00	9.98	0.06	-0.02	42.49	1.99	101.03	0.23	100.80
3 / 9 .	0.48	0.08	1.71	2.24	1.42	8.86	10.31	0.69	19.89	0.11	9.99	0.04	-0.04	42.73	2.00	100.55	0.22	100.33
3 / 10 .	0.51	0.08	1.69	2.22	1.42	8.73	10.20	0.68	20.39	0.08	9.98	0.06	-0.02	42.61	1.99	100.64	0.23	100.41
Avg 111_amph_2	0.55	0.08	1.67	2.23	1.44	8.78	10.35	0.69	20.18	0.01	10.05	0.03	0.00	42.59	1.99	100.65	0.25	100.40

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
111_amph_3																		
1 / 1 .	0.51	0.06	1.69	2.16	1.37	8.88	10.33	0.72	20.30	0.01	9.93	0.06	0.04	42.49	1.87	100.43	0.23	100.20
1 / 2 .	0.58	0.09	1.65	2.18	1.38	8.85	10.36	0.77	19.98	0.00	10.01	-0.01	0.01	42.54	1.89	100.27	0.26	100.01
1 / 3 .	0.47	0.07	1.71	2.09	1.39	8.69	10.42	0.74	20.44	0.04	10.11	0.05	0.02	42.48	1.92	100.67	0.21	100.45
1 / 4 .	0.45	0.08	1.71	2.09	1.38	8.70	10.37	0.72	20.10	-0.02	9.96	-0.02	0.16	42.47	1.99	100.19	0.21	99.98
1 / 5 .	0.53	0.08	1.67	2.14	1.36	8.73	10.42	0.75	19.92	0.02	9.93	0.01	-0.01	42.42	1.84	99.82	0.24	99.58
1 / 6 .	0.46	0.07	1.73	2.11	1.37	8.73	10.44	0.76	20.44	0.11	9.98	0.06	-0.01	42.75	2.04	101.04	0.21	100.83
1 / 7 .	0.58	0.09	1.64	2.18	1.36	8.73	10.31	0.77	20.31	-0.06	9.96	-0.01	0.04	42.39	1.80	100.15	0.26	99.89
1 / 8 .	0.49	0.08	1.70	2.09	1.36	8.79	10.49	0.75	20.01	0.08	9.89	0.08	-0.01	42.69	1.90	100.39	0.22	100.17
1 / 9 .	0.54	0.08	1.67	2.10	1.35	8.67	10.59	0.74	20.23	0.01	9.95	0.05	0.01	42.49	2.02	100.51	0.24	100.27
1 / 10 .	0.47	0.08	1.71	2.04	1.33	8.73	10.49	0.72	20.24	-0.03	9.91	0.08	-0.03	42.50	1.97	100.26	0.21	100.05
2 / 1 .	0.53	0.07	1.69	2.20	1.42	8.66	10.46	0.72	20.47	-0.05	9.91	0.00	0.05	42.78	1.87	100.84	0.24	100.60
2 / 2 .	0.56	0.05	1.67	2.22	1.40	8.67	10.24	0.75	20.59	-0.04	9.92	0.05	-0.02	42.57	1.91	100.63	0.25	100.38
2 / 3 .	0.49	0.08	1.69	2.19	1.42	8.63	10.36	0.74	20.15	0.08	9.88	0.02	0.03	42.48	2.18	100.43	0.23	100.21
2 / 4 .	0.53	0.08	1.68	2.24	1.47	8.71	10.38	0.70	20.41	0.29	9.94	0.03	0.01	42.61	1.96	101.04	0.24	100.80
2 / 5 .	0.54	0.07	1.68	2.24	1.46	8.67	10.32	0.72	20.38	-0.02	10.02	0.03	-0.04	42.41	2.15	100.68	0.24	100.44
2 / 6 .	0.60	0.07	1.64	2.27	1.46	8.74	10.26	0.73	20.14	0.06	9.95	0.04	-0.01	42.25	2.11	100.31	0.27	100.04
2 / 7 .	0.46	0.07	1.71	2.21	1.44	8.65	10.35	0.76	20.09	-0.02	10.00	0.06	0.00	42.53	2.06	100.40	0.21	100.19
2 / 8 .	0.53	0.07	1.68	2.22	1.42	8.74	10.30	0.72	20.34	0.06	9.99	0.04	-0.04	42.46	1.98	100.56	0.24	100.32
2 / 9 .	0.50	0.08	1.69	2.18	1.44	8.70	10.25	0.73	20.24	0.02	10.03	0.02	0.03	42.33	1.92	100.16	0.23	99.93
2 / 10 .	0.49	0.08	1.69	2.24	1.42	8.71	10.26	0.74	20.21	0.00	9.93	0.01	0.03	42.44	2.11	100.36	0.23	100.13
Avg 111_amph_3	0.51	0.08	1.68	2.17	1.40	8.72	10.37	0.74	20.25	0.03	9.96	0.03	0.01	42.50	1.97	100.43	0.23	100.20
111_amph_4																		
1 / 1 .	0.52	0.06	1.69	2.20	1.38	8.85	10.37	0.72	19.96	0.07	9.78	0.06	0.02	42.94	1.56	100.17	0.23	99.94
1 / 2 .	0.58	0.07	1.66	2.18	1.39	8.90	10.40	0.83	20.14	0.03	9.81	0.01	-0.02	42.91	1.60	100.50	0.26	100.24
1 / 3 .	0.55	0.07	1.67	2.16	1.40	8.82	10.44	0.73	19.96	-0.04	9.78	0.01	-0.01	42.83	1.76	100.16	0.25	99.92
1 / 4 .	0.54	0.09	1.68	2.16	1.40	8.76	10.56	0.70	20.50	0.05	9.92	-0.01	-0.01	42.75	1.78	100.88	0.24	100.63
1 / 5 .	0.55	0.07	1.68	2.19	1.41	8.80	10.53	0.76	20.27	0.03	9.84	0.03	0.05	42.85	1.77	100.82	0.25	100.57
1 / 6 .	0.68	0.06	1.61	2.15	1.44	8.78	10.56	0.70	20.10	0.02	9.85	0.07	-0.02	42.71	1.93	100.67	0.30	100.37
1 / 7 .	0.53	0.07	1.69	2.11	1.38	8.68	10.67	0.68	20.15	0.05	9.83	0.07	0.02	43.00	1.91	100.83	0.24	100.59

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 8 .	0.52	0.07	1.69	2.12	1.41	8.78	10.50	0.71	20.03	0.11	9.85	0.06	0.01	42.77	1.89	100.51	0.23	100.27
1 / 9 .	0.58	0.07	1.66	2.15	1.42	8.77	10.37	0.71	20.13	0.01	9.90	0.04	-0.03	42.88	1.78	100.45	0.26	100.19
1 / 10 .	0.49	0.07	1.70	2.13	1.39	8.69	10.59	0.77	20.15	-0.10	9.87	0.04	0.01	42.66	2.00	100.56	0.22	100.34
2 / 1 .	0.52	0.09	1.68	2.35	1.44	8.67	10.26	0.69	20.00	0.09	10.00	-0.01	0.01	42.55	1.82	100.17	0.24	99.93
2 / 2 .	0.53	0.09	1.68	2.30	1.38	8.67	10.59	0.73	20.32	0.01	9.91	0.03	0.01	42.60	1.91	100.75	0.24	100.51
2 / 3 .	0.61	0.08	1.64	2.34	1.42	8.64	10.39	0.74	19.96	0.13	9.87	0.06	0.01	42.78	2.10	100.79	0.27	100.52
2 / 4 .	0.52	0.08	1.67	2.26	1.38	8.66	10.49	0.79	20.18	0.04	9.86	-0.01	0.03	42.26	1.97	100.20	0.24	99.96
2 / 5 .	0.51	0.09	1.68	2.28	1.39	8.58	10.24	0.72	20.31	-0.03	9.90	0.02	0.02	42.62	1.95	100.32	0.24	100.08
2 / 6 .	0.43	0.08	1.74	2.28	1.44	8.66	10.63	0.74	20.25	-0.01	9.95	0.01	-0.02	42.87	1.84	100.92	0.20	100.72
2 / 7 .	0.53	0.07	1.68	2.26	1.39	8.71	10.46	0.73	20.06	-0.01	9.92	0.05	0.00	42.48	1.94	100.29	0.24	100.05
2 / 8 .	0.52	0.08	1.69	2.19	1.45	8.71	10.48	0.74	20.21	0.09	9.93	0.09	0.01	42.64	1.99	100.83	0.24	100.60
2 / 9 .	0.54	0.08	1.68	2.23	1.45	8.70	10.35	0.73	20.28	-0.02	9.92	0.02	0.00	42.70	2.03	100.71	0.24	100.46
2 / 10 .	0.52	0.08	1.69	2.22	1.45	8.74	10.42	0.70	20.19	0.11	10.04	0.06	-0.03	42.56	1.99	100.75	0.24	100.52
3 / 1 .	0.60	0.06	1.65	2.20	1.43	8.73	10.38	0.76	20.14	0.04	9.89	0.02	-0.02	42.65	1.88	100.41	0.27	100.15
3 / 2 .	0.55	0.08	1.66	2.21	1.39	8.72	10.32	0.68	20.21	0.04	9.83	0.04	0.04	42.64	1.87	100.29	0.25	100.04
3 / 3 .	0.55	0.10	1.66	2.19	1.45	8.75	10.31	0.74	20.14	-0.05	9.84	0.03	0.04	42.76	1.87	100.42	0.25	100.17
3 / 4 .	0.49	0.07	1.70	2.14	1.42	8.78	10.32	0.66	20.28	-0.01	9.86	0.02	0.06	42.92	1.89	100.63	0.22	100.40
3 / 5 .	0.48	0.08	1.71	2.23	1.44	8.80	10.49	0.70	20.16	0.04	9.95	-0.05	0.04	42.74	1.85	100.70	0.22	100.48
3 / 6 .	0.49	0.08	1.70	2.26	1.43	8.78	10.33	0.72	20.40	-0.01	9.99	0.00	-0.01	42.59	1.96	100.74	0.22	100.52
3 / 7 .	0.58	0.08	1.65	2.20	1.46	8.61	10.35	0.70	20.26	-0.03	9.90	0.02	-0.05	42.57	2.03	100.43	0.26	100.17
3 / 8 .	0.52	0.07	1.69	2.23	1.45	8.72	10.37	0.68	20.39	-0.06	9.93	0.01	0.01	42.66	1.88	100.61	0.23	100.37
3 / 9 .	0.53	0.08	1.67	2.18	1.45	8.66	10.30	0.65	20.29	0.06	9.88	0.08	0.03	42.63	1.80	100.31	0.24	100.07
3 / 10 .	0.56	0.08	1.67	2.21	1.42	8.75	10.41	0.68	20.44	-0.02	9.98	0.03	-0.02	42.79	1.88	100.91	0.25	100.65
Avg 111_amph_4	0.54	0.08	1.68	2.21	1.42	8.73	10.43	0.72	20.20	0.02	9.89	0.03	0.01	42.71	1.88	100.53	0.24	100.29

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109 amph 1	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 .	0.79	0.08	1.57	2.39	1.47	9.86	10.59	0.62	18.59	0.09	9.86	0.08	-0.02	43.10	1.90	100.98	0.35	100.62
1 / 2 .	0.88	0.06	1.53	2.33	1.45	10.01	10.71	0.69	18.46	0.05	9.62	0.04	-0.01	43.37	1.79	100.99	0.39	100.61
1 / 3 .	0.90	0.09	1.51	2.30	1.48	9.99	10.77	0.71	18.20	-0.09	9.91	0.04	0.02	43.05	1.86	100.83	0.40	100.43
1 / 4 .	0.86	0.09	1.54	2.31	1.50	9.83	10.85	0.59	18.60	0.12	10.00	-0.02	-0.03	43.14	1.90	101.33	0.38	100.95

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 5 .	0.84	0.11	1.53	2.27	1.56	9.80	10.71	0.68	18.73	0.04	10.02	0.00	0.02	42.97	1.78	101.08	0.38	100.70
1 / 6 .	0.77	0.08	1.58	2.31	1.50	9.85	10.73	0.68	18.52	-0.03	10.06	0.05	-0.06	42.95	1.88	100.94	0.34	100.60
1 / 7 .	0.83	0.09	1.54	2.24	1.51	9.80	10.94	0.61	18.77	0.13	10.05	-0.03	-0.02	42.71	1.91	101.14	0.37	100.77
1 / 8 .	0.86	0.11	1.53	2.22	1.50	9.79	10.82	0.64	18.57	0.02	10.26	0.00	-0.03	43.05	1.78	101.15	0.38	100.76
1 / 9 .	0.75	0.12	1.57	2.21	1.50	9.64	10.91	0.68	18.64	-0.01	10.14	0.01	-0.09	42.72	1.84	100.72	0.34	100.37
1 / 10 .	0.82	0.11	1.54	2.20	1.49	9.71	10.70	0.65	18.33	0.07	10.37	0.04	0.02	42.55	1.84	100.44	0.37	100.07
Avg 109_amph_1	0.83	0.09	1.54	2.28	1.50	9.83	10.77	0.65	18.54	0.04	10.03	0.02	0.00	42.96	1.85	100.93	0.37	100.56
109 amph2																		
1 / 1 . *	0.87	0.14	1.52	2.36	1.51	10.26	10.94	0.57	18.63	-0.02	10.53	0.01	0.02	42.57	1.51	101.44	0.40	101.05
1 / 2 .	0.87	0.10	1.52	2.32	1.58	10.07	10.96	0.59	18.18	0.02	10.50	0.06	0.01	42.48	1.43	100.71	0.39	100.32
1 / 3 .	1.01	0.12	1.44	2.33	1.54	10.14	10.75	0.60	18.07	-0.10	10.42	0.03	0.01	42.60	1.47	100.52	0.45	100.06
1 / 4 .	0.91	0.12	1.50	2.29	1.54	10.10	11.05	0.60	18.56	-0.11	10.61	0.06	-0.01	42.40	1.40	101.15	0.41	100.74
1 / 5 .	0.96	0.11	1.48	2.29	1.54	10.15	10.86	0.68	18.15	0.05	10.67	0.01	-0.04	42.59	1.54	101.10	0.43	100.67
1 / 6 .	0.87	0.09	1.53	2.29	1.59	10.10	10.91	0.64	17.95	-0.02	10.60	0.01	0.01	42.49	1.66	100.74	0.39	100.35
1 / 7 .	0.90	0.09	1.50	2.31	1.56	10.02	10.80	0.56	18.16	0.02	10.55	0.05	-0.01	42.48	1.51	100.50	0.40	100.10
1 / 8 .	0.79	0.09	1.57	2.33	1.56	10.26	10.84	0.58	18.24	0.03	10.57	0.05	-0.04	42.60	1.54	101.06	0.35	100.71
1 / 9 .	0.84	0.11	1.54	2.34	1.56	10.14	10.86	0.60	18.01	0.15	10.54	0.00	-0.01	42.65	1.64	100.98	0.38	100.61
1 / 10 .	0.95	0.12	1.48	2.28	1.58	10.22	10.90	0.59	18.19	0.01	10.51	0.01	-0.05	42.67	1.47	101.00	0.43	100.57
Avg 109_amph_2	0.90	0.11	1.51	2.31	1.56	10.13	10.88	0.60	18.17	0.01	10.55	0.03	-0.01	42.55	1.52	100.82	0.40	100.42
109 amph3																		
1 / 1 .	0.91	0.11	1.51	2.26	1.51	10.36	10.98	0.60	17.72	-0.02	10.42	-0.02	-0.10	43.09	1.43	100.91	0.41	100.50
1 / 2 .	1.03	0.10	1.44	2.28	1.56	10.37	11.00	0.59	17.75	-0.03	10.38	0.01	0.01	42.64	1.50	100.67	0.45	100.21
1 / 3 .	1.01	0.10	1.45	2.31	1.55	10.16	10.96	0.58	17.89	-0.02	10.39	-0.01	0.05	42.71	1.55	100.71	0.45	100.26
1 / 4 .	0.97	0.13	1.46	2.25	1.56	10.20	10.71	0.58	17.87	-0.01	10.38	-0.01	-0.01	42.82	1.60	100.53	0.44	100.10
1 / 5 .	0.98	0.12	1.46	2.28	1.53	10.17	10.85	0.58	18.40	0.05	10.37	0.03	-0.01	42.67	1.47	100.97	0.44	100.53
1 / 6 .	1.03	0.13	1.43	2.27	1.56	10.17	11.01	0.59	18.07	0.07	10.38	0.05	0.01	42.72	1.39	100.88	0.46	100.42
1 / 7 .	0.83	0.11	1.53	2.23	1.46	10.26	10.37	0.56	18.23	-0.05	10.47	-0.03	-0.02	42.31	1.61	99.95	0.37	99.58
1 / 8 .	0.85	0.09	1.53	2.25	1.52	10.13	10.86	0.57	17.92	0.13	10.31	0.09	0.03	42.68	1.59	100.57	0.38	100.19
1 / 9 .	0.84	0.11	1.53	2.22	1.57	10.21	10.86	0.63	18.23	-0.02	10.40	0.00	0.03	42.55	1.40	100.58	0.38	100.20
1 / 10 .	0.80	0.12	1.55	2.25	1.56	10.17	10.84	0.59	18.24	0.00	10.26	-0.01	-0.01	42.68	1.60	100.67	0.36	100.30

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
Avg 109_amph_3	0.93	0.11	1.49	2.26	1.54	10.22	10.84	0.59	18.03	0.01	10.38	0.01	0.00	42.69	1.51	100.60	0.41	100.19
109 amph4																		
1 / 1 . *	0.83	0.11	1.55	2.22	1.55	10.04	11.14	0.64	18.37	0.06	10.37	0.03	-0.02	43.13	1.60	101.64	0.38	101.27
1 / 2 .	0.89	0.11	1.51	2.20	1.52	10.03	10.96	0.53	18.14	-0.01	10.27	0.07	0.00	42.64	1.59	100.44	0.40	100.05
1 / 3 .	0.86	0.11	1.52	2.23	1.53	9.95	10.82	0.65	18.45	0.09	10.26	0.04	-0.01	42.71	1.56	100.78	0.39	100.39
1 / 4 .	0.86	0.12	1.53	2.28	1.54	9.87	10.89	0.55	18.48	-0.08	10.49	0.02	0.05	42.73	1.74	101.14	0.39	100.76
1 / 5 .	0.89	0.10	1.51	2.32	1.52	9.93	10.90	0.56	18.64	0.07	10.47	0.04	-0.03	42.63	1.69	101.29	0.40	100.89
1 / 6 .	0.93	0.13	1.49	2.34	1.54	9.87	10.88	0.57	18.31	-0.07	10.34	0.03	0.05	42.94	1.73	101.14	0.42	100.72
1 / 7 .	0.86	0.08	1.53	2.23	1.52	9.79	11.09	0.64	18.61	-0.09	10.29	0.03	0.01	42.71	1.67	101.08	0.38	100.70
1 / 8 .	0.91	0.11	1.51	2.25	1.55	9.96	10.92	0.64	18.44	0.14	10.28	-0.05	-0.01	42.97	1.73	101.41	0.41	101.00
1 / 9 .	0.90	0.10	1.51	2.22	1.56	10.02	10.95	0.56	18.48	-0.07	10.09	0.03	-0.01	42.91	1.63	100.96	0.40	100.56
1 / 10 .	0.99	0.12	1.47	2.17	1.49	10.13	10.91	0.61	18.28	-0.05	10.09	0.03	0.03	43.31	1.61	101.22	0.44	100.78
Avg 109_amph_4	0.90	0.11	1.51	2.25	1.53	9.95	10.92	0.59	18.43	-0.01	10.29	0.03	0.01	42.84	1.66	101.00	0.40	100.60
109 amph5																		
1 / 1 .	0.94	0.09	1.48	2.16	1.50	9.92	10.99	0.57	17.85	-0.01	10.13	0.08	0.03	42.79	1.89	100.44	0.42	100.02
1 / 2 .	0.89	0.09	1.52	2.16	1.52	10.10	11.06	0.56	17.98	0.10	10.06	0.03	0.04	43.08	1.94	101.14	0.40	100.74
1 / 3 .	0.82	0.11	1.54	2.21	1.51	10.11	10.85	0.59	17.78	0.09	10.12	0.03	-0.01	42.78	1.83	100.37	0.37	100.00
1 / 4 .	0.83	0.09	1.55	2.23	1.52	10.18	10.93	0.60	17.85	0.02	9.99	-0.02	-0.03	43.05	1.99	100.83	0.37	100.46
1 / 5 .	0.83	0.10	1.53	2.27	1.48	10.19	10.79	0.62	17.81	0.01	9.99	-0.02	0.02	42.76	1.88	100.28	0.37	99.91
1 / 6 .	0.75	0.10	1.59	2.26	1.51	10.31	10.98	0.62	17.90	0.02	10.05	-0.01	0.04	42.94	1.91	100.96	0.34	100.62
1 / 7 .	0.84	0.08	1.55	2.28	1.48	10.28	10.90	0.55	17.79	0.06	10.00	0.03	0.00	42.79	2.12	100.75	0.37	100.37
1 / 8 .	0.86	0.09	1.54	2.28	1.48	10.28	10.76	0.66	17.90	0.10	10.08	0.01	0.01	42.92	2.12	101.08	0.38	100.70
1 / 9 .	0.89	0.10	1.52	2.21	1.49	10.25	11.01	0.63	17.86	0.05	9.99	0.02	0.04	42.82	2.16	101.03	0.40	100.64
1 / 10 .	0.85	0.10	1.54	2.25	1.52	10.13	10.89	0.62	18.02	0.02	10.13	0.04	0.03	43.09	2.09	101.33	0.38	100.95
Avg 109_amph_5	0.85	0.10	1.54	2.23	1.50	10.18	10.92	0.60	17.87	0.05	10.05	0.02	0.02	42.90	1.99	100.81	0.38	100.43
109 amph6																		
1 / 1 .	0.89	0.12	1.50	2.35	1.53	9.82	10.72	0.80	18.59	-0.02	10.27	0.04	0.02	42.30	1.90	100.85	0.40	100.45
1 / 2 . *	0.83	0.10	1.55	2.28	1.57	9.95	10.73	0.71	18.72	0.04	10.29	0.06	-0.04	42.58	1.96	101.37	0.37	101.00
1 / 3 .	0.83	0.11	1.53	2.31	1.53	9.85	10.72	0.71	18.57	0.18	10.24	0.02	-0.01	42.27	1.91	100.77	0.37	100.39

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 4 .	0.80	0.11	1.55	2.31	1.58	9.87	10.74	0.67	18.51	-0.06	10.23	-0.01	0.02	42.27	1.95	100.60	0.36	100.24
1 / 5 .	0.89	0.09	1.51	2.31	1.53	9.82	10.67	0.72	18.59	0.06	10.27	0.02	0.00	42.39	1.86	100.73	0.40	100.34
1 / 6 .	0.93	0.10	1.49	2.32	1.52	9.84	10.62	0.72	18.30	-0.05	10.24	0.01	-0.04	42.62	1.75	100.44	0.41	100.03
1 / 7 .	0.79	0.10	1.55	2.29	1.54	9.86	10.62	0.70	18.39	0.07	10.26	0.01	0.02	42.50	1.84	100.55	0.36	100.19
1 / 8 .	0.86	0.10	1.51	2.30	1.58	9.84	10.69	0.74	18.46	0.01	10.18	0.03	0.04	42.47	1.54	100.36	0.38	99.97
1 / 9 .	0.79	0.12	1.55	2.26	1.56	9.78	10.77	0.67	18.44	0.02	10.18	0.08	0.01	42.60	1.80	100.63	0.36	100.27
1 / 10 .	0.81	0.10	1.54	2.22	1.49	9.81	10.62	0.72	18.37	-0.05	10.32	0.04	0.01	42.56	1.65	100.26	0.36	99.89
Avg 109_amph_6	0.84	0.10	1.53	2.30	1.54	9.83	10.69	0.72	18.47	0.02	10.24	0.03	0.01	42.44	1.80	100.55	0.38	100.17
109 amph7																		
1 / 1 .	0.80	0.12	1.53	2.30	1.49	9.81	10.54	0.75	18.62	0.04	9.87	0.06	0.00	42.30	1.70	99.92	0.36	99.56
1 / 2 .	0.81	0.13	1.53	2.29	1.53	9.88	10.65	0.78	18.93	0.20	9.94	-0.01	0.02	42.40	1.79	100.87	0.37	100.50
1 / 3 .	0.89	0.11	1.49	2.28	1.51	9.80	10.60	0.79	18.87	-0.07	9.90	-0.03	0.01	42.17	1.88	100.31	0.40	99.91
1 / 4 .	0.93	0.12	1.46	2.24	1.53	9.82	10.72	0.80	18.59	-0.03	9.76	-0.01	0.02	42.39	1.70	100.08	0.42	99.66
1 / 5 .	0.79	0.13	1.53	2.20	1.46	9.94	10.76	0.76	18.64	0.11	9.61	0.05	0.01	42.53	1.68	100.20	0.36	99.84
1 / 6 .	0.87	0.12	1.51	2.17	1.39	10.21	10.65	0.79	18.40	0.00	9.55	-0.02	0.01	42.93	1.76	100.37	0.39	99.98
1 / 7 .	0.83	0.13	1.52	2.19	1.50	9.95	10.68	0.75	18.76	0.06	9.62	0.03	-0.03	42.73	1.70	100.44	0.38	100.06
1 / 8 .	0.89	0.13	1.48	2.22	1.49	9.91	10.62	0.76	18.55	-0.02	9.72	0.06	-0.01	42.45	1.74	100.02	0.40	99.62
1 / 9 .	0.82	0.12	1.52	2.21	1.50	9.76	10.62	0.76	18.66	-0.03	9.88	0.01	0.02	42.50	1.59	99.97	0.37	99.60
1 / 10 .	0.83	0.10	1.53	2.25	1.46	9.89	10.58	0.69	18.78	0.03	9.75	0.01	0.03	42.77	1.62	100.31	0.37	99.94
Avg 109_amph_7	0.85	0.12	1.51	2.24	1.48	9.90	10.64	0.76	18.68	0.03	9.76	0.02	0.01	42.52	1.72	100.22	0.38	99.84
109 amph8																		
1 / 1 .	0.91	0.14	1.50	2.21	1.51	9.71	10.70	0.77	18.50	0.07	9.98	0.02	-0.02	43.14	1.99	101.14	0.41	100.72
1 / 2 .	0.81	0.11	1.53	2.22	1.46	9.65	10.32	0.72	18.42	-0.05	9.86	0.08	0.05	42.73	1.85	99.82	0.37	99.46
1 / 3 .	0.73	0.11	1.58	2.22	1.46	9.67	10.53	0.73	18.86	-0.04	9.95	0.00	0.05	43.08	1.76	100.74	0.33	100.41
1 / 4 .	0.75	0.12	1.57	2.21	1.47	9.76	10.84	0.77	18.62	0.04	9.97	0.03	0.00	42.74	1.86	100.77	0.34	100.43
1 / 5 .	0.82	0.12	1.54	2.21	1.46	9.77	10.64	0.71	18.42	0.00	9.95	0.03	-0.03	43.01	1.88	100.56	0.37	100.19
1 / 6 .	0.81	0.10	1.55	2.22	1.51	9.69	10.64	0.71	18.59	-0.08	9.99	0.05	0.03	42.81	1.83	100.54	0.36	100.18
1 / 7 .	0.81	0.10	1.54	2.20	1.47	9.76	10.72	0.66	18.55	0.10	10.03	0.01	0.01	42.77	1.77	100.50	0.36	100.13
1 / 8 . *	0.75	0.12	1.59	2.21	1.51	9.98	10.84	0.75	18.64	0.03	10.00	0.05	0.03	42.99	1.95	101.42	0.34	101.08
1 / 9 .	0.85	0.10	1.54	2.19	1.45	9.88	10.74	0.69	18.49	0.00	10.04	0.06	0.00	43.04	1.85	100.92	0.38	100.54

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 10 .	0.82	0.12	1.54	2.16	1.42	9.92	10.73	0.72	17.92	0.03	9.98	0.02	-0.02	43.19	1.83	100.41	0.37	100.03
Avg 109_amph_8.1	0.81	0.11	1.54	2.21	1.47	9.76	10.65	0.72	18.48	0.01	9.97	0.03	0.01	42.95	1.85	100.57	0.37	100.20
2 / 1 .	0.84	0.13	1.52	2.24	1.41	10.18	10.78	0.72	18.23	0.03	9.54	0.00	0.02	43.09	1.67	100.40	0.38	100.02
2 / 2 .	0.91	0.10	1.49	2.25	1.38	10.18	10.58	0.77	18.19	0.02	9.59	0.00	0.02	43.05	1.67	100.21	0.41	99.81
2 / 3 .	0.90	0.11	1.51	2.26	1.38	10.15	10.74	0.75	18.34	0.02	9.72	0.04	0.02	43.25	1.70	100.88	0.40	100.47
2 / 4 .	0.91	0.10	1.49	2.17	1.43	9.92	10.72	0.70	18.36	-0.03	9.88	0.03	0.07	42.85	1.72	100.36	0.41	99.95
2 / 5 .	0.79	0.11	1.56	2.15	1.48	9.98	10.99	0.70	18.43	-0.01	9.89	-0.01	0.04	43.09	1.70	100.89	0.35	100.54
2 / 6 .	0.81	0.13	1.54	2.22	1.48	9.92	10.87	0.71	18.31	-0.08	9.92	0.07	-0.03	42.77	1.74	100.48	0.37	100.11
2 / 7 .	0.87	0.12	1.52	2.24	1.46	10.06	10.90	0.73	18.65	-0.04	10.01	0.04	-0.03	42.88	1.67	101.15	0.39	100.76
2 / 8 .	0.98	0.12	1.46	2.24	1.47	9.95	10.77	0.72	18.43	-0.08	9.94	-0.01	-0.01	43.04	1.71	100.82	0.44	100.38
2 / 9 .	0.87	0.13	1.51	2.27	1.42	10.02	10.90	0.67	18.56	-0.03	9.95	0.01	0.04	42.79	1.71	100.84	0.39	100.44
2 / 10 . *	0.90	0.11	1.51	2.25	1.44	9.99	10.69	0.72	18.56	-0.05	10.06	0.03	0.03	43.18	1.91	101.38	0.41	100.97
Avg 109_amph_8.2	0.87	0.12	1.51	2.22	1.43	10.04	10.81	0.72	18.39	-0.02	9.83	0.02	0.02	42.98	1.70	100.63	0.39	100.24
FR-108c																		
108c amph 1																		
1 / 1 .	0.85	0.10	1.50	2.23	1.58	10.14	10.53	0.72	18.02	0.04	10.03	0.02	-0.01	41.94	1.85	99.57	0.38	99.19
1 / 2 .	0.80	0.09	1.54	2.24	1.58	10.24	10.70	0.69	18.05	0.10	10.16	0.06	0.00	42.02	1.70	99.97	0.36	99.61
1 / 3 .	0.90	0.09	1.49	2.29	1.55	10.34	10.66	0.73	18.29	-0.05	10.02	-0.01	0.00	41.88	1.81	100.04	0.40	99.64
1 / 4 .	0.93	0.11	1.47	2.33	1.58	10.27	10.73	0.75	18.14	0.11	9.97	0.05	-0.02	42.05	1.77	100.25	0.41	99.84
1 / 5 .	0.85	0.08	1.52	2.31	1.58	10.49	10.70	0.71	18.26	-0.04	9.95	0.03	-0.02	42.15	1.69	100.32	0.38	99.95
1 / 6 .	0.87	0.10	1.51	2.41	1.60	10.20	10.49	0.71	18.22	0.08	10.25	0.09	-0.01	42.05	1.82	100.39	0.39	100.00
1 / 7 .	0.89	0.08	1.50	2.40	1.59	10.31	10.59	0.75	18.32	0.16	10.22	0.07	0.01	41.83	1.82	100.52	0.39	100.13
1 / 8 .	0.85	0.10	1.52	2.37	1.60	10.18	10.73	0.71	18.32	0.04	10.17	0.00	0.02	42.14	1.95	100.72	0.38	100.34
1 / 9 .	0.91	0.09	1.49	2.37	1.55	10.24	10.57	0.80	18.14	-0.06	10.04	0.01	-0.04	42.17	1.81	100.19	0.41	99.78
1 / 10 .	0.83	0.11	1.52	2.35	1.58	10.31	10.45	0.65	17.94	-0.03	9.96	0.01	0.00	42.39	1.74	99.84	0.37	99.47
Avg 108c amph 1.1	0.87	0.10	1.51	2.33	1.58	10.27	10.61	0.72	18.17	0.04	10.08	0.03	0.00	42.06	1.79	100.16	0.39	99.77
2 / 1 .	0.78	0.10	1.55	2.31	1.60	10.20	10.68	0.74	18.02	-0.04	10.41	0.03	-0.08	41.82	1.83	100.07	0.35	99.72
2 / 2 .	0.77	0.09	1.55	2.32	1.63	10.21	10.78	0.69	18.07	0.11	10.37	-0.01	-0.02	41.75	1.65	100.01	0.35	99.66

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
2 / 3 .	0.83	0.10	1.52	2.32	1.60	10.07	10.75	0.76	18.32	0.02	10.50	0.06	-0.01	41.55	1.72	100.10	0.37	99.73
2 / 4 .	0.89	0.11	1.48	2.37	1.66	10.01	10.64	0.80	18.19	0.00	10.45	0.01	0.03	41.60	1.71	99.96	0.40	99.55
2 / 5 .	0.91	0.09	1.48	2.30	1.66	9.94	10.82	0.69	18.37	0.10	10.37	0.04	-0.03	41.63	1.69	100.09	0.41	99.69
2 / 6 .	0.85	0.10	1.51	2.38	1.59	10.05	10.70	0.75	18.25	-0.06	10.41	0.10	-0.03	41.41	1.79	99.87	0.38	99.50
2 / 7 .	0.85	0.12	1.51	2.37	1.60	9.92	10.69	0.71	18.15	0.03	10.48	-0.01	0.01	41.70	1.82	99.94	0.38	99.56
2 / 8 .	0.89	0.08	1.50	2.41	1.61	10.01	10.77	0.68	18.64	0.02	10.47	0.08	0.00	41.55	1.85	100.58	0.39	100.19
2 / 9 .	0.80	0.10	1.54	2.34	1.59	10.06	10.65	0.69	18.29	0.01	10.50	0.03	-0.01	41.72	1.83	100.16	0.36	99.80
2 / 10 .	0.76	0.10	1.56	2.32	1.53	10.18	10.75	0.76	18.64	-0.07	10.43	-0.03	0.00	41.59	1.72	100.33	0.34	99.99
Avg 108c amph 1.2	0.83	0.10	1.52	2.34	1.61	10.06	10.72	0.73	18.29	0.01	10.44	0.03	0.00	41.63	1.76	100.09	0.37	99.71
108c amph2	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 .	0.88	0.10	1.49	2.20	1.55	10.13	10.70	0.77	18.22	-0.10	10.23	0.05	-0.04	41.84	1.68	99.85	0.39	99.46
1 / 2 .	0.89	0.07	1.50	2.25	1.57	10.13	10.79	0.66	18.35	0.02	10.30	0.01	-0.09	41.89	1.72	100.13	0.39	99.74
1 / 3 .	0.90	0.09	1.49	2.26	1.59	10.15	10.71	0.71	18.22	0.04	10.14	0.03	0.00	41.92	1.65	99.90	0.40	99.50
1 / 4 .	0.87	0.08	1.50	2.29	1.58	10.12	10.61	0.63	18.18	0.05	10.31	-0.03	0.04	41.82	1.60	99.69	0.39	99.30
1 / 5 .	0.97	0.08	1.46	2.28	1.57	10.24	10.67	0.69	18.01	0.05	10.26	0.02	-0.07	42.00	1.64	99.94	0.43	99.52
2 / 1 .	0.98	0.09	1.47	2.27	1.62	10.22	10.76	0.68	18.54	-0.02	10.45	0.04	0.02	42.17	1.62	100.93	0.43	100.50
2 / 2 .	0.82	0.07	1.53	2.32	1.63	10.13	10.66	0.74	17.90	-0.07	10.39	0.03	0.01	41.85	1.74	99.81	0.36	99.45
2 / 3 .	0.91	0.09	1.47	2.29	1.62	10.13	10.77	0.73	17.75	0.02	10.37	0.06	-0.01	41.65	1.59	99.45	0.40	99.05
2 / 4 .	0.95	0.09	1.46	2.30	1.54	10.38	10.82	0.76	18.02	0.08	10.30	0.06	0.01	41.81	1.51	100.11	0.42	99.69
2 / 5 .	0.83	0.10	1.52	2.26	1.62	10.36	10.69	0.76	17.96	-0.05	10.17	0.05	-0.03	42.00	1.49	99.81	0.37	99.44
Avg 108c amph 2.1	0.90	0.09	1.49	2.27	1.59	10.20	10.72	0.71	18.12	0.00	10.29	0.03	-0.02	41.90	1.62	99.91	0.40	99.51
3 / 1 .	0.86	0.10	1.51	2.24	1.55	10.45	10.83	0.76	18.06	0.14	10.10	0.04	-0.02	41.97	1.93	100.55	0.39	100.17
3 / 2 .	0.85	0.10	1.51	2.26	1.58	10.23	10.72	0.72	18.14	0.00	10.16	0.05	-0.02	42.08	1.66	100.06	0.38	99.68
3 / 3 .	0.82	0.08	1.54	2.22	1.56	10.23	10.80	0.76	17.88	-0.04	10.12	0.03	0.02	42.05	1.85	99.95	0.36	99.59
3 / 4 .	0.86	0.09	1.50	2.23	1.56	10.25	10.78	0.73	17.96	0.03	10.02	0.06	-0.02	41.87	1.65	99.58	0.38	99.20
3 / 5 .	0.89	0.10	1.50	2.21	1.58	10.32	10.84	0.73	18.14	0.08	10.09	0.04	-0.02	42.22	1.74	100.49	0.40	100.09
Avg 108c amph 2.2	0.86	0.09	1.51	2.23	1.56	10.29	10.79	0.74	18.04	0.04	10.10	0.05	0.00	42.04	1.76	100.11	0.38	99.73
4 / 1 .	0.94	0.10	1.47	2.32	1.54	10.25	10.77	0.78	18.12	0.05	10.07	0.03	0.01	41.97	1.73	100.14	0.42	99.72
4 / 2 .	0.84	0.09	1.53	2.27	1.54	10.21	10.83	0.74	18.42	0.08	10.24	0.04	-0.08	41.97	1.82	100.59	0.37	100.22

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
4 / 3 .	0.78	0.10	1.55	2.19	1.59	10.20	10.81	0.69	18.50	0.04	10.17	0.06	0.02	42.12	1.64	100.47	0.35	100.12
4 / 4 .	0.81	0.10	1.53	2.27	1.59	10.28	10.81	0.72	18.40	0.01	10.22	-0.03	0.01	41.89	1.76	100.40	0.37	100.04
4 / 5 .	0.80	0.08	1.55	2.15	1.58	10.18	10.78	0.69	18.76	0.05	10.21	-0.03	0.00	41.94	1.74	100.51	0.36	100.15
4 / 6 .	0.79	0.09	1.54	2.18	1.56	10.11	10.66	0.67	18.55	0.06	10.15	-0.02	0.02	41.93	1.77	100.08	0.36	99.73
4 / 7 .	0.99	0.09	1.44	2.22	1.54	9.99	10.81	0.69	18.31	0.10	10.11	0.03	0.04	41.98	1.66	100.01	0.44	99.57
4 / 8 .	0.83	0.08	1.53	2.20	1.56	10.18	10.85	0.74	18.39	0.01	10.14	-0.01	-0.03	41.99	1.67	100.17	0.37	99.81
4 / 9 .	0.95	0.09	1.47	2.24	1.54	10.28	10.75	0.67	18.43	-0.11	10.03	0.04	0.03	41.94	1.95	100.40	0.42	99.98
4 / 10 .	0.91	0.08	1.49	2.23	1.59	10.33	10.79	0.75	17.92	0.06	9.92	0.09	-0.01	42.09	1.63	99.88	0.40	99.48
Avg 108c amph 2.3	0.86	0.09	1.51	2.23	1.56	10.20	10.78	0.71	18.38	0.04	10.13	0.02	0.00	41.98	1.74	100.24	0.38	99.85
108c amph3																		
1 / 1 .	0.92	0.08	1.48	2.21	1.59	10.31	10.81	0.70	18.22	-0.02	10.20	0.03	0.01	41.92	1.51	99.98	0.41	99.58
1 / 2 .	0.90	0.07	1.49	2.20	1.60	10.28	10.83	0.71	18.13	0.05	10.18	0.02	0.05	41.82	1.58	99.91	0.39	99.52
1 / 3 . *	0.84	0.09	1.51	2.17	1.61	10.22	10.73	0.66	17.80	0.01	10.07	-0.04	0.04	42.04	1.44	99.22	0.38	98.84
1 / 4 .	0.80	0.09	1.53	2.19	1.62	10.28	10.77	0.71	18.00	0.04	10.17	0.03	0.01	41.81	1.40	99.43	0.36	99.08
1 / 5 .	0.96	0.09	1.46	2.13	1.58	10.45	10.85	0.59	17.94	-0.01	10.10	0.07	-0.01	42.13	1.48	99.85	0.42	99.42
1 / 6 .	1.02	0.09	1.43	2.28	1.60	10.31	10.90	0.68	18.20	-0.06	10.11	0.05	0.06	41.74	1.54	100.00	0.45	99.56
1 / 7 .	0.87	0.09	1.51	2.30	1.59	10.30	10.65	0.70	18.30	0.12	10.22	0.02	-0.11	42.07	1.63	100.36	0.38	99.97
1 / 8 . *	0.89	0.09	1.48	2.24	1.60	10.26	10.95	0.64	17.83	-0.05	10.07	0.06	0.01	41.66	1.61	99.39	0.40	99.00
1 / 9 .	1.05	0.09	1.41	2.26	1.64	10.18	10.60	0.63	18.19	-0.02	10.28	-0.02	0.00	41.94	1.62	99.89	0.46	99.43
1 / 10 .	0.76	0.08	1.55	2.27	1.63	10.25	10.74	0.68	18.09	0.01	10.22	0.02	0.03	41.77	1.52	99.63	0.34	99.29
2 / 1 .	0.93	0.10	1.48	2.25	1.60	10.22	10.60	0.70	18.40	0.04	10.17	0.11	0.04	41.99	1.67	100.28	0.41	99.87
2 / 2 . *	0.93	0.08	1.47	2.25	1.57	10.11	10.58	0.72	17.92	-0.04	10.11	0.04	-0.02	41.91	1.66	99.34	0.41	98.93
2 / 3 .	0.81	0.08	1.54	2.36	1.59	10.26	10.78	0.69	18.54	0.10	10.13	-0.02	0.01	42.05	1.64	100.60	0.36	100.24
2 / 4 .	0.97	0.08	1.46	2.37	1.60	10.11	10.85	0.73	18.29	0.06	10.17	0.03	-0.03	41.92	1.74	100.39	0.43	99.96
2 / 5 .	0.87	0.08	1.50	2.32	1.57	10.25	10.60	0.75	17.98	0.04	10.11	0.00	0.02	42.15	1.59	99.82	0.39	99.44
2 / 6 .	0.84	0.09	1.52	2.34	1.60	10.28	10.75	0.67	18.16	-0.02	10.08	0.02	0.01	41.95	1.74	100.05	0.38	99.68
2 / 7 .	0.94	0.08	1.47	2.36	1.59	10.36	10.58	0.71	17.89	0.04	9.97	0.06	0.00	42.04	1.82	99.92	0.42	99.51
2 / 8 .	0.83	0.08	1.53	2.36	1.59	10.32	10.79	0.73	18.10	0.01	10.12	0.02	0.00	42.13	1.72	100.34	0.37	99.97
2 / 9 .	0.94	0.09	1.47	2.38	1.55	10.29	10.79	0.70	17.80	0.02	9.94	0.02	-0.07	42.06	1.59	99.64	0.42	99.22
2 / 10 .	0.97	0.10	1.46	2.39	1.54	10.37	10.78	0.71	18.06	-0.03	9.90	0.08	0.01	42.19	1.86	100.41	0.43	99.98

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
Avg 108c_amph_3	0.90	0.09	1.49	2.29	1.59	10.28	10.74	0.69	18.14	0.02	10.12	0.03	0.00	41.98	1.63	100.01	0.40	99.60
108c amph4																		
1 / 1 .	0.95	0.09	1.47	2.24	1.58	10.45	10.75	0.72	17.70	0.02	9.91	0.06	0.03	42.48	1.68	100.12	0.42	99.70
1 / 2 .	0.82	0.09	1.53	2.26	1.59	10.43	10.71	0.70	17.57	0.06	9.91	0.01	0.00	42.50	1.75	99.94	0.37	99.57
1 / 3 .	0.93	0.08	1.48	2.30	1.55	10.47	10.66	0.69	18.10	-0.07	9.92	-0.02	0.00	42.27	1.49	99.94	0.41	99.53
1 / 4 .	0.81	0.09	1.53	2.25	1.57	10.31	10.53	0.78	17.73	0.03	10.08	0.04	0.02	42.05	1.71	99.52	0.36	99.16
1 / 5 .	1.04	0.09	1.43	2.20	1.59	10.54	10.80	0.70	18.08	-0.11	10.18	0.02	0.00	42.26	1.53	100.47	0.46	100.01
1 / 6 .	1.01	0.08	1.44	2.17	1.60	10.51	10.62	0.76	17.57	0.11	10.06	0.06	0.04	42.31	1.57	99.91	0.44	99.46
1 / 7 .	0.99	0.08	1.45	2.15	1.61	10.52	10.85	0.65	17.63	-0.06	10.15	0.05	0.01	42.25	1.54	99.93	0.43	99.49
1 / 8 .	0.98	0.09	1.46	2.27	1.57	10.50	10.76	0.72	17.87	0.05	10.25	0.04	0.04	42.21	1.72	100.54	0.43	100.11
1 / 9 .	0.94	0.09	1.47	2.31	1.61	10.48	10.75	0.68	17.73	0.00	10.23	0.05	0.03	41.91	1.64	99.93	0.42	99.51
1 / 10 .	0.96	0.10	1.46	2.28	1.58	10.46	10.82	0.69	17.61	0.04	10.29	0.05	-0.03	41.94	1.52	99.78	0.42	99.36
Avg 108c_amph_4.1	0.94	0.09	1.47	2.24	1.58	10.47	10.73	0.71	17.76	0.01	10.10	0.04	0.01	42.22	1.61	99.98	0.42	99.56
2 / 1 .	0.92	0.07	1.48	2.24	1.55	10.49	10.67	0.74	17.45	0.02	9.88	0.04	-0.01	42.17	1.83	99.56	0.40	99.16
2 / 2 . *	0.95	0.08	1.46	2.22	1.56	10.35	10.75	0.74	17.46	0.05	10.14	-0.01	0.01	41.80	1.76	99.32	0.42	98.91
2 / 3 .	0.87	0.11	1.50	2.33	1.58	10.46	10.72	0.75	17.38	0.06	10.07	0.03	-0.01	41.83	1.98	99.68	0.39	99.29
2 / 4 .	0.97	0.08	1.46	2.24	1.57	10.39	10.76	0.74	17.73	-0.07	10.05	0.00	0.02	41.97	1.91	99.90	0.43	99.47
2 / 5 .	0.87	0.07	1.51	2.17	1.49	10.64	10.78	0.78	17.49	0.02	10.11	0.03	-0.01	42.11	1.62	99.69	0.38	99.30
3 / 1 .	0.97	0.09	1.45	2.10	1.46	10.68	10.92	0.71	17.25	0.07	9.85	0.08	-0.01	42.27	1.53	99.44	0.43	99.02
3 / 2 . *	0.90	0.09	1.49	2.17	1.51	10.54	10.76	0.65	17.32	0.04	9.87	0.06	-0.01	42.26	1.73	99.38	0.40	98.99
3 / 3 .	0.96	0.08	1.46	2.21	1.48	10.52	10.81	0.74	17.49	-0.05	9.96	0.03	-0.03	42.18	1.75	99.67	0.42	99.24
3 / 4 . *	0.87	0.09	1.49	2.18	1.53	10.34	10.72	0.75	17.51	-0.12	9.95	0.00	-0.02	41.87	1.69	98.99	0.39	98.60
3 / 5 .	0.96	0.09	1.46	2.12	1.50	10.41	10.78	0.71	17.79	-0.03	10.06	0.04	0.00	41.96	1.71	99.59	0.42	99.17
3 / 6 . *	0.84	0.10	1.50	2.18	1.53	10.42	10.68	0.73	17.53	0.05	10.00	-0.01	-0.12	41.85	1.75	99.17	0.38	98.79
3 / 7 .	0.93	0.10	1.47	2.12	1.53	10.54	11.00	0.71	17.78	-0.02	9.86	-0.02	-0.01	41.96	1.72	99.72	0.41	99.30
3 / 8 .	0.80	0.10	1.53	2.14	1.57	10.42	10.75	0.76	17.64	-0.02	9.91	0.06	0.03	42.02	1.75	99.46	0.36	99.11
3 / 9 .	0.88	0.10	1.50	2.15	1.52	10.61	10.69	0.72	17.60	-0.07	10.00	0.03	0.03	42.17	1.78	99.77	0.39	99.38
3 / 10 .	0.88	0.08	1.51	2.11	1.50	10.72	10.73	0.69	17.17	0.04	10.22	0.05	0.05	42.15	1.84	99.74	0.39	99.35
Avg 108c_amph_4.2	0.91	0.09	1.48	2.18	1.52	10.54	10.78	0.73	17.52	0.00	10.00	0.03	0.00	42.07	1.77	99.63	0.40	99.22

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
108c amph5																		
1 / 1 .	0.86	0.08	1.51	2.17	1.55	10.23	10.73	0.68	17.92	0.00	10.18	-0.02	-0.01	41.89	1.75	99.55	0.38	99.17
1 / 2 .	0.84	0.08	1.52	2.25	1.58	10.26	10.74	0.75	18.14	0.13	10.05	0.01	0.02	41.77	1.75	99.89	0.37	99.52
1 / 3 .	0.76	0.10	1.54	2.21	1.55	10.16	10.66	0.70	18.08	-0.05	10.02	0.02	0.03	41.78	1.75	99.37	0.34	99.02
1 / 4 .	0.82	0.08	1.52	2.26	1.57	10.10	10.52	0.67	18.06	0.07	10.25	-0.02	0.01	41.86	1.70	99.49	0.36	99.13
1 / 5 .	0.88	0.07	1.51	2.22	1.63	10.23	10.67	0.77	17.98	-0.08	10.15	0.03	-0.01	41.91	1.91	99.95	0.39	99.56
1 / 6 .	0.89	0.08	1.50	2.28	1.58	10.39	10.70	0.70	17.97	0.06	10.27	0.03	-0.01	41.91	1.71	100.06	0.39	99.67
1 / 7 .	0.94	0.09	1.46	2.24	1.56	10.23	10.70	0.76	17.63	0.10	10.21	0.04	0.00	41.81	1.82	99.59	0.42	99.17
1 / 8 . *	0.93	0.11	1.46	2.19	1.56	10.30	10.71	0.72	17.57	0.06	10.06	-0.04	0.05	41.87	1.81	99.39	0.42	98.97
1 / 9 . *	0.90	0.10	1.48	2.29	1.58	10.32	10.73	0.72	17.39	0.00	10.06	0.03	0.05	41.87	1.76	99.28	0.40	98.87
1 / 10 . *	0.96	0.08	1.46	2.24	1.53	10.52	10.69	0.71	17.10	0.05	10.12	0.01	0.00	42.00	1.62	99.09	0.42	98.67
Avg 108c_amph_5	0.85	0.08	1.51	2.23	1.58	10.23	10.67	0.72	17.97	0.03	10.16	0.01	0.00	41.85	1.77	99.67	0.38	99.29
108c amph6																		
1 / 1 . *	0.81	0.09	1.53	2.11	1.48	10.20	10.79	0.76	17.51	0.00	10.02	0.01	0.00	42.08	1.77	99.16	0.36	98.80
1 / 2 . *	0.77	0.09	1.54	2.16	1.54	10.21	10.77	0.71	17.76	0.01	9.98	-0.02	0.03	41.95	1.63	99.17	0.35	98.82
1 / 3 .	0.85	0.09	1.51	2.17	1.53	10.22	10.70	0.76	17.89	0.07	10.00	0.04	0.02	41.94	1.78	99.59	0.38	99.21
1 / 4 .	0.96	0.08	1.46	2.23	1.55	10.22	10.60	0.70	17.76	-0.02	10.18	-0.01	-0.01	41.84	1.92	99.50	0.42	99.08
1 / 5 . *	0.80	0.09	1.53	2.20	1.58	10.22	10.83	0.70	17.64	0.01	10.06	0.10	-0.04	41.67	1.85	99.27	0.36	98.92
1 / 6 .	0.88	0.08	1.50	2.22	1.58	10.34	10.78	0.72	17.74	0.01	10.02	0.03	-0.05	41.75	1.83	99.46	0.39	99.08
1 / 7 . *	0.79	0.07	1.54	2.22	1.59	10.31	10.65	0.67	17.69	0.00	10.11	0.05	0.01	41.82	1.64	99.15	0.35	98.80
1 / 8 .	0.91	0.09	1.48	2.16	1.58	10.37	10.82	0.69	18.02	0.03	10.10	0.04	-0.02	41.95	1.63	99.88	0.40	99.48
1 / 9 .	0.90	0.08	1.49	2.12	1.55	10.22	10.85	0.66	17.75	0.07	10.06	0.05	-0.01	42.09	1.77	99.66	0.40	99.26
1 / 10 .	0.80	0.09	1.53	2.18	1.52	10.36	10.79	0.70	17.62	0.02	9.86	0.04	0.01	42.32	1.69	99.54	0.36	99.18
Avg 108c_amph_6.1	0.88	0.09	1.49	2.18	1.55	10.29	10.76	0.71	17.80	0.03	10.04	0.03	0.00	41.98	1.77	99.60	0.39	99.20
2 / 1 . *	0.93	0.10	1.47	2.07	1.47	10.52	10.73	0.65	17.61	-0.03	9.97	0.03	0.00	42.26	1.44	99.25	0.41	98.84
2 / 2 . *	0.89	0.10	1.48	2.21	1.52	10.26	10.66	0.71	17.56	-0.02	10.10	0.01	0.02	41.89	1.67	99.08	0.40	98.68
2 / 3 .	0.92	0.08	1.48	2.27	1.55	10.34	10.60	0.75	17.91	-0.05	10.12	0.05	-0.04	41.79	1.80	99.66	0.41	99.25
2 / 4 .	0.88	0.09	1.50	2.21	1.53	10.41	10.66	0.69	17.96	0.00	10.00	0.10	-0.03	42.02	1.75	99.80	0.39	99.41
2 / 5 . *	0.99	0.08	1.44	2.17	1.51	10.41	10.70	0.70	17.68	0.04	9.93	-0.01	0.03	41.98	1.71	99.37	0.43	98.94
3 / 1 .	0.97	0.10	1.46	2.17	1.48	10.53	10.73	0.72	17.73	-0.03	10.01	0.05	-0.02	42.38	1.45	99.77	0.43	99.34

Table B3: Amphibole Chemistries
* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
3 / 2 . *	0.97	0.08	1.45	2.15	1.50	10.42	10.58	0.67	17.58	0.14	10.05	0.03	-0.07	42.03	1.57	99.23	0.43	98.80
3 / 3 . *	0.91	0.08	1.48	2.10	1.51	10.48	10.45	0.67	17.90	0.08	10.35	-0.04	0.02	41.85	1.48	99.38	0.40	98.98
3 / 4 .	0.88	0.09	1.50	2.21	1.48	10.31	10.76	0.66	17.83	0.02	10.20	0.00	0.03	42.13	1.57	99.66	0.39	99.27
3 / 5 . *	0.95	0.09	1.46	2.15	1.51	10.28	10.68	0.61	17.69	0.04	10.03	0.03	-0.01	42.24	1.44	99.18	0.42	98.76
Avg 108c_amph_6.2	0.91	0.09	1.48	2.22	1.51	10.40	10.69	0.70	17.86	-0.02	10.08	0.05	0.00	42.08	1.64	99.69	0.40	99.29
108c amph7																		
1 / 1 .	0.87	0.08	1.50	2.25	1.57	10.06	10.67	0.73	18.20	0.05	10.03	0.06	0.01	41.98	1.71	99.78	0.38	99.39
1 / 2 .	0.89	0.07	1.49	2.23	1.55	10.00	10.71	0.79	18.72	-0.03	10.04	0.04	0.00	41.78	1.81	100.12	0.39	99.73
1 / 3 .	0.81	0.08	1.54	2.28	1.58	10.06	10.59	0.77	18.26	-0.04	10.27	0.03	0.00	42.01	1.78	100.05	0.36	99.70
1 / 4 .	0.75	0.09	1.55	2.30	1.54	10.02	10.46	0.82	18.34	0.09	10.04	0.04	-0.06	41.68	1.87	99.61	0.34	99.27
1 / 5 .	0.81	0.08	1.53	2.23	1.53	10.03	10.50	0.72	18.31	-0.01	10.03	0.01	-0.03	41.94	1.86	99.58	0.36	99.22
1 / 6 .	0.83	0.10	1.51	2.30	1.59	9.96	10.67	0.71	18.34	0.07	10.01	0.09	0.03	41.84	1.81	99.88	0.37	99.51
1 / 7 .	0.93	0.07	1.47	2.27	1.58	9.95	10.64	0.79	18.42	-0.08	9.97	0.05	0.03	41.91	1.82	99.93	0.41	99.52
1 / 8 .	0.88	0.09	1.49	2.25	1.60	10.11	10.66	0.73	18.16	-0.05	9.78	0.01	0.04	42.00	1.85	99.66	0.39	99.27
1 / 9 .	0.98	0.08	1.45	2.28	1.55	9.99	10.63	0.76	18.29	0.03	9.84	0.06	-0.06	42.11	1.82	99.87	0.43	99.44
1 / 10 .	0.77	0.08	1.55	2.24	1.55	10.13	10.31	0.75	18.38	0.06	9.81	0.04	0.04	42.07	2.00	99.79	0.34	99.45
Avg 108c_amph_7	0.85	0.08	1.51	2.26	1.56	10.03	10.58	0.76	18.34	0.01	9.98	0.05	0.00	41.93	1.83	99.79	0.38	99.41
108c amph8																		
1 / 1 .	0.85	0.08	1.51	2.28	1.64	10.21	10.57	0.73	18.14	-0.03	10.30	0.02	0.00	41.61	1.72	99.66	0.38	99.28
1 / 2 .	0.86	0.10	1.50	2.28	1.62	10.14	10.60	0.81	18.18	0.07	10.11	0.03	0.02	41.71	1.71	99.75	0.39	99.37
1 / 3 . *	0.90	0.08	1.48	2.29	1.59	10.06	10.41	0.73	18.07	0.04	10.24	0.06	0.02	41.60	1.82	99.38	0.40	98.99
1 / 4 .	1.01	0.09	1.43	2.26	1.55	10.23	10.74	0.76	18.06	-0.04	10.14	0.00	-0.02	41.72	1.97	99.97	0.45	99.53
1 / 5 .	0.92	0.09	1.48	2.29	1.55	10.30	10.53	0.75	17.86	0.05	10.15	0.03	0.00	41.99	1.80	99.78	0.41	99.37
1 / 6 .	0.82	0.09	1.52	2.26	1.60	10.28	10.66	0.69	18.04	-0.07	10.12	0.02	0.03	41.79	1.78	99.69	0.37	99.32
1 / 7 .	0.89	0.07	1.50	2.26	1.53	10.18	10.65	0.72	18.23	0.06	10.17	0.01	0.02	41.93	2.15	100.37	0.39	99.98
1 / 8 .	0.91	0.09	1.48	2.22	1.59	10.21	10.82	0.66	17.91	0.02	10.02	0.04	-0.04	41.90	1.79	99.65	0.40	99.24
1 / 9 .	0.87	0.08	1.51	2.28	1.58	10.31	10.68	0.72	18.10	-0.09	10.14	0.01	0.04	41.77	2.01	100.10	0.38	99.72
1 / 10 .	0.94	0.08	1.47	2.28	1.56	10.23	10.52	0.72	17.97	0.02	9.98	-0.01	0.03	42.02	1.93	99.74	0.41	99.33
Avg 108c_amph_8	0.90	0.08	1.49	2.27	1.58	10.23	10.64	0.73	18.05	0.00	10.13	0.02	0.01	41.83	1.87	99.82	0.40	99.43

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
108c amph9																		
1 / 1 .	1.09	0.08	1.41	2.21	1.55	11.02	10.87	0.69	17.19	0.04	10.23	-0.04	0.04	42.34	1.35	100.11	0.48	99.63
1 / 2 .	0.92	0.09	1.48	2.22	1.53	10.82	10.89	0.67	17.28	0.02	10.14	0.00	0.01	42.39	1.36	99.84	0.41	99.43
1 / 3 .	1.00	0.08	1.46	2.17	1.55	10.79	10.79	0.65	17.50	0.04	10.20	0.02	0.02	42.39	1.50	100.15	0.44	99.71
1 / 4 .	0.99	0.10	1.44	2.25	1.54	10.67	10.79	0.73	17.26	0.07	10.13	0.02	0.00	42.18	1.46	99.62	0.44	99.18
1 / 5 .	0.96	0.10	1.46	2.26	1.53	10.64	10.81	0.71	17.57	0.02	10.28	-0.01	-0.11	42.04	1.27	99.65	0.43	99.23
1 / 6 . *	0.95	0.11	1.46	2.22	1.56	10.61	10.77	0.64	17.46	0.03	10.23	0.01	-0.01	42.01	1.37	99.42	0.42	99.00
1 / 7 .	0.98	0.09	1.45	2.22	1.60	10.72	10.74	0.66	17.50	0.03	10.24	-0.04	-0.01	42.10	1.46	99.79	0.43	99.36
1 / 8 . *	0.97	0.11	1.44	2.17	1.57	10.62	10.64	0.64	17.48	-0.06	10.20	0.02	0.01	42.10	1.47	99.42	0.43	98.99
1 / 9 .	0.99	0.09	1.45	2.26	1.52	10.61	10.84	0.68	17.39	-0.04	10.20	-0.01	-0.05	42.21	1.32	99.55	0.44	99.12
1 / 10 .	0.98	0.08	1.45	2.14	1.51	10.73	10.80	0.70	17.47	-0.04	10.23	-0.01	0.01	42.25	1.25	99.59	0.43	99.16
Avg 108c_amph_9	0.99	0.09	1.45	2.22	1.54	10.75	10.81	0.69	17.40	0.02	10.21	-0.01	0.00	42.24	1.37	99.76	0.44	99.32
108c amph10																		
1 / 1 .	0.89	0.07	1.51	2.02	1.51	10.58	11.07	0.66	17.36	0.02	10.15	0.06	0.05	42.29	1.81	100.05	0.39	99.66
1 / 2 .	0.91	0.08	1.49	2.07	1.47	10.54	10.93	0.68	17.68	-0.02	10.22	0.03	-0.03	42.23	1.74	100.06	0.40	99.66
1 / 3 .	0.74	0.08	1.57	2.15	1.50	10.59	10.78	0.68	17.43	0.02	10.00	0.01	0.03	42.29	1.74	99.63	0.33	99.30
1 / 4 .	0.83	0.10	1.53	2.02	1.54	10.85	10.98	0.62	17.27	0.03	9.83	0.08	-0.01	42.59	1.59	99.85	0.37	99.48
1 / 5 .	1.00	0.09	1.45	2.18	1.54	10.65	10.94	0.64	17.64	-0.07	10.04	0.06	0.01	42.34	1.75	100.33	0.44	99.89
1 / 6 .	0.99	0.08	1.46	2.19	1.53	10.59	10.89	0.66	17.60	0.04	10.02	-0.04	-0.01	42.39	1.75	100.19	0.43	99.76
1 / 7 .	0.87	0.09	1.51	2.19	1.50	10.70	10.90	0.65	17.60	0.01	10.09	0.03	-0.01	42.25	1.72	100.10	0.39	99.71
1 / 8 .	0.91	0.10	1.50	2.12	1.52	10.74	11.11	0.59	17.60	-0.04	9.99	0.08	0.00	42.36	1.67	100.29	0.40	99.88
1 / 9 .	1.01	0.09	1.45	2.18	1.47	10.63	10.80	0.68	17.44	0.08	9.99	-0.01	0.01	42.52	1.68	100.02	0.44	99.57
1 / 10 .	0.88	0.08	1.51	2.11	1.46	10.84	11.04	0.66	17.21	-0.05	9.89	0.03	0.00	42.68	1.58	99.98	0.39	99.59
Avg 108c_amph_10	0.90	0.09	1.50	2.12	1.50	10.67	10.94	0.65	17.48	0.00	10.02	0.03	0.00	42.39	1.70	100.02	0.40	99.62

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108_amph_1	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 .	0.88	0.08	1.52	2.30	1.43	10.58	10.69	0.73	17.82	0.12	10.17	-0.01	0.06	42.37	1.88	100.64	0.39	100.25
1 / 2 .	0.80	0.09	1.54	2.30	1.38	10.52	10.50	0.73	17.76	-0.01	9.98	0.03	0.03	42.33	1.79	99.77	0.36	99.42
1 / 3 .	0.91	0.10	1.49	2.31	1.43	10.50	10.70	0.74	17.69	0.05	10.13	0.01	-0.02	42.22	1.81	100.07	0.41	99.67

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 4 .	0.89	0.12	1.48	2.27	1.51	10.30	10.45	0.81	17.40	0.05	10.17	0.10	0.13	41.98	1.82	99.48	0.40	99.08
1 / 5 .	0.83	0.08	1.53	2.32	1.46	10.39	10.47	0.71	17.96	0.05	10.26	0.04	-0.01	42.08	1.84	100.02	0.37	99.65
1 / 6 .	0.88	0.11	1.49	2.26	1.53	10.38	10.49	0.75	17.63	0.06	10.33	0.02	0.01	41.95	1.91	99.81	0.40	99.41
1 / 7 .	0.94	0.09	1.48	2.29	1.42	10.44	10.53	0.63	17.56	-0.13	10.22	0.03	0.08	42.35	1.85	99.91	0.42	99.49
1 / 8 .	0.92	0.10	1.47	2.33	1.48	10.27	10.39	0.75	17.73	0.09	10.33	0.05	-0.06	41.72	1.95	99.58	0.41	99.17
1 / 9 .	0.86	0.10	1.50	2.36	1.44	10.32	10.65	0.71	17.85	0.03	10.22	0.05	0.00	41.87	1.71	99.68	0.39	99.29
1 / 10 . *	0.93	0.09	1.47	2.32	1.46	10.28	10.31	0.69	17.72	-0.06	10.21	0.04	0.03	41.81	1.91	99.25	0.41	98.84
Avg 108_amph_1	0.88	0.10	1.50	2.30	1.45	10.41	10.54	0.73	17.71	0.04	10.20	0.03	0.03	42.10	1.84	99.86	0.39	99.47
108_amph_2	F	Cl	H2O	Na2O	K2O	MgO	CaO	MnO	FeO	BaO	Al2O3	V2O3	Cr2O3	SiO2	TiO2	Total	O=F , Cl	Total
1 / 1 .	0.88	0.08	1.55	2.22	1.22	11.19	10.56	0.73	17.10	0.02	9.46	0.08	0.00	44.41	1.77	101.29	0.39	100.90
1 / 2 .	0.95	0.08	1.52	2.17	1.31	11.16	10.57	0.71	17.13	0.08	9.45	0.01	0.01	44.40	1.79	101.33	0.42	100.92
1 / 3 . *	0.95	0.09	1.51	2.31	1.34	10.55	10.57	0.76	17.87	0.13	9.98	0.08	-0.03	43.52	1.90	101.54	0.42	101.12
1 / 4 . *	0.91	0.10	1.53	2.24	1.34	10.64	10.64	0.69	18.06	0.05	9.96	0.03	-0.04	43.73	1.90	101.83	0.41	101.42
1 / 5 .	0.84	0.11	1.56	2.07	1.19	11.26	10.77	0.75	17.31	-0.04	9.20	0.02	0.02	44.47	1.63	101.19	0.38	100.81
1 / 6 .	0.80	0.09	1.58	2.12	1.31	10.78	10.52	0.73	17.56	-0.32	9.69	0.07	0.04	43.75	1.83	100.87	0.36	100.51
1 / 7 .	0.88	0.10	1.54	2.02	1.20	11.19	10.55	0.71	17.20	0.00	9.35	0.07	-0.02	44.35	1.70	100.85	0.39	100.46
1 / 8 .	0.78	0.11	1.58	2.09	1.34	10.82	10.87	0.73	17.57	0.06	9.67	0.10	-0.08	43.77	1.80	101.29	0.35	100.94
1 / 9 .	0.87	0.12	1.53	2.21	1.32	10.67	10.62	0.70	17.84	-0.04	9.94	0.09	-0.01	43.41	1.77	101.09	0.39	100.70
1 / 10 . *	0.82	0.12	1.56	2.23	1.37	10.68	10.79	0.70	17.53	0.08	10.03	0.02	0.07	43.58	1.77	101.37	0.37	101.00
Avg 108_amph_2.1	0.86	0.10	1.55	2.13	1.27	11.01	10.64	0.72	17.39	-0.03	9.54	0.06	-0.01	44.08	1.76	101.06	0.38	100.68
2 / 1 . *	0.95	0.09	1.50	2.33	1.42	10.50	10.43	0.82	17.90	0.11	9.97	0.01	0.02	43.47	1.93	101.45	0.42	101.03
2 / 2 .	0.84	0.10	1.55	2.38	1.42	10.40	10.57	0.73	17.88	-0.10	10.22	0.03	0.05	43.16	1.93	101.26	0.38	100.89
2 / 3 .	0.87	0.13	1.53	2.39	1.39	10.43	10.65	0.71	17.69	0.05	10.22	0.02	-0.04	43.11	2.10	101.27	0.40	100.88
2 / 4 .	0.90	0.10	1.51	2.39	1.44	10.38	10.38	0.68	17.80	0.00	10.18	0.04	0.05	42.98	2.00	100.84	0.40	100.43
2 / 5 .	0.83	0.11	1.55	2.38	1.45	10.28	10.42	0.72	17.68	0.08	10.23	0.06	-0.02	43.08	2.08	100.94	0.37	100.57
2 / 6 .	0.82	0.10	1.55	2.37	1.44	10.33	10.30	0.69	17.66	0.03	10.14	0.07	0.05	43.11	1.92	100.57	0.37	100.20
2 / 7 .	0.88	0.11	1.53	2.39	1.42	10.39	10.64	0.76	17.80	-0.01	10.20	0.08	-0.06	42.92	1.91	101.03	0.39	100.63
2 / 8 .	0.90	0.11	1.52	2.33	1.44	10.37	10.74	0.73	18.10	-0.05	10.20	0.06	0.00	42.93	2.16	101.59	0.40	101.19
2 / 9 .	0.77	0.11	1.58	2.32	1.44	10.31	10.44	0.71	17.65	-0.08	10.10	0.03	0.00	43.24	2.00	100.71	0.35	100.36
2 / 10 .	0.90	0.10	1.52	2.39	1.48	10.34	10.47	0.78	17.65	0.00	10.19	0.00	0.07	43.12	2.09	101.10	0.40	100.69

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
Avg 108_amph_2.2	0.85	0.11	1.54	2.38	1.43	10.36	10.48	0.72	17.73	0.00	10.19	0.04	0.01	43.09	2.00	100.93	0.38	100.54
108_amph_3																		
1 / 1 . *	0.93	0.12	1.51	2.28	1.37	10.47	10.72	0.70	17.87	0.01	10.22	0.03	-0.01	43.25	2.15	101.64	0.42	101.22
1 / 2 . *	0.91	0.11	1.52	2.21	1.38	10.58	10.70	0.71	17.95	0.18	10.07	0.05	0.02	43.33	2.13	101.85	0.41	101.44
1 / 3 .	0.84	0.10	1.55	2.24	1.33	10.73	10.69	0.72	17.36	0.01	9.79	0.07	-0.01	43.31	2.07	100.81	0.38	100.43
1 / 4 .	0.88	0.12	1.53	2.26	1.38	10.65	10.61	0.67	17.83	0.05	9.99	0.01	-0.02	43.06	2.09	101.12	0.40	100.72
1 / 5 .	0.85	0.11	1.55	2.27	1.34	10.75	10.68	0.75	17.58	-0.03	9.88	-0.02	-0.01	43.47	2.05	101.27	0.38	100.89
1 / 6 .	0.78	0.09	1.57	2.33	1.38	10.60	10.69	0.68	17.35	0.04	10.12	0.03	0.05	42.85	1.98	100.56	0.35	100.21
1 / 7 . *	0.90	0.11	1.52	2.28	1.39	10.65	10.55	0.73	17.69	0.16	10.20	0.04	0.03	43.17	2.04	101.46	0.40	101.06
1 / 8 .	0.83	0.10	1.56	2.21	1.37	10.73	10.63	0.70	17.64	-0.09	10.07	0.05	-0.01	43.28	1.84	101.00	0.37	100.63
1 / 9 .	0.97	0.09	1.49	2.27	1.34	10.75	10.65	0.70	17.21	-0.01	9.88	0.04	-0.14	43.59	1.91	100.91	0.43	100.48
1 / 10 .	0.84	0.11	1.54	2.28	1.39	10.62	10.60	0.70	17.20	-0.05	10.18	0.07	0.00	42.95	2.05	100.53	0.38	100.15
2 / 1 .	0.92	0.11	1.51	2.29	1.45	10.41	10.65	0.72	17.52	0.00	10.39	0.05	0.02	42.87	2.00	100.91	0.41	100.50
2 / 2 .	0.91	0.13	1.51	2.32	1.41	10.43	10.47	0.67	17.83	-0.02	10.31	0.00	0.00	42.99	1.99	100.97	0.41	100.56
2 / 3 .	0.89	0.10	1.52	2.32	1.42	10.34	10.59	0.70	17.93	0.07	10.37	0.08	0.03	42.96	1.88	101.20	0.40	100.80
2 / 4 .	0.94	0.11	1.49	2.32	1.36	10.56	10.52	0.71	17.74	0.06	10.34	0.02	0.00	42.92	1.93	101.01	0.42	100.59
2 / 5 .	0.85	0.11	1.54	2.33	1.36	10.59	10.66	0.70	17.98	0.04	10.20	-0.03	0.00	42.92	1.94	101.22	0.38	100.84
2 / 6 .	0.92	0.12	1.51	2.28	1.41	10.57	10.70	0.69	17.75	-0.01	10.11	0.06	-0.01	43.21	1.92	101.25	0.41	100.83
2 / 7 .	0.89	0.09	1.52	2.22	1.41	10.55	10.64	0.73	17.46	0.26	10.02	0.05	0.01	43.24	1.96	101.06	0.40	100.66
2 / 8 .	0.87	0.12	1.54	2.24	1.43	10.70	10.62	0.69	17.58	0.06	10.10	0.05	0.02	43.27	1.95	101.23	0.39	100.84
2 / 9 .	0.97	0.10	1.49	2.27	1.43	10.66	10.75	0.64	17.38	-0.13	10.09	0.02	-0.01	43.20	1.91	100.91	0.43	100.48
2 / 10 .	0.82	0.09	1.56	2.24	1.38	10.63	10.60	0.72	17.40	0.11	10.13	0.01	-0.04	43.15	1.91	100.75	0.36	100.38
Avg 108_amph_3	0.88	0.11	1.53	2.28	1.39	10.60	10.63	0.70	17.57	0.02	10.12	0.03	-0.01	43.13	1.96	100.95	0.39	100.55
108_amph_4																		
1 / 1 .	0.77	0.10	1.59	2.16	1.31	10.69	10.76	0.72	17.48	-0.05	10.05	0.04	-0.03	43.43	1.71	100.79	0.35	100.44
1 / 2 .	0.90	0.10	1.53	2.23	1.34	10.54	10.46	0.72	17.82	0.06	10.16	0.02	-0.02	43.47	1.79	101.14	0.40	100.74
1 / 3 .	0.85	0.10	1.54	2.21	1.36	10.59	10.54	0.71	17.44	-0.07	10.11	-0.02	0.01	43.34	1.85	100.66	0.38	100.28
1 / 4 .	0.84	0.11	1.55	2.24	1.35	10.48	10.71	0.76	17.87	-0.02	10.18	0.01	-0.01	43.39	1.81	101.31	0.38	100.93
1 / 5 .	0.95	0.12	1.49	2.29	1.38	10.65	10.48	0.71	17.47	0.12	10.14	-0.08	0.01	43.05	2.02	100.87	0.43	100.44
1 / 6 .	0.91	0.11	1.50	2.29	1.36	10.53	10.52	0.68	17.42	-0.11	10.27	0.05	-0.01	42.70	1.85	100.20	0.41	99.79

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 7 .	0.87	0.11	1.53	2.24	1.36	10.58	10.64	0.68	17.92	0.20	10.10	0.03	0.04	42.97	1.92	101.19	0.39	100.80
1 / 8 .	0.85	0.12	1.53	2.03	1.22	11.26	9.86	0.65	17.87	0.18	10.34	0.00	-0.02	42.68	1.49	100.08	0.38	99.70
1 / 9 .	0.76	0.11	1.59	2.19	1.32	10.61	10.80	0.64	17.61	-0.03	10.16	0.02	-0.05	43.52	1.70	101.03	0.35	100.68
1 / 10 .	0.86	0.10	1.54	2.14	1.29	10.75	10.59	0.63	17.32	0.03	10.05	0.03	0.00	43.49	1.71	100.54	0.39	100.15
2 / 1 .	1.03	0.11	1.46	2.18	1.37	10.75	10.71	0.66	17.57	0.05	10.06	0.02	0.00	43.38	1.87	101.21	0.46	100.75
2 / 2 .	0.89	0.11	1.52	2.24	1.41	10.69	10.49	0.77	17.93	0.03	9.98	0.04	0.03	43.34	1.79	101.27	0.40	100.87
2 / 3 .	0.93	0.13	1.50	2.29	1.35	10.56	10.64	0.61	17.47	0.12	10.04	0.03	0.05	43.23	1.95	100.89	0.42	100.47
2 / 4 .	1.00	0.12	1.47	2.24	1.39	10.60	10.68	0.63	17.61	-0.05	10.03	0.03	-0.07	43.14	2.08	101.02	0.45	100.57
2 / 5 .	0.95	0.10	1.49	2.21	1.40	10.61	10.50	0.65	17.93	0.05	9.93	0.01	0.01	43.19	1.71	100.74	0.42	100.32
2 / 6 .	0.86	0.11	1.53	2.21	1.37	10.45	10.66	0.67	17.71	0.03	10.25	0.06	-0.03	43.05	1.89	100.84	0.39	100.46
2 / 7 .	0.85	0.12	1.52	2.21	1.37	10.51	10.36	0.68	17.94	0.03	10.15	-0.03	0.01	42.76	1.84	100.35	0.39	99.97
2 / 8 .	0.84	0.10	1.55	2.21	1.37	10.59	10.49	0.65	17.98	0.06	10.24	0.03	0.00	42.97	1.92	101.00	0.37	100.62
2 / 9 .	0.98	0.11	1.49	2.29	1.34	10.69	10.56	0.62	17.62	0.04	10.27	0.01	0.00	43.14	2.17	101.31	0.44	100.87
2 / 10 .	0.87	0.11	1.54	2.26	1.43	10.56	10.72	0.62	17.67	0.01	10.21	0.00	0.04	43.16	1.89	101.07	0.39	100.68
108_amph_4.1	0.89	0.11	1.52	2.22	1.35	10.63	10.56	0.67	17.68	0.03	10.14	0.02	0.00	43.17	1.85	100.84	0.40	100.44
3 / 1 .	0.81	0.12	1.53	2.13	1.28	11.25	9.45	0.54	18.30	0.01	10.41	0.07	-0.02	42.12	1.68	99.71	0.37	99.34
3 / 2 .	0.80	0.11	1.56	2.29	1.41	10.50	10.56	0.58	17.53	0.09	10.17	0.05	0.03	43.20	1.75	100.64	0.36	100.28
3 / 3 .	0.93	0.11	1.50	2.27	1.40	10.50	10.57	0.63	17.65	0.07	10.21	0.05	-0.01	43.24	1.76	100.89	0.42	100.47
3 / 4 .	0.92	0.12	1.51	2.28	1.42	10.57	10.50	0.66	17.82	0.03	10.15	0.02	0.02	43.27	1.72	101.01	0.41	100.59
3 / 5 .	0.92	0.11	1.51	2.26	1.38	10.47	10.69	0.68	17.66	0.04	10.06	0.09	-0.02	43.44	1.79	101.12	0.41	100.71
3 / 6 .	0.84	0.11	1.54	2.22	1.41	10.48	10.83	0.64	17.64	0.12	10.11	0.09	0.01	43.20	1.69	100.97	0.38	100.59
3 / 7 .	0.90	0.11	1.51	2.21	1.39	10.42	10.80	0.61	17.55	0.07	10.11	0.00	0.02	43.08	1.73	100.50	0.40	100.09
3 / 8 .	0.78	0.13	1.57	2.20	1.40	10.51	10.77	0.66	18.01	0.04	10.15	0.07	0.00	43.15	1.64	101.07	0.36	100.71
3 / 9 .	0.89	0.10	1.52	2.26	1.37	10.57	10.50	0.59	17.68	0.03	10.10	0.05	-0.04	43.03	1.73	100.43	0.40	100.03
3 / 10 .	0.85	0.12	1.53	2.20	1.39	10.46	10.57	0.58	17.60	-0.03	10.14	0.02	0.01	43.21	1.79	100.47	0.38	100.09
Avg 108_amph_4.3	0.86	0.11	1.53	2.23	1.39	10.57	10.52	0.62	17.75	0.05	10.16	0.05	0.00	43.09	1.73	100.67	0.39	100.28
108_amph_5																		
1 / 1 .	0.96	0.11	1.48	2.37	1.46	10.36	10.51	0.62	17.91	0.07	10.25	0.05	0.05	42.98	1.86	101.03	0.43	100.60
1 / 2 .	0.79	0.11	1.57	2.31	1.41	10.39	10.53	0.69	17.59	-0.07	10.39	0.10	0.02	42.95	1.79	100.64	0.36	100.28
1 / 3 .	0.92	0.10	1.51	2.33	1.41	10.47	10.73	0.66	17.83	0.02	10.25	0.06	-0.01	42.91	1.92	101.13	0.41	100.72

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 4 .	0.91	0.09	1.52	2.33	1.41	10.46	10.58	0.60	17.92	-0.03	10.21	0.06	0.00	43.18	1.91	101.18	0.40	100.78
1 / 5 .	0.94	0.10	1.50	2.29	1.42	10.67	10.62	0.67	17.53	0.08	10.10	-0.01	0.02	43.40	1.72	101.08	0.42	100.66
1 / 6 .	0.86	0.09	1.55	2.30	1.44	10.59	10.84	0.60	17.60	-0.01	9.94	0.04	0.01	43.51	1.77	101.14	0.38	100.76
1 / 7 .	0.88	0.08	1.53	2.31	1.39	10.58	10.63	0.61	17.88	0.00	9.99	0.05	-0.02	43.34	1.73	101.01	0.39	100.62
1 / 8 .	0.88	0.09	1.54	2.33	1.46	10.40	10.75	0.65	17.91	-0.03	10.12	0.07	0.02	43.16	1.88	101.26	0.39	100.87
1 / 9 .	0.87	0.09	1.53	2.34	1.43	10.44	10.72	0.71	17.60	0.09	10.26	0.01	-0.03	42.89	1.95	100.92	0.39	100.53
1 / 10 .	0.87	0.06	1.54	2.26	1.45	10.51	10.79	0.68	17.56	0.05	10.23	0.08	0.04	42.98	1.74	100.85	0.38	100.47
Avg 108_amph_5.1	0.89	0.09	1.53	2.32	1.43	10.49	10.67	0.65	17.73	0.02	10.17	0.05	0.01	43.13	1.83	101.00	0.39	100.61
2 / 1 .	0.87	0.12	1.53	2.42	1.41	10.56	10.39	0.64	17.83	-0.01	10.17	0.05	-0.04	43.03	2.01	101.05	0.39	100.65
2 / 2 .	0.88	0.14	1.52	2.48	1.42	10.70	10.46	0.73	17.89	0.01	10.09	0.03	0.04	43.12	1.79	101.29	0.40	100.89
2 / 3 .	0.83	0.13	1.55	2.43	1.41	10.58	10.50	0.73	17.60	-0.09	10.06	0.00	0.01	43.28	1.96	101.08	0.38	100.70
2 / 4 .	0.92	0.09	1.51	2.35	1.43	10.52	10.39	0.69	17.45	0.05	10.17	0.00	0.00	43.29	1.88	100.72	0.41	100.31
2 / 5 .	0.92	0.10	1.51	2.36	1.44	10.54	10.37	0.69	17.86	0.11	10.19	0.01	0.00	43.15	1.96	101.21	0.41	100.80
2 / 6 . *	0.97	0.09	1.49	2.40	1.47	10.53	10.56	0.75	17.69	-0.07	10.15	0.15	0.05	43.21	1.88	101.39	0.43	100.96
2 / 7 .	0.84	0.09	1.56	2.36	1.43	10.49	10.44	0.67	17.93	0.03	10.21	0.07	0.05	43.13	2.00	101.27	0.37	100.90
2 / 8 .	0.87	0.08	1.54	2.37	1.41	10.61	10.57	0.67	17.75	0.02	10.10	0.07	0.01	43.14	1.97	101.18	0.38	100.80
2 / 9 .	0.87	0.09	1.53	2.31	1.43	10.43	10.49	0.70	17.70	0.04	10.29	0.05	-0.02	43.06	1.89	100.87	0.39	100.48
2 / 10 .	0.98	0.10	1.48	2.31	1.42	10.32	10.64	0.70	17.76	0.05	10.15	0.06	0.01	43.05	1.96	100.98	0.43	100.55
Avg 108_amph_5.2	0.89	0.10	1.53	2.38	1.42	10.53	10.47	0.69	17.75	0.02	10.16	0.04	0.01	43.14	1.94	101.05	0.40	100.66
108_amph_6																		
1 / 1 .	0.88	0.10	1.53	2.21	1.37	10.52	10.55	0.66	17.58	0.08	10.22	0.01	-0.03	43.10	2.07	100.88	0.39	100.49
1 / 2 .	0.90	0.10	1.51	2.23	1.37	10.60	10.38	0.68	17.52	-0.04	10.16	-0.01	-0.02	43.04	1.98	100.47	0.40	100.07
1 / 3 .	0.91	0.12	1.51	2.25	1.40	10.39	10.74	0.63	17.74	0.09	10.27	0.05	-0.01	43.08	1.97	101.17	0.41	100.76
1 / 4 .	0.93	0.13	1.49	2.26	1.43	10.48	10.50	0.66	17.70	0.06	10.18	0.03	-0.03	43.02	2.00	100.87	0.42	100.45
1 / 5 .	0.87	0.10	1.53	2.24	1.38	10.41	10.64	0.64	17.72	-0.01	10.17	0.03	0.05	43.05	2.09	100.93	0.39	100.55
1 / 6 .	0.98	0.11	1.47	2.21	1.42	10.46	10.68	0.67	17.69	0.00	10.19	0.02	0.00	42.98	2.10	100.99	0.44	100.55
1 / 7 .	0.88	0.11	1.52	2.25	1.42	10.52	10.45	0.59	17.62	-0.08	10.22	0.03	0.04	43.01	2.05	100.72	0.40	100.32
2 / 1 .	0.92	0.10	1.51	2.25	1.41	10.58	10.46	0.68	17.53	0.05	10.16	-0.01	0.00	43.34	1.85	100.86	0.41	100.45
2 / 2 .	0.91	0.08	1.52	2.22	1.37	10.58	10.61	0.68	17.20	-0.01	10.21	0.02	0.02	43.32	1.99	100.74	0.40	100.34
2 / 3 .	0.89	0.11	1.53	2.19	1.40	10.57	10.78	0.68	17.45	0.00	10.24	0.02	0.03	43.28	1.96	101.14	0.40	100.74

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
2 / 4 .	0.92	0.11	1.50	2.22	1.35	10.63	10.65	0.69	17.36	0.03	10.16	0.04	-0.03	43.07	1.88	100.62	0.41	100.21
2 / 5 .	0.84	0.10	1.55	2.21	1.36	10.64	10.50	0.66	17.27	-0.02	10.03	0.04	0.04	43.38	1.96	100.58	0.37	100.21
2 / 6 .	0.90	0.11	1.52	2.21	1.33	10.71	10.81	0.68	17.25	-0.02	9.94	0.04	0.01	43.54	1.91	100.97	0.40	100.57
2 / 7 .	0.82	0.09	1.57	2.17	1.31	10.76	10.72	0.64	17.22	-0.01	10.02	-0.01	-0.02	43.58	1.84	100.74	0.37	100.38
Avg 108_amph_6.2	0.89	0.10	1.53	2.21	1.36	10.64	10.65	0.67	17.33	0.00	10.11	0.02	0.01	43.36	1.91	100.79	0.40	100.39
3 / 1 .	0.81	0.12	1.56	2.24	1.42	10.99	10.67	0.67	17.17	0.05	10.11	0.02	-0.02	43.13	1.91	100.87	0.37	100.51
3 / 2 .	1.03	0.10	1.47	2.23	1.39	10.90	10.80	0.68	17.03	-0.06	10.26	0.07	0.01	43.22	2.11	101.31	0.46	100.85
3 / 3 .	0.89	0.10	1.53	2.23	1.44	10.80	10.77	0.65	17.33	0.08	10.23	0.05	0.00	42.95	2.04	101.10	0.40	100.71
3 / 4 .	0.93	0.12	1.49	2.10	1.31	11.04	9.90	0.61	18.01	-0.03	10.30	-0.02	0.03	42.64	1.92	100.40	0.42	99.98
3 / 5 .	0.82	0.10	1.56	2.09	1.34	11.04	10.43	0.69	17.53	0.02	10.25	0.01	0.03	42.82	1.87	100.59	0.37	100.23
3 / 6 .	0.79	0.13	1.56	2.21	1.38	10.69	10.87	0.63	17.22	0.01	10.03	0.05	0.03	42.99	2.00	100.60	0.36	100.23
3 / 7 .	0.90	0.11	1.52	2.26	1.36	10.83	10.61	0.68	17.30	-0.10	10.04	0.04	0.00	43.30	1.97	100.92	0.40	100.52
4 / 1 .	0.91	0.08	1.52	2.25	1.37	10.91	10.74	0.69	17.15	0.02	10.12	0.00	0.03	43.15	2.02	100.96	0.40	100.56
4 / 2 .	0.89	0.11	1.53	2.26	1.35	10.97	10.73	0.69	17.11	-0.02	9.98	0.06	0.01	43.16	2.08	100.92	0.40	100.52
4 / 3 .	0.87	0.09	1.53	2.11	1.37	10.88	10.62	0.70	16.73	0.01	10.07	0.03	0.01	43.41	1.84	100.30	0.39	99.91
4 / 4 .	0.90	0.09	1.53	2.18	1.35	11.07	10.64	0.68	16.90	0.06	9.99	-0.06	-0.01	43.46	1.87	100.73	0.40	100.33
4 / 5 .	0.86	0.11	1.54	2.04	1.37	11.05	10.84	0.65	16.88	-0.11	9.86	-0.01	-0.01	43.47	1.99	100.66	0.39	100.28
4 / 6 .	0.60	0.07	1.62	1.35	0.71	12.18	8.15	0.49	19.86	-0.03	10.50	0.02	0.01	40.43	2.25	98.24	0.27	97.97
4 / 7 .	0.89	0.09	1.53	2.03	1.30	11.20	10.74	0.74	16.69	0.07	9.81	0.01	0.01	43.69	1.91	100.71	0.40	100.32
Avg 108_amph_6.4	0.85	0.09	1.54	2.03	1.26	11.18	10.35	0.66	17.33	0.00	10.05	0.01	0.01	42.97	1.99	100.32	0.38	99.95
108_amph_7																		
1 / 1 .	0.90	0.11	1.52	2.28	1.42	10.51	10.51	0.69	17.64	0.09	10.24	0.08	-0.01	42.95	1.96	100.88	0.40	100.48
1 / 2 .	0.92	0.11	1.50	2.36	1.46	10.38	10.61	0.64	17.57	0.04	10.35	0.06	-0.04	42.76	2.17	100.94	0.41	100.52
1 / 3 .	0.82	0.12	1.55	2.28	1.44	10.41	10.65	0.72	17.83	0.07	10.34	0.01	0.03	42.80	2.20	101.29	0.37	100.92
1 / 4 .	0.83	0.11	1.54	2.34	1.47	10.27	10.54	0.73	17.85	-0.01	10.35	0.01	0.00	42.60	1.98	100.61	0.37	100.24
1 / 5 .	0.87	0.11	1.53	2.28	1.43	10.19	10.60	0.68	17.63	-0.05	10.43	0.06	0.03	42.67	2.23	100.73	0.39	100.34
1 / 6 .	0.91	0.10	1.51	2.29	1.44	10.35	10.59	0.59	17.64	0.10	10.37	0.04	0.00	42.74	2.24	100.90	0.41	100.50
1 / 7 .	0.79	0.11	1.56	2.33	1.44	10.31	10.44	0.63	17.72	-0.01	10.34	0.06	-0.06	42.73	2.05	100.51	0.36	100.15
1 / 8 .	0.87	0.11	1.53	2.29	1.41	10.58	10.75	0.69	17.47	0.05	10.22	-0.01	0.03	42.96	2.04	101.01	0.39	100.62
1 / 9 .	0.81	0.11	1.56	2.28	1.41	10.31	10.47	0.69	17.76	0.03	10.28	-0.04	-0.04	43.10	2.01	100.81	0.36	100.45

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 10 .	0.96	0.11	1.48	2.27	1.40	10.48	10.54	0.68	17.89	0.01	10.29	0.03	0.01	42.89	1.95	101.01	0.43	100.58
Avg 108_amph_7.1	0.87	0.11	1.53	2.30	1.43	10.38	10.57	0.67	17.70	0.03	10.32	0.03	0.00	42.82	2.08	100.84	0.39	100.45
2 / 1 .	0.86	0.11	1.54	2.25	1.44	10.55	10.60	0.63	17.64	0.00	10.11	0.05	0.01	43.01	2.17	100.97	0.39	100.58
2 / 2 .	0.87	0.10	1.52	2.22	1.38	10.32	10.79	0.62	17.52	0.00	9.97	0.03	-0.02	43.03	2.03	100.41	0.39	100.03
2 / 3 .	0.86	0.10	1.54	2.32	1.43	10.40	10.82	0.64	17.60	-0.04	10.10	-0.01	-0.02	42.96	1.98	100.74	0.38	100.36
2 / 4 .	0.85	0.11	1.54	2.29	1.45	10.45	10.77	0.71	17.63	0.13	10.10	0.05	0.03	42.99	2.17	101.25	0.38	100.87
2 / 5 .	0.78	0.10	1.58	2.35	1.45	10.49	10.66	0.71	17.92	-0.01	10.12	0.03	0.06	42.90	2.08	101.22	0.35	100.87
2 / 6 .	0.85	0.09	1.54	2.32	1.43	10.38	10.51	0.69	17.75	-0.08	10.04	0.04	0.03	42.86	2.03	100.53	0.38	100.16
2 / 7 .	0.82	0.12	1.55	2.35	1.40	10.47	10.80	0.65	17.74	0.10	10.07	0.03	-0.07	43.08	2.01	101.20	0.37	100.83
2 / 8 .	0.74	0.10	1.60	2.29	1.44	10.66	10.72	0.67	17.65	0.06	9.99	-0.04	-0.06	43.12	1.97	101.01	0.33	100.68
2 / 9 .	0.86	0.09	1.54	2.27	1.41	10.61	10.64	0.65	17.56	0.09	9.82	0.05	-0.01	43.31	2.01	100.90	0.38	100.52
2 / 10 .	0.81	0.10	1.56	2.27	1.39	10.66	10.76	0.68	17.38	0.03	9.71	0.02	0.07	43.40	1.97	100.80	0.36	100.43
Avg 108_amph_7.2	0.83	0.10	1.55	2.29	1.42	10.50	10.71	0.67	17.64	0.03	10.00	0.02	0.00	43.07	2.04	100.87	0.37	100.50
108_amph_8																		
1 / 1 .	0.96	0.10	1.49	2.33	1.43	10.45	10.87	0.63	17.61	-0.10	10.46	0.07	0.00	42.75	2.10	101.25	0.43	100.82
1 / 2 .	0.92	0.11	1.50	2.38	1.43	10.41	10.48	0.66	17.73	0.10	10.54	0.03	-0.01	42.89	1.72	100.90	0.41	100.49
1 / 3 .	0.88	0.11	1.53	2.38	1.44	10.50	10.69	0.64	17.53	-0.01	10.55	-0.01	-0.08	43.08	1.82	101.15	0.39	100.76
1 / 4 . *	0.84	0.12	1.55	2.32	1.40	10.47	10.75	0.65	17.94	0.10	10.55	0.02	-0.01	42.90	1.88	101.48	0.38	101.10
1 / 5 .	0.86	0.12	1.53	2.34	1.41	10.50	10.63	0.64	18.03	0.12	10.51	0.05	0.00	42.79	1.77	101.31	0.39	100.92
1 / 6 .	0.92	0.11	1.50	2.28	1.49	10.46	10.80	0.62	17.52	0.12	10.63	-0.03	-0.01	42.85	1.84	101.15	0.41	100.74
1 / 7 .	1.01	0.12	1.46	2.37	1.37	10.55	10.67	0.79	17.65	0.05	10.41	0.02	0.03	42.94	1.84	101.27	0.45	100.82
1 / 8 .	0.96	0.10	1.49	2.31	1.45	10.48	10.67	0.68	17.61	0.00	10.42	0.03	-0.02	42.86	1.93	100.99	0.43	100.57
1 / 9 .	0.86	0.10	1.54	2.28	1.48	10.45	10.81	0.62	17.74	-0.01	10.48	-0.02	-0.01	42.79	1.80	100.93	0.38	100.55
1 / 10 .	0.94	0.12	1.49	2.34	1.41	10.53	10.49	0.66	17.62	-0.02	10.35	0.02	0.01	42.99	1.74	100.71	0.42	100.29
Avg 108_amph_8	0.92	0.11	1.50	2.33	1.43	10.48	10.68	0.66	17.67	0.03	10.48	0.02	-0.01	42.88	1.84	101.04	0.41	100.62
108_amph_9																		
1 / 1 .	0.87	0.09	1.54	2.37	1.47	10.54	10.71	0.72	17.53	-0.06	10.21	0.04	0.03	43.12	1.85	101.08	0.39	100.69
1 / 2 .	0.77	0.11	1.58	2.32	1.44	10.45	10.51	0.73	17.72	0.06	10.16	0.04	0.06	42.96	1.99	100.90	0.35	100.56
1 / 3 .	0.90	0.10	1.51	2.43	1.46	10.40	10.58	0.74	17.66	0.00	10.11	0.00	0.01	43.03	1.94	100.88	0.40	100.47

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 4 .	0.82	0.10	1.56	2.34	1.46	10.46	10.47	0.69	17.45	0.00	10.09	0.06	0.00	43.26	1.92	100.66	0.37	100.30
1 / 5 .	0.87	0.09	1.54	2.26	1.38	10.72	10.66	0.66	17.64	-0.04	9.89	0.03	-0.05	43.36	1.99	101.08	0.39	100.70
1 / 6 .	0.83	0.10	1.55	2.37	1.45	10.44	10.63	0.75	17.88	0.04	10.08	0.02	0.09	43.09	1.96	101.30	0.37	100.93
1 / 7 .	0.85	0.10	1.54	2.39	1.44	10.33	10.46	0.70	17.55	0.04	10.30	0.00	-0.01	42.95	1.87	100.53	0.38	100.15
1 / 8 .	0.83	0.10	1.55	2.36	1.42	10.39	10.52	0.72	17.62	0.04	10.23	0.05	0.03	43.09	1.84	100.79	0.37	100.42
1 / 9 .	0.84	0.08	1.55	2.37	1.45	10.32	10.53	0.66	17.95	-0.05	10.14	0.01	0.01	42.99	2.12	101.01	0.37	100.64
1 / 10 .	0.82	0.10	1.56	2.37	1.48	10.34	10.62	0.68	17.83	-0.02	10.28	-0.01	-0.01	43.19	1.93	101.21	0.37	100.84
Avg 108_amph_9	0.84	0.10	1.55	2.36	1.44	10.44	10.57	0.70	17.68	0.00	10.15	0.02	0.02	43.10	1.94	100.92	0.38	100.54
108_amph_10																		
1 / 1 .	0.92	0.09	1.50	2.33	1.41	10.49	10.37	0.65	17.26	0.01	10.04	0.06	0.05	43.28	1.80	100.26	0.41	99.85
1 / 2 .	0.86	0.10	1.54	2.37	1.44	10.56	10.69	0.66	17.61	0.09	10.04	0.05	-0.02	43.18	2.01	101.21	0.39	100.82
1 / 3 .	0.91	0.11	1.51	2.40	1.41	10.49	10.49	0.64	17.80	0.08	10.15	0.05	-0.01	43.29	1.91	101.24	0.41	100.83
1 / 4 . *	0.93	0.11	1.51	2.37	1.44	10.58	10.67	0.65	17.62	-0.08	10.21	0.08	-0.01	43.23	2.09	101.49	0.42	101.07
1 / 5 . *	0.91	0.11	1.52	2.37	1.45	10.57	10.62	0.60	17.77	-0.09	10.13	0.05	0.01	43.40	1.89	101.39	0.41	100.99
1 / 6 .	0.95	0.11	1.49	2.39	1.37	10.56	10.66	0.61	17.75	0.07	10.04	0.01	-0.01	43.31	1.92	101.24	0.43	100.82
1 / 7 .	0.91	0.11	1.51	2.42	1.40	10.51	10.50	0.64	17.72	-0.03	10.07	0.03	0.00	43.22	1.83	100.86	0.41	100.45
1 / 8 .	0.87	0.09	1.54	2.33	1.41	10.65	10.56	0.63	17.68	-0.07	10.17	0.04	-0.11	43.08	1.85	100.90	0.39	100.52
1 / 9 .	0.82	0.10	1.55	2.40	1.39	10.57	10.59	0.60	17.96	0.16	10.14	0.02	0.03	42.91	1.75	101.00	0.37	100.63
1 / 10 .	0.85	0.12	1.54	2.37	1.47	10.38	10.78	0.67	17.52	0.00	10.11	0.07	0.02	43.09	1.96	100.94	0.38	100.56
Avg 108_amph_10	0.89	0.10	1.52	2.38	1.41	10.53	10.58	0.63	17.66	0.04	10.10	0.04	-0.01	43.17	1.88	100.92	0.40	100.53
FR-103																		
103_amph_1																		
1 / 1 .	0.60	0.13	1.63	2.10	1.58	8.98	10.88	0.94	19.28	-0.05	10.70	-0.02	0.00	42.09	1.73	100.64	0.28	100.36
1 / 2 .	0.49	0.11	1.68	2.07	1.63	8.99	11.05	0.85	19.12	-0.05	10.56	0.01	0.01	41.78	1.62	99.98	0.23	99.75
1 / 3 .	0.58	0.11	1.64	2.11	1.60	8.90	10.93	0.83	19.54	0.07	10.52	0.01	0.01	41.91	1.67	100.43	0.27	100.17
1 / 4 .	0.67	0.09	1.61	2.10	1.58	8.89	10.78	0.88	19.43	-0.02	10.64	0.04	0.02	42.15	1.65	100.54	0.30	100.23
1 / 5 .	0.51	0.10	1.67	2.05	1.62	8.81	10.91	0.86	19.40	-0.03	10.62	0.04	-0.03	41.79	1.59	99.95	0.23	99.72
1 / 6 .	0.54	0.12	1.66	2.05	1.60	8.91	11.10	0.90	19.40	0.11	10.59	0.03	0.01	41.84	1.64	100.52	0.25	100.26
1 / 7 .	0.57	0.12	1.64	2.07	1.57	8.83	11.04	0.87	19.48	0.03	10.58	0.07	-0.01	41.81	1.67	100.35	0.27	100.08

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 8 .	0.49	0.09	1.70	2.13	1.64	8.89	11.05	0.92	19.65	0.06	10.54	0.02	-0.01	42.00	1.58	100.76	0.23	100.54
1 / 9 .	0.58	0.10	1.64	2.07	1.64	8.79	10.72	0.90	19.38	0.14	10.72	0.02	-0.03	41.82	1.74	100.26	0.27	99.99
1 / 10 .	0.56	0.12	1.65	2.10	1.63	8.97	10.91	0.91	19.56	0.04	10.73	0.02	-0.01	41.85	1.66	100.71	0.26	100.45
Avg 103_amph_1	0.56	0.11	1.65	2.09	1.61	8.89	10.94	0.89	19.42	0.03	10.62	0.02	0.00	41.91	1.66	100.39	0.26	100.13
103_amph_2																		
1 / 1 .	0.57	0.13	1.63	1.88	1.56	8.99	10.78	0.73	19.46	0.04	10.60	0.01	-0.02	41.88	1.47	99.71	0.27	99.44
1 / 2 .	0.56	0.10	1.65	1.84	1.59	8.94	10.93	0.72	19.42	0.07	10.58	0.05	-0.06	42.05	1.27	99.76	0.26	99.50
1 / 3 .	0.51	0.12	1.66	1.88	1.54	8.95	10.98	0.64	19.71	0.11	10.60	0.03	0.01	41.63	1.38	99.75	0.24	99.51
1 / 4 .	0.57	0.11	1.64	1.92	1.61	8.95	10.96	0.69	19.66	-0.02	10.60	0.04	0.03	41.84	1.25	99.87	0.26	99.60
1 / 5 .	0.59	0.11	1.64	1.92	1.59	8.92	11.12	0.69	19.85	-0.02	10.73	0.03	-0.04	41.96	1.41	100.56	0.27	100.29
1 / 6 .	0.63	0.12	1.61	1.97	1.59	8.89	11.03	0.76	19.77	0.06	10.66	0.02	0.00	41.92	1.18	100.21	0.29	99.91
1 / 7 .	0.59	0.13	1.62	2.01	1.56	8.77	10.88	0.87	19.56	0.04	10.56	0.01	0.01	41.84	1.38	99.83	0.28	99.55
1 / 8 .	0.61	0.13	1.62	2.05	1.63	8.81	10.86	0.80	19.79	0.01	10.72	0.04	-0.02	42.00	1.22	100.29	0.29	100.01
1 / 9 .	0.66	0.14	1.59	2.06	1.61	8.80	10.89	0.79	19.64	-0.09	10.53	0.07	0.01	41.91	1.40	100.09	0.31	99.78
1 / 10 .	0.66	0.11	1.60	2.07	1.59	8.87	10.86	0.81	19.73	-0.04	10.58	0.01	-0.01	41.86	1.38	100.11	0.30	99.81
Avg 103_amph_2	0.60	0.12	1.62	1.96	1.59	8.89	10.93	0.75	19.66	0.02	10.62	0.03	-0.01	41.89	1.33	99.99	0.28	99.71
103_amph_4																		
1 / 1 .	0.66	0.11	1.60	2.08	1.61	8.96	10.97	0.79	19.35	0.07	10.54	0.01	0.04	41.97	1.37	100.13	0.30	99.83
1 / 2 .	0.61	0.11	1.62	2.13	1.65	9.13	10.80	0.92	19.08	0.02	10.48	-0.02	0.01	41.88	1.48	99.92	0.28	99.64
1 / 3 .	0.55	0.08	1.66	2.10	1.65	9.08	10.77	0.78	19.47	-0.10	10.59	0.12	-0.01	41.80	1.53	100.19	0.25	99.94
1 / 4 .	0.58	0.12	1.64	2.10	1.62	9.14	10.79	0.82	19.13	0.07	10.53	0.03	0.03	42.16	1.54	100.32	0.27	100.05
1 / 5 .	0.66	0.12	1.60	2.09	1.64	9.09	10.86	0.81	19.48	0.01	10.53	0.05	0.01	41.81	1.53	100.27	0.30	99.97
1 / 6 .	0.62	0.13	1.62	2.08	1.61	9.04	10.91	0.92	19.24	0.07	10.53	0.01	-0.03	42.08	1.70	100.56	0.29	100.27
1 / 7 .	0.63	0.11	1.62	2.02	1.60	9.21	10.90	0.81	19.19	0.06	10.36	0.06	0.00	42.28	1.44	100.27	0.29	99.98
1 / 8 .	0.64	0.11	1.61	2.09	1.59	9.10	10.98	0.88	19.08	0.07	10.50	0.00	0.00	42.08	1.47	100.21	0.29	99.92
1 / 9 .	0.58	0.12	1.64	2.05	1.60	9.14	10.91	0.88	19.20	0.12	10.59	0.08	-0.04	42.11	1.51	100.51	0.27	100.23
1 / 10 .	0.57	0.10	1.65	2.05	1.60	9.09	10.94	0.80	19.16	0.07	10.39	0.01	0.00	42.33	1.56	100.31	0.26	100.05
Avg 103_amph_4	0.61	0.11	1.63	2.08	1.62	9.10	10.88	0.84	19.24	0.05	10.50	0.03	0.00	42.05	1.51	100.25	0.28	99.97
103_amph_5																		

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 1 .	0.66	0.12	1.59	1.97	1.60	8.87	11.06	0.84	19.61	0.04	10.39	0.03	-0.01	42.07	1.28	100.13	0.31	99.83
1 / 2 .	0.59	0.12	1.63	2.02	1.62	8.92	10.97	0.74	19.94	0.13	10.47	0.02	0.02	41.87	1.39	100.44	0.28	100.17
1 / 3 .	0.74	0.12	1.54	1.93	1.65	8.95	10.89	0.69	19.63	0.00	10.37	0.07	0.02	41.75	1.16	99.53	0.34	99.19
1 / 4 .	0.65	0.12	1.60	1.93	1.59	9.11	11.01	0.68	19.71	0.05	10.34	0.01	-0.02	42.01	1.32	100.12	0.30	99.82
1 / 5 .	0.60	0.10	1.64	1.90	1.53	9.12	11.11	0.78	19.78	0.06	10.33	0.04	-0.01	42.35	1.23	100.57	0.27	100.30
1 / 6 .	0.61	0.12	1.62	1.93	1.52	9.09	11.13	0.69	19.70	0.04	10.35	0.07	0.06	42.12	1.20	100.24	0.28	99.96
1 / 7 .	0.50	0.12	1.67	1.94	1.52	9.16	11.09	0.68	19.57	-0.01	10.42	0.02	0.04	42.05	1.19	99.97	0.24	99.73
1 / 8 .	0.68	0.11	1.58	1.90	1.56	9.04	11.13	0.64	19.68	-0.02	10.32	0.05	-0.03	41.95	1.29	99.93	0.31	99.62
1 / 9 .	0.69	0.12	1.58	1.96	1.56	9.01	11.12	0.66	20.05	0.05	10.48	-0.03	0.02	42.08	1.21	100.59	0.32	100.28
1 / 10 .	0.62	0.14	1.60	1.95	1.56	8.96	11.00	0.66	20.04	0.07	10.52	-0.01	0.01	41.88	1.21	100.22	0.29	99.93
Avg 103_amph_5	0.63	0.12	1.61	1.94	1.57	9.02	11.05	0.71	19.77	0.04	10.40	0.03	0.01	42.01	1.25	100.16	0.29	99.87
103_amph_6																		
1 / 1 .	0.56	0.11	1.65	2.08	1.66	9.20	10.77	0.92	19.32	-0.01	10.43	-0.01	-0.03	42.12	1.42	100.25	0.26	99.98
1 / 2 .	0.55	0.11	1.65	2.12	1.58	9.12	10.96	0.87	19.33	0.05	10.49	-0.01	-0.02	41.86	1.55	100.24	0.26	99.98
1 / 3 .	0.60	0.12	1.63	2.04	1.61	9.02	10.83	0.84	19.41	0.09	10.47	0.04	0.01	41.96	1.62	100.29	0.28	100.01
1 / 4 .	0.49	0.10	1.69	2.06	1.63	9.03	10.94	0.88	19.14	0.09	10.52	0.05	0.02	41.93	1.52	100.10	0.23	99.87
1 / 5 .	0.67	0.12	1.60	2.03	1.62	9.02	11.13	0.91	19.30	-0.03	10.37	0.03	0.01	42.27	1.40	100.48	0.31	100.17
1 / 6 .	0.57	0.12	1.64	1.99	1.61	9.15	10.92	0.85	19.07	-0.07	10.40	0.02	0.00	42.08	1.57	99.98	0.27	99.72
1 / 7 .	0.69	0.11	1.59	1.99	1.62	9.17	10.98	0.90	19.33	-0.06	10.43	0.06	-0.01	41.96	1.51	100.33	0.31	100.02
1 / 8 .	0.58	0.10	1.63	2.04	1.58	9.13	10.90	0.89	18.81	-0.05	10.26	-0.03	0.01	41.94	1.56	99.42	0.27	99.16
1 / 9 .	0.69	0.11	1.58	1.99	1.52	9.29	10.58	0.78	19.56	-0.03	10.31	0.06	0.00	42.11	1.38	99.95	0.32	99.64
1 / 10 . *	0.63	0.11	1.60	1.89	1.50	9.41	10.32	0.82	19.64	-0.02	10.36	0.02	-0.02	41.64	1.31	99.23	0.29	98.94
Avg 103_amph_6	0.60	0.11	1.63	2.04	1.60	9.13	10.89	0.87	19.25	0.00	10.41	0.02	0.00	42.03	1.50	100.08	0.28	99.80
103_amph_7																		
1 / 1 .	0.61	0.16	1.61	2.16	1.69	8.98	10.93	0.86	19.31	0.05	10.44	0.03	-0.04	41.92	1.60	100.35	0.29	100.06
1 / 2 .	0.71	0.11	1.57	2.05	1.64	9.02	10.77	0.90	19.37	-0.02	10.53	0.01	-0.03	42.12	1.49	100.30	0.33	99.97
1 / 3 .	0.61	0.10	1.63	2.07	1.60	9.11	10.91	0.85	19.29	0.06	10.42	-0.02	0.01	42.11	1.56	100.34	0.28	100.06
1 / 4 .	0.58	0.12	1.63	2.08	1.57	8.99	10.84	0.84	19.40	-0.04	10.51	0.03	0.04	41.99	1.54	100.17	0.27	99.89
1 / 5 .	0.64	0.10	1.61	2.04	1.64	9.06	10.89	0.87	19.10	0.08	10.38	0.08	-0.02	42.01	1.62	100.11	0.29	99.82
1 / 6 .	0.56	0.11	1.65	2.00	1.66	9.15	10.79	0.91	19.06	0.01	10.48	-0.04	0.04	41.84	1.57	99.83	0.26	99.57

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 7 .	0.66	0.11	1.59	2.09	1.61	9.10	10.83	0.82	19.15	-0.06	10.50	0.02	0.01	41.90	1.50	99.90	0.31	99.59
1 / 8 .	0.52	0.10	1.66	2.06	1.60	9.08	10.91	0.85	19.08	0.03	10.52	0.04	-0.03	41.85	1.57	99.89	0.24	99.64
1 / 9 .	0.59	0.11	1.64	2.05	1.63	9.12	10.95	0.87	19.25	-0.01	10.53	0.10	0.03	41.93	1.60	100.40	0.27	100.12
1 / 10 .	0.64	0.11	1.62	2.06	1.65	9.10	10.97	0.90	19.36	0.07	10.50	0.06	0.01	42.24	1.59	100.90	0.29	100.60
Avg 103_amph_7.1	0.61	0.11	1.62	2.07	1.63	9.07	10.88	0.87	19.24	0.02	10.48	0.03	0.00	41.99	1.56	100.19	0.28	99.90
2 / 1 .	0.59	0.14	1.63	1.92	1.55	9.24	11.09	0.84	19.31	0.02	10.38	0.02	-0.02	42.28	1.44	100.45	0.28	100.17
2 / 2 .	0.62	0.11	1.63	1.84	1.55	9.08	11.03	0.87	19.44	0.09	10.44	0.04	-0.01	42.31	1.48	100.52	0.29	100.24
2 / 3 .	0.58	0.11	1.64	1.86	1.55	9.04	11.02	0.88	19.29	0.02	10.43	0.05	0.03	42.20	1.70	100.41	0.27	100.14
2 / 4 .	0.58	0.11	1.64	1.94	1.57	9.03	10.98	0.83	19.42	-0.04	10.46	-0.01	0.01	42.18	1.52	100.28	0.27	100.01
2 / 5 .	0.69	0.11	1.59	1.99	1.59	9.14	11.09	0.96	19.17	0.06	10.41	-0.01	0.00	42.41	1.53	100.74	0.32	100.42
2 / 6 .	0.52	0.10	1.68	1.90	1.49	9.35	10.90	0.85	19.09	-0.09	10.23	0.01	-0.01	42.69	1.55	100.37	0.24	100.13
2 / 7 .	0.55	0.13	1.65	1.84	1.55	9.04	11.18	0.88	19.07	0.04	10.59	0.13	-0.01	42.23	1.30	100.17	0.26	99.91
2 / 8 .	0.51	0.13	1.67	1.69	1.52	9.14	11.12	0.78	18.93	0.05	10.55	0.04	0.02	42.11	1.48	99.72	0.24	99.47
2 / 9 .	0.56	0.11	1.65	1.94	1.62	9.19	10.95	0.85	19.15	0.08	10.48	0.06	0.01	41.96	1.56	100.16	0.26	99.90
2 / 10 .	0.61	0.12	1.63	1.93	1.59	9.15	10.97	0.89	19.09	0.10	10.47	0.03	-0.02	42.31	1.68	100.55	0.28	100.27
Avg 103_amph_7.2	0.58	0.12	1.64	1.89	1.56	9.14	11.03	0.86	19.20	0.03	10.44	0.04	0.00	42.27	1.52	100.31	0.27	100.04
103_amph_8																		
1 / 1 .	0.57	0.11	1.65	2.05	1.54	8.97	10.92	0.81	19.51	0.00	10.66	0.06	0.01	42.12	1.34	100.32	0.26	100.06
1 / 2 .	0.63	0.12	1.61	2.06	1.63	9.03	10.81	0.78	19.29	0.11	10.50	-0.06	0.00	42.05	1.46	100.08	0.29	99.79
1 / 3 .	0.56	0.12	1.64	2.01	1.56	9.07	10.79	0.82	19.39	0.06	10.47	0.03	-0.02	42.10	1.33	99.98	0.26	99.71
1 / 4 .	0.70	0.10	1.58	2.03	1.61	9.06	10.89	0.80	19.42	0.07	10.51	0.00	0.02	41.99	1.34	100.12	0.32	99.80
1 / 5 .	0.73	0.10	1.56	2.01	1.59	9.22	10.74	0.83	19.43	-0.08	10.36	0.05	0.02	42.12	1.29	100.06	0.33	99.73
1 / 6 .	0.64	0.11	1.61	2.00	1.53	9.13	11.07	0.82	19.10	0.10	10.53	-0.01	-0.02	42.29	1.24	100.17	0.30	99.87
1 / 7 .	0.63	0.12	1.62	2.03	1.60	9.17	10.99	0.79	19.20	0.06	10.58	0.08	0.05	42.19	1.22	100.33	0.29	100.04
1 / 8 .	0.57	0.12	1.65	1.99	1.60	9.25	10.90	0.79	19.58	-0.02	10.57	0.02	0.00	42.20	1.33	100.59	0.27	100.32
1 / 9 .	0.69	0.13	1.58	1.96	1.58	9.25	10.91	0.82	19.33	-0.04	10.51	0.08	-0.04	42.20	1.16	100.21	0.32	99.89
1 / 10 .	0.63	0.12	1.61	1.93	1.57	9.28	10.88	0.79	19.32	0.03	10.54	0.00	0.03	42.15	1.03	99.92	0.29	99.63
Avg 103_amph_8	0.64	0.12	1.61	2.01	1.58	9.14	10.89	0.81	19.36	0.03	10.52	0.03	0.01	42.14	1.27	100.15	0.29	99.86

103_amph_9

Table B3: Amphibole Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	V_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 1 .	0.62	0.14	1.62	1.94	1.57	9.34	11.03	0.88	19.17	-0.06	10.46	0.02	0.01	42.30	1.36	100.45	0.29	100.16
1 / 2 .	0.53	0.11	1.67	1.92	1.60	9.28	11.08	0.85	18.95	-0.11	10.46	0.08	0.03	42.46	1.33	100.36	0.25	100.11
1 / 3 .	0.65	0.11	1.60	1.93	1.57	9.19	11.01	0.84	18.91	0.03	10.46	0.00	0.01	42.27	1.29	99.88	0.30	99.58
1 / 4 .	0.68	0.11	1.59	1.87	1.56	9.26	10.95	0.84	18.91	0.07	10.49	0.01	-0.01	42.26	1.30	99.91	0.31	99.60
1 / 5 .	0.61	0.14	1.62	1.90	1.58	9.25	10.93	0.78	19.27	0.01	10.41	0.04	-0.01	42.25	1.53	100.29	0.29	100.01
1 / 6 .	0.51	0.13	1.66	1.85	1.54	9.32	10.96	0.89	18.88	0.05	10.35	0.01	-0.02	42.17	1.36	99.69	0.25	99.44
1 / 7 .	0.66	0.11	1.60	1.86	1.58	9.24	11.05	0.88	19.03	0.06	10.41	0.03	-0.04	42.40	1.40	100.32	0.30	100.02
1 / 8 .	0.50	0.12	1.67	1.88	1.56	9.24	10.92	0.79	18.99	0.06	10.38	0.01	-0.04	42.23	1.32	99.67	0.24	99.43
1 / 9 .	0.58	0.11	1.64	1.88	1.55	9.24	11.19	0.80	19.17	0.10	10.39	0.04	0.00	42.39	1.31	100.40	0.27	100.13
1 / 10 .	0.60	0.12	1.63	1.88	1.52	9.29	11.10	0.83	19.04	0.03	10.44	0.01	-0.03	42.27	1.40	100.18	0.28	99.90
Avg 103_amph_9	0.59	0.12	1.63	1.89	1.56	9.26	11.02	0.84	19.03	0.02	10.43	0.02	-0.01	42.30	1.36	100.08	0.28	99.80
103_amph_10																		
1 / 1 .	0.55	0.10	1.65	2.10	1.64	8.94	10.93	1.00	19.15	0.04	10.58	0.04	0.02	41.99	1.46	100.20	0.26	99.94
1 / 2 .	0.56	0.11	1.65	2.10	1.61	8.96	10.84	1.00	18.90	-0.03	10.47	-0.01	0.00	42.08	1.58	99.85	0.26	99.59
1 / 3 .	0.54	0.12	1.65	2.13	1.63	8.93	10.77	1.07	18.84	-0.08	10.59	0.00	-0.03	41.88	1.60	99.75	0.25	99.50
1 / 4 .	0.60	0.10	1.63	2.11	1.57	8.98	10.83	0.98	19.11	-0.14	10.66	0.05	0.03	41.77	1.48	99.91	0.27	99.63
1 / 5 .	0.50	0.11	1.67	2.16	1.58	8.84	10.74	1.02	19.02	-0.06	10.61	0.01	0.04	42.01	1.56	99.89	0.24	99.65
1 / 6 .	0.61	0.12	1.62	2.13	1.62	8.94	10.79	0.99	19.23	-0.09	10.46	0.03	-0.01	42.02	1.60	100.15	0.28	99.87
1 / 7 .	0.59	0.10	1.63	2.17	1.62	8.98	10.85	0.99	19.01	0.15	10.43	0.01	-0.05	41.87	1.44	99.83	0.27	99.56
1 / 8 .	0.56	0.10	1.65	2.15	1.63	8.91	10.92	1.00	19.28	0.11	10.56	0.06	-0.01	41.92	1.49	100.36	0.26	100.10
1 / 9 .	0.58	0.13	1.63	2.17	1.62	8.90	10.88	0.94	18.90	-0.02	10.53	0.02	0.00	41.92	1.57	99.80	0.28	99.53
1 / 10 .	0.56	0.11	1.65	2.17	1.63	8.94	10.65	1.08	19.42	0.07	10.53	0.04	0.00	42.13	1.63	100.61	0.26	100.35
Avg 103_amph_10	0.57	0.11	1.64	2.14	1.62	8.93	10.82	1.01	19.09	0.00	10.54	0.02	0.00	41.96	1.54	99.98	0.26	99.72

APPENDIX B
MINERAL CHEMISTRIES FROM KM-SCALE GRADIENTS

Table B4: Garnet Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	MgO	CaO	MnO	FeO	Al_2O_3	Cr_2O_3	Y_2O_3	SiO_2	TiO_2	Total
BR-70											
BR-70 gt 1											
1 / 1 .	0.02	2.78	6.34	7.09	26.68	20.29	0.04	-0.01	37.03	0.02	100.29
1 / 2 .	0.02	2.70	6.47	7.03	26.62	20.54	0.01	0.01	36.89	0.06	100.35
1 / 3 .	0.05	2.74	6.49	7.00	26.44	20.46	0.03	0.03	37.05	0.09	100.38
1 / 4 .	0.03	2.72	6.56	6.88	26.54	20.53	0.00	0.01	37.16	0.08	100.51
1 / 5 .	0.03	2.75	6.55	6.87	26.54	20.74	0.00	0.08	36.86	0.04	100.47
1 / 6 .	0.03	2.77	6.55	6.99	26.19	20.58	0.02	0.02	37.20	0.08	100.43
1 / 7 .	0.06	2.76	6.54	6.95	26.35	20.47	0.01	0.02	37.02	0.04	100.22
1 / 8 .	0.03	2.71	6.56	6.67	26.18	20.55	0.05	0.09	36.99	0.03	99.86
1 / 9 .	0.03	2.82	6.46	6.77	26.45	20.50	0.02	0.10	36.96	0.03	100.14
1 / 10 .	0.05	2.77	6.40	7.03	26.48	20.56	0.04	0.09	36.86	0.06	100.34
BR-70 gt 1	0.04	2.75	6.49	6.93	26.45	20.52	0.02	0.04	37.00	0.05	100.30
BR-70m gt 1											
1 / 1 .	0.01	2.20	5.98	8.10	25.86	20.63	0.01	0.28	36.94	-0.01	100.02
1 / 2 .	0.04	2.24	5.95	8.25	26.03	20.55	0.00	0.29	36.91	0.02	100.27
1 / 3 .	0.03	2.30	5.91	7.95	26.02	20.51	0.01	0.25	36.88	0.03	99.88
1 / 4 .	0.01	2.33	6.00	7.94	25.75	20.62	0.01	0.18	36.87	0.03	99.74
1 / 5 .	0.02	2.36	5.99	7.95	25.70	20.62	0.00	0.22	36.75	-0.02	99.61
1 / 6 .	0.01	2.38	5.96	8.12	25.85	20.53	-0.01	0.19	37.06	-0.01	100.11
1 / 7 .	0.01	2.35	5.97	7.96	25.92	20.34	-0.03	0.21	36.78	0.00	99.55
1 / 8 .	0.02	2.43	5.92	8.16	25.87	20.53	-0.01	0.19	37.03	0.01	100.15
1 / 9 .	0.02	2.34	5.91	8.09	25.93	20.54	-0.01	0.23	37.02	0.00	100.08
1 / 10 .	0.01	2.42	6.00	8.00	25.92	20.54	-0.01	0.31	36.99	0.01	100.19
BR-70m gt 1	0.02	2.34	5.96	8.05	25.89	20.54	0.00	0.24	36.92	0.01	99.95
BR-71											

Table B4: Garnet Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	MgO	CaO	MnO	FeO	Al_2O_3	Cr_2O_3	Y_2O_3	SiO_2	TiO_2	Total
71 gt 1											
1 / 1 .	-0.01	2.94	6.06	6.24	27.45	20.45	-0.01	0.10	37.01	0.06	100.30
1 / 2 .	-0.01	2.93	6.03	6.17	27.44	20.54	-0.02	0.02	37.32	0.12	100.57
1 / 3 .	0.01	2.94	6.04	6.15	27.51	20.55	-0.02	0.06	36.91	0.10	100.27
1 / 4 .	0.01	2.96	6.04	6.16	27.44	20.43	-0.02	0.03	37.22	0.11	100.40
1 / 5 .	-0.01	2.91	6.04	6.22	27.02	20.56	-0.03	0.09	37.13	0.05	100.02
1 / 6 .	-0.01	2.95	6.14	6.09	26.75	20.71	-0.02	0.12	37.14	0.07	99.98
1 / 7 .	0.00	2.86	6.17	6.14	26.84	20.64	-0.03	0.12	37.09	0.03	99.89
1 / 8 .	0.00	2.87	5.96	6.14	26.85	20.70	-0.01	0.12	37.32	0.06	100.03
1 / 9 .	0.01	2.93	6.13	6.41	26.89	20.75	0.00	0.11	36.96	0.05	100.25
1 / 10 .	0.01	2.89	6.20	6.31	26.97	20.64	-0.02	0.10	37.35	0.06	100.53
Avg 71 gt 1.1	0.00	2.92	6.08	6.20	27.12	20.60	-0.02	0.09	37.15	0.07	100.22
2 / 1 .	0.00	2.93	6.03	6.32	26.94	20.92	-0.01	0.11	37.33	0.10	100.67
2 / 2 .	0.00	2.93	5.95	6.07	27.01	20.82	0.00	0.07	37.22	0.08	100.15
2 / 3 .	0.02	2.92	5.95	6.11	27.42	20.63	-0.03	0.03	37.34	0.07	100.49
2 / 4 .	0.00	2.90	5.96	6.28	26.90	20.72	-0.03	0.07	36.92	0.06	99.81
2 / 5 .	0.01	2.91	5.88	6.32	26.92	20.75	0.02	0.07	37.17	0.05	100.10
2 / 6 .	0.01	2.89	5.95	6.18	27.08	20.84	0.00	0.07	37.06	0.04	100.11
2 / 7 .	0.02	2.90	5.94	6.30	27.31	20.67	-0.03	0.05	37.30	0.09	100.57
2 / 8 .	0.00	2.85	5.85	6.26	26.81	20.85	-0.04	0.04	37.11	0.07	99.85
2 / 9 .	0.00	2.88	6.07	6.31	26.96	20.71	-0.01	0.10	37.23	0.04	100.31
2 / 10 .	0.01	2.84	6.01	6.39	26.97	20.76	-0.05	0.17	37.13	0.06	100.34
Avg 71 gt 1.2	0.01	2.90	5.96	6.25	27.03	20.77	-0.02	0.08	37.18	0.07	100.24
71 gt 2											
1 / 1 .	0.02	2.56	6.55	6.69	26.48	20.12	0.03	0.30	36.69	0.08	99.52
1 / 2 .	0.04	2.57	6.50	6.82	26.16	20.60	0.02	0.36	36.86	0.01	99.95
1 / 3 .	0.03	2.51	6.42	6.58	26.27	20.42	0.02	0.23	36.67	0.00	99.15
1 / 4 .	0.01	2.53	6.53	6.67	26.22	20.36	-0.01	0.30	36.94	0.02	99.57
1 / 5 .	0.03	2.51	6.55	6.79	26.71	20.60	0.00	0.31	37.05	0.04	100.59

Table B4: Garnet Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	MgO	CaO	MnO	FeO	Al_2O_3	Cr_2O_3	Y_2O_3	SiO_2	TiO_2	Total
1 / 6 .	0.02	2.51	6.51	6.88	26.67	20.48	0.02	0.30	36.69	0.03	100.10
1 / 7 .	0.02	2.45	6.62	6.83	26.16	20.53	0.00	0.31	36.96	-0.02	99.88
1 / 8 .	0.03	2.51	6.57	6.65	25.96	20.37	0.00	0.34	36.75	0.03	99.21
1 / 9 .	0.02	2.50	6.63	6.64	26.34	20.48	-0.01	0.36	36.60	0.02	99.59
1 / 10 .	0.03	2.50	6.73	6.67	25.95	20.59	0.00	0.30	36.75	-0.01	99.53
Avg 71 gt 2	0.03	2.52	6.56	6.72	26.29	20.46	0.01	0.31	36.80	0.02	99.71
71 gt 3											
1 / 1 .	-0.01	3.18	5.98	6.04	27.13	20.52	0.01	0.01	37.14	0.02	100.02
1 / 2 .	0.00	3.21	5.98	5.96	26.95	20.85	-0.02	-0.01	37.17	0.03	100.15
1 / 3 .	0.01	3.21	6.02	6.09	27.41	20.91	-0.01	-0.01	37.28	0.03	100.95
1 / 4 .	0.00	3.23	6.08	5.98	27.28	20.73	0.00	0.01	37.04	0.03	100.38
1 / 5 .	-0.01	3.20	6.08	6.01	27.34	20.55	0.02	0.00	37.18	-0.02	100.40
1 / 6 .	-0.03	3.18	5.93	6.12	27.10	20.63	0.00	0.00	37.18	0.02	100.16
1 / 7 .	0.00	3.08	5.94	6.25	26.95	20.83	0.02	0.00	37.32	0.04	100.43
1 / 8 .	0.00	3.01	5.97	6.34	27.33	20.61	0.02	-0.01	37.14	0.02	100.44
1 / 9 .	0.00	2.88	5.94	6.24	27.03	20.70	0.01	0.01	37.15	0.04	100.01
1 / 10 .	0.00	2.83	6.00	6.61	26.69	20.86	0.01	0.02	37.13	0.03	100.19
Avg 71 gt 3	0.00	3.10	5.99	6.16	27.12	20.72	0.01	0.00	37.17	0.02	100.31
71 gt 4											
1 / 1 .	0.04	2.72	6.12	6.64	26.04	20.92	0.04	0.31	37.28	0.04	100.15
1 / 2 .	0.03	2.86	6.06	6.48	26.49	20.65	0.01	0.33	37.12	0.05	100.09
1 / 3 .	0.02	2.85	6.13	6.59	26.13	20.64	-0.01	0.30	37.30	0.05	100.00
1 / 4 .	0.04	2.81	6.08	6.62	26.49	20.90	0.01	0.28	37.15	0.03	100.41
1 / 5 .	0.02	2.82	6.08	6.62	26.39	20.70	-0.02	0.25	37.32	0.04	100.25
1 / 6 .	0.04	2.84	6.08	6.52	26.10	20.88	-0.01	0.30	37.31	0.04	100.10
1 / 7 .	0.02	2.79	6.09	6.51	26.09	20.84	0.02	0.30	37.17	0.01	99.84
1 / 8 .	0.01	2.78	6.10	6.63	26.09	20.86	0.05	0.34	37.18	0.01	100.06
1 / 9 .	0.02	2.77	6.18	6.52	26.30	20.78	0.01	0.27	37.13	0.08	100.05
1 / 10 .	0.03	2.77	6.21	6.58	26.34	20.92	0.00	0.27	37.22	0.03	100.38

Table B4: Garnet Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	MgO	CaO	MnO	FeO	Al_2O_3	Cr_2O_3	Y_2O_3	SiO_2	TiO_2	Total
2 / 1 .	0.03	2.70	6.31	6.47	25.94	20.40	0.01	0.32	36.82	0.06	99.05
2 / 2 .	0.04	2.72	6.30	6.80	25.85	20.39	-0.01	0.37	36.95	0.06	99.48
2 / 3 .	0.02	2.72	6.29	6.67	26.04	20.64	-0.02	0.34	37.19	0.05	99.96
2 / 4 .	0.04	2.72	6.32	6.56	25.91	20.37	0.01	0.42	37.48	0.05	99.88
2 / 5 .	0.02	2.73	6.36	6.50	25.78	20.53	0.01	0.33	36.93	0.07	99.25
2 / 6 .	0.04	2.68	6.30	6.63	26.39	20.76	0.02	0.35	37.06	0.07	100.30
2 / 7 .	0.03	2.67	6.39	6.54	26.08	20.68	0.01	0.34	36.68	0.01	99.44
3 / 1 .	0.02	2.83	6.40	6.52	26.01	20.33	0.01	0.35	36.62	0.03	99.11
3 / 2 .	0.03	2.84	6.17	6.53	26.43	20.66	0.02	0.34	36.87	0.03	99.93
3 / 3 .	0.02	2.80	6.25	6.67	25.96	20.65	0.00	0.31	36.80	0.03	99.49
3 / 4 .	0.03	2.82	6.28	6.69	26.15	20.62	-0.01	0.31	37.24	0.03	100.18
3 / 5 .	0.03	2.82	6.29	6.70	26.16	20.76	0.01	0.37	37.05	0.04	100.22
3 / 6 .	0.01	2.83	6.26	6.55	26.08	20.76	0.03	0.33	37.24	0.03	100.11
3 / 7 .	0.01	2.87	6.24	6.51	26.24	20.78	0.03	0.36	36.84	0.01	99.89
3 / 8 .	0.03	2.83	6.23	6.67	26.31	20.54	0.02	0.35	37.33	0.04	100.35
3 / 9 .	0.01	2.83	6.24	6.66	26.31	20.69	0.01	0.39	36.74	0.05	99.94
3 / 10 . *	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Avg 71 gt 4	0.03	2.79	6.22	6.59	26.16	20.68	0.01	0.33	37.08	0.04	99.92
BR-13											
13 gt 1											
1 / 1 . *	0.01	0.32	6.07	7.06	25.77	20.47	0.01	0.29	36.70	-0.01	96.70
1 / 2 . *	0.00	0.24	6.15	7.11	25.53	20.24	0.00	0.29	36.96	-0.01	96.51
1 / 3 . *	0.00	0.20	5.98	7.02	25.71	20.30	0.00	0.30	36.89	-0.01	96.40
1 / 4 . *	-0.01	0.12	6.09	7.16	25.50	20.35	0.00	0.27	36.99	-0.01	96.49
1 / 5 . *	-0.01	0.08	6.09	7.36	25.58	20.30	0.01	0.29	36.89	0.02	96.61
1 / 6 . *	-0.01	0.03	6.21	7.09	25.62	20.21	0.01	0.33	37.08	-0.01	96.57
1 / 7 . *	-0.02	-0.01	6.10	7.29	25.17	20.37	0.00	0.28	36.89	0.00	96.10
1 / 8 . *	-0.01	-0.02	6.08	7.13	25.72	20.49	0.00	0.27	36.96	0.00	96.65
1 / 9 . *	-0.01	-0.02	6.08	7.05	25.88	20.99	0.01	0.24	36.79	-0.01	97.05

Table B4: Garnet Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	MgO	CaO	MnO	FeO	Al_2O_3	Cr_2O_3	Y_2O_3	SiO_2	TiO_2	Total
1 / 10 . *	-0.02	-0.02	6.10	7.19	25.40	20.90	-0.01	0.25	36.89	0.00	96.73
2 / 1 . *	0.03	0.73	6.12	7.14	25.47	20.49	0.06	0.12	36.89	0.04	97.08
2 / 2 . *	0.06	0.84	6.19	7.01	25.76	20.53	0.08	0.11	36.93	0.06	97.58
2 / 3 . *	0.05	0.95	6.05	7.18	25.37	20.42	0.04	0.12	36.95	0.05	97.18
2 / 4 . *	0.07	1.08	6.12	7.21	25.56	20.39	0.10	0.11	36.84	0.10	97.58
2 / 5 . *	0.08	1.19	6.15	7.30	25.82	20.34	0.11	0.15	36.92	0.04	98.11
2 / 6 . *	0.07	1.34	6.22	7.24	25.39	20.32	0.12	0.15	37.25	0.09	98.18
2 / 7 . *	0.06	1.49	6.13	7.31	25.36	20.23	0.11	0.21	36.82	0.12	97.83
2 / 8 . *	0.07	1.60	6.15	7.58	25.68	20.38	0.13	0.18	37.01	0.11	98.91
2 / 9 .	0.07	1.82	6.28	7.65	25.56	20.36	0.11	0.16	37.01	0.12	99.12
2 / 10 .	0.07	1.90	6.22	7.47	25.57	20.43	0.16	0.22	36.88	0.11	99.02
3 / 1 .	0.10	2.34	6.20	7.69	25.29	20.33	0.17	0.26	36.77	0.13	99.28
3 / 2 .	0.08	2.19	6.10	7.73	25.54	20.23	0.16	0.26	36.94	0.13	99.36
3 / 3 .	0.09	2.06	6.19	7.77	25.56	20.39	0.18	0.24	37.10	0.15	99.73
3 / 4 .	0.07	1.96	6.11	7.71	25.57	20.33	0.12	0.22	36.91	0.15	99.14
3 / 5 . *	0.08	1.79	6.12	7.54	25.40	20.57	0.13	0.20	37.02	0.10	98.94
3 / 6 . *	0.07	1.60	6.20	7.49	25.32	20.46	0.11	0.19	36.88	0.10	98.42
3 / 7 . *	0.07	1.55	6.16	7.40	25.90	20.55	0.10	0.20	36.87	0.12	98.91
3 / 8 . *	0.07	1.36	6.11	7.19	25.57	20.34	0.10	0.19	36.83	0.09	97.84
3 / 9 . *	0.07	1.22	6.12	7.27	25.37	20.52	0.09	0.21	36.85	0.06	97.78
3 / 10 . *	0.04	0.98	6.17	7.23	25.36	20.54	0.10	0.23	36.93	0.07	97.66
Avg 13 gt 1	0.08	2.05	6.18	7.67	25.52	20.35	0.15	0.23	36.94	0.13	99.28
BR-13 gt 2											
1 / 1 .	0.01	2.97	6.35	7.02	25.59	20.42	0.01	0.03	37.21	0.07	99.68
1 / 2 .	0.02	3.04	6.34	7.04	25.86	20.38	-0.03	0.13	36.97	0.03	99.80
1 / 3 .	0.02	3.02	6.39	7.00	25.72	20.32	-0.02	0.09	37.25	0.05	99.87
1 / 4 .	0.03	3.13	6.29	7.06	25.96	20.48	0.00	0.06	37.32	0.08	100.41
1 / 5 .	0.01	3.06	6.20	7.00	25.68	20.84	0.03	0.10	36.77	0.02	99.69
1 / 6 .	0.03	3.04	6.36	6.90	25.81	20.51	-0.02	0.15	37.04	0.02	99.86
1 / 7 .	0.02	3.13	6.21	6.93	25.81	20.74	-0.01	0.16	37.16	0.02	100.17

Table B4: Garnet Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	MgO	CaO	MnO	FeO	Al_2O_3	Cr_2O_3	Y_2O_3	SiO_2	TiO_2	Total
1 / 8 .	0.02	3.15	6.24	6.91	25.81	20.43	-0.01	0.14	36.97	0.05	99.73
1 / 9 .	0.02	3.12	6.22	6.90	25.61	20.51	0.03	0.18	37.02	0.06	99.67
1 / 10 .	0.03	3.12	6.25	6.87	26.05	20.42	-0.04	0.27	37.18	0.01	100.21
2 / 1 .	0.02	3.01	6.10	7.04	25.96	20.21	-0.02	0.20	36.71	0.04	99.30
2 / 2 .	0.02	3.06	6.18	7.07	25.92	20.38	-0.01	0.20	37.00	0.02	99.85
2 / 3 .	0.03	3.10	6.11	7.21	25.78	20.32	0.00	0.21	37.29	0.01	100.05
2 / 4 .	0.02	3.06	6.06	6.96	26.09	20.47	-0.02	0.19	37.17	0.02	100.02
2 / 5 .	0.02	3.10	6.20	7.11	25.69	20.42	-0.02	0.14	37.12	0.03	99.84
2 / 6 .	0.03	3.09	6.11	6.99	25.46	20.29	-0.04	0.21	37.09	0.04	99.31
2 / 7 .	0.02	3.04	6.14	7.01	25.70	20.41	0.00	0.23	37.01	0.04	99.61
2 / 8 .	0.03	3.17	6.19	7.07	26.15	20.51	-0.01	0.23	37.01	0.02	100.38
2 / 9 .	0.02	3.05	6.27	6.94	25.71	20.39	0.00	0.18	36.99	0.03	99.58
2 / 10 .	0.02	3.13	6.18	7.17	25.62	20.47	-0.01	0.17	37.12	0.06	99.94
3 / 1 .	0.02	3.04	6.08	7.33	26.01	20.40	-0.01	0.16	36.89	0.06	100.00
3 / 2 .	0.00	3.00	6.12	7.28	25.89	20.43	-0.02	0.16	36.68	0.03	99.59
3 / 3 .	0.00	3.04	6.20	6.96	25.66	20.52	0.00	0.18	36.51	0.08	99.17
3 / 4 .	0.01	3.01	6.14	7.18	25.84	20.47	-0.01	0.16	36.55	0.01	99.37
3 / 5 .	0.02	3.06	6.13	7.23	25.70	20.86	0.02	0.17	36.33	0.04	99.56
3 / 6 .	0.02	3.06	6.23	6.96	26.09	20.73	-0.04	0.08	36.65	0.02	99.85
3 / 7 .	0.01	3.06	6.31	7.07	25.54	20.20	0.00	0.09	37.29	-0.01	99.58
3 / 8 .	0.01	3.03	6.23	7.08	25.55	20.34	0.00	0.06	36.73	0.05	99.07
3 / 9 .	0.01	3.07	6.32	7.12	25.69	20.38	0.00	0.08	36.93	0.05	99.64
3 / 10 .	0.01	3.01	6.25	7.17	25.49	20.76	-0.01	0.08	36.88	0.00	99.65
Avg 13 gt 2	0.02	3.07	6.21	7.05	25.78	20.47	-0.01	0.15	36.96	0.04	99.75
BR-13 gt 4											
1 / 1 .	0.01	3.31	6.39	6.61	25.82	20.53	0.01	0.12	37.03	0.05	99.89
1 / 2 .	0.02	3.33	6.23	6.42	25.94	20.57	0.00	0.11	37.07	0.02	99.72
1 / 3 .	0.01	3.33	6.35	6.38	26.31	20.27	0.01	0.25	37.11	0.04	100.08
1 / 4 .	0.01	3.36	6.29	6.26	25.53	20.43	0.00	0.15	37.23	0.01	99.27
1 / 5 .	0.01	3.39	6.30	6.46	26.06	20.54	0.00	0.08	37.05	0.03	99.92

Table B4: Garnet Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	MgO	CaO	MnO	FeO	Al_2O_3	Cr_2O_3	Y_2O_3	SiO_2	TiO_2	Total
1 / 6 .	0.00	3.37	6.38	6.31	25.77	20.81	0.04	0.09	36.94	0.06	99.76
1 / 7 .	0.00	3.45	6.37	5.95	26.06	20.46	0.01	0.07	37.10	0.04	99.51
1 / 8 .	0.01	3.41	6.39	6.29	25.72	20.50	0.01	0.08	37.11	0.07	99.59
1 / 9 .	0.00	3.37	6.33	6.15	25.84	20.34	0.03	0.09	37.23	0.03	99.41
1 / 10 .	0.01	3.40	6.47	6.36	26.07	20.79	-0.02	0.08	37.20	0.03	100.42
Avg 13 gt 4	0.01	3.37	6.35	6.32	25.91	20.52	0.01	0.11	37.11	0.04	99.76
FR-111											
111_gt_1											
1 / 1 .	0.04	2.38	6.39	7.65	26.02	20.37	0.01	0.51	37.04	0.03	100.44
1 / 2 .	0.06	2.31	6.29	7.83	26.02	20.49	0.02	0.50	36.87	-0.01	100.38
1 / 3 .	0.06	2.31	6.28	7.68	26.04	20.45	0.02	0.51	37.01	0.00	100.37
1 / 4 .	0.04	2.35	6.37	7.68	25.82	20.47	-0.01	0.48	36.97	0.01	100.19
1 / 5 .	0.06	2.33	6.39	7.78	25.52	20.27	-0.01	0.41	36.82	0.09	99.67
1 / 6 .	0.04	2.36	6.49	7.79	26.04	20.26	-0.01	0.53	37.01	0.07	100.59
1 / 7 .	0.03	2.33	6.35	7.78	26.24	20.38	-0.04	0.52	36.79	0.04	100.47
1 / 8 .	0.05	2.34	6.48	7.73	25.94	20.12	0.00	0.70	36.83	0.00	100.19
1 / 9 .	0.04	2.31	6.47	7.72	25.63	20.08	0.01	0.71	36.65	0.05	99.67
1 / 10 .	0.03	2.33	6.26	7.71	25.65	20.42	0.03	0.67	36.71	0.02	99.84
111_gt_1.1	0.04	2.34	6.38	7.74	25.89	20.33	0.00	0.56	36.87	0.03	100.17
2 / 1 .	0.04	2.32	6.45	7.59	25.84	20.49	0.02	0.61	37.17	0.02	100.56
2 / 2 .	0.06	2.35	6.52	7.74	25.83	20.38	-0.01	0.56	36.71	0.02	100.16
2 / 3 .	0.05	2.29	6.53	7.78	26.26	20.16	0.01	0.47	36.85	0.03	100.43
2 / 4 .	0.06	2.32	6.45	7.90	25.82	20.18	0.02	0.51	36.90	0.10	100.28
2 / 5 .	0.07	2.31	6.45	7.73	26.20	20.31	-0.09	0.55	36.87	0.10	100.59
2 / 6 .	0.04	2.28	6.44	7.87	25.74	20.36	0.02	0.50	36.99	0.04	100.29
2 / 7 .	0.05	2.32	6.49	7.88	26.08	20.19	0.03	0.46	36.89	0.06	100.45
2 / 8 .	0.05	2.28	6.45	7.85	25.77	20.26	-0.03	0.50	36.74	0.01	99.92
2 / 9 .	0.06	2.30	6.39	7.95	25.38	20.55	-0.01	0.51	37.04	0.05	100.24
2 / 10 .	0.05	2.30	6.44	7.98	25.81	20.39	0.03	0.46	37.11	0.04	100.60

Table B4: Garnet Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	MgO	CaO	MnO	FeO	Al_2O_3	Cr_2O_3	Y_2O_3	SiO_2	TiO_2	Total
111_gt_1.2	0.05	2.31	6.46	7.83	25.87	20.33	0.00	0.51	36.93	0.05	100.34
111_gt_2											
1 / 1 .	0.02	2.35	6.35	7.58	25.81	20.16	0.00	0.84	36.69	0.04	99.86
1 / 2 .	0.03	2.27	6.43	7.79	25.51	20.56	-0.02	0.89	36.60	0.01	100.08
1 / 3 .	0.07	2.28	6.47	7.69	25.71	20.33	0.02	0.78	36.71	0.04	100.11
1 / 4 .	0.07	2.27	6.43	7.76	25.84	20.43	0.00	0.77	36.82	-0.02	100.40
1 / 5 .	0.03	2.35	6.46	7.73	25.56	20.34	-0.01	0.76	36.68	-0.02	99.92
1 / 6 .	0.06	2.27	6.39	7.83	25.66	20.24	-0.05	0.72	37.00	-0.02	100.18
1 / 7 .	0.06	2.28	6.50	7.82	25.76	20.29	-0.01	0.72	36.63	0.02	100.08
1 / 8 .	0.08	2.27	6.41	7.96	25.84	20.25	0.01	0.74	36.62	0.02	100.19
1 / 9 .	0.06	2.31	6.38	7.59	25.80	20.43	0.04	0.77	36.61	-0.01	100.00
1 / 10 .	0.08	2.31	6.49	7.64	25.66	20.26	0.01	0.78	36.47	0.03	99.75
111_gt_2	0.06	2.30	6.43	7.74	25.71	20.33	0.00	0.78	36.68	0.01	100.04
111_gt_3											
1 / 1 .	0.02	2.59	6.36	7.60	26.96	20.71	-0.09	0.11	36.96	0.00	101.31
1 / 2 .	0.01	2.60	6.35	7.46	26.38	20.27	-0.04	0.14	36.74	0.07	100.02
1 / 3 .	0.01	2.55	6.43	7.54	26.52	20.77	0.02	0.05	36.94	-0.02	100.84
1 / 4 .	0.01	2.62	6.42	7.64	26.34	20.33	0.00	0.09	36.91	0.10	100.45
1 / 5 .	0.02	2.57	6.45	7.45	26.65	20.46	0.03	0.14	36.88	0.05	100.70
1 / 6 .	0.02	2.61	6.50	7.52	26.53	20.44	-0.02	0.07	37.05	0.03	100.77
1 / 7 .	0.00	2.57	6.37	7.59	26.39	20.63	-0.05	0.13	37.21	0.04	100.93
1 / 8 .	0.03	2.55	6.35	7.52	26.69	20.49	0.02	0.15	36.90	0.02	100.72
1 / 9 .	0.01	2.55	6.50	7.70	26.33	20.24	0.01	0.12	37.13	-0.02	100.60
1 / 10 .	0.02	2.57	6.38	7.71	26.67	20.52	0.01	0.12	36.90	0.11	101.00
111_gt_3	0.01	2.58	6.41	7.57	26.55	20.49	-0.01	0.11	36.96	0.04	100.71
111_gt_4											
1 / 1 .	0.07	2.10	6.38	8.39	25.66	20.46	-0.02	0.42	36.71	0.00	100.20
1 / 2 .	0.04	2.11	6.36	8.15	25.52	20.54	-0.04	0.38	36.57	0.02	99.69
1 / 3 .	0.03	2.10	6.33	8.02	25.61	20.22	-0.05	0.40	36.57	0.05	99.34

Table B4: Garnet Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	MgO	CaO	MnO	FeO	Al_2O_3	Cr_2O_3	Y_2O_3	SiO_2	TiO_2	Total
1 / 4 .	0.03	2.13	6.31	8.15	25.60	20.27	0.01	0.52	36.59	-0.03	99.61
1 / 5 .	0.03	2.16	6.28	8.27	25.65	20.38	0.05	0.41	36.66	0.03	99.92
1 / 6 .	0.03	2.15	6.29	8.14	26.16	20.39	0.00	0.41	36.41	-0.01	100.00
1 / 7 .	0.03	2.15	6.27	8.12	26.22	20.46	-0.01	0.34	36.59	-0.01	100.17
1 / 8 .	0.05	2.21	6.32	8.24	25.96	20.20	0.03	0.35	36.42	0.08	99.86
1 / 9 .	0.04	2.13	6.23	8.17	25.99	20.30	-0.05	0.43	36.76	0.02	100.08
1 / 10 .	0.03	2.14	6.26	8.09	25.72	20.66	-0.01	0.46	36.45	0.07	99.89
111_gt_4	0.04	2.14	6.30	8.17	25.81	20.39	-0.01	0.41	36.57	0.02	99.85
111_gt_5											
1 / 1 .	0.03	2.42	6.11	7.88	26.24	20.85	0.00	0.23	37.00	0.07	100.84
1 / 2 .	0.02	2.50	6.05	8.02	26.07	20.60	0.00	0.27	36.97	0.01	100.51
1 / 3 .	0.00	2.47	6.07	7.83	26.46	20.59	-0.01	0.23	36.94	0.11	100.68
1 / 4 .	0.02	2.42	5.95	7.97	26.40	20.57	0.03	0.15	37.06	0.05	100.63
1 / 5 .	0.02	2.44	6.04	7.82	26.60	20.62	0.00	0.21	36.95	-0.03	100.71
1 / 6 .	0.00	2.51	5.98	8.12	26.91	20.46	0.03	0.11	37.10	-0.03	101.22
1 / 7 .	0.02	2.43	6.06	8.03	26.54	20.65	-0.05	0.18	37.04	0.00	100.94
1 / 8 .	0.02	2.43	6.08	7.98	26.54	20.71	0.00	0.11	36.93	0.04	100.84
1 / 9 .	0.00	2.48	6.04	7.95	26.44	20.53	0.05	0.10	37.12	0.01	100.73
1 / 10 .	0.01	2.49	6.08	8.22	26.40	20.88	0.00	0.17	36.95	0.03	101.21
111_gt_5	0.01	2.46	6.05	7.98	26.46	20.65	0.00	0.18	37.01	0.03	100.82
111_gt_6											
1 / 1 .	0.03	2.51	6.21	7.49	26.40	20.74	0.00	0.34	37.04	0.02	100.79
1 / 2 .	0.01	2.58	6.23	7.56	26.41	20.54	-0.06	0.25	36.97	-0.02	100.55
1 / 3 .	0.02	2.60	6.22	7.67	26.22	20.68	-0.03	0.24	37.17	0.07	100.89
1 / 4 .	0.03	2.52	6.18	7.54	26.70	20.60	0.03	0.26	36.83	0.06	100.76
1 / 5 .	0.02	2.53	6.23	7.58	26.85	20.73	0.03	0.21	37.03	-0.02	101.19
1 / 6 .	0.03	2.58	6.17	7.63	26.18	20.42	-0.01	0.13	37.01	0.08	100.23
1 / 7 .	0.03	2.54	6.23	7.48	26.80	20.74	0.03	0.20	36.99	-0.02	101.06
1 / 8 .	0.04	2.47	6.23	7.51	26.31	20.61	-0.01	0.14	36.93	0.04	100.29

Table B4: Garnet Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	MgO	CaO	MnO	FeO	Al_2O_3	Cr_2O_3	Y_2O_3	SiO_2	TiO_2	Total
1 / 9 .	0.02	2.53	6.20	7.72	26.35	20.39	0.00	0.29	37.10	0.05	100.63
1 / 10 .	0.02	2.54	6.23	7.61	26.39	20.49	-0.07	0.26	37.17	-0.03	100.72
111_gt_6.1	0.03	2.54	6.21	7.58	26.46	20.59	-0.01	0.23	37.02	0.02	100.68
2 / 1 .	0.03	2.51	6.27	7.42	26.42	20.64	0.01	0.32	36.93	0.07	100.61
2 / 2 .	0.03	2.51	6.27	7.47	26.42	20.59	-0.03	0.23	36.91	0.01	100.44
2 / 3 .	0.02	2.55	6.27	7.61	26.36	20.53	0.00	0.26	37.02	0.04	100.66
2 / 4 .	0.02	2.49	6.23	7.68	26.30	20.65	-0.03	0.27	37.15	0.09	100.88
2 / 5 .	0.03	2.50	6.23	7.46	26.41	20.64	0.04	0.32	36.91	0.02	100.56
2 / 6 .	0.02	2.46	6.37	7.65	25.97	20.62	0.01	0.29	36.92	0.04	100.36
2 / 7 .	0.02	2.45	6.42	7.71	26.10	20.46	0.03	0.31	37.29	-0.01	100.78
2 / 8 .	0.03	2.48	6.42	7.49	26.03	20.51	0.06	0.38	37.04	-0.01	100.45
2 / 9 .	0.01	2.45	6.31	7.52	26.19	20.46	0.04	0.39	36.95	0.04	100.37
2 / 10 .	0.03	2.46	6.34	7.36	25.86	20.45	0.04	0.35	37.03	0.06	99.97
111_gt_6.2	0.02	2.49	6.31	7.54	26.21	20.56	0.02	0.31	37.02	0.03	100.50
111_gt_7											
1 / 1 .	0.01	2.29	6.25	7.65	26.78	20.32	-0.04	0.15	36.74	0.06	100.25
1 / 2 .	0.02	2.33	6.28	7.74	26.53	20.51	0.02	0.13	36.76	0.03	100.34
1 / 3 .	0.00	2.34	6.27	7.85	26.65	20.56	0.01	0.09	37.28	0.03	101.08
1 / 4 .	0.01	2.38	6.30	7.99	26.43	20.40	0.05	0.12	36.77	0.05	100.49
1 / 5 .	0.01	2.42	6.22	7.80	26.47	20.34	0.01	0.11	36.85	0.01	100.24
1 / 6 .	0.01	2.33	6.33	7.90	26.21	20.55	0.03	0.10	36.80	0.04	100.30
1 / 7 .	0.01	2.34	6.26	7.95	26.44	20.59	-0.03	0.11	37.22	0.06	100.98
1 / 8 .	0.02	2.28	6.33	7.82	26.68	20.45	0.01	0.12	37.06	0.01	100.79
1 / 9 .	0.02	2.26	6.34	7.82	26.43	20.63	0.00	0.11	37.18	0.03	100.84
1 / 10 .	0.01	2.24	6.32	7.87	26.58	20.52	0.00	0.10	36.99	0.09	100.73
111_gt_7.1	0.01	2.32	6.29	7.84	26.52	20.49	0.01	0.11	36.97	0.04	100.60
2 / 1 .	0.02	2.27	6.44	7.93	26.48	20.46	0.00	0.09	37.38	0.05	101.13
2 / 2 .	0.01	2.27	6.46	8.09	26.33	20.56	-0.01	0.10	37.21	0.04	101.08
2 / 3 .	0.03	2.27	6.40	7.88	26.02	20.65	0.01	0.09	37.08	0.03	100.47

Table B4: Garnet Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	MgO	CaO	MnO	FeO	Al_2O_3	Cr_2O_3	Y_2O_3	SiO_2	TiO_2	Total
2 / 4 .	0.01	2.29	6.49	7.89	26.29	20.38	0.02	0.16	37.18	0.05	100.76
2 / 5 .	0.01	2.25	6.34	7.96	26.44	20.50	0.08	0.07	37.08	0.06	100.79
2 / 6 .	0.02	2.30	6.45	7.81	26.44	20.53	0.02	0.07	37.35	0.01	101.00
2 / 7 .	0.01	2.29	6.42	7.95	26.44	20.28	-0.01	0.07	37.07	0.08	100.61
2 / 8 .	0.04	2.27	6.42	7.98	26.41	20.66	0.05	0.12	37.02	0.01	100.98
2 / 9 .	0.03	2.22	6.39	8.12	26.22	20.41	0.00	0.13	36.89	0.06	100.48
2 / 10 .	0.02	2.18	6.33	8.17	26.00	20.63	-0.01	0.12	36.97	0.03	100.45
111_gt_7.2	0.02	2.26	6.41	7.98	26.31	20.51	0.02	0.10	37.12	0.04	100.77
111_gt_8											
1 / 1 .	0.01	2.44	6.35	7.62	26.84	20.39	0.01	0.07	37.07	0.00	100.82
1 / 2 .	-0.01	2.49	6.30	7.40	26.62	20.51	0.03	0.10	37.03	0.02	100.50
1 / 3 .	0.02	2.52	6.20	7.61	26.83	20.45	0.01	0.07	36.97	0.06	100.73
1 / 4 .	0.01	2.53	6.21	7.38	26.93	20.68	0.00	0.08	37.10	0.04	100.94
1 / 5 .	0.01	2.48	6.24	7.60	26.93	20.59	0.00	0.03	37.15	0.06	101.09
1 / 6 .	0.00	2.57	6.43	7.55	26.68	20.46	0.04	0.07	37.09	0.07	100.98
1 / 7 .	0.02	2.53	6.48	7.60	26.99	20.38	-0.03	0.04	37.06	0.07	101.18
1 / 8 .	0.01	2.47	6.41	7.69	26.68	20.67	0.02	0.02	37.01	0.06	101.06
1 / 9 .	0.01	2.43	6.29	7.67	26.74	20.56	-0.03	0.05	36.82	0.03	100.60
1 / 10 .	0.01	2.42	6.28	7.81	26.43	20.43	-0.04	0.20	37.16	0.02	100.75
111_gt_8.1	0.01	2.49	6.32	7.59	26.77	20.51	0.00	0.07	37.05	0.04	100.85
2 / 1 .	0.02	2.37	6.14	7.70	26.38	20.59	0.06	0.23	37.00	0.06	100.54
2 / 2 .	0.01	2.39	6.15	7.68	26.55	20.40	0.02	0.23	37.01	0.01	100.44
2 / 3 .	0.04	2.36	6.16	7.53	26.55	20.58	-0.03	0.25	36.97	0.05	100.49
2 / 4 .	0.03	2.38	6.16	7.76	26.55	20.58	-0.02	0.21	37.12	0.02	100.80
2 / 5 .	0.02	2.42	6.23	7.74	26.10	20.62	-0.03	0.29	37.03	0.05	100.52
2 / 6 .	0.01	2.41	6.25	7.65	26.20	20.41	-0.03	0.30	37.04	-0.03	100.27
2 / 7 .	0.03	2.38	6.23	7.78	26.28	20.59	0.00	0.22	37.00	0.01	100.51
2 / 8 .	0.03	2.36	6.06	7.62	26.18	20.48	-0.02	0.21	37.00	0.06	100.01
2 / 9 .	0.03	2.39	6.14	7.86	26.33	20.59	0.01	0.19	37.00	0.07	100.61

Table B4: Garnet Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	MgO	CaO	MnO	FeO	Al_2O_3	Cr_2O_3	Y_2O_3	SiO_2	TiO_2	Total
2 / 10 .	0.03	2.38	6.29	7.84	26.43	20.65	0.03	0.27	36.86	0.02	100.80
111_gt_8.2	0.02	2.38	6.18	7.72	26.36	20.55	0.00	0.24	37.00	0.03	100.48
FR-108											
108_gt_1											
1 / 1 .	0.02	2.96	5.87	6.86	25.48	20.48	0.05	0.27	37.27	0.04	99.29
1 / 2 .	0.02	2.98	5.81	6.82	25.55	20.40	0.01	0.19	37.26	0.08	99.12
1 / 3 .	0.02	3.04	5.78	6.92	25.79	20.57	-0.03	0.13	36.97	0.01	99.24
1 / 4 .	0.00	3.04	5.76	6.89	26.04	20.33	0.00	0.08	37.49	0.02	99.65
1 / 5 . *	0.02	3.05	5.69	6.75	25.70	20.45	0.00	0.08	37.22	0.03	98.99
1 / 6 .	0.05	3.03	5.70	6.71	25.74	20.49	0.01	0.10	37.26	0.08	99.16
1 / 7 .	0.01	3.03	5.71	6.74	25.92	20.41	-0.06	0.11	37.15	0.07	99.16
108_gt_1_2.1	0.02	3.01	5.77	6.82	25.75	20.45	0.00	0.15	37.23	0.05	99.25
2 / 1 .	0.03	3.22	5.63	6.72	25.69	20.66	-0.02	0.13	37.15	0.06	99.29
2 / 2 . *	0.01	3.27	5.62	6.71	25.35	20.50	-0.01	0.13	37.29	0.02	98.90
2 / 3 . *	0.04	3.29	5.63	6.78	25.30	20.61	-0.05	0.08	37.19	0.00	98.92
2 / 4 .	0.02	3.22	5.67	6.71	25.51	20.61	0.00	0.10	37.36	0.07	99.27
2 / 5 .	0.00	3.27	5.64	6.68	25.41	20.51	-0.04	0.20	37.53	-0.02	99.24
2 / 6 .	0.04	3.32	5.79	6.54	25.63	20.49	-0.01	0.16	37.30	0.03	99.32
2 / 7 .	0.02	3.35	5.62	6.69	25.54	20.53	0.03	0.21	37.19	0.02	99.21
108_gt_1_2.2	0.02	3.28	5.67	6.67	25.56	20.56	-0.01	0.16	37.31	0.03	99.25
108_gt_3											
1 / 1 .	0.00	3.12	5.94	7.83	25.03	20.89	-0.02	0.17	36.55	0.01	99.55
1 / 2 .	0.03	3.12	5.84	7.84	25.56	21.00	-0.01	0.12	36.94	0.10	100.56
1 / 3 .	0.02	3.11	5.91	7.89	25.13	20.94	-0.01	0.08	36.73	0.09	99.89
1 / 4 .	0.03	3.09	5.98	7.65	25.58	20.83	-0.01	0.04	36.43	0.00	99.64
1 / 5 .	-0.01	3.04	5.97	7.63	25.59	20.71	0.03	0.03	37.06	0.06	100.12
1 / 6 .	0.01	3.05	6.02	7.89	25.40	20.90	-0.03	0.04	36.53	0.03	99.88
1 / 7 .	0.00	3.04	6.04	7.67	25.47	20.70	-0.01	0.08	36.45	0.04	99.49

Table B4: Garnet Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	MgO	CaO	MnO	FeO	Al_2O_3	Cr_2O_3	Y_2O_3	SiO_2	TiO_2	Total
1 / 8 .	0.00	2.91	5.91	7.74	25.49	20.68	-0.05	0.07	36.87	0.07	99.75
1 / 9 .	0.02	2.88	5.90	7.87	25.47	20.79	0.01	0.15	36.33	0.02	99.44
1 / 10 .	0.03	2.76	5.88	7.65	25.71	20.53	0.02	0.15	36.28	0.03	99.05
108_gt_3	0.01	3.01	5.94	7.77	25.44	20.80	-0.01	0.09	36.62	0.05	99.72
108_gt_4											
1 / 1 .	0.02	2.97	5.82	8.35	25.57	20.60	-0.03	0.13	36.80	0.07	100.33
1 / 2 .	0.04	2.95	5.94	8.21	25.27	20.82	0.01	0.21	36.82	-0.02	100.27
1 / 3 . *	0.05	4.24	5.15	7.18	25.48	19.59	0.03	0.19	35.62	0.01	97.53
1 / 4 .	0.02	3.10	5.92	8.33	25.12	20.80	-0.01	0.23	36.81	0.01	100.35
1 / 5 .	0.01	3.08	6.00	8.16	24.86	20.48	-0.04	0.25	36.52	0.05	99.41
1 / 6 .	0.00	3.13	5.84	7.98	25.10	20.61	-0.02	0.23	36.61	0.05	99.53
1 / 7 .	0.01	3.07	5.81	8.20	24.97	20.81	-0.01	0.19	37.06	0.00	100.13
1 / 8 .	0.02	3.11	5.79	8.26	25.05	20.65	0.00	0.21	36.81	0.02	99.92
1 / 9 .	0.04	3.13	5.78	8.12	24.98	20.80	-0.06	0.17	36.74	0.05	99.80
1 / 10 .	0.01	3.10	5.90	8.18	24.94	20.50	0.03	0.23	36.66	0.04	99.58
108_gt_4	0.02	3.07	5.87	8.20	25.09	20.67	-0.02	0.20	36.76	0.03	99.90
108_gt_5											
1 / 1 .	0.03	3.21	6.07	7.46	25.14	20.59	0.04	0.43	37.24	0.00	100.20
1 / 2 .	0.00	3.24	6.13	7.39	25.59	20.50	-0.01	0.36	37.31	0.02	100.54
1 / 3 .	0.02	3.30	6.11	7.61	25.52	20.57	-0.02	0.42	37.20	0.02	100.77
1 / 4 .	0.02	3.24	6.17	7.63	25.67	20.45	0.00	0.33	37.30	0.01	100.81
1 / 5 .	0.01	3.17	6.28	7.45	25.25	20.41	0.01	0.45	37.19	-0.01	100.22
1 / 6 .	0.00	3.17	6.14	7.28	25.04	20.66	0.00	0.38	37.18	0.02	99.88
1 / 7 .	0.02	3.25	6.05	7.36	25.45	20.71	-0.03	0.37	37.10	-0.01	100.30
108_gt_5.1	0.01	3.22	6.14	7.46	25.38	20.55	0.00	0.39	37.22	0.01	100.38
2 / 1 .	0.03	3.06	6.06	7.82	25.30	20.72	-0.05	0.40	37.36	0.06	100.82
2 / 2 .	0.00	3.13	5.99	8.00	25.44	20.49	0.00	0.31	37.06	-0.01	100.43
2 / 3 .	0.00	3.19	5.94	7.86	25.43	20.52	-0.01	0.31	37.15	0.04	100.45
2 / 4 .	0.01	3.08	6.02	7.82	25.54	20.54	0.00	0.31	37.01	0.02	100.34

Table B4: Garnet Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	MgO	CaO	MnO	FeO	Al_2O_3	Cr_2O_3	Y_2O_3	SiO_2	TiO_2	Total
2 / 5 .	0.02	3.24	5.81	7.71	25.50	20.41	0.06	0.32	37.18	0.09	100.34
2 / 6 .	0.02	3.30	5.64	7.58	25.64	20.49	0.00	0.27	37.15	0.06	100.14
2 / 7 .	0.02	3.24	5.89	7.54	25.07	20.70	0.02	0.34	36.93	0.05	99.79
2 / 8 .	0.03	3.14	6.10	7.49	25.25	20.52	0.03	0.33	36.96	0.05	99.91
2 / 9 .	0.02	3.14	6.19	7.56	24.79	20.50	0.01	0.30	37.09	0.08	99.68
2 / 10 .	0.02	3.10	6.37	7.38	24.93	20.53	0.02	0.35	36.85	0.09	99.64
108_gt_5.2	0.02	3.16	6.00	7.68	25.29	20.54	0.01	0.32	37.07	0.05	100.14
108_gt_6											
1 / 1 .	0.04	3.02	6.20	7.81	25.42	20.76	0.05	0.41	37.12	0.03	100.86
1 / 2 .	0.03	2.98	6.11	7.81	25.15	20.74	0.02	0.36	37.45	0.02	100.67
1 / 3 .	0.04	2.95	6.17	7.83	25.10	20.71	-0.03	0.37	37.25	0.02	100.44
1 / 4 .	0.02	2.98	6.24	7.69	24.83	20.74	0.03	0.43	37.29	-0.01	100.26
1 / 5 .	0.05	2.93	6.31	7.96	24.81	20.57	0.01	0.45	37.27	0.04	100.40
1 / 6 .	0.03	2.94	6.41	7.81	24.84	20.76	0.02	0.43	36.99	0.03	100.27
1 / 7 .	0.02	2.98	6.35	7.80	24.52	20.56	-0.02	0.41	37.11	0.03	99.76
1 / 8 .	0.03	2.99	6.26	7.63	25.03	20.73	0.00	0.40	37.16	0.06	100.27
1 / 9 .	0.04	2.98	6.15	7.78	25.01	20.54	0.03	0.37	37.15	0.05	100.09
1 / 10 .	0.02	3.62	5.91	7.17	25.70	20.45	0.01	0.36	36.96	0.06	100.26
108_gt_6.1	0.03	3.04	6.21	7.73	25.04	20.66	0.01	0.40	37.17	0.03	100.32
2 / 1 .	0.03	3.09	6.16	7.60	25.20	20.84	0.00	0.43	37.21	0.05	100.61
2 / 2 .	0.02	3.03	6.03	7.57	24.87	20.72	-0.01	0.32	37.09	0.01	99.66
2 / 3 .	0.04	3.01	6.13	7.55	24.73	20.73	0.00	0.37	37.09	0.00	99.67
2 / 4 .	0.02	3.09	6.09	7.60	25.31	20.46	0.04	0.38	37.21	0.03	100.23
2 / 5 .	0.03	3.07	6.11	7.68	25.10	20.85	0.02	0.38	37.22	-0.01	100.45
2 / 6 .	0.03	2.99	6.10	7.73	25.02	20.96	0.03	0.42	37.40	-0.01	100.69
2 / 7 .	0.04	2.95	6.27	7.76	24.65	20.88	0.15	0.34	37.31	0.02	100.35
108_gt_6.2	0.03	3.04	6.13	7.64	24.98	20.78	0.03	0.38	37.22	0.01	100.23
108_gt_7											
1 / 1 . *	0.00	3.61	5.71	6.96	26.22	20.93	0.01	0.12	37.48	-0.02	101.05

Table B4: Garnet Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	MgO	CaO	MnO	FeO	Al_2O_3	Cr_2O_3	Y_2O_3	SiO_2	TiO_2	Total
1 / 2 . *	0.00	3.68	5.62	7.08	26.35	20.75	-0.02	0.11	37.42	-0.04	101.02
1 / 3 .	0.01	3.60	5.81	6.90	26.15	20.95	-0.03	0.10	37.28	0.02	100.82
1 / 4 .	0.00	3.59	5.78	6.98	26.01	20.92	-0.03	0.05	37.15	0.09	100.58
1 / 5 .	-0.02	3.58	5.85	6.94	26.04	20.77	-0.03	0.05	37.44	0.06	100.75
1 / 6 . *	-0.01	3.55	5.80	7.06	26.15	20.72	0.01	0.07	37.63	0.08	101.06
1 / 7 .	0.01	3.62	6.00	6.92	25.94	21.05	0.02	0.06	37.02	0.04	100.67
1 / 8 .	0.01	3.51	5.81	7.03	26.17	20.72	-0.10	0.10	37.47	-0.03	100.81
1 / 9 . *	0.01	3.60	5.94	7.25	25.88	20.85	0.03	0.08	37.48	0.06	101.18
1 / 10 . *	0.02	3.51	5.88	7.17	26.12	20.71	0.00	0.08	37.53	0.00	101.02
108_gt_7.1	0.00	3.58	5.85	6.96	26.06	20.88	-0.03	0.07	37.27	0.04	100.68
2 / 1 .	0.00	3.21	5.93	7.57	25.67	20.82	0.00	0.09	37.47	0.06	100.84
2 / 2 .	0.01	3.22	6.03	7.45	25.41	20.68	-0.01	0.09	37.29	0.02	100.19
2 / 3 . *	0.01	3.22	6.10	7.60	25.67	20.81	0.02	0.12	37.47	-0.04	101.00
2 / 4 .	0.02	3.16	5.98	7.33	25.10	20.36	-0.01	0.10	38.73	0.05	100.82
2 / 5 .	0.02	3.23	5.95	7.42	25.78	20.82	-0.01	0.08	37.46	0.05	100.82
2 / 6 . *	0.01	3.26	5.97	7.41	25.90	20.86	0.00	0.10	37.57	0.04	101.11
2 / 7 .	0.02	3.27	6.02	7.45	25.63	20.76	-0.01	0.03	37.51	0.03	100.72
2 / 8 .	0.01	3.20	6.06	7.32	25.87	20.84	-0.01	0.01	37.53	0.09	100.91
2 / 9 . *	0.02	3.24	6.08	7.56	25.94	21.10	0.02	0.04	37.44	0.07	101.50
2 / 10 .	0.01	3.12	5.98	7.64	25.81	20.87	0.03	0.10	37.30	0.08	100.94
108_gt_7.2	0.01	3.20	5.99	7.45	25.61	20.74	0.00	0.07	37.61	0.05	100.74
3 / 1 . *	0.01	3.41	5.98	7.46	26.03	20.88	0.00	0.07	37.72	0.04	101.60
3 / 2 . *	0.03	3.34	6.08	7.17	26.34	20.88	0.00	0.05	37.16	0.03	101.09
3 / 3 .	0.01	3.49	6.03	7.21	25.73	20.84	-0.01	0.06	37.59	0.00	100.96
3 / 4 .	0.00	3.47	5.97	7.19	25.84	20.91	0.00	0.07	37.30	0.05	100.81
3 / 5 .	0.02	3.42	6.10	7.11	26.03	20.76	-0.01	0.04	37.18	0.03	100.67
3 / 6 . *	0.00	3.43	6.15	7.05	25.77	20.88	0.03	0.04	37.63	0.13	101.12
3 / 7 .	0.00	3.45	6.12	7.02	25.73	20.61	0.00	0.06	37.29	0.06	100.34
3 / 8 .	0.01	3.41	6.03	7.16	25.86	20.97	0.00	0.09	37.39	0.07	100.98

Table B4: Garnet Chemistries

* analyses not used in mineral chemistry calculations

Wt% Oxide	Na_2O	MgO	CaO	MnO	FeO	Al_2O_3	Cr_2O_3	Y_2O_3	SiO_2	TiO_2	Total
3 / 9 .	0.02	3.38	6.00	7.18	25.55	20.69	-0.02	0.15	37.27	0.06	100.31
3 / 10 .	0.02	3.38	6.11	7.33	25.42	20.70	-0.06	0.13	37.62	0.03	100.75
108_gt_7.3	0.01	3.43	6.05	7.17	25.74	20.78	-0.02	0.08	37.38	0.04	100.67
108_gt_8											
1 / 1 .	0.01	3.30	5.92	7.26	25.74	20.55	-0.04	0.18	37.18	0.01	100.16
1 / 2 .	0.02	3.29	5.90	7.26	25.78	20.53	-0.04	0.16	37.05	0.06	100.05
1 / 3 .	0.00	3.37	5.84	7.24	26.32	20.64	0.00	0.15	37.21	0.07	100.85
1 / 4 .	-0.01	3.30	5.93	7.33	26.30	20.87	-0.03	0.12	37.11	-0.02	100.96
1 / 5 .	0.00	3.28	5.99	7.15	26.11	20.61	0.02	0.11	37.09	0.08	100.45
1 / 6 .	0.01	3.29	5.87	7.26	25.90	20.71	-0.01	0.08	37.19	0.01	100.32
1 / 7 .	0.03	3.27	5.86	7.36	26.01	20.63	-0.01	0.16	36.98	0.00	100.30
1 / 8 .	0.01	3.22	5.89	7.35	25.89	20.67	-0.01	0.16	37.05	0.00	100.25
1 / 9 .	0.00	3.27	5.90	7.34	25.83	20.96	-0.02	0.10	37.13	0.01	100.55
1 / 10 .	0.01	3.21	5.83	7.30	25.89	20.65	0.01	0.10	37.25	0.08	100.35
1 / 11 .	0.00	3.25	5.96	7.35	25.75	20.64	0.00	0.16	37.14	-0.01	100.25
1 / 12 .	0.00	3.14	6.01	7.62	25.77	20.79	0.00	0.19	36.96	0.11	100.60
1 / 13 .	0.01	3.16	5.91	7.44	25.80	20.84	0.04	0.19	37.01	0.01	100.42
1 / 14 .	0.01	3.11	5.95	7.50	25.81	20.75	-0.03	0.27	37.21	0.02	100.62
1 / 15 .	0.02	3.12	5.87	7.67	25.48	20.92	0.00	0.21	36.95	0.02	100.27
108_gt_8	0.01	3.24	5.91	7.36	25.89	20.72	-0.01	0.16	37.10	0.03	100.41

APPENDIX C

Table C: EBSD settings for Km-scale gradients

sample	phase	step size (μm)	minimum grain size (μm)
201a	quartz	15	100
202	quartz	25	100
70	quartz	25	100
109	quartz	20	100
108	quartz	15	100
103	quartz	15	75

APPENDIX D
U-Pb DATA

Table D1: Sample 201

Granite	spot/grain		$^{207}Pb/^{235}U$	$^{207}Pb/^{235}U$	$^{206}Pb/^{238}U$	$^{206}Pb/^{238}U$	Err. Corr	$^{207}Pb/^{206}Pb$	$^{207}Pb/^{206}Pb$	$^{206}Pb/^{238}U$ Age	$^{206}Pb/^{238}U$	$^{207}Pb/^{206}Pb$ Age	$^{207}Pb/^{206}Pb$ Age	U	Th	Th/U
				2SE		2SE			2SE	Ma	2SE	Ma	2SE	ppm	ppm	
201- spot analyses	1		3.022	0.084	0.2394	0.0058	0.593	0.0908	0.0018	1383	30	1441	37	98.8	91.5	66.67
	2	*	2.606	0.086	0.2156	0.0062	0.466	0.0878	0.0024	1258	33	1368	53	55.1	41.8	17.54
	3		3.181	0.086	0.2553	0.0064	0.431	0.0902	0.002	1465	33	1427	42	64.7	101.6	32.26
	4	*	2.238	0.064	0.1956	0.0049	0.560	0.0816	0.0017	1151	26	1243	41	100.8	37.4	11.63
	5		3.403	0.085	0.2632	0.0061	0.635	0.093	0.0016	1508	30	1485	34	195.6	73.9	27.03
	6		2.997	0.072	0.2405	0.0057	0.345	0.0912	0.0018	1389	29	1449	38	140.9	93	10.20
	7		3.155	0.079	0.2465	0.0055	0.572	0.0929	0.0017	1420	28	1492	33	146.1	41.9	13.51
	8	*	3.21	0.084	0.245	0.0069	0.674	0.0962	0.0019	1412	35	1555	39	172	48.6	10.64
	9		3.61	0.18	0.25	0.0074	0.637	0.1049	0.005	1438	38	1708	92	27.1	34.7	13.70
	10	*	3.352	0.085	0.2544	0.0065	0.474	0.0959	0.0022	1460	33	1540	43	149	100.3	15.38
	10		3.72	0.14	0.2508	0.0071	0.335	0.107	0.0034	1442	37	1758	63	55.2	54	40.00
	11		3.02	0.092	0.2379	0.006	0.337	0.0915	0.0025	1375	31	1460	53	36.7	37	52.63
	12		2.865	0.073	0.2335	0.0058	0.488	0.0885	0.0017	1352	30	1395	38	96.9	54.3	19.23
	14		3.217	0.081	0.2536	0.0058	0.522	0.0917	0.0017	1456	30	1464	34	127.5	102.9	26.32
	15	*	2.207	0.068	0.2039	0.0052	0.462	0.0781	0.002	1196	28	1154	54	158.8	24.16	4.35
			3.378	0.12	0.2642	0.0079	0.774	0.0926	0.002	1511	40	1478	41	110.9	122	14.49
spot analyses (cont)	16	*	3.89	0.33	0.2368	0.0076	0.215	0.115	0.0085	1370	40	1920	140	38.7	61.1	41.67
			3.04	0.11	0.2413	0.0081	0.070	0.0924	0.0036	1393	42	1462	74	53.3	67.6	16.39
	17	*	3.318	0.078	0.2568	0.0059	0.529	0.0939	0.0017	1473	30	1502	34	199.1	125.7	43.48
	18		3.138	0.079	0.2507	0.006	0.552	0.09	0.0016	1444	32	1425	36	95.5	105	10.42
	19		3.298	0.082	0.2609	0.0061	0.458	0.0918	0.0018	1494	31	1462	38	120	65.9	8.33
	20		3.289	0.082	0.2569	0.0058	0.422	0.0925	0.0017	1474	30	1474	36	84.5	114	27.78
	21		3.431	0.085	0.268	0.0061	0.596	0.0922	0.0017	1530	31	1474	36	121	123	34.48
201- profile analyses	1		2.964	0.054	0.2414	0.0042	0.736	0.08864	0.00071	1394	22	1394	15	78.1	143.6	76.92
	2	*	3.693	0.1	0.26	0.0057	0.357	0.1015	0.003	1490	29	1659	60	49.4	92	18.87
			3.288	0.054	0.2566	0.0043	0.358	0.09286	0.00084	1472.4	22	1484	17	120.3	118.3	20.83
	3		3.298	0.065	0.26	0.0046	0.345	0.0911	0.0012	1489	24	1444	25	29.7	54.1	52.63
	4		3.218	0.053	0.2555	0.0041	0.316	0.09107	0.00076	1467.5	21	1445	16	75.9	75.9	31.25

Table D1: Sample 201

Granite	spot/ grain		$^{207}Pb/^{235}U$	$^{207}Pb/^{235}U$	$^{206}Pb/^{238}U$	$^{206}Pb/^{238}U$	Err. Corr	$^{207}Pb/^{206}Pb$	$^{207}Pb/^{206}Pb$	$^{206}Pb/^{238}U$ Age	$^{206}Pb/^{238}U$	$^{207}Pb/^{206}Pb$ Age	$^{207}Pb/^{206}Pb$ Age	U	Th	Th/U
				2SE		2SE			2SE	Ma	2SE	Ma	2SE	ppm	ppm	
201- profile analyses (con't)	6	*	3.328	0.086	0.2422	0.0046	0.211	0.099	0.0022	1398	24	1603	42	100.5	70.13	55.56
		*	5.05	0.14	0.259	0.0055	0.184	0.1399	0.0034	1484	28	2229	45	45.4	99.8	71.43
			2.982	0.054	0.2422	0.0042	0.318	0.0893	0.0011	1398	22	1411	22	102.9	106	47.62
	7	*	3.358	0.06	0.2436	0.005	0.343	0.1012	0.0015	1405	26	1645	28	154	132.1	10.42
		*	3.41	0.1	0.1968	0.0065	0.212	0.1258	0.0043	1158	35	2049	55	26	47	10.42
			2.756	0.059	0.2243	0.0046	0.751	0.08912	0.00097	1304	24	1405	21	264	210	18.18
	8	*	3.177	0.06	0.2305	0.0044	0.643	0.1	0.0011	1337	23	1623	20	134.6	149.4	71.43
		*	2.09	0.11	0.19	0.012	0.696	0.0815	0.0011	1121	64	1233	28	262	113.5	2.44
			2.83	0.046	0.2297	0.0037	0.507	0.08893	0.00065	1332.7	19	1401	14	204	180	66.67
	9		3.303	0.059	0.2582	0.0044	0.150	0.0927	0.0012	1481	22	1480	24	44.2	66.4	47.62
	10		3.081	0.06	0.2393	0.0044	0.827	0.09338	0.00068	1383	23	1494	14	84.7	74.3	38.46
	11		3.316	0.055	0.2616	0.0043	0.559	0.09181	0.00057	1497.8	22	1463	12	78	99.1	23.26
	12		3.31	0.06	0.2627	0.0046	0.308	0.0917	0.0011	1503	24	1466	23	57.4	64.6	32.26
			3.96	0.15	0.2742	0.011	0.214	0.1063	0.005	1561	54	1764	87	9.89	17.34	66.67
	12_2		1.729	0.058	0.1658	0.005	0.418	0.0742	0.0022	989	28	1068	67	167	19.1	0.48
			2.996	0.083	0.2335	0.0051	0.622	0.0921	0.0021	1352	27	1468	42	78	83.3	40.00
	13		3.389	0.059	0.2672	0.0045	0.443	0.09196	0.00092	1526	23	1464	19	43.3	50.4	101.01
	14	*	3.391	0.061	0.2602	0.0044	0.335	0.09456	0.00098	1491	22	1519	20	42.8	55	62.50
	15		3.124	0.059	0.2479	0.0041	0.088	0.0906	0.00092	1427.6	21	1434	20	84.8	80	34.48
	15_2		3.146	0.059	0.2452	0.004	0.249	0.0911	0.0013	1413	21	1449	28	145	136.8	27.78
	16		3.469	0.059	0.273	0.0044	0.519	0.09168	0.00074	1556	23	1460	15	75.7	64.4	21.28
	17		3.425	0.067	0.2705	0.0051	0.690	0.0919	0.0011	1543	26	1463	23	148	116.8	31.25
	17_2		4.616	0.078	0.316	0.0052	0.390	0.1055	0.00094	1770	25	1721	16	58.6	34.4	71.43
			3.023	0.061	0.2363	0.0037	0.413	0.0918	0.0011	1367	19	1460	23	114.5	104.2	47.62
	18	*	5.4	0.14	0.2777	0.0072	0.295	0.1402	0.0043	1580	36	2226	53	19.54	29.44	55.56
			3.375	0.064	0.2659	0.0046	0.391	0.092	0.0011	1520	24	1462	23	36.8	38.5	22.22
	19	*	2.66	0.12	0.2261	0.0084	0.903	0.0849	0.0016	1313	44	1310	36	156	84.2	4.76
			3.363	0.057	0.2662	0.0043	0.474	0.09153	0.00078	1521.1	22	1461	16	65.2	51.1	19.23
	19_2	*	2.353	0.099	0.2048	0.0096	0.973	0.0835	0.0013	1201	52	1280	30	231.9	106	2.63
			3.208	0.066	0.2491	0.0045	0.224	0.0921	0.0014	1434	23	1465	30	103.1	109.6	83.33
	20		3.283	0.062	0.2557	0.0045	0.476	0.09244	0.00099	1467	23	1473	21	35.5	46.9	34.48

Table D1: Sample 201

Granite	spot/ grain		$^{207}Pb/^{235}U$	$^{207}Pb/^{235}U$	$^{206}Pb/^{238}U$	$^{206}Pb/^{238}U$	Err. Corr	$^{207}Pb/^{206}Pb$	$^{207}Pb/^{206}Pb$	$^{206}Pb/^{238}U$ Age	$^{206}Pb/^{238}U$	$^{207}Pb/^{206}Pb$ Age	$^{207}Pb/^{206}Pb$ Age	U	Th	Th/U
				2SE		2SE			2SE	Ma	2SE	Ma	2SE	ppm	ppm	
201- profile analyses (con't)	21		3.002	0.062	0.2416	0.0044	0.254	0.092	0.0016	1395	23	1462	33	183	204	33.33
		*	2.914	0.084	0.2263	0.0067	0.615	0.0949	0.0022	1317	34	1520	43	65.8	43.6	12.20
	22		1.708	0.069	0.1674	0.0097	0.240	0.0756	0.0045	998	54	1070	120	151.8	5.67	0.23
		*	1.96	0.14	0.1821	0.01	0.760	0.0807	0.0039	1078	55	1230	86	156.1	20.1	0.18
			2.981	0.071	0.2311	0.004	0.369	0.093	0.0018	1340	21	1489	38	98	120	41.67
	23		3.025	0.067	0.2408	0.004	0.444	0.0915	0.0014	1391	21	1459	28	83.1	89	55.56
	24		1.836	0.073	0.1758	0.0051	0.494	0.0766	0.0028	1044	28	1103	73	189	26	0.77
			2.903	0.076	0.2289	0.0047	0.746	0.0918	0.0016	1328	25	1461	32	133	169	31.25
			3.41	0.18	0.2404	0.0074	0.230	0.1035	0.006	1388	38	1670	110	35.8	46.8	37.04
	25		2.999	0.063	0.2368	0.004	0.082	0.0922	0.0016	1370	21	1471	32	99	113	62.50
	26		2.652	0.071	0.2138	0.0044	0.625	0.0886	0.0016	1249	24	1404	34	97	78.8	30.30
		*	2.08	0.14	0.199	0.009	0.815	0.0759	0.0029	1170	49	1090	75	195	51	1.25
			3.004	0.057	0.2338	0.0037	0.501	0.092	0.0011	1354	19	1467	22	192	145	22.73
	27		2.775	0.09	0.2202	0.006	0.902	0.0899	0.0012	1282	32	1419	26	134.7	68.3	3.33
	28		2.874	0.055	0.2274	0.0036	0.529	0.0909	0.0011	1321	19	1446	22	145.2	113	8.33
	29	*	4.095	0.099	0.2531	0.0059	0.633	0.1151	0.0018	1454	30	1885	27	124.9	83	45.45
	30		3.04	0.065	0.2389	0.004	0.532	0.0916	0.0013	1381	21	1454	27	84.4	91.3	41.67
			3.13	0.13	0.2487	0.0098	0.518	0.093	0.003	1441	51	1480	62	26.8	13.31	6.25
	31		1.83	0.11	0.1763	0.0037	0.436	0.0759	0.004	1047	20	1080	110	204	22.6	1.72
			2.924	0.054	0.2331	0.004	0.472	0.092	0.0012	1350	21	1473	25	165	133.3	8.33
	32		3.088	0.061	0.2417	0.0039	0.525	0.09249	0.00098	1395	20	1478	19	166	118.5	5.00
	33	*	2.447	0.091	0.2157	0.0041	0.724	0.0836	0.002	1259	21	1281	45	146.9	54.7	2.94
			3.079	0.069	0.2441	0.0043	0.365	0.0919	0.0013	1408	22	1464	27	136	163	23.26
	34	*	3.044	0.058	0.2378	0.004	0.458	0.0943	0.0012	1375	21	1517	24	120.3	172	76.92
	35		2.958	0.055	0.2425	0.0041	0.649	0.0889	0.00088	1401	22	1402	19	267	114.5	14.29
	36		2.989	0.097	0.2058	0.0066	0.375	0.1041	0.0035	1206	35	1729	61	39.1	26.5	3.13

* analysis not used in age calculations

Table D2: Sample 70

Granite	spot/ grain	$^{207}Pb/^{235}U$	$^{207}Pb/^{235}U$	$^{206}Pb/^{238}U$	$^{206}Pb/^{238}U$	Err. Corr	$^{207}Pb/^{206}Pb$	$^{207}Pb/^{206}Pb$	$^{206}Pb/^{238}U$ Age	$^{206}Pb/^{238}U$	$^{207}Pb/^{206}Pb$ Age	$^{207}Pb/^{206}Pb$ Age	U	Th	Th/U
			2SE		2SE			2SE	Ma	2SE	Ma	2SE	ppm	ppm	
70 spot analyses	1	3.165	0.086	0.247	0.006	0.597	0.093	0.002	1421	32	1477	42	102.4	60.7	0.593
	2 *	2.356	0.079	0.207	0.005	0.276	0.084	0.003	1213	29	1291	55	53.9	41.8	0.776
	3	3.244	0.086	0.255	0.006	0.514	0.092	0.002	1464	29	1461	37	74.9	50.1	0.669
	4	3.116	0.083	0.244	0.006	0.375	0.093	0.002	1410	33	1483	44	71.7	72	1.004
	5	3.008	0.080	0.242	0.006	0.577	0.090	0.002	1395	31	1426	40	105.3	65.2	0.619
	6	2.933	0.092	0.231	0.006	0.614	0.091	0.002	1339	32	1434	43	69	35.9	0.520
	7	3.033	0.084	0.238	0.006	0.522	0.093	0.002	1377	31	1478	41	90.5	62.21	0.687
	*	2.600	0.120	0.225	0.007	0.649	0.086	0.002	1308	38	1323	55	116.8	41.7	0.357
	8	2.965	0.079	0.233	0.006	0.493	0.092	0.002	1353	29	1468	40	122.3	71.9	0.588
	9	3.140	0.079	0.247	0.006	0.427	0.093	0.002	1423	28	1473	36	102.5	51.8	0.505
	10	2.770	0.075	0.227	0.006	0.584	0.089	0.002	1317	29	1401	38	66.8	81.8	1.225
	11 *	4.525	0.110	0.308	0.007	0.580	0.107	0.002	1731	33	1751	30	146.7	86.1	0.587
	12	3.155	0.082	0.247	0.005	0.496	0.092	0.002	1428	29	1486	35	117.5	68.2	0.580
	13	3.368	0.086	0.272	0.006	0.583	0.090	0.002	1555	33	1420	37	96	54.4	0.567
	14	3.295	0.078	0.256	0.006	0.272	0.092	0.002	1470	29	1469	37	103.2	75.1	0.728
	15	3.046	0.084	0.245	0.006	0.479	0.090	0.002	1413	30	1426	42	91.2	70.7	0.775
	16	2.859	0.079	0.236	0.006	0.438	0.088	0.002	1366	31	1385	42	64.7	49	0.757
	17	3.172	0.079	0.246	0.006	0.637	0.093	0.002	1419	30	1484	34	112	80.9	0.722
	18	3.176	0.089	0.251	0.006	0.473	0.091	0.002	1440	31	1444	41	53.3	45	0.844
	19	3.216	0.074	0.255	0.006	0.407	0.092	0.002	1463	29	1463	35	120.9	86.8	0.718
70 profile analyses	1	3.307	0.055	0.258	0.004	0.264	0.093	0.001	1480.4	22	1483	16	65	69.5	1.069
	2	3.264	0.055	0.256	0.004	0.220	0.092	0.001	1466.5	21	1476	18	61.9	69.5	1.123
	3	3.200	0.059	0.253	0.004	0.277	0.092	0.001	1452.4	22	1458	23	38.4	48.1	1.253
	4 *	3.631	0.066	0.274	0.005	0.633	0.096	0.001	1559	24	1547	18	47.7	32.9	0.690
	5	3.181	0.059	0.254	0.004	0.450	0.091	0.001	1456	22	1457	22	54.3	55.3	1.018
	*	3.457	0.082	0.266	0.006	0.274	0.094	0.002	1520	28	1515	40	28.45	44.8	1.575
	6	3.005	0.049	0.244	0.004	0.374	0.089	0.001	1407.7	20	1408	14	87	63.9	0.734
	7	3.159	0.051	0.251	0.004	0.294	0.092	0.001	1440.9	21	1454	17	61.47	62.1	1.010
	8	1.683	0.059	0.167	0.004	0.554	0.073	0.002	995	25	1023	55	219	19.1	0.087
	*	2.481	0.058	0.215	0.004	0.336	0.084	0.002	1254	22	1293	33	127.4	69.3	0.544

Table D2: Sample 70

Granite	spot/ grain	$^{207}Pb/^{235}U$	$^{207}Pb/^{235}U$	$^{206}Pb/^{238}U$	$^{206}Pb/^{238}U$	Err. Corr	$^{207}Pb/^{206}Pb$	$^{207}Pb/^{206}Pb$	$^{206}Pb/^{238}U$ Age	$^{206}Pb/^{238}U$	$^{207}Pb/^{206}Pb$ Age	$^{207}Pb/^{206}Pb$ Age	U	Th	Th/U
			2SE		2SE			2SE	Ma	2SE	Ma	2SE	ppm	ppm	
70 profile analyses (cont)	9	3.150	0.059	0.250	0.004	0.415	0.091	0.001	1437	22	1451	22	57	67.3	1.181
	*	4.050	0.160	0.249	0.006	0.558	0.118	0.004	1430	33	1928	54	20.31	22.13	1.090
	10	1.671	0.049	0.164	0.005	0.711	0.074	0.002	980	28	1045	41	333.9	11	0.033
		3.262	0.053	0.259	0.004	0.313	0.091	0.001	1485	22	1454	16	82.2	108.6	1.321
	11 *	2.379	0.038	0.209	0.003	0.508	0.083	0.001	1223.4	18	1270	13	134	139.1	1.038
	12	3.029	0.049	0.243	0.004	0.445	0.090	0.001	1402.3	20	1431	13	104.4	61.2	0.586

* analysis not used in age calculations

Table D3: Sample 71

Granite	spot/ grain	$^{207}Pb/^{235}U$	$^{207}Pb/^{235}U$	$^{206}Pb/^{238}U$	$^{206}Pb/^{238}U$	Err. Corr	$^{207}Pb/^{206}Pb$	$^{207}Pb/^{206}Pb$	$^{206}Pb/^{238}U$ Age	$^{206}Pb/^{238}U$	$^{207}Pb/^{206}Pb$ Age	$^{207}Pb/^{206}Pb$ Age	U	Th	Th/U
			2SE		2SE			2SE	Ma	2SE	Ma	2SE	ppm	ppm	
71 spot analyses	1 *	2.891	0.080	0.227	0.006	0.495	0.094	0.002	1319	31	1498	43	103.9	72.5	0.70
	2	2.871	0.075	0.227	0.006	0.535	0.091	0.002	1320	30	1447	40	92.8	147.1	1.59
	3	2.900	0.077	0.229	0.006	0.553	0.091	0.002	1329	29	1451	40	105.2	93.4	0.89
	4 *	3.028	0.088	0.234	0.006	0.241	0.094	0.002	1354	30	1503	49	48.5	46.9	0.97
	5	3.105	0.084	0.246	0.006	0.494	0.091	0.002	1419	32	1435	42	67.9	39.8	0.59
	6	3.015	0.074	0.241	0.006	0.377	0.091	0.002	1390	32	1450	40	128.4	92.1	0.72
	7 *	2.728	0.072	0.224	0.006	0.338	0.089	0.002	1300	29	1388	45	98.7	122	1.24
	8	2.923	0.094	0.237	0.007	0.377	0.093	0.002	1368	35	1480	48	53.4	64.1	1.20
	*	3.131	0.100	0.221	0.007	0.291	0.101	0.003	1289	36	1642	59	57.5	40.9	0.71
	9	2.914	0.077	0.233	0.006	0.408	0.091	0.002	1350	30	1444	39	64.3	75.3	1.17
	10 *	3.334	0.090	0.241	0.006	0.417	0.100	0.002	1391	29	1620	45	47.9	45.1	0.94
	11	2.880	0.073	0.231	0.005	0.408	0.091	0.002	1341	27	1435	37	132.2	77.1	0.58
	12 *	2.876	0.077	0.231	0.006	0.470	0.089	0.002	1339	31	1414	43	50.5	40.6	0.80
	13 *	3.310	0.130	0.234	0.008	0.428	0.104	0.004	1355	43	1703	53	57.1	61.4	1.08
	14 *	3.207	0.097	0.246	0.007	0.705	0.093	0.002	1419	35	1486	39	69.4	46.4	0.67
	15	3.004	0.086	0.235	0.006	0.441	0.092	0.002	1359	30	1464	44	69.3	45.4	0.66
	16	3.146	0.081	0.248	0.006	0.311	0.092	0.002	1426	31	1462	42	65.8	51	0.78
	17	3.040	0.084	0.243	0.006	0.580	0.091	0.002	1402	31	1443	40	78.9	61.4	0.78
71 profile analyses	1	3.295	0.056	0.262	0.004	0.405	0.092	0.001	1501.8	22	1460	16	61.3	61.9	1.01
	2	3.243	0.054	0.257	0.004	0.227	0.092	0.001	1472.5	21	1465	17	70.4	70.7	1.00
	3	3.029	0.050	0.244	0.004	0.430	0.090	0.001	1410.2	20	1423	15	106.6	125.6	1.18
	4	3.216	0.053	0.256	0.004	0.370	0.091	0.001	1468.7	21	1452	15	56	57.4	1.03
	5	3.121	0.052	0.247	0.004	0.391	0.091	0.001	1424.8	21	1450	17	69.8	70.2	1.01
	6	3.192	0.059	0.252	0.005	0.452	0.092	0.001	1449	23	1464	20	66.9	47.9	0.72
	*	3.370	0.065	0.255	0.005	0.727	0.095	0.001	1466	25	1533	19	174	103	0.59
	7	3.143	0.050	0.251	0.004	0.326	0.090	0.001	1443.4	21	1429	15	72.1	71.3	0.99
	8	3.151	0.058	0.251	0.004	0.518	0.091	0.001	1444.5	22	1446	18	59.2	57.2	0.97

* analysis not used in age calculations

Table D4: Sample 108

Granite	spot/ grain	$^{207}Pb/^{235}U$	$^{207}Pb/^{235}U$	$^{206}Pb/^{238}U$	$^{206}Pb/^{238}U$	Err. Corr	$^{207}Pb/^{206}Pb$	$^{207}Pb/^{206}Pb$	$^{206}Pb/^{238}U$ Age	$^{206}Pb/^{238}U$	$^{207}Pb/^{206}Pb$ Age	$^{207}Pb/^{206}Pb$ Age	U	Th	Th/U
			2SE		2SE			2SE	Ma	2SE	Ma	2SE	ppm	ppm	
108 spot analyses	1	1.772	0.052	0.174	0.005	0.642	0.072	0.002	1035	26	1006	44	86.7	9.26	0.107
	2	3.149	0.083	0.246	0.006	0.529	0.093	0.002	1414	33	1491	37	80.8	68.00	0.842
	3	3.140	0.200	0.215	0.008	0.770	0.104	0.004	1257	43	1732	83	95.0	62.00	0.653
	*	2.579	0.086	0.212	0.006	0.426	0.089	0.003	1240	33	1394	62	68.4	57.80	0.845
	4	2.933	0.072	0.236	0.006	0.379	0.091	0.002	1365	30	1439	38	113.9	91.50	0.803
	5 *	2.845	0.100	0.234	0.008	0.849	0.088	0.002	1355	41	1386	36	129.0	122.00	0.946
	6	4.173	0.100	0.286	0.006	0.493	0.106	0.002	1623	32	1721	34	120.9	92.90	0.768
	7	2.480	0.140	0.197	0.011	0.967	0.091	0.002	1154	59	1449	32	228.0	265.00	1.162
	8	3.040	0.080	0.240	0.006	0.497	0.092	0.002	1386	30	1464	37	73.5	39.60	0.539
	9	3.016	0.086	0.235	0.006	0.477	0.093	0.002	1361	30	1484	43	50.5	40.40	0.800
	10	2.936	0.076	0.234	0.006	0.484	0.091	0.002	1356	30	1452	36	100.2	84.01	0.838
	11	3.006	0.077	0.238	0.006	0.368	0.092	0.002	1378	29	1451	41	104.4	76.40	0.732
	12 *	2.929	0.077	0.228	0.006	0.389	0.094	0.002	1323	29	1506	40	87.4	79.70	0.912
	13	2.917	0.079	0.234	0.006	0.590	0.090	0.002	1352	30	1438	38	103.9	63.90	0.615
	14	3.073	0.084	0.245	0.006	0.694	0.092	0.002	1413	32	1451	37	133.5	230.00	1.723
	15	3.151	0.082	0.246	0.006	0.518	0.093	0.002	1418	32	1494	40	79.5	65.50	0.824
	16	4.036	0.100	0.282	0.007	0.595	0.103	0.002	1605	33	1677	33	214.2	272.60	1.273
	17	2.940	0.120	0.233	0.009	0.932	0.093	0.002	1347	46	1482	35	640.0	610.00	0.953
108 profile analyses	1	3.200	0.053	0.252	0.004	0.444	0.093	0.001	1449	21	1477	14	76.4	126.80	1.660
	2	3.375	0.058	0.268	0.005	0.487	0.092	0.001	1529	23	1463	17	45.8	34.70	0.758
	3	2.991	0.052	0.238	0.004	0.498	0.091	0.001	1374	21	1450	17	78.6	71.80	0.913
	4	3.223	0.054	0.256	0.004	0.316	0.091	0.001	1470	22	1451	17	67.0	50.00	0.746
	5	4.434	0.072	0.306	0.005	0.555	0.106	0.001	1719	24	1728	13	74.6	73.10	0.980
	6	1.873	0.037	0.182	0.003	0.306	0.074	0.001	1079	17	1047	26	79.0	74.60	0.944
	*	2.365	0.051	0.204	0.004	0.563	0.085	0.001	1194	20	1310	31	52.1	106.00	2.035
	6_2	3.280	0.079	0.260	0.006	0.431	0.092	0.002	1487	29	1461	42	44.4	46.90	1.056
	7	3.396	0.056	0.267	0.004	0.472	0.093	0.001	1527	22	1481	14	89.6	84.40	0.942
	8	3.141	0.056	0.253	0.004	0.657	0.091	0.001	1454	22	1440	15	75.7	141.90	1.875
	9	3.214	0.051	0.254	0.004	0.553	0.092	0.001	1459	21	1471	12	115.9	139.60	1.204
	10	3.269	0.056	0.260	0.004	0.419	0.092	0.001	1488	22	1466	17	73.4	70.60	0.962
	11	3.257	0.054	0.257	0.004	0.573	0.092	0.001	1475	21	1468	16	78.9	94.30	1.195

Table D4: Sample 108

Granite	spot/ grain	$^{207}Pb/^{235}U$	$^{207}Pb/^{235}U$	$^{206}Pb/^{238}U$	$^{206}Pb/^{238}U$	Err. Corr	$^{207}Pb/^{206}Pb$	$^{207}Pb/^{206}Pb$	$^{206}Pb/^{238}U$ Age	$^{206}Pb/^{238}U$	$^{207}Pb/^{206}Pb$ Age	$^{207}Pb/^{206}Pb$ Age	U	Th	Th/U
			2SE		2SE			2SE	Ma	2SE	Ma	2SE	ppm	ppm	
108 profile analyses (cont)	12	3.160	0.057	0.254	0.005	0.636	0.091	0.001	1457	23	1441	16	86.9	65.50	0.754
	13 *	35.850	0.990	0.469	0.015	0.502	0.562	0.017	2478	64	4408	44	10.8	10.20	0.945
	14	3.058	0.058	0.240	0.004	0.905	0.093	0.001	1386	23	1481	11	449.0	280.50	0.625
	15	3.168	0.053	0.251	0.004	0.488	0.092	0.001	1444	21	1456	15	100.3	122.10	1.217
	15_2	3.019	0.062	0.237	0.004	0.252	0.092	0.002	1375	20	1469	31	132.2	123.60	0.935
	*	1.975	0.063	0.191	0.011	0.698	0.079	0.004	1127	58	1160	110	177.6	47.00	0.265
	15_3	3.117	0.065	0.246	0.005	0.479	0.092	0.001	1418	23	1474	26	197.7	132.80	0.672
	16	3.103	0.091	0.250	0.007	0.965	0.091	0.001	1436	35	1444	17	149.0	155.00	1.040
	18	3.153	0.054	0.250	0.004	0.520	0.091	0.001	1439	21	1452	16	59.0	64.90	1.100
	19	3.393	0.059	0.269	0.005	0.479	0.091	0.001	1533	23	1451	18	63.1	52.10	0.826
	19_2	3.079	0.061	0.245	0.004	0.510	0.092	0.001	1411	21	1457	22	162.3	125.60	0.774
	20	3.290	0.060	0.259	0.004	0.397	0.092	0.001	1487	23	1461	20	51.0	107.80	2.114
	21c	3.122	0.068	0.249	0.005	0.478	0.091	0.001	1434	24	1450	28	86.0	89.40	1.040
	21t	3.250	0.200	0.227	0.008	0.819	0.104	0.004	1318	44	1696	64	88.5	63.40	0.716
	*	2.884	0.058	0.231	0.004	0.457	0.090	0.001	1340	20	1433	26	152.0	108.90	0.716
	22 *	1.845	0.095	0.179	0.005	0.711	0.077	0.003	1061	25	1113	68	150.1	17.40	0.116
	*	2.977	0.079	0.242	0.005	0.229	0.089	0.002	1398	27	1405	47	43.0	85.10	1.979
	23	3.034	0.060	0.239	0.004	0.306	0.092	0.002	1380	21	1472	31	102.8	83.00	0.807
	*	2.530	0.140	0.220	0.006	0.721	0.086	0.003	1280	32	1321	72	135.2	48.20	0.357
	24	3.025	0.058	0.240	0.004	0.568	0.092	0.001	1387	20	1466	20	153.4	176.00	1.147
	25c	2.800	0.062	0.228	0.004	0.493	0.090	0.001	1322	21	1433	28	101.9	80.40	0.789
	25t	3.563	0.100	0.248	0.005	0.186	0.106	0.003	1429	25	1721	52	49.8	56.80	1.141
	*	3.292	0.098	0.251	0.006	0.446	0.096	0.002	1443	30	1539	48	45.1	60.90	1.350
	26	3.064	0.066	0.242	0.004	0.472	0.092	0.001	1396	21	1467	28	100.4	113.30	1.128
	27c	3.100	0.067	0.245	0.004	0.300	0.092	0.002	1413	22	1474	32	101.4	86.80	0.856
	27t	3.127	0.059	0.247	0.004	0.534	0.093	0.001	1427	22	1492	21	181.7	154.60	0.851
	*	2.310	0.200	0.217	0.015	0.957	0.079	0.002	1264	80	1177	54	119.3	28.80	0.241
	28c *	2.670	0.052	0.219	0.003	0.330	0.089	0.001	1277	17	1408	25	145.6	113.80	0.782
	28t *	2.656	0.059	0.216	0.004	0.315	0.089	0.001	1260	19	1417	30	116.8	62.20	0.533

Table D4: Sample 108

Granite	spot/ grain	$^{207}Pb/^{235}U$	$^{207}Pb/^{235}U$	$^{206}Pb/^{238}U$	$^{206}Pb/^{238}U$	Err. Corr	$^{207}Pb/^{206}Pb$	$^{207}Pb/^{206}Pb$	$^{206}Pb/^{238}U$ Age	$^{206}Pb/^{238}U$	$^{207}Pb/^{206}Pb$ Age	$^{207}Pb/^{206}Pb$ Age	U	Th	Th/U
			2SE		2SE			2SE	Ma	2SE	Ma	2SE	ppm	ppm	
108 profile analyses (cont)	29c	3.043	0.067	0.245	0.004	0.269	0.091	0.002	1410	23	1448	34	68.0	56.40	0.829
	29t	3.204	0.067	0.253	0.005	0.534	0.092	0.001	1451	24	1481	26	84.3	72.00	0.854
	*	2.370	0.160	0.207	0.010	0.781	0.087	0.004	1213	52	1354	83	122.4	47.40	0.387
	30c	3.259	0.089	0.258	0.006	0.763	0.092	0.001	1478	29	1474	28	70.9	108.40	1.529
	30t	3.050	0.063	0.239	0.004	0.516	0.093	0.001	1379	22	1488	26	116.9	79.90	0.683
	31c *	2.408	0.048	0.204	0.003	0.308	0.085	0.001	1196	18	1321	27	130.0	161.40	1.242
	31t	3.180	0.062	0.247	0.004	0.404	0.093	0.001	1422	20	1486	22	125.7	125.60	0.999
	32c	2.991	0.059	0.233	0.004	0.294	0.093	0.001	1348	19	1479	26	132.4	153.10	1.156
	33c *	3.085	0.068	0.235	0.004	0.640	0.095	0.001	1362	21	1526	22	196.0	81.20	0.414
	34c	1.660	0.120	0.172	0.008	0.606	0.071	0.004	1024	46	950	120	180.8	15.90	0.088
		2.891	0.074	0.232	0.005	0.106	0.090	0.003	1344	24	1433	58	52.4	55.80	1.065
	*	2.250	0.180	0.201	0.010	0.923	0.082	0.003	1177	53	1234	78	160.5	74.00	0.461
	34t	3.077	0.064	0.243	0.004	0.587	0.092	0.001	1403	21	1464	23	147.0	136.10	0.926
	*	2.520	0.120	0.220	0.007	0.814	0.084	0.002	1283	34	1301	40	230.0	110.00	0.478
	35c	3.041	0.080	0.245	0.006	0.418	0.090	0.002	1415	27	1439	44	93.6	111.20	1.188
	*	1.849	0.089	0.185	0.009	0.678	0.076	0.003	1091	49	1088	85	142.9	20.80	0.146
	36c	3.027	0.079	0.244	0.005	0.212	0.092	0.002	1408	24	1469	46	71.3	84.10	1.180
	37c	3.061	0.065	0.243	0.004	0.450	0.092	0.001	1400	22	1472	29	90.5	77.60	0.857
	38c	1.704	0.069	0.170	0.004	0.801	0.074	0.002	1013	21	1040	44	178.6	8.75	0.049
		3.104	0.065	0.249	0.005	0.282	0.092	0.002	1432	26	1468	38	111.4	103.40	0.928
	39c	3.075	0.063	0.246	0.004	0.592	0.093	0.001	1419	22	1482	22	92.4	85.90	0.930
	40c	1.640	0.110	0.178	0.006	0.854	0.070	0.003	1056	33	970	140	122.8	19.40	0.158
	*	2.050	0.110	0.188	0.006	0.378	0.081	0.004	1109	30	1230	110	122.2	36.90	0.302
	*	2.635	0.055	0.220	0.004	0.388	0.089	0.001	1282	21	1397	31	123.0	99.00	0.805

* analysis not used in age calculations

Table D5: Sample 205

pOgn	spot/ grain	$^{207}Pb/^{235}U$	$^{207}Pb/^{235}U$	$^{206}Pb/^{238}U$	$^{206}Pb/^{238}U$	Err. Corr	$^{207}Pb/^{206}Pb$	$^{207}Pb/^{206}Pb$	$^{206}Pb/^{238}U$ Age	$^{206}Pb/^{238}U$	$^{207}Pb/^{206}Pb$ Age	$^{207}Pb/^{206}Pb$ Age	U	Th	Th/U
			2SE		2SE			2SE	Ma	2SE	Ma	2SE	ppm	ppm	
spot analyses	1	4.429	0.095	0.301	0.006	0.667	0.107	0.002	1698	31	1744	27	1220	812	0.666
	2	3.317	0.120	0.253	0.008	0.916	0.094	0.002	1455	39	1511	31	1144	318	0.278
	*	3.568	0.120	0.265	0.007	0.927	0.097	0.002	1512	35	1569	31	972	342	0.352
	3	3.259	0.072	0.255	0.005	0.697	0.093	0.001	1462	27	1482	28	969	278.4	0.287
	*	3.259	0.072	0.255	0.005	0.697	0.093	0.001	1462	27	1482	28	969	278.4	0.287
	4	4.270	0.160	0.292	0.010	0.846	0.106	0.002	1648	49	1727	40	225	143	0.636
	*	3.409	0.096	0.252	0.007	0.910	0.098	0.002	1448	35	1593	30	854	203	0.238
	5	3.217	0.084	0.248	0.006	0.713	0.094	0.002	1428	33	1514	33	1191	65	0.055
		4.082	0.120	0.285	0.007	0.861	0.104	0.002	1615	36	1688	31	1019	505	0.496
	6	4.330	0.099	0.300	0.007	0.722	0.104	0.002	1692	32	1696	27	689	426	0.618
	7	3.254	0.078	0.251	0.006	0.651	0.094	0.002	1441	32	1507	33	738	83.1	0.113
		4.145	0.120	0.288	0.008	0.749	0.104	0.002	1631	38	1696	35	369.4	201	0.544
	8	4.149	0.100	0.286	0.007	0.843	0.104	0.002	1628	32	1693	27	956	678	0.709
	9	4.207	0.098	0.286	0.006	0.791	0.107	0.002	1619	31	1743	27	528	326	0.617
	10	4.376	0.098	0.299	0.006	0.678	0.106	0.002	1685	30	1733	26	1360	919	0.676
	11	3.404	0.120	0.262	0.009	0.774	0.094	0.002	1501	44	1511	36	392	140	0.357
		4.266	0.100	0.292	0.007	0.715	0.106	0.002	1649	35	1728	32	678	548	0.808
	12	4.241	0.098	0.292	0.006	0.668	0.105	0.002	1651	32	1721	29	317	217.7	0.687
	13	3.180	0.075	0.248	0.005	0.696	0.092	0.001	1428	28	1475	29	728	176.4	0.242
	14	3.263	0.083	0.249	0.006	0.585	0.096	0.002	1433	32	1536	38	747	90.7	0.121
		4.280	0.190	0.300	0.014	0.749	0.104	0.004	1691	71	1691	61	965	397	0.411
	15	4.194	0.100	0.287	0.007	0.835	0.106	0.002	1624	33	1730	28	1069	654	0.612
	16	3.174	0.070	0.249	0.005	0.649	0.093	0.001	1433	27	1485	28	874	265	0.303
	17	4.260	0.097	0.291	0.006	0.632	0.106	0.002	1644	30	1737	28	655	626	0.956
	18	3.205	0.077	0.251	0.006	0.762	0.092	0.001	1443	28	1472	30	457	127.8	0.280
	19	4.143	0.100	0.286	0.007	0.875	0.104	0.002	1621	33	1705	26	937	547	0.584
	20	3.099	0.070	0.243	0.005	0.635	0.093	0.001	1404	27	1482	30	427	148.4	0.348
	21	3.165	0.088	0.247	0.008	0.699	0.094	0.002	1422	39	1512	36	696	67	0.096
		3.942	0.099	0.277	0.006	0.780	0.105	0.002	1574	32	1709	29	833	502.5	0.603
	1	3.257	0.049	0.253	0.004	0.506	0.093	0.000	1456	20	1480.9	8.2	414	161.1	0.389
	1t	3.292	0.051	0.256	0.004	0.661	0.093	0.000	1467.1	20	1485.4	7.7	470.7	192.9	0.410

Table D5: Sample 205

pOgn	spot/ grain	$^{207}Pb/^{235}U$	$^{207}Pb/^{235}U$	$^{206}Pb/^{238}U$	$^{206}Pb/^{238}U$	Err. Corr	$^{207}Pb/^{206}Pb$	$^{207}Pb/^{206}Pb$	$^{206}Pb/^{238}U$ Age	$^{206}Pb/^{238}U$	$^{207}Pb/^{206}Pb$ Age	$^{207}Pb/^{206}Pb$ Age	U	Th	Th/U
			2SE		2SE			2SE	Ma	2SE	Ma	2SE	ppm	ppm	
profile analayses	2	3.065	0.100	0.211	0.006	0.938	0.104	0.001	1235	33	1702	21	702	246.3	0.351
	*	2.199	0.072	0.178	0.005	0.964	0.089	0.001	1055	30	1410	17	1560	308	0.197
	3 *	3.797	0.064	0.277	0.005	0.887	0.099	0.000	1575	24	1606.7	9	434	288	0.664
	4	3.368	0.055	0.263	0.004	0.554	0.092	0.001	1503	22	1473	14	751	128.7	0.171
		4.584	0.078	0.311	0.005	0.667	0.106	0.001	1747	26	1724	15	976	508	0.520
	5	2.961	0.068	0.233	0.006	0.887	0.093	0.001	1352	30	1488	21	392	132.3	0.338
		4.183	0.067	0.286	0.005	0.726	0.105	0.001	1624.1	22	1713.3	9.3	514	310	0.603
	6 *	1.128	0.050	0.105	0.004	0.976	0.078	0.001	641	25	1151	21	2460	541	0.220
	6a	4.122	0.079	0.282	0.005	0.872	0.106	0.001	1599	27	1726	11	339	231	0.681
	*	4.040	0.077	0.290	0.006	0.861	0.101	0.001	1639	28	1647	11	576	204.9	0.356
	7 *	2.967	0.049	0.218	0.004	0.787	0.098	0.001	1271.6	19	1590.3	9.7	1054	68.9	0.065
	9	4.384	0.088	0.304	0.006	0.826	0.105	0.001	1710	28	1715	14	1163	592	0.509
	*	3.728	0.061	0.269	0.004	0.880	0.100	0.000	1537.9	22	1627.3	7.5	1228	725	0.590
	10	4.359	0.084	0.304	0.006	0.919	0.104	0.001	1712	28	1702	9.5	679	406.3	0.598
	14	2.710	0.110	0.214	0.009	0.938	0.093	0.001	1250	47	1490	22	980	287	0.293
		4.374	0.069	0.303	0.005	0.735	0.105	0.000	1704.5	24	1718.2	8.9	528	299	0.566
	*	3.650	0.100	0.273	0.008	0.939	0.098	0.001	1554	42	1586	27	867	225	0.260
	16	3.249	0.079	0.255	0.006	0.778	0.093	0.001	1463	33	1492	24	316	120.4	0.381
		4.467	0.075	0.312	0.005	0.822	0.105	0.001	1750	25	1712.3	9.8	205	171	0.834
	17	3.142	0.059	0.251	0.005	0.704	0.092	0.001	1442	26	1471	17	617	223	0.361
		3.201	0.059	0.221	0.004	0.880	0.106	0.001	1285	22	1730	12	908	403	0.444
	*	4.317	0.097	0.262	0.005	0.692	0.120	0.001	1502	27	1962	21	303	253	0.835
	19	4.387	0.081	0.303	0.005	0.641	0.106	0.001	1707	26	1725	15	574	361	0.629
	*	4.927	0.083	0.249	0.005	0.598	0.145	0.001	1435	25	2282	14	775	2451	3.163
	20	4.644	0.072	0.318	0.005	0.682	0.107	0.001	1777.8	24	1745.6	9	376	466	1.239

* analysis not used in age calculations

Table D6: Sample 106

pOgn	spot/ grain	$^{207}Pb/^{235}U$	$^{207}Pb/^{235}U$	$^{206}Pb/^{238}U$	$^{206}Pb/^{238}U$	Err. Corr	$^{207}Pb/^{206}Pb$	$^{207}Pb/^{206}Pb$	$^{206}Pb/^{238}U$ Age	$^{206}Pb/^{238}U$	$^{207}Pb/^{206}Pb$ Age	$^{207}Pb/^{206}Pb$ Age	U	Th	Th/U
			2SE		2SE			2SE	Ma	2SE	Ma	2SE	ppm	ppm	
106 spot analyses	1	4.307	0.1	0.292	0.0063	0.7925	0.10699	0.0016	1651	32	1748	27	513	337	0.657
	2	1.7	0.11	0.1338	0.008	0.98459	0.09196	0.0015	808	46	1465	30	994	429	0.432
		3.4	0.14	0.248	0.012	0.83435	0.1012	0.0027	1429	61	1643	50	868	266	0.306
	3	3.962	0.12	0.2742	0.0088	0.93172	0.10435	0.0016	1561	45	1702	29	1110	956	0.861
	4 *	3.09	0.073	0.2373	0.0054	0.76609	0.09445	0.0014	1372	28	1516	29	456	114	0.250
	5	4.345	0.11	0.2979	0.0068	0.57258	0.1054	0.0019	1681	34	1719	33	251	238.9	0.952
	6 *	3.656	0.11	0.2603	0.0075	0.72107	0.1022	0.0021	1491	38	1661	39	1846	732	0.397
	7	2.82	0.12	0.2246	0.0096	0.97686	0.09033	0.0014	1309	50	1433	28	1040	145	0.139
	8	3.795	0.097	0.2619	0.006	0.85497	0.10444	0.0016	1499	31	1703	29	1424	920	0.646
	9	4.182	0.099	0.2882	0.0065	0.83266	0.10508	0.0016	1632	33	1714	27	530	388	0.732
	10	4.095	0.095	0.2795	0.0062	0.79512	0.10574	0.0016	1588	31	1726	28	449	328	0.731
	11	3.044	0.07	0.2392	0.0051	0.75595	0.0924	0.0014	1382	27	1476	29	693	85.3	0.123
	12 *	3.059	0.12	0.2305	0.0075	0.85558	0.0966	0.002	1337	39	1558	39	947	260	0.275
	13 *	3.85	0.092	0.2741	0.0061	0.83828	0.10151	0.0015	1564	32	1653	27	1860	723	0.389
106 profile analyses	1	2.253	0.076	0.1758	0.0061	0.96701	0.09205	0.00071	1041	34	1467	15	311	136	0.437
	2	3.058	0.095	0.2381	0.0067	0.98854	0.09303	0.00064	1377	35	1488	13	1340	197.2	0.147
		2.75	0.077	0.1946	0.0053	0.98014	0.10186	0.0005	1145	29	1659.3	8.8	649	267.2	0.412
	3	1.883	0.084	0.1499	0.0061	0.94991	0.0905	0.0012	900	34	1435	25	949	114.3	0.120
	*	1.238	0.023	0.1105	0.0022	0.90472	0.08109	0.00048	675.6	13	1223	12	1469	238	0.162
	4 *	2.339	0.1	0.1727	0.0068	0.99177	0.09716	0.00057	1023	37	1573	11	426	273	0.641
	5	1.553	0.046	0.1557	0.0057	0.8177	0.0731	0.001	932	32	1025	33	2710	140.3	0.052
		2.99	0.069	0.2354	0.0052	0.9169	0.09155	0.00072	1363	27	1457	15	622	114.5	0.184
		3.443	0.089	0.2422	0.0061	0.50924	0.1021	0.0014	1398	32	1669	22	62.1	53.3	0.858
	5	1.62	0.059	0.1607	0.0063	0.51659	0.0738	0.0022	960	35	1035	61	2470	181	0.073
	*	2.829	0.054	0.2178	0.0038	0.60602	0.0938	0.0011	1270	20	1503	23	526	162.1	0.308
	6	3.279	0.06	0.2583	0.0046	0.80614	0.09226	0.00069	1481	23	1472	14	984	215.4	0.219
		3.599	0.072	0.257	0.0051	0.94217	0.10121	0.00076	1474	26	1649	15	418	194.5	0.465
	7	4.636	0.076	0.3157	0.0055	0.73821	0.10689	0.00057	1769	27	1746.8	9.6	915	441.9	0.483
		4.001	0.065	0.2797	0.0045	0.80508	0.10334	0.00044	1589.6	22	1685.7	8	1008	735	0.729
	*	4.496	0.097	0.2866	0.0074	0.87481	0.11347	0.001	1624	37	1855	16	433	281	0.649
	8	4.305	0.072	0.2928	0.0049	0.89495	0.10614	0.00046	1655	24	1733.6	7.9	472	323	0.684

Table D6: Sample 106

pOgn	spot/ grain		$^{207}Pb/^{235}U$	$^{207}Pb/^{235}U$	$^{206}Pb/^{238}U$	$^{206}Pb/^{238}U$	Err. Corr	$^{207}Pb/^{206}Pb$	$^{207}Pb/^{206}Pb$	$^{206}Pb/^{238}U$ Age	$^{206}Pb/^{238}U$	$^{207}Pb/^{206}Pb$ Age	$^{207}Pb/^{206}Pb$ Age	U	Th	Th/U
				2SE		2SE			2SE	Ma	2SE	Ma	2SE	ppm	ppm	
106 profile analyses (cont)	9		1.561	0.054	0.1576	0.0045	0.95798	0.0722	0.0006	943	25	991	17	3039	127.5	0.042
			3.861	0.08	0.2727	0.0054	0.93577	0.10231	0.00054	1554	27	1666.2	9.9	404	298	0.738
	9		1.243	0.029	0.1239	0.0035	0.80558	0.0733	0.0013	753	20	1028	34	1925	132.7	0.069
		*	2.314	0.075	0.1733	0.0045	0.94346	0.09572	0.001	1030	25	1541	20	1113	260	0.234
	10		3.129	0.063	0.2235	0.0047	0.90404	0.10152	0.00072	1300	25	1651	13	611	464	0.759
	12		4.003	0.085	0.2751	0.0057	0.83866	0.10448	0.00089	1567	29	1704	16	543	515	0.948
		*	2.084	0.039	0.1567	0.0029	0.88511	0.09664	0.00061	938.4	16	1559	12	410.8	328	0.798
	13		3.089	0.085	0.2418	0.0069	0.86173	0.0928	0.0014	1396	36	1484	30	806	157.1	0.195
			4.449	0.068	0.3037	0.0047	0.54989	0.1064	0.0005	1709.8	23	1738	8.6	309	254	0.822
	14		4.013	0.064	0.2747	0.0045	0.74356	0.10506	0.00059	1564.8	23	1715.1	10	526.8	565.9	1.074
		*	3.574	0.068	0.2671	0.0051	0.88669	0.09715	0.00067	1526	26	1570	13	1652	324	0.196
	15		3.231	0.058	0.2549	0.0044	0.74872	0.09221	0.00058	1463	23	1471	12	1004	232	0.231
			3.688	0.077	0.2562	0.0051	0.91812	0.10466	0.00072	1470	26	1710	13	685	458	0.669
		*	2.42	0.11	0.1761	0.0066	0.97349	0.0994	0.0011	1045	36	1616	20	1413	709	0.502
	16		3.649	0.06	0.2496	0.0041	0.66756	0.10564	0.00071	1436.5	21	1725	12	356	302	0.848
		*	0.986	0.084	0.0997	0.0077	0.99769	0.0718	0.00079	613	45	980	22	3060	241	0.079
		*	1.45	0.04	0.1257	0.0037	0.98014	0.0838	0.0012	763	21	1287	28	2454	448	0.183
			3.676	0.069	0.2622	0.005	0.87181	0.10149	0.00077	1501	26	1651	14	891	406	0.456
	16_2	*	2.002	0.07	0.1665	0.0061	0.85428	0.0859	0.0017	997	35	1340	38	759	109	0.144
	17		3.83	0.063	0.2673	0.0044	0.90829	0.10413	0.00044	1526.6	23	1698.4	7.9	514	352	0.685
	18	*	0.92	0.17	0.077	0.014	0.9975	0.0863	0.0013	478	83	1345	30	2000	770	0.385
		*	2.01	0.11	0.1519	0.009	0.98982	0.09803	0.00078	909	50	1586	15	452	191.6	0.424
	19		4.181	0.077	0.2793	0.0049	0.91298	0.1083	0.00055	1587	25	1771.1	9.4	476	313	0.658
		*	1.807	0.088	0.1705	0.0067	0.75063	0.0764	0.0014	1015	37	1121	45	2470	94.1	0.038
		*	3.03	0.15	0.2218	0.0098	0.96016	0.0997	0.0011	1291	52	1618	21	839	148.5	0.177
	20	*	3.336	0.055	0.2405	0.0039	0.59125	0.10054	0.0006	1389.1	20	1633	11	701	329.1	0.469
	21c		1.63	0.11	0.158	0.01	0.97715	0.0759	0.0011	943	57	1091	29	1423	86.4	0.061
			3.007	0.057	0.2392	0.004	0.48754	0.0918	0.0011	1382	21	1462	23	334	70.7	0.212
		*	2.141	0.092	0.1901	0.0068	0.87695	0.0812	0.0011	1122	37	1227	28	730	45.2	0.062
	21t		1.155	0.095	0.0902	0.0078	0.99624	0.09248	0.00086	554	45	1478	17	1810	1160	0.641
		*	1.72	0.086	0.1559	0.0076	0.95579	0.0817	0.001	934	43	1237	25	1609	387	0.241

Table D6: Sample 106

pOgn	spot/ grain		$^{207}Pb/^{235}U$	$^{207}Pb/^{235}U$	$^{206}Pb/^{238}U$	$^{206}Pb/^{238}U$	Err. Corr	$^{207}Pb/^{206}Pb$	$^{207}Pb/^{206}Pb$	$^{206}Pb/^{238}U$ Age	$^{206}Pb/^{238}U$	$^{207}Pb/^{206}Pb$ Age	$^{207}Pb/^{206}Pb$ Age	U	Th	Th/U
				2SE		2SE			2SE	Ma	2SE	Ma	2SE	ppm	ppm	
106 profile analyses (cont)	22	*	2.527	0.066	0.1916	0.0048	0.95543	0.09496	0.00072	1130	26	1527	14	1428	322.8	0.226
	23c		2.974	0.079	0.2419	0.0052	0.5618	0.0904	0.0021	1396	27	1432	44	642	188	0.293
		*	3.843	0.073	0.2667	0.0048	0.63811	0.10351	0.00094	1524	24	1687	17	385	298	0.774
	23t		1.692	0.033	0.1682	0.0034	0.60724	0.07366	0.00088	1002	19	1038	26	2901	234	0.081
			2.73	0.11	0.2172	0.0073	0.93248	0.0911	0.0014	1266	38	1446	29	648	340	0.525
		*	1.688	0.061	0.1554	0.0049	0.86028	0.0786	0.0014	931	27	1169	38	1550	217.6	0.140
	24		3.22	0.068	0.2527	0.0053	0.73286	0.0928	0.001	1452	27	1484	21	1001	140	0.140
	25		3.832	0.093	0.2651	0.0062	0.92928	0.10492	0.00078	1515	32	1712	14	570	406	0.712
	25t		1.675	0.058	0.1699	0.0042	0.50463	0.073	0.002	1012	23	1013	55	2090	115.5	0.055
			2.969	0.1	0.2393	0.0061	0.97152	0.09023	0.00094	1382	32	1428	20	960	154.5	0.161
	27c		1.517	0.067	0.1546	0.0058	0.79609	0.073	0.002	926	32	1013	54	3640	162.6	0.045
			3.187	0.097	0.2518	0.0063	0.88327	0.0928	0.0013	1447	32	1482	27	702	126.8	0.181
		*	1.87	0.17	0.174	0.012	0.97086	0.0793	0.0021	1031	69	1178	51	1960	146.1	0.075
	28		1.514	0.049	0.122	0.0033	0.91875	0.0913	0.0014	742	19	1452	29	2510	457	0.182
	29c		1.374	0.091	0.137	0.0095	0.98011	0.07237	0.00099	826	54	995	28	3180	224	0.070
		*	1.127	0.066	0.1048	0.0059	0.91806	0.078	0.0016	642	34	1143	40	1050	257	0.245
		*	1.236	0.062	0.1053	0.004	0.8559	0.0873	0.0026	645	23	1364	58	479	153	0.319
	30c		2.8	0.12	0.224	0.01	0.86349	0.0912	0.0019	1305	55	1450	40	975	222	0.228
		*	3.674	0.091	0.263	0.006	0.90318	0.10117	0.00095	1504	30	1651	17	947	539	0.569

* analysis not used in age calculations

APPENDIX E
INDIVIDUAL SITE CONCORDIA DIAGRAMS AND WEIGHTED AVERAGES

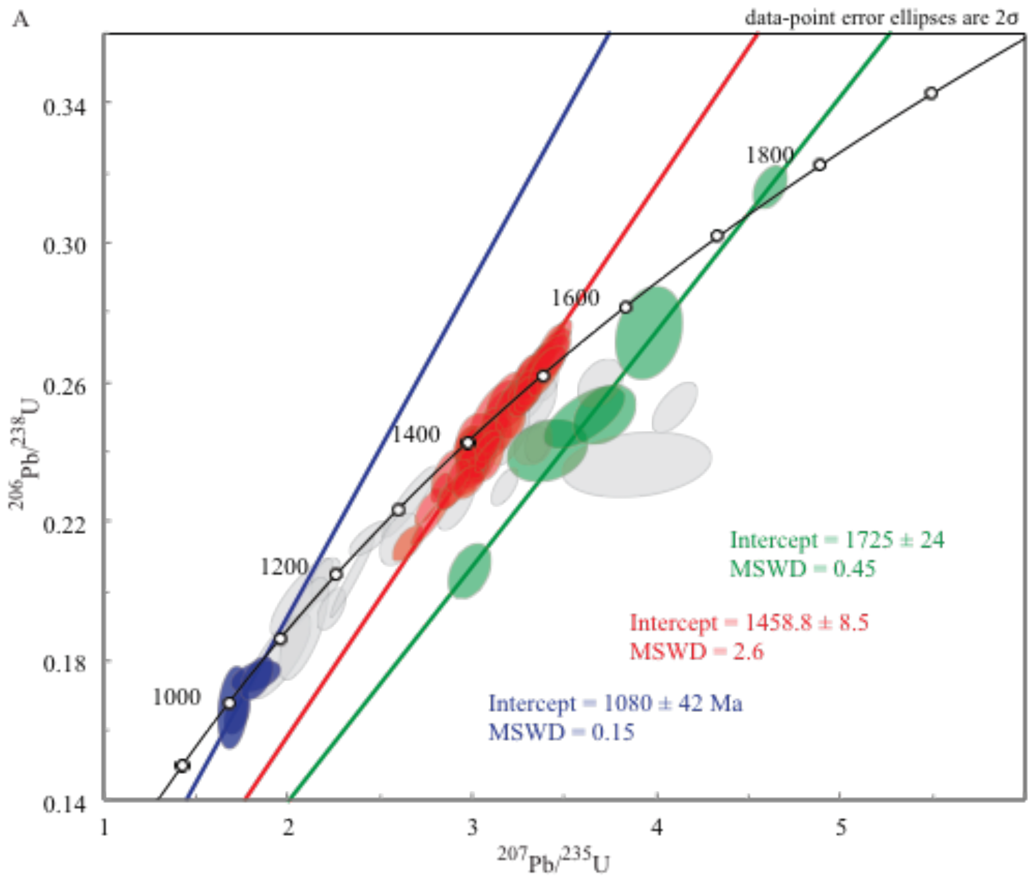

Figure E-1 Sample 201 Concordia and Weighted Average. A. Concordia for westernmost granite sample 201.

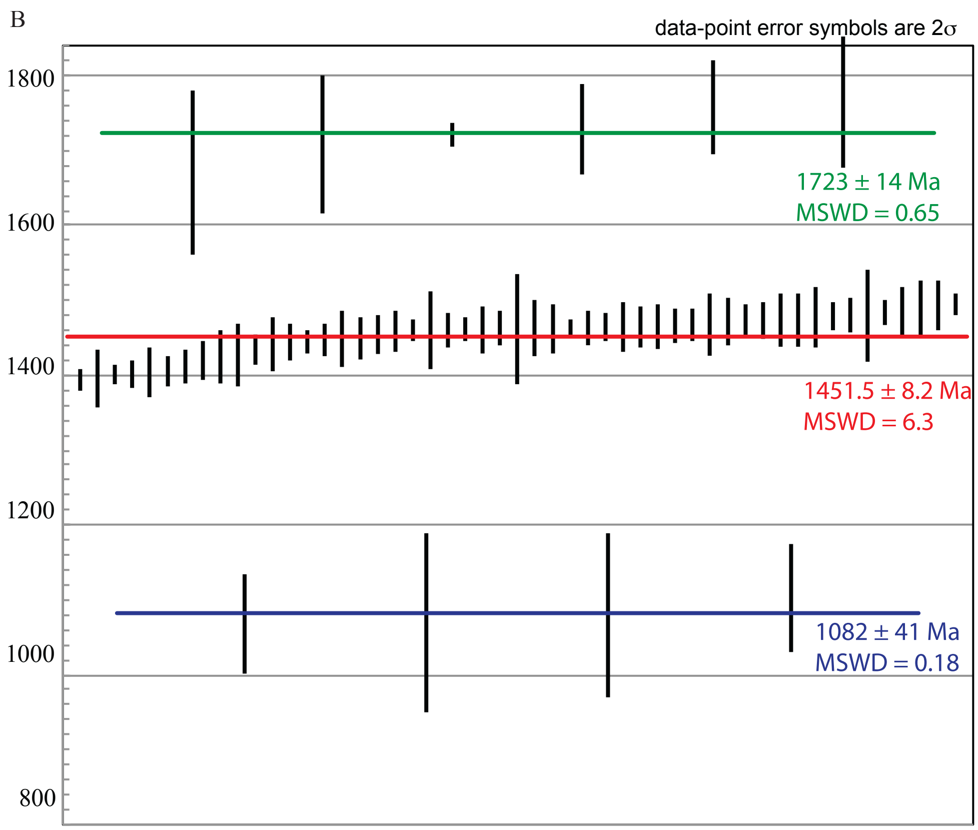

Figure E-1 Sample 201 Concordia and Weighted Average (continued). B**.** Weighted Average for westernmost granite sample 201.

A

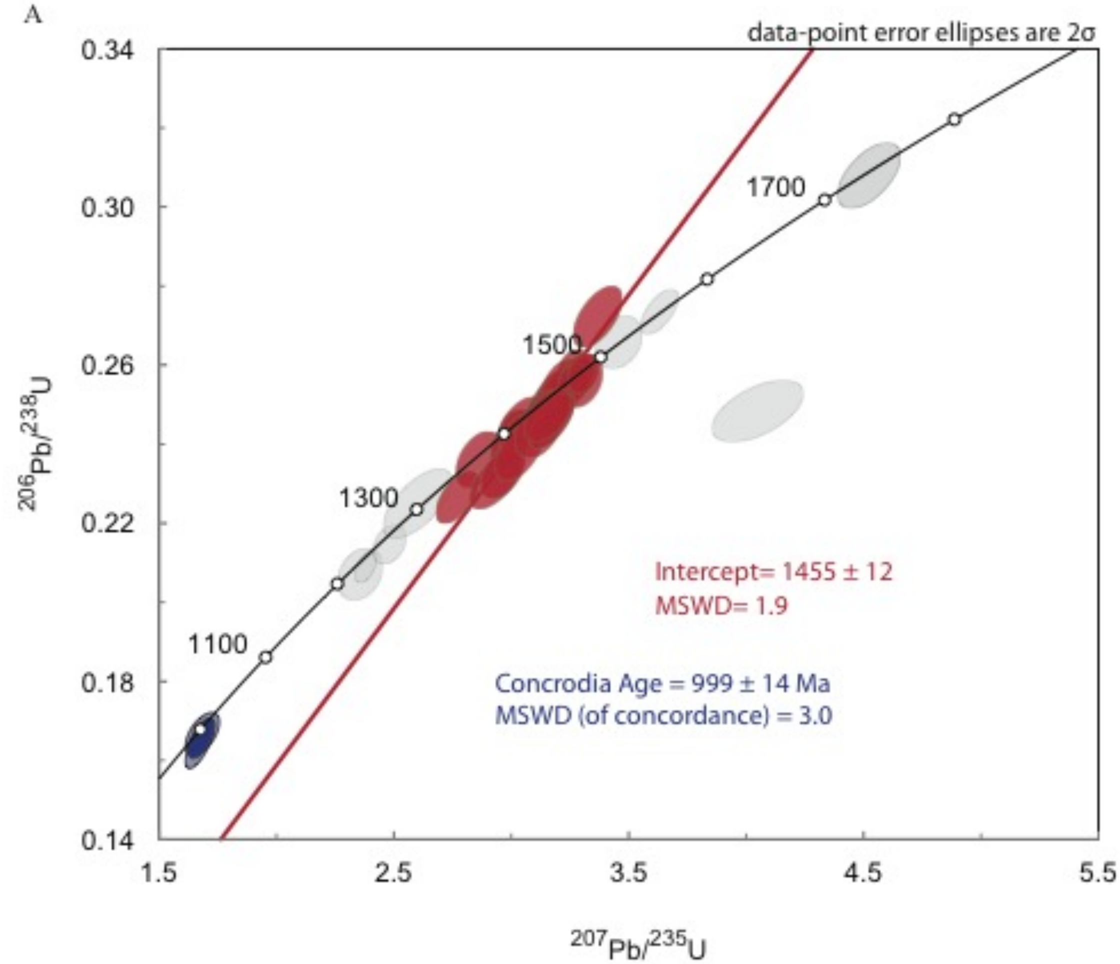

Figure E-2 Sample 70 Concordia and Weighted Average. A. Concordia for granite least strained sample 70.

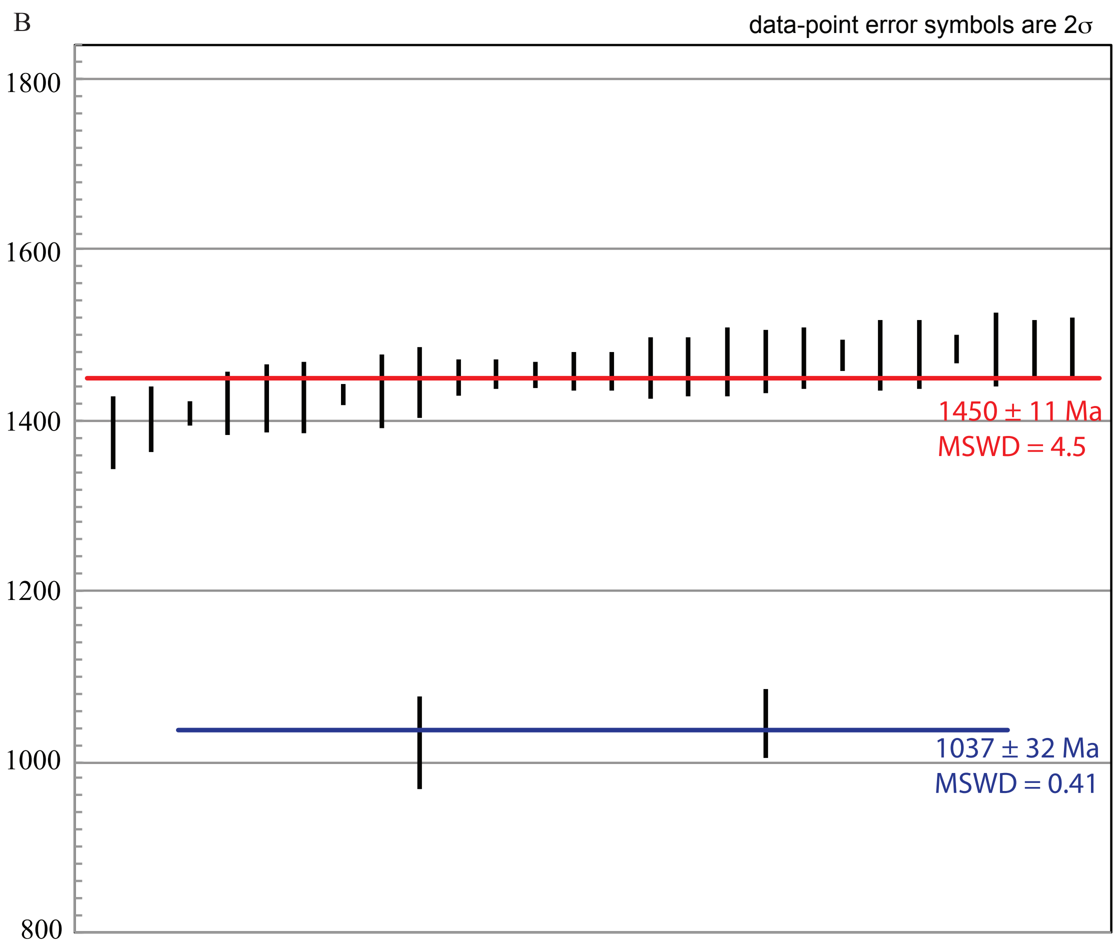

Figure E-2 Sample 70 Concordia and Weighted Average (continued). B. Weighted Average for granite least strained sample 70.

A

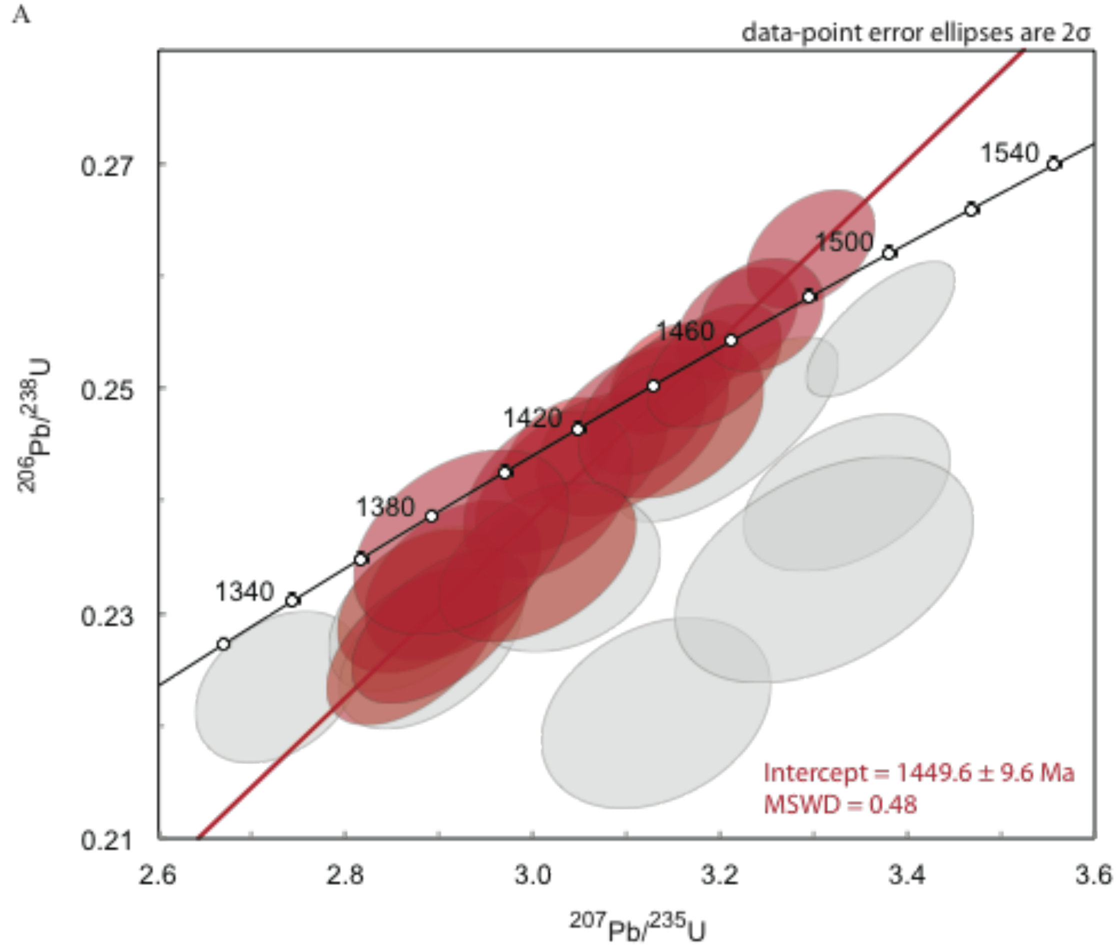

Figure E-3 Sample 71 Concordia and Weighted Average. A. Concordia for granite Sample 71.

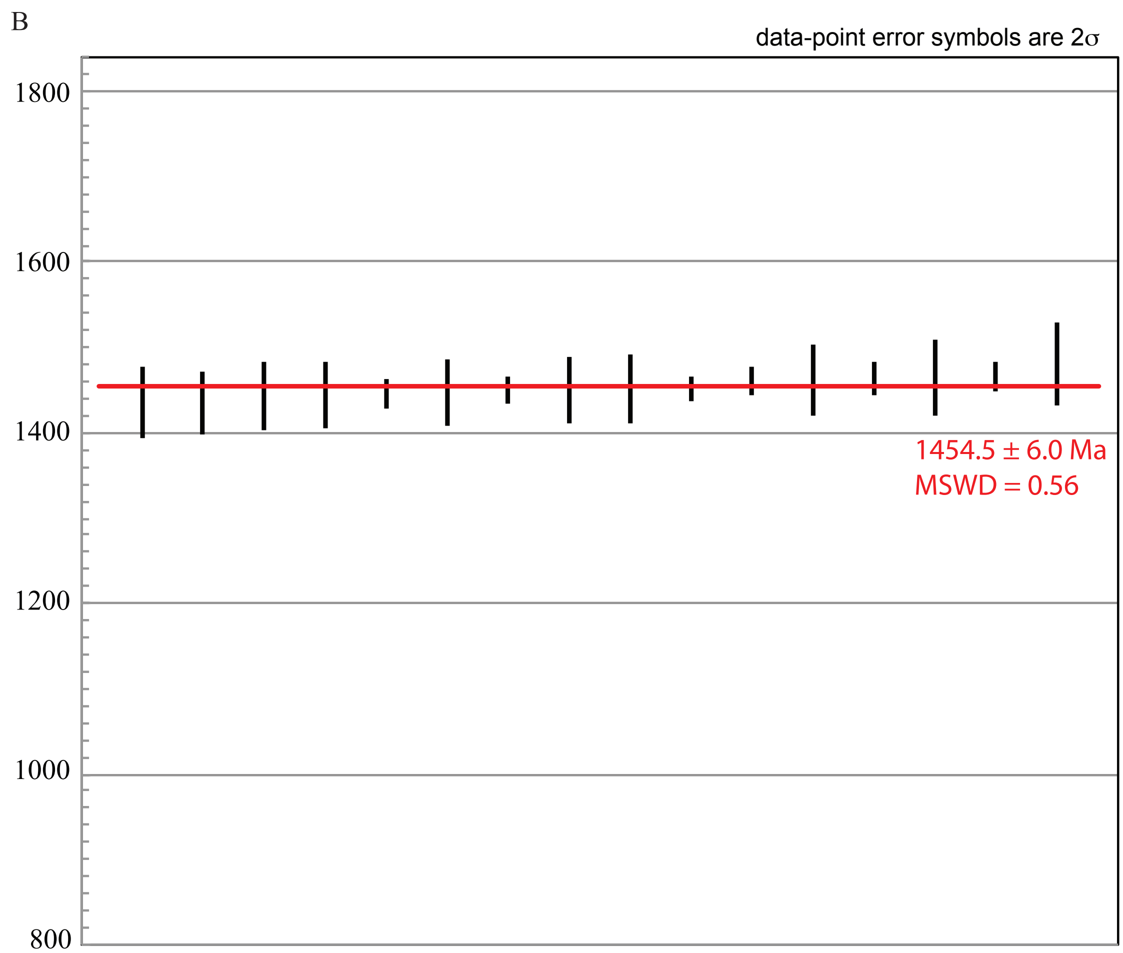

Figure E-3 Sample 71 Concordia and Weighted Average (continued). B. Weighted average for granite Sample 71.

A

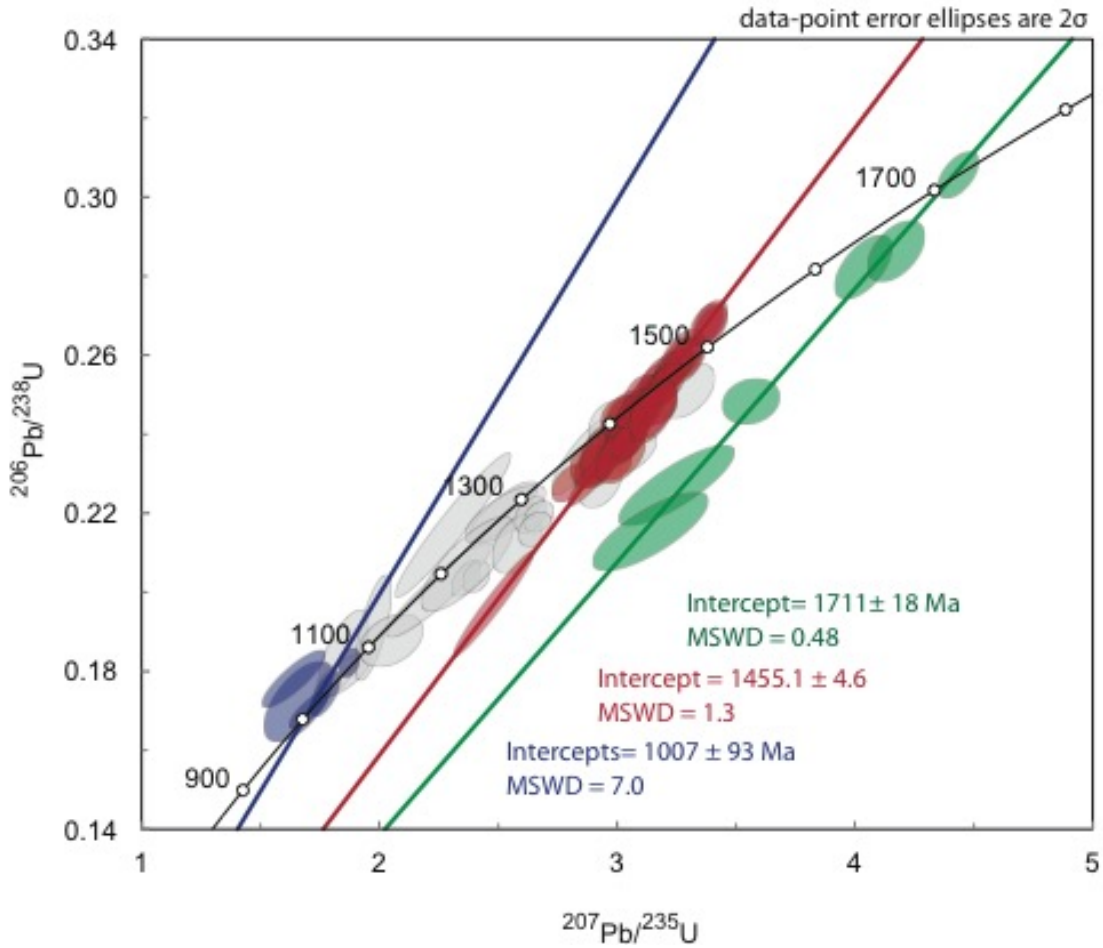

Figure E-4 Sample 108 Concordia and Weighted Average. A. Concordia for eastern most granite sample 108.

B

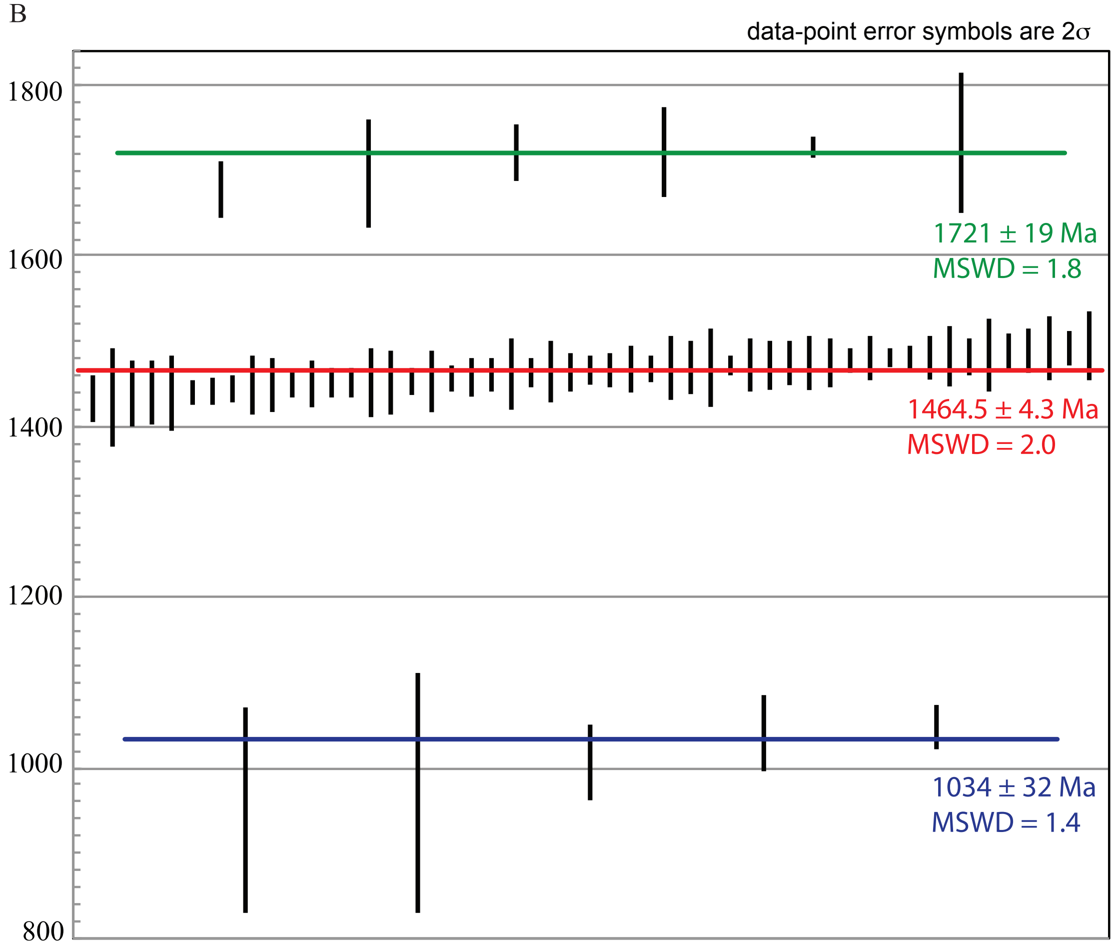

Figure E-4 Sample 108 Concordia and Weighted Average (continued). B. Weighted average for eastern most granite sample 108.

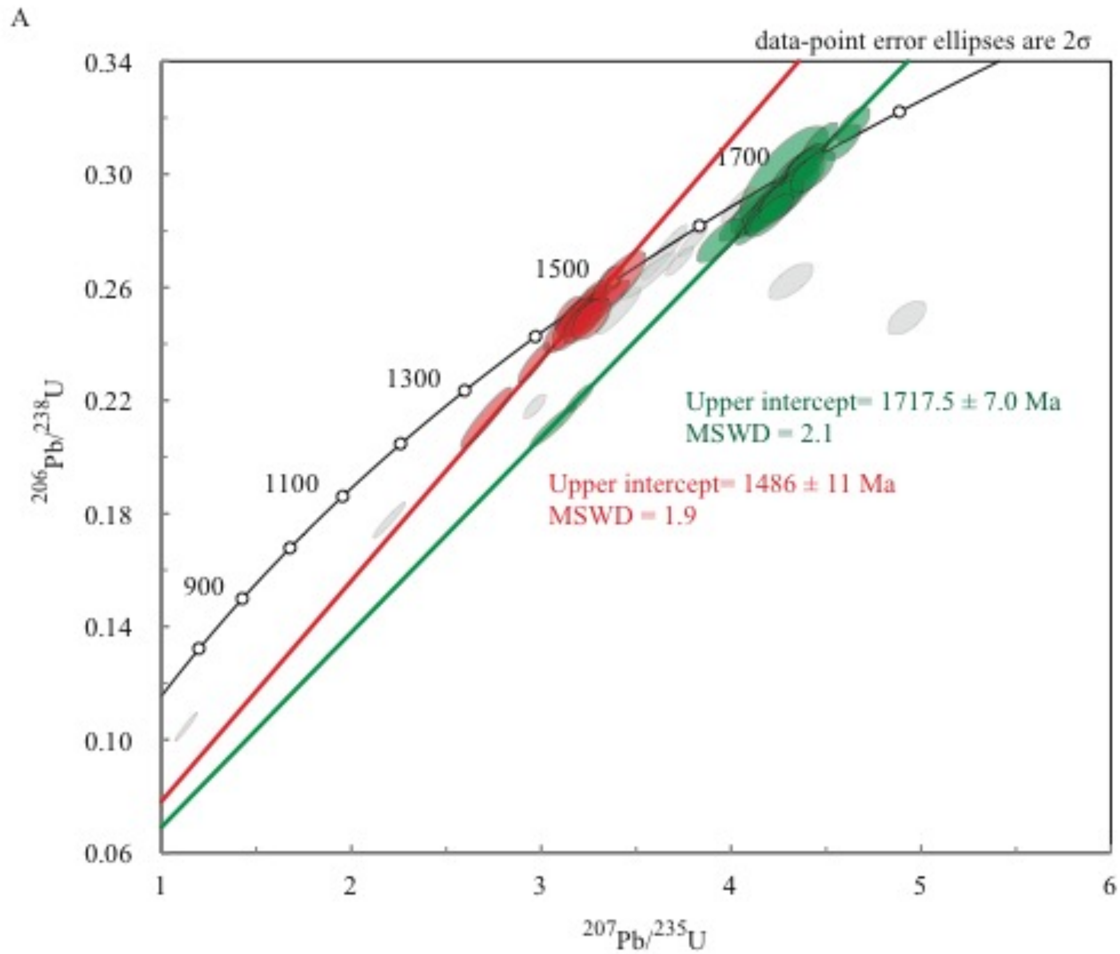

Figure E-5 Sample 205 Concordia and Weighted Average. A. Concordia for western pink orthogneiss sample 205.

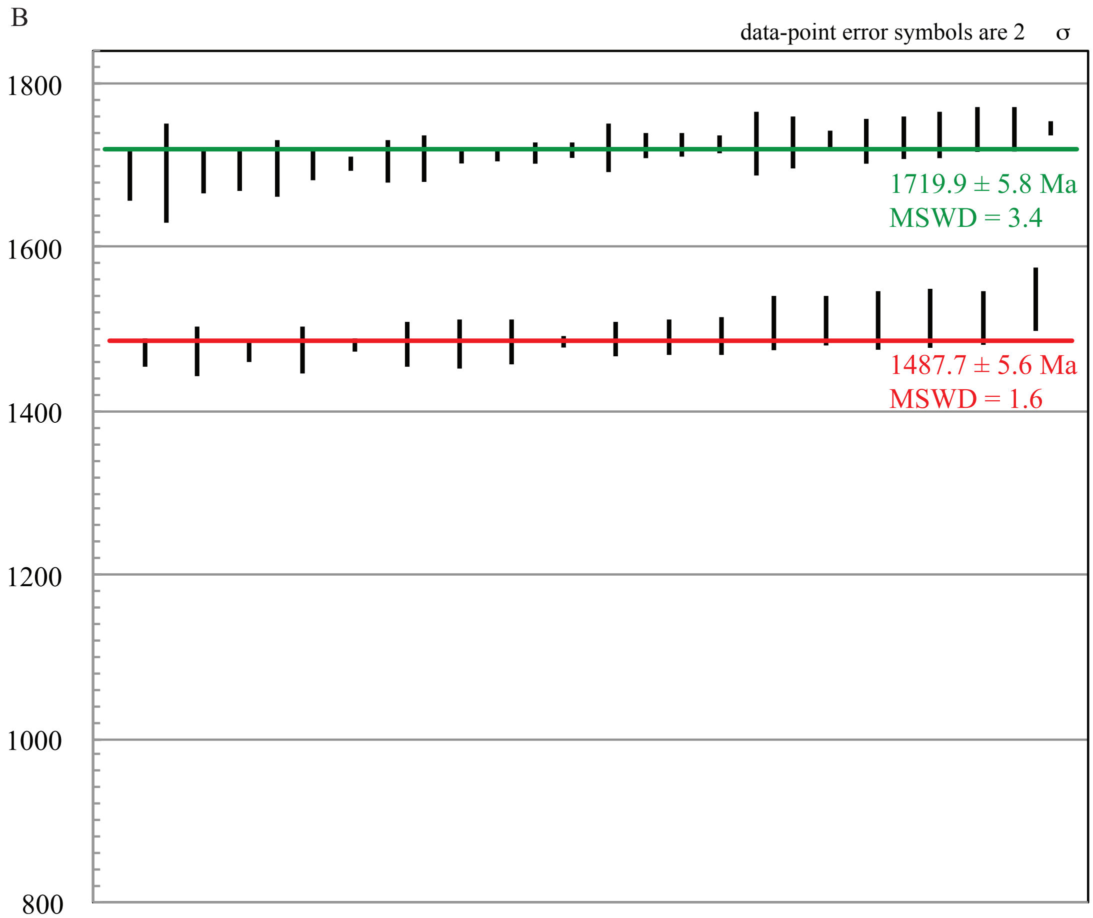

Figure E-5 Sample 205 Concordia and Weighted Average (continued). B. Weighted average for western pink orthogneiss sample 205.

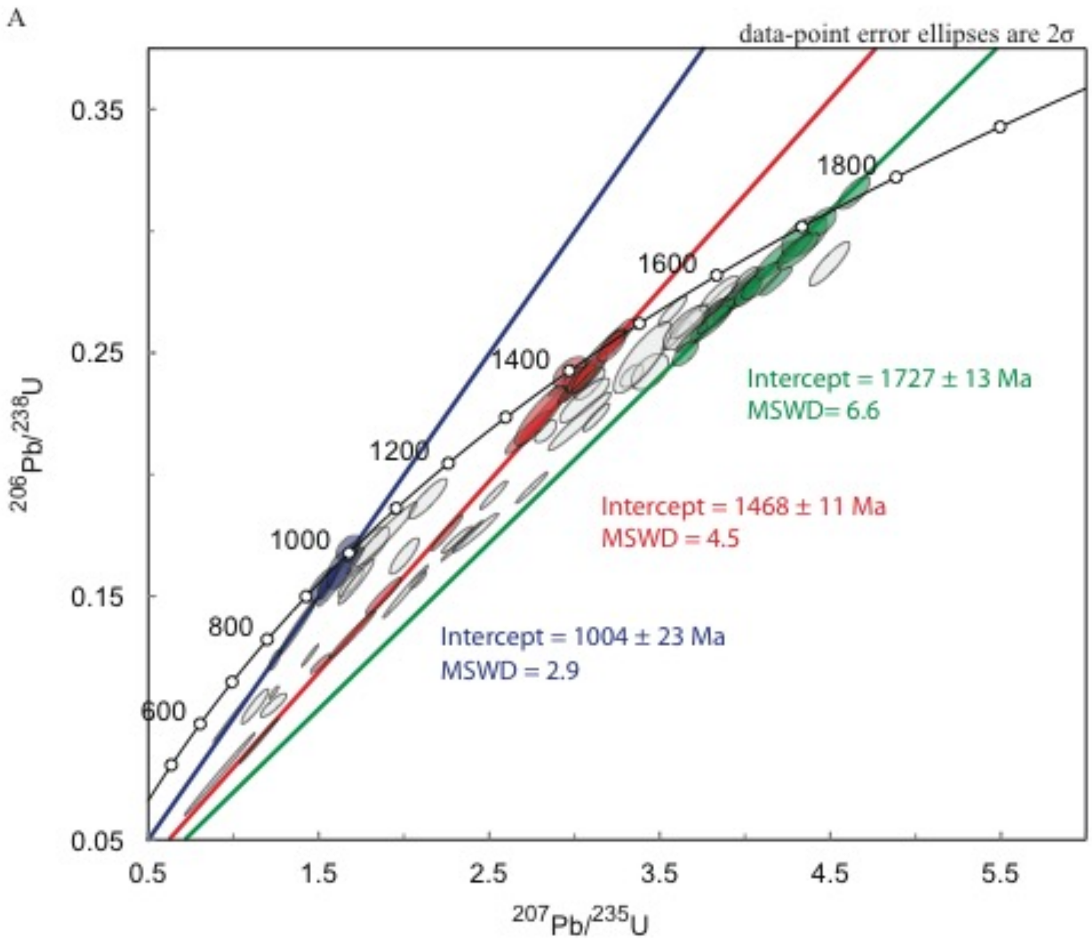

Figure E-6 Sample 106 Concordia and Weighted Average. A. Concordia for eastern pink orthogneiss sample 106.

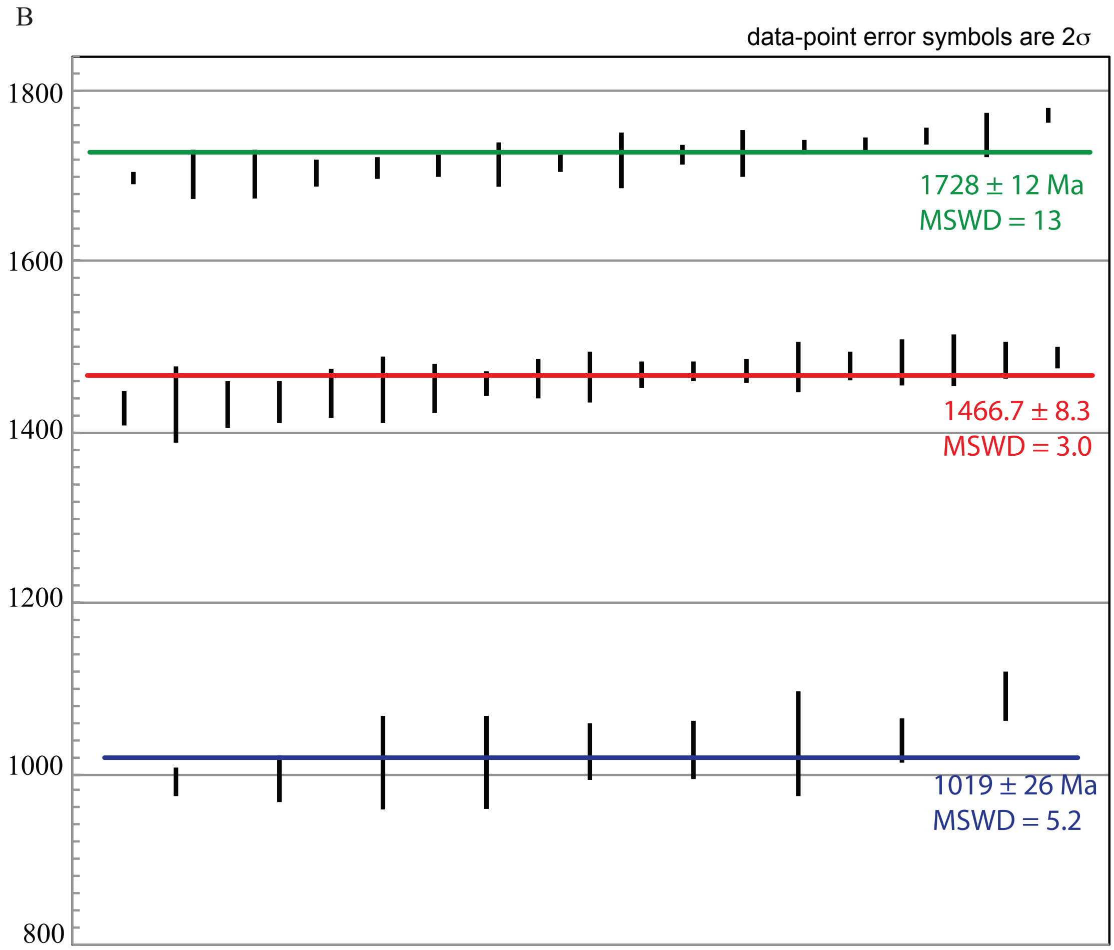

Figure E-6 Sample 106 Concordia and Weighted Average (continued). B. Weighted average for eastern pink orthogneiss sample 106.

APPENDIX F

Table F: M-scale Shear Zone Enclave Measurements

ID	northing (m)	easting (m)	length cm	width cm	aspect ratio (l/w)
	5084493	501754	3.7	2	1.9
	5084493	501754	2.3	1.1	2.1
	5084493	501754	2.7	1.4	1.9
	5084493	501754	5.2	1.4	3.7
	5084493	501754	1.8	1.3	1.4
	5084493	501754	1.3	1.4	1.1
	5084493	501754	3.4	1	3.4
	5084493	501754	1.7	1.4	1.2
	5084493	501754	2.2	1.1	2.0
	5084493	501754	2.3	3	1.3
	5084493	501754	3	1.5	2.0
	5084493	501754	10.7	3.1	3.5
	5084493	501754	3.3	2	1.7
	5084493	501754	2.1	3.4	1.6
	5084493	501754	1.4	3.1	2.2
	5084493	501754	2.5	1.2	2.1
	5084493	501754	2	1.5	1.3
	5084493	501754	2.2	1.1	2.0
30a	5084493	501754	3.7	1.1	3.4
	5084493	501754	3.4	1.3	2.6
	5084493	501754	3.6	1.6	2.3
	5084493	501754	2.2	2	1.1
	5084493	501754	4.9	2.5	2.0
	5084493	501754	3.4	1	3.4
	5084493	501754	27	9.5	2.8
	5084493	501754	3.3	1.5	2.2
	5084493	501754	2.3	1	2.3
	5084493	501754	2	0.7	2.9
	5084493	501754	1.9	1.1	1.7
	5084493	501754	2.2	1.2	1.8
	5084493	501754	7.5	1.1	6.8
	5084493	501754	4.2	2	2.1
	5084493	501754	3.5	1.6	2.2
	5084493	501754	3.4	2.4	1.4
	5084493	501754	2.7	1	2.7
	5084493	501754	2.3	1.8	1.3
	5084493	501754	3.3	1.5	2.2
	5084493	501754	1.5	1.5	1.0
	5084493	501754	2.4	0.8	3.0
	5084493	501754	3.2	1.1	2.9
	5084493	501754	4.3	2.3	1.9
	5084493	501754	5.4	4.2	1.3
	5084493	501754	3.3	1.5	2.2
	5084493	501754	3	1.5	2.0
	5084493	501754	4.2	3.4	1.2
30a con't	5084493	501754	1.7	1	1.7
	5084493	501754	2.3	1.2	1.9
	5084493	501754	2.2	2.1	1.0
	5084493	501754	2.6	1.4	1.9
	5084493	501754	2.7	2	1.4
	5084493	501754	5	6.8	1.4
	5084493	501754	2	0.9	2.2
	5084493	501754	1.3	0.9	1.4

ID	northing (m)	easting (m)	length cm	width cm	aspect ratio (l/w)
30b	5084391	501625	25.5	3	8.5
	5084391	501625	10.7	1.7	6.3
	5084391	501625	13.4	1.8	7.4
	5084391	501625	11.2	1.6	7.0
	5084391	501625	6.6	0.5	13.2
	5084391	501625	17.4	1.8	9.7
	5084391	501625	3.7	1.6	2.3
	5084391	501625	4.4	0.5	8.8
	5084391	501625	8.7	0.8	10.9
	5084391	501625	18.4	1	18.4
	5084391	501625	6.8	1.1	6.2
	5084391	501625	9.4	0.7	13.4
	5084391	501625	7.7	1.1	7.0
	5084391	501625	6.5	0.9	7.2
	5084391	501625	14.2	1.3	10.9
	5084391	501625	9.1	1.4	6.5
	5084391	501625	7.9	1.2	6.6
	5084391	501625	11.8	1.2	9.8
	5084391	501625	7	0.6	11.7
	5084391	501625	9.5	0.8	11.9
	5084391	501625	11.1	0.6	18.5
	5084391	501625	3.8	1	3.8
	5084391	501625	19	2.8	6.8
	5084391	501625	4.5	0.6	7.5
	5084391	501625	6.9	0.4	17.3
	5084391	501625	5	0.3	16.7
30b con't	5084391	501625	7.3	0.7	10.4
	5084391	501625	9.3	0.7	13.3
	5084391	501625	9.1	1.2	7.6
	5084391	501625	7.5	1.4	5.4
	5084391	501625	7.9	2.1	3.8
	5084391	501625	3.4	1	3.4
	5084391	501625	5	1.9	2.6
	5084391	501625	4	0.7	5.7
30c	5084399	501619	15.5	4.2	3.7
	5084399	501619	4.2	0.9	4.7
	5084399	501619	8.1	1.5	5.4
	5084399	501619	4.7	0.8	5.9
	5084399	501619	4.5	2.4	1.9
	5084399	501619	5.6	0.8	7.0
	5084399	501619	9.7	2.6	3.7
	5084399	501619	5.4	0.9	6.0
	5084399	501619	4	1.6	2.5
	5084399	501619	3.5	0.7	5.0
	5084399	501619	6.8	1.6	4.3
	5084399	501619	8.4	1.9	4.4
	5084399	501619	2.8	1.1	2.5
	5084399	501619	6.1	2.1	2.9
	5084399	501619	5.7	0.8	7.1
	5084399	501619	2.9	0.8	3.6
	5084399	501619	3.5	1	3.5
	5084399	501619	2.5	1.1	2.3
	5084402	501618	10.5	1.8	5.8
	5084402	501618	6.2	1.2	5.2
	5084402	501618	5.9	2.6	2.3
	5084402	501618	6.8	1.9	3.6

ID	northing (m)	easting (m)	length cm	width cm	aspect ratio (l/w)
30d	5084402	501618	3.2	1.1	2.9
	5084402	501618	2.8	1.1	2.5
	5084402	501618	3.8	1.1	3.5
	5084402	501618	2.9	0.6	4.8
	5084402	501618	1.8	0.6	3.0
30e	5084406	501612	16.6	4	4.2
	5084406	501612	8.7	2.4	3.6
	5084406	501612	4.3	1.5	2.9
	5084406	501612	4.7	1.2	3.9
	5084406	501612	9.8	2.2	4.5
	5084406	501612	2.3	3.2	1.4
	5084406	501612	6.1	1.2	5.1
	5084406	501612	5.2	1	5.2
	5084406	501612	2.9	1.2	2.4
	5084406	501612	6.7	3.4	2.0
	5084406	501612	3.5	0.8	4.4
30f	5084405	501599	3.2	0.5	6.4
	5084405	501599	3.6	1.9	1.9
	5084405	501599	2.6	1.5	1.7
	5084405	501599	3.4	0.8	4.3
	5084405	501599	1.4	1.6	1.1
	5084405	501599	7.5	3.3	2.3
	5084405	501599	2.4	1.2	2.0
	5084405	501599	3.7	1.1	3.4
	5084405	501599	3.1	1.2	2.6
	5084405	501599	8.2	2.5	3.3
	5084405	501599	8.7	5	1.7
	5084405	501599	3.2	1	3.2
	5084405	501599	2.3	1.3	1.8
	5084405	501599	0.7	0.8	1.1
	5084405	501599	3.6	1.5	2.4
	5084405	501599	3.1	1.4	2.2
	5084405	501599	4	0.9	4.4
30g	5084419	501601	3.4	1.9	1.8
	5084419	501601	3.1	1.5	2.1
	5084419	501601	4	2	2.0
	5084419	501601	4.4	1.7	2.6
	5084419	501601	3.5	8.8	2.5
	5084419	501601	4.1	5.1	1.2
	5084419	501601	3.2	3.1	1.0
	5084419	501601	5.6	2.4	2.3
	5084419	501601	3.2	1.6	2.0
	5084419	501601	2.7	0.8	3.4

APPENDIX G
MINERAL CHEMISTRIES OF M-SCALE SHEAR ZONE

Table G1: Plagioclase Chemistries

* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
BR-20									
20_plag_1									
1 / 1 .	8.83	0.40	4.12	0.02	0.07	0.49	23.00	63.58	100.50
1 / 2 .	8.98	0.35	4.15	0.00	0.06	0.49	23.15	63.68	100.85
1 / 3 .	8.95	0.35	4.08	0.00	0.03	0.51	22.86	63.48	100.27
1 / 4 .	8.94	0.39	4.17	0.01	0.09	0.53	22.87	63.42	100.43
1 / 5 .	8.99	0.41	4.11	0.00	0.08	0.52	22.91	63.60	100.61
1 / 6 .	8.93	0.40	4.10	0.01	0.09	0.50	22.92	63.59	100.54
1 / 7 .	9.02	0.38	4.15	0.00	0.04	0.52	22.88	63.69	100.68
1 / 8 .	8.94	0.40	4.22	0.01	0.09	0.49	23.03	63.55	100.73
1 / 9 .	9.09	0.38	4.13	0.00	0.09	0.49	22.93	63.41	100.53
1 / 10 .	8.97	0.36	4.15	0.01	0.09	0.49	22.89	63.68	100.65
Avg 20_1	8.96	0.38	4.14	0.01	0.07	0.50	22.94	63.57	100.58
20_plag_2									
1 / 1 .	9.56	0.18	3.61	0.00	0.10	0.50	22.45	63.78	100.18
1 / 2 .	9.45	0.17	3.64	-0.01	0.09	0.50	22.71	64.29	100.84
1 / 3 .	9.53	0.15	3.61	-0.01	0.09	0.47	22.78	64.50	101.13
1 / 4 .	9.53	0.17	3.42	0.01	0.08	0.47	22.45	64.15	100.28
1 / 5 .	9.38	0.17	3.58	-0.01	0.07	0.50	22.40	64.42	100.52
1 / 6 .	9.50	0.18	3.54	-0.01	0.10	0.47	22.62	64.05	100.46
1 / 7 .	9.45	0.17	3.40	0.01	0.15	0.48	22.36	64.46	100.48
1 / 8 .	9.47	0.16	3.57	0.01	0.08	0.49	22.56	64.54	100.87
1 / 9 .	9.51	0.14	3.53	-0.01	0.09	0.47	22.69	64.36	100.78
1 / 10 .	9.42	0.16	3.62	-0.01	0.09	0.51	22.48	64.28	100.55
Avg 20_2.1	9.48	0.16	3.55	0.00	0.09	0.49	22.55	64.28	100.60
2 / 1 .	9.56	0.18	3.61	0.00	0.10	0.50	22.45	63.78	100.18
2 / 2 .	9.45	0.17	3.64	-0.01	0.09	0.50	22.71	64.29	100.84

Table G1: Plagioclase Chemistries

* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
2 / 3 .	9.53	0.15	3.61	-0.01	0.09	0.47	22.78	64.50	101.13
2 / 4 .	9.53	0.17	3.42	0.01	0.08	0.47	22.45	64.15	100.28
2 / 5 .	9.38	0.17	3.58	-0.01	0.07	0.50	22.40	64.42	100.52
2 / 6 .	9.50	0.18	3.54	-0.01	0.10	0.47	22.62	64.05	100.46
2 / 7 .	9.45	0.17	3.40	0.01	0.15	0.48	22.36	64.46	100.48
2 / 8 .	9.47	0.16	3.57	0.01	0.08	0.49	22.56	64.54	100.87
2 / 9 .	9.51	0.14	3.53	-0.01	0.09	0.47	22.69	64.36	100.78
2 / 10 .	9.42	0.16	3.62	-0.01	0.09	0.51	22.48	64.28	100.55
Avg 20_2.2	9.48	0.16	3.55	0.00	0.09	0.49	22.55	64.28	100.60
20_plag_3									
1 / 1 .	9.43	0.28	3.58	0.00	0.04	0.49	22.29	64.45	100.56
1 / 2 .	9.29	0.28	3.55	0.01	0.06	0.50	22.52	64.26	100.46
1 / 3 .	9.39	0.27	3.56	0.01	0.04	0.47	22.53	64.33	100.60
1 / 4 .	9.49	0.25	3.58	-0.01	0.02	0.47	22.49	64.21	100.50
1 / 5 .	9.35	0.24	3.57	0.01	0.06	0.49	22.27	64.27	100.25
1 / 6 .	9.27	0.24	3.60	-0.01	0.04	0.48	22.27	64.20	100.09
1 / 7 .	9.33	0.22	3.62	0.03	0.06	0.48	22.47	64.27	100.48
1 / 8 .	9.39	0.24	3.57	0.00	0.05	0.48	22.53	64.30	100.55
1 / 9 .	9.34	0.25	3.59	0.00	0.05	0.49	22.61	64.48	100.81
1 / 10 .	9.30	0.22	3.60	0.00	0.05	0.47	22.53	64.04	100.20
Avg 20_3	9.36	0.25	3.58	0.00	0.05	0.48	22.45	64.28	100.45
20_plag_4									
1 / 1 .	9.34	0.22	3.50	0.00	0.17	0.50	22.46	64.32	100.51
1 / 2 .	9.41	0.24	3.55	-0.02	0.17	0.53	22.64	64.21	100.75
1 / 3 .	9.38	0.23	3.49	0.00	0.12	0.49	22.43	64.40	100.53
1 / 4 .	9.34	0.24	3.47	-0.02	0.15	0.49	22.32	64.45	100.46
1 / 5 .	9.39	0.24	3.48	0.01	0.17	0.50	22.18	63.85	99.83
1 / 6 .	9.22	0.23	3.49	0.02	0.13	0.47	22.47	64.15	100.19
1 / 7 .	9.49	0.22	3.55	-0.02	0.09	0.48	22.40	64.26	100.49
1 / 8 .	9.37	0.23	3.47	0.00	0.15	0.51	22.46	64.21	100.40

Table G1: Plagioclase Chemistries

* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
1 / 9 .	9.31	0.24	3.58	0.00	0.11	0.51	22.23	63.97	99.94
1 / 10 .	9.30	0.24	3.51	0.00	0.11	0.48	22.46	64.04	100.14
Avg 20_4.1	9.35	0.23	3.51	0.00	0.14	0.50	22.40	64.19	100.32
2 / 1 .	9.43	0.20	3.62	0.00	0.12	0.48	22.65	64.13	100.63
2 / 2 .	9.50	0.22	3.64	-0.01	0.11	0.50	22.52	64.19	100.67
2 / 3 .	9.39	0.21	3.60	-0.02	0.17	0.50	22.56	64.32	100.75
2 / 4 .	9.45	0.22	3.57	-0.02	0.14	0.49	22.46	64.31	100.63
2 / 5 .	9.48	0.22	3.57	-0.01	0.14	0.47	22.59	64.25	100.72
2 / 6 .	9.48	0.21	3.58	-0.01	0.13	0.50	22.52	63.97	100.39
2 / 7 .	9.40	0.22	3.54	0.01	0.13	0.50	22.53	63.99	100.32
2 / 8 .	9.45	0.20	3.56	0.00	0.11	0.49	22.44	64.24	100.48
2 / 9 .	9.37	0.20	3.55	-0.01	0.14	0.49	22.38	64.35	100.48
2 / 10 .	9.40	0.19	3.58	-0.01	0.12	0.50	22.36	64.31	100.45
Avg 20_4.2	9.44	0.21	3.58	-0.01	0.13	0.49	22.50	64.21	100.54
BR-16									
16_plag 1									
1 / 1 .	9.38	0.18	3.82	-0.01	0.11	0.51	22.72	63.42	100.15
1 / 2 .	9.49	0.21	3.76	0.02	0.07	0.53	22.66	63.62	100.37
1 / 3 .	9.32	0.19	3.86	0.01	0.07	0.52	22.77	63.74	100.48
1 / 4 .	9.38	0.20	3.89	0.02	0.16	0.50	22.87	63.62	100.64
1 / 5 .	9.31	0.21	3.82	0.01	0.08	0.51	22.85	63.17	99.97
1 / 6 .	9.25	0.21	3.85	0.01	0.09	0.49	22.68	63.64	100.23
1 / 7 .	9.32	0.22	3.82	0.01	0.08	0.50	22.58	63.46	99.99
1 / 8 .	9.32	0.19	3.80	0.01	0.08	0.52	22.76	63.63	100.31
1 / 9 .	9.33	0.21	3.66	0.01	0.06	0.50	22.61	63.78	100.16
1 / 10 .	9.51	0.18	3.51	0.01	0.03	0.52	22.34	63.99	100.09
Avg 16_1	9.36	0.20	3.78	0.01	0.08	0.51	22.69	63.61	100.24

Table G1: Plagioclase Chemistries

* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
16_ plag 2									
1 / 1 .	9.25	0.19	3.84	-0.01	0.08	0.52	22.72	63.58	100.17
1 / 2 .	9.31	0.19	3.81	0.01	0.03	0.53	22.60	63.53	100.00
1 / 3 .	9.22	0.21	3.84	-0.03	0.01	0.51	22.67	63.89	100.35
1 / 4 .	9.31	0.24	3.76	-0.01	0.03	0.51	22.44	63.81	100.09
1 / 5 .	9.24	0.24	3.73	0.00	0.02	0.51	22.55	63.40	99.69
1 / 6 .	9.23	0.35	3.66	-0.01	0.04	0.53	22.39	63.54	99.73
1 / 7 .	9.36	0.24	3.79	0.00	0.07	0.52	22.48	63.74	100.19
1 / 8 .	9.35	0.25	3.67	-0.01	0.03	0.52	22.59	63.85	100.27
1 / 9 .	9.35	0.21	3.79	-0.01	0.05	0.48	22.65	63.54	100.07
1 / 10 .	9.35	0.24	3.74	-0.02	0.04	0.52	22.63	63.66	100.18
Avg 16_2.1	9.30	0.24	3.76	-0.01	0.04	0.51	22.57	63.65	100.06
2 / 1 .	9.25	0.24	3.85	0.00	0.04	0.52	22.78	63.35	100.04
2 / 2 .	9.26	0.25	3.82	0.01	-0.01	0.51	22.69	63.16	99.70
2 / 3 .	9.13	0.26	3.86	0.00	0.02	0.50	22.77	63.70	100.23
2 / 4 .	9.29	0.27	3.89	-0.02	-0.04	0.50	22.59	63.55	100.09
2 / 5 .	9.31	0.27	3.81	0.01	0.03	0.52	22.52	63.51	99.99
2 / 6 .	9.28	0.26	3.79	0.00	-0.02	0.49	22.74	63.66	100.20
2 / 7 .	9.29	0.25	3.84	0.01	0.05	0.48	22.52	63.56	100.01
2 / 8 .	9.29	0.25	3.77	-0.01	0.09	0.52	22.65	63.76	100.32
2 / 9 .	9.26	0.26	3.86	-0.02	0.06	0.51	22.51	63.79	100.25
2 / 10 .	9.29	0.25	3.85	-0.01	0.03	0.50	22.73	63.79	100.46
Avg 16_2.2	9.27	0.26	3.84	0.00	0.03	0.51	22.65	63.58	100.12
16_plag 3									
1 / 1 .	9.33	0.26	3.76	-0.01	0.07	0.50	22.73	64.07	100.72
1 / 2 .	9.26	0.27	3.73	0.00	0.08	0.50	22.57	63.65	100.07
1 / 3 .	9.34	0.30	3.71	0.00	0.09	0.50	22.85	63.44	100.23
1 / 4 .	9.23	0.30	3.76	0.00	0.05	0.52	22.63	63.70	100.18
1 / 5 .	9.33	0.26	3.62	-0.01	0.11	0.49	22.53	63.80	100.15
1 / 6 .	9.31	0.29	3.66	0.02	0.11	0.49	22.61	63.91	100.41

Table G1: Plagioclase Chemistries

* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
1 / 7 .	9.34	0.29	3.69	0.00	0.08	0.50	22.58	63.48	99.97
1 / 8 .	9.32	0.30	3.71	0.00	0.07	0.51	22.71	63.71	100.34
1 / 9 .	9.33	0.31	3.71	-0.02	0.09	0.48	22.57	63.42	99.91
1 / 10 .	9.32	0.28	3.67	0.00	0.04	0.51	22.44	63.51	99.77
Avg 16_3.1	9.31	0.29	3.71	0.00	0.08	0.50	22.62	63.67	100.17
2 / 1 .	7.86	2.60	1.63	0.00	0.18	0.52	23.94	62.16	98.88
2 / 2 .	9.43	0.15	3.81	0.01	0.02	0.51	22.69	63.69	100.32
2 / 3 .	9.34	0.16	3.81	0.00	0.04	0.50	22.89	63.43	100.17
2 / 4 .	9.26	0.15	3.76	0.01	0.07	0.51	22.82	63.82	100.40
2 / 5 .	9.26	0.16	3.78	0.00	0.06	0.53	22.54	63.66	100.00
2 / 6 .	9.49	0.16	3.73	0.01	0.04	0.51	22.83	63.98	100.74
2 / 7 .	9.41	0.17	3.73	0.00	0.06	0.52	22.78	63.74	100.41
2 / 8 .	9.39	0.22	3.89	-0.01	0.02	0.49	22.80	63.48	100.29
2 / 9 .	9.23	0.23	3.83	-0.01	0.03	0.52	22.72	63.60	100.17
2 / 10 .	9.34	0.20	3.90	0.01	0.04	0.53	22.85	63.58	100.45
Avg 16_3.2	9.20	0.42	3.59	0.00	0.06	0.51	22.89	63.52	100.18
16_plag 4									
1 / 1 .	9.39	0.12	3.78	0.00	0.06	0.50	22.66	63.42	99.93
1 / 2 .	9.29	0.16	3.83	0.00	0.07	0.50	22.72	63.53	100.11
1 / 3 .	9.31	0.16	3.82	0.00	0.04	0.50	22.77	63.54	100.15
1 / 4 .	9.36	0.15	3.90	0.02	0.06	0.52	22.80	63.24	100.05
1 / 5 .	9.01	0.38	3.77	0.00	0.05	0.53	22.70	63.39	99.83
1 / 6 .	9.31	0.15	3.93	0.01	0.04	0.48	22.89	63.39	100.21
1 / 7 .	9.39	0.15	3.84	0.00	0.09	0.50	23.00	63.52	100.49
1 / 8 .	9.33	0.15	3.91	0.00	0.06	0.49	22.69	63.45	100.08
1 / 9 .	9.36	0.17	3.90	-0.01	0.05	0.50	22.81	63.51	100.29
1 / 10 .	9.35	0.16	3.77	0.00	0.05	0.52	22.70	63.78	100.33
Avg 16_4	9.31	0.18	3.84	0.00	0.06	0.50	22.77	63.48	100.15

Table G1: Plagioclase Chemistries

* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
BR-14 B4									
B4_plag 1									
1 / 1 .	9.27	0.26	3.91	0.01	0.07	0.53	22.85	63.63	100.54
1 / 2 .	9.24	0.24	3.91	0.03	0.08	0.53	22.84	63.40	100.27
1 / 3 .	9.39	0.23	3.89	0.02	0.10	0.51	22.91	63.15	100.20
1 / 4 .	9.32	0.26	3.88	0.02	0.11	0.53	22.81	63.96	100.88
1 / 5 .	9.23	0.25	3.87	0.02	0.10	0.51	22.86	63.52	100.35
1 / 6 .	9.35	0.27	3.88	0.00	0.10	0.50	22.64	63.33	100.06
1 / 7 .	9.26	0.25	3.94	0.02	0.08	0.51	22.76	63.39	100.21
1 / 8 .	9.34	0.24	3.96	0.04	0.07	0.51	22.76	63.64	100.56
1 / 9 .	9.32	0.24	3.92	0.02	0.08	0.50	22.82	63.62	100.53
1 / 10 .	9.34	0.22	3.90	0.01	0.08	0.48	22.88	63.43	100.34
Avg B4_1.1	9.30	0.25	3.91	0.02	0.09	0.51	22.81	63.51	100.39
2 / 1 .	9.41	0.14	3.84	0.03	0.10	0.52	22.88	64.12	101.03
2 / 2 .	9.30	0.15	3.89	0.01	0.08	0.51	22.91	63.73	100.58
2 / 3 .	9.35	0.17	3.96	0.03	0.10	0.50	22.89	63.57	100.58
2 / 4 .	9.24	0.18	3.97	0.00	0.10	0.49	22.92	63.62	100.53
2 / 5 .	9.28	0.19	3.99	0.01	0.08	0.51	23.01	63.68	100.76
2 / 6 .	9.38	0.18	3.91	0.03	0.11	0.49	23.07	63.53	100.70
2 / 7 .	9.27	0.20	3.96	0.01	0.09	0.50	22.97	63.74	100.75
2 / 8 .	9.36	0.21	3.96	0.02	0.09	0.50	22.94	63.70	100.78
2 / 9 .	9.19	0.20	3.94	0.02	0.06	0.50	22.87	63.64	100.43
2 / 10 .	9.29	0.18	3.94	0.02	0.11	0.51	22.83	63.73	100.62
Avg B4_1.2	9.31	0.18	3.94	0.02	0.09	0.50	22.93	63.71	100.68
3 / 1 .	9.29	0.15	3.96	0.01	0.08	0.51	22.94	63.44	100.38
3 / 2 .	9.29	0.18	4.00	0.02	0.13	0.53	22.80	63.79	100.74
3 / 3 .	9.32	0.19	4.03	0.02	0.10	0.49	22.89	63.58	100.63
3 / 4 .	9.30	0.19	4.01	0.02	0.12	0.49	23.02	63.73	100.88
3 / 5 .	9.29	0.20	3.98	0.03	0.14	0.49	23.07	64.02	101.21

Table G1: Plagioclase Chemistries
* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
3 / 6 .	9.29	0.18	4.06	0.01	0.13	0.51	22.76	63.45	100.40
3 / 7 .	9.33	0.16	3.87	0.03	0.14	0.51	22.85	63.85	100.75
3 / 8 .	9.40	0.15	3.96	0.02	0.10	0.52	22.82	64.01	100.98
3 / 9 .	9.45	0.12	3.88	0.03	0.09	0.51	22.66	63.34	100.08
3 / 10 . *	10.43	0.16	0.58	0.05	0.17	0.46	19.26	65.63	96.73
Avg B4_1.3	9.33	0.17	3.97	0.02	0.11	0.51	22.87	63.69	100.67
4 / 1 .	9.19	0.35	3.94	0.03	0.11	0.49	22.96	63.41	100.48
4 / 2 .	9.13	0.34	3.91	0.02	0.15	0.50	22.79	63.13	99.97
4 / 3 .	9.17	0.35	3.94	0.01	0.12	0.49	22.93	63.41	100.42
4 / 4 .	9.40	0.33	3.77	0.02	0.11	0.50	22.79	63.64	100.57
4 / 5 .	9.17	0.35	3.93	0.02	0.10	0.50	22.92	63.36	100.35
4 / 6 .	9.13	0.36	3.93	0.01	0.08	0.53	22.99	63.24	100.27
4 / 7 .	9.26	0.30	4.03	0.03	0.14	0.50	22.90	63.24	100.42
4 / 8 .	9.25	0.36	3.95	0.03	0.15	0.49	22.91	63.33	100.47
4 / 9 .	9.22	0.34	3.95	0.04	0.07	0.51	22.90	63.58	100.61
4 / 10 .	9.30	0.31	3.94	0.00	0.11	0.49	23.05	64.01	101.22
Avg B4_1.4	9.22	0.34	3.93	0.02	0.11	0.50	22.91	63.44	100.48
B4_plag 2									
1 / 1 .	9.24	0.22	4.02	-0.01	-0.01	0.50	22.75	63.35	100.08
1 / 2 .	9.41	0.24	3.97	0.02	0.01	0.50	22.68	63.72	100.55
1 / 3 .	9.20	0.22	3.92	0.00	0.01	0.50	22.73	63.48	100.06
1 / 4 .	9.25	0.22	4.03	0.00	0.00	0.51	22.78	63.61	100.40
1 / 5 .	9.26	0.26	3.95	-0.01	0.02	0.51	22.66	63.54	100.20
1 / 6 .	9.17	0.22	4.01	0.01	-0.04	0.52	22.74	63.79	100.45
1 / 7 .	9.20	0.20	3.95	0.01	0.01	0.49	22.96	63.39	100.22
1 / 8 .	9.24	0.21	3.97	0.01	-0.03	0.53	22.94	63.70	100.60
1 / 9 .	9.19	0.21	3.98	0.01	0.00	0.50	23.03	63.49	100.40
1 / 10 .	9.27	0.21	3.99	0.01	0.02	0.51	23.17	63.88	101.05
Avg B4_2.1	9.24	0.22	3.98	0.00	0.00	0.51	22.84	63.60	100.39

Table G1: Plagioclase Chemistries

* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
2 / 1 .	9.29	0.21	4.00	0.00	0.02	0.50	22.93	63.41	100.36
2 / 2 .	9.17	0.24	3.92	0.01	0.06	0.52	22.61	63.62	100.15
2 / 3 .	9.07	0.26	3.99	0.00	0.03	0.55	22.82	63.43	100.15
2 / 4 .	9.19	0.25	3.92	0.01	0.05	0.51	22.64	63.23	99.79
2 / 5 .	9.17	0.26	3.98	0.00	0.03	0.51	22.79	63.32	100.07
2 / 6 .	9.24	0.26	3.97	0.01	0.04	0.53	22.74	63.55	100.34
2 / 7 .	9.11	0.27	3.99	0.01	0.00	0.51	22.77	63.41	100.09
2 / 8 .	9.12	0.28	3.86	-0.01	0.03	0.51	22.81	62.87	99.47
2 / 9 .	9.04	0.25	3.96	0.01	0.02	0.54	22.68	63.15	99.66
2 / 10 .	9.05	0.27	3.96	0.01	0.04	0.52	22.93	63.36	100.14
Avg B4_2.2	9.14	0.26	3.96	0.00	0.03	0.52	22.77	63.33	100.02
B4_plag 3									
Formula	Na2O	K2O	CaO	MnO	FeO	SrO	Al2O3	SiO2	Total
1 / 1 .	9.21	0.22	3.96	-0.01	0.11	0.51	22.73	63.74	100.49
1 / 2 .	9.23	0.23	3.93	-0.01	0.09	0.50	22.87	63.69	100.54
1 / 3 .	9.37	0.22	3.60	0.01	0.11	0.52	22.59	63.99	100.41
1 / 4 .	9.26	0.25	3.83	0.00	0.05	0.51	22.77	63.83	100.50
1 / 5 .	9.19	0.25	3.83	-0.01	0.07	0.53	22.65	63.67	100.19
1 / 6 .	9.25	0.26	3.92	0.00	0.08	0.52	22.81	63.73	100.57
1 / 7 .	9.23	0.24	3.85	0.01	0.03	0.51	22.63	63.57	100.07
1 / 8 .	9.24	0.24	3.89	-0.01	0.04	0.52	22.68	63.78	100.39
1 / 9 .	9.30	0.20	3.78	0.01	0.07	0.49	22.75	63.73	100.32
1 / 10 .	9.22	0.20	3.88	0.01	0.08	0.52	22.92	63.77	100.59
Avg B4_3.1	9.25	0.23	3.85	0.00	0.07	0.51	22.74	63.75	100.40
2 / 1 .	11.31	0.08	0.82	-0.01	0.03	0.46	20.21	67.79	100.71
2 / 2 .	9.33	0.13	3.90	0.00	0.12	0.51	22.84	63.64	100.47
2 / 3 .	9.23	0.18	3.92	0.00	0.07	0.51	22.76	63.35	100.02
2 / 4 .	9.25	0.20	3.89	0.00	0.08	0.51	22.95	63.60	100.49
2 / 5 .	9.25	0.19	3.98	0.00	0.09	0.52	23.02	63.53	100.58

Table G1: Plagioclase Chemistries

* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
2 / 6 .	9.21	0.21	4.02	0.00	0.09	0.52	22.89	63.65	100.58
2 / 7 .	9.07	0.23	3.95	-0.02	0.08	0.51	23.01	63.10	99.95
2 / 8 .	9.28	0.23	4.00	-0.03	0.09	0.51	22.88	63.37	100.36
2 / 9 .	9.13	0.26	3.91	-0.01	0.08	0.50	22.79	63.59	100.26
2 / 10 .	9.18	0.23	3.92	0.00	0.11	0.52	22.87	63.58	100.41
Avg B4_3.2	9.42	0.19	3.63	-0.01	0.08	0.51	22.62	63.92	100.38
B4_plag 4									
1 / 1 .	9.28	0.20	3.89	0.00	0.09	0.51	22.77	63.39	100.12
1 / 2 .	9.20	0.19	3.98	0.00	0.09	0.49	22.73	63.58	100.27
1 / 3 .	9.35	0.20	3.96	-0.01	0.11	0.49	23.11	63.71	100.94
1 / 4 .	9.27	0.21	4.03	-0.01	0.13	0.50	22.90	63.69	100.71
1 / 5 .	9.20	0.22	4.01	0.00	0.12	0.53	22.61	63.56	100.25
1 / 6 .	9.21	0.23	3.94	-0.01	0.10	0.49	22.75	63.64	100.35
1 / 7 .	9.21	0.21	3.98	0.00	0.13	0.51	22.91	63.79	100.75
1 / 8 .	9.25	0.20	3.97	-0.01	0.17	0.50	22.77	63.67	100.54
1 / 9 .	9.29	0.17	3.97	0.01	0.13	0.50	22.95	63.94	100.96
1 / 10 .	9.29	0.16	3.99	-0.01	0.09	0.49	22.74	63.21	99.98
Avg B4_4	9.25	0.20	3.97	-0.01	0.12	0.50	22.82	63.62	100.48
B4_plag 5									
1 / 1 .	9.24	0.22	3.93	0.03	0.04	0.53	22.86	63.48	100.33
1 / 2 .	9.11	0.23	3.98	-0.01	0.04	0.51	22.71	63.33	99.92
1 / 3 .	9.29	0.24	3.93	-0.01	0.10	0.51	22.64	63.40	100.09
1 / 4 .	9.19	0.25	3.97	-0.01	0.01	0.51	23.01	63.90	100.84
1 / 5 .	9.15	0.24	3.90	0.00	0.09	0.51	22.88	63.58	100.35
1 / 6 .	9.20	0.22	3.95	-0.01	0.07	0.52	23.01	63.48	100.46
1 / 7 .	9.28	0.21	4.02	0.00	0.04	0.50	22.86	63.06	99.96
1 / 8 .	9.38	0.24	3.94	-0.01	0.10	0.50	22.71	63.27	100.14
1 / 9 .	9.39	0.19	3.97	0.00	0.05	0.49	22.72	63.67	100.47
1 / 10 .	9.27	0.16	3.93	0.01	0.10	0.51	22.93	63.37	100.27
Avg B4_5	9.25	0.22	3.95	0.00	0.06	0.51	22.83	63.45	100.28

Table G1: Plagioclase Chemistries

* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
BR-14 B1									
B1_plag 1									
1 / 1 .	9.33	0.18	3.82	0.02	0.45	0.51	22.91	64.06	101.29
1 / 2 .	9.36	0.19	3.92	0.03	0.43	0.49	22.86	64.07	101.34
1 / 3 .	9.31	0.18	3.85	0.01	0.38	0.51	22.82	64.11	101.16
1 / 4 .	9.36	0.19	3.85	0.03	0.45	0.51	22.75	64.25	101.38
1 / 5 .	9.37	0.21	3.81	0.02	0.39	0.53	22.74	64.16	101.22
1 / 6 .	9.38	0.20	3.72	0.02	0.48	0.53	22.65	64.23	101.20
1 / 7 .	9.39	0.18	3.77	0.04	0.45	0.51	22.74	64.12	101.20
1 / 8 .	9.39	0.22	3.70	0.02	0.49	0.53	22.67	64.17	101.19
1 / 9 .	9.35	0.22	3.49	0.02	0.62	0.49	22.44	64.29	100.92
1 / 10 .	9.33	0.23	3.55	0.03	0.53	0.53	22.47	64.35	101.02
Avg B1_1.1	9.35	0.20	3.75	0.02	0.47	0.51	22.70	64.18	101.19
2 / 1 . *	1.44	1.50	11.15	0.50	19.98	0.36	10.11	41.12	86.17
2 / 2 .	9.31	0.18	3.81	0.01	0.45	0.52	22.70	64.21	101.19
2 / 3 .	9.35	0.21	3.79	0.03	0.35	0.52	22.64	63.82	100.69
2 / 4 .	9.49	0.20	3.81	0.01	0.31	0.51	22.86	64.37	101.56
2 / 5 .	9.37	0.21	3.88	0.03	0.27	0.54	22.79	63.98	101.07
2 / 6 .	9.24	0.22	3.91	0.01	0.25	0.48	22.97	63.64	100.73
2 / 7 .	9.27	0.19	3.86	0.01	0.17	0.51	22.70	64.10	100.81
2 / 8 .	9.22	0.20	3.97	0.01	0.09	0.53	22.96	63.76	100.74
2 / 9 .	9.34	0.23	3.84	0.00	0.18	0.51	22.80	63.85	100.75
2 / 10 .	9.25	0.21	3.94	0.02	0.11	0.49	22.87	63.45	100.34
2 / 11 .	9.13	0.22	4.02	0.01	0.15	0.49	23.11	64.05	101.19
2 / 12 .	9.11	0.23	3.92	0.03	0.14	0.54	23.03	63.69	100.68
2 / 13 .	9.21	0.22	4.04	0.01	0.11	0.52	22.97	63.60	100.68
2 / 14 .	9.20	0.23	3.95	0.02	0.14	0.51	22.75	63.90	100.71
2 / 15 .	9.22	0.21	4.05	0.03	0.14	0.50	22.95	64.02	101.12

Table G1: Plagioclase Chemistries

* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
Avg B1_1.2	9.27	0.21	3.91	0.02	0.20	0.51	22.86	63.89	100.87
3 / 1 .	9.15	0.23	3.93	0.02	0.13	0.52	22.87	64.02	100.86
3 / 2 .	9.17	0.21	3.90	0.01	0.12	0.51	22.88	63.77	100.57
3 / 3 .	9.33	0.22	4.05	0.01	0.10	0.52	22.92	63.68	100.83
3 / 4 .	9.32	0.22	3.98	0.01	0.09	0.53	22.80	63.78	100.74
3 / 5 .	9.15	0.21	3.98	0.01	0.13	0.49	22.91	63.63	100.52
3 / 6 .	9.33	0.23	3.98	0.01	0.12	0.52	22.85	63.92	100.95
3 / 7 .	9.16	0.20	3.96	0.01	0.13	0.51	22.79	63.64	100.38
3 / 8 .	9.28	0.20	3.97	0.00	0.12	0.51	22.78	63.83	100.69
3 / 9 .	9.28	0.20	3.98	0.02	0.12	0.51	23.05	63.68	100.84
3 / 10 .	9.19	0.18	3.93	0.00	0.11	0.51	22.96	63.93	100.81
Avg B1_1.3	9.23	0.21	3.97	0.01	0.12	0.51	22.88	63.79	100.72
B1_plag 2									
1 / 1 .	9.32	0.19	3.99	0.00	0.11	0.53	22.98	63.99	101.11
1 / 2 .	9.26	0.19	3.96	-0.01	0.08	0.49	22.87	63.66	100.52
1 / 3 .	9.23	0.21	3.93	0.01	0.06	0.52	22.95	63.61	100.53
1 / 4 .	9.16	0.24	3.93	0.01	0.09	0.53	23.04	63.74	100.74
1 / 5 .	9.25	0.21	3.96	-0.01	0.08	0.50	22.97	63.95	100.93
1 / 6 .	9.23	0.23	3.95	0.01	0.10	0.51	23.02	63.74	100.78
1 / 7 .	9.25	0.22	3.99	0.00	0.08	0.53	22.94	63.71	100.72
1 / 8 .	9.26	0.22	3.96	0.00	0.09	0.51	22.93	63.79	100.76
1 / 9 .	9.27	0.23	3.92	0.02	0.08	0.51	23.06	63.88	100.97
1 / 10 .	9.29	0.23	3.99	0.01	0.09	0.51	23.00	63.94	101.07
Avg B1_2.1	9.25	0.22	3.96	0.01	0.09	0.51	22.98	63.80	100.81
2 / 1 .	11.34	0.08	0.77	0.00	0.12	0.45	20.20	68.21	101.16
2 / 2 .	11.41	0.08	0.45	0.02	0.10	0.47	19.95	68.67	101.14
2 / 3 .	11.49	0.09	0.42	0.01	0.11	0.45	19.92	68.45	100.94
2 / 4 .	11.17	0.19	0.40	0.00	0.11	0.46	20.01	68.55	100.89
2 / 5 .	11.35	0.11	0.44	0.00	0.17	0.45	20.19	68.74	101.45

Table G1: Plagioclase Chemistries

* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
2 / 6 .	11.03	0.29	0.41	0.00	0.13	0.44	19.97	68.58	100.87
2 / 7 .	11.32	0.15	0.49	0.00	0.15	0.47	19.86	69.02	101.46
Avg B1_2.2	11.30	0.14	0.48	0.01	0.13	0.46	20.01	68.60	101.13
B1_plag 3									
1 / 1 .	0.01	0.03	0.00	0.01	0.20	0.65	0.02	100.83	101.75
1 / 2 .	0.00	0.02	0.01	0.03	0.15	0.67	0.02	100.80	101.71
1 / 3 .	0.00	0.02	0.02	0.02	0.17	0.66	0.00	100.94	101.83
1 / 4 .	0.01	0.03	0.01	0.00	0.14	0.65	0.00	101.09	101.92
1 / 5 .	0.01	0.01	0.01	0.04	0.16	0.66	0.02	100.72	101.63
1 / 6 .	0.02	0.02	0.03	0.01	0.17	0.67	0.01	100.78	101.70
1 / 7 .	0.01	0.03	0.04	0.01	0.22	0.64	0.04	100.67	101.66
1 / 8 .	0.05	0.05	0.24	0.04	0.81	0.62	0.40	97.65	99.86
Avg B1_3.1	0.01	0.03	0.04	0.02	0.25	0.65	0.06	100.43	101.51
2 / 1 . *	9.31	0.20	4.05	0.00	0.14	0.51	23.03	63.99	101.23
2 / 2 .	9.34	0.23	3.99	0.01	0.18	0.52	22.87	64.09	101.23
2 / 3 .	9.26	0.22	4.05	0.01	0.18	0.52	22.95	63.91	101.09
2 / 4 .	9.28	0.23	4.03	0.02	0.11	0.51	23.02	63.94	101.14
2 / 5 .	9.34	0.23	4.00	0.01	0.15	0.54	22.80	63.87	100.94
2 / 6 .	9.25	0.21	3.88	0.03	0.12	0.50	22.86	63.66	100.51
2 / 7 .	9.42	0.23	4.02	0.03	0.10	0.52	22.94	63.86	101.12
2 / 8 .	9.32	0.21	3.98	0.01	0.15	0.49	23.07	63.79	101.03
2 / 9 .	9.35	0.19	3.93	0.03	0.14	0.51	23.06	63.86	101.06
2 / 10 .	9.31	0.18	4.01	0.01	0.13	0.56	22.94	63.79	100.91
Avg B1_3.2	9.32	0.21	3.99	0.02	0.14	0.52	22.95	63.87	101.03
3 / 1 .	11.33	0.08	0.60	0.01	0.08	0.50	20.20	68.48	101.28
3 / 2 .	9.33	0.18	3.94	0.02	0.14	0.50	23.21	64.10	101.42
3 / 3 .	9.39	0.20	4.03	0.02	0.16	0.51	22.98	64.10	101.39
3 / 4 .	9.42	0.20	4.04	0.02	0.11	0.52	23.18	63.63	101.12
3 / 5 .	9.28	0.18	4.05	0.02	0.13	0.52	22.87	63.99	101.04

Table G1: Plagioclase Chemistries

* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
3 / 6 .	9.40	0.22	4.03	0.03	0.18	0.52	23.11	63.72	101.21
3 / 7 .	9.31	0.19	4.04	0.01	0.13	0.53	23.10	63.58	100.89
3 / 8 .	9.28	0.21	4.00	0.03	0.15	0.51	22.84	63.76	100.78
3 / 9 .	9.34	0.20	4.00	0.02	0.09	0.51	23.01	63.98	101.15
3 / 10 .	9.37	0.22	3.93	0.03	0.13	0.49	22.94	63.76	100.87
Avg B1_3.3	9.54	0.19	3.67	0.02	0.13	0.51	22.74	64.31	101.11

Table G2: K-feldspar Chemistries
* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
BR-20									
20_ksp 1									
1 / 1 .	1.42	14.28	0.05	-0.01	0.05	0.61	18.67	64.50	99.58
1 / 2 .	1.73	13.86	0.03	-0.02	0.10	0.61	18.62	64.57	99.52
1 / 3 .	1.00	14.74	0.02	-0.01	0.07	0.58	18.49	64.17	99.08
1 / 4 .	0.88	14.81	0.02	-0.01	0.09	0.64	18.46	63.88	98.78
1 / 5 .	2.13	13.09	0.04	0.01	0.09	0.58	18.62	64.72	99.27
1 / 6 .	1.04	14.86	0.03	-0.01	0.06	0.56	18.56	64.21	99.32
1 / 7 .	0.97	14.80	0.03	-0.01	0.08	0.58	18.54	63.99	98.99
1 / 8 .	2.49	12.72	0.03	-0.01	0.10	0.55	18.80	65.05	99.74
1 / 9 .	1.09	14.68	0.04	0.00	0.10	0.58	18.36	64.37	99.22
1 / 10 .	1.07	14.73	0.04	-0.02	0.10	0.61	18.55	64.27	99.37
Avg 20_1.1	1.38	14.26	0.03	-0.01	0.08	0.59	18.57	64.37	99.28
2 / 1 .	1.10	14.69	-0.02	0.01	0.06	0.54	18.51	64.50	99.40
2 / 2 .	0.66	15.21	-0.01	0.00	0.05	0.51	18.27	64.42	99.11
2 / 3 .	0.80	15.21	0.00	0.01	0.08	0.52	18.49	64.62	99.74
2 / 4 .	0.86	15.11	-0.01	0.00	0.11	0.55	18.23	64.64	99.50
2 / 5 .	0.44	15.69	0.00	-0.01	0.06	0.51	18.56	63.93	99.20
2 / 6 .	0.62	15.34	0.00	-0.01	0.07	0.55	18.43	63.96	98.97
2 / 7 .	0.41	15.72	-0.01	0.00	0.09	0.54	18.27	64.03	99.06
2 / 8 .	0.78	15.24	-0.01	-0.01	0.08	0.58	18.46	64.53	99.67
2 / 9 .	0.64	15.46	0.00	-0.02	0.07	0.55	18.29	64.28	99.29
2 / 10 .	0.58	15.37	0.00	-0.01	0.05	0.54	18.46	64.15	99.15
Avg 20_1.2	0.69	15.30	-0.01	0.00	0.07	0.54	18.40	64.31	99.30
3 / 1 .	0.87	15.02	-0.01	0.01	0.13	0.51	18.33	64.45	99.32
3 / 2 .	0.91	14.82	-0.02	0.00	0.06	0.51	18.26	64.43	98.98
3 / 3 .	0.90	14.96	-0.01	-0.01	0.16	0.54	18.42	64.37	99.36
3 / 4 .	0.91	15.07	0.00	0.01	0.11	0.55	18.38	64.06	99.09
3 / 5 .	1.02	14.88	-0.01	0.00	0.14	0.52	18.52	64.50	99.59
3 / 6 .	1.05	14.81	-0.01	-0.01	0.11	0.52	18.36	64.52	99.37

Table G2: K-feldspar Chemistries
* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
3 / 7 .	1.01	14.92	0.00	-0.02	0.11	0.55	18.46	64.57	99.62
3 / 8 .	0.90	15.01	0.00	-0.02	0.10	0.54	18.30	64.42	99.27
3 / 9 .	0.82	15.05	0.00	0.01	0.10	0.52	18.47	64.26	99.23
3 / 10 .	0.78	15.33	-0.01	-0.01	0.09	0.56	18.37	64.36	99.50
Avg 20_1.3	0.92	14.99	-0.01	0.00	0.11	0.53	18.39	64.40	99.32
20_ksp 2									
1 / 1 .	0.98	14.99	0.03	0.02	0.01	0.55	18.42	64.08	99.09
1 / 2 .	1.36	14.27	0.02	0.02	-0.05	0.57	18.50	64.38	99.12
1 / 3 .	1.49	14.17	0.03	0.01	-0.02	0.56	18.58	64.55	99.40
1 / 4 .	1.62	13.99	0.03	0.02	-0.02	0.54	18.50	64.63	99.32
1 / 5 .	1.05	14.85	0.03	0.01	-0.04	0.55	18.41	63.87	98.77
1 / 6 .	0.97	14.93	0.03	0.01	-0.05	0.56	18.66	64.22	99.38
1 / 7 .	1.13	14.69	0.03	0.02	-0.01	0.55	18.61	64.45	99.48
1 / 8 .	1.13	14.81	0.03	0.00	0.03	0.58	18.60	64.34	99.51
1 / 9 .	1.25	14.29	0.03	0.02	0.02	0.58	18.59	64.44	99.21
1 / 10 .	1.16	14.56	0.03	0.00	-0.03	0.59	18.71	64.40	99.46
Avg 20_2	1.21	14.55	0.03	0.01	-0.02	0.56	18.56	64.34	99.25
20_ksp 3									
1 / 1 .	0.92	14.92	0.01	0.00	0.01	0.50	18.33	64.58	99.27
1 / 2 .	0.98	14.37	0.03	0.01	0.05	0.53	18.41	64.01	98.38
1 / 3 .	1.23	14.64	0.03	-0.01	0.01	0.54	18.64	64.33	99.42
1 / 4 .	1.16	14.73	0.03	-0.01	0.01	0.57	18.67	64.39	99.56
1 / 5 .	1.48	14.08	0.03	0.01	0.01	0.55	18.57	64.48	99.22
1 / 6 .	1.97	12.88	0.16	0.01	0.06	0.54	18.89	65.06	99.56
1 / 7 .	1.42	14.33	0.04	0.01	0.00	0.57	18.60	64.17	99.13
1 / 8 .	1.53	14.09	0.03	0.00	0.03	0.59	18.57	64.35	99.20
1 / 9 .	0.82	14.85	0.02	0.00	0.02	0.56	18.47	63.56	98.31
1 / 10 .	1.19	14.65	0.03	0.01	0.04	0.56	18.58	64.58	99.63
1 / 11 .	1.29	14.20	0.03	0.00	0.01	0.57	18.53	63.94	98.55
1 / 12 .	1.11	14.76	0.04	0.01	0.03	0.55	18.73	64.29	99.52

Table G2: K-feldspar Chemistries
* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
1 / 13 .	1.51	14.03	0.04	0.02	0.00	0.57	18.57	64.39	99.13
1 / 14 .	1.29	14.41	0.03	0.01	0.04	0.54	18.40	64.37	99.08
1 / 15 .	1.49	14.21	0.02	0.02	0.01	0.55	18.58	65.05	99.94
Avg 20_3.1	1.29	14.34	0.04	0.01	0.02	0.55	18.57	64.37	99.19
2 / 1 .	0.96	15.12	0.00	0.00	0.01	0.54	18.36	63.93	98.93
2 / 2 .	0.95	15.04	0.00	-0.01	0.04	0.53	18.45	63.80	98.81
2 / 3 .	0.94	15.03	0.00	-0.01	0.06	0.56	18.34	63.89	98.82
2 / 4 .	0.92	14.99	0.00	0.01	0.04	0.55	18.41	64.20	99.13
2 / 5 .	0.91	15.11	0.01	-0.01	0.03	0.57	18.30	64.15	99.07
2 / 6 .	0.92	14.88	0.01	-0.01	0.00	0.55	18.41	64.21	98.98
2 / 7 .	0.94	15.02	0.01	0.01	0.02	0.56	18.35	64.15	99.05
2 / 8 .	0.95	15.11	0.01	0.02	0.03	0.56	18.41	63.87	98.95
2 / 9 .	0.97	14.91	0.01	0.00	0.02	0.54	18.22	64.02	98.71
2 / 10 .	0.69	14.95	0.01	0.01	0.01	0.51	17.74	61.50	95.43
Avg 20_3.2	0.92	15.01	0.01	0.00	0.03	0.55	18.30	63.77	98.58
3 / 1 .	0.91	15.11	0.00	0.00	0.05	0.52	18.22	64.80	99.60
3 / 2 .	0.90	15.21	-0.01	0.02	0.04	0.56	18.45	64.37	99.55
3 / 3 .	0.87	15.20	0.00	0.00	0.05	0.53	18.31	63.97	98.93
3 / 4 .	0.74	15.26	0.00	0.01	0.06	0.55	18.24	64.26	99.13
3 / 5 .	0.77	15.43	0.01	0.00	0.03	0.55	18.45	64.36	99.59
3 / 6 .	0.62	15.44	0.01	0.01	0.03	0.52	18.31	64.11	99.05
3 / 7 .	0.78	15.43	0.00	0.02	0.00	0.52	18.52	64.55	99.82
3 / 8 .	0.80	15.29	0.01	0.01	0.02	0.54	18.43	64.37	99.47
3 / 9 .	0.92	15.08	0.00	0.03	0.01	0.54	18.31	64.16	99.06
3 / 10 .	0.68	15.43	0.01	0.02	0.04	0.54	18.54	64.21	99.48
Avg 20_3.2	0.80	15.29	0.00	0.01	0.03	0.54	18.38	64.32	99.37
4 / 1 .	1.36	14.33	0.03	0.01	0.05	0.56	18.71	64.32	99.36
4 / 2 .	0.61	15.45	0.03	0.01	-0.03	0.58	18.36	64.19	99.22
4 / 3 .	1.65	13.94	0.03	0.00	0.00	0.55	18.67	64.63	99.48

Table G2: K-feldspar Chemistries
* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
4 / 4 .	1.05	14.83	0.02	0.00	-0.01	0.58	18.54	64.36	99.38
4 / 5 .	1.23	14.61	0.03	0.02	0.06	0.56	18.64	64.56	99.71
4 / 6 .	1.10	14.68	0.02	0.00	0.01	0.54	18.61	64.22	99.18
4 / 7 .	1.11	14.72	0.02	0.01	0.03	0.54	18.51	64.30	99.24
4 / 8 .	1.34	14.48	0.03	0.00	-0.03	0.56	18.48	64.62	99.50
4 / 9 .	1.29	14.36	0.02	0.01	0.01	0.55	18.54	64.21	98.99
4 / 10 .	1.38	14.53	0.03	0.02	-0.04	0.54	18.41	64.51	99.42
Avg 20_3.4	1.21	14.59	0.03	0.01	0.01	0.56	18.55	64.39	99.34
BR-16									
16_ksp 1									
1 / 1 .	1.24	14.48	0.05	0.01	0.00	0.56	18.58	64.36	99.28
1 / 2 .	1.65	13.85	0.05	0.00	0.02	0.59	18.95	64.79	99.91
1 / 3 .	1.32	14.28	0.06	0.02	0.06	0.59	18.84	64.58	99.74
1 / 4 .	0.82	14.87	0.05	0.00	0.07	0.59	18.59	63.58	98.57
1 / 5 .	1.01	14.83	0.09	0.02	0.07	0.58	18.61	64.41	99.61
1 / 6 .	0.94	14.79	0.05	0.00	-0.01	0.61	18.69	64.26	99.36
1 / 7 .	1.28	14.18	0.05	-0.02	0.04	0.57	18.76	64.68	99.57
1 / 8 .	1.52	13.89	0.07	0.00	0.02	0.57	18.64	64.33	99.03
1 / 9 .	1.31	14.17	0.06	0.00	0.03	0.59	18.98	64.63	99.78
1 / 10 .	1.27	14.35	0.05	0.00	0.05	0.58	18.65	64.22	99.18
Avg 16_1	1.24	14.37	0.06	0.00	0.04	0.58	18.73	64.38	99.40
16_ksp 2									
1 / 1 .	0.88	15.11	0.01	0.01	0.07	0.55	18.57	64.84	100.03
1 / 2 .	0.76	15.28	0.00	0.00	0.00	0.55	18.50	64.34	99.43
1 / 3 .	0.82	15.27	0.00	0.01	0.05	0.58	18.70	64.28	99.70
1 / 4 .	0.81	15.09	0.01	0.01	0.02	0.57	18.62	64.48	99.61
1 / 5 .	0.81	15.24	0.00	-0.01	0.06	0.55	18.61	64.07	99.34
1 / 6 .	0.82	15.28	0.01	0.01	0.06	0.55	18.60	64.54	99.86

Table G2: K-feldspar Chemistries
* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
1 / 7 .	0.81	15.41	-0.01	0.01	0.04	0.58	18.46	64.17	99.48
1 / 8 .	0.77	15.37	0.00	0.02	0.05	0.58	18.84	63.94	99.58
1 / 9 .	0.73	15.33	0.01	0.02	0.09	0.56	18.33	64.26	99.33
1 / 10 .	0.73	15.42	0.00	0.02	0.07	0.56	18.50	64.51	99.81
Avg 16_2	0.79	15.28	0.00	0.01	0.05	0.56	18.57	64.34	99.62
16_ksp 3									
1 / 1 .	1.49	14.26	0.02	-0.01	-0.01	0.58	18.79	64.41	99.55
1 / 2 .	1.45	14.19	0.04	-0.03	-0.02	0.58	18.56	64.53	99.35
1 / 3 .	1.04	14.65	0.02	-0.01	0.01	0.58	18.59	63.99	98.88
1 / 4 .	1.28	14.49	0.04	-0.03	0.00	0.59	18.69	64.43	99.52
1 / 5 .	1.13	14.63	0.03	-0.04	0.02	0.59	18.57	64.14	99.12
1 / 6 .	1.11	14.53	0.04	-0.05	-0.01	0.61	18.41	63.97	98.67
1 / 7 .	1.26	14.47	0.04	-0.05	0.01	0.58	18.62	64.25	99.22
1 / 8 .	1.38	14.28	0.03	-0.03	0.00	0.58	18.72	64.25	99.24
1 / 9 .	2.22	13.24	0.06	-0.02	0.05	0.58	18.56	64.66	99.37
1 / 10 .	1.18	14.79	0.03	-0.04	0.00	0.59	18.72	64.47	99.78
Avg 16_3	1.35	14.35	0.03	-0.03	0.01	0.59	18.62	64.31	99.24
16_ksp 4									
1 / 1 .	1.34	14.34	0.01	0.00	0.04	0.56	18.71	64.08	99.08
1 / 2 .	1.26	14.47	0.02	0.02	-0.02	0.58	18.48	64.27	99.10
1 / 3 .	1.51	14.07	0.03	-0.01	0.03	0.56	18.72	64.36	99.27
1 / 4 .	1.42	14.32	0.03	0.02	0.00	0.58	18.55	64.62	99.55
1 / 5 .	1.01	14.85	0.02	0.02	-0.02	0.59	18.51	64.10	99.10
1 / 6 .	2.40	12.86	0.04	0.01	-0.01	0.59	18.65	64.61	99.16
1 / 7 .	0.71	15.01	0.01	0.01	-0.01	0.54	18.50	64.20	98.98
1 / 8 .	1.31	14.29	0.03	0.02	0.02	0.58	18.74	64.60	99.58
1 / 9 .	1.25	14.57	0.04	0.00	0.02	0.64	18.66	63.97	99.15
1 / 10 .	1.96	13.35	0.03	0.02	0.00	0.56	18.80	64.82	99.54
Avg 16_4	1.42	14.21	0.03	0.01	0.00	0.58	18.63	64.36	99.24

Table G2: K-feldspar Chemistries
* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
BR-14 B4									
B4_ksp 1									
1 / 1 .	1.00	14.98	-0.01	0.00	0.04	0.58	18.75	64.51	99.86
1 / 2 .	1.18	15.04	0.02	0.01	0.04	0.58	18.65	64.41	99.95
1 / 3 .	1.19	14.77	0.00	0.00	0.02	0.59	18.72	64.80	100.10
1 / 4 .	1.52	14.29	0.01	-0.01	0.02	0.59	18.93	64.92	100.29
1 / 5 .	1.49	14.24	0.00	-0.01	0.01	0.56	18.74	64.18	99.22
1 / 6 .	1.25	14.66	0.01	0.00	0.02	0.57	18.71	64.76	99.97
1 / 7 .	1.25	14.70	0.01	0.00	0.01	0.57	18.64	64.49	99.68
1 / 8 .	1.22	14.67	0.02	-0.01	0.03	0.60	18.85	64.77	100.15
1 / 9 .	1.26	14.57	0.00	0.00	0.02	0.58	18.58	64.82	99.84
1 / 10 .	1.23	14.77	0.00	0.00	0.02	0.56	18.69	64.26	99.53
Avg B4_1.1	1.26	14.67	0.01	0.00	0.02	0.58	18.73	64.59	99.85
2 / 1 .	0.79	15.14	0.02	0.01	0.06	0.61	18.66	64.29	99.57
2 / 2 .	1.22	14.81	0.01	0.01	0.04	0.60	18.76	64.53	99.96
2 / 3 .	1.26	14.68	0.01	0.02	-0.01	0.59	18.56	64.51	99.61
2 / 4 .	1.10	14.82	0.03	0.01	0.03	0.61	18.69	64.41	99.69
2 / 5 .	1.35	14.42	0.02	0.01	0.01	0.60	18.70	64.32	99.43
2 / 6 .	1.14	14.79	0.02	0.01	0.05	0.61	18.60	64.36	99.57
2 / 7 .	1.25	14.61	0.03	-0.01	0.03	0.59	18.80	64.94	100.25
2 / 8 .	1.58	14.18	0.02	0.01	0.02	0.59	18.77	64.17	99.33
2 / 9 .	1.17	15.02	0.03	0.00	0.08	0.59	18.66	64.25	99.81
2 / 10 .	1.23	14.95	0.01	-0.01	0.04	0.59	18.63	63.98	99.43
Avg B4_1.2	1.21	14.74	0.02	0.00	0.03	0.60	18.68	64.38	99.66
B4_ksp 2									
1 / 1 .	1.74	13.93	0.08	-0.01	0.01	0.62	18.88	64.38	99.66
1 / 2 .	1.22	14.53	0.07	-0.02	0.04	0.61	18.82	64.43	99.72
1 / 3 .	2.07	13.30	0.08	0.00	0.04	0.61	18.80	64.70	99.62

Table G2: K-feldspar Chemistries
* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
1 / 4 .	1.22	14.58	0.05	-0.02	0.07	0.61	18.84	64.38	99.75
1 / 5 .	1.30	14.45	0.05	-0.02	0.07	0.62	18.61	64.20	99.31
1 / 6 .	1.25	14.66	0.07	-0.01	0.05	0.61	18.73	64.64	100.00
1 / 7 .	1.66	13.92	0.06	-0.02	0.03	0.64	18.85	64.67	99.83
1 / 8 .	1.48	14.13	0.07	-0.01	0.05	0.61	19.04	64.65	100.02
1 / 9 .	2.18	13.18	0.09	0.00	0.02	0.63	18.86	64.55	99.51
1 / 10 .	1.26	14.47	0.07	-0.01	0.08	0.61	18.71	64.09	99.29
Avg B4_2	1.54	14.11	0.07	-0.01	0.05	0.62	18.81	64.47	99.66
B4_ksp 3									
1 / 1 .	1.12	14.74	0.01	-0.01	0.08	0.56	18.54	64.55	99.60
1 / 2 .	1.23	14.70	0.00	-0.02	0.07	0.57	18.83	64.54	99.95
1 / 3 .	1.21	14.48	0.01	-0.02	0.02	0.55	18.76	64.69	99.73
1 / 4 .	1.23	14.77	0.02	0.00	0.07	0.57	18.70	64.39	99.76
1 / 5 .	1.24	14.54	0.01	0.00	0.10	0.58	18.78	64.56	99.80
1 / 6 .	1.23	14.62	0.01	0.01	0.09	0.55	18.74	64.53	99.79
1 / 7 .	1.27	14.40	0.02	0.01	0.03	0.55	18.70	64.58	99.55
1 / 8 .	1.24	14.66	0.02	-0.01	0.05	0.58	18.96	64.54	100.04
1 / 9 .	1.22	14.62	0.00	-0.01	0.05	0.57	18.95	64.63	100.03
1 / 10 .	1.10	14.72	0.02	0.00	0.11	0.56	18.45	64.55	99.50
Avg B4_3	1.21	14.63	0.01	0.00	0.07	0.56	18.74	64.56	99.77
B4_ksp 4									
1 / 1 .	0.99	15.01	0.02	0.00	0.06	0.60	18.57	64.62	99.88
1 / 2 .	1.15	14.64	0.01	0.00	0.01	0.59	18.55	64.45	99.41
1 / 3 .	1.08	14.90	0.01	-0.01	0.06	0.60	18.53	64.43	99.61
1 / 4 .	9.29	0.05	3.83	-0.01	0.06	0.47	22.79	64.13	100.62
1 / 5 .	9.45	0.06	3.88	-0.01	0.05	0.49	23.08	64.24	101.25
1 / 6 .	9.46	0.04	3.87	0.00	0.07	0.48	22.73	64.33	100.99
1 / 7 .	9.85	0.01	3.35	-0.01	0.04	0.48	22.42	65.00	101.16
1 / 8 .	1.19	14.72	0.00	0.00	0.06	0.56	18.44	64.93	99.89
1 / 9 .	1.14	14.61	-0.01	0.01	0.03	0.56	18.55	65.07	99.96

Table G2: K-feldspar Chemistries
* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
1 / 10 .	1.09	14.67	0.00	-0.01	0.05	0.59	18.65	64.65	99.70
Avg B4_4.1	4.47	8.87	1.50	-0.01	0.05	0.54	20.23	64.58	100.24
2 / 1 .	1.32	14.25	0.01	0.01	0.03	0.57	18.62	64.36	99.18
2 / 2 .	1.36	14.38	0.01	0.00	0.03	0.59	18.70	64.50	99.57
2 / 3 .	1.17	14.56	0.02	-0.01	0.04	0.58	18.73	64.51	99.60
2 / 4 .	1.31	14.53	0.02	0.00	0.08	0.59	18.54	64.41	99.48
2 / 5 .	1.27	14.45	0.03	-0.01	0.06	0.56	18.75	64.52	99.63
2 / 6 .	1.40	14.27	0.02	0.01	0.05	0.57	18.84	64.73	99.89
2 / 7 .	1.51	14.18	0.03	0.00	0.06	0.60	18.78	64.23	99.39
2 / 8 .	1.82	13.75	0.03	0.00	0.09	0.59	18.80	64.79	99.87
2 / 9 .	1.16	14.62	0.00	0.00	0.02	0.60	18.64	64.72	99.77
2 / 10 .	0.83	15.10	0.00	0.00	0.06	0.57	18.57	64.13	99.25
Avg B4_4.2	1.32	14.41	0.02	0.00	0.05	0.58	18.70	64.49	99.56
B4_ksp 5									
1 / 1 .	1.27	14.57	0.02	0.00	0.05	0.58	18.66	64.57	99.74
1 / 2 .	1.46	14.33	0.04	-0.01	0.08	0.63	18.72	64.49	99.74
1 / 3 .	1.46	14.14	0.04	0.00	0.03	0.60	18.71	64.22	99.20
1 / 4 .	1.35	14.45	0.04	0.01	0.08	0.60	18.63	64.54	99.71
1 / 5 .	1.39	14.46	0.05	-0.01	0.00	0.58	18.67	64.19	99.33
1 / 6 .	1.33	14.32	0.05	0.00	0.08	0.58	18.66	64.55	99.56
1 / 7 .	0.57	15.30	0.01	-0.01	0.06	0.54	18.26	63.86	98.58
1 / 8 .	0.65	15.18	0.02	0.00	0.18	0.53	18.11	64.24	98.91
1 / 9 .	1.33	14.39	0.01	-0.01	0.07	0.54	18.67	64.91	99.92
1 / 10 .	1.12	14.99	0.01	0.00	0.10	0.58	18.62	64.54	99.97
Avg B4_5.1	1.19	14.61	0.03	0.00	0.07	0.58	18.57	64.41	99.46
2 / 1 .	1.12	14.89	0.01	0.00	0.07	0.56	18.73	63.96	99.34
2 / 2 .	1.22	14.72	0.01	0.01	0.06	0.58	18.55	64.45	99.61
2 / 3 .	0.88	15.08	0.02	0.00	0.09	0.58	18.53	64.01	99.20
2 / 4 .	0.88	15.07	0.01	0.02	0.09	0.56	18.69	64.24	99.56

Table G2: K-feldspar Chemistries
* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
2 / 5 .	0.96	15.11	0.03	-0.01	0.06	0.57	18.82	64.29	99.84
2 / 6 .	1.73	14.19	0.03	0.01	0.06	0.59	18.68	64.61	99.91
2 / 7 .	1.29	14.52	0.03	0.00	0.08	0.58	18.53	64.22	99.25
2 / 8 .	2.08	13.79	0.02	0.00	0.08	0.60	18.67	64.68	99.93
2 / 9 .	1.30	14.65	0.02	-0.01	0.09	0.58	18.82	64.03	99.50
2 / 10 .	2.02	13.49	0.02	0.01	0.09	0.59	18.75	64.12	99.08
Avg B4_5.2	1.35	14.55	0.02	0.00	0.08	0.58	18.68	64.26	99.52
3 / 1 .	0.56	15.19	0.02	0.02	0.07	0.50	17.98	64.72	99.06
3 / 2 .	1.07	15.16	0.00	0.00	0.04	0.53	18.42	63.97	99.20
3 / 3 .	1.08	14.98	0.01	-0.02	0.12	0.54	18.52	64.07	99.32
3 / 4 .	1.04	14.97	0.00	-0.01	0.03	0.55	18.58	64.36	99.53
3 / 5 .	1.06	14.89	-0.01	0.00	0.03	0.55	18.51	64.45	99.49
3 / 6 .	1.12	14.92	0.01	0.01	0.02	0.52	18.51	64.16	99.26
3 / 7 .	1.04	14.75	0.00	0.00	0.04	0.54	18.45	64.75	99.57
3 / 8 .	1.07	14.75	0.02	-0.01	0.07	0.54	18.67	64.36	99.49
3 / 9 .	1.06	14.71	0.00	0.01	0.13	0.54	18.53	64.29	99.26
3 / 10 .	1.05	14.90	0.01	0.01	0.12	0.56	18.53	63.95	99.12
Avg B4_5.3	1.02	14.92	0.01	0.00	0.07	0.54	18.47	64.31	99.33
BR-14 B1									
B1_ksp 1									
1 / 1 .	0.67	14.83	0.03	-0.01	0.04	0.49	18.40	63.90	98.36
1 / 2 .	0.88	13.73	0.01	-0.02	0.06	0.51	17.24	65.78	98.21
1 / 3 .	0.71	14.32	0.03	0.00	0.04	0.50	17.41	65.59	98.60
1 / 4 .	0.50	6.17	-0.01	-0.04	0.06	0.56	7.77	83.16	98.22
Avg B1_1.1	0.69	12.26	0.02	-0.02	0.05	0.52	15.21	69.61	98.33
2 / 1 .	9.51	0.07	3.62	-0.03	0.04	0.50	22.53	64.42	100.68
2 / 2 .	11.48	0.03	0.66	-0.04	0.02	0.44	20.18	68.47	101.28
2 / 3 .	1.00	14.68	0.01	0.00	0.10	0.52	18.60	64.25	99.16

Table G2: K-feldspar Chemistries

* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
2 / 4 .	1.39	14.33	0.01	-0.01	0.06	0.51	18.42	64.37	99.08
2 / 5 .	1.32	14.37	0.00	-0.01	0.08	0.59	18.79	64.42	99.57
2 / 6 .	1.22	14.58	0.01	-0.01	0.10	0.56	18.44	64.23	99.15
2 / 7 .	1.18	14.53	0.01	-0.02	0.11	0.58	18.80	64.44	99.65
2 / 8 .	1.26	14.46	0.02	-0.01	0.15	0.55	18.77	64.32	99.53
2 / 9 .	1.04	14.83	0.00	-0.01	0.19	0.57	18.62	64.21	99.47
2 / 10 .	0.84	15.14	0.01	-0.02	0.32	0.51	18.48	64.19	99.50
Avg B1_1.2	3.02	11.70	0.43	-0.02	0.12	0.53	19.16	64.73	99.69
3 / 1 .	1.18	14.64	0.02	0.00	0.09	0.54	18.50	64.33	99.29
3 / 2 .	1.19	14.49	0.00	0.00	0.10	0.54	18.68	64.13	99.13
3 / 3 .	1.20	14.59	0.00	-0.01	0.11	0.55	18.71	64.29	99.45
3 / 4 .	1.07	14.74	0.01	-0.02	0.08	0.56	18.73	64.45	99.64
3 / 5 .	1.17	14.65	0.00	-0.02	0.13	0.56	18.80	64.26	99.59
3 / 6 .	1.83	13.19	0.02	-0.03	0.07	0.55	18.55	64.37	98.58
3 / 7 .	1.44	14.25	0.01	-0.01	0.08	0.54	18.62	64.02	98.97
3 / 8 .	1.36	14.42	0.01	-0.01	0.10	0.52	18.52	64.55	99.48
3 / 9 .	1.24	14.52	0.01	-0.02	0.08	0.51	18.53	64.41	99.30
3 / 10 .	1.88	13.41	0.03	-0.01	0.06	0.54	18.46	64.57	98.96
Avg B1_1.3	1.36	14.29	0.01	-0.01	0.09	0.54	18.61	64.34	99.23
4 / 1 .	1.08	14.63	0.03	0.00	0.08	0.57	18.61	64.02	99.01
4 / 2 .	1.13	14.87	0.01	-0.02	0.13	0.55	18.61	64.36	99.67
4 / 3 .	1.14	14.73	0.01	-0.02	0.08	0.55	18.68	63.98	99.18
4 / 4 .	1.13	14.59	0.01	-0.01	0.15	0.56	18.42	64.14	98.99
4 / 5 .	1.23	14.57	0.00	-0.01	0.07	0.55	18.53	64.50	99.46
4 / 6 .	1.12	14.74	0.01	-0.01	0.11	0.55	18.53	64.52	99.57
4 / 7 .	1.23	14.75	0.02	-0.03	0.11	0.54	18.61	64.23	99.48
4 / 8 .	1.10	14.79	0.01	-0.01	0.05	0.56	18.57	64.50	99.59
4 / 9 .	1.15	14.79	0.02	-0.02	0.08	0.56	18.36	64.42	99.38
4 / 10 .	1.22	14.58	0.02	-0.03	0.06	0.53	18.49	64.35	99.24
Avg B1_1.4	1.15	14.70	0.02	-0.02	0.09	0.55	18.54	64.30	99.34

Table G2: K-feldspar Chemistries

* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
B1_ksp 2									
1 / 1 .	1.30	14.35	0.03	0.00	0.01	0.60	18.51	63.51	98.30
1 / 2 .	1.26	14.51	0.01	-0.01	0.03	0.61	18.55	64.40	99.37
1 / 3 .	1.33	14.50	0.02	-0.03	0.00	0.58	18.67	64.18	99.28
1 / 4 .	1.27	14.50	0.01	-0.01	0.06	0.62	18.72	64.16	99.34
1 / 5 .	1.27	14.31	0.01	-0.01	0.02	0.58	18.56	64.12	98.87
1 / 6 .	1.26	14.63	0.02	-0.01	0.02	0.58	18.68	64.37	99.55
1 / 7 .	1.29	14.58	0.00	-0.02	0.02	0.62	18.61	64.20	99.31
1 / 8 .	1.28	14.38	0.02	-0.03	0.00	0.61	18.65	64.10	99.05
1 / 9 .	1.25	14.56	0.01	-0.02	0.03	0.56	18.60	63.98	99.00
1 / 10 .	1.23	14.50	0.01	0.00	0.04	0.59	18.63	64.09	99.09
Avg B1_2.1	1.27	14.48	0.01	-0.01	0.02	0.60	18.62	64.11	99.10
2 / 1 . *	10.27	0.69	1.02	-0.04	-0.01	0.45	19.58	64.34	96.37
2 / 2 .	1.31	14.54	0.02	-0.03	0.00	0.58	18.73	64.28	99.46
2 / 3 .	1.32	14.41	0.01	-0.02	-0.01	0.59	18.54	64.00	98.88
2 / 4 .	1.37	14.32	0.02	-0.02	-0.01	0.60	18.72	64.31	99.34
2 / 5 .	1.50	14.13	0.03	-0.01	0.02	0.57	18.70	64.50	99.44
2 / 6 .	1.28	14.32	0.03	-0.02	0.00	0.57	18.61	63.98	98.78
2 / 7 .	1.30	14.22	0.04	-0.02	0.04	0.59	18.76	64.41	99.36
2 / 8 .	1.30	14.35	0.02	-0.03	0.01	0.59	18.70	64.11	99.07
2 / 9 .	1.33	14.37	0.02	-0.01	0.03	0.57	18.70	64.15	99.17
2 / 10 .	1.34	14.45	0.02	-0.02	0.08	0.59	18.78	64.24	99.51
2 / 11 .	1.26	14.55	0.03	-0.02	0.08	0.59	18.68	64.03	99.21
2 / 12 .	1.23	14.37	0.02	-0.02	0.00	0.61	18.58	64.21	99.01
2 / 13 .	1.27	14.44	0.04	-0.01	0.05	0.60	18.47	64.13	99.01
2 / 14 .	1.26	14.50	0.02	-0.01	0.09	0.62	18.56	64.20	99.26
2 / 15 . *	1.14	12.47	0.12	0.03	3.62	0.55	17.44	59.42	94.79
2 / 16 .	1.30	14.31	0.02	-0.01	0.04	0.58	18.73	64.42	99.39
2 / 17 .	1.30	14.41	0.02	-0.01	0.01	0.57	18.81	64.02	99.14
2 / 18 .	1.29	14.45	0.03	-0.02	0.07	0.60	18.62	64.50	99.56

Table G2: K-feldspar Chemistries
* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
2 / 19 .	1.30	14.35	0.03	-0.01	0.07	0.59	18.39	64.46	99.19
2 / 20 .	1.27	14.52	0.01	-0.02	0.06	0.58	18.71	64.16	99.30
Avg B1_2.2	1.31	14.39	0.02	-0.02	0.04	0.59	18.65	64.23	99.21
3 / 1 .	1.05	14.71	0.02	-0.01	0.04	0.61	18.52	64.18	99.13
3 / 2 .	1.04	14.83	0.00	-0.02	-0.05	0.58	18.69	64.16	99.29
3 / 3 .	1.00	14.82	0.01	-0.02	-0.03	0.56	18.71	64.15	99.24
3 / 4 .	1.17	14.53	0.02	-0.03	0.01	0.56	18.76	63.98	99.04
3 / 5 .	1.07	14.88	0.00	-0.02	0.00	0.54	18.57	64.25	99.32
3 / 6 .	0.89	14.84	0.01	-0.03	0.02	0.55	18.33	63.93	98.56
3 / 7 .	0.87	14.91	0.00	-0.01	0.05	0.52	18.46	64.10	98.91
3 / 8 .	0.89	14.86	0.01	-0.01	0.06	0.54	18.37	63.98	98.71
3 / 9 .	0.74	15.04	0.01	-0.01	0.04	0.51	18.28	64.05	98.68
3 / 10 . *	0.55	15.22	0.00	-0.01	0.05	0.53	18.17	63.14	97.66
Avg B1_2.3	0.97	14.82	0.01	-0.02	0.02	0.55	18.52	64.09	98.96
B1_ksp 3									
1 / 1 .	1.03	14.62	0.02	-0.02	0.12	0.59	18.54	64.07	98.99
1 / 2 .	1.27	14.30	0.02	0.00	0.03	0.60	18.74	64.35	99.31
1 / 3 .	1.39	14.14	0.02	0.00	0.02	0.59	19.14	63.66	98.97
1 / 4 .	1.47	13.95	0.01	-0.02	0.07	0.58	18.60	64.50	99.19
1 / 5 .	0.92	14.83	0.00	-0.01	-0.02	0.61	18.71	63.98	99.06
1 / 6 .	1.26	14.50	0.02	-0.02	0.01	0.60	18.51	63.92	98.82
1 / 7 .	1.15	14.45	0.01	-0.01	0.00	0.60	18.57	64.08	98.86
1 / 8 .	1.33	14.34	0.00	-0.01	-0.04	0.59	18.68	64.32	99.26
1 / 9 .	1.12	14.85	0.02	-0.03	0.02	0.62	18.69	64.26	99.58
1 / 10 .	1.33	14.31	0.00	-0.02	-0.02	0.60	18.62	64.21	99.07
Avg B1_3.1	1.23	14.43	0.01	-0.01	0.02	0.60	18.68	64.13	99.09
2 / 1 .	1.30	14.31	0.03	-0.01	0.03	0.62	18.61	64.19	99.09
2 / 2 .	1.27	14.36	0.02	-0.03	0.00	0.61	18.66	64.06	98.98
2 / 3 .	1.27	14.46	0.01	-0.02	0.02	0.60	18.56	64.36	99.29

Table G2: K-feldspar Chemistries
* Analysis not used in mineral chemistry calculation

Wt % oxide	Na_2O	K_2O	CaO	MnO	FeO	SrO	Al_2O_3	SiO_2	Total
2 / 4 .	1.25	14.61	0.03	-0.01	0.02	0.60	18.65	63.95	99.10
2 / 5 .	1.21	14.36	0.02	-0.01	0.01	0.61	18.54	63.77	98.52
2 / 6 .	1.23	14.51	0.03	-0.03	0.01	0.60	18.76	64.09	99.25
2 / 7 .	1.19	14.50	0.03	0.00	0.01	0.62	18.54	63.61	98.51
2 / 8 .	1.20	14.57	0.03	-0.01	0.04	0.60	18.58	64.02	99.02
2 / 9 .	1.24	14.40	0.03	-0.01	-0.02	0.59	18.58	64.10	98.94
2 / 10 .	1.27	14.44	0.03	0.00	0.02	0.58	18.78	64.00	99.11
Avg B1_3.2	1.24	14.45	0.03	-0.01	0.01	0.60	18.63	64.02	98.97
3 / 1 .	1.38	14.48	0.00	-0.01	0.09	0.57	18.55	64.47	99.54
3 / 2 .	1.41	14.57	0.01	-0.01	0.08	0.54	18.54	64.20	99.35
3 / 3 .	1.24	14.47	0.01	-0.01	0.08	0.57	18.48	64.14	98.98
3 / 4 .	1.13	14.81	0.00	0.01	0.08	0.59	18.68	64.01	99.31
3 / 5 .	1.22	14.51	0.02	-0.02	-0.01	0.59	18.49	64.38	99.21
3 / 6 .	1.29	14.68	0.01	-0.01	0.03	0.57	18.56	63.82	98.97
3 / 7 .	1.24	14.70	0.01	-0.02	0.03	0.56	18.58	64.24	99.37
3 / 8 .	1.29	14.76	0.01	-0.01	0.01	0.55	18.62	64.08	99.33
3 / 9 .	1.26	14.70	0.01	-0.01	0.05	0.57	18.67	64.29	99.55
3 / 10 .	1.00	14.78	0.01	0.00	-0.04	0.58	18.64	64.16	99.18
Avg B1_3.3	1.25	14.65	0.01	-0.01	0.04	0.57	18.58	64.18	99.26
4 / 1 . *	1.07	14.65	-0.01	0.00	-0.01	0.57	17.74	63.87	97.90
4 / 2 .	1.18	14.79	0.00	0.00	-0.04	0.52	18.41	64.02	98.91
4 / 3 .	1.07	14.83	-0.01	-0.01	0.01	0.55	18.43	63.75	98.64
4 / 4 .	1.15	14.70	0.01	-0.04	0.03	0.55	18.48	64.10	99.03
4 / 5 .	1.11	14.75	0.01	-0.01	0.03	0.53	18.41	64.06	98.90
4 / 6 .	1.07	14.98	-0.01	-0.02	0.01	0.55	18.45	63.73	98.80
4 / 7 .	1.02	14.88	0.00	-0.01	0.03	0.54	18.53	64.23	99.23
4 / 8 .	1.01	15.01	0.00	-0.01	-0.03	0.53	18.35	63.79	98.70
4 / 9 .	1.02	14.85	0.00	-0.02	0.08	0.53	18.48	64.24	99.20
4 / 10 .	0.91	15.02	0.01	-0.02	0.01	0.54	18.64	63.73	98.85
Avg B1_3.4	1.06	14.87	0.00	-0.02	0.01	0.54	18.46	63.96	98.89

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
BR-20																	
20_bt 1																	
1 / 1 .	2.01	0.12	2.89	0.12	9.52	12.00	0.02	0.37	19.68	0.52	13.28	0.04	37.61	3.71	101.90	0.87	101.03
1 / 2 .	1.98	0.13	2.89	0.10	9.53	11.92	0.04	0.30	19.79	0.67	13.27	0.02	37.35	3.90	101.92	0.86	101.06
1 / 3 .	1.96	0.11	2.90	0.12	9.56	11.76	0.02	0.33	19.36	0.54	13.29	0.04	37.50	3.76	101.24	0.85	100.38
1 / 4 .	2.07	0.11	2.85	0.12	9.61	12.02	0.02	0.38	19.61	0.65	13.24	0.03	37.32	3.79	101.82	0.90	100.93
1 / 5 .	1.94	0.13	2.89	0.15	9.39	11.83	0.04	0.40	19.43	0.57	13.18	0.04	37.32	3.78	101.09	0.85	100.24
1 / 6 .	1.96	0.14	2.89	0.14	9.42	11.95	0.01	0.40	19.58	0.49	13.14	0.06	37.48	3.76	101.43	0.86	100.57
1 / 7 .	2.03	0.13	2.85	0.13	9.54	11.95	0.01	0.34	19.73	0.46	13.19	0.04	37.22	3.66	101.27	0.88	100.39
1 / 8 .	1.95	0.12	2.91	0.10	9.48	11.94	0.04	0.40	19.55	0.46	13.23	0.02	37.45	3.70	101.34	0.85	100.49
1 / 9 .	2.02	0.13	2.86	0.13	9.45	12.05	0.02	0.36	19.64	0.52	13.25	0.01	37.42	3.60	101.47	0.88	100.59
1 / 10 .	2.03	0.12	2.86	0.10	9.30	11.97	0.03	0.41	19.73	0.50	13.15	0.05	37.31	3.90	101.45	0.88	100.57
Avg 20_1	2.00	0.12	2.88	0.12	9.48	11.94	0.02	0.37	19.61	0.54	13.22	0.04	37.40	3.76	101.49	0.87	100.62
20_bt 2																	
1 / 1 .	1.99	0.11	2.89	0.05	9.54	11.46	0.01	0.46	20.11	0.25	13.10	0.03	37.71	3.92	101.61	0.86	100.75
1 / 2 .	1.86	0.11	2.95	0.06	9.58	11.52	0.00	0.39	20.05	0.35	13.11	-0.02	37.37	3.96	101.31	0.81	100.50
1 / 3 .	1.92	0.14	2.90	0.07	9.52	11.49	0.00	0.41	19.90	0.20	13.10	0.02	37.52	3.90	101.09	0.84	100.25
1 / 4 .	2.04	0.10	2.86	0.06	9.57	11.43	-0.01	0.37	20.08	0.29	13.07	0.03	37.49	4.07	101.47	0.88	100.59
1 / 5 .	1.87	0.11	2.95	0.05	9.55	11.50	0.01	0.36	20.14	0.38	13.15	0.02	37.40	4.00	101.47	0.81	100.66
1 / 6 .	2.00	0.11	2.90	0.05	9.71	11.51	0.00	0.35	20.28	0.39	13.08	-0.01	37.71	4.03	102.11	0.87	101.24
1 / 7 .	1.93	0.10	2.89	0.08	9.56	11.36	0.00	0.35	20.07	0.26	13.01	0.01	37.36	3.81	100.79	0.84	99.96
1 / 8 .	1.84	0.12	2.95	0.06	9.51	11.48	0.02	0.41	20.03	0.20	13.03	0.01	37.42	3.98	101.08	0.80	100.27
1 / 9 .	1.68	0.09	3.00	0.03	8.22	11.50	0.02	0.35	21.82	0.31	13.55	0.04	36.20	3.48	100.29	0.73	99.56
1 / 10 .	1.92	0.10	2.91	0.02	9.35	11.60	0.01	0.41	19.98	0.31	13.18	0.02	37.28	3.82	100.90	0.83	100.07
Avg 20_2.1	1.90	0.11	2.92	0.05	9.41	11.48	0.01	0.39	20.25	0.29	13.14	0.01	37.35	3.90	101.21	0.83	100.38
2 / 1 .	1.94	0.11	2.89	0.07	9.51	11.51	0.00	0.37	19.95	0.35	13.07	-0.05	37.39	3.81	100.97	0.84	100.13
2 / 2 .	2.04	0.12	2.87	0.03	9.65	11.44	-0.01	0.40	20.21	0.35	13.10	0.01	37.63	3.93	101.78	0.88	100.89
2 / 3 .	1.95	0.13	2.92	0.03	9.58	11.45	-0.01	0.40	20.39	0.36	13.15	0.03	37.67	3.87	101.92	0.85	101.07
2 / 4 .	1.98	0.10	2.90	0.04	9.69	11.53	-0.01	0.39	20.24	0.32	13.16	-0.01	37.51	3.86	101.70	0.86	100.84
2 / 5 .	1.93	0.13	2.90	0.07	9.50	11.39	0.01	0.41	20.45	0.35	13.06	-0.02	37.31	3.99	101.50	0.84	100.66

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
2 / 6 .	2.00	0.12	2.89	0.06	9.54	11.49	-0.02	0.35	20.41	0.35	13.17	0.02	37.52	3.91	101.81	0.87	100.95
2 / 7 .	1.97	0.13	2.90	0.05	9.55	11.59	0.00	0.37	20.15	0.31	13.24	0.01	37.58	3.79	101.63	0.86	100.77
2 / 8 .	1.99	0.12	2.86	0.06	9.47	11.51	0.03	0.34	19.93	0.15	13.04	0.00	37.32	3.89	100.72	0.87	99.85
2 / 9 .	2.06	0.11	2.87	0.04	9.67	11.63	-0.02	0.46	20.34	0.35	13.10	0.04	37.74	3.95	102.36	0.89	101.46
2 / 10 .	1.89	0.11	2.93	0.04	9.58	11.56	-0.01	0.41	20.40	0.36	13.17	0.00	37.30	3.75	101.51	0.82	100.69
Avg 20_2.2	1.97	0.12	2.89	0.05	9.57	11.51	-0.01	0.39	20.25	0.32	13.13	0.00	37.50	3.88	101.57	0.86	100.71
20_bt 3																	
1 / 1 .	1.94	0.12	2.92	0.05	9.67	11.38	0.03	0.23	19.42	0.45	13.88	0.02	37.70	3.75	101.56	0.85	100.71
1 / 2 .	1.97	0.12	2.89	0.09	9.67	11.27	0.02	0.20	19.33	0.33	13.87	-0.04	37.41	3.87	101.04	0.86	100.19
1 / 3 .	1.84	0.10	2.97	0.05	9.62	11.25	0.01	0.22	19.70	0.42	13.80	-0.01	37.50	3.95	101.44	0.80	100.64
1 / 4 .	1.78	0.11	3.00	0.05	9.56	11.39	0.01	0.25	19.43	0.36	13.91	0.02	37.55	3.81	101.24	0.78	100.46
1 / 5 .	1.86	0.11	2.96	0.05	9.63	11.25	0.02	0.18	19.45	0.46	13.95	-0.02	37.62	3.72	101.28	0.81	100.47
1 / 6 .	1.85	0.12	2.98	0.04	9.71	11.31	0.01	0.23	19.47	0.54	13.88	0.06	37.69	3.83	101.73	0.80	100.92
1 / 7 .	1.91	0.11	2.95	0.05	9.73	11.26	0.00	0.17	19.59	0.45	13.89	0.00	37.59	4.04	101.74	0.83	100.91
1 / 8 .	1.90	0.12	2.94	0.06	9.58	11.22	0.01	0.27	19.36	0.43	13.88	-0.01	37.58	3.92	101.26	0.83	100.43
1 / 9 .	1.87	0.11	2.96	0.07	9.66	11.32	0.00	0.26	19.76	0.41	13.93	-0.02	37.49	3.81	101.67	0.81	100.86
1 / 10 .	1.95	0.11	2.94	0.05	9.76	11.34	0.01	0.25	19.66	0.43	13.88	0.00	37.55	4.13	102.07	0.85	101.22
Avg 20_3	1.89	0.11	2.95	0.06	9.66	11.30	0.01	0.23	19.52	0.43	13.89	0.00	37.57	3.88	101.49	0.82	100.67
20_bt 4																	
1 / 1 . *	1.98	0.11	2.37	0.07	9.44	0.09	-0.01	0.32	19.72	0.54	12.85	-0.04	36.74	4.10	88.33	0.86	87.47
1 / 2 .	2.06	0.14	2.84	0.07	9.56	11.50	0.00	0.33	19.57	0.32	13.34	-0.05	37.52	4.13	101.39	0.90	100.49
1 / 3 .	1.95	0.13	2.88	0.08	9.38	11.40	0.02	0.33	19.55	0.31	13.28	-0.05	37.26	4.08	100.65	0.85	99.80
1 / 4 .	1.97	0.13	2.87	0.09	9.32	11.40	0.03	0.27	19.34	0.39	13.26	-0.04	37.44	4.06	100.58	0.86	99.72
1 / 5 .	1.97	0.14	2.89	0.09	9.53	11.44	0.00	0.32	19.52	0.37	13.43	-0.07	37.57	4.02	101.29	0.86	100.43
1 / 6 .	1.91	0.14	2.91	0.09	9.49	11.41	0.01	0.35	19.18	0.53	13.35	-0.03	37.40	4.24	101.03	0.84	100.19
1 / 7 .	2.00	0.12	2.88	0.08	9.57	11.46	-0.01	0.31	19.67	0.48	13.32	-0.06	37.48	4.02	101.39	0.87	100.52
1 / 8 .	1.98	0.15	2.88	0.11	9.44	11.50	0.01	0.32	19.61	0.36	13.35	-0.07	37.43	4.08	101.19	0.87	100.33
1 / 9 .	1.97	0.14	2.89	0.09	9.58	11.52	-0.01	0.34	19.28	0.50	13.38	-0.03	37.52	4.11	101.33	0.86	100.47
1 / 10 .	1.94	0.14	2.90	0.09	9.43	11.46	0.02	0.34	19.28	0.39	13.37	-0.05	37.49	4.12	100.97	0.85	100.13
Avg 20_4	1.97	0.14	2.88	0.09	9.48	11.45	0.01	0.32	19.45	0.41	13.34	-0.05	37.46	4.09	101.04	0.86	100.18

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
20_bt 5																	
1 / 1 .	2.29	0.18	2.75	0.08	9.27	13.30	0.03	0.39	18.64	0.09	13.32	-0.02	38.46	2.61	101.42	1.01	100.41
1 / 2 .	2.46	0.16	2.66	0.06	9.26	13.41	0.02	0.40	18.86	-0.06	13.38	0.03	38.27	2.45	101.43	1.07	100.36
1 / 3 .	2.40	0.15	2.70	0.09	9.33	13.58	0.02	0.43	18.68	0.08	13.36	-0.01	38.18	2.49	101.49	1.04	100.45
1 / 4 .	2.49	0.17	2.67	0.07	9.56	13.60	0.02	0.37	18.45	0.02	13.40	0.03	38.51	2.53	101.87	1.09	100.78
1 / 5 .	2.44	0.17	2.68	0.07	9.55	13.37	0.02	0.40	18.14	0.01	13.43	0.01	38.68	2.40	101.36	1.06	100.30
1 / 6 .	2.46	0.15	2.70	0.07	9.51	13.23	0.04	0.41	18.59	0.01	13.48	0.03	38.76	2.64	102.09	1.07	101.02
1 / 7 .	2.44	0.17	2.70	0.09	9.52	13.24	0.04	0.39	18.48	0.11	13.54	0.00	38.80	2.54	102.06	1.07	100.99
1 / 8 .	2.38	0.15	2.74	0.07	9.45	13.28	0.02	0.36	18.57	0.01	13.42	0.01	38.76	2.86	102.09	1.04	101.05
1 / 9 .	2.39	0.18	2.74	0.09	9.52	13.22	0.02	0.40	18.84	0.11	13.41	0.00	38.84	2.80	102.54	1.04	101.50
Avg 20_5.1	2.42	0.16	2.70	0.08	9.44	13.36	0.03	0.39	18.58	0.04	13.41	0.01	38.58	2.59	101.81	1.05	100.75
2 / 1 .	2.09	0.16	2.85	0.04	9.69	12.17	0.00	0.42	18.70	0.09	13.43	0.01	38.21	3.64	101.52	0.92	100.60
2 / 2 .	2.20	0.15	2.80	0.06	9.85	12.19	0.00	0.48	18.63	-0.03	13.33	0.03	38.35	3.52	101.61	0.96	100.64
2 / 3 .	2.21	0.16	2.88	0.07	9.50	12.05	0.02	0.44	18.24	0.05	13.29	-0.02	40.00	3.78	102.68	0.96	101.71
2 / 4 .	2.03	0.17	2.89	0.06	9.79	12.20	0.00	0.41	18.58	0.14	13.25	0.00	38.28	3.88	101.69	0.89	100.79
2 / 5 .	2.24	0.16	2.79	0.09	9.93	12.30	-0.02	0.40	18.71	0.10	13.24	0.00	38.44	3.56	101.97	0.98	100.99
2 / 6 .	2.11	0.16	2.83	0.08	9.76	11.98	0.00	0.40	19.00	0.11	13.59	0.01	37.78	3.72	101.54	0.92	100.62
2 / 7 .	2.19	0.14	2.79	0.06	9.73	12.06	0.01	0.35	18.42	0.04	13.50	0.02	37.93	3.83	101.08	0.95	100.13
2 / 8 .	2.18	0.15	2.80	0.07	9.76	12.13	0.01	0.37	18.56	0.08	13.44	0.00	38.04	3.69	101.27	0.95	100.32
Avg 20_5.2	2.19	0.16	2.82	0.07	9.72	12.27	0.00	0.41	18.60	0.07	13.39	0.01	38.40	3.58	101.68	0.96	100.72
3 / 1 .	2.39	0.19	2.65	0.07	9.06	13.48	0.13	0.40	18.42	0.01	13.79	0.02	37.66	2.00	100.25	1.05	99.20
3 / 2 .	2.35	0.18	2.73	0.06	9.53	13.71	0.08	0.38	18.35	0.07	13.83	0.01	38.27	2.08	101.63	1.03	100.60
3 / 3 .	2.47	0.19	2.66	0.08	9.53	13.79	0.06	0.38	17.99	-0.08	13.72	0.02	38.38	2.14	101.41	1.08	100.32
3 / 4 .	2.49	0.17	2.64	0.06	9.85	13.61	0.04	0.36	17.90	-0.07	13.81	0.01	38.22	2.09	101.25	1.09	100.16
3 / 5 .	2.35	0.19	2.68	0.09	9.86	13.06	0.02	0.36	18.71	0.11	14.02	0.00	37.58	2.13	101.15	1.03	100.12
3 / 6 .	2.27	0.19	2.73	0.08	9.80	13.00	0.02	0.40	18.59	0.01	14.09	0.03	37.66	2.10	100.96	1.00	99.96
3 / 7 .	2.19	0.19	2.74	0.08	9.49	12.77	0.03	0.41	18.70	0.02	14.25	-0.02	37.22	2.19	100.30	0.96	99.34
3 / 8 .	1.65	0.18	3.00	0.06	8.52	12.92	0.02	0.35	20.36	-0.05	14.34	0.01	36.25	2.08	99.74	0.73	99.00
3 / 9 .	2.20	0.21	2.74	0.08	9.79	12.86	0.04	0.37	18.78	0.02	14.49	0.03	37.01	2.13	100.75	0.97	99.78
3 / 10 .	2.17	0.17	2.77	0.08	9.53	12.93	0.08	0.37	18.39	0.01	14.30	0.01	37.36	2.11	100.27	0.95	99.32

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
Avg 20_5.3	2.25	0.19	2.73	0.07	9.50	13.21	0.05	0.38	18.62	0.00	14.06	0.01	37.56	2.10	100.75	0.99	99.76
20_bt 6																	
1 / 1 .	2.14	0.12	2.77	0.07	9.46	11.58	0.00	0.31	19.45	0.40	13.26	-0.05	37.04	3.80	100.41	0.93	99.48
1 / 2 .	2.03	0.14	2.83	0.10	9.49	11.50	0.03	0.24	19.86	0.40	13.23	-0.02	37.17	3.96	100.98	0.89	100.09
1 / 3 .	1.93	0.17	2.83	0.11	9.46	11.25	0.04	0.32	19.20	0.51	13.11	0.00	36.96	3.72	99.61	0.85	98.76
1 / 4 .	1.98	0.14	2.88	0.08	9.45	11.60	0.03	0.36	19.85	0.36	13.30	-0.06	37.22	3.98	101.22	0.86	100.36
1 / 5 .	2.05	0.13	2.80	0.09	9.57	11.41	0.01	0.30	19.67	0.49	13.21	0.01	36.94	3.72	100.39	0.89	99.50
1 / 6 .	1.95	0.16	2.84	0.07	9.49	11.30	0.02	0.33	19.75	0.40	13.07	-0.04	36.94	3.97	100.30	0.86	99.44
1 / 7 .	1.92	0.16	2.85	0.09	9.39	11.18	0.02	0.38	19.95	0.43	13.01	-0.04	36.92	3.89	100.18	0.84	99.34
1 / 8 .	1.95	0.15	2.86	0.09	9.54	11.22	0.01	0.25	19.46	0.38	13.10	-0.06	37.11	4.17	100.28	0.85	99.43
1 / 9 .	1.99	0.14	2.86	0.09	9.53	11.38	0.02	0.33	20.11	0.37	13.16	-0.06	37.09	4.04	101.10	0.87	100.23
1 / 10 .	2.02	0.16	2.77	0.10	9.49	11.11	0.04	0.30	19.64	0.32	13.07	-0.08	36.42	4.02	99.46	0.89	98.57
Avg 20_6	2.00	0.15	2.83	0.09	9.49	11.35	0.02	0.31	19.69	0.41	13.15	-0.04	36.98	3.93	100.35	0.87	99.48
BR-16																	
16_bt 1																	
1 / 1 .	1.76	0.13	3.00	0.11	9.55	11.93	-0.02	0.34	19.93	0.24	13.27	-0.01	37.29	3.66	101.19	0.77	100.42
1 / 2 .	1.73	0.14	3.02	0.10	9.53	11.98	-0.03	0.39	19.79	0.35	13.41	0.01	37.40	3.68	101.54	0.76	100.78
1 / 3 .	1.86	0.16	2.93	0.08	9.63	11.90	-0.03	0.37	19.48	0.41	13.38	-0.02	37.32	3.57	101.08	0.82	100.26
1 / 4 .	1.76	0.17	2.99	0.09	9.62	11.92	-0.02	0.33	19.63	0.32	13.36	0.05	37.56	3.47	101.28	0.78	100.50
1 / 5 .	1.73	0.15	3.01	0.10	9.68	11.94	-0.02	0.28	19.46	0.26	13.32	-0.03	37.38	3.85	101.16	0.76	100.39
1 / 6 .	1.83	0.16	2.95	0.09	9.71	11.97	-0.03	0.34	19.22	0.44	13.40	-0.01	37.53	3.45	101.10	0.80	100.29
1 / 7 .	1.78	0.17	2.96	0.11	9.48	11.91	-0.02	0.28	19.62	0.32	13.29	0.03	37.16	3.59	100.69	0.79	99.91
1 / 8 .	1.78	0.16	2.95	0.09	9.12	11.93	-0.02	0.34	19.89	0.23	13.37	0.00	36.98	3.48	100.32	0.78	99.54
1 / 9 .	1.87	0.16	2.94	0.08	9.50	11.99	0.00	0.32	19.63	0.15	13.49	-0.01	37.40	3.60	101.12	0.82	100.30
1 / 10 .	1.86	0.16	2.94	0.08	9.62	11.98	-0.02	0.35	19.53	0.34	13.40	0.00	37.51	3.41	101.18	0.82	100.36
Avg 16_1.1	1.80	0.16	2.97	0.09	9.54	11.94	-0.02	0.34	19.62	0.31	13.37	0.00	37.35	3.58	101.04	0.79	100.25
2 / 1 .	1.61	0.14	3.11	0.07	9.54	11.40	-0.02	0.36	20.32	0.47	13.47	0.00	37.61	4.09	102.18	0.71	101.47
2 / 2 .	1.56	0.15	3.13	0.07	9.57	11.37	-0.03	0.43	20.50	0.39	13.39	0.01	37.69	3.96	102.21	0.69	101.52

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
2 / 3 .	1.61	0.14	3.08	0.07	9.58	11.29	-0.01	0.41	20.43	0.42	13.36	0.02	37.54	3.79	101.74	0.71	101.03
2 / 4 .	1.81	0.14	2.96	0.09	9.47	11.19	-0.02	0.41	20.19	0.36	13.35	-0.03	37.34	3.87	101.17	0.79	100.38
2 / 5 .	1.68	0.16	3.04	0.07	9.56	11.36	-0.01	0.36	20.02	0.42	13.41	0.01	37.41	4.11	101.62	0.75	100.87
2 / 6 .	1.67	0.13	3.02	0.06	9.49	11.29	-0.01	0.38	19.90	0.34	13.25	-0.02	37.30	3.84	100.68	0.73	99.95
2 / 7 .	1.59	0.13	3.09	0.06	9.55	11.39	-0.02	0.33	20.17	0.32	13.26	0.03	37.52	3.96	101.40	0.70	100.70
2 / 8 .	1.60	0.14	3.08	0.10	9.29	11.34	-0.02	0.40	20.57	0.32	13.15	-0.04	37.51	4.00	101.50	0.71	100.80
2 / 9 .	1.66	0.13	3.05	0.07	9.71	11.33	-0.03	0.35	20.27	0.26	13.21	-0.03	37.52	3.80	101.36	0.73	100.63
2 / 10 .	1.49	0.14	3.14	0.08	9.56	11.25	-0.01	0.34	20.61	0.29	13.31	0.00	37.51	3.72	101.45	0.66	100.79
Avg 16_1.2	1.63	0.14	3.07	0.07	9.53	11.32	-0.02	0.38	20.30	0.36	13.32	0.00	37.50	3.91	101.50	0.72	100.79
16_bt 2																	
1 / 1 . *	1.60	0.15	3.09	0.06	9.62	10.89	-0.02	0.45	20.81	0.32	13.35	-0.01	37.40	4.35	102.07	0.71	101.37
1 / 2 . *	1.62	0.16	3.09	0.07	9.58	11.08	-0.02	0.46	20.89	0.37	13.33	0.02	37.35	4.44	102.45	0.72	101.73
1 / 3 .	1.71	0.14	3.02	0.07	9.53	10.93	-0.02	0.39	20.44	0.37	13.31	0.02	37.32	4.22	101.48	0.75	100.73
1 / 4 .	1.55	0.15	3.10	0.06	9.58	10.81	-0.01	0.43	20.76	0.43	13.36	0.00	37.10	4.38	101.72	0.69	101.03
1 / 5 .	1.59	0.14	3.08	0.11	9.40	10.69	-0.02	0.35	20.72	0.29	13.29	0.00	37.29	4.52	101.48	0.70	100.78
1 / 6 .	1.60	0.16	3.08	0.06	9.58	10.87	-0.03	0.37	20.47	0.61	13.39	0.03	37.35	4.23	101.79	0.71	101.08
1 / 7 .	1.55	0.14	3.11	0.08	9.46	10.83	-0.02	0.45	20.79	0.43	13.36	-0.03	37.16	4.38	101.74	0.68	101.05
1 / 8 .	1.55	0.15	3.10	0.04	9.52	10.84	-0.02	0.42	20.44	0.47	13.37	0.03	37.29	4.33	101.54	0.69	100.86
1 / 9 .	1.50	0.17	3.11	0.05	9.53	10.84	-0.02	0.38	20.52	0.28	13.35	0.03	37.19	4.43	101.40	0.67	100.73
1 / 10 .	1.55	0.15	3.11	0.07	9.59	10.91	-0.02	0.42	20.36	0.46	13.39	-0.01	37.14	4.56	101.70	0.69	101.02
Avg 16_2	1.57	0.15	3.09	0.07	9.52	10.84	-0.02	0.40	20.56	0.42	13.35	0.01	37.23	4.38	101.58	0.70	100.89
16_bt 3																	
1 / 1 .	1.73	0.15	3.01	0.06	9.60	12.06	-0.01	0.31	19.22	0.39	13.32	0.05	37.62	3.47	100.99	0.76	100.23
1 / 2 .	1.80	0.16	2.98	0.09	9.58	11.91	-0.01	0.28	19.43	0.42	13.26	-0.01	37.74	3.57	101.21	0.79	100.42
1 / 3 .	1.85	0.16	2.93	0.06	9.59	11.85	-0.02	0.25	19.42	0.53	13.26	0.03	37.47	3.54	100.94	0.81	100.13
1 / 4 .	1.84	0.19	2.95	0.10	9.59	11.88	-0.02	0.28	19.66	0.44	13.51	0.02	37.57	3.40	101.43	0.82	100.61
1 / 5 .	1.66	0.16	3.04	0.09	9.60	11.96	-0.02	0.29	19.60	0.49	13.43	0.04	37.37	3.59	101.34	0.74	100.60
1 / 6 .	1.72	0.15	3.03	0.10	9.72	11.89	-0.02	0.34	19.71	0.49	13.38	0.04	37.58	3.55	101.69	0.76	100.93
1 / 7 .	1.76	0.17	2.99	0.07	9.55	11.91	-0.01	0.38	19.82	0.52	13.38	0.01	37.41	3.66	101.64	0.78	100.86
1 / 8 .	1.74	0.16	3.02	0.07	9.74	11.92	-0.01	0.29	19.86	0.50	13.56	0.04	37.57	3.32	101.80	0.77	101.04

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 9 .	1.78	0.17	2.98	0.08	9.53	11.90	-0.01	0.30	20.05	0.44	13.30	0.05	37.42	3.51	101.51	0.79	100.72
1 / 10 .	1.71	0.17	3.01	0.08	9.55	11.89	-0.01	0.31	19.68	0.39	13.40	0.06	37.52	3.45	101.22	0.76	100.47
Avg 16_3.1	1.76	0.16	2.99	0.08	9.60	11.92	-0.01	0.30	19.65	0.46	13.38	0.03	37.53	3.50	101.36	0.78	100.59
2 / 1 .	1.76	0.14	3.03	0.07	9.63	12.14	-0.01	0.41	18.23	0.41	13.78	0.05	37.83	3.87	101.35	0.77	100.58
2 / 2 .	1.73	0.17	3.04	0.07	9.62	12.20	-0.02	0.35	18.26	0.48	13.65	0.02	37.92	3.87	101.38	0.77	100.62
2 / 3 .	1.75	0.15	3.02	0.07	9.71	12.13	-0.01	0.30	18.54	0.31	13.73	0.03	37.76	3.78	101.29	0.77	100.52
2 / 4 .	1.69	0.15	3.04	0.06	9.55	11.91	-0.02	0.40	17.89	0.27	13.73	0.04	37.90	3.76	100.39	0.74	99.64
2 / 5 .	1.73	0.18	3.02	0.07	9.58	12.10	-0.01	0.33	18.35	0.32	13.70	0.09	37.62	3.95	101.05	0.77	100.28
2 / 6 .	1.88	0.17	2.93	0.07	9.61	12.10	-0.01	0.39	17.85	0.37	13.65	0.04	37.71	3.85	100.62	0.83	99.79
2 / 7 .	1.69	0.13	3.03	0.07	9.58	12.04	-0.03	0.29	18.08	0.43	13.57	0.01	37.54	3.84	100.30	0.74	99.56
2 / 8 .	1.86	0.15	2.97	0.07	9.74	12.22	-0.02	0.37	17.92	0.44	13.66	0.05	37.92	3.89	101.28	0.82	100.46
2 / 9 .	1.62	0.14	3.08	0.10	9.18	11.92	0.00	0.38	18.82	0.54	13.78	0.05	37.35	3.94	100.90	0.71	100.18
2 / 10 .	1.70	0.15	3.04	0.05	9.56	12.21	-0.01	0.34	18.15	0.33	13.63	0.05	37.72	3.92	100.84	0.75	100.09
Avg 16_3.2	1.74	0.15	3.02	0.07	9.58	12.10	-0.01	0.36	18.21	0.39	13.69	0.04	37.73	3.87	100.93	0.77	100.16
16_bt 4																	
1 / 1 .	1.45	0.14	3.15	0.06	9.59	10.87	-0.01	0.41	20.20	0.40	13.40	-0.02	37.21	4.30	101.18	0.64	100.54
1 / 2 .	1.65	0.18	3.03	0.06	9.53	11.08	-0.01	0.36	20.16	0.42	13.41	-0.04	37.18	4.11	101.17	0.74	100.44
1 / 3 .	1.60	0.15	3.06	0.08	9.52	10.95	-0.02	0.37	20.46	0.31	13.50	-0.03	37.14	4.13	101.28	0.71	100.57
1 / 4 .	1.57	0.14	3.08	0.10	9.62	10.90	-0.03	0.34	20.37	0.58	13.36	0.01	37.13	4.26	101.47	0.69	100.77
1 / 5 .	1.47	0.14	3.14	0.06	9.62	10.96	-0.02	0.38	20.77	0.34	13.34	-0.02	37.10	4.35	101.68	0.65	101.03
1 / 6 .	1.51	0.15	3.11	0.07	9.62	10.98	-0.01	0.41	20.66	0.35	13.32	-0.02	37.05	4.30	101.54	0.67	100.87
1 / 7 .	1.68	0.16	3.03	0.07	9.51	10.99	-0.02	0.32	20.95	0.35	13.43	0.01	36.93	4.37	101.79	0.74	101.04
1 / 8 .	1.57	0.15	3.09	0.07	9.68	11.12	-0.02	0.39	20.69	0.37	13.45	-0.02	37.09	4.14	101.80	0.69	101.11
1 / 9 .	1.65	0.16	3.03	0.07	9.69	11.01	-0.02	0.29	20.42	0.35	13.29	0.00	37.16	3.98	101.10	0.73	100.37
1 / 10 .	1.68	0.14	3.01	0.07	9.62	11.20	-0.02	0.31	20.20	0.32	13.28	0.01	37.06	4.13	101.03	0.74	100.29
Avg 16_4	1.58	0.15	3.07	0.07	9.60	11.00	-0.02	0.36	20.49	0.38	13.38	-0.01	37.11	4.21	101.37	0.70	100.67
16_bt 5																	
1 / 1 .	1.89	0.16	2.94	0.13	9.50	11.81	0.02	0.33	19.93	0.45	13.42	-0.02	37.54	3.75	101.86	0.83	101.03
1 / 2 .	1.75	0.15	3.01	0.10	9.62	11.88	0.01	0.30	20.11	0.44	13.40	0.01	37.51	3.53	101.83	0.77	101.06

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 3 .	1.81	0.18	2.97	0.10	9.65	11.85	0.01	0.34	20.05	0.51	13.53	-0.04	37.55	3.26	101.81	0.80	101.00
1 / 4 .	1.66	0.16	3.06	0.10	9.51	11.72	0.01	0.31	19.99	0.49	13.48	-0.02	37.57	3.63	101.70	0.73	100.96
1 / 5 .	1.80	0.14	3.01	0.10	9.53	11.85	0.00	0.34	20.30	0.63	13.62	0.00	37.51	3.66	102.47	0.79	101.68
1 / 6 .	1.88	0.16	2.92	0.17	9.50	11.73	0.03	0.39	20.17	0.57	13.36	0.00	37.06	3.61	101.54	0.83	100.72
1 / 7 .	1.70	0.17	3.03	0.10	9.47	11.80	0.00	0.34	20.28	0.58	13.42	-0.02	37.48	3.61	101.99	0.76	101.23
1 / 8 .	1.81	0.17	2.95	0.14	9.48	11.77	0.04	0.33	19.96	0.53	13.30	-0.01	37.29	3.49	101.26	0.80	100.45
1 / 9 . *	1.74	0.15	3.03	0.09	9.61	12.00	0.00	0.34	20.41	0.62	13.48	-0.01	37.52	3.47	102.45	0.77	101.68
1 / 10 .	1.79	0.17	2.95	0.17	9.39	11.65	0.05	0.26	19.96	0.64	13.34	0.01	37.17	3.46	101.01	0.79	100.22
Avg 16_5	1.79	0.16	2.98	0.12	9.52	11.78	0.02	0.33	20.08	0.54	13.43	-0.01	37.41	3.55	101.71	0.79	100.92
BR-14 B8																	
B8_bt 1																	
1 / 1 .	1.84	0.15	2.98	0.07	9.66	12.34	0.04	0.25	19.09	0.30	13.61	0.00	37.90	3.23	101.45	0.81	100.64
1 / 2 .	1.68	0.15	3.06	0.08	9.69	12.37	0.05	0.16	19.28	0.37	13.68	0.00	37.96	2.95	101.49	0.74	100.75
1 / 3 .	1.80	0.17	2.98	0.08	9.53	12.34	0.07	0.17	18.76	0.55	13.65	0.02	37.83	3.14	101.09	0.79	100.30
1 / 4 .	1.74	0.15	3.02	0.08	9.62	12.45	0.07	0.17	18.78	0.53	13.73	0.01	37.77	3.12	101.25	0.77	100.48
1 / 5 .	1.81	0.17	2.99	0.08	9.56	12.35	0.07	0.16	19.22	0.45	13.63	0.00	37.90	3.11	101.47	0.80	100.67
1 / 6 .	1.91	0.16	2.93	0.06	9.41	12.41	0.07	0.20	19.24	0.32	13.66	0.03	37.87	2.97	101.24	0.84	100.40
1 / 7 .	1.74	0.16	2.99	0.06	9.34	12.39	0.11	0.21	18.87	0.33	13.63	0.00	37.61	2.85	100.30	0.77	99.53
1 / 8 .	1.57	0.15	3.03	0.08	8.63	12.43	0.15	0.21	19.16	0.31	13.47	-0.01	37.03	2.79	99.02	0.70	98.32
1 / 9 .	1.63	0.16	3.00	0.08	8.68	12.61	0.16	0.21	18.89	0.14	13.40	0.00	37.19	2.64	98.79	0.72	98.07
1 / 10 . *	1.39	0.15	3.01	0.07	7.33	12.73	0.25	0.18	18.67	0.19	13.04	-0.01	35.97	2.42	95.40	0.62	94.78
Avg B8_1.1	1.75	0.16	3.00	0.07	9.34	12.41	0.09	0.19	19.03	0.37	13.61	0.01	37.67	2.98	100.68	0.77	99.90
2 / 1 .	1.57	0.14	3.10	0.05	9.31	11.88	0.04	0.24	19.74	0.28	13.63	0.01	37.74	3.23	100.95	0.69	100.25
2 / 2 .	1.65	0.17	3.04	0.07	9.59	11.91	0.03	0.19	19.16	0.34	13.54	0.00	37.78	3.21	100.67	0.73	99.94
2 / 3 .	1.70	0.16	3.05	0.04	9.61	12.12	0.03	0.22	19.62	0.36	13.56	-0.02	37.87	3.25	101.59	0.75	100.84
2 / 4 .	1.56	0.15	3.10	0.06	9.38	11.98	0.04	0.25	19.09	0.39	13.48	0.03	37.71	3.50	100.71	0.69	100.02
2 / 5 .	1.67	0.16	3.05	0.06	9.54	12.00	0.03	0.21	19.54	0.34	13.52	0.05	37.76	3.47	101.41	0.74	100.67
2 / 6 .	1.61	0.16	3.07	0.07	9.46	11.98	0.05	0.23	19.61	0.45	13.46	-0.02	37.57	3.42	101.15	0.71	100.44
2 / 7 .	1.70	0.15	3.02	0.08	9.41	12.02	0.05	0.26	19.61	0.29	13.46	-0.02	37.49	3.31	100.86	0.75	100.11

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
2 / 8 .	1.72	0.15	3.01	0.06	9.14	12.10	0.03	0.21	19.72	0.29	13.56	0.03	37.43	3.22	100.67	0.76	99.91
2 / 9 .	1.63	0.13	3.08	0.05	8.89	12.21	0.04	0.23	20.58	0.22	13.82	0.06	37.18	3.30	101.43	0.72	100.71
2 / 10 .	1.72	0.16	3.03	0.04	9.00	12.29	0.04	0.23	20.21	0.14	13.73	0.05	37.36	3.38	101.37	0.76	100.61
Avg B8_1.2	1.65	0.15	3.05	0.06	9.33	12.05	0.04	0.23	19.69	0.31	13.58	0.02	37.59	3.33	101.07	0.73	100.34
3 / 1 .	1.37	0.15	3.16	0.07	8.95	10.92	0.08	0.37	20.64	0.19	13.52	0.00	37.10	3.84	100.36	0.61	99.75
3 / 2 .	1.40	0.18	3.16	0.05	9.02	11.12	0.11	0.29	20.32	0.35	13.19	0.01	37.55	3.89	100.63	0.63	100.00
3 / 3 .	1.40	0.17	3.16	0.05	9.02	11.00	0.08	0.30	20.16	0.30	13.28	0.02	37.57	4.01	100.52	0.63	99.89
3 / 4 .	1.37	0.17	3.17	0.05	9.06	10.91	0.08	0.33	20.18	0.27	13.21	0.01	37.50	3.95	100.25	0.61	99.63
3 / 5 .	1.50	0.16	3.12	0.04	9.33	10.99	0.05	0.33	20.48	0.33	13.25	0.02	37.51	4.02	101.14	0.67	100.47
3 / 6 .	1.45	0.16	3.14	0.04	9.32	11.02	0.03	0.31	20.33	0.26	13.23	-0.02	37.55	3.93	100.76	0.65	100.12
3 / 7 .	1.48	0.15	3.13	0.03	9.11	11.01	0.03	0.30	20.32	0.45	13.30	0.02	37.57	3.95	100.84	0.66	100.18
3 / 8 .	1.34	0.17	3.20	0.05	9.44	10.70	0.03	0.32	19.97	0.41	13.18	0.01	38.17	3.98	100.97	0.60	100.37
Avg B8_1.3	1.41	0.16	3.15	0.05	9.16	10.96	0.06	0.32	20.30	0.32	13.27	0.01	37.57	3.95	100.68	0.63	100.05
B8_bt 2																	
1 / 1 .	1.79	0.16	2.97	0.04	9.59	11.94	0.00	0.25	19.61	0.39	13.50	0.04	37.55	3.27	101.11	0.79	100.32
1 / 2 .	1.15	0.13	3.76	0.03	6.76	7.94	-0.01	0.16	13.78	-0.03	8.86	-0.01	57.23	2.19	102.01	0.52	101.49
1 / 3 . *	-0.45	-0.01	5.59	-0.04	-0.03	-0.03	-0.02	-0.07	0.07	-0.23	-0.07	-0.01	102.43	0.02	108.11	0.00	108.11
1 / 4 . *	-0.44	0.01	5.35	1.84	0.11	-0.02	0.67	-0.04	0.52	-0.20	4.98	0.00	92.33	-0.05	105.82	0.00	105.82
1 / 5 . *	-0.42	0.00	5.00	8.43	0.12	-0.03	3.93	-0.02	0.10	-0.22	23.11	-0.02	64.95	-0.03	105.65	0.00	105.65
1 / 6 . *	-0.45	0.03	4.83	7.86	0.24	0.13	3.87	-0.05	0.40	-0.21	22.17	0.00	62.98	0.03	102.55	0.01	102.54
1 / 7 . *	-0.43	-0.01	4.99	8.41	0.16	-0.02	3.89	-0.04	0.13	-0.14	23.09	-0.02	64.84	0.01	105.53	0.00	105.53
1 / 8 . *	-0.45	-0.01	5.59	-0.02	-0.04	-0.02	-0.02	-0.07	-0.02	-0.24	-0.07	0.02	102.48	0.00	108.09	0.00	108.09
1 / 9 . *	-0.47	-0.02	5.59	-0.02	-0.01	-0.02	-0.04	-0.05	-0.04	-0.21	-0.06	-0.03	102.51	-0.04	108.10	0.00	108.10
1 / 10 . *	-0.49	0.01	4.74	0.58	15.50	0.00	0.00	-0.05	0.05	1.04	18.61	0.00	65.05	0.00	105.58	0.00	105.58
Avg B8_2.1	1.47	0.15	3.37	0.04	8.17	9.94	0.00	0.21	16.70	0.18	11.18	0.02	47.39	2.73	101.53	0.65	100.88
2 / 1 .	1.35	0.15	3.14	0.04	8.49	10.65	0.07	0.25	22.35	0.06	14.02	0.01	36.24	3.16	99.99	0.60	99.39
2 / 2 .	1.23	0.16	3.19	0.07	8.18	10.47	0.05	0.27	23.28	0.24	13.89	0.03	36.06	3.10	100.20	0.56	99.64
2 / 3 .	1.28	0.13	3.12	0.06	8.02	10.20	0.06	0.29	23.19	0.27	13.78	0.06	35.45	3.16	99.06	0.57	98.49
2 / 4 .	1.33	0.15	3.09	0.06	8.04	10.13	0.04	0.32	23.08	0.19	13.68	0.03	35.56	3.12	98.83	0.59	98.23

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
2 / 5 .	1.23	0.13	3.13	0.07	7.68	10.04	0.08	0.27	23.90	0.27	13.94	0.04	35.08	2.92	98.78	0.55	98.24
2 / 6 . *	1.15	0.16	3.15	0.07	7.50	10.16	0.11	0.22	23.24	0.25	13.94	0.05	35.11	2.94	98.06	0.52	97.53
2 / 7 .	1.24	0.15	3.14	0.05	7.95	10.22	0.05	0.25	23.12	0.42	13.96	0.08	35.49	2.88	99.00	0.56	98.44
2 / 8 .	1.26	0.14	3.13	0.06	7.80	10.19	0.07	0.26	23.36	0.40	14.09	0.05	35.20	3.06	99.07	0.56	98.50
2 / 9 .	1.38	0.17	3.10	0.06	8.36	10.54	0.09	0.26	22.45	0.29	13.54	0.01	36.08	3.37	99.70	0.62	99.08
2 / 10 .	1.49	0.18	3.04	0.06	8.88	10.73	0.08	0.25	21.53	0.31	13.30	0.01	36.45	3.35	99.66	0.67	99.00
Avg B8_2.2	1.31	0.15	3.12	0.06	8.16	10.35	0.07	0.27	22.92	0.27	13.80	0.04	35.73	3.12	99.37	0.59	98.78
3 / 1 .	1.58	0.16	3.10	0.07	9.70	11.46	0.01	0.24	20.96	0.28	13.53	0.01	37.57	3.42	102.09	0.70	101.39
3 / 2 .	1.74	0.17	3.01	0.06	9.73	11.36	0.00	0.33	20.44	0.29	13.58	0.05	37.62	3.42	101.81	0.77	101.04
3 / 3 .	1.74	0.17	2.99	0.05	9.79	11.41	0.00	0.30	20.42	0.29	13.54	0.02	37.48	3.24	101.44	0.77	100.67
3 / 4 .	1.72	0.17	3.00	0.07	9.61	11.46	0.01	0.24	20.43	0.26	13.50	0.04	37.50	3.31	101.34	0.76	100.57
3 / 5 .	1.72	0.16	3.01	0.05	9.71	11.48	0.00	0.26	20.58	0.15	13.44	0.04	37.51	3.37	101.47	0.76	100.71
3 / 6 .	1.70	0.17	3.03	0.06	9.62	11.57	-0.01	0.32	20.60	0.27	13.52	0.01	37.57	3.32	101.76	0.76	101.01
3 / 7 .	1.71	0.17	3.00	0.04	9.74	11.42	0.00	0.27	20.16	0.35	13.42	0.02	37.49	3.32	101.12	0.76	100.35
3 / 8 .	1.69	0.16	3.01	0.05	9.61	11.41	0.01	0.22	20.77	0.32	13.44	0.03	37.44	3.13	101.29	0.75	100.55
3 / 9 .	1.63	0.18	3.07	0.04	9.67	11.55	0.01	0.28	20.67	0.30	13.52	0.00	37.50	3.49	101.91	0.73	101.19
3 / 10 .	1.67	0.17	3.04	0.03	9.63	11.60	0.02	0.26	20.48	0.32	13.47	0.03	37.54	3.35	101.61	0.74	100.87
Avg B8_2.3	1.69	0.17	3.03	0.05	9.68	11.47	0.00	0.27	20.55	0.28	13.50	0.02	37.52	3.34	101.58	0.75	100.83
B8_bt 3																	
1 / 1 .	1.56	0.16	3.11	0.06	9.71	11.35	0.02	0.30	19.87	0.43	13.43	-0.01	37.56	4.14	101.69	0.69	100.99
1 / 2 .	1.59	0.14	3.08	0.04	9.63	11.35	0.01	0.31	20.03	0.34	13.31	-0.03	37.46	3.96	101.27	0.70	100.57
1 / 3 .	1.50	0.16	3.14	0.05	9.69	11.37	0.03	0.37	19.75	0.46	13.39	-0.01	37.64	4.01	101.56	0.67	100.90
1 / 4 .	1.63	0.16	3.06	0.06	9.57	11.30	0.03	0.38	20.20	0.38	13.37	0.01	37.41	3.99	101.55	0.72	100.83
1 / 5 .	1.53	0.15	3.13	0.06	9.57	11.34	0.02	0.35	20.15	0.47	13.37	-0.03	37.71	4.09	101.96	0.68	101.28
1 / 6 .	1.65	0.15	3.08	0.06	9.77	11.29	-0.01	0.27	20.43	0.58	13.40	0.01	37.55	4.27	102.50	0.73	101.77
1 / 7 .	1.55	0.15	3.12	0.06	9.61	11.38	0.02	0.32	20.47	0.50	13.44	0.00	37.50	4.11	102.24	0.69	101.55
1 / 8 . *	1.51	0.14	3.16	0.05	9.71	11.37	0.02	0.42	20.52	0.41	13.40	-0.01	37.76	4.07	102.55	0.67	101.89
1 / 9 .	1.63	0.15	3.08	0.05	9.73	11.36	0.01	0.35	20.11	0.40	13.35	-0.03	37.51	4.20	101.92	0.72	101.20
1 / 10 .	1.63	0.15	3.08	0.04	9.78	11.32	0.00	0.28	20.02	0.37	13.49	-0.02	37.69	4.06	101.92	0.72	101.19
Avg B8_3.1	1.59	0.15	3.10	0.05	9.67	11.34	0.02	0.33	20.12	0.44	13.39	-0.01	37.56	4.09	101.83	0.70	101.13

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
2 / 1 .	1.61	0.17	3.07	0.05	9.67	11.36	-0.01	0.35	19.96	0.46	13.36	0.05	37.41	4.03	101.54	0.72	100.82
2 / 2 .	1.62	0.14	3.08	0.06	9.66	11.33	0.00	0.37	19.97	0.36	13.42	0.03	37.66	3.94	101.64	0.71	100.92
2 / 3 .	1.58	0.16	3.09	0.05	9.72	11.34	0.00	0.34	20.28	0.45	13.31	-0.02	37.57	3.78	101.69	0.70	100.99
2 / 4 .	1.61	0.14	3.08	0.05	9.65	11.35	0.01	0.32	19.80	0.57	13.38	0.00	37.54	4.08	101.58	0.71	100.87
2 / 5 .	1.58	0.13	3.12	0.05	9.64	11.41	0.00	0.35	20.11	0.45	13.47	-0.02	37.64	3.97	101.90	0.69	101.21
2 / 6 .	1.52	0.15	3.14	0.07	9.67	11.38	0.01	0.29	20.39	0.52	13.33	-0.01	37.57	4.05	102.07	0.67	101.40
2 / 7 .	1.61	0.15	3.07	0.03	9.61	11.18	0.01	0.30	19.64	0.44	13.47	0.01	37.51	4.05	101.08	0.71	100.37
2 / 8 .	1.58	0.17	3.09	0.07	9.71	11.33	0.00	0.29	20.09	0.36	13.41	0.00	37.34	4.13	101.58	0.70	100.87
2 / 9 .	1.64	0.17	3.04	0.05	9.61	11.28	0.01	0.35	20.21	0.52	13.25	0.00	37.42	3.79	101.33	0.73	100.60
2 / 10 .	1.55	0.14	3.09	0.06	9.50	11.26	0.01	0.31	20.25	0.39	13.44	0.00	37.25	3.78	101.04	0.68	100.36
Avg B8_3.2	1.59	0.15	3.09	0.05	9.64	11.32	0.00	0.33	20.07	0.45	13.38	0.00	37.49	3.96	101.54	0.70	100.84
3 / 1 .	0.65	0.16	3.64	1.02	3.25	9.06	8.08	0.50	21.90	0.13	11.48	-0.01	40.21	1.84	101.92	0.31	101.61
3 / 2 .	1.68	0.14	3.06	0.06	9.65	11.62	0.04	0.31	20.45	0.19	13.33	-0.01	37.61	3.88	102.01	0.74	101.27
3 / 3 .	1.57	0.15	3.13	0.05	9.59	11.44	0.02	0.26	20.46	0.27	13.43	0.02	37.75	4.00	102.14	0.69	101.45
3 / 4 .	1.56	0.13	3.11	0.05	9.68	11.46	0.01	0.32	20.20	0.38	13.36	-0.02	37.59	3.79	101.64	0.69	100.96
3 / 5 .	1.62	0.15	3.11	0.06	9.57	11.56	0.00	0.28	20.41	0.56	13.36	-0.06	37.75	4.08	102.50	0.72	101.79
3 / 6 .	1.54	0.17	3.12	0.05	9.65	11.48	0.00	0.32	20.29	0.48	13.44	0.00	37.55	3.93	102.01	0.69	101.33
3 / 7 .	1.62	0.17	3.08	0.03	9.75	11.44	0.00	0.34	20.41	0.48	13.27	0.03	37.53	4.04	102.18	0.72	101.46
3 / 8 .	1.61	0.15	3.08	0.05	9.58	11.34	0.01	0.33	20.32	0.44	13.25	0.01	37.53	3.92	101.63	0.71	100.92
3 / 9 .	1.53	0.16	3.11	0.05	9.69	11.41	0.01	0.29	20.05	0.34	13.29	0.00	37.46	3.98	101.37	0.68	100.69
3 / 10 .	1.71	0.15	3.02	0.05	9.63	11.45	0.00	0.30	20.13	0.36	13.29	0.00	37.46	3.94	101.49	0.75	100.74
Avg B8_3.3	1.51	0.15	3.15	0.15	9.00	11.23	0.82	0.32	20.46	0.36	13.15	0.00	37.84	3.74	101.88	0.67	101.21
4 / 1 .	1.39	0.12	3.38	1.57	7.95	9.86	0.42	0.27	16.44	0.23	14.83	0.02	42.63	2.90	102.01	0.61	101.39
4 / 2 .	1.71	0.14	3.10	0.65	8.93	11.23	0.14	0.35	18.64	0.29	14.16	0.01	39.38	3.06	101.79	0.75	101.04
4 / 3 .	1.56	0.15	3.21	0.98	8.91	10.91	0.18	0.32	18.39	0.36	14.27	0.02	40.18	3.01	102.44	0.69	101.75
4 / 4 .	1.59	0.16	3.13	0.18	9.35	11.70	0.05	0.27	19.52	0.63	13.62	-0.01	38.61	3.41	102.23	0.71	101.52
4 / 5 . *	1.60	0.14	3.19	0.10	9.24	11.45	0.05	0.27	20.03	0.59	13.43	0.04	39.88	3.27	103.28	0.71	102.57
4 / 6 . *	1.70	0.14	3.16	0.09	9.21	11.57	0.04	0.29	19.23	0.41	13.20	0.00	40.68	3.39	103.12	0.75	102.38
4 / 7 . *	1.41	0.13	3.51	0.08	8.41	10.37	0.03	0.30	17.12	0.38	11.62	-0.04	48.21	2.92	104.49	0.62	103.86

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
4 / 8 . *	1.42	0.15	3.51	0.04	8.46	10.20	0.01	0.26	17.32	0.33	11.68	0.02	48.37	2.90	104.65	0.63	104.02
4 / 9 . *	1.57	0.15	3.37	0.06	8.62	10.52	0.02	0.29	17.50	0.39	11.96	0.02	46.51	2.95	103.92	0.70	103.23
4 / 10 . *	1.37	0.11	3.63	0.05	7.87	9.55	0.00	0.24	16.02	0.38	10.86	-0.03	52.04	2.79	104.92	0.60	104.32
Avg B8_3.4	1.56	0.14	3.21	0.84	8.78	10.93	0.20	0.30	18.25	0.38	14.22	0.01	40.20	3.09	102.11	0.69	101.42
5 / 1 .	1.65	0.17	3.08	0.05	9.68	11.46	0.00	0.40	20.31	0.44	13.40	0.05	37.65	4.02	102.34	0.73	101.61
5 / 2 .	1.61	0.14	3.08	0.09	9.70	11.30	0.00	0.28	20.02	0.54	13.33	0.02	37.51	4.05	101.68	0.71	100.96
5 / 3 .	1.66	0.15	3.09	0.06	9.51	11.39	0.01	0.29	20.93	0.50	13.47	-0.02	37.64	4.22	102.92	0.73	102.19
5 / 4 .	1.68	0.15	3.05	0.06	9.69	11.40	-0.01	0.29	20.47	0.38	13.37	0.02	37.44	4.04	102.03	0.74	101.29
5 / 5 .	1.54	0.17	3.14	0.05	9.67	11.35	0.02	0.28	21.11	0.42	13.48	-0.04	37.49	4.01	102.73	0.69	102.04
5 / 6 .	1.61	0.14	3.09	0.06	9.60	11.30	0.02	0.29	20.64	0.59	13.32	0.00	37.48	3.99	102.13	0.71	101.42
5 / 7 .	1.66	0.16	3.06	0.06	9.68	11.30	0.01	0.32	20.49	0.51	13.32	-0.04	37.63	3.85	102.05	0.74	101.32
5 / 8 .	1.62	0.14	3.09	0.07	9.72	11.36	0.00	0.30	20.79	0.49	13.45	0.02	37.45	3.96	102.48	0.72	101.77
5 / 9 .	1.67	0.15	3.08	0.06	9.76	11.39	0.00	0.31	20.60	0.46	13.48	-0.02	37.67	3.95	102.59	0.74	101.85
5 / 10 .	1.52	0.17	3.12	0.05	9.57	11.35	0.01	0.29	20.40	0.46	13.47	0.03	37.43	3.88	101.76	0.68	101.08
Avg B8_3.5	1.62	0.15	3.08	0.06	9.65	11.35	0.01	0.31	20.39	0.49	13.37	0.01	37.52	3.97	101.99	0.72	101.27
B8_bt 4																	
1 / 1 . *	-0.20	-0.01	4.78	1.01	15.07	0.02	-0.01	0.03	0.48	0.88	18.76	0.07	65.35	0.01	106.46	0.00	106.46
1 / 2 .	1.84	0.15	2.96	0.06	9.68	11.78	0.00	0.35	19.70	0.31	13.39	0.07	37.56	3.68	101.54	0.81	100.73
1 / 3 .	1.80	0.17	2.98	0.05	9.69	11.75	0.01	0.38	19.63	0.28	13.32	0.05	37.53	3.88	101.52	0.80	100.73
1 / 4 .	1.94	0.17	2.92	0.07	9.69	11.92	0.00	0.34	19.35	0.57	13.52	0.07	37.69	3.80	102.06	0.86	101.20
1 / 5 .	2.00	0.18	2.88	0.07	9.81	11.80	0.00	0.29	19.56	0.35	13.50	0.06	37.55	3.70	101.75	0.88	100.87
1 / 6 .	1.89	0.14	2.93	0.07	9.74	11.91	0.01	0.35	19.21	0.61	13.51	0.07	37.44	3.53	101.41	0.83	100.58
1 / 7 .	1.88	0.14	2.95	0.08	9.67	12.12	0.00	0.27	19.63	0.56	13.62	0.05	37.40	3.57	101.94	0.83	101.11
1 / 8 .	1.89	0.18	2.94	0.07	9.76	12.02	0.01	0.36	19.22	0.43	13.67	0.06	37.61	3.55	101.76	0.84	100.93
1 / 9 .	1.91	0.17	2.94	0.07	9.77	12.32	0.00	0.31	19.17	0.40	13.71	0.06	37.68	3.45	101.96	0.84	101.12
1 / 10 .	1.93	0.15	2.93	0.06	9.73	12.31	-0.01	0.29	18.84	0.45	13.73	0.05	37.74	3.37	101.56	0.84	100.72
Avg B8_4.1	1.90	0.16	2.94	0.07	9.73	11.99	0.00	0.33	19.37	0.44	13.55	0.06	37.58	3.61	101.72	0.84	100.89
2 / 1 .	1.81	0.17	2.99	0.07	9.74	11.60	0.01	0.30	20.03	0.58	13.56	0.06	37.40	3.97	102.30	0.80	101.50
2 / 2 .	1.61	0.14	3.03	0.06	8.35	11.19	0.02	0.38	21.85	0.35	13.53	0.04	36.37	3.58	100.50	0.71	99.79

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
2 / 3 .	1.82	0.16	2.99	0.06	9.72	11.58	0.00	0.35	20.30	0.51	13.46	0.08	37.46	4.01	102.48	0.80	101.68
2 / 4 .	1.82	0.18	2.96	0.05	9.68	11.48	0.00	0.31	19.90	0.54	13.33	0.08	37.54	3.85	101.73	0.81	100.92
2 / 5 .	1.72	0.17	3.03	0.06	9.60	11.52	0.00	0.37	20.29	0.54	13.44	0.04	37.50	3.93	102.21	0.76	101.45
2 / 6 .	1.81	0.19	2.99	0.06	9.71	11.51	0.01	0.37	20.01	0.36	13.43	0.07	37.55	4.17	102.24	0.80	101.44
2 / 7 .	1.89	0.17	2.95	0.06	9.65	11.66	0.00	0.40	19.94	0.47	13.33	0.04	37.59	4.03	102.17	0.83	101.34
2 / 8 .	1.90	0.17	2.95	0.07	9.61	11.61	0.02	0.38	20.00	0.46	13.45	0.08	37.58	4.04	102.32	0.84	101.48
2 / 9 .	1.85	0.16	2.97	0.10	9.63	11.49	0.02	0.37	19.95	0.41	13.46	0.08	37.54	4.11	102.15	0.82	101.33
2 / 10 .	1.83	0.17	2.98	0.09	9.69	11.62	0.01	0.43	19.71	0.43	13.47	0.07	37.73	3.91	102.13	0.81	101.32
Avg B8_4.2	1.81	0.17	2.98	0.07	9.54	11.53	0.01	0.37	20.20	0.46	13.45	0.06	37.43	3.96	102.02	0.80	101.22
B8_bt 5																	
1 / 1 . *	-0.24	0.00	4.76	1.17	14.52	0.14	0.01	0.01	0.52	0.78	18.70	0.02	65.10	0.06	105.79	0.00	105.79
1 / 2 .	1.83	0.16	2.92	0.05	9.23	12.05	0.01	0.31	20.31	0.21	13.27	-0.01	37.18	2.95	100.49	0.81	99.68
1 / 3 .	1.83	0.15	2.97	0.04	9.60	12.10	0.01	0.27	20.33	0.38	13.43	0.03	37.58	3.17	101.90	0.81	101.10
1 / 4 .	1.92	0.18	2.89	0.04	9.54	11.93	0.03	0.24	20.06	0.37	13.41	0.03	37.49	3.14	101.26	0.85	100.41
1 / 5 .	1.98	0.16	2.89	0.06	9.72	11.89	0.01	0.24	20.54	0.35	13.29	0.01	37.52	3.28	101.92	0.87	101.06
1 / 6 .	1.90	0.17	2.90	0.05	9.65	11.84	0.02	0.23	20.05	0.46	13.32	0.00	37.45	3.14	101.18	0.84	100.34
1 / 7 .	1.82	0.15	2.95	0.06	9.71	11.76	0.02	0.29	20.45	0.47	13.29	0.00	37.48	3.09	101.53	0.80	100.73
1 / 8 .	1.94	0.17	2.89	0.06	9.73	11.75	0.02	0.28	20.06	0.47	13.44	0.00	37.57	3.12	101.51	0.85	100.66
1 / 9 .	1.96	0.15	2.88	0.07	9.64	11.81	0.02	0.31	19.96	0.46	13.32	0.03	37.37	3.22	101.19	0.86	100.33
1 / 10 .	1.92	0.18	2.90	0.05	9.55	11.72	0.04	0.30	20.12	0.53	13.40	0.08	37.32	3.38	101.48	0.85	100.63
1 / 11 .	1.87	0.16	2.91	0.05	9.65	11.69	0.03	0.31	20.04	0.33	13.32	0.01	37.31	3.30	100.98	0.82	100.16
1 / 12 .	1.86	0.17	2.93	0.05	9.63	11.69	0.03	0.30	20.27	0.46	13.33	-0.02	37.39	3.39	101.50	0.82	100.68
1 / 13 .	1.92	0.17	2.91	0.07	9.58	11.52	0.03	0.29	20.64	0.46	13.32	0.02	37.41	3.47	101.83	0.85	100.98
1 / 14 .	1.77	0.16	2.99	0.05	9.72	11.51	0.04	0.28	20.40	0.47	13.36	0.03	37.50	3.63	101.92	0.78	101.13
1 / 15 .	1.90	0.15	2.91	0.06	9.61	11.51	0.01	0.35	20.11	0.50	13.32	0.01	37.32	3.57	101.34	0.83	100.50
1 / 16 .	1.82	0.16	2.95	0.04	9.76	11.47	0.04	0.30	20.61	0.33	13.11	0.05	37.43	3.56	101.61	0.80	100.81
1 / 17 .	1.84	0.17	2.94	0.06	9.69	11.56	0.02	0.29	20.42	0.40	13.21	-0.03	37.41	3.59	101.60	0.81	100.78
1 / 18 .	1.81	0.18	2.93	0.04	9.36	11.55	0.03	0.35	20.58	0.48	13.20	0.01	37.16	3.47	101.16	0.80	100.36
1 / 19 .	1.38	0.14	3.19	0.13	8.67	9.56	0.11	0.28	19.38	0.49	13.92	-0.02	39.49	2.99	99.73	0.61	99.12
1 / 20 .	-0.27	-0.01	4.77	0.87	15.04	0.00	0.01	0.00	0.24	0.89	18.76	0.02	65.46	0.00	106.06	0.00	106.06
Avg B8_5.1	1.74	0.15	3.03	0.10	9.85	11.00	0.03	0.27	19.19	0.45	13.63	0.01	38.99	3.13	101.57	0.77	100.80

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
BR-14 B4																	
B4_bt 1*																	
B4_bt 2																	
1 / 1 .	1.85	0.14	2.98	0.06	9.48	12.40	0.05	0.30	20.42	0.17	13.38	0.04	37.73	3.23	102.25	0.81	101.44
1 / 2 .	1.87	0.17	2.95	0.06	9.57	12.32	0.05	0.25	19.45	0.30	13.46	-0.01	37.78	3.33	101.58	0.83	100.75
1 / 3 .	1.80	0.16	2.98	0.09	9.40	12.20	0.05	0.29	20.05	0.20	13.24	0.03	37.68	3.35	101.53	0.79	100.73
1 / 4 .	1.88	0.14	2.94	0.08	9.63	12.07	0.04	0.32	19.85	0.25	13.29	0.02	37.55	3.36	101.42	0.82	100.60
1 / 5 .	1.82	0.15	2.97	0.07	9.52	12.07	0.04	0.40	19.78	0.23	13.27	0.03	37.58	3.38	101.32	0.80	100.52
1 / 6 .	1.92	0.17	2.90	0.04	9.52	12.18	0.04	0.32	19.77	0.27	13.21	0.01	37.47	3.24	101.07	0.84	100.23
1 / 7 .	1.83	0.16	2.96	0.05	9.55	12.17	0.05	0.27	19.70	0.20	13.31	0.01	37.46	3.42	101.14	0.81	100.34
1 / 8 .	1.85	0.14	2.94	0.06	9.68	12.24	0.04	0.30	19.42	0.17	13.19	-0.01	37.46	3.30	100.80	0.81	99.99
1 / 9 .	1.84	0.16	2.98	0.05	9.51	12.31	0.05	0.36	19.97	0.27	13.36	0.01	37.81	3.28	101.97	0.81	101.15
1 / 10 .	1.98	0.15	2.90	0.08	9.59	12.25	0.06	0.26	19.82	0.22	13.28	0.02	37.65	3.49	101.73	0.87	100.86
Avg B4_2.1	1.86	0.15	2.95	0.06	9.55	12.22	0.05	0.31	19.82	0.23	13.30	0.01	37.62	3.34	101.48	0.82	100.66
2 / 1 .	1.85	0.17	2.95	0.06	9.25	12.22	0.04	0.27	19.91	0.24	13.41	0.00	37.64	3.23	101.23	0.82	100.41
2 / 2 .	1.83	0.16	2.96	0.08	9.43	12.27	0.03	0.28	20.06	0.31	13.34	0.01	37.55	3.26	101.58	0.81	100.77
2 / 3 .	1.88	0.16	2.94	0.09	9.54	12.10	0.01	0.31	19.66	0.42	13.27	-0.02	37.62	3.41	101.40	0.83	100.57
2 / 4 .	1.89	0.15	2.94	0.09	9.54	12.06	0.02	0.35	19.90	0.24	13.35	0.04	37.47	3.56	101.60	0.83	100.76
2 / 5 .	1.85	0.15	2.92	0.12	9.42	11.89	0.02	0.34	19.95	0.34	13.24	0.01	36.93	3.50	100.68	0.81	99.87
Avg B4_2.2	1.86	0.16	2.94	0.09	9.43	12.11	0.02	0.31	19.90	0.31	13.32	0.01	37.44	3.39	101.29	0.82	100.47
3 / 1 .	1.88	0.14	2.93	0.14	9.47	12.11	0.04	0.31	19.45	0.27	13.18	0.02	37.58	3.41	100.94	0.82	100.12
3 / 2 .	1.88	0.16	2.91	0.15	9.42	11.88	0.04	0.31	19.87	0.30	13.21	0.01	37.37	3.32	100.84	0.83	100.01
3 / 3 .	1.96	0.16	2.87	0.11	9.54	12.08	0.01	0.34	19.75	0.20	13.12	0.00	37.30	3.46	100.90	0.86	100.04
3 / 4 .	1.85	0.17	2.92	0.08	9.56	12.01	0.00	0.31	19.54	0.31	13.16	0.03	37.39	3.26	100.58	0.81	99.76
3 / 5 .	1.98	0.15	2.87	0.08	9.49	12.12	0.00	0.32	19.71	0.34	13.15	0.01	37.50	3.25	100.97	0.87	100.10
3 / 6 .	1.98	0.14	2.85	0.07	9.61	11.99	0.00	0.25	19.17	0.43	13.12	0.03	37.14	3.58	100.37	0.86	99.50
3 / 7 .	1.98	0.15	2.86	0.08	9.54	12.10	0.00	0.32	19.93	0.24	13.10	0.01	37.30	3.41	101.02	0.87	100.15

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
3 / 8 .	1.94	0.15	2.89	0.08	9.59	12.03	0.00	0.30	19.48	0.45	13.35	0.04	37.32	3.44	101.07	0.85	100.22
3 / 9 .	1.91	0.15	2.92	0.09	9.58	12.00	0.01	0.33	20.03	0.41	13.17	0.01	37.35	3.61	101.57	0.84	100.73
3 / 10 .	1.85	0.17	2.93	0.10	9.52	12.15	0.02	0.25	20.15	0.57	13.27	-0.01	37.14	3.46	101.58	0.82	100.76
Avg B4_2.3	1.92	0.16	2.89	0.10	9.53	12.05	0.01	0.30	19.71	0.35	13.18	0.01	37.34	3.42	100.98	0.84	100.14
B4_bt 3																	
1 / 1 .	1.87	0.14	2.94	0.04	9.56	12.41	0.05	0.28	19.47	0.17	13.20	0.00	37.54	3.26	100.94	0.82	100.12
1 / 2 .	2.17	0.12	2.79	0.07	9.65	12.72	0.01	0.32	19.18	0.16	13.14	-0.05	37.52	3.25	101.10	0.94	100.16
1 / 3 .	1.87	0.13	2.95	0.04	9.59	12.76	0.02	0.35	19.22	0.29	13.14	0.00	37.54	3.39	101.29	0.82	100.47
1 / 4 .	1.66	0.11	2.90	0.07	5.25	12.85	0.14	0.42	22.74	0.18	13.98	-0.03	34.05	2.55	96.89	0.72	96.17
1 / 5 .	1.95	0.14	2.89	0.05	9.61	12.61	0.03	0.34	19.55	0.16	13.22	-0.03	37.36	3.09	101.01	0.85	100.15
1 / 6 .	1.00	0.09	3.29	0.06	6.10	10.84	0.10	0.30	26.77	0.21	13.59	0.01	34.79	2.55	99.70	0.44	99.26
1 / 7 .	1.92	0.14	2.92	0.08	9.53	12.41	0.06	0.35	19.66	0.22	13.24	-0.06	37.49	3.45	101.48	0.84	100.64
Avg B4_3.1	1.78	0.12	2.95	0.06	8.47	12.37	0.06	0.34	20.94	0.20	13.36	-0.02	36.61	3.08	100.32	0.78	99.54
2 / 1 .	0.84	0.14	3.47	0.19	5.14	11.67	0.30	0.29	24.72	0.10	15.18	-0.02	36.23	2.09	100.37	0.39	99.98
2 / 2 .	1.87	0.12	2.93	0.03	9.15	12.44	0.05	0.31	19.84	0.10	13.33	0.00	37.33	3.17	100.68	0.82	99.86
2 / 3 .	1.90	0.14	2.94	0.06	9.22	12.71	0.03	0.32	19.91	0.29	13.44	-0.05	37.42	3.18	101.57	0.83	100.74
2 / 4 .	1.89	0.13	2.92	0.06	9.05	12.50	0.03	0.30	19.80	0.14	13.46	-0.05	37.21	3.14	100.63	0.82	99.81
2 / 5 .	1.94	0.14	2.94	0.04	9.76	12.53	0.02	0.35	19.26	0.29	13.30	-0.06	37.93	3.45	101.95	0.85	101.10
2 / 6 .	1.85	0.13	3.00	0.04	9.80	12.61	0.00	0.33	19.69	0.23	13.41	-0.04	37.97	3.43	102.49	0.81	101.68
2 / 7 .	1.98	0.15	2.92	0.04	9.58	12.56	0.01	0.34	19.55	0.31	13.36	-0.04	37.89	3.40	102.09	0.87	101.22
2 / 8 .	1.90	0.16	2.96	0.07	9.74	12.49	0.01	0.33	19.21	0.20	13.35	-0.06	38.06	3.54	102.03	0.84	101.19
2 / 9 .	1.97	0.14	2.91	0.07	9.71	12.39	0.01	0.27	19.54	0.27	13.39	-0.07	37.73	3.42	101.82	0.86	100.96
2 / 10 .	1.75	0.14	3.04	0.06	9.34	12.45	0.02	0.33	20.26	0.24	13.47	-0.02	37.52	3.47	102.09	0.77	101.32
Avg B4_3.2	1.79	0.14	3.00	0.07	9.05	12.44	0.05	0.31	20.18	0.22	13.57	-0.04	37.53	3.23	101.53	0.78	100.75
B4_bt 4																	
1 / 1 .	2.17	0.20	2.79	0.05	9.50	12.82	0.01	0.26	19.19	0.36	13.36	-0.03	37.71	3.21	101.63	0.96	100.67
1 / 2 .	2.09	0.19	2.81	0.05	9.59	12.81	0.02	0.26	18.52	0.45	13.24	0.00	37.64	3.09	100.75	0.92	99.83
1 / 3 .	2.11	0.20	2.81	0.07	9.64	12.93	0.02	0.25	18.83	0.45	13.31	-0.02	37.71	3.07	101.38	0.93	100.45
1 / 4 .	2.10	0.21	2.82	0.06	9.63	12.89	0.02	0.25	18.88	0.58	13.33	-0.03	37.83	3.05	101.64	0.93	100.71

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 5 .	2.01	0.21	2.84	0.06	9.33	12.71	0.02	0.30	18.83	0.45	13.25	0.00	37.67	2.99	100.65	0.89	99.76
1 / 6 .	1.98	0.19	2.89	0.09	9.55	12.72	0.02	0.24	19.07	0.42	13.21	-0.01	37.90	3.23	101.50	0.88	100.62
1 / 7 .	1.93	0.20	2.91	0.07	9.55	12.61	0.02	0.31	18.83	0.56	13.39	-0.05	37.75	3.27	101.42	0.86	100.56
1 / 8 .	1.99	0.21	2.87	0.06	9.56	12.62	0.03	0.29	19.10	0.52	13.23	-0.01	37.83	3.16	101.47	0.89	100.59
1 / 9 .	1.93	0.21	2.90	0.07	9.67	12.69	0.02	0.23	18.90	0.37	13.31	0.00	37.92	3.00	101.22	0.86	100.36
1 / 10 .	2.09	0.17	2.83	0.07	9.65	12.98	0.01	0.24	18.79	0.18	13.14	0.03	37.82	3.23	101.25	0.92	100.33
Avg B4_4.1	2.04	0.20	2.85	0.07	9.57	12.78	0.02	0.26	18.89	0.43	13.28	-0.01	37.78	3.13	101.28	0.90	100.37
2 / 1 .	0.71	0.26	3.63	1.84	1.74	8.43	11.09	0.58	20.82	0.01	10.65	0.01	41.57	1.25	102.60	0.36	102.25
2 / 2 .	0.67	0.24	3.60	1.37	1.70	9.13	10.12	0.55	21.00	-0.02	10.72	0.01	41.01	0.84	100.95	0.33	100.62
2 / 3 .	2.11	0.20	2.77	0.07	9.65	12.89	0.10	0.33	18.51	0.24	13.01	-0.03	37.40	2.94	100.20	0.93	99.27
2 / 4 .	2.02	0.20	2.83	0.06	9.52	12.65	0.03	0.29	18.94	0.54	13.24	-0.02	37.44	3.03	100.77	0.90	99.88
2 / 5 .	2.14	0.20	2.78	0.04	9.70	12.58	0.01	0.25	18.74	0.37	13.23	0.04	37.73	3.04	100.84	0.95	99.90
2 / 6 .	2.01	0.20	2.85	0.05	9.59	12.71	0.01	0.27	18.81	0.47	13.31	0.02	37.80	2.87	100.97	0.89	100.07
2 / 7 .	2.08	0.20	2.85	0.06	9.64	12.92	0.01	0.28	18.85	0.59	13.36	0.04	37.84	3.22	101.93	0.92	101.01
2 / 8 .	2.01	0.19	2.86	0.05	9.52	12.76	0.00	0.32	18.77	0.31	13.38	-0.04	37.71	2.93	100.80	0.89	99.91
2 / 9 .	2.08	0.18	2.84	0.07	9.43	12.85	0.01	0.26	18.89	0.33	13.25	0.01	38.06	2.99	101.24	0.92	100.32
2 / 10 .	2.01	0.19	2.89	0.07	9.58	12.94	0.01	0.25	19.40	0.34	13.33	0.01	37.93	3.08	102.03	0.89	101.14
2 / 11 .	2.07	0.20	2.85	0.08	9.50	12.96	0.02	0.29	18.82	0.42	13.35	0.06	38.01	3.13	101.76	0.92	100.84
2 / 12 .	2.11	0.20	2.83	0.06	9.53	13.00	0.03	0.32	18.87	0.40	13.32	-0.02	38.01	3.07	101.74	0.93	100.81
2 / 13 .	2.03	0.19	2.91	0.03	9.46	13.28	0.06	0.29	18.49	0.32	13.46	0.04	38.51	3.00	102.07	0.90	101.17
2 / 14 .	1.86	0.19	3.03	0.07	8.99	13.14	0.95	0.29	19.02	0.30	13.36	-0.01	39.00	2.70	102.90	0.83	102.07
2 / 15 . *	0.42	0.25	3.87	1.47	1.48	8.48	11.12	0.61	21.20	0.04	11.39	0.01	43.08	0.68	104.09	0.24	103.85
Avg B4_4.2	1.76	0.21	3.02	0.36	7.94	12.05	2.24	0.34	19.27	0.31	12.82	0.01	38.74	2.58	101.65	0.79	100.87
3 / 1 .	1.00	0.26	3.43	1.21	2.33	9.29	9.66	0.53	20.77	0.02	11.13	0.03	40.98	0.81	101.46	0.48	100.98
3 / 2 . *	2.22	0.19	2.65	0.10	9.16	12.62	0.29	0.28	18.75	0.17	12.64	-0.03	36.90	2.76	98.73	0.98	97.76
3 / 3 .	0.78	0.27	3.47	1.13	2.05	9.67	9.00	0.53	21.55	0.10	11.14	0.03	39.47	0.91	100.11	0.39	99.72
3 / 4 . *	0.96	0.20	3.29	0.81	1.98	10.51	6.91	0.45	22.54	0.05	12.07	-0.02	36.80	1.14	97.72	0.45	97.27
Avg B4_4.1	0.89	0.27	3.45	1.17	2.19	9.48	9.33	0.53	21.16	0.06	11.14	0.03	40.22	0.86	100.78	0.43	100.35

B4_bt 5

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 1 .	1.84	0.18	2.97	0.05	9.53	12.28	0.01	0.32	19.43	0.38	13.56	0.00	37.68	3.46	101.68	0.81	100.87
1 / 2 .	1.99	0.18	2.86	0.07	9.57	12.15	0.02	0.29	18.90	0.40	13.47	0.02	37.66	3.27	100.85	0.88	99.97
1 / 3 .	1.94	0.18	2.90	0.06	9.52	12.17	0.01	0.29	19.18	0.33	13.43	0.03	37.66	3.47	101.17	0.86	100.31
1 / 4 .	1.84	0.16	2.96	0.06	9.68	12.19	0.01	0.32	19.15	0.54	13.55	0.02	37.52	3.62	101.62	0.81	100.81
1 / 5 .	1.95	0.16	2.91	0.06	9.58	12.16	0.01	0.31	18.93	0.45	13.60	0.01	37.80	3.49	101.42	0.86	100.56
1 / 6 .	2.00	0.20	2.87	0.06	9.67	12.30	0.00	0.26	19.38	0.42	13.40	-0.02	37.54	3.50	101.60	0.89	100.71
1 / 7 .	1.74	0.19	3.01	0.06	9.64	12.18	0.01	0.29	19.13	0.39	13.52	0.00	37.72	3.44	101.31	0.77	100.53
1 / 8 .	1.92	0.18	2.91	0.08	9.65	12.27	0.00	0.23	19.65	0.44	13.50	0.07	37.44	3.29	101.64	0.85	100.79
1 / 9 .	1.84	0.19	2.96	0.07	9.63	12.17	0.01	0.36	19.55	0.38	13.52	0.01	37.65	3.44	101.79	0.82	100.97
1 / 10 .	1.95	0.20	2.89	0.06	9.69	12.27	0.02	0.28	19.28	0.34	13.56	0.02	37.48	3.28	101.31	0.86	100.45
Avg B4_5.1	1.90	0.18	2.92	0.06	9.62	12.21	0.01	0.29	19.26	0.41	13.51	0.02	37.61	3.43	101.44	0.84	100.60
2 / 1 .	1.95	0.16	2.94	0.06	9.68	12.47	0.08	0.27	19.38	0.18	13.41	-0.03	37.98	3.47	102.01	0.86	101.16
2 / 2 .	1.86	0.18	2.96	0.08	9.64	12.43	0.06	0.27	19.38	0.07	13.38	0.03	37.95	3.40	101.69	0.83	100.86
2 / 3 .	1.78	0.18	3.01	0.06	9.62	12.41	0.06	0.31	19.20	0.10	13.55	0.01	37.87	3.40	101.55	0.79	100.76
2 / 4 .	1.83	0.19	2.96	0.07	9.62	12.36	0.07	0.27	19.39	0.07	13.55	0.02	37.66	3.28	101.34	0.81	100.52
2 / 5 .	1.87	0.17	2.96	0.07	9.62	12.45	0.05	0.29	19.15	0.30	13.45	0.01	37.91	3.38	101.66	0.83	100.84
2 / 6 .	1.97	0.18	2.91	0.07	9.67	12.44	0.05	0.18	19.42	0.24	13.50	0.03	37.86	3.48	101.99	0.87	101.12
2 / 7 .	2.01	0.19	2.89	0.06	9.70	12.36	0.04	0.30	19.34	0.23	13.52	0.04	37.81	3.60	102.10	0.89	101.21
2 / 8 .	2.03	0.19	2.86	0.06	9.75	12.38	0.03	0.29	19.21	0.39	13.45	0.01	37.58	3.47	101.71	0.90	100.82
2 / 9 .	1.90	0.17	2.95	0.07	9.55	12.50	0.04	0.23	19.50	0.33	13.60	0.02	37.80	3.29	101.94	0.84	101.10
2 / 10 .	1.80	0.17	2.99	0.05	9.66	12.38	0.02	0.28	19.03	0.35	13.59	0.03	37.66	3.53	101.55	0.80	100.76
Avg B4_5.2	1.90	0.18	2.94	0.06	9.65	12.42	0.05	0.27	19.30	0.23	13.50	0.02	37.81	3.43	101.75	0.84	100.91
3 / 1 .	1.84	0.15	2.94	0.09	9.50	11.68	0.02	0.30	19.56	0.40	13.30	0.02	37.56	3.58	100.95	0.81	100.15
3 / 2 .	1.87	0.18	2.94	0.05	9.72	11.83	0.00	0.34	19.70	0.23	13.47	0.01	37.53	3.73	101.60	0.83	100.78
3 / 3 .	1.74	0.17	2.98	0.07	9.50	11.72	0.01	0.27	19.41	0.48	13.34	0.03	37.44	3.48	100.65	0.77	99.88
3 / 4 .	1.78	0.16	2.98	0.05	9.55	11.70	0.00	0.29	20.02	0.31	13.45	0.06	37.40	3.71	101.49	0.79	100.70
3 / 5 .	1.81	0.17	2.97	0.05	9.68	11.77	0.00	0.30	19.83	0.42	13.40	0.02	37.38	3.90	101.68	0.80	100.88
3 / 6 .	1.77	0.18	2.98	0.07	9.54	11.70	0.01	0.23	19.92	0.31	13.43	0.03	37.54	3.56	101.28	0.78	100.49
3 / 7 .	1.77	0.18	2.97	0.05	9.45	11.69	0.00	0.32	19.69	0.33	13.46	0.06	37.31	3.62	100.88	0.78	100.09
Avg B4_5.3	1.79	0.17	2.97	0.06	9.56	11.73	0.01	0.29	19.73	0.35	13.41	0.03	37.45	3.66	101.22	0.79	100.42

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
4 / 1 . *	1.66	0.16	3.11	0.07	9.83	11.41	0.01	0.21	19.27	0.23	14.01	0.04	38.79	3.42	102.20	0.74	101.47
4 / 2 .	1.69	0.18	3.00	0.08	9.54	11.59	0.02	0.36	19.70	0.05	13.30	0.04	37.48	3.49	100.53	0.75	99.78
4 / 3 . *	1.37	0.16	3.63	0.07	8.80	10.68	0.04	0.21	18.67	0.27	12.91	0.04	47.60	3.46	107.91	0.61	107.30
4 / 4 . *	1.64	0.18	3.13	0.05	9.60	11.56	0.06	0.30	20.21	0.10	13.46	0.02	39.06	3.41	102.79	0.73	102.06
4 / 5 . *	1.65	0.19	3.09	0.05	9.67	11.67	0.03	0.36	19.73	0.19	13.48	0.03	38.44	3.45	102.03	0.74	101.29
4 / 6 .	1.83	0.19	2.96	0.06	9.58	12.07	0.05	0.26	19.78	0.19	13.34	0.02	37.55	3.61	101.48	0.81	100.67
Avg B4_5.4	1.76	0.19	2.98	0.07	9.56	11.83	0.04	0.31	19.74	0.12	13.32	0.03	37.51	3.55	101.00	0.78	100.22
B4_bt 6																	
1 / 1 .	1.89	0.18	2.95	0.08	9.61	12.18	0.01	0.32	19.34	0.32	13.46	-0.03	37.94	3.43	101.71	0.84	100.87
1 / 2 .	1.90	0.16	2.95	0.08	9.66	12.19	0.00	0.28	19.22	0.34	13.59	0.01	37.65	3.70	101.72	0.83	100.88
1 / 3 . *	1.97	0.15	2.93	0.07	9.81	12.17	0.00	0.33	19.31	0.34	13.54	0.00	37.90	3.74	102.27	0.86	101.40
1 / 4 .	1.86	0.16	2.95	0.09	9.61	12.03	0.03	0.26	19.56	0.43	13.46	0.01	37.43	3.72	101.61	0.82	100.79
1 / 5 .	1.79	0.17	2.99	0.09	9.56	12.14	0.01	0.32	19.42	0.45	13.49	0.02	37.67	3.49	101.60	0.79	100.81
1 / 6 . *	1.80	0.18	3.01	0.08	9.61	12.12	0.00	0.25	19.57	0.47	13.73	-0.03	37.94	3.47	102.22	0.80	101.42
1 / 7 .	1.91	0.17	2.94	0.08	9.67	12.13	0.01	0.28	19.63	0.31	13.58	0.00	37.65	3.48	101.82	0.84	100.98
1 / 8 . *	1.88	0.19	2.95	0.08	9.71	12.07	0.00	0.27	19.60	0.46	13.70	0.02	37.55	3.54	102.03	0.84	101.19
1 / 9 . *	1.74	0.18	3.03	0.08	9.70	12.09	0.00	0.29	19.77	0.45	13.60	0.06	37.52	3.62	102.12	0.77	101.35
1 / 10 . *	1.85	0.18	2.98	0.06	9.60	12.20	0.00	0.31	19.70	0.46	13.58	0.02	37.76	3.52	102.23	0.82	101.41
Avg B4_6	1.86	0.17	2.97	0.08	9.65	12.13	0.01	0.29	19.51	0.40	13.57	0.01	37.70	3.57	101.93	0.82	101.10
B4_bt 7																	
1 / 1 .	1.76	0.12	3.01	0.06	9.65	11.89	-0.01	0.34	19.23	0.49	13.45	0.01	37.39	3.83	101.21	0.77	100.45
1 / 2 .	1.74	0.16	3.02	0.06	9.56	11.85	0.00	0.36	19.88	0.45	13.43	0.02	37.47	3.85	101.84	0.77	101.07
1 / 3 .	1.67	0.16	3.04	0.05	9.73	11.88	0.00	0.38	19.57	0.46	13.55	0.05	37.14	3.69	101.36	0.74	100.62
1 / 4 .	1.71	0.17	3.00	0.05	9.54	11.84	-0.01	0.39	19.64	0.45	13.51	0.04	36.96	3.72	101.00	0.76	100.25
1 / 5 .	1.75	0.11	3.02	0.07	9.72	11.83	0.01	0.39	20.10	0.51	13.47	0.02	37.16	3.74	101.90	0.76	101.14
1 / 6 .	1.63	0.14	3.06	0.06	9.67	11.71	0.00	0.37	19.76	0.45	13.38	0.01	37.25	3.81	101.31	0.72	100.59
1 / 7 .	1.60	0.16	3.07	0.08	9.35	11.71	0.01	0.33	20.03	0.59	13.47	0.05	37.15	3.86	101.48	0.71	100.77
1 / 8 .	1.68	0.14	3.03	0.07	9.66	11.75	-0.01	0.30	19.85	0.56	13.41	0.00	37.18	3.76	101.40	0.74	100.66
1 / 9 .	1.70	0.14	3.03	0.09	9.52	11.90	0.00	0.40	19.93	0.57	13.49	0.00	37.19	3.66	101.62	0.75	100.87

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 10 .	1.70	0.13	3.03	0.06	9.65	11.85	0.01	0.37	19.65	0.43	13.41	0.03	37.29	3.84	101.46	0.75	100.72
Avg B4_7.1	1.69	0.14	3.03	0.07	9.61	11.82	0.00	0.36	19.76	0.50	13.46	0.02	37.22	3.78	101.45	0.75	100.71
BR-14 B3																	
B3_bt 1																	
1 / 1 .	1.51	0.13	3.06	0.00	7.32	12.45	0.14	0.31	20.96	0.18	13.85	0.02	35.77	3.20	98.89	0.66	98.23
1 / 2 .	1.82	0.16	2.97	0.02	9.57	12.35	0.04	0.25	19.28	0.39	13.53	-0.01	37.61	3.15	101.13	0.80	100.33
1 / 3 .	1.85	0.16	2.96	0.04	9.66	12.40	0.01	0.30	19.28	0.47	13.54	0.00	37.79	3.08	101.55	0.81	100.73
1 / 4 .	1.94	0.15	2.93	0.03	9.81	12.42	0.01	0.27	19.28	0.49	13.62	-0.01	37.82	3.01	101.76	0.85	100.91
1 / 5 .	1.97	0.15	2.92	0.03	9.75	12.35	0.01	0.30	19.48	0.34	13.65	-0.01	37.87	3.18	102.00	0.86	101.13
1 / 6 .	1.95	0.16	2.92	0.03	9.76	12.44	0.00	0.25	19.35	0.41	13.69	-0.01	37.62	3.13	101.70	0.85	100.84
1 / 7 .	1.95	0.14	2.93	0.03	9.77	12.60	0.01	0.27	19.34	0.48	13.61	0.01	37.90	3.02	102.06	0.85	101.21
1 / 8 .	1.98	0.16	2.90	0.03	9.91	12.56	0.03	0.30	19.08	0.35	13.55	-0.01	37.91	3.06	101.83	0.87	100.96
1 / 9 .	1.84	0.14	2.93	0.04	8.33	12.99	0.09	0.24	19.80	0.23	13.70	0.01	36.90	2.77	100.00	0.81	99.20
1 / 10 .	0.67	0.19	3.67	1.44	1.69	8.40	11.09	0.49	20.60	-0.05	10.54	0.05	42.12	1.25	102.20	0.33	101.88
Avg B3_1.1	1.75	0.15	3.02	0.17	8.56	12.09	1.14	0.30	19.64	0.33	13.33	0.01	37.93	2.88	101.30	0.77	100.53
2 / 1 .	1.37	0.12	3.19	0.05	8.82	11.16	0.02	0.30	21.06	0.19	13.74	0.01	37.00	3.78	100.80	0.60	100.20
2 / 2 .	1.48	0.13	3.13	0.04	9.68	10.91	0.02	0.32	20.08	0.41	13.41	0.02	37.38	4.09	101.11	0.65	100.46
2 / 3 .	1.57	0.13	3.12	0.03	9.75	10.99	0.01	0.27	20.15	0.48	13.49	0.02	37.30	4.64	101.93	0.69	101.24
2 / 4 .	1.60	0.12	3.10	0.04	9.62	10.95	0.01	0.27	20.56	0.55	13.49	-0.01	37.44	4.39	102.15	0.70	101.45
2 / 5 .	1.56	0.11	3.13	0.05	9.70	11.02	0.01	0.27	20.64	0.37	13.45	-0.01	37.55	4.31	102.17	0.68	101.49
2 / 6 .	1.58	0.13	3.08	0.05	9.59	10.85	0.02	0.24	20.12	0.51	13.37	-0.01	37.37	4.24	101.15	0.70	100.45
2 / 7 .	1.65	0.12	3.05	0.01	9.82	10.98	0.00	0.30	20.15	0.43	13.31	0.00	37.43	4.17	101.43	0.72	100.71
2 / 8 .	1.57	0.14	3.09	0.05	9.58	11.00	0.05	0.27	20.52	0.35	13.36	0.02	37.29	4.11	101.40	0.69	100.70
2 / 9 .	1.56	0.13	3.09	0.02	9.83	11.04	0.02	0.30	20.09	0.43	13.25	-0.02	37.38	3.98	101.12	0.69	100.44
2 / 10 .	1.22	0.13	3.41	0.10	9.86	10.03	0.04	0.24	18.88	0.34	14.29	-0.03	40.52	3.81	102.89	0.54	102.34
Avg B3_1.2	1.52	0.13	3.14	0.04	9.63	10.89	0.02	0.28	20.23	0.41	13.52	0.00	37.67	4.15	101.61	0.67	100.94
B3_bt 2																	
1 / 1 .	1.79	0.16	2.97	0.04	9.59	11.94	0.00	0.25	19.61	0.39	13.50	0.04	37.55	3.27	101.11	0.79	100.32

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 2 .	1.15	0.13	3.76	0.03	6.76	7.94	-0.01	0.16	13.78	-0.03	8.86	-0.01	57.23	2.19	102.01	0.52	101.49
1 / 3 . *	-0.45	-0.01	5.59	-0.04	-0.03	-0.03	-0.02	-0.07	0.07	-0.23	-0.07	-0.01	102.43	0.02	108.11	0.00	108.11
1 / 4 . *	-0.44	0.01	5.35	1.84	0.11	-0.02	0.67	-0.04	0.52	-0.20	4.98	0.00	92.33	-0.05	105.82	0.00	105.82
1 / 5 . *	-0.42	0.00	5.00	8.43	0.12	-0.03	3.93	-0.02	0.10	-0.22	23.11	-0.02	64.95	-0.03	105.65	0.00	105.65
1 / 6 . *	-0.45	0.03	4.83	7.86	0.24	0.13	3.87	-0.05	0.40	-0.21	22.17	0.00	62.98	0.03	102.55	0.01	102.54
1 / 7 . *	-0.43	-0.01	4.99	8.41	0.16	-0.02	3.89	-0.04	0.13	-0.14	23.09	-0.02	64.84	0.01	105.53	0.00	105.53
1 / 8 . *	-0.45	-0.01	5.59	-0.02	-0.04	-0.02	-0.02	-0.07	-0.02	-0.24	-0.07	0.02	102.48	0.00	108.09	0.00	108.09
1 / 9 . *	-0.47	-0.02	5.59	-0.02	-0.01	-0.02	-0.04	-0.05	-0.04	-0.21	-0.06	-0.03	102.51	-0.04	108.10	0.00	108.10
1 / 10 . *	-0.49	0.01	4.74	0.58	15.50	0.00	0.00	-0.05	0.05	1.04	18.61	0.00	65.05	0.00	105.58	0.00	105.58
Avg B3_2.1	1.47	0.15	3.37	0.04	8.17	9.94	0.00	0.21	16.70	0.18	11.18	0.02	47.39	2.73	101.53	0.65	100.88
2 / 1 .	1.35	0.15	3.14	0.04	8.49	10.65	0.07	0.25	22.35	0.06	14.02	0.01	36.24	3.16	99.99	0.60	99.39
2 / 2 .	1.23	0.16	3.19	0.07	8.18	10.47	0.05	0.27	23.28	0.24	13.89	0.03	36.06	3.10	100.20	0.56	99.64
2 / 3 .	1.28	0.13	3.12	0.06	8.02	10.20	0.06	0.29	23.19	0.27	13.78	0.06	35.45	3.16	99.06	0.57	98.49
2 / 4 .	1.33	0.15	3.09	0.06	8.04	10.13	0.04	0.32	23.08	0.19	13.68	0.03	35.56	3.12	98.83	0.59	98.23
2 / 5 .	1.23	0.13	3.13	0.07	7.68	10.04	0.08	0.27	23.90	0.27	13.94	0.04	35.08	2.92	98.78	0.55	98.24
2 / 6 . *	1.15	0.16	3.15	0.07	7.50	10.16	0.11	0.22	23.24	0.25	13.94	0.05	35.11	2.94	98.06	0.52	97.53
2 / 7 .	1.24	0.15	3.14	0.05	7.95	10.22	0.05	0.25	23.12	0.42	13.96	0.08	35.49	2.88	99.00	0.56	98.44
2 / 8 .	1.26	0.14	3.13	0.06	7.80	10.19	0.07	0.26	23.36	0.40	14.09	0.05	35.20	3.06	99.07	0.56	98.50
2 / 9 .	1.38	0.17	3.10	0.06	8.36	10.54	0.09	0.26	22.45	0.29	13.54	0.01	36.08	3.37	99.70	0.62	99.08
2 / 10 .	1.49	0.18	3.04	0.06	8.88	10.73	0.08	0.25	21.53	0.31	13.30	0.01	36.45	3.35	99.66	0.67	99.00
Avg B3_2.2	1.29	0.15	3.12	0.06	8.09	10.33	0.07	0.26	22.95	0.27	13.81	0.04	35.67	3.11	99.23	0.58	98.65
3 / 1 .	1.58	0.16	3.10	0.07	9.70	11.46	0.01	0.24	20.96	0.28	13.53	0.01	37.57	3.42	102.09	0.70	101.39
3 / 2 .	1.74	0.17	3.01	0.06	9.73	11.36	0.00	0.33	20.44	0.29	13.58	0.05	37.62	3.42	101.81	0.77	101.04
3 / 3 .	1.74	0.17	2.99	0.05	9.79	11.41	0.00	0.30	20.42	0.29	13.54	0.02	37.48	3.24	101.44	0.77	100.67
3 / 4 .	1.72	0.17	3.00	0.07	9.61	11.46	0.01	0.24	20.43	0.26	13.50	0.04	37.50	3.31	101.34	0.76	100.57
3 / 5 .	1.72	0.16	3.01	0.05	9.71	11.48	0.00	0.26	20.58	0.15	13.44	0.04	37.51	3.37	101.47	0.76	100.71
3 / 6 .	1.70	0.17	3.03	0.06	9.62	11.57	-0.01	0.32	20.60	0.27	13.52	0.01	37.57	3.32	101.76	0.76	101.01
3 / 7 .	1.71	0.17	3.00	0.04	9.74	11.42	0.00	0.27	20.16	0.35	13.42	0.02	37.49	3.32	101.12	0.76	100.35
3 / 8 .	1.69	0.16	3.01	0.05	9.61	11.41	0.01	0.22	20.77	0.32	13.44	0.03	37.44	3.13	101.29	0.75	100.55
3 / 9 .	1.63	0.18	3.07	0.04	9.67	11.55	0.01	0.28	20.67	0.30	13.52	0.00	37.50	3.49	101.91	0.73	101.19

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
3 / 10 .	1.67	0.17	3.04	0.03	9.63	11.60	0.02	0.26	20.48	0.32	13.47	0.03	37.54	3.35	101.61	0.74	100.87
Avg B3_2.3	1.69	0.17	3.03	0.05	9.68	11.47	0.00	0.27	20.55	0.28	13.50	0.02	37.52	3.34	101.58	0.75	100.83
B3_bt 3																	
1 / 1 .	1.56	0.16	3.11	0.06	9.71	11.35	0.02	0.30	19.87	0.43	13.43	-0.01	37.56	4.14	101.69	0.69	100.99
1 / 2 .	1.59	0.14	3.08	0.04	9.63	11.35	0.01	0.31	20.03	0.34	13.31	-0.03	37.46	3.96	101.27	0.70	100.57
1 / 3 .	1.50	0.16	3.14	0.05	9.69	11.37	0.03	0.37	19.75	0.46	13.39	-0.01	37.64	4.01	101.56	0.67	100.90
1 / 4 .	1.63	0.16	3.06	0.06	9.57	11.30	0.03	0.38	20.20	0.38	13.37	0.01	37.41	3.99	101.55	0.72	100.83
1 / 5 .	1.53	0.15	3.13	0.06	9.57	11.34	0.02	0.35	20.15	0.47	13.37	-0.03	37.71	4.09	101.96	0.68	101.28
1 / 6 .	1.65	0.15	3.08	0.06	9.77	11.29	-0.01	0.27	20.43	0.58	13.40	0.01	37.55	4.27	102.50	0.73	101.77
1 / 7 .	1.55	0.15	3.12	0.06	9.61	11.38	0.02	0.32	20.47	0.50	13.44	0.00	37.50	4.11	102.24	0.69	101.55
1 / 8 .	1.51	0.14	3.16	0.05	9.71	11.37	0.02	0.42	20.52	0.41	13.40	-0.01	37.76	4.07	102.55	0.67	101.89
1 / 9 .	1.63	0.15	3.08	0.05	9.73	11.36	0.01	0.35	20.11	0.40	13.35	-0.03	37.51	4.20	101.92	0.72	101.20
1 / 10 .	1.63	0.15	3.08	0.04	9.78	11.32	0.00	0.28	20.02	0.37	13.49	-0.02	37.69	4.06	101.92	0.72	101.19
Avg B3_3.1	1.58	0.15	3.11	0.05	9.68	11.34	0.02	0.33	20.16	0.43	13.39	-0.01	37.58	4.09	101.90	0.70	101.20
2 / 1 .	1.61	0.17	3.07	0.05	9.67	11.36	-0.01	0.35	19.96	0.46	13.36	0.05	37.41	4.03	101.54	0.72	100.82
2 / 2 .	1.62	0.14	3.08	0.06	9.66	11.33	0.00	0.37	19.97	0.36	13.42	0.03	37.66	3.94	101.64	0.71	100.92
2 / 3 .	1.58	0.16	3.09	0.05	9.72	11.34	0.00	0.34	20.28	0.45	13.31	-0.02	37.57	3.78	101.69	0.70	100.99
2 / 4 .	1.61	0.14	3.08	0.05	9.65	11.35	0.01	0.32	19.80	0.57	13.38	0.00	37.54	4.08	101.58	0.71	100.87
2 / 5 .	1.58	0.13	3.12	0.05	9.64	11.41	0.00	0.35	20.11	0.45	13.47	-0.02	37.64	3.97	101.90	0.69	101.21
2 / 6 .	1.52	0.15	3.14	0.07	9.67	11.38	0.01	0.29	20.39	0.52	13.33	-0.01	37.57	4.05	102.07	0.67	101.40
2 / 7 .	1.61	0.15	3.07	0.03	9.61	11.18	0.01	0.30	19.64	0.44	13.47	0.01	37.51	4.05	101.08	0.71	100.37
2 / 8 .	1.58	0.17	3.09	0.07	9.71	11.33	0.00	0.29	20.09	0.36	13.41	0.00	37.34	4.13	101.58	0.70	100.87
2 / 9 .	1.64	0.17	3.04	0.05	9.61	11.28	0.01	0.35	20.21	0.52	13.25	0.00	37.42	3.79	101.33	0.73	100.60
2 / 10 .	1.55	0.14	3.09	0.06	9.50	11.26	0.01	0.31	20.25	0.39	13.44	0.00	37.25	3.78	101.04	0.68	100.36
Avg B3_3.2	1.59	0.15	3.09	0.05	9.64	11.32	0.00	0.33	20.07	0.45	13.38	0.00	37.49	3.96	101.54	0.70	100.84
3 / 1 .	0.65	0.16	3.64	1.02	3.25	9.06	8.08	0.50	21.90	0.13	11.48	-0.01	40.21	1.84	101.92	0.31	101.61
3 / 2 .	1.68	0.14	3.06	0.06	9.65	11.62	0.04	0.31	20.45	0.19	13.33	-0.01	37.61	3.88	102.01	0.74	101.27
3 / 3 .	1.57	0.15	3.13	0.05	9.59	11.44	0.02	0.26	20.46	0.27	13.43	0.02	37.75	4.00	102.14	0.69	101.45
3 / 4 .	1.56	0.13	3.11	0.05	9.68	11.46	0.01	0.32	20.20	0.38	13.36	-0.02	37.59	3.79	101.64	0.69	100.96

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
3 / 5 .	1.62	0.15	3.11	0.06	9.57	11.56	0.00	0.28	20.41	0.56	13.36	-0.06	37.75	4.08	102.50	0.72	101.79
3 / 6 .	1.54	0.17	3.12	0.05	9.65	11.48	0.00	0.32	20.29	0.48	13.44	0.00	37.55	3.93	102.01	0.69	101.33
3 / 7 .	1.62	0.17	3.08	0.03	9.75	11.44	0.00	0.34	20.41	0.48	13.27	0.03	37.53	4.04	102.18	0.72	101.46
3 / 8 .	1.61	0.15	3.08	0.05	9.58	11.34	0.01	0.33	20.32	0.44	13.25	0.01	37.53	3.92	101.63	0.71	100.92
3 / 9 .	1.53	0.16	3.11	0.05	9.69	11.41	0.01	0.29	20.05	0.34	13.29	0.00	37.46	3.98	101.37	0.68	100.69
3 / 10 .	1.71	0.15	3.02	0.05	9.63	11.45	0.00	0.30	20.13	0.36	13.29	0.00	37.46	3.94	101.49	0.75	100.74
Avg B3_3.3	1.51	0.15	3.15	0.15	9.00	11.23	0.82	0.32	20.46	0.36	13.15	0.00	37.84	3.74	101.88	0.67	101.21
4 / 1 .	1.39	0.12	3.38	1.57	7.95	9.86	0.42	0.27	16.44	0.23	14.83	0.02	42.63	2.90	102.01	0.61	101.39
4 / 2 .	1.71	0.14	3.10	0.65	8.93	11.23	0.14	0.35	18.64	0.29	14.16	0.01	39.38	3.06	101.79	0.75	101.04
4 / 3 .	1.56	0.15	3.21	0.98	8.91	10.91	0.18	0.32	18.39	0.36	14.27	0.02	40.18	3.01	102.44	0.69	101.75
4 / 4 .	1.59	0.16	3.13	0.18	9.35	11.70	0.05	0.27	19.52	0.63	13.62	-0.01	38.61	3.41	102.23	0.71	101.52
4 / 5 . *	1.60	0.14	3.19	0.10	9.24	11.45	0.05	0.27	20.03	0.59	13.43	0.04	39.88	3.27	103.28	0.71	102.57
4 / 6 .	1.70	0.14	3.16	0.09	9.21	11.57	0.04	0.29	19.23	0.41	13.20	0.00	40.68	3.39	103.12	0.75	102.38
4 / 7 . *	1.41	0.13	3.51	0.08	8.41	10.37	0.03	0.30	17.12	0.38	11.62	-0.04	48.21	2.92	104.49	0.62	103.86
4 / 8 . *	1.42	0.15	3.51	0.04	8.46	10.20	0.01	0.26	17.32	0.33	11.68	0.02	48.37	2.90	104.65	0.63	104.02
4 / 9 . *	1.57	0.15	3.37	0.06	8.62	10.52	0.02	0.29	17.50	0.39	11.96	0.02	46.51	2.95	103.92	0.70	103.23
4 / 10 . *	1.37	0.11	3.63	0.05	7.87	9.55	0.00	0.24	16.02	0.38	10.86	-0.03	52.04	2.79	104.92	0.60	104.32
Avg B3_3.4	1.53	0.14	3.32	0.38	8.69	10.74	0.09	0.29	18.02	0.40	12.96	0.00	43.65	3.06	103.28	0.68	102.60
5 / 1 .	1.65	0.17	3.08	0.05	9.68	11.46	0.00	0.40	20.31	0.44	13.40	0.05	37.65	4.02	102.34	0.73	101.61
5 / 2 .	1.61	0.14	3.08	0.09	9.70	11.30	0.00	0.28	20.02	0.54	13.33	0.02	37.51	4.05	101.68	0.71	100.96
5 / 3 .	1.66	0.15	3.09	0.06	9.51	11.39	0.01	0.29	20.93	0.50	13.47	-0.02	37.64	4.22	102.92	0.73	102.19
5 / 4 .	1.68	0.15	3.05	0.06	9.69	11.40	-0.01	0.29	20.47	0.38	13.37	0.02	37.44	4.04	102.03	0.74	101.29
5 / 5 .	1.54	0.17	3.14	0.05	9.67	11.35	0.02	0.28	21.11	0.42	13.48	-0.04	37.49	4.01	102.73	0.69	102.04
5 / 6 .	1.61	0.14	3.09	0.06	9.60	11.30	0.02	0.29	20.64	0.59	13.32	0.00	37.48	3.99	102.13	0.71	101.42
5 / 7 .	1.66	0.16	3.06	0.06	9.68	11.30	0.01	0.32	20.49	0.51	13.32	-0.04	37.63	3.85	102.05	0.74	101.32
5 / 8 .	1.62	0.14	3.09	0.07	9.72	11.36	0.00	0.30	20.79	0.49	13.45	0.02	37.45	3.96	102.48	0.72	101.77
5 / 9 .	1.67	0.15	3.08	0.06	9.76	11.39	0.00	0.31	20.60	0.46	13.48	-0.02	37.67	3.95	102.59	0.74	101.85
5 / 10 .	1.52	0.17	3.12	0.05	9.57	11.35	0.01	0.29	20.40	0.46	13.47	0.03	37.43	3.88	101.76	0.68	101.08
Avg B3_3.5	1.62	0.15	3.09	0.06	9.66	11.36	0.01	0.30	20.58	0.48	13.41	0.00	37.54	4.00	102.26	0.72	101.54

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
B3_bt 4																	
1 / 1 . *	-0.20	-0.01	4.78	1.01	15.07	0.02	-0.01	0.03	0.48	0.88	18.76	0.07	65.35	0.01	106.46	0.00	106.46
1 / 2 .	1.84	0.15	2.96	0.06	9.68	11.78	0.00	0.35	19.70	0.31	13.39	0.07	37.56	3.68	101.54	0.81	100.73
1 / 3 .	1.80	0.17	2.98	0.05	9.69	11.75	0.01	0.38	19.63	0.28	13.32	0.05	37.53	3.88	101.52	0.80	100.73
1 / 4 .	1.94	0.17	2.92	0.07	9.69	11.92	0.00	0.34	19.35	0.57	13.52	0.07	37.69	3.80	102.06	0.86	101.20
1 / 5 .	2.00	0.18	2.88	0.07	9.81	11.80	0.00	0.29	19.56	0.35	13.50	0.06	37.55	3.70	101.75	0.88	100.87
1 / 6 .	1.89	0.14	2.93	0.07	9.74	11.91	0.01	0.35	19.21	0.61	13.51	0.07	37.44	3.53	101.41	0.83	100.58
1 / 7 .	1.88	0.14	2.95	0.08	9.67	12.12	0.00	0.27	19.63	0.56	13.62	0.05	37.40	3.57	101.94	0.83	101.11
1 / 8 .	1.89	0.18	2.94	0.07	9.76	12.02	0.01	0.36	19.22	0.43	13.67	0.06	37.61	3.55	101.76	0.84	100.93
1 / 9 .	1.91	0.17	2.94	0.07	9.77	12.32	0.00	0.31	19.17	0.40	13.71	0.06	37.68	3.45	101.96	0.84	101.12
1 / 10 .	1.93	0.15	2.93	0.06	9.73	12.31	-0.01	0.29	18.84	0.45	13.73	0.05	37.74	3.37	101.56	0.84	100.72
Avg B3_4.1	1.69	0.14	3.12	0.16	10.26	10.80	0.00	0.30	17.48	0.48	14.07	0.06	40.35	3.25	102.17	0.75	101.42
2 / 1 .	1.81	0.17	2.99	0.07	9.74	11.60	0.01	0.30	20.03	0.58	13.56	0.06	37.40	3.97	102.30	0.80	101.50
2 / 2 .	1.61	0.14	3.03	0.06	8.35	11.19	0.02	0.38	21.85	0.35	13.53	0.04	36.37	3.58	100.50	0.71	99.79
2 / 3 .	1.82	0.16	2.99	0.06	9.72	11.58	0.00	0.35	20.30	0.51	13.46	0.08	37.46	4.01	102.48	0.80	101.68
2 / 4 .	1.82	0.18	2.96	0.05	9.68	11.48	0.00	0.31	19.90	0.54	13.33	0.08	37.54	3.85	101.73	0.81	100.92
2 / 5 .	1.72	0.17	3.03	0.06	9.60	11.52	0.00	0.37	20.29	0.54	13.44	0.04	37.50	3.93	102.21	0.76	101.45
2 / 6 .	1.81	0.19	2.99	0.06	9.71	11.51	0.01	0.37	20.01	0.36	13.43	0.07	37.55	4.17	102.24	0.80	101.44
2 / 7 .	1.89	0.17	2.95	0.06	9.65	11.66	0.00	0.40	19.94	0.47	13.33	0.04	37.59	4.03	102.17	0.83	101.34
2 / 8 .	1.90	0.17	2.95	0.07	9.61	11.61	0.02	0.38	20.00	0.46	13.45	0.08	37.58	4.04	102.32	0.84	101.48
2 / 9 .	1.85	0.16	2.97	0.10	9.63	11.49	0.02	0.37	19.95	0.41	13.46	0.08	37.54	4.11	102.15	0.82	101.33
2 / 10 .	1.83	0.17	2.98	0.09	9.69	11.62	0.01	0.43	19.71	0.43	13.47	0.07	37.73	3.91	102.13	0.81	101.32
Avg B3_4.2	1.81	0.17	2.98	0.07	9.54	11.53	0.01	0.37	20.20	0.46	13.45	0.06	37.43	3.96	102.02	0.80	101.22
B3_bt 5																	
1 / 1 . *	-0.24	0.00	4.76	1.17	14.52	0.14	0.01	0.01	0.52	0.78	18.70	0.02	65.10	0.06	105.79	0.00	105.79
1 / 2 .	1.83	0.16	2.92	0.05	9.23	12.05	0.01	0.31	20.31	0.21	13.27	-0.01	37.18	2.95	100.49	0.81	99.68
1 / 3 .	1.83	0.15	2.97	0.04	9.60	12.10	0.01	0.27	20.33	0.38	13.43	0.03	37.58	3.17	101.90	0.81	101.10
1 / 4 .	1.92	0.18	2.89	0.04	9.54	11.93	0.03	0.24	20.06	0.37	13.41	0.03	37.49	3.14	101.26	0.85	100.41
1 / 5 .	1.98	0.16	2.89	0.06	9.72	11.89	0.01	0.24	20.54	0.35	13.29	0.01	37.52	3.28	101.92	0.87	101.06
1 / 6 .	1.90	0.17	2.90	0.05	9.65	11.84	0.02	0.23	20.05	0.46	13.32	0.00	37.45	3.14	101.18	0.84	100.34

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 7 .	1.82	0.15	2.95	0.06	9.71	11.76	0.02	0.29	20.45	0.47	13.29	0.00	37.48	3.09	101.53	0.80	100.73
1 / 8 .	1.94	0.17	2.89	0.06	9.73	11.75	0.02	0.28	20.06	0.47	13.44	0.00	37.57	3.12	101.51	0.85	100.66
1 / 9 .	1.96	0.15	2.88	0.07	9.64	11.81	0.02	0.31	19.96	0.46	13.32	0.03	37.37	3.22	101.19	0.86	100.33
1 / 10 .	1.92	0.18	2.90	0.05	9.55	11.72	0.04	0.30	20.12	0.53	13.40	0.08	37.32	3.38	101.48	0.85	100.63
1 / 11 .	1.87	0.16	2.91	0.05	9.65	11.69	0.03	0.31	20.04	0.33	13.32	0.01	37.31	3.30	100.98	0.82	100.16
1 / 12 .	1.86	0.17	2.93	0.05	9.63	11.69	0.03	0.30	20.27	0.46	13.33	-0.02	37.39	3.39	101.50	0.82	100.68
1 / 13 .	1.92	0.17	2.91	0.07	9.58	11.52	0.03	0.29	20.64	0.46	13.32	0.02	37.41	3.47	101.83	0.85	100.98
1 / 14 .	1.77	0.16	2.99	0.05	9.72	11.51	0.04	0.28	20.40	0.47	13.36	0.03	37.50	3.63	101.92	0.78	101.13
1 / 15 .	1.90	0.15	2.91	0.06	9.61	11.51	0.01	0.35	20.11	0.50	13.32	0.01	37.32	3.57	101.34	0.83	100.50
1 / 16 .	1.82	0.16	2.95	0.04	9.76	11.47	0.04	0.30	20.61	0.33	13.11	0.05	37.43	3.56	101.61	0.80	100.81
1 / 17 .	1.84	0.17	2.94	0.06	9.69	11.56	0.02	0.29	20.42	0.40	13.21	-0.03	37.41	3.59	101.60	0.81	100.78
1 / 18 .	1.81	0.18	2.93	0.04	9.36	11.55	0.03	0.35	20.58	0.48	13.20	0.01	37.16	3.47	101.16	0.80	100.36
1 / 19 .	1.38	0.14	3.19	0.13	8.67	9.56	0.11	0.28	19.38	0.49	13.92	-0.02	39.49	2.99	99.73	0.61	99.12
1 / 20 .	-0.27	-0.01	4.77	0.87	15.04	0.00	0.01	0.00	0.24	0.89	18.76	0.02	65.46	0.00	106.06	0.00	106.06
Avg B3_5.1	1.59	0.15	3.14	0.14	10.07	10.21	0.03	0.27	18.27	0.48	13.89	0.01	40.39	3.10	101.74	0.71	101.02
2 / 1 .	0.70	0.19	3.65	1.48	1.58	8.63	11.12	0.59	19.96	-0.03	10.68	0.00	42.07	1.22	101.89	0.34	101.55
~~2 / 2 . *~~	~~0.78~~	~~0.20~~	~~3.64~~	~~1.57~~	~~1.70~~	~~8.61~~	~~11.31~~	~~0.58~~	~~20.33~~	~~-0.01~~	~~10.57~~	~~0.06~~	~~42.13~~	~~1.43~~	~~102.90~~	~~0.37~~	~~102.53~~
2 / 3 .	0.78	0.22	3.62	1.62	1.74	8.55	11.01	0.62	20.37	0.07	10.59	0.01	42.04	1.44	102.67	0.38	102.29
2 / 4 .	0.78	0.18	3.63	1.66	1.74	8.44	11.09	0.63	20.50	0.02	10.62	-0.02	41.92	1.58	102.79	0.37	102.42
2 / 5 .	0.86	0.19	3.59	1.72	1.71	8.52	11.01	0.65	20.53	0.09	10.61	-0.02	41.81	1.60	102.87	0.40	102.46
2 / 6 .	0.78	0.20	3.61	1.69	1.65	8.48	11.04	0.59	20.29	0.05	10.64	0.03	41.67	1.57	102.30	0.37	101.93
2 / 7 .	0.79	0.20	3.60	1.68	1.69	8.38	10.91	0.62	20.66	0.02	10.56	0.00	41.71	1.57	102.38	0.38	102.00
2 / 8 .	0.87	0.20	3.57	1.70	1.72	8.44	11.09	0.63	20.42	0.14	10.55	0.01	41.84	1.64	102.83	0.41	102.41
~~2 / 9 . *~~	~~0.86~~	~~0.22~~	~~3.57~~	~~1.71~~	~~1.73~~	~~8.42~~	~~11.12~~	~~0.67~~	~~20.69~~	~~0.02~~	~~10.63~~	~~0.04~~	~~41.65~~	~~1.62~~	~~102.96~~	~~0.41~~	~~102.54~~
2 / 10 .	0.84	0.20	3.59	1.67	1.70	8.46	11.11	0.63	20.49	0.05	10.65	-0.01	41.74	1.59	102.72	0.40	102.32
Avg B3_5.2	0.80	0.20	3.61	1.65	1.70	8.49	11.08	0.62	20.43	0.04	10.61	0.01	41.86	1.53	102.62	0.38	102.24
BR-14 B1																	
B1_bt 1																	
1 / 1 .	1.78	0.12	3.01	0.08	9.56	11.56	0.01	0.23	20.59	0.64	13.53	-0.03	37.34	3.96	102.43	0.78	101.66

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 2 .	1.79	0.12	3.02	0.08	9.60	11.67	-0.01	0.26	20.58	0.61	13.57	0.02	37.34	3.98	102.65	0.78	101.87
1 / 3 .	1.83	0.13	2.98	0.07	9.59	11.63	0.00	0.25	20.43	0.73	13.42	0.04	37.38	3.82	102.31	0.80	101.51
1 / 4 .	1.76	0.12	3.01	0.05	9.55	11.57	0.00	0.23	20.20	0.51	13.36	0.01	37.43	3.88	101.68	0.77	100.91
1 / 5 .	1.80	0.14	3.00	0.07	9.57	11.57	0.01	0.24	20.59	0.43	13.43	0.02	37.56	3.75	102.19	0.79	101.40
1 / 6 .	1.81	0.13	2.97	0.04	9.58	11.58	0.02	0.25	20.06	0.40	13.39	0.02	37.36	3.78	101.40	0.79	100.61
1 / 7 .	1.53	0.14	3.13	0.03	9.20	12.04	0.03	0.23	20.43	0.28	13.55	0.04	37.21	3.71	101.56	0.68	100.88
1 / 8 . *	-0.42	-0.03	5.05	10.09	0.19	-0.02	3.93	-0.08	0.06	0.02	23.24	-0.04	65.08	-0.02	107.67	0.00	107.67
1 / 9 . *	-0.41	-0.02	5.05	9.96	0.20	-0.01	4.03	-0.08	0.02	-0.09	23.25	-0.04	65.01	-0.03	107.51	0.00	107.51
1 / 10 . *	-0.40	-0.02	5.04	10.01	0.20	-0.01	3.95	-0.07	-0.02	-0.02	23.32	-0.08	64.82	-0.04	107.33	0.00	107.33
Avg B1_1.1	1.76	0.13	3.02	0.06	9.52	11.66	0.01	0.24	20.41	0.51	13.46	0.02	37.38	3.84	102.03	0.77	101.26
2 / 1 .	1.78	0.10	2.99	0.06	9.58	11.68	0.01	0.21	19.89	0.44	13.28	0.00	37.33	3.86	101.20	0.77	100.42
2 / 2 .	1.77	0.11	3.00	0.05	9.51	11.59	-0.02	0.32	20.26	0.34	13.35	-0.02	37.28	3.92	101.51	0.77	100.74
2 / 3 .	1.86	0.13	2.94	0.07	9.53	11.48	0.01	0.26	20.54	0.38	13.27	0.03	37.28	3.84	101.61	0.81	100.80
2 / 4 .	1.76	0.14	3.01	0.07	9.68	11.49	0.00	0.20	20.70	0.46	13.27	0.00	37.34	3.92	102.04	0.77	101.27
2 / 5 .	1.80	0.13	3.00	0.05	9.70	11.58	0.00	0.25	20.46	0.55	13.42	0.03	37.52	3.94	102.43	0.79	101.64
2 / 6 .	1.76	0.12	3.03	0.07	9.60	11.62	0.00	0.28	20.56	0.44	13.37	0.00	37.53	4.00	102.38	0.77	101.61
2 / 7 .	1.78	0.14	2.99	0.05	9.63	11.62	-0.01	0.26	19.80	0.47	13.36	0.02	37.46	3.78	101.35	0.78	100.57
2 / 8 .	1.79	0.13	2.99	0.06	9.51	11.72	-0.01	0.20	20.25	0.48	13.37	0.03	37.33	3.81	101.68	0.78	100.90
2 / 9 .	1.79	0.14	3.00	0.07	9.51	11.70	0.01	0.28	20.01	0.61	13.39	-0.01	37.50	3.92	101.93	0.78	101.15
2 / 10 .	1.75	0.14	3.02	0.06	9.54	11.68	-0.01	0.23	20.17	0.54	13.41	0.02	37.47	3.90	101.93	0.77	101.16
Avg B1_1.2	1.78	0.13	3.00	0.06	9.58	11.62	0.00	0.25	20.26	0.47	13.35	0.01	37.40	3.89	101.80	0.78	101.02
B1_bt 2																	
1 / 1 .	1.83	0.15	2.96	0.04	9.44	11.23	0.01	0.23	20.77	0.63	13.54	-0.03	37.28	3.84	101.97	0.81	101.16
1 / 2 .	1.75	0.15	3.01	0.06	9.50	11.33	0.00	0.26	20.57	0.63	13.59	-0.03	37.39	3.72	101.95	0.77	101.18
1 / 3 .	1.74	0.12	3.01	0.06	9.41	11.36	0.01	0.25	20.73	0.56	13.48	0.00	37.26	3.67	101.67	0.76	100.91
1 / 4 .	1.75	0.14	2.98	0.06	9.30	11.24	0.01	0.22	20.52	0.50	13.48	-0.04	37.32	3.58	101.11	0.77	100.34
1 / 5 .	1.70	0.15	3.00	0.06	9.44	11.22	0.01	0.21	20.45	0.57	13.43	-0.04	37.07	3.57	100.87	0.75	100.12
1 / 6 .	1.65	0.14	3.05	0.07	9.46	11.28	0.01	0.24	20.85	0.57	13.47	-0.02	37.32	3.62	101.72	0.73	100.99
1 / 7 .	1.75	0.14	2.99	0.07	9.42	11.25	0.01	0.23	20.44	0.63	13.59	0.00	37.26	3.66	101.44	0.77	100.67
1 / 8 .	1.73	0.15	2.97	0.08	9.56	11.28	0.02	0.25	20.53	0.69	13.43	0.02	36.89	3.43	101.03	0.76	100.27

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 9 .	1.84	0.14	2.93	0.07	9.54	11.20	0.00	0.25	20.47	0.65	13.46	-0.01	37.02	3.63	101.20	0.81	100.40
1 / 10 .	1.80	0.15	2.95	0.07	9.41	11.30	0.01	0.24	20.56	0.66	13.49	0.01	37.08	3.57	101.30	0.79	100.50
Avg B1_bt2	1.75	0.14	2.99	0.06	9.45	11.27	0.01	0.24	20.59	0.61	13.50	-0.02	37.19	3.63	101.41	0.77	100.64
B1_bt 3																	
1 / 1 . *	1.41	0.13	3.02	0.07	4.99	13.29	0.15	0.24	22.67	0.20	14.18	0.01	33.96	2.32	96.64	0.62	96.01
1 / 2 . *	1.63	0.13	2.97	0.05	6.29	13.21	0.12	0.20	21.73	0.28	13.99	0.04	35.14	2.43	98.20	0.72	97.49
1 / 3 . *	1.20	0.11	3.19	0.06	4.19	14.05	0.15	0.27	22.84	0.16	14.91	0.03	33.89	2.28	97.34	0.53	96.81
2 / 1 .	1.59	0.13	3.02	0.08	7.87	12.61	0.11	0.24	21.08	0.18	13.21	0.06	36.37	2.79	99.33	0.70	98.63
2 / 2 .	1.77	0.12	3.00	0.07	9.31	12.24	0.08	0.24	20.40	0.26	12.88	0.02	37.83	3.21	101.44	0.77	100.67
2 / 3 . *	1.63	0.14	2.51	0.09	8.93	12.53	0.10	0.20	20.53	0.20	13.24	0.05	27.24	2.96	90.37	0.72	89.65
2 / 4 . *	1.37	0.13	3.08	0.07	6.05	12.68	0.13	0.27	22.37	0.19	13.75	0.03	35.00	2.60	97.70	0.60	97.09
2 / 5 . *	1.26	0.08	3.22	0.14	6.24	12.28	0.23	0.25	21.69	0.10	14.02	0.03	36.46	2.64	98.63	0.55	98.08
3 / 1 .	1.60	0.11	3.07	0.09	7.86	12.97	0.12	0.24	20.71	0.30	13.50	0.06	37.07	2.49	100.19	0.70	99.49
3 / 2 .	1.78	0.12	2.99	0.09	8.76	12.64	0.09	0.18	20.04	0.24	13.22	0.03	37.55	3.07	100.80	0.77	100.03
3 / 3 .	1.90	0.16	2.92	0.08	9.32	12.34	0.05	0.25	20.09	0.26	13.34	0.04	37.66	2.88	101.27	0.84	100.43
3 / 4 .	1.87	0.15	2.95	0.08	9.49	12.16	0.04	0.24	20.09	0.34	13.22	0.08	37.95	2.94	101.59	0.82	100.77
3 / 5 .	1.96	0.12	2.89	0.07	9.41	12.11	0.04	0.20	19.52	0.43	13.32	0.05	37.60	3.15	100.89	0.85	100.04
3 / 6 .	1.88	0.15	2.92	0.09	9.47	12.03	0.02	0.18	19.88	0.42	13.39	0.04	37.65	2.84	100.97	0.83	100.14
3 / 7 .	1.92	0.13	2.92	0.06	9.66	12.04	0.02	0.22	19.98	0.31	13.27	0.02	37.69	3.23	101.50	0.84	100.66
3 / 8 .	1.86	0.16	2.92	0.22	9.52	12.21	0.06	0.19	19.93	0.34	13.37	0.03	37.38	2.81	101.00	0.82	100.18
3 / 9 .	1.90	0.13	2.93	0.09	9.49	12.25	0.01	0.17	20.10	0.33	13.47	0.05	37.58	2.95	101.44	0.83	100.61
3 / 10 .	1.88	0.13	2.94	0.10	9.46	12.32	0.01	0.22	19.43	0.40	13.40	0.06	37.86	2.91	101.13	0.82	100.31
Avg B1_3.3	1.86	0.14	2.95	0.10	9.24	12.31	0.05	0.21	19.98	0.34	13.35	0.05	37.60	2.93	101.08	0.81	100.27
4 / 1 .	2.07	0.18	2.87	0.06	9.31	13.15	0.05	0.28	19.05	0.16	13.54	0.05	38.42	2.47	101.66	0.91	100.74
4 / 2 .	2.15	0.17	2.83	0.08	9.52	13.39	0.06	0.25	18.23	0.23	13.52	0.05	38.53	2.36	101.38	0.94	100.44
4 / 3 .	2.25	0.21	2.76	0.07	9.25	13.25	0.05	0.27	18.83	0.26	13.39	0.03	38.38	2.44	101.43	0.99	100.44
4 / 4 .	2.25	0.18	2.76	0.07	9.25	13.29	0.05	0.28	18.64	0.11	13.36	0.04	38.49	2.31	101.09	0.99	100.10
4 / 5 .	2.26	0.20	2.75	0.07	9.01	13.56	0.03	0.31	19.06	0.12	13.17	0.04	38.40	2.26	101.26	1.00	100.26
4 / 6 .	2.17	0.22	2.79	0.08	8.97	13.48	0.04	0.26	18.95	0.20	13.40	-0.01	38.14	2.49	101.18	0.96	100.22

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
4 / 7 .	2.16	0.22	2.77	0.04	8.85	13.11	0.05	0.29	19.10	0.12	13.42	0.06	37.92	2.38	100.47	0.96	99.51
4 / 8 .	1.96	0.19	2.89	0.06	8.58	13.44	0.07	0.28	19.47	0.04	13.70	0.07	37.47	2.37	100.58	0.87	99.71
4 / 9 .	1.52	0.21	3.09	0.08	8.25	12.90	0.09	0.27	20.29	0.09	13.88	0.02	37.07	2.38	100.13	0.69	99.45
4 / 10 .	1.65	0.20	3.04	0.08	8.37	13.30	0.06	0.26	20.28	0.07	13.82	0.08	37.09	2.32	100.60	0.74	99.86
Avg B1_3.4	2.04	0.20	2.85	0.07	8.94	13.29	0.06	0.27	19.19	0.14	13.52	0.04	37.99	2.38	100.98	0.91	100.07
B1_bt 4																	
1 / 1 .	1.86	0.13	3.00	0.06	9.51	12.39	0.06	0.27	20.07	0.28	13.06	0.00	37.96	3.94	102.61	0.81	101.79
1 / 2 .	1.85	0.12	2.98	0.08	9.58	12.19	0.06	0.24	19.83	0.23	13.02	0.03	37.80	3.81	101.81	0.81	101.01
1 / 3 .	1.75	0.11	3.04	0.06	9.55	12.11	0.04	0.26	20.37	0.42	13.06	0.00	37.54	4.06	102.38	0.76	101.62
1 / 4 .	1.84	0.12	2.97	0.05	9.40	11.99	0.05	0.22	19.99	0.33	13.09	0.02	37.59	3.92	101.60	0.80	100.79
1 / 5 .	1.81	0.13	2.99	0.07	9.57	12.11	0.05	0.22	19.76	0.24	13.04	0.02	37.78	3.81	101.60	0.79	100.81
1 / 6 .	1.74	0.12	3.04	0.05	9.59	12.38	0.05	0.23	19.79	0.23	12.97	0.00	37.79	3.71	101.70	0.76	100.94
1 / 7 . *	0.79	0.07	3.42	0.17	4.23	14.05	0.19	0.21	24.27	-0.10	13.30	0.02	35.10	1.98	97.81	0.35	97.46
Avg B1_4.1	1.81	0.12	3.00	0.06	9.54	12.20	0.05	0.24	19.97	0.29	13.04	0.01	37.74	3.87	101.95	0.79	101.16
2 / 1 .	1.86	0.12	2.95	0.07	9.15	12.36	0.07	0.25	19.68	0.17	13.26	0.01	37.19	3.93	101.08	0.81	100.27
2 / 2 .	1.89	0.11	2.97	0.06	9.22	12.57	0.09	0.21	19.64	0.18	13.21	-0.01	37.76	3.66	101.57	0.82	100.75
2 / 3 .	1.93	0.13	2.94	0.06	9.43	12.42	0.07	0.16	19.25	0.24	13.14	0.06	37.52	4.25	101.59	0.84	100.75
2 / 4 .	1.52	0.10	3.12	0.09	7.38	13.14	0.17	0.31	20.83	0.07	13.36	-0.01	36.55	3.59	100.23	0.66	99.57
Avg B1_4.2	1.80	0.11	3.00	0.07	8.80	12.62	0.10	0.23	19.85	0.16	13.24	0.01	37.26	3.85	101.11	0.78	100.33
3 / 1 . *	1.35	0.11	3.12	0.10	5.33	13.69	0.15	0.23	22.66	-0.10	13.87	-0.03	34.71	2.73	98.05	0.59	97.46
3 / 2 . *	0.46	0.05	3.51	0.29	1.78	14.81	0.23	0.23	26.44	-0.11	13.42	-0.03	33.56	0.76	95.54	0.21	95.34
3 / 3 . *	0.19	0.05	3.64	0.38	0.47	16.10	0.34	0.15	25.97	-0.01	12.95	-0.01	33.77	0.21	94.22	0.09	94.13
3 / 4 . *	0.23	0.06	3.59	0.38	0.61	16.38	0.29	0.15	25.13	-0.09	12.76	0.01	33.48	0.39	93.46	0.11	93.35
3 / 5 . *	0.92	0.09	3.32	0.14	5.09	13.55	0.18	0.22	23.14	0.00	13.17	0.00	35.16	2.21	97.20	0.41	96.80
3 / 6 . *	0.53	0.06	3.37	0.17	2.44	13.27	0.44	0.23	26.19	-0.06	12.96	0.03	32.74	1.20	93.65	0.24	93.41
3 / 7 . *	1.47	0.12	3.03	0.05	6.02	13.41	0.16	0.26	21.51	0.09	13.38	0.01	34.83	3.07	97.39	0.65	96.75
3 / 8 . *	0.46	0.06	3.36	0.48	1.30	11.56	1.71	0.22	25.04	0.06	11.55	-0.01	30.10	7.16	93.09	0.21	92.88
4 / 1 .	1.86	0.12	2.99	0.06	9.74	12.70	0.13	0.24	19.49	0.05	12.91	0.01	37.93	3.79	102.02	0.81	101.21
4 / 2 .	1.88	0.14	2.95	0.06	9.72	12.41	0.08	0.26	19.30	0.17	12.93	0.02	37.78	3.79	101.49	0.83	100.66

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
4 / 3 . *	2.01	0.14	2.92	0.06	9.60	12.51	0.10	0.20	19.65	0.24	12.99	0.04	38.02	4.05	102.53	0.88	101.66
4 / 4 . *	1.96	0.13	2.95	0.06	9.69	12.56	0.08	0.24	19.74	0.29	12.95	0.05	38.20	3.70	102.59	0.85	101.74
4 / 5 .	1.68	0.13	3.07	0.06	9.46	12.24	0.09	0.22	19.39	0.15	13.07	-0.03	38.07	3.75	101.38	0.74	100.64
4 / 6 .	1.79	0.11	3.02	0.05	9.45	12.40	0.10	0.22	20.03	0.38	13.00	0.03	37.50	3.94	102.02	0.78	101.24
4 / 7 .	1.74	0.12	3.02	0.07	8.82	12.45	0.08	0.19	19.70	0.23	13.25	0.01	37.27	3.86	100.80	0.76	100.04
4 / 8 .	1.72	0.14	3.02	0.07	9.20	12.25	0.07	0.27	19.85	0.14	13.18	0.02	37.42	3.80	101.14	0.76	100.39
Avg B1_4.4	1.83	0.13	2.99	0.06	9.46	12.44	0.09	0.23	19.64	0.20	13.04	0.02	37.77	3.84	101.74	0.80	100.94
5 / 1 .	1.89	0.20	2.94	0.03	9.32	13.27	0.07	0.22	18.96	0.32	13.82	0.02	37.78	2.48	101.33	0.84	100.49
5 / 2 .	1.93	0.21	2.90	0.05	8.91	13.40	0.10	0.27	19.11	0.08	13.88	-0.03	37.34	2.49	100.67	0.86	99.81
5 / 3 . *	1.38	0.15	3.11	0.05	6.18	13.23	0.46	0.22	19.77	0.09	13.78	0.00	34.98	4.25	97.65	0.62	97.03
5 / 4 .	1.81	0.21	2.96	0.07	9.25	13.13	0.10	0.22	18.83	0.09	13.62	-0.03	37.58	2.77	100.64	0.81	99.83
5 / 5 .	1.51	0.19	3.11	0.10	9.16	12.75	0.28	0.28	19.78	0.05	13.49	0.03	37.26	2.77	100.77	0.68	100.09
5 / 6 .	2.24	0.21	2.75	0.06	9.58	13.87	0.13	0.27	17.79	-0.01	12.76	-0.02	38.54	2.67	100.88	0.99	99.89
Avg B1_4.5	1.79	0.20	2.96	0.06	8.73	13.27	0.19	0.25	19.04	0.10	13.56	0.00	37.25	2.91	100.31	0.80	99.51
6 / 1 .	2.02	0.20	2.88	0.06	8.84	14.33	0.15	0.23	18.26	-0.09	12.86	0.03	38.64	2.28	100.78	0.90	99.89
6 / 2 .	2.17	0.20	2.79	0.06	9.71	13.54	0.06	0.21	18.21	0.01	12.91	-0.03	38.44	2.68	100.97	0.96	100.02
6 / 3 .	2.04	0.20	2.84	0.08	9.70	13.17	0.04	0.19	18.27	0.06	13.35	0.00	37.98	2.78	100.70	0.91	99.80
6 / 4 .	2.13	0.18	2.82	0.05	9.79	12.97	0.03	0.21	18.29	0.33	13.48	0.00	38.19	2.71	101.17	0.94	100.24
6 / 5 .	2.08	0.17	2.85	0.07	9.59	12.93	0.01	0.27	18.87	0.31	13.54	0.00	38.00	2.71	101.40	0.91	100.49
6 / 6 .	1.96	0.20	2.90	0.05	9.72	12.82	0.02	0.26	18.76	0.35	13.60	-0.01	37.98	2.89	101.51	0.87	100.63
6 / 7 .	1.97	0.19	2.90	0.07	9.51	12.85	0.02	0.27	19.48	0.20	13.57	0.03	37.66	2.85	101.58	0.87	100.71
6 / 8 .	1.86	0.22	2.93	0.07	9.59	12.83	0.04	0.26	19.23	0.39	13.60	0.02	37.65	2.63	101.31	0.83	100.48
6 / 9 .	2.04	0.19	2.84	0.07	9.68	12.71	0.02	0.27	18.63	0.42	13.51	0.02	37.74	2.66	100.79	0.90	99.89
6 / 10 .	1.76	0.21	2.98	0.04	9.59	12.77	0.03	0.24	18.62	0.33	13.46	-0.01	37.85	2.84	100.74	0.79	99.95
Avg B1_4.6	2.00	0.20	2.87	0.06	9.57	13.09	0.04	0.24	18.66	0.23	13.39	0.00	38.01	2.70	101.08	0.89	100.19
7 / 1 .	1.79	0.13	3.00	0.06	9.58	11.84	0.01	0.22	20.05	0.17	13.43	-0.02	38.02	3.16	101.44	0.78	100.65
7 / 2 .	1.75	0.16	3.00	0.05	9.45	11.79	0.01	0.22	19.97	0.23	13.46	-0.01	37.64	3.41	101.13	0.77	100.36
7 / 3 .	1.81	0.17	2.95	0.07	9.42	11.76	0.03	0.20	20.03	0.14	13.37	0.01	37.42	3.42	100.81	0.80	100.01
7 / 4 .	1.73	0.16	3.01	0.07	9.63	11.79	0.05	0.18	19.96	0.18	13.63	0.01	37.71	3.17	101.28	0.77	100.51

Table G3: Biotite Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
7 / 5 .	1.75	0.15	3.00	0.05	9.49	11.87	0.05	0.18	20.05	0.33	13.60	-0.01	37.60	3.07	101.19	0.77	100.42
7 / 6 .	1.74	0.13	3.02	0.07	9.48	11.73	0.05	0.21	20.41	0.45	13.59	0.02	37.57	3.28	101.75	0.76	100.98
7 / 7 .	1.73	0.15	2.99	0.04	9.50	11.63	0.06	0.22	19.88	0.48	13.51	0.00	37.52	3.18	100.90	0.76	100.13
7 / 8 .	1.78	0.14	2.97	0.04	9.42	11.65	0.05	0.25	20.02	0.26	13.55	0.03	37.46	3.13	100.75	0.78	99.97
7 / 9 .	1.79	0.15	2.96	0.05	9.52	11.55	0.07	0.21	20.02	0.28	13.52	0.03	37.35	3.31	100.81	0.79	100.03
7 / 10 .	1.89	0.13	2.94	0.04	9.65	11.66	0.06	0.29	20.23	0.21	13.49	0.01	37.67	3.23	101.53	0.83	100.70
Avg B1_4.7	1.78	0.15	2.98	0.05	9.51	11.73	0.04	0.22	20.06	0.27	13.51	0.01	37.60	3.23	101.15	0.78	100.37

Table G4: Amphibole Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
BR-14 B8																	
B8_amph1																	
1 / 1 .	0.68	0.19	1.56	1.56	1.69	8.64	11.11	0.52	20.69	0.10	10.55	0.04	41.83	1.28	100.44	0.33	100.11
1 / 2 .	0.65	0.19	1.57	1.62	1.67	8.68	10.97	0.50	20.27	0.18	10.54	0.02	41.83	1.19	99.87	0.31	99.56
1 / 3 .	0.69	0.19	1.55	1.64	1.75	8.65	10.98	0.49	20.24	0.09	10.55	0.02	41.72	1.54	100.10	0.33	99.76
1 / 4 .	0.64	0.20	1.58	1.64	1.68	8.72	10.97	0.51	20.56	0.10	10.50	0.00	41.76	1.52	100.38	0.32	100.07
1 / 5 .	0.68	0.19	1.56	1.61	1.72	8.71	11.11	0.53	20.29	0.08	10.54	0.04	41.88	1.29	100.23	0.33	99.90
1 / 6 .	0.60	0.22	1.59	1.60	1.73	8.72	11.18	0.50	20.40	0.05	10.54	0.03	41.79	1.31	100.25	0.30	99.95
1 / 7 .	0.62	0.19	1.59	1.58	1.70	8.69	11.22	0.45	20.52	0.10	10.64	-0.01	41.74	1.28	100.32	0.31	100.01
1 / 8 .	0.66	0.20	1.56	1.58	1.67	8.74	11.01	0.54	20.48	0.08	10.54	0.02	41.83	1.27	100.19	0.32	99.87
1 / 9 .	0.64	0.20	1.57	1.57	1.71	8.90	11.14	0.46	19.96	0.14	10.55	0.01	41.88	1.17	99.91	0.32	99.59
1 / 10 .	0.63	0.21	1.57	1.50	1.70	8.79	10.96	0.49	19.89	0.00	10.53	0.01	41.88	1.20	99.36	0.31	99.05
Avg B8_1.1	0.65	0.20	1.57	1.59	1.70	8.73	11.06	0.50	20.33	0.09	10.55	0.02	41.81	1.31	100.10	0.32	99.79
2 / 1 .	0.53	0.21	1.62	1.46	1.58	8.40	11.05	0.48	20.28	0.07	10.58	0.01	41.73	1.22	99.20	0.27	98.93
2 / 2 . *	0.33	0.12	1.59	0.81	0.74	9.30	5.32	0.29	27.74	0.01	11.98	0.00	35.13	0.55	93.92	0.16	93.75
2 / 3 .	0.66	0.20	1.57	1.54	1.65	8.46	11.07	0.50	20.66	0.14	10.65	-0.01	41.78	1.28	100.17	0.32	99.84
2 / 4 .	0.60	0.22	1.59	1.55	1.64	8.43	11.11	0.45	20.74	0.08	10.60	0.00	41.79	1.34	100.13	0.30	99.83
2 / 5 .	0.61	0.21	1.58	1.51	1.72	8.32	11.03	0.53	20.71	0.12	10.56	0.01	41.69	1.25	99.85	0.30	99.54
2 / 6 .	0.56	0.21	1.60	1.50	1.69	8.30	11.05	0.46	20.83	0.17	10.54	-0.01	41.69	1.18	99.76	0.28	99.48
2 / 7 .	0.50	0.18	1.63	1.52	1.67	8.12	11.01	0.43	20.94	0.01	10.54	0.06	41.48	1.25	99.33	0.25	99.08
2 / 8 .	0.48	0.22	1.63	1.55	1.67	8.04	10.96	0.49	21.00	0.00	10.51	0.05	41.68	1.15	99.44	0.25	99.18
2 / 9 .	0.49	0.19	1.64	1.44	1.64	8.08	11.04	0.45	20.77	0.13	10.46	0.03	41.77	1.25	99.38	0.25	99.13
2 / 10 .	0.54	0.21	1.61	1.39	1.58	7.97	11.10	0.48	21.25	0.11	10.59	0.03	41.78	1.06	99.70	0.28	99.43
Avg B8_1.2	0.55	0.21	1.61	1.50	1.65	8.24	11.05	0.47	20.80	0.09	10.56	0.02	41.71	1.22	99.66	0.28	99.38
3 / 1 .	0.61	0.20	1.59	1.68	1.70	8.64	11.09	0.57	20.50	0.08	10.55	0.04	41.62	1.47	100.34	0.30	100.04
3 / 2 .	0.61	0.18	1.59	1.64	1.76	8.55	10.93	0.48	20.36	0.03	10.50	0.04	41.71	1.35	99.74	0.30	99.44
3 / 3 .	0.67	0.19	1.56	1.70	1.73	8.56	11.06	0.49	20.69	0.26	10.68	0.07	41.62	1.38	100.65	0.33	100.32
3 / 4 .	0.66	0.19	1.56	1.69	1.72	8.51	11.05	0.55	20.34	0.12	10.65	-0.01	41.52	1.38	99.94	0.32	99.62
3 / 5 .	0.60	0.20	1.59	1.72	1.65	8.60	10.96	0.53	20.63	0.08	10.58	0.02	41.48	1.52	100.17	0.30	99.88

Table G4: Amphibole Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
3 / 6 .	0.75	0.20	1.52	1.67	1.74	8.55	11.08	0.50	20.22	0.07	10.63	-0.02	41.65	1.48	100.08	0.36	99.72
3 / 7 .	0.64	0.19	1.58	1.69	1.77	8.65	10.99	0.51	20.54	0.06	10.73	0.00	41.61	1.46	100.43	0.31	100.12
3 / 8 .	0.64	0.19	1.59	1.71	1.76	8.62	11.22	0.56	20.21	0.14	10.61	0.04	41.86	1.50	100.63	0.31	100.31
3 / 9 .	0.59	0.20	1.60	1.70	1.74	8.69	11.04	0.48	20.03	0.10	10.63	0.02	41.49	1.55	99.85	0.29	99.55
3 / 10 .	0.65	0.19	1.57	1.66	1.71	8.65	11.08	0.49	20.20	0.10	10.63	0.00	41.68	1.49	100.11	0.32	99.79
Avg B8_1.3	0.64	0.19	1.58	1.69	1.73	8.60	11.05	0.52	20.37	0.10	10.62	0.02	41.62	1.46	100.19	0.31	99.88
B8_amph 2																	
1 / 1 .	0.60	0.20	1.60	1.44	1.56	8.57	11.05	0.55	20.33	0.05	10.56	0.02	41.86	1.67	100.07	0.30	99.77
1 / 2 .	0.62	0.20	1.59	1.46	1.64	8.61	11.21	0.44	20.40	0.17	10.52	0.00	42.02	1.61	100.50	0.31	100.19
1 / 3 .	0.54	0.19	1.62	1.47	1.67	8.62	11.13	0.43	19.95	0.04	10.56	0.01	41.83	1.60	99.67	0.27	99.40
1 / 4 .	0.65	0.19	1.57	1.49	1.66	8.61	11.18	0.42	20.11	0.06	10.57	0.02	41.73	1.68	99.95	0.32	99.63
1 / 5 .	0.60	0.19	1.59	1.50	1.64	8.59	11.17	0.48	20.11	0.11	10.51	0.07	41.63	1.58	99.77	0.30	99.47
1 / 6 .	0.54	0.21	1.62	1.51	1.65	8.56	11.05	0.46	19.90	0.12	10.44	0.02	42.00	1.56	99.65	0.28	99.38
1 / 7 .	0.62	0.17	1.59	1.49	1.67	8.53	11.19	0.46	20.36	0.12	10.51	0.01	41.94	1.46	100.12	0.30	99.82
1 / 8 .	0.55	0.19	1.62	1.49	1.70	8.54	11.09	0.43	20.05	0.08	10.51	0.06	41.99	1.56	99.86	0.28	99.59
1 / 9 .	0.52	0.20	1.64	1.43	1.72	8.55	10.87	0.51	19.78	0.10	10.69	0.02	42.16	1.67	99.85	0.26	99.58
Avg B8_2.1	0.59	0.19	1.61	1.48	1.66	8.57	11.10	0.46	20.11	0.10	10.54	0.02	41.91	1.60	99.94	0.29	99.65
2 / 1 .	0.58	0.20	1.62	1.57	1.64	8.56	11.22	0.50	20.03	0.05	10.75	0.00	41.90	1.66	100.28	0.29	99.99
2 / 2 .	0.61	0.17	1.60	1.65	1.64	8.62	11.10	0.50	19.99	0.18	10.65	0.00	41.79	1.58	100.10	0.30	99.80
2 / 3 .	0.68	0.19	1.57	1.67	1.66	8.65	11.21	0.52	20.37	0.11	10.74	0.00	41.96	1.55	100.90	0.33	100.57
2 / 4 .	0.62	0.19	1.60	1.63	1.67	8.63	11.17	0.47	20.20	0.07	10.71	0.02	41.82	1.61	100.40	0.30	100.09
2 / 5 .	0.64	0.18	1.59	1.68	1.70	8.60	11.20	0.47	20.26	0.12	10.68	-0.01	41.78	1.69	100.58	0.31	100.27
2 / 6 .	0.68	0.16	1.58	1.70	1.67	8.61	11.05	0.56	20.39	0.09	10.68	-0.03	41.89	1.56	100.60	0.32	100.28
2 / 7 .	0.67	0.17	1.58	1.67	1.68	8.52	11.10	0.48	20.39	0.00	10.72	0.04	41.84	1.50	100.35	0.32	100.03
2 / 8 .	0.69	0.18	1.57	1.70	1.67	8.66	11.12	0.55	20.21	0.14	10.73	0.03	41.84	1.57	100.65	0.33	100.32
2 / 9 .	0.66	0.15	1.58	1.70	1.70	8.59	11.06	0.53	19.95	0.08	10.64	-0.04	41.71	1.60	99.95	0.31	99.64
2 / 10 .	0.70	0.18	1.56	1.69	1.70	8.65	11.06	0.56	20.21	0.14	10.54	0.00	41.86	1.54	100.39	0.33	100.05
Avg B8_2.2	0.65	0.18	1.58	1.67	1.67	8.61	11.13	0.52	20.20	0.10	10.68	0.00	41.84	1.59	100.41	0.31	100.10

Table G4: Amphibole Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
3 / 1 .	0.67	0.19	1.56	1.54	1.70	8.64	11.04	0.48	20.18	0.05	10.51	0.02	41.89	1.51	99.96	0.32	99.64
3 / 2 .	0.63	0.17	1.58	1.58	1.69	8.62	11.05	0.53	19.86	0.05	10.49	-0.01	41.81	1.58	99.64	0.30	99.34
3 / 3 .	0.67	0.20	1.56	1.60	1.70	8.54	11.06	0.38	20.15	0.07	10.53	0.02	41.78	1.62	99.87	0.33	99.55
3 / 4 .	0.70	0.19	1.55	1.62	1.71	8.57	10.96	0.52	20.04	0.10	10.64	0.00	41.76	1.57	99.93	0.34	99.59
3 / 5 .	0.69	0.20	1.55	1.65	1.76	8.52	11.04	0.52	20.53	0.02	10.61	0.03	41.82	1.54	100.50	0.34	100.16
3 / 6 .	0.65	0.18	1.58	1.61	1.74	8.48	11.02	0.42	20.52	0.16	10.68	0.02	41.65	1.64	100.35	0.31	100.03
3 / 7 .	0.61	0.19	1.59	1.67	1.68	8.44	11.01	0.45	20.59	0.05	10.56	-0.01	41.55	1.51	99.89	0.30	99.59
3 / 8 .	0.69	0.19	1.58	1.67	1.76	8.59	11.28	0.46	20.83	0.07	10.78	-0.01	42.24	1.41	101.56	0.33	101.22
3 / 9 .	0.63	0.15	1.59	1.61	1.71	8.46	10.94	0.48	20.70	0.09	10.53	-0.01	41.82	1.44	100.17	0.30	99.87
3 / 10 .	0.63	0.19	1.59	1.60	1.75	8.46	11.02	0.56	20.90	0.12	10.68	0.01	41.67	1.50	100.68	0.31	100.37
Avg B8_2.3	0.66	0.18	1.57	1.62	1.72	8.53	11.04	0.48	20.43	0.08	10.60	0.00	41.80	1.53	100.25	0.32	99.93
B8_amph 3																	
1 / 1 .	0.58	0.22	1.59	1.56	1.69	8.45	11.05	0.55	20.20	-0.02	10.51	-0.01	41.74	1.44	99.59	0.29	99.29
1 / 2 .	0.65	0.21	1.57	1.55	1.65	8.55	11.07	0.53	20.46	0.04	10.53	-0.01	41.76	1.53	100.08	0.32	99.76
1 / 3 .	0.63	0.21	1.57	1.55	1.68	8.52	11.00	0.53	20.51	0.03	10.46	0.01	41.65	1.46	99.83	0.31	99.52
1 / 4 .	0.55	0.21	1.62	1.61	1.66	8.55	11.12	0.59	20.54	0.03	10.53	-0.03	41.77	1.50	100.28	0.28	100.00
1 / 5 .	0.57	0.21	1.60	1.56	1.69	8.41	11.16	0.56	20.37	-0.01	10.51	-0.05	41.72	1.46	99.80	0.29	99.52
1 / 6 .	0.63	0.19	1.57	1.55	1.65	8.38	11.14	0.50	19.58	0.10	10.46	-0.02	41.64	1.52	98.91	0.31	98.60
1 / 7 .	0.74	0.20	1.53	1.54	1.67	8.47	11.16	0.50	20.66	0.05	10.52	-0.04	41.88	1.50	100.43	0.35	100.08
1 / 8 .	0.69	0.19	1.54	1.56	1.67	8.48	11.16	0.53	20.19	0.00	10.47	-0.03	41.65	1.48	99.62	0.33	99.29
1 / 9 .	0.55	0.20	1.61	1.54	1.69	8.39	11.02	0.56	20.38	-0.03	10.44	-0.03	41.77	1.41	99.56	0.28	99.28
1 / 10 .	0.65	0.20	1.57	1.53	1.66	8.39	11.20	0.56	20.57	0.01	10.61	-0.06	41.75	1.44	100.15	0.32	99.83
Avg B8_3.1	0.62	0.20	1.58	1.56	1.67	8.46	11.11	0.54	20.35	0.02	10.50	-0.03	41.73	1.47	99.79	0.31	99.48
2 / 1 .	0.65	0.19	1.57	1.57	1.66	8.40	11.08	0.54	20.31	0.07	10.61	-0.03	41.81	1.28	99.73	0.32	99.42
2 / 2 .	0.58	0.20	1.60	1.61	1.70	8.38	11.11	0.53	20.74	0.15	10.49	0.01	41.67	1.47	100.23	0.29	99.94
2 / 3 .	0.62	0.19	1.59	1.61	1.68	8.40	11.04	0.47	21.02	0.07	10.50	-0.04	41.69	1.31	100.20	0.30	99.89
2 / 4 .	0.72	0.20	1.54	1.62	1.71	8.37	11.13	0.51	20.50	0.04	10.61	-0.04	41.95	1.31	100.20	0.35	99.85
2 / 5 .	0.61	0.21	1.59	1.60	1.66	8.34	11.09	0.56	20.85	0.09	10.58	-0.04	41.74	1.48	100.38	0.30	100.08
2 / 6 .	0.64	0.19	1.57	1.62	1.70	8.52	11.02	0.53	20.52	0.12	10.53	-0.06	41.65	1.41	100.01	0.31	99.70

Table G4: Amphibole Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
2 / 7 .	0.63	0.19	1.58	1.63	1.67	8.53	10.98	0.59	20.62	0.05	10.57	-0.04	41.77	1.48	100.30	0.31	99.99
2 / 8 .	0.52	0.19	1.64	1.59	1.71	8.50	11.08	0.54	21.07	0.04	10.55	-0.02	41.82	1.40	100.65	0.26	100.39
2 / 9 .	0.65	0.19	1.57	1.55	1.68	8.46	11.10	0.54	20.32	-0.06	10.61	-0.03	41.78	1.36	99.81	0.32	99.50
2 / 10 .	0.64	0.21	1.58	1.50	1.62	8.44	11.15	0.49	20.53	0.06	10.66	0.00	41.93	1.37	100.19	0.32	99.87
Avg B8_3.2	0.63	0.20	1.58	1.59	1.68	8.43	11.08	0.53	20.65	0.06	10.57	-0.03	41.78	1.39	100.13	0.31	99.83
B8_amph 4																	
1 / 1 .	0.66	0.20	1.57	1.72	1.66	8.46	11.07	0.50	20.68	0.07	10.77	0.00	41.52	1.49	100.35	0.32	100.03
1 / 2 .	0.69	0.16	1.56	1.74	1.72	8.50	10.99	0.52	20.52	0.16	10.71	0.02	41.53	1.55	100.35	0.33	100.02
1 / 3 .	0.66	0.21	1.57	1.79	1.71	8.56	10.94	0.59	20.64	0.13	10.75	-0.03	41.73	1.43	100.71	0.33	100.39
1 / 4 .	0.68	0.21	1.55	1.75	1.71	8.53	11.00	0.52	20.45	0.09	10.72	0.01	41.39	1.58	100.20	0.34	99.86
1 / 5 .	0.74	0.18	1.53	1.74	1.71	8.50	11.01	0.59	20.19	0.19	10.79	-0.02	41.48	1.55	100.21	0.35	99.86
1 / 6 .	0.72	0.20	1.54	1.72	1.70	8.40	10.99	0.57	20.56	0.17	10.83	-0.04	41.45	1.72	100.57	0.35	100.22
1 / 7 .	0.68	0.19	1.56	1.73	1.74	8.63	10.96	0.54	20.47	0.07	10.88	-0.03	41.47	1.64	100.57	0.33	100.24
1 / 8 .	0.67	0.18	1.57	1.73	1.74	8.47	10.97	0.55	20.30	0.10	10.77	-0.01	41.62	1.56	100.23	0.32	99.91
1 / 9 .	0.72	0.20	1.55	1.77	1.69	8.58	11.12	0.64	20.71	0.10	10.82	0.01	41.57	1.67	101.15	0.35	100.80
1 / 10 .	0.70	0.22	1.54	1.74	1.66	8.53	10.94	0.54	20.48	0.15	10.83	0.01	41.48	1.53	100.36	0.34	100.01
Avg B8_4.1	0.69	0.20	1.55	1.74	1.70	8.52	11.00	0.55	20.50	0.12	10.79	-0.01	41.52	1.57	100.46	0.34	100.12
B8_amph 5																	
1 / 1 .	0.63	0.21	1.57	1.51	1.63	8.45	11.10	0.54	20.18	0.01	10.78	-0.01	41.67	1.43	99.71	0.31	99.40
1 / 2 .	0.66	0.20	1.57	1.56	1.62	8.67	11.20	0.50	20.11	0.06	10.68	-0.05	42.07	1.25	100.15	0.32	99.82
1 / 3 .	0.63	0.20	1.59	1.53	1.67	8.59	11.21	0.55	20.17	0.05	10.63	0.01	42.00	1.30	100.11	0.31	99.80
1 / 4 .	0.65	0.18	1.58	1.57	1.68	8.58	11.08	0.63	20.75	-0.01	10.69	-0.01	41.73	1.51	100.63	0.31	100.32
1 / 5 .	0.64	0.19	1.58	1.59	1.70	8.60	11.15	0.56	20.06	0.13	10.58	0.02	41.76	1.57	100.13	0.31	99.81
1 / 6 .	0.73	0.16	1.54	1.63	1.70	8.62	11.15	0.54	20.05	0.04	10.63	-0.02	41.74	1.48	100.00	0.34	99.65
1 / 7 .	0.57	0.19	1.63	1.68	1.71	8.56	11.22	0.52	20.29	0.07	10.69	-0.02	41.99	1.54	100.66	0.28	100.38
1 / 8 .	0.67	0.19	1.56	1.64	1.70	8.57	11.01	0.55	20.08	0.00	10.62	-0.04	41.92	1.48	100.01	0.33	99.69
1 / 9 .	0.61	0.18	1.59	1.60	1.69	8.60	11.07	0.47	19.97	-0.01	10.66	-0.04	41.88	1.44	99.76	0.30	99.47
1 / 10 .	0.69	0.20	1.54	1.50	1.71	8.64	11.08	0.53	19.91	-0.03	10.55	-0.03	41.72	1.43	99.51	0.33	99.18
Avg B8_5.1	0.65	0.19	1.58	1.58	1.68	8.59	11.13	0.54	20.16	0.03	10.65	-0.02	41.85	1.44	100.04	0.32	99.73

Table G4: Amphibole Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
B8_amph 6																	
1 / 1 .	0.73	0.23	1.52	1.46	1.61	8.44	11.17	0.43	20.67	0.05	10.37	-0.01	42.03	1.35	100.07	0.36	99.71
1 / 2 .	0.68	0.18	1.56	1.51	1.63	8.45	11.18	0.57	20.56	-0.07	10.46	0.01	42.01	1.46	100.26	0.33	99.93
1 / 3 .	0.61	0.17	1.60	1.57	1.67	8.42	11.09	0.49	20.68	0.03	10.57	0.05	41.83	1.30	100.07	0.30	99.77
1 / 4 . *	0.71	0.19	1.29	1.65	1.64	8.60	11.22	0.51	20.34	0.07	10.66	0.02	31.84	1.32	90.06	0.34	89.72
1 / 5 .	0.68	0.19	1.56	1.59	1.63	8.51	11.10	0.60	20.64	0.00	10.63	0.02	41.89	1.46	100.48	0.33	100.15
1 / 6 .	0.73	0.19	1.54	1.57	1.67	8.55	11.12	0.50	20.40	0.03	10.58	0.02	41.95	1.38	100.23	0.35	99.88
1 / 7 .	0.62	0.17	1.55	1.40	1.45	8.54	9.73	0.46	22.55	0.01	10.76	0.06	40.29	1.19	98.78	0.30	98.48
1 / 8 .	0.76	0.17	1.53	1.56	1.68	8.44	11.15	0.46	20.55	0.07	10.44	0.03	41.95	1.36	100.15	0.36	99.80
1 / 9 .	0.65	0.18	1.57	1.57	1.66	8.40	11.19	0.50	20.45	0.08	10.49	0.02	41.75	1.45	99.96	0.32	99.64
1 / 10 .	0.66	0.19	1.57	1.50	1.69	8.50	11.17	0.43	20.60	0.02	10.61	0.01	41.97	1.35	100.29	0.32	99.97
Avg B8_6.1	0.68	0.19	1.56	1.53	1.63	8.47	10.99	0.49	20.79	0.03	10.55	0.02	41.74	1.37	100.02	0.33	99.69
2 / 1 .	0.67	0.18	1.56	1.54	1.67	8.37	11.06	0.49	20.46	-0.09	10.54	0.02	41.65	1.43	99.63	0.32	99.31
2 / 2 .	0.71	0.20	1.54	1.53	1.71	8.38	11.14	0.43	20.38	-0.04	10.49	0.02	41.83	1.46	99.82	0.34	99.48
2 / 3 .	0.66	0.18	1.57	1.55	1.71	8.41	11.13	0.47	20.61	0.15	10.50	0.00	41.98	1.49	100.41	0.32	100.09
2 / 4 .	0.73	0.20	1.53	1.51	1.66	8.42	11.17	0.45	20.48	0.00	10.52	0.05	41.91	1.55	100.18	0.35	99.83
2 / 5 .	0.68	0.19	1.56	1.50	1.72	8.34	11.27	0.51	20.30	0.06	10.44	0.01	41.85	1.51	99.93	0.33	99.60
2 / 6 .	0.68	0.22	1.55	1.54	1.70	8.47	11.20	0.55	20.32	0.02	10.52	0.02	41.71	1.59	100.08	0.33	99.75
2 / 7 .	0.72	0.21	1.53	1.53	1.68	8.46	11.00	0.51	20.09	-0.06	10.51	-0.01	41.85	1.48	99.56	0.35	99.21
2 / 8 .	0.59	0.19	1.60	1.50	1.67	8.51	11.10	0.52	20.34	0.04	10.55	0.00	41.67	1.43	99.70	0.29	99.42
2 / 9 .	0.67	0.19	1.56	1.49	1.65	8.46	11.11	0.49	20.27	0.06	10.63	0.04	41.83	1.38	99.83	0.33	99.50
2 / 10 .	0.71	0.21	1.54	1.49	1.66	8.42	11.08	0.48	20.45	0.12	10.57	0.03	41.82	1.48	100.04	0.35	99.70
Avg B8_6.2	0.68	0.19	1.55	1.52	1.68	8.42	11.13	0.49	20.37	0.03	10.53	0.02	41.81	1.48	99.90	0.33	99.57
BR-14 B4																	
B4_amph 1																	
1 / 1 .	0.79	0.21	1.50	1.86	1.64	8.60	10.91	0.61	20.87	0.12	10.46	0.04	41.68	1.40	100.71	0.38	100.33
1 / 2 .	0.73	0.20	1.53	1.85	1.64	8.65	11.01	0.60	20.63	0.04	10.46	0.01	41.65	1.44	100.44	0.35	100.08

Table G4: Amphibole Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 3 .	0.68	0.18	1.55	1.79	1.59	8.72	10.47	0.57	21.17	0.01	10.67	0.02	41.13	1.38	99.92	0.32	99.60
1 / 4 .	0.77	0.22	1.51	1.87	1.69	8.63	10.97	0.63	19.99	0.14	10.62	0.05	41.76	1.40	100.24	0.37	99.87
1 / 5 .	0.80	0.23	1.49	1.91	1.65	8.72	11.02	0.56	20.50	0.03	10.48	0.03	41.86	1.18	100.46	0.39	100.07
1 / 6 .	0.71	0.21	1.54	1.90	1.65	8.65	10.94	0.57	20.39	0.00	10.51	0.04	41.86	1.26	100.22	0.34	99.88
1 / 7 .	0.74	0.19	1.52	1.87	1.61	8.61	11.01	0.57	20.11	0.07	10.47	0.03	41.79	1.26	99.85	0.36	99.49
1 / 8 .	0.78	0.19	1.51	1.78	1.61	8.65	11.04	0.61	19.94	0.04	10.56	0.04	42.02	1.22	99.99	0.37	99.62
Avg B4_1.1	0.75	0.20	1.52	1.85	1.64	8.65	10.92	0.59	20.45	0.06	10.53	0.03	41.72	1.32	100.23	0.36	99.87
2 / 1 .	0.79	0.19	1.51	1.77	1.56	9.04	11.17	0.65	20.20	0.14	10.29	0.02	42.03	1.27	100.62	0.37	100.24
2 / 2 .	0.83	0.20	1.49	1.79	1.63	8.99	11.05	0.55	20.04	0.12	10.38	0.01	41.92	1.36	100.35	0.39	99.96
2 / 3 .	0.84	0.20	1.49	1.85	1.64	9.10	11.04	0.66	20.16	0.06	10.50	0.07	41.75	1.46	100.81	0.40	100.42
2 / 4 .	0.87	0.20	1.47	1.88	1.67	9.08	11.12	0.58	19.46	0.06	10.59	-0.02	41.70	1.42	100.08	0.41	99.67
2 / 5 .	0.83	0.21	1.49	1.90	1.66	9.13	11.29	0.56	19.90	0.02	10.66	0.04	41.51	1.47	100.67	0.40	100.27
2 / 6 .	0.87	0.18	1.47	1.86	1.65	9.07	11.06	0.60	19.40	0.04	10.80	0.03	41.56	1.57	100.17	0.41	99.77
2 / 7 .	0.82	0.18	1.49	1.90	1.61	8.95	11.14	0.62	19.36	0.03	10.83	0.02	41.46	1.54	99.96	0.39	99.58
~~2 / 8 . *~~	~~0.64~~	~~0.17~~	~~1.47~~	~~1.51~~	~~1.38~~	~~8.01~~	~~9.01~~	~~0.59~~	~~23.28~~	~~0.04~~	~~10.59~~	~~0.03~~	~~37.86~~	~~1.36~~	~~95.94~~	~~0.31~~	~~95.63~~
Avg B4_1.2	0.83	0.19	1.49	1.85	1.63	9.05	11.12	0.60	19.79	0.07	10.58	0.02	41.70	1.44	100.38	0.40	99.98
3 / 1 .	0.78	0.18	1.52	2.05	1.67	8.63	10.99	0.65	20.30	0.08	10.72	0.06	41.44	1.59	100.65	0.37	100.28
3 / 2 .	0.76	0.19	1.52	2.09	1.66	8.49	10.98	0.62	20.36	0.09	10.73	0.03	41.38	1.68	100.60	0.37	100.24
3 / 3 .	0.77	0.22	1.51	2.09	1.75	8.52	10.91	0.65	20.44	0.10	10.81	0.06	41.34	1.64	100.80	0.37	100.43
3 / 4 .	0.75	0.19	1.53	2.08	1.70	8.44	10.85	0.71	20.47	0.09	10.82	0.05	41.32	1.64	100.64	0.36	100.28
3 / 5 .	0.84	0.20	1.48	2.11	1.73	8.47	10.91	0.68	20.67	0.15	10.84	0.01	41.28	1.63	100.98	0.40	100.58
3 / 6 .	0.84	0.20	1.48	2.12	1.72	8.49	11.02	0.60	20.32	0.06	10.80	0.03	41.41	1.80	100.89	0.40	100.50
3 / 7 .	0.86	0.20	1.46	2.07	1.73	8.47	10.81	0.67	20.31	0.11	10.79	0.01	41.31	1.65	100.44	0.41	100.03
3 / 8 .	0.82	0.19	1.49	2.10	1.72	8.47	10.84	0.63	20.71	0.14	10.83	0.01	41.13	1.72	100.78	0.39	100.39
3 / 9 .	0.77	0.19	1.51	2.08	1.75	8.47	10.79	0.64	20.09	0.06	10.78	0.02	41.30	1.61	100.06	0.37	99.69
3 / 10 .	0.76	0.18	1.52	2.13	1.72	8.44	10.87	0.60	20.15	0.04	10.75	0.00	41.32	1.71	100.19	0.36	99.83
Avg B4_1.3	0.80	0.19	1.50	2.09	1.72	8.49	10.90	0.65	20.38	0.09	10.79	0.03	41.32	1.67	100.60	0.38	100.22
4 / 1 .	0.80	0.22	1.49	1.97	1.68	8.63	11.11	0.62	20.26	0.04	10.65	0.04	41.44	1.59	100.56	0.39	100.17

Table G4: Amphibole Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
4 / 2 .	0.87	0.18	1.47	1.95	1.71	8.62	11.17	0.66	20.18	0.05	10.65	0.04	41.46	1.64	100.66	0.41	100.25
4 / 3 .	0.82	0.20	1.49	1.94	1.69	8.66	11.07	0.62	20.02	0.07	10.70	-0.02	41.44	1.56	100.27	0.39	99.88
4 / 4 .	0.81	0.18	1.50	1.93	1.71	8.59	11.09	0.67	20.60	0.12	10.60	0.01	41.51	1.44	100.77	0.38	100.38
4 / 5 .	0.72	0.19	1.53	1.91	1.70	8.47	11.01	0.67	20.16	0.09	10.75	0.01	41.30	1.55	100.05	0.35	99.71
4 / 6 .	0.82	0.21	1.49	1.91	1.66	8.55	11.14	0.56	20.49	0.01	10.63	0.00	41.54	1.37	100.36	0.39	99.97
4 / 7 .	0.76	0.17	1.53	1.94	1.69	8.62	11.06	0.66	20.42	0.02	10.62	0.02	41.44	1.56	100.49	0.36	100.13
4 / 8 .	0.74	0.22	1.52	1.91	1.69	8.57	11.01	0.64	20.64	0.09	10.61	0.01	41.53	1.50	100.69	0.36	100.33
4 / 9 .	0.78	0.21	1.51	2.02	1.64	8.56	11.03	0.60	20.67	0.02	10.61	0.08	41.65	1.43	100.83	0.38	100.45
4 / 10 .	0.81	0.20	1.51	1.94	1.58	8.66	11.02	0.55	20.47	0.00	10.54	0.04	41.98	1.62	100.93	0.38	100.54
Avg B4_1.4	0.79	0.20	1.50	1.94	1.67	8.59	11.07	0.62	20.39	0.05	10.64	0.02	41.53	1.53	100.56	0.38	100.18
5 / 1 .	0.70	0.18	1.56	1.84	1.59	8.59	11.16	0.62	20.23	0.06	10.67	0.03	41.91	1.48	100.61	0.34	100.27
5 / 2 .	0.69	0.21	1.55	1.88	1.61	8.56	11.09	0.69	19.96	0.19	10.65	0.02	41.68	1.64	100.42	0.34	100.08
5 / 3 .	0.67	0.21	1.57	1.82	1.59	8.57	11.16	0.61	20.14	0.10	10.64	0.02	41.78	1.71	100.59	0.33	100.27
5 / 4 .	0.76	0.17	1.53	1.88	1.69	8.57	11.22	0.67	20.07	0.14	10.62	0.00	41.73	1.67	100.72	0.36	100.36
5 / 5 .	0.75	0.21	1.52	1.84	1.69	8.54	11.13	0.63	20.05	0.05	10.66	0.01	41.53	1.69	100.31	0.36	99.94
5 / 6 .	0.83	0.19	1.49	1.89	1.67	8.54	11.09	0.67	20.09	0.06	10.61	0.01	41.77	1.54	100.44	0.39	100.05
5 / 7 .	0.81	0.20	1.50	1.92	1.63	8.55	11.09	0.66	20.08	0.05	10.55	0.01	41.68	1.65	100.37	0.38	99.98
5 / 8 .	0.77	0.19	1.52	1.95	1.67	8.59	11.11	0.58	20.22	-0.01	10.57	0.04	41.82	1.72	100.77	0.37	100.40
5 / 9 .	0.77	0.19	1.52	1.92	1.69	8.60	11.14	0.68	20.11	0.09	10.63	0.03	41.86	1.59	100.82	0.37	100.45
5 / 10 .	0.79	0.19	1.52	1.93	1.65	8.60	10.96	0.68	20.36	0.11	10.58	0.04	41.90	1.65	100.93	0.37	100.55
Avg B4_1.5	0.75	0.19	1.53	1.89	1.65	8.57	11.11	0.65	20.13	0.08	10.62	0.02	41.77	1.63	100.60	0.36	100.24
6 / 1 .	0.84	0.20	1.47	1.75	1.67	8.58	11.19	0.67	20.45	-0.02	10.74	0.03	41.31	1.12	100.00	0.40	99.60
6 / 2 .	0.73	0.20	1.55	1.79	1.60	8.52	11.27	0.70	20.67	0.02	10.94	0.03	41.78	1.16	100.95	0.35	100.60
6 / 3 .	0.80	0.19	1.50	1.78	1.63	8.51	11.24	0.67	20.39	0.09	10.88	0.00	41.65	1.13	100.47	0.38	100.09
6 / 4 .	0.77	0.22	1.51	1.77	1.61	8.62	11.19	0.67	20.77	0.09	10.82	0.02	41.66	1.16	100.89	0.37	100.52
6 / 5 .	0.68	0.19	1.57	1.71	1.61	8.69	11.17	0.59	20.55	0.03	10.81	0.06	41.76	1.21	100.63	0.33	100.30
6 / 6 .	0.77	0.20	1.52	1.74	1.62	8.69	11.19	0.60	20.88	0.05	10.77	0.03	41.74	1.21	101.00	0.37	100.64
6 / 7 .	0.83	0.19	1.49	1.80	1.58	8.70	10.99	0.67	20.66	-0.03	10.80	0.01	41.57	1.24	100.51	0.39	100.12
avg B4_1.6	0.77	0.20	1.51	1.76	1.62	8.61	11.18	0.65	20.62	0.03	10.82	0.03	41.64	1.18	100.63	0.37	100.26

Table G4: Amphibole Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
7 / 1 .	0.68	0.19	1.57	1.79	1.59	8.59	11.15	0.62	20.28	0.09	10.87	0.02	41.83	1.13	100.39	0.33	100.07
7 / 2 .	0.81	0.18	1.50	1.87	1.64	8.62	11.21	0.63	20.88	0.05	10.67	0.04	41.54	1.31	100.96	0.38	100.57
7 / 3 .	0.87	0.19	1.47	1.90	1.68	8.58	11.02	0.62	20.65	0.06	10.72	0.06	41.52	1.29	100.64	0.41	100.23
7 / 4 .	0.76	0.19	1.51	1.89	1.70	8.59	11.27	0.59	20.17	0.04	10.56	0.00	41.33	1.35	99.94	0.36	99.58
7 / 5 .	0.78	0.21	1.51	1.92	1.66	8.69	11.26	0.66	20.42	0.04	10.58	-0.05	41.66	1.47	100.87	0.37	100.49
7 / 6 .	0.79	0.22	1.50	1.92	1.71	8.56	11.15	0.63	20.49	0.02	10.78	0.02	41.43	1.43	100.67	0.38	100.29
7 / 7 .	0.83	0.20	1.49	1.98	1.67	8.63	11.09	0.69	20.74	0.14	10.68	0.02	41.57	1.40	101.12	0.39	100.73
7 / 8 .	0.83	0.21	1.48	1.97	1.70	8.52	11.03	0.63	20.60	0.09	10.77	0.04	41.51	1.42	100.80	0.40	100.40
7 / 9 .	0.82	0.19	1.49	1.99	1.66	8.52	11.17	0.69	20.40	0.09	10.78	0.01	41.41	1.32	100.54	0.39	100.14
7 / 10 .	0.77	0.19	1.51	2.03	1.67	8.49	11.08	0.65	20.38	0.07	10.72	0.04	41.28	1.35	100.22	0.37	99.86
Avg B4_1.7	0.79	0.20	1.50	1.93	1.67	8.58	11.14	0.64	20.50	0.07	10.71	0.02	41.51	1.35	100.61	0.38	100.23
B4_amph 2																	
1 / 1 .	0.74	0.17	1.54	2.18	1.77	8.18	10.93	0.65	20.80	0.06	11.09	-0.02	40.94	1.85	100.91	0.35	100.56
1 / 2 .	0.70	0.18	1.56	2.19	1.75	8.27	10.79	0.66	20.80	-0.01	10.96	-0.05	41.10	1.94	100.91	0.33	100.57
1 / 3 .	0.76	0.19	1.53	2.24	1.76	8.32	10.88	0.61	20.42	-0.05	11.05	0.01	41.26	1.94	100.98	0.36	100.61
1 / 4 .	0.78	0.19	1.51	2.24	1.71	8.24	10.81	0.67	20.13	0.00	11.04	0.00	41.10	1.97	100.39	0.37	100.02
1 / 5 .	0.81	0.19	1.50	2.18	1.69	8.33	10.80	0.54	20.44	-0.10	10.98	-0.01	41.29	1.87	100.59	0.38	100.21
1 / 6 .	0.73	0.17	1.54	2.23	1.74	8.32	10.72	0.72	20.34	-0.11	10.97	-0.02	41.18	1.94	100.61	0.35	100.26
1 / 7 .	0.82	0.18	1.50	2.18	1.75	8.31	10.91	0.65	20.50	0.03	11.09	0.00	41.15	1.85	100.94	0.39	100.56
1 / 8 .	0.74	0.18	1.54	2.20	1.75	8.40	10.80	0.72	20.49	-0.02	11.07	-0.02	41.14	1.90	100.93	0.35	100.58
1 / 9 .	0.73	0.18	1.54	2.23	1.70	8.25	10.93	0.70	20.56	-0.03	11.01	-0.03	41.20	1.93	100.97	0.35	100.62
1 / 10 .	0.85	0.17	1.49	2.24	1.77	8.33	10.81	0.69	20.30	0.02	11.08	-0.03	41.20	1.88	100.82	0.40	100.42
Avg B4_2.1	0.77	0.18	1.52	2.21	1.74	8.30	10.84	0.66	20.48	-0.02	11.03	-0.02	41.16	1.91	100.75	0.36	100.39
2 / 1 .	0.70	0.18	1.56	1.77	1.68	8.60	11.20	0.59	20.45	-0.06	10.80	-0.03	41.54	1.75	100.81	0.34	100.48
2 / 2 .	0.67	0.16	1.58	1.83	1.60	8.74	11.21	0.60	19.92	-0.03	10.77	-0.01	41.74	1.72	100.54	0.32	100.21
2 / 3 .	0.72	0.16	1.56	1.94	1.61	8.65	11.13	0.67	20.33	0.00	10.71	-0.05	41.87	1.60	100.95	0.34	100.61
2 / 4 .	0.64	0.18	1.58	1.83	1.53	8.64	11.03	0.59	19.89	0.00	10.69	-0.05	41.70	1.72	100.04	0.31	99.73
2 / 5 .	0.64	0.17	1.60	1.82	1.57	8.67	11.08	0.62	20.00	-0.02	10.82	-0.02	41.83	1.68	100.48	0.31	100.17

Table G4: Amphibole Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
2 / 6 .	0.68	0.17	1.58	1.85	1.58	8.79	11.08	0.68	20.21	-0.09	10.77	-0.01	41.82	1.63	100.83	0.33	100.50
2 / 7 .	0.72	0.19	1.55	1.85	1.62	8.71	11.05	0.60	20.25	-0.04	10.73	0.00	41.66	1.63	100.55	0.35	100.20
2 / 8 .	0.70	0.18	1.56	1.90	1.61	8.57	11.08	0.59	19.81	-0.01	10.82	-0.04	41.63	1.75	100.20	0.33	99.86
2 / 9 .	0.72	0.17	1.55	1.83	1.60	8.55	10.98	0.69	20.12	-0.11	10.70	-0.01	41.65	1.50	100.05	0.34	99.71
2 / 10 .	0.68	0.16	1.57	1.91	1.63	8.52	10.99	0.60	19.97	-0.02	10.82	-0.01	41.74	1.63	100.23	0.32	99.91
Avg B4_2.2	0.69	0.17	1.57	1.85	1.60	8.64	11.08	0.62	20.10	-0.04	10.76	-0.02	41.72	1.66	100.41	0.33	100.08
3 / 1 .	0.67	0.16	1.58	1.78	1.56	8.55	11.15	0.61	20.06	0.07	10.75	-0.06	41.94	1.58	100.48	0.32	100.16
3 / 2 .	0.74	0.17	1.54	1.92	1.59	8.63	10.86	0.68	20.18	-0.02	10.67	-0.09	41.57	1.56	100.10	0.35	99.75
3 / 3 .	0.74	0.17	1.54	2.01	1.66	8.41	11.06	0.69	20.41	0.02	10.67	-0.01	41.61	1.70	100.69	0.35	100.34
3 / 4 .	0.76	0.18	1.53	2.04	1.68	8.54	10.95	0.71	20.36	-0.03	10.78	-0.06	41.43	1.66	100.62	0.36	100.26
3 / 5 .	0.72	0.20	1.54	1.96	1.69	8.46	11.01	0.67	20.07	-0.19	10.67	-0.03	41.43	1.70	100.11	0.35	99.77
3 / 6 .	0.78	0.17	1.53	2.05	1.69	8.52	10.90	0.64	20.72	-0.06	10.77	-0.05	41.64	1.72	101.14	0.37	100.77
3 / 7 .	0.74	0.18	1.54	2.08	1.66	8.50	10.92	0.70	20.36	-0.11	10.75	-0.03	41.63	1.87	100.93	0.35	100.58
3 / 8 .	0.75	0.18	1.53	2.04	1.67	8.57	10.96	0.71	20.24	0.01	10.76	-0.02	41.49	1.73	100.66	0.36	100.30
3 / 9 .	0.77	0.19	1.53	2.11	1.61	8.40	11.08	0.66	20.14	-0.04	10.69	-0.03	41.63	1.89	100.69	0.36	100.32
3 / 10 .	0.79	0.16	1.51	2.08	1.70	8.44	10.91	0.66	20.33	0.11	10.77	0.02	41.32	1.77	100.58	0.37	100.21
Avg B4_2.3	0.75	0.18	1.54	2.01	1.65	8.50	10.98	0.67	20.29	-0.02	10.73	-0.04	41.57	1.72	100.51	0.35	100.16
4 / 1 .	0.80	0.17	1.51	1.95	1.75	8.43	11.06	0.63	20.68	-0.07	10.89	-0.06	41.45	1.59	100.91	0.37	100.54
4 / 2 .	0.71	0.18	1.55	2.03	1.73	8.44	10.98	0.57	20.75	-0.02	10.89	-0.02	41.46	1.39	100.67	0.34	100.33
4 / 3 .	0.78	0.16	1.52	2.03	1.77	8.49	10.92	0.65	20.48	0.06	10.82	-0.04	41.36	1.55	100.58	0.36	100.22
4 / 4 .	0.78	0.18	1.51	2.00	1.73	8.55	10.98	0.61	20.44	0.06	10.76	-0.09	41.44	1.49	100.52	0.37	100.15
4 / 5 .	0.82	0.20	1.50	1.87	1.75	8.98	11.11	0.63	20.48	-0.11	10.59	-0.01	41.85	1.19	100.97	0.39	100.58
4 / 6 .	0.82	0.18	1.47	1.85	1.54	8.83	10.38	0.56	21.12	-0.08	10.77	-0.04	40.84	1.09	99.43	0.39	99.04
4 / 7 .	0.76	0.19	1.51	2.02	1.73	8.55	10.95	0.62	19.95	0.07	10.58	0.00	41.55	1.58	100.07	0.36	99.70
4 / 8 .	0.81	0.18	1.50	1.93	1.70	8.65	10.85	0.67	20.52	-0.03	10.72	-0.03	41.56	1.50	100.59	0.38	100.21
4 / 9 .	0.75	0.18	1.53	1.94	1.72	8.61	11.00	0.63	20.14	0.01	10.58	-0.03	41.60	1.58	100.26	0.36	99.90
4 / 10 .	0.76	0.21	1.52	1.82	1.69	8.61	11.00	0.65	20.38	0.00	10.63	-0.04	41.56	1.58	100.41	0.37	100.05
Avg B4_2.4	0.78	0.18	1.51	1.94	1.71	8.61	10.92	0.62	20.49	-0.01	10.72	-0.04	41.47	1.45	100.37	0.37	100.01

Table G4: Amphibole Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
5 / 1 .	0.67	0.19	1.56	1.83	1.79	8.19	11.08	0.59	20.97	0.01	10.68	-0.02	41.30	1.54	100.39	0.32	100.07
5 / 2 .	0.82	0.19	1.49	1.98	1.69	8.56	10.98	0.53	20.51	0.00	10.60	-0.01	41.54	1.56	100.47	0.39	100.08
5 / 3 .	0.80	0.17	1.51	2.01	1.71	8.63	11.00	0.63	20.02	-0.05	10.67	-0.07	41.65	1.63	100.43	0.38	100.06
5 / 4 .	0.80	0.18	1.51	2.06	1.71	8.66	11.01	0.61	20.26	0.00	10.75	-0.03	41.63	1.49	100.69	0.38	100.31
5 / 5 .	0.75	0.15	1.53	2.11	1.69	8.56	10.90	0.69	19.96	0.07	10.75	0.00	41.49	1.68	100.32	0.35	99.97
5 / 6 .	0.82	0.16	1.51	2.13	1.71	8.48	10.98	0.62	20.65	-0.10	10.80	-0.07	41.62	1.66	101.14	0.38	100.76
5 / 7 .	0.72	0.20	1.55	2.06	1.75	8.62	10.91	0.62	20.39	-0.05	10.79	-0.03	41.54	1.69	100.84	0.35	100.49
5 / 8 .	0.71	0.16	1.56	2.12	1.77	8.49	10.90	0.66	20.56	-0.10	10.76	-0.06	41.35	1.77	100.81	0.34	100.48
5 / 9 .	0.73	0.19	1.54	2.08	1.74	8.42	10.88	0.65	20.46	0.03	10.77	0.00	41.65	1.58	100.72	0.35	100.37
5 / 10 .	0.81	0.19	1.50	2.08	1.74	8.48	10.96	0.69	20.14	-0.11	10.74	-0.03	41.42	1.61	100.34	0.38	99.96
Avg B4_2.5	0.76	0.18	1.53	2.05	1.73	8.51	10.96	0.63	20.39	-0.03	10.73	-0.03	41.52	1.62	100.54	0.36	100.18
6 / 1 .	0.74	0.19	1.54	1.82	1.61	8.42	10.99	0.52	21.05	-0.04	10.82	-0.04	41.93	1.16	100.79	0.35	100.44
6 / 2 .	0.70	0.17	1.57	1.81	1.59	8.46	11.13	0.63	21.36	-0.02	10.78	-0.02	41.98	0.99	101.16	0.33	100.83
6 / 3 .	0.73	0.19	1.54	1.75	1.66	8.41	11.11	0.56	20.99	-0.02	10.74	-0.03	41.95	1.11	100.75	0.35	100.40
6 / 4 .	0.76	0.19	1.53	1.85	1.64	8.42	11.04	0.63	20.93	0.12	10.82	-0.02	41.89	1.05	100.88	0.36	100.52
6 / 5 .	0.69	0.20	1.57	1.76	1.64	8.45	11.22	0.59	21.36	-0.02	10.86	-0.07	42.05	0.97	101.36	0.33	101.02
6 / 6 .	0.79	0.18	1.52	1.83	1.61	8.45	11.06	0.65	21.48	-0.11	10.81	0.02	41.88	1.05	101.33	0.37	100.96
6 / 7 .	0.68	0.20	1.56	1.78	1.61	8.42	11.15	0.59	21.03	-0.04	10.79	0.00	41.85	0.94	100.62	0.33	100.28
6 / 8 .	0.65	0.19	1.58	1.80	1.66	8.30	11.13	0.52	21.20	0.03	10.85	0.05	41.80	1.09	100.86	0.32	100.55
6 / 9 .	0.75	0.18	1.54	1.85	1.60	8.52	11.08	0.60	21.05	0.04	10.78	-0.03	41.98	0.99	100.95	0.36	100.60
6 / 10 .	0.76	0.19	1.53	1.73	1.62	8.47	11.23	0.53	21.07	0.03	10.74	-0.01	41.92	0.92	100.75	0.36	100.39
Avg B4_2.6	0.72	0.19	1.55	1.80	1.62	8.43	11.12	0.58	21.15	0.00	10.80	-0.01	41.92	1.03	100.90	0.35	100.55
7 / 1 . *	0.10	0.02	1.64	0.36	0.37	7.20	1.29	0.26	35.35	-0.18	15.36	-0.01	30.05	0.10	92.11	0.05	92.07
7 / 2 .	0.75	0.18	1.53	1.84	1.65	8.44	11.03	0.63	20.73	-0.12	10.84	-0.05	41.80	1.16	100.58	0.36	100.23
7 / 3 .	0.80	0.19	1.50	1.89	1.69	8.43	11.00	0.62	21.31	-0.04	10.84	0.02	41.42	1.21	100.92	0.38	100.54
7 / 4 .	0.86	0.18	1.47	1.98	1.68	8.35	10.91	0.64	20.70	-0.02	10.80	-0.05	41.61	1.25	100.45	0.40	100.05
7 / 5 .	0.86	0.19	1.47	1.95	1.70	8.45	11.02	0.65	21.06	0.02	10.81	-0.04	41.50	1.25	100.94	0.41	100.54
7 / 6 .	0.83	0.19	1.48	2.03	1.70	8.38	10.98	0.63	20.80	-0.11	10.69	-0.01	41.45	1.35	100.50	0.39	100.11
7 / 7 .	0.80	0.18	1.51	1.99	1.70	8.39	11.11	0.70	20.88	-0.05	10.80	-0.03	41.63	1.42	101.10	0.37	100.73

Table G4: Amphibole Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
7 / 8 .	0.74	0.18	1.54	1.91	1.67	8.50	11.08	0.59	20.96	0.04	10.68	-0.03	41.66	1.38	100.94	0.35	100.59
7 / 9 .	0.67	0.18	1.57	1.97	1.65	8.54	11.17	0.62	20.71	0.00	10.60	-0.01	41.69	1.27	100.64	0.32	100.32
7 / 10 .	0.73	0.19	1.53	1.87	1.63	8.45	11.03	0.56	20.55	-0.02	10.54	-0.03	41.67	1.33	100.09	0.35	99.74
Avg B4_2.7	0.78	0.18	1.51	1.94	1.67	8.44	11.04	0.63	20.86	-0.03	10.73	-0.02	41.60	1.29	100.62	0.37	100.25
8 / 1 .	0.79	0.16	1.51	2.08	1.69	8.47	10.95	0.67	20.75	-0.05	10.81	-0.04	41.22	1.50	100.60	0.37	100.24
8 / 2 .	0.75	0.19	1.52	2.05	1.69	8.55	10.97	0.66	20.46	-0.05	10.81	-0.06	41.31	1.52	100.48	0.36	100.12
8 / 3 .	0.72	0.17	1.55	2.05	1.66	8.44	10.95	0.67	20.47	-0.12	10.87	-0.06	41.35	1.65	100.55	0.34	100.21
8 / 4 .	0.73	0.17	1.54	2.11	1.73	8.41	10.99	0.64	20.59	0.01	10.80	-0.06	41.22	1.49	100.43	0.35	100.09
8 / 5 .	0.81	0.17	1.50	2.10	1.74	8.54	10.91	0.62	20.57	-0.03	10.84	0.01	41.30	1.55	100.67	0.38	100.29
8 / 6 .	0.83	0.19	1.49	2.10	1.72	8.52	10.94	0.67	20.56	0.07	10.89	-0.06	41.32	1.50	100.81	0.39	100.42
8 / 7 .	0.77	0.19	1.51	2.08	1.73	8.43	10.92	0.69	20.43	-0.06	10.86	-0.05	41.23	1.56	100.40	0.37	100.03
8 / 8 .	0.77	0.18	1.52	2.09	1.78	8.41	10.96	0.67	20.35	-0.07	10.90	-0.01	41.25	1.61	100.50	0.36	100.13
8 / 9 .	0.74	0.18	1.53	2.08	1.72	8.42	10.84	0.66	20.69	-0.04	10.89	-0.04	41.14	1.62	100.51	0.35	100.16
8 / 10 .	0.77	0.19	1.52	2.10	1.72	8.44	10.91	0.58	20.73	0.00	10.96	-0.02	41.18	1.62	100.73	0.37	100.36
Avg B4_2.8	0.77	0.18	1.52	2.08	1.72	8.46	10.93	0.65	20.56	-0.03	10.86	-0.04	41.25	1.56	100.49	0.36	100.12
B4_amph 3																	
1 / 1 .	0.79	0.20	1.50	2.10	1.68	8.42	10.91	0.63	20.64	-0.02	10.78	0.01	41.34	1.73	100.74	0.38	100.36
1 / 2 .	0.74	0.20	1.53	2.07	1.63	8.39	10.89	0.66	20.71	0.10	10.81	0.03	41.27	1.59	100.63	0.36	100.28
1 / 3 .	0.79	0.18	1.51	2.10	1.71	8.43	10.91	0.59	20.43	0.12	10.83	0.03	41.26	1.61	100.50	0.37	100.12
1 / 4 .	0.76	0.20	1.51	2.08	1.65	8.38	11.01	0.57	20.60	-0.04	10.78	0.02	41.24	1.62	100.45	0.37	100.08
1 / 5 .	0.77	0.20	1.51	2.05	1.69	8.38	10.97	0.67	20.41	0.05	10.79	-0.01	41.20	1.66	100.34	0.37	99.97
1 / 6 .	0.76	0.20	1.52	2.07	1.68	8.45	10.85	0.66	20.80	0.12	10.79	0.05	41.18	1.59	100.72	0.36	100.36
1 / 7 .	0.80	0.20	1.50	2.11	1.71	8.39	10.98	0.65	20.70	0.14	10.86	0.00	41.18	1.62	100.85	0.38	100.47
1 / 8 .	0.78	0.20	1.51	2.09	1.68	8.37	10.87	0.68	20.99	0.06	10.82	0.01	41.37	1.53	100.96	0.37	100.58
1 / 9 .	0.81	0.19	1.50	2.06	1.68	8.50	10.84	0.68	20.48	0.03	10.78	0.00	41.50	1.72	100.77	0.38	100.39
1 / 10 .	0.84	0.20	1.48	2.09	1.70	8.55	11.08	0.63	20.27	0.04	10.79	0.01	41.35	1.73	100.76	0.40	100.36
Avg B4_3.1	0.78	0.20	1.51	2.08	1.68	8.43	10.93	0.64	20.60	0.06	10.80	0.02	41.29	1.64	100.66	0.37	100.29
2 / 1 .	0.83	0.19	1.49	1.87	1.59	8.82	11.09	0.61	19.68	0.10	10.65	0.01	42.05	1.30	100.29	0.39	99.89

Table G4: Amphibole Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
2 / 2 .	0.82	0.19	1.49	1.89	1.57	8.80	11.04	0.57	19.66	0.15	10.54	0.01	41.88	1.50	100.13	0.39	99.74
2 / 3 .	0.71	0.19	1.55	1.94	1.60	8.83	10.97	0.62	19.95	0.08	10.51	0.02	41.98	1.44	100.38	0.34	100.04
2 / 4 .	0.80	0.18	1.51	1.84	1.55	8.92	11.03	0.61	19.85	0.05	10.65	-0.02	41.87	1.58	100.44	0.38	100.06
2 / 5 .	0.76	0.19	1.53	1.82	1.53	8.86	11.02	0.61	19.72	0.08	10.83	0.00	41.93	1.51	100.39	0.36	100.03
Avg B4_3.2	0.79	0.19	1.51	1.96	1.62	8.67	10.99	0.63	20.13	0.07	10.71	0.01	41.69	1.55	100.53	0.38	100.15
B4_ amph 4																	
1 / 1 .	0.79	0.20	1.50	2.10	1.68	8.42	10.91	0.63	20.64	-0.02	10.78	0.01	41.34	1.73	100.74	0.38	100.36
1 / 2 .	0.74	0.20	1.53	2.07	1.63	8.39	10.89	0.66	20.71	0.10	10.81	0.03	41.27	1.59	100.63	0.36	100.28
1 / 3 .	0.79	0.18	1.51	2.10	1.71	8.43	10.91	0.59	20.43	0.12	10.83	0.03	41.26	1.61	100.50	0.37	100.12
1 / 4 .	0.76	0.20	1.51	2.08	1.65	8.38	11.01	0.57	20.60	-0.04	10.78	0.02	41.24	1.62	100.45	0.37	100.08
1 / 5 .	0.77	0.20	1.51	2.05	1.69	8.38	10.97	0.67	20.41	0.05	10.79	-0.01	41.20	1.66	100.34	0.37	99.97
1 / 6 .	0.76	0.20	1.52	2.07	1.68	8.45	10.85	0.66	20.80	0.12	10.79	0.05	41.18	1.59	100.72	0.36	100.36
1 / 7 .	0.80	0.20	1.50	2.11	1.71	8.39	10.98	0.65	20.70	0.14	10.86	0.00	41.18	1.62	100.85	0.38	100.47
1 / 8 .	0.78	0.20	1.51	2.09	1.68	8.37	10.87	0.68	20.99	0.06	10.82	0.01	41.37	1.53	100.96	0.37	100.58
1 / 9 .	0.81	0.19	1.50	2.06	1.68	8.50	10.84	0.68	20.48	0.03	10.78	0.00	41.50	1.72	100.77	0.38	100.39
1 / 10 .	0.84	0.20	1.48	2.09	1.70	8.55	11.08	0.63	20.27	0.04	10.79	0.01	41.35	1.73	100.76	0.40	100.36
Avg B4_4.1	0.78	0.20	1.51	2.08	1.68	8.43	10.93	0.64	20.60	0.06	10.80	0.02	41.29	1.64	100.66	0.37	100.29
2 / 1 .	0.83	0.19	1.49	1.87	1.59	8.82	11.09	0.61	19.68	0.10	10.65	0.01	42.05	1.30	100.29	0.39	99.89
2 / 2 .	0.82	0.19	1.49	1.89	1.57	8.80	11.04	0.57	19.66	0.15	10.54	0.01	41.88	1.50	100.13	0.39	99.74
2 / 3 .	0.71	0.19	1.55	1.94	1.60	8.83	10.97	0.62	19.95	0.08	10.51	0.02	41.98	1.44	100.38	0.34	100.04
2 / 4 .	0.80	0.18	1.51	1.84	1.55	8.92	11.03	0.61	19.85	0.05	10.65	-0.02	41.87	1.58	100.44	0.38	100.06
2 / 5 .	0.76	0.19	1.53	1.82	1.53	8.86	11.02	0.61	19.72	0.08	10.83	0.00	41.93	1.51	100.39	0.36	100.03
Avg B4_4.2	0.79	0.19	1.51	1.96	1.62	8.67	10.99	0.63	20.13	0.07	10.71	0.01	41.69	1.55	100.53	0.38	100.15
B4_amph 5																	
1 / 1 .	0.69	0.19	1.56	1.76	1.72	8.32	11.01	0.59	20.50	0.01	10.80	-0.02	41.90	1.19	100.25	0.33	99.91
1 / 2 .	0.74	0.18	1.53	1.85	1.70	8.38	11.02	0.60	20.86	-0.02	10.64	-0.01	41.69	1.21	100.41	0.35	100.06
1 / 3 .	0.66	0.19	1.57	1.84	1.70	8.44	11.01	0.63	20.55	0.12	10.68	0.02	41.73	1.20	100.31	0.32	99.99
1 / 4 .	0.62	0.22	1.58	1.84	1.66	8.40	10.99	0.63	20.98	-0.01	10.58	0.03	41.83	1.27	100.63	0.31	100.32

Table G4: Amphibole Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 5 .	0.71	0.20	1.53	1.81	1.74	8.41	11.02	0.57	20.32	0.03	10.57	0.00	41.64	1.13	99.69	0.34	99.35
Avg B4_5.1	0.71	0.19	1.54	1.84	1.67	8.50	11.01	0.61	20.44	0.04	10.69	0.00	41.77	1.29	100.31	0.34	99.96
2 / 1 .	0.70	0.17	1.55	1.89	1.68	8.34	11.04	0.69	20.96	0.09	10.79	-0.02	41.49	1.32	100.71	0.34	100.38
2 / 2 .	0.69	0.21	1.55	1.89	1.76	8.41	10.91	0.56	20.89	0.09	10.80	0.00	41.54	1.32	100.63	0.34	100.29
2 / 3 .	0.70	0.23	1.54	1.82	1.65	8.43	10.95	0.57	20.74	0.11	10.77	0.02	41.66	1.22	100.41	0.35	100.06
2 / 4 .	0.73	0.21	1.52	1.85	1.72	8.46	11.01	0.62	20.32	0.10	10.72	0.01	41.64	1.19	100.10	0.36	99.74
2 / 5 .	0.70	0.23	1.53	1.80	1.69	8.55	11.03	0.56	20.10	0.14	10.71	-0.01	41.76	1.25	100.05	0.35	99.70
2 / 6 .	0.73	0.20	1.53	1.80	1.69	8.53	11.10	0.64	20.27	0.05	10.70	0.00	41.77	1.10	100.10	0.35	99.74
Avg B4_5.2	0.70	0.21	1.54	1.84	1.69	8.45	11.01	0.60	20.56	0.07	10.70	0.00	41.68	1.23	100.29	0.34	99.94
3 / 1 .	0.72	0.20	1.53	1.93	1.66	8.41	11.14	0.61	20.56	0.15	10.71	0.03	41.30	1.41	100.37	0.35	100.02
3 / 2 .	0.78	0.22	1.51	1.98	1.71	8.41	11.04	0.64	20.69	0.02	10.74	-0.02	41.45	1.44	100.62	0.38	100.24
3 / 3 .	0.75	0.18	1.53	1.98	1.65	8.32	11.00	0.55	20.98	0.03	10.76	0.02	41.51	1.45	100.71	0.36	100.35
3 / 4 .	0.69	0.20	1.55	2.02	1.72	8.28	11.06	0.65	20.61	0.04	10.80	-0.01	41.32	1.57	100.49	0.34	100.16
3 / 5 .	0.72	0.21	1.53	2.00	1.74	8.23	11.00	0.62	20.79	0.09	10.80	0.02	41.27	1.36	100.38	0.35	100.03
3 / 6 .	0.77	0.19	1.51	2.01	1.66	8.19	10.90	0.64	20.84	0.03	10.88	-0.03	41.32	1.43	100.38	0.37	100.01
3 / 7 .	0.75	0.18	1.52	2.00	1.70	8.34	10.96	0.65	20.86	0.01	10.88	-0.02	41.21	1.38	100.45	0.35	100.10
3 / 8 .	0.73	0.18	1.53	2.04	1.70	8.14	11.11	0.62	20.86	0.01	10.81	-0.02	41.37	1.41	100.50	0.35	100.15
3 / 9 .	0.67	0.18	1.57	2.00	1.63	8.22	11.03	0.62	21.06	0.04	10.86	-0.01	41.31	1.55	100.75	0.32	100.42
3 / 10 .	0.69	0.19	1.56	1.89	1.75	8.32	10.91	0.61	21.11	0.14	10.81	0.01	41.44	1.53	100.97	0.34	100.63
Avg B4_5.3	0.73	0.19	1.53	1.99	1.69	8.29	11.01	0.62	20.84	0.06	10.80	0.00	41.35	1.45	100.55	0.35	100.20
B4_amph 6																	
1 / 1 .	0.77	0.20	1.51	1.94	1.69	8.58	10.84	0.50	20.28	0.11	10.47	-0.03	41.73	1.42	100.04	0.37	99.68
1 / 2 .	0.71	0.17	1.53	1.77	1.54	8.70	9.93	0.47	21.50	0.12	10.75	0.03	41.10	1.30	99.62	0.34	99.28
1 / 3 .	0.82	0.18	1.49	1.96	1.67	8.54	10.92	0.51	20.48	0.03	10.60	-0.01	41.58	1.45	100.24	0.39	99.86
1 / 4 .	0.75	0.19	1.52	1.99	1.73	8.52	10.84	0.54	20.08	0.07	10.59	0.00	41.50	1.43	99.74	0.36	99.39
1 / 5 .	0.84	0.19	1.49	2.01	1.72	8.57	10.89	0.52	20.63	0.00	10.68	0.01	41.66	1.48	100.69	0.40	100.29
1 / 6 .	0.78	0.21	1.50	2.00	1.68	8.47	10.87	0.58	20.37	0.06	10.53	0.03	41.54	1.63	100.24	0.37	99.86
1 / 7 .	0.87	0.19	1.46	2.02	1.68	8.50	10.79	0.49	20.01	0.09	10.68	-0.01	41.62	1.62	100.03	0.41	99.62

Table G4: Amphibole Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 8 .	0.79	0.18	1.50	1.98	1.72	8.45	10.72	0.47	20.43	0.05	10.67	-0.02	41.45	1.56	99.97	0.37	99.60
1 / 9 .	0.77	0.18	1.52	2.01	1.67	8.52	10.88	0.57	20.38	0.07	10.65	0.03	41.58	1.69	100.53	0.37	100.16
1 / 10 .	0.63	0.19	1.58	1.91	1.64	8.57	10.90	0.45	20.22	0.08	10.61	0.00	41.60	1.62	100.00	0.31	99.69
Avg B4_6	0.77	0.19	1.51	1.96	1.68	8.54	10.76	0.51	20.44	0.07	10.62	0.00	41.54	1.52	100.10	0.37	99.73
B4_amph 7																	
1 / 1 .	0.74	0.18	1.54	1.89	1.60	8.49	10.97	0.63	20.85	0.01	10.69	0.05	41.67	1.57	100.88	0.35	100.53
1 / 2 .	0.75	0.17	1.52	1.92	1.66	8.50	11.03	0.55	20.24	0.02	10.57	0.02	41.65	1.43	100.04	0.36	99.69
1 / 3 .	0.70	0.17	1.55	1.88	1.60	8.59	11.00	0.58	20.52	0.06	10.52	0.05	41.61	1.40	100.22	0.33	99.89
1 / 4 .	0.68	0.19	1.56	1.90	1.66	8.52	11.07	0.60	20.26	0.03	10.64	0.03	41.48	1.48	100.10	0.33	99.77
1 / 5 .	0.67	0.19	1.55	2.01	1.66	8.30	10.89	0.64	20.59	0.10	10.69	0.06	41.18	1.47	100.00	0.32	99.68
1 / 6 .	0.69	0.19	1.54	1.95	1.73	8.23	10.83	0.70	20.47	-0.06	10.76	0.02	41.29	1.51	99.90	0.33	99.56
1 / 7 .	0.66	0.17	1.57	1.99	1.69	8.25	11.09	0.64	20.53	0.01	10.77	0.06	41.12	1.61	100.15	0.32	99.83
1 / 8 .	0.75	0.19	1.51	1.98	1.73	8.20	10.89	0.63	20.70	-0.05	10.78	-0.04	41.20	1.53	100.10	0.36	99.74
1 / 9 .	0.65	0.18	1.57	2.01	1.71	8.30	10.83	0.66	20.61	0.00	10.80	0.02	41.09	1.59	100.02	0.31	99.71
1 / 10 .	0.70	0.18	1.55	1.97	1.75	8.31	10.91	0.71	20.95	-0.01	10.78	0.01	41.16	1.60	100.58	0.34	100.24
Avg B4_7	0.70	0.18	1.55	1.95	1.68	8.37	10.95	0.63	20.57	0.01	10.70	0.03	41.34	1.52	100.18	0.34	99.85
BR-14 B3																	
B3_amph 1																	
1 / 1 .	0.75	0.16	1.54	1.65	1.66	8.47	11.00	0.55	20.88	0.10	10.57	0.02	41.72	1.47	100.55	0.35	100.20
1 / 2 .	0.67	0.18	1.57	1.65	1.68	8.46	11.02	0.49	21.01	0.00	10.60	0.01	41.69	1.49	100.52	0.32	100.20
1 / 3 .	0.68	0.18	1.55	1.65	1.71	8.35	11.08	0.58	20.43	0.14	10.57	0.00	41.53	1.44	99.90	0.33	99.57
1 / 4 .	0.66	0.15	1.58	1.64	1.68	8.38	11.08	0.54	20.47	0.04	10.62	0.01	41.69	1.51	100.03	0.31	99.72
1 / 5 .	0.78	0.17	1.52	1.69	1.71	8.37	11.15	0.48	20.55	0.14	10.63	0.06	41.76	1.51	100.50	0.37	100.13
1 / 6 .	0.70	0.17	1.55	1.67	1.66	8.40	11.13	0.58	20.50	0.07	10.62	0.03	41.56	1.49	100.13	0.33	99.79
1 / 7 .	0.77	0.16	1.52	1.65	1.70	8.32	11.12	0.51	20.62	0.13	10.60	0.00	41.68	1.42	100.21	0.36	99.85
1 / 8 .	0.67	0.18	1.57	1.64	1.73	8.48	11.03	0.57	20.64	0.14	10.53	0.06	41.69	1.45	100.38	0.32	100.06
1 / 9 .	0.74	0.16	1.54	1.59	1.70	8.49	11.08	0.50	20.57	0.07	10.65	0.06	41.72	1.40	100.27	0.34	99.93
1 / 10 .	0.74	0.16	1.53	1.57	1.64	8.39	11.06	0.56	20.60	0.01	10.59	0.01	41.65	1.36	99.88	0.35	99.53

Table G4: Amphibole Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
Avg B3_1.1	0.71	0.17	1.55	1.64	1.69	8.41	11.08	0.54	20.63	0.09	10.60	0.03	41.67	1.45	100.24	0.34	99.90
2 / 1 .	0.71	0.17	1.54	1.61	1.68	8.28	11.04	0.56	20.56	0.02	10.55	-0.02	41.60	1.42	99.75	0.34	99.41
2 / 2 .	0.62	0.18	1.58	1.63	1.70	8.38	11.04	0.51	20.76	0.14	10.56	0.02	41.57	1.32	100.01	0.30	99.71
2 / 3 .	0.72	0.17	1.54	1.66	1.69	8.35	10.98	0.48	20.75	0.19	10.53	0.00	41.82	1.33	100.20	0.34	99.86
2 / 4 .	0.69	0.18	1.54	1.58	1.71	8.32	11.14	0.52	20.49	0.07	10.56	0.03	41.48	1.30	99.63	0.33	99.30
2 / 5 .	0.79	0.16	1.50	1.62	1.68	8.29	11.03	0.53	20.53	0.14	10.55	0.01	41.67	1.25	99.75	0.37	99.38
2 / 6 .	0.67	0.16	1.56	1.59	1.69	8.33	11.13	0.50	20.34	0.10	10.58	0.02	41.51	1.38	99.55	0.32	99.23
2 / 7 .	0.71	0.15	1.55	1.57	1.68	8.34	11.08	0.50	20.62	0.08	10.61	-0.01	41.62	1.36	99.87	0.33	99.54
2 / 8 .	0.76	0.17	1.51	1.59	1.65	8.40	11.06	0.54	20.46	-0.01	10.63	0.02	41.45	1.33	99.57	0.36	99.21
2 / 9 .	0.72	0.18	1.53	1.58	1.65	8.41	11.14	0.58	20.53	0.01	10.54	0.02	41.69	1.26	99.83	0.34	99.49
2 / 10 .	0.74	0.16	1.54	1.59	1.67	8.42	11.15	0.47	20.89	0.00	10.66	0.01	41.74	1.20	100.22	0.35	99.87
Avg B3_1.2	0.71	0.17	1.54	1.60	1.68	8.35	11.08	0.52	20.59	0.07	10.58	0.01	41.61	1.31	99.83	0.34	99.50
B3_amph 2																	
1 / 1 .	0.72	0.17	1.54	1.62	1.71	8.42	11.11	0.49	20.49	0.06	10.59	0.02	41.85	1.43	100.23	0.34	99.89
1 / 2 .	0.68	0.18	1.57	1.70	1.69	8.36	11.11	0.50	20.69	-0.06	10.65	0.03	41.69	1.50	100.34	0.32	100.02
1 / 3 .	0.67	0.15	1.57	1.65	1.66	8.33	11.06	0.48	20.71	0.13	10.64	-0.02	41.63	1.50	100.19	0.32	99.87
1 / 4 .	0.61	0.19	1.58	1.64	1.70	8.40	11.02	0.46	20.64	0.11	10.66	-0.01	41.44	1.49	99.95	0.30	99.65
1 / 5 .	0.64	0.17	1.58	1.66	1.69	8.35	11.08	0.56	20.52	-0.01	10.59	-0.01	41.71	1.33	99.87	0.31	99.57
1 / 6 .	0.67	0.17	1.57	1.66	1.69	8.41	11.12	0.46	20.79	-0.05	10.71	0.00	41.62	1.43	100.30	0.32	99.98
1 / 7 .	0.73	0.17	1.54	1.67	1.69	8.42	11.14	0.52	20.68	0.02	10.59	-0.04	41.53	1.47	100.17	0.35	99.83
1 / 8 .	0.64	0.17	1.58	1.65	1.67	8.32	11.10	0.52	20.78	-0.01	10.55	0.03	41.53	1.43	99.95	0.31	99.64
1 / 9 .	0.60	0.15	1.61	1.66	1.72	8.38	11.10	0.51	20.82	-0.02	10.68	-0.01	41.85	1.41	100.49	0.29	100.20
1 / 10 .	0.65	0.17	1.57	1.64	1.66	8.36	11.17	0.45	20.57	-0.06	10.57	-0.04	41.87	1.32	100.01	0.31	99.70
Avg B3_2.1	0.66	0.17	1.57	1.66	1.69	8.37	11.10	0.50	20.67	0.01	10.62	-0.01	41.67	1.43	100.12	0.32	99.80
2 / 1 .	0.68	0.17	1.56	1.45	1.57	8.71	11.19	0.47	20.66	-0.06	10.63	-0.01	41.76	1.15	100.00	0.32	99.68
2 / 2 .	0.72	0.19	1.53	1.51	1.61	8.55	11.16	0.46	20.62	-0.02	10.64	0.01	41.85	1.01	99.87	0.35	99.52
2 / 3 .	0.67	0.15	1.58	1.53	1.66	8.67	11.22	0.46	20.94	0.02	10.70	0.02	41.83	1.03	100.48	0.32	100.17
2 / 4 .	0.62	0.18	1.59	1.56	1.67	8.56	11.22	0.51	20.58	-0.03	10.67	0.00	41.80	1.14	100.12	0.30	99.82

Table G4: Amphibole Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
2 / 5 .	0.68	0.19	1.55	1.49	1.71	8.52	11.06	0.58	20.63	0.05	10.65	0.03	41.66	1.16	99.94	0.33	99.61
2 / 6 .	0.71	0.18	1.54	1.59	1.68	8.45	11.12	0.45	20.55	-0.02	10.60	0.01	41.72	1.31	99.89	0.34	99.55
2 / 7 .	0.72	0.15	1.55	1.61	1.65	8.48	11.04	0.46	20.82	-0.02	10.69	-0.03	41.70	1.17	100.06	0.34	99.72
2 / 8 .	0.68	0.15	1.57	1.56	1.67	8.54	11.08	0.54	21.30	-0.06	10.71	-0.03	41.75	1.27	100.84	0.32	100.52
2 / 9 .	0.55	0.18	1.60	1.52	1.56	8.48	10.28	0.43	21.83	-0.06	10.50	-0.05	41.13	1.31	99.37	0.27	99.10
2 / 10 .	0.58	0.16	1.61	1.53	1.70	8.36	11.02	0.52	20.57	-0.05	10.63	0.04	41.88	1.21	99.82	0.28	99.54
Avg B3_2.2	0.66	0.17	1.57	1.53	1.65	8.53	11.04	0.49	20.85	-0.03	10.64	0.00	41.71	1.18	99.99	0.32	99.68
B3_amph 3																	
1 / 1 .	0.57	0.17	1.62	1.38	1.55	8.47	11.22	0.46	20.30	0.08	10.79	0.00	41.98	1.31	99.91	0.28	99.63
1 / 2 .	0.71	0.15	1.56	1.53	1.59	8.52	11.23	0.46	20.67	0.14	10.63	-0.02	41.94	1.34	100.47	0.33	100.13
1 / 3 .	0.67	0.17	1.57	1.51	1.69	8.46	11.22	0.49	20.51	0.02	10.49	0.03	41.87	1.36	100.06	0.32	99.74
1 / 4 .	0.71	0.19	1.55	1.54	1.63	8.53	11.12	0.54	20.31	0.13	10.64	-0.02	41.85	1.43	100.17	0.34	99.83
1 / 5 .	0.72	0.17	1.54	1.58	1.70	8.49	11.19	0.53	20.73	-0.01	10.51	0.05	41.72	1.36	100.32	0.34	99.97
1 / 6 .	0.68	0.18	1.56	1.56	1.68	8.47	11.11	0.47	20.50	0.11	10.50	-0.03	41.85	1.36	100.03	0.33	99.70
1 / 7 .	0.62	0.18	1.58	1.48	1.69	8.51	11.02	0.45	20.31	0.00	10.51	0.01	41.87	1.31	99.56	0.30	99.26
1 / 8 .	0.71	0.18	1.55	1.55	1.63	8.46	11.20	0.56	20.50	0.08	10.52	0.00	41.82	1.31	100.06	0.34	99.72
1 / 9 .	0.67	0.20	1.56	1.45	1.61	8.48	11.20	0.54	20.24	0.08	10.51	0.01	41.88	1.35	99.77	0.33	99.45
1 / 10 .	0.65	0.17	1.58	1.42	1.60	8.41	11.08	0.47	20.28	0.01	10.84	-0.01	42.14	1.22	99.88	0.31	99.57
Avg B3_3	0.67	0.18	1.57	1.50	1.64	8.48	11.16	0.50	20.43	0.06	10.59	0.00	41.89	1.34	100.01	0.32	99.69
B3_amph 4																	
1 / 1 . *	0.38	0.13	1.61	0.69	0.91	13.66	5.32	0.24	21.56	0.09	11.88	0.00	36.36	0.73	93.55	0.19	93.36
1 / 2 .	0.60	0.19	1.60	1.52	1.72	8.28	11.13	0.50	20.97	0.05	10.53	-0.03	41.98	1.37	100.43	0.29	100.14
1 / 3 .	0.65	0.18	1.58	1.56	1.70	8.29	11.00	0.50	20.79	0.13	10.55	-0.04	42.00	1.48	100.40	0.31	100.09
1 / 4 .	0.64	0.17	1.60	1.59	1.75	8.32	11.03	0.44	21.24	0.16	10.63	-0.03	42.27	1.44	101.27	0.31	100.96
1 / 5 .	0.63	0.19	1.58	1.58	1.70	8.36	11.10	0.47	20.91	0.05	10.53	-0.05	41.64	1.39	100.13	0.31	99.82
1 / 6 .	0.75	0.18	1.52	1.59	1.69	8.37	10.92	0.48	20.84	0.11	10.53	0.00	41.94	1.36	100.28	0.36	99.92
1 / 7 .	0.66	0.19	1.57	1.54	1.69	8.30	10.97	0.46	20.79	0.18	10.61	0.00	42.02	1.47	100.44	0.32	100.12
1 / 8 .	0.58	0.18	1.62	1.60	1.72	8.44	11.05	0.51	20.89	0.09	10.56	-0.04	42.03	1.37	100.63	0.28	100.34
1 / 9 .	0.63	0.17	1.59	1.55	1.63	8.44	11.04	0.47	20.87	0.04	10.62	0.00	42.00	1.28	100.34	0.30	100.03

Table G4: Amphibole Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 10 .	0.64	0.16	1.59	1.53	1.71	8.49	11.09	0.44	20.34	0.12	10.58	0.00	42.25	1.33	100.29	0.31	99.98
1 / 11 .	0.66	0.17	1.58	1.48	1.72	8.57	11.26	0.44	20.30	0.04	10.64	-0.03	42.20	1.24	100.31	0.32	99.99
1 / 12 .	0.65	0.18	1.58	1.45	1.64	8.53	11.20	0.48	20.41	0.15	10.60	0.00	41.98	1.46	100.30	0.31	99.99
1 / 13 . *	-0.18	0.02	2.13	0.72	9.70	3.60	0.70	0.01	12.06	0.74	17.54	-0.02	54.78	0.11	102.11	0.01	102.10
Avg B3_4.1	0.64	0.18	1.58	1.54	1.70	8.40	11.07	0.47	20.76	0.10	10.58	-0.02	42.03	1.38	100.42	0.31	100.11
2 / 1 .	0.63	0.17	1.60	1.57	1.68	8.44	11.22	0.43	20.72	0.04	10.54	-0.05	41.99	1.44	100.45	0.30	100.15
2 / 2 .	0.64	0.17	1.59	1.59	1.72	8.33	11.06	0.45	20.84	0.19	10.61	-0.02	41.88	1.44	100.50	0.31	100.20
2 / 3 .	0.59	0.17	1.61	1.61	1.66	8.21	11.03	0.48	21.04	0.12	10.73	-0.04	41.93	1.33	100.51	0.29	100.22
2 / 4 .	0.70	0.16	1.57	1.71	1.71	8.22	11.10	0.43	20.84	0.03	10.80	-0.03	41.77	1.58	100.62	0.33	100.29
2 / 5 .	0.68	0.16	1.58	1.64	1.72	8.24	10.98	0.49	21.01	0.10	10.86	-0.01	41.91	1.47	100.83	0.32	100.50
2 / 6 .	0.70	0.19	1.57	1.66	1.73	8.20	11.03	0.52	21.28	0.07	10.87	-0.02	42.02	1.53	101.38	0.34	101.04
2 / 7 .	0.67	0.16	1.58	1.66	1.71	8.21	11.03	0.55	20.96	0.21	10.84	-0.02	41.78	1.65	101.00	0.32	100.69
2 / 8 .	0.66	0.18	1.58	1.64	1.75	8.19	11.13	0.53	20.96	0.06	10.82	0.01	41.79	1.47	100.78	0.32	100.46
2 / 9 .	0.62	0.18	1.59	1.67	1.69	8.18	11.06	0.47	20.64	0.14	10.71	0.00	41.79	1.58	100.34	0.30	100.03
2 / 10 .	0.68	0.18	1.57	1.64	1.71	8.28	11.14	0.47	20.53	0.12	10.69	0.02	41.99	1.40	100.40	0.33	100.07
Avg B3_4.2	0.66	0.17	1.58	1.64	1.71	8.25	11.08	0.48	20.88	0.11	10.75	-0.02	41.88	1.49	100.66	0.32	100.35
B3_amph 5																	
1 / 1 .	0.78	0.16	1.51	1.64	1.68	8.45	11.15	0.54	20.31	-0.08	10.73	-0.05	41.63	1.45	100.03	0.37	99.67
1 / 2 .	0.73	0.16	1.55	1.65	1.70	8.42	11.10	0.59	20.56	-0.07	10.79	-0.02	41.69	1.56	100.50	0.34	100.16
1 / 3 .	0.70	0.16	1.56	1.59	1.75	8.34	11.13	0.56	20.74	-0.08	10.76	-0.01	41.64	1.48	100.40	0.33	100.07
1 / 4 .	0.67	0.18	1.56	1.56	1.69	8.41	11.09	0.56	20.40	-0.01	10.77	0.02	41.54	1.43	99.89	0.32	99.57
1 / 5 .	0.71	0.18	1.55	1.66	1.72	8.36	11.11	0.52	20.87	-0.08	10.83	0.01	41.78	1.32	100.63	0.34	100.29
1 / 6 .	0.73	0.16	1.55	1.61	1.73	8.41	11.19	0.52	20.50	-0.10	10.79	0.00	41.76	1.46	100.39	0.34	100.05
1 / 7 .	0.63	0.17	1.59	1.60	1.70	8.52	11.18	0.53	20.90	-0.06	10.72	-0.03	41.80	1.33	100.66	0.31	100.36
1 / 8 .	0.68	0.15	1.57	1.62	1.72	8.41	11.06	0.47	20.69	-0.05	10.73	0.03	41.51	1.48	100.12	0.32	99.80
1 / 9 .	0.67	0.15	1.57	1.54	1.68	8.42	11.13	0.56	20.52	-0.07	10.73	-0.02	41.54	1.44	99.96	0.31	99.64
1 / 10 .	0.66	0.15	1.58	1.57	1.69	8.48	11.15	0.51	20.65	-0.17	10.78	-0.01	41.87	1.39	100.48	0.31	100.16
Avg B3_5.1	0.70	0.16	1.56	1.60	1.71	8.42	11.13	0.53	20.61	-0.08	10.76	-0.01	41.68	1.43	100.21	0.33	99.88

Table G4: Amphibole Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
2 / 1 .	0.74	0.15	1.55	1.60	1.71	8.58	11.12	0.55	20.24	-0.19	10.75	-0.01	42.14	1.41	100.54	0.35	100.19
2 / 2 .	0.69	0.17	1.56	1.57	1.65	8.46	11.04	0.48	20.40	-0.10	10.70	-0.03	41.77	1.48	99.97	0.33	99.64
2 / 3 .	0.61	0.15	1.60	1.66	1.76	8.29	11.05	0.58	20.08	-0.06	10.67	0.05	41.93	1.50	99.94	0.29	99.65
2 / 4 .	0.72	0.16	1.55	1.62	1.70	8.41	11.20	0.50	20.24	-0.13	10.72	0.01	41.76	1.44	100.03	0.34	99.69
2 / 5 .	0.73	0.19	1.54	1.64	1.70	8.36	11.06	0.55	20.70	-0.01	10.60	0.02	41.87	1.64	100.62	0.35	100.27
2 / 6 .	0.66	0.16	1.57	1.66	1.67	8.42	11.06	0.49	20.63	-0.07	10.67	-0.03	41.58	1.44	100.01	0.31	99.69
2 / 7 .	0.70	0.17	1.55	1.61	1.73	8.32	11.21	0.54	20.67	-0.13	10.62	-0.02	41.63	1.62	100.36	0.33	100.03
2 / 8 .	0.73	0.18	1.53	1.60	1.75	8.28	11.09	0.52	20.65	-0.11	10.63	-0.01	41.70	1.48	100.14	0.35	99.80
2 / 9 .	0.66	0.18	1.57	1.61	1.73	8.20	11.12	0.56	20.90	-0.07	10.61	0.00	41.72	1.50	100.36	0.32	100.04
2 / 10 .	0.74	0.18	1.54	1.68	1.72	8.37	11.23	0.56	21.05	-0.12	10.62	-0.04	41.69	1.32	100.69	0.35	100.34
Avg B3_5.2	0.70	0.17	1.56	1.63	1.71	8.37	11.12	0.53	20.55	-0.10	10.66	-0.01	41.78	1.48	100.15	0.33	99.82
BR-14 B1																	
B1_ amph 1																	
1 / 1 .	0.64	0.18	1.58	1.77	1.62	8.50	11.11	0.49	20.84	0.11	10.51	-0.05	41.87	1.23	100.46	0.31	100.15
1 / 2 .	0.76	0.19	1.52	1.80	1.61	8.54	11.10	0.46	20.53	0.00	10.53	-0.06	41.91	1.17	100.12	0.36	99.76
1 / 3 .	0.74	0.21	1.52	1.85	1.61	8.52	11.13	0.52	20.51	0.12	10.52	-0.01	41.66	1.46	100.38	0.36	100.02
1 / 4 .	0.81	0.17	1.51	1.77	1.59	8.60	11.08	0.54	20.80	0.10	10.58	-0.05	41.83	1.25	100.62	0.38	100.24
1 / 5 .	0.78	0.17	1.51	1.76	1.63	8.70	11.27	0.56	20.37	0.07	10.55	-0.02	41.73	1.28	100.38	0.37	100.01
1 / 6 .	0.73	0.17	1.54	1.82	1.62	8.65	11.08	0.45	20.35	0.03	10.56	-0.04	41.96	1.29	100.24	0.35	99.89
1 / 7 .	0.78	0.19	1.51	1.70	1.62	8.63	11.10	0.53	20.52	-0.03	10.52	-0.02	41.88	1.24	100.23	0.37	99.86
1 / 8 . *	0.71	0.15	1.51	1.50	1.28	10.23	9.55	0.44	20.22	-0.01	10.93	-0.02	40.04	1.03	97.58	0.33	97.25
1 / 9 .	0.63	0.18	1.58	1.66	1.62	8.51	11.14	0.50	20.40	-0.02	10.51	-0.07	41.91	1.24	99.88	0.31	99.57
1 / 10 .	0.63	0.20	1.58	1.70	1.56	8.59	11.19	0.46	20.79	0.00	10.54	0.00	41.84	1.25	100.34	0.31	100.03
Avg B1_1.1	0.72	0.18	1.54	1.76	1.61	8.58	11.14	0.50	20.57	0.04	10.54	-0.03	41.84	1.27	100.25	0.35	99.91
2 / 1 .	0.76	0.16	1.53	2.02	1.72	8.55	11.08	0.50	20.71	0.10	10.58	-0.01	41.60	1.43	100.75	0.36	100.39
2 / 2 .	0.73	0.17	1.55	2.02	1.73	8.54	10.99	0.53	20.56	0.15	10.63	0.02	41.75	1.49	100.84	0.35	100.50
2 / 3 .	0.73	0.17	1.54	2.02	1.66	8.61	10.93	0.47	20.81	0.14	10.60	0.02	41.48	1.45	100.63	0.35	100.28
2 / 4 . *	0.46	0.16	1.59	1.39	1.28	9.37	7.99	0.36	23.94	0.02	11.22	-0.01	38.06	1.01	96.85	0.23	96.62

Table G4: Amphibole Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
2 / 5 .	0.82	0.18	1.50	2.02	1.70	8.60	11.10	0.56	20.39	0.02	10.60	0.00	41.74	1.36	100.58	0.39	100.20
2 / 6 .	0.84	0.19	1.48	1.96	1.67	8.68	11.04	0.49	20.81	0.12	10.70	0.02	41.43	1.39	100.82	0.40	100.43
2 / 7 .	0.76	0.14	1.54	1.97	1.68	8.70	10.91	0.51	20.50	0.10	10.65	-0.04	41.65	1.54	100.66	0.35	100.31
2 / 8 .	0.85	0.14	1.49	1.95	1.67	8.70	11.03	0.46	20.35	0.07	10.71	-0.04	41.72	1.43	100.56	0.39	100.17
2 / 9 .	0.79	0.15	1.52	1.98	1.68	8.64	11.02	0.55	20.41	-0.03	10.59	-0.04	41.68	1.49	100.50	0.37	100.13
2 / 10 .	0.70	0.17	1.55	1.94	1.65	8.67	11.00	0.49	20.54	0.02	10.61	-0.02	41.30	1.53	100.17	0.33	99.84
Avg B1_1.2	0.78	0.17	1.52	1.99	1.68	8.63	11.01	0.51	20.57	0.08	10.63	-0.01	41.59	1.46	100.59	0.36	100.23
3 / 1 .	0.68	0.17	1.56	1.80	1.70	8.44	11.04	0.49	21.12	0.06	10.54	-0.03	41.62	1.15	100.39	0.33	100.06
3 / 2 .	0.72	0.18	1.54	1.86	1.64	8.38	11.12	0.49	20.93	0.02	10.47	-0.01	41.94	1.17	100.47	0.34	100.12
3 / 3 .	0.66	0.17	1.58	1.83	1.67	8.36	11.12	0.54	21.03	-0.02	10.61	0.00	41.86	1.17	100.59	0.32	100.28
3 / 4 .	0.65	0.16	1.59	1.83	1.71	8.43	11.10	0.51	21.31	0.00	10.64	-0.02	41.77	1.08	100.79	0.31	100.48
3 / 5 .	0.65	0.18	1.57	1.85	1.62	8.28	10.89	0.49	21.18	0.10	10.66	0.01	41.43	1.21	100.12	0.31	99.81
3 / 6 .	0.67	0.18	1.57	1.83	1.65	8.35	11.13	0.53	21.02	0.11	10.74	-0.04	41.67	1.19	100.64	0.32	100.31
3 / 7 .	0.72	0.18	1.54	1.82	1.70	8.34	11.19	0.46	20.89	0.12	10.56	0.03	41.78	1.21	100.54	0.34	100.20
3 / 8 .	0.79	0.16	1.51	1.84	1.67	8.27	11.03	0.48	20.58	0.12	10.62	-0.04	41.78	1.28	100.13	0.37	99.77
3 / 9 . *	0.71	0.18	1.51	1.83	1.62	8.20	10.96	0.42	20.33	0.05	10.32	0.01	40.92	1.26	98.32	0.34	97.98
3 / 10 .	0.69	0.18	1.56	1.81	1.70	8.45	11.06	0.53	20.82	0.16	10.54	-0.06	41.61	1.40	100.51	0.33	100.18
Avg B1_1.3	0.69	0.17	1.56	1.83	1.67	8.37	11.08	0.50	20.99	0.07	10.60	-0.02	41.72	1.21	100.44	0.33	100.11
4 / 1 .	0.70	0.16	1.57	1.86	1.56	8.63	11.17	0.52	20.51	0.11	10.65	-0.03	41.90	1.48	100.81	0.33	100.48
4 / 2 .	0.69	0.15	1.56	2.02	1.61	8.62	11.28	0.47	20.16	0.04	10.58	-0.01	41.70	1.34	100.23	0.33	99.90
4 / 3 .	0.76	0.14	1.53	1.83	1.64	8.69	11.10	0.44	19.70	0.07	10.63	-0.04	41.80	1.42	99.75	0.35	99.40
4 / 4 .	0.68	0.15	1.58	1.86	1.63	8.79	11.05	0.59	20.47	0.10	10.60	-0.05	41.87	1.42	100.79	0.32	100.46
4 / 5 .	0.81	0.15	1.50	1.83	1.60	8.79	11.06	0.47	19.88	-0.02	10.65	-0.04	41.74	1.31	99.80	0.38	99.43
4 / 6 .	0.71	0.17	1.55	1.86	1.63	8.64	11.04	0.48	20.19	0.01	10.63	-0.02	41.99	1.34	100.23	0.34	99.90
4 / 7 .	0.73	0.16	1.55	1.86	1.63	8.79	11.10	0.50	20.35	-0.02	10.60	-0.03	41.99	1.17	100.44	0.34	100.10
4 / 8 .	0.75	0.17	1.53	1.83	1.67	8.72	10.97	0.49	20.32	0.09	10.64	-0.02	41.85	1.22	100.24	0.36	99.89
4 / 9 .	0.74	0.18	1.53	1.89	1.63	8.68	11.04	0.49	20.39	0.03	10.55	0.00	41.63	1.10	99.88	0.35	99.53
4 / 10 .	0.71	0.20	1.54	1.81	1.58	8.66	11.03	0.46	20.38	0.08	10.66	-0.05	42.01	1.08	100.19	0.34	99.85
Avg B1_1.4	0.73	0.16	1.54	1.86	1.62	8.70	11.08	0.49	20.23	0.05	10.62	-0.03	41.85	1.29	100.20	0.34	99.86

Table G4: Amphibole Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
B1_ amph 2																	
1 / 1 .	0.78	0.16	1.51	1.98	1.69	8.58	10.98	0.48	20.43	-0.01	10.59	0.02	41.35	1.33	99.87	0.36	99.50
1 / 2 .	0.74	0.15	1.54	1.92	1.67	8.55	10.92	0.43	20.49	-0.09	10.66	0.01	41.62	1.43	100.14	0.34	99.80
1 / 3 .	0.73	0.16	1.55	1.95	1.69	8.50	10.99	0.41	20.70	-0.12	10.66	0.02	41.77	1.53	100.64	0.34	100.30
1 / 4 .	0.72	0.16	1.55	1.94	1.73	8.52	11.07	0.43	20.75	-0.04	10.60	0.05	41.70	1.38	100.61	0.34	100.27
1 / 5 .	0.78	0.16	1.51	1.96	1.69	8.51	11.00	0.43	20.53	-0.01	10.49	0.02	41.48	1.45	100.01	0.36	99.64
1 / 6 .	0.85	0.17	1.49	1.94	1.72	8.57	11.05	0.44	20.59	-0.13	10.69	0.05	41.79	1.27	100.61	0.39	100.22
1 / 7 .	0.73	0.16	1.54	1.96	1.70	8.53	11.07	0.45	20.63	0.02	10.64	0.03	41.39	1.32	100.16	0.34	99.82
1 / 8 .	0.68	0.14	1.58	1.99	1.66	8.54	11.13	0.47	21.11	-0.15	10.51	0.01	41.77	1.48	101.08	0.32	100.76
1 / 9 .	0.74	0.15	1.54	1.98	1.68	8.49	11.04	0.44	20.87	-0.04	10.52	0.04	41.49	1.55	100.52	0.35	100.18
1 / 10 .	0.80	0.15	1.51	1.94	1.72	8.55	11.10	0.46	21.06	-0.12	10.49	-0.01	41.39	1.46	100.63	0.37	100.26
Avg B1_2.1	0.76	0.16	1.53	1.96	1.69	8.53	11.04	0.44	20.72	-0.07	10.58	0.02	41.57	1.42	100.36	0.35	100.00
2 / 1 .	0.70	0.15	1.57	1.87	1.66	8.54	11.05	0.47	20.90	-0.01	10.72	0.04	41.78	1.32	100.77	0.33	100.44
2 / 2 .	0.76	0.17	1.53	1.89	1.61	8.63	11.07	0.50	21.05	-0.05	10.57	0.01	41.77	1.32	100.88	0.36	100.52
2 / 3 .	0.78	0.16	1.53	1.89	1.67	8.76	11.07	0.50	20.57	-0.02	10.65	0.03	41.98	1.26	100.84	0.36	100.48
2 / 4 .	0.74	0.16	1.54	1.87	1.67	8.70	11.06	0.45	20.67	-0.02	10.68	0.05	41.84	1.17	100.60	0.35	100.25
2 / 5 .	0.81	0.18	1.50	1.98	1.67	8.65	11.07	0.46	20.86	-0.15	10.72	0.02	41.41	1.20	100.52	0.38	100.14
2 / 6 .	0.75	0.16	1.54	1.91	1.66	8.56	11.12	0.46	20.67	0.03	10.63	0.00	41.93	1.21	100.63	0.35	100.28
2 / 7 .	0.82	0.17	1.50	1.91	1.67	8.59	11.04	0.53	21.13	-0.03	10.72	0.05	41.42	1.42	100.96	0.38	100.58
2 / 8 .	0.80	0.15	1.51	1.89	1.67	8.47	10.98	0.47	20.69	-0.07	10.72	0.04	41.55	1.42	100.38	0.37	100.01
2 / 9 .	0.78	0.16	1.52	1.90	1.64	8.50	10.98	0.42	20.90	-0.08	10.64	0.03	41.61	1.36	100.42	0.36	100.06
2 / 10 .	0.75	0.16	1.53	1.92	1.68	8.56	11.12	0.51	21.26	-0.06	10.53	0.00	41.50	1.38	100.92	0.35	100.56
Avg B1_2.2	0.77	0.16	1.53	1.90	1.66	8.60	11.06	0.48	20.87	-0.05	10.66	0.03	41.68	1.31	100.64	0.36	100.28
3 / 1 .	0.75	0.16	1.52	1.74	1.67	8.26	11.03	0.42	21.60	-0.11	10.60	0.05	41.47	1.06	100.34	0.35	99.98
3 / 2 .	0.65	0.18	1.56	1.78	1.66	8.13	10.94	0.42	21.44	0.04	10.58	0.03	41.30	1.27	99.99	0.32	99.68
3 / 3 .	0.64	0.17	1.57	1.77	1.65	7.91	11.05	0.47	22.00	-0.06	10.51	0.04	41.36	1.14	100.29	0.31	99.98
3 / 4 .	0.75	0.16	1.51	1.80	1.69	8.03	11.08	0.40	21.41	-0.04	10.51	0.05	41.15	1.12	99.66	0.35	99.31
3 / 5 .	0.71	0.18	1.53	1.77	1.69	7.99	11.08	0.40	21.79	-0.13	10.45	0.02	41.42	1.11	100.13	0.34	99.79

Table G4: Amphibole Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
3 / 6 .	0.66	0.14	1.56	1.86	1.68	8.10	11.07	0.43	21.53	-0.06	10.46	0.03	41.12	1.21	99.87	0.31	99.56
3 / 7 .	0.76	0.15	1.52	1.85	1.69	8.31	11.03	0.45	21.11	-0.18	10.46	0.03	41.23	1.37	99.95	0.35	99.60
3 / 8 .	0.63	0.17	1.58	1.80	1.71	8.24	11.08	0.49	21.33	-0.10	10.45	0.02	41.57	1.22	100.29	0.31	99.98
3 / 9 .	0.77	0.15	1.52	1.84	1.69	8.35	11.08	0.48	21.23	-0.11	10.56	0.03	41.50	1.17	100.37	0.36	100.01
3 / 10 .	0.67	0.18	1.58	1.85	1.66	8.37	11.16	0.48	21.37	-0.09	10.73	0.04	41.83	1.32	101.23	0.32	100.91
Avg B1_2.3	0.70	0.16	1.55	1.81	1.68	8.17	11.06	0.45	21.48	-0.08	10.53	0.03	41.40	1.20	100.13	0.33	99.79
B1_amph 3																	
1 / 1 .	0.75	0.19	1.52	1.67	1.66	8.19	10.91	0.50	20.88	0.04	10.83	-0.01	41.65	1.54	100.35	0.36	99.99
1 / 2 .	0.63	0.20	1.58	1.72	1.74	8.26	10.94	0.51	20.99	0.01	10.78	0.02	41.64	1.43	100.46	0.31	100.15
1 / 3 .	0.66	0.22	1.57	1.66	1.82	8.21	10.89	0.51	21.21	-0.06	10.86	-0.01	41.72	1.36	100.68	0.33	100.36
1 / 4 .	0.66	0.19	1.58	1.71	1.76	8.18	10.98	0.50	20.97	0.17	10.72	0.01	41.85	1.59	100.87	0.32	100.55
1 / 5 .	0.78	0.17	1.52	1.74	1.69	8.35	10.98	0.52	20.83	0.05	10.71	-0.01	41.80	1.51	100.66	0.37	100.29
1 / 6 .	1.06	0.20	1.30	0.63	4.53	12.07	4.25	0.30	20.73	0.13	12.83	0.00	37.50	1.57	97.08	0.49	96.59
1 / 7 .	1.32	0.21	1.17	0.47	5.51	12.54	3.18	0.24	20.39	0.03	13.09	-0.01	37.37	1.77	97.29	0.60	96.69
Avg B1_3.1	0.84	0.20	1.46	1.37	2.67	9.40	8.88	0.44	20.86	0.05	11.40	0.00	40.50	1.54	99.61	0.40	99.21
2 / 1 .	0.69	0.17	1.57	1.81	1.63	8.51	11.17	0.43	20.00	-0.01	10.80	0.00	41.92	1.47	100.17	0.33	99.85
2 / 2 .	0.68	0.16	1.57	1.87	1.64	8.56	11.13	0.44	20.08	0.11	10.73	-0.01	41.72	1.43	100.12	0.32	99.79
2 / 3 .	0.80	0.15	1.51	1.87	1.66	8.55	11.10	0.43	20.15	0.00	10.64	-0.04	41.69	1.51	100.08	0.37	99.71
2 / 4 .	0.75	0.18	1.52	1.92	1.71	8.53	11.07	0.46	20.09	0.10	10.66	-0.02	41.68	1.35	100.02	0.36	99.66
2 / 5 .	0.75	0.16	1.54	1.89	1.66	8.58	11.05	0.54	20.31	0.07	10.70	-0.04	41.76	1.49	100.49	0.35	100.14
2 / 6 .	0.75	0.15	1.53	1.93	1.65	8.44	11.06	0.52	20.05	-0.04	10.59	-0.01	41.60	1.36	99.63	0.35	99.28
2 / 7 .	0.75	0.16	1.54	1.94	1.71	8.61	11.13	0.53	20.35	0.04	10.63	0.01	41.63	1.53	100.55	0.35	100.20
2 / 8 .	0.74	0.17	1.53	1.87	1.69	8.54	11.14	0.42	20.29	0.10	10.64	-0.03	41.40	1.51	100.04	0.35	99.69
2 / 9 .	0.70	0.18	1.55	1.88	1.64	8.62	11.13	0.47	20.14	0.03	10.60	-0.06	41.74	1.33	100.00	0.34	99.66
2 / 10 .	0.80	0.18	1.50	1.80	1.63	8.62	11.06	0.46	20.22	-0.02	10.64	-0.03	41.73	1.44	100.08	0.38	99.70
Avg B1_3.2	0.74	0.17	1.53	1.88	1.66	8.56	11.10	0.47	20.17	0.04	10.66	-0.02	41.69	1.44	100.09	0.35	99.74
B1_amph 4																	
1 / 1 .	0.75	0.17	1.52	1.48	1.64	8.61	10.35	0.39	21.76	-0.09	10.66	0.06	41.59	1.14	100.12	0.35	99.77

Table G4: Amphibole Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
1 / 2 .	0.83	0.19	1.48	1.64	1.65	8.45	11.14	0.41	20.93	-0.05	10.57	0.00	41.75	1.26	100.31	0.39	99.92
1 / 3 .	1.29	0.14	1.23	0.64	4.85	10.90	5.09	0.30	21.40	0.10	11.87	0.06	39.20	2.35	99.42	0.58	98.85
1 / 4 .	0.84	0.16	1.50	1.68	1.68	8.52	11.10	0.42	20.73	-0.13	10.70	0.04	42.04	1.25	100.66	0.39	100.27
1 / 5 .	0.84	0.17	1.49	1.24	2.62	9.56	9.09	0.34	21.35	-0.09	10.92	-0.02	41.51	1.39	100.50	0.39	100.11
1 / 6 .	0.71	0.18	1.52	1.69	1.65	8.28	11.12	0.42	21.25	-0.04	10.31	0.01	41.34	1.08	99.55	0.34	99.21
1 / 7 .	0.74	0.17	1.54	1.67	1.63	8.43	11.25	0.45	21.16	-0.04	10.53	0.01	42.13	1.20	100.92	0.35	100.57
1 / 8 .	0.80	0.18	1.50	1.78	1.71	8.47	11.05	0.44	20.93	-0.12	10.55	0.03	41.80	1.08	100.32	0.38	99.95
1 / 9 .	0.78	0.17	1.51	1.75	1.66	8.50	11.08	0.43	21.09	-0.07	10.49	0.04	41.82	1.15	100.47	0.37	100.11
Avg B1_4.1	0.84	0.17	1.48	1.51	2.12	8.86	10.14	0.40	21.18	-0.06	10.73	0.03	41.47	1.32	100.18	0.39	99.79
2 / 1 .	0.92	0.19	1.44	1.74	1.71	8.42	11.05	0.41	21.07	0.01	10.52	0.03	41.80	1.27	100.59	0.43	100.16
2 / 2 .	0.79	0.17	1.50	1.68	1.66	8.42	10.93	0.44	21.20	-0.05	10.62	0.00	41.20	1.31	99.91	0.37	99.54
2 / 3 .	0.89	0.17	1.47	1.79	1.69	8.57	11.06	0.40	20.99	-0.06	10.70	0.07	41.83	1.29	100.92	0.41	100.51
2 / 4 .	0.86	0.19	1.47	1.84	1.65	8.48	11.01	0.49	20.85	-0.02	10.54	0.03	41.52	1.34	100.26	0.40	99.85
2 / 5 .	0.85	0.17	1.48	1.83	1.68	8.45	11.09	0.38	20.77	-0.05	10.58	0.00	41.69	1.33	100.30	0.40	99.90
2 / 6 .	0.88	0.18	1.47	1.83	1.62	8.48	11.08	0.40	21.01	-0.03	10.66	0.06	41.69	1.29	100.65	0.41	100.24
2 / 7 .	0.76	0.17	1.51	1.74	1.69	8.69	10.51	0.46	20.80	-0.11	10.68	0.01	41.24	1.23	99.48	0.36	99.12
Avg B1_4.2	0.85	0.18	1.47	1.78	1.67	8.50	10.96	0.42	20.96	-0.04	10.62	0.03	41.57	1.29	100.26	0.40	99.86
3 / 1 .	0.84	0.16	1.48	1.98	1.71	8.26	11.07	0.44	20.54	-0.10	10.53	0.03	41.44	1.54	100.01	0.39	99.62
3 / 2 .	0.86	0.16	1.47	1.97	1.69	8.40	11.09	0.45	20.97	0.00	10.74	0.04	41.23	1.46	100.55	0.40	100.15
3 / 3 .	0.88	0.17	1.46	1.98	1.66	8.29	11.10	0.45	20.76	-0.05	10.61	0.06	41.47	1.47	100.37	0.41	99.96
3 / 4 .	0.88	0.19	1.45	2.01	1.65	8.29	11.09	0.44	20.46	-0.15	10.69	0.03	41.45	1.52	100.16	0.41	99.74
3 / 5 .	0.89	0.18	1.46	1.99	1.70	8.32	11.09	0.53	20.77	-0.02	10.63	0.05	41.51	1.54	100.67	0.42	100.25
3 / 6 .	0.86	0.18	1.48	2.01	1.68	8.39	11.00	0.47	20.72	0.05	10.65	0.05	41.65	1.60	100.79	0.40	100.39
3 / 7 .	0.89	0.17	1.45	1.97	1.64	8.30	11.02	0.38	20.81	-0.10	10.75	0.01	41.25	1.44	100.07	0.41	99.66
3 / 8 .	0.87	0.17	1.47	1.96	1.66	8.39	11.20	0.46	20.99	-0.06	10.67	0.03	41.44	1.45	100.76	0.40	100.36
3 / 9 .	0.85	0.18	1.47	1.95	1.69	8.30	11.12	0.44	20.78	-0.02	10.60	0.06	41.48	1.42	100.35	0.40	99.95
3 / 10 .	0.80	0.15	1.51	2.01	1.68	8.39	11.16	0.46	20.67	-0.05	10.61	0.04	41.55	1.61	100.64	0.37	100.27
Avg B1_4.3	0.86	0.17	1.47	1.98	1.68	8.33	11.09	0.45	20.75	-0.05	10.65	0.04	41.45	1.50	100.38	0.40	99.98

Table G4: Amphibole Chemistries

* Analysis not used in mineral chemistry calculation

Wt% Oxide	F	Cl	H_2O	Na_2O	K_2O	MgO	CaO	MnO	FeO	BaO	Al_2O_3	Cr_2O_3	SiO_2	TiO_2	Total	O=F,Cl	Total
4 / 1 .	0.85	0.17	1.48	1.93	1.66	8.51	11.01	0.40	20.41	-0.09	10.52	-0.02	41.78	1.32	100.05	0.39	99.65
4 / 2 .	0.88	0.15	1.46	1.94	1.65	8.56	11.13	0.38	20.57	-0.08	10.51	0.04	41.49	1.31	100.08	0.40	99.67
4 / 3 .	0.90	0.19	1.45	1.91	1.66	8.51	11.13	0.42	20.45	-0.03	10.43	0.07	41.80	1.46	100.38	0.42	99.95
4 / 4 .	0.85	0.18	1.48	1.92	1.68	8.57	10.99	0.48	20.86	-0.05	10.54	0.05	41.63	1.42	100.67	0.40	100.27
4 / 5 .	0.83	0.16	1.50	1.94	1.63	8.56	11.13	0.40	20.98	-0.10	10.59	0.05	41.72	1.45	100.95	0.38	100.57
4 / 6 .	0.91	0.17	1.46	1.96	1.65	8.55	11.12	0.48	20.97	-0.07	10.58	0.08	41.69	1.36	100.97	0.42	100.54
4 / 7 .	0.73	0.17	1.55	1.87	1.65	8.51	11.10	0.42	20.82	-0.16	10.53	0.06	41.87	1.51	100.80	0.34	100.45
4 / 8 .	0.90	0.15	1.46	1.90	1.66	8.39	10.92	0.42	21.01	-0.17	10.47	0.08	41.77	1.28	100.41	0.41	99.99
4 / 9 .	0.82	0.19	1.50	1.85	1.68	8.51	11.01	0.40	20.80	-0.01	10.50	0.07	41.96	1.44	100.72	0.39	100.33
4 / 10 .	0.84	0.16	1.49	1.88	1.69	8.56	11.10	0.43	20.96	-0.03	10.52	0.04	41.55	1.45	100.67	0.39	100.28
Avg B1_4.4	0.85	0.17	1.48	1.91	1.66	8.52	11.06	0.42	20.78	-0.08	10.52	0.05	41.73	1.40	100.49	0.40	100.09