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Geoarchaeological Investigations along the Tambo-Ilo Coast of Southern Peru

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GEOARCHAEOLOGICAL INVESTIGATIONS ALONG THE TAMBO-ILO COAST OF SOUTHERN PERU

By

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Thesis Advisor: Dr. Gregory Zaro

An Abstract of the Thesis Presented
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The south coast of Peru has had a long history of cultural occupancy from the Preceramic through Chiribaya periods, and into Spanish Colonial / Post-Colonial periods. Procurement and modification of lithic material was an important activity throughout each of these periods but remains an under-explored dataset for late Prehispanic and Colonial populations in the region. Analysis at the Cola de Zorro archaeological site and within the Tambo-Ilo region examined the relation cultures have with their environment through a geoarchaeological analysis of the local geology and the distribution of lithics. Surveys were completed at Cola de Zorro in the quebrada drainage, on the pampa surface, on a colonial structure, and among domestic debris scatters. The investigations explored the potential of lithic material to offer insight into the nature of coastal resource procurement and the role of local vs. non-local materials. This investigation has also developed a standard geoarchaeological methodology to assess local and more regional raw material procurement and utilization. Geologically, local material was used in the

creation of structures and stone-walled terraces. Lithic tools were predominantly made from chert, which was acquired from beyond the Pampa Dispensilla region, and likely from beyond the Tambo-Ilo coastal region. Materials collected during the 2006 Tambo-Ilo survey are surface collections with a bias toward tool assemblages and projectile points. Analysis of coastal projectile points shows a range of typologies, with the most prevalent forms dating from the Terminal Archaic through Late Horizon (3300 BC – A.D. 1532). However, the coastal environment and stratigraphy of Tambo-Ilo must be taken into account, where deposition can be minimal and surface deflation high placing thousands of years in a single stratigraphic layer.

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CHAPTER 1

INTRODUCTION:

The Peruvian south coast is a dry and desolate landscape that is described as a hyperarid environment. Archaeological survey along the Tambo-Ilo intervalley coastline suggests a long span of human occupation stretching from the Preceramic through Chiribaya periods, and into Spanish Colonial / Post-Colonial occupation. Lithic tool production can be seen throughout the coastline, yet it is an under-explored data set for this region, and its cultural role remains unclear. Lithics are the dominant artifact during the preceramic period, but with the introduction of ceramic technology they generally receive less attention. The focus of this thesis is on methodological strategies used to understand lithic resource procurement at Cola de Zorro (Figure 1.1), a site that has components stretching back at least five centuries from pre-Hispanic Chiribaya occupation (A.D. 900-1400) and possibly into the 20th century. While the methodology created here is only applied to Cola de Zorro and its immediate hinterland, it can be successfully employed as a standard for other lithic resource procurement studies of any scale.

By creating a standard methodology in geologic analysis of both cultural and geologic material, one can employ the same methods across multiple sites in order to better understand lithic resource use. If communities were only exploiting their local environment, then lithic artifacts found onsite should correspond to locally available raw material. On the other hand, if stone tools were made from non-local geologic material, then it signifies coastal occupants were either practicing long distance resource extraction or obtaining raw materials or modified materials via trade networks. The methodology developed here assesses the geologic nature of both cultural and raw materials in a standardized fashion, which in turn facilitates lithic resource identification and distribution on local and regional scales around the Cola de Zorro archaeological site.

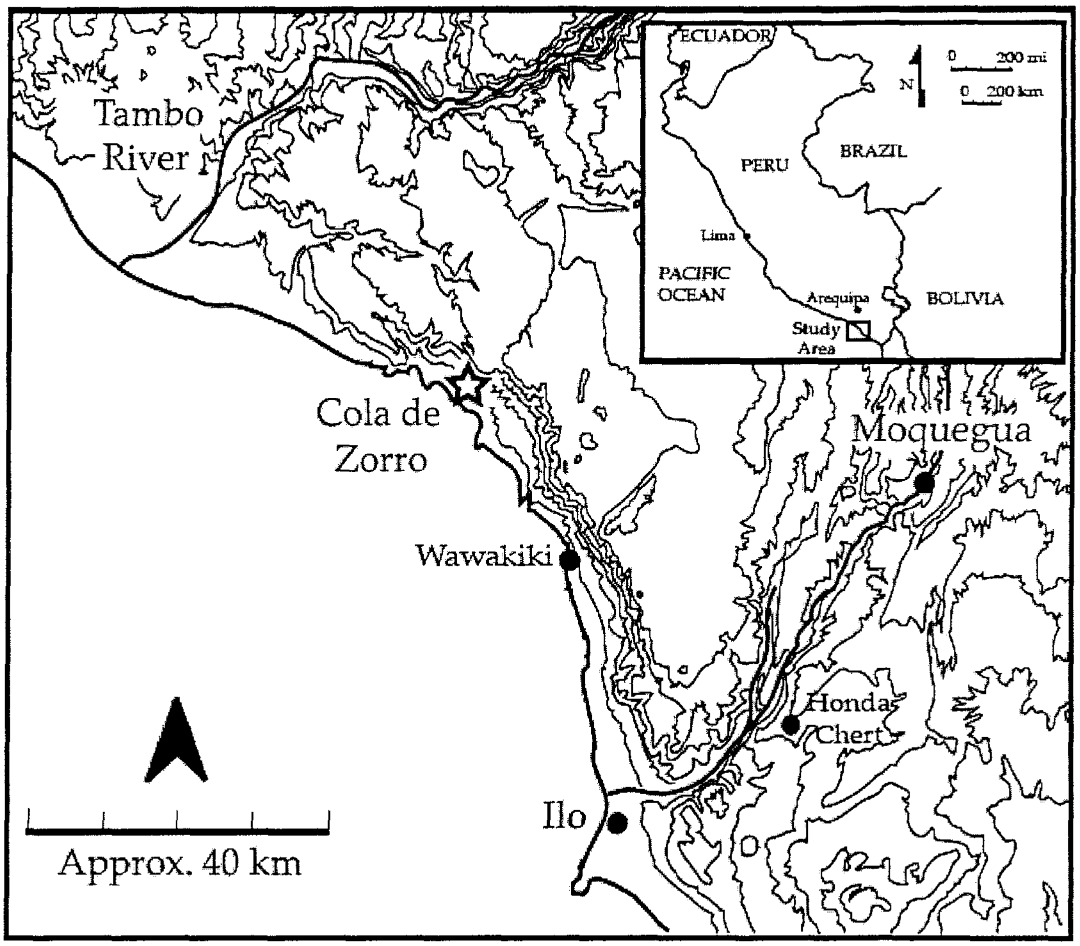

Figure 1.1: Map of Study Area.

1.1. Organization of Chapters

Chapter two describes the geologic, environmental, and cultural setting of the study. The geologic section refers to published geologic INGEMMET maps of southern Peru and material described by Bellido and Guevara (1963). The environmental section refers to the south coastal environment and Osmore drainage, the local ecology, and the effects of El Niño on culture and landscapes. The cultural setting takes on a chronologic sequence describing the history of the area from the Preceramic though post-Spanish contact periods.

Chapter three discusses the research questions, hypotheses, and methodology used for the study. Research questions and hypotheses center on the importance of variability in geologic material and the significance of local versus non-local resources. Methodology is broken into raw material and cultural material. The assessment of raw material includes a systematic survey of the dry wash along which Cola de Zorro is situated and the surrounding pampa. Additionally, informal surveys were conducted on pampa Dispensilla, along the coast, and at Quebrada Honda (farther inland but near the principal Ilo river valley). Assessments of cultural material include an examination of lithic scatters across the surface of Cola de Zorro. Chapter three also describes the systematic methodology used in both formal and informal surveys.

Chapter four is structured similarly to the methodology section of chapter three. Results are separated into raw material and cultural material. Both sections discuss counts, percentages, and general differences/similarities in rock types. Emphasis is placed on the geologic variability between natural and cultural material.

Chapter five discusses the differences in raw material and cultural material. It reviews rock types present and discusses their suitability for tool manufacture. Projectile points found at Cola de Zorro and along the Tambo-Ilo coast are also discussed and compared to Klink and Aldenderfer's 2005 study of highland projectile point typologies and the inherent problems with this on the coast. Chapter five concludes by highlighting the geologic methodology used in the study, its potential use in other studies, and some limitations.

CHAPTER 2

GEOLOGY, ENVIRONMENT, AND CULTURAL SETTING

2.1. Geologic Setting

The coastal region of southern Peru contains a mix of geological material made of igneous, sedimentary, and metamorphic deposits that range from Precambrian to Quaternary in age. The older deposits are predominantly found in the Andean mountain range known as the Cordillera de la Costa with sporadic deposits and more modern deposits along the coastal region. The underlying coastal region is known as the Arequipa Massif (Shackleton et al. 1979).

The Arequipa Massif underlies the Central Volcanic Zone between the coast and Andes of Peru (Shackleton et al. 1979). The Arequipa Massif is exposed in outcrops along faults extending 130km inland from the coast. It is composed of deformations, metamorphisms, and magmatism. The first metamorphic event (1,851 and 1819 m.y.a.) formed granitic, banded gneisses, which have sedimentary protoliths (Loewy et al. 2004). A later Mesoproterozoic event during the Sansás Orogeny (1,052 and 935 m.y.a.) also affected the region when the crust of the Arequipa-Antofalla basement collided with Amazonia (Loewy et al. 2004). Since the entire western side of Peru contains the Arequipa Massif as its base, it is considered an important tectonic element.

The center of the research is at Cola de Zorro, located between the Tambo and Ilo river valleys on Pampa Dispensilla, roughly 45km north of the coastal town of Ilo (Figure 1.1). The surrounding area contains deeply incised canyons and alluvial fan drainages, many of which descend from the adjacent Clemesí Desert, which in turn create lowdischarge springs (Bawden 1989; Clement and Moseley 1991). Prehispanic and Spanish Colonial coastal sites relied heavily on terracing and spring-fed irrigation systems for farming (Clement and Moseley 1991; Zaro and Umire Alvarez 2005). The Cola de Zorro archaeological site is located between the coastal points of Cocotea and Las Almas and is on Quaternary period alluvium that contains a mixed aggregate of geologic materials. The site's pediment surface slopes southerly toward the coast.

Surrounding the study area are four types of geologic formations ranging in age from Jurassic to Quaternary (Figure 2.1). Information on the geologic formations and their composition is from work by Bellido and Guevara (1963) in *Geología de los Cuadrángulos de Punta de Bombón y Clemesí.* Formations from oldest to youngest include Volcanic Chocolate, Guaneros, Toquepala Volcanics, and alluvial deposits.

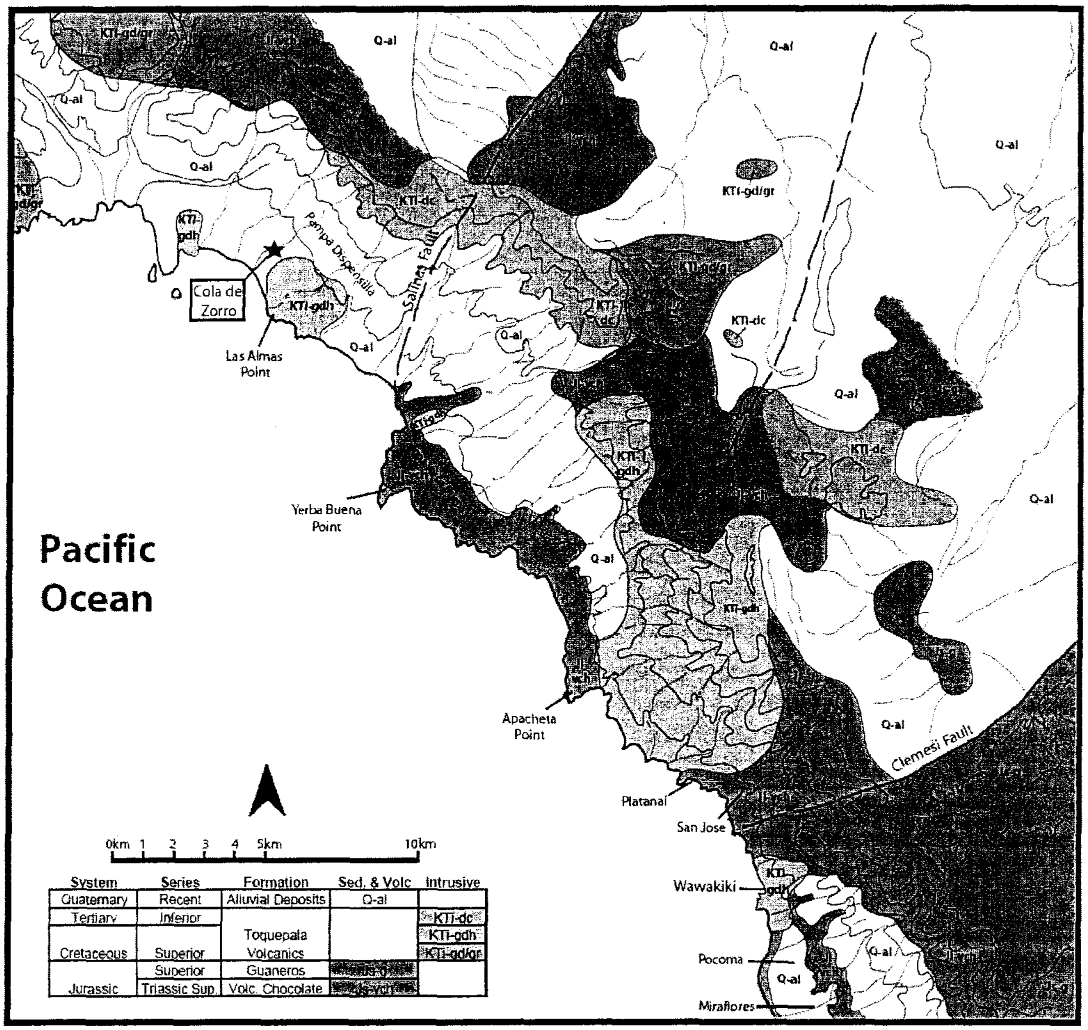

Figure 2.1: Geologic formations surrounding the study area (redrawn from Bellido and Guevara (1963), *Mapa Geológico del Cuadrángulo de Clemesí*).

2.1.1. Volcanic Chocolate

The *Volcanic Chocolate* formation occurred during the lower Jurassic and is found stratigraphically under the Guaneros formation. The formation contains spills and pyroclasts composed of porforitic and afanitic andesite. The andesite varies in color from grayish green, to maroon, to other obscure tones. The formation itself contains andesite, dacite, and brecchas that are maroon/green and have a matrix that is chocolate, rose, or sometimes black. At Pocoma (30km southeast of Cola de Zorro) the formation has an angular discordance against Precambrian gneisses. At the Tambo Valley the formation has a parallel discordance with the Yamayo group, which is older and usually under the Volcanic Chocolate formation. This formation varies in thickness, but at Pocoma it is approximately 1,000 meters.

2.1.2. Guaneros

The *Guaneros* formation is described as a lithologic sequence of marine clasts formed from sandstone and shale, and an abundance of fossils can also be found. The sequence contains a mix of rocks that are volcanic and sedimentary approximately 2,350m in thickness. The volcanic rocks are composed of porphyritic andesite, in which there are phenocrystals of plagioclase, hornblende, and occasionally grains of quartz.

2.1.3. Toquepala Volcanics

The *Toquepala Volcanics* formation consists of prophoritic dacite and rhyolite of a rose to grayish clear color in the upper sequence and brown andesite in the lower sequence. Fine-grained pyroclastic flows are present and composed of andesite, dacite, trachyte, and rhyolite. The sequence's thickness in this area is 1,000 to 1,200 meters. The Toquepala Volcanics occur through the Cretaceous and Tertiary periods, and on geologic maps they do not appear as sedimentary or volcanic, but rather as igneous intrusive sequences. Three different sequences occur within this study area and each with a different composition: dacite (dc), grano-diorite (gdh), and gd/gr (grano-diorite/granite).

2.1.4. Alluvial Deposits

The Quaternary period *Alluvial Deposits* is the most recent formation. It consists of unconsolidated conglomerates with lenses of sand, clay, and occasionally volcanic tuff. The material is principally formed from different types of volcanic rocks whose dimensions vary from 1cm to 20cm in diameter. The thickness of the alluvial deposits varies from a few meters to a maximum of 100m.

2.2. Quebrada Honda

The mouth of Quebrada Honda lies roughly 30km northeast of Ilo and 50km southeast of Cola de Zorro (Figure 1.1). The geologic formations present are similar to those found along the coast except the Moquegua geologic formation is found near and around the chert source (Figure 2.2). The sequence is made of alternating clays, sandstones, conglomerates, tufaceous sandstones, and reddish to yellowish white tuffs of continental origin that emerges from the Moquegua valley. The Moquegua formation is broken into upper and lower sections. The lower layer contains layers of gray/beige sandstone alternating with lenses of conglomerates. The upper sequence is present at a conglomerate base with channels of subangular volcanics followed by coarse-grained sandstone, conglomerates, and tuff banks. The formation varies in depth but is approximately 500m thick.

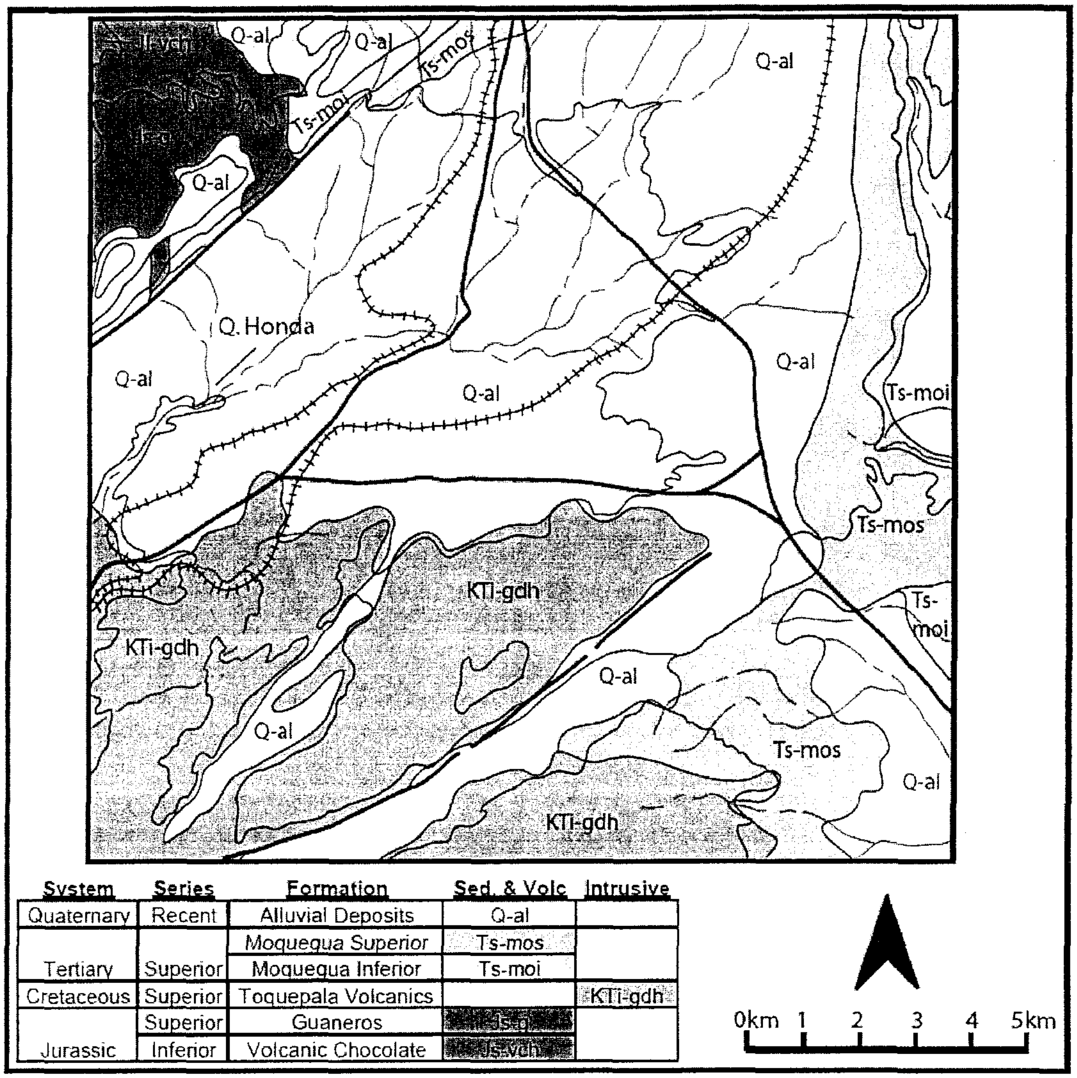

Figure 2.2: Geologic map surrounding Quebrada Honda (redrawn from Bellido and Guevara (1963); see Figure 1.1 for regional location of Quebrada Honda).

2.3. Environmental Setting

Bawden (1989) describes the south coastal environment of Peru as a multi-component ecological micro-complex, where the geographic location and subsistence potentials encourage interdependence. The foothills to the north from the coast mark the end to the ecological system. Additionally, these foothills supported the growth of lomas, a fog-fed vegetation (Reycraft 2000). Today's environment is arid, but remains from a number of different trees and crops suggest an earlier more extensive *lomas*. These slopes with localized catchment basins at their foot created a natural habitat for hunting small game and collecting lomas plants. Abundant surface collections of projectile points along the coast indicate the importance of small game hunting in these microzones. Modern subsistence along the coastal piedmont is restricted to quebrada drainages, where plants such as olive trees are grown.

The coast is mostly a rocky shoreline, with intermittent quebrada drainages creating alluvial fans and sandy beaches (Figure 2.3). This shoreline provides an excellent habitat for shellfish and the easy beaching of fishing craft for a marine-based settlement. During Chiribaya occupancy, inhabitants exploited both offshore high-density pelagic species of fish and near-shore shellfish (Bawden 1989). The combination of spring-fed irrigation systems with lomas dry farming and coastal fishing likely reduced the risks of farming in arid environments and the impacts of infrequent but regular flooding events associated with El Niño (Zaro 2007; Zaro and Umire Alvarez 2005).

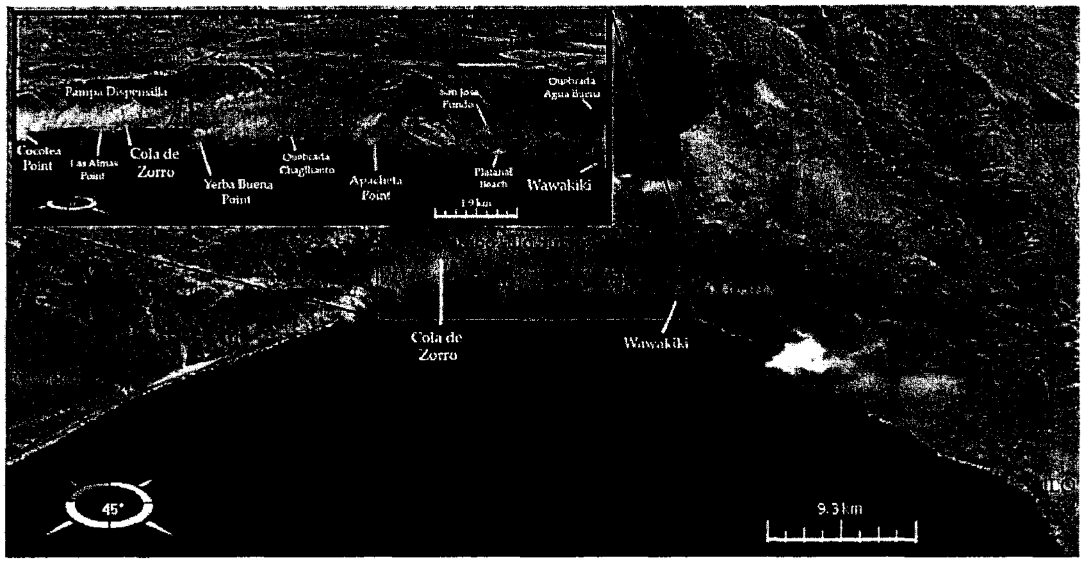

Figure 2.3: Tambo-Ilo coastal environment (image modified from NASA World Wind).

When it occurs, there is an influx of tropical currents, where warm water raises sea surface temperatures and depresses cold waters of the nutrient-rich Humboldt Current. This pushes the thermocline into deep water. The change in ocean current affects cold-water marine species, which tend to move southward causing drastically lower fishing yields for the area (Reycraft 2000). Annual precipitation along this hyperarid coast is only a few millimeters per year. However, in years of very strong El Niños, precipitation can be much higher. As described by Keefer and Moseley (2004), small amounts of sudden precipitation can have large consequences in this environment. During 2002, a large cold front came over central and southern Peru and disrupted the coastal temperature that usually prevented precipitation. During the night of July 2-3 total precipitation was 6-12mm. Keefer and Moseley observed that this small amount of rain can lead to significant runoff, erosion, and sediment transport through all parts of the coastal drainage. A flash flood event occurred south of Ilo, when only a trace amount of rainfall had taken place. The adverse affects of large El Niño events likely played a role in the abandonment of some coastal spring sites. During Chiribaya occupation, a number of coastal spring sites remained occupied (with the exception of Miraflores) after the mega El Niño event of the fourteenth century (Reycraft 2000; Satterlee et al. 2001). Substantial portions of every site were abandoned due to debris flows, which buried agricultural fields and irrigation canals (Reycraft 2000).

2.4. Culture History

2.4.1. Preceramic Period (pre 1800 B.C.)

To the south of Ilo, Quebrada Tacahuay (30km) and the Ring Site (7.5km) are some of the oldest in South America, dating to ca. 12,700 cal. years B.P. and ca. 11,300 cal. years B.P., respectively. These coastal communities invested heavily in marine resources from their area (Keefer et al. 1998; Sandweiss et al. 1989). At Quebrada Tacahuay, subsistence consisted mainly of seabirds and marine fish (deFrance 2001). Butchering was evident through cut marks on 18 seabird bones, and 15 of the specimens were found with lithic debitage (Keefer et al. 1998). All lithic artifacts are unifaces made of chalcedony or chert and have features consistent with use as cutting tools.

Ten kilometers north of Ilo, the Kilometer 4 site (5,000- 3000 B.P.) had an ocean-oriented economy with the use of cotton, wild vegetable fibers and camelid wool for textile production (Wise et al. 1994). Named for its location on the Southern Peru Copper Corporation's railroad, Kilometer 4 contained a stratified shell midden near the beach and domestic terraces upland. Chalcedony made up 71 percent of raw materials at Kilometer 4 with small quantities of chert, quartzite, quartz, jasper, and obsidian (Sievert and Wise 2001). Work by Sievert and Wise (2001) identified changes in lithic use over time, which included the retouch or retooling of material, changes in raw materials (such as shell), and general function. This variability likely occurred due to a number of factors, including raw material availability, mobility, and subsistence resource focus. Even though it appears that Kilometer 4 had a specialized marine economy, the lithic assemblage did not appear to be specialized, with the exception of a few tools (e.g., harpoon points). The assemblage included debitage (flakes, angular fragments, and cores) and a generalized tool category which included unifaces, bifaces, and projectile points.

2.4.2. The Initial Period (1800 B.C. – 800 B.C.), Early Horizon (800 B.C. – 200 B.C.), and Early Intermediate (200 B.C. – A.D. 600)

Many sites in south coastal Peru have Early Ceramic components, including Carrizal, Wawakiki, and El Algodonal along the coast, and Omo, Loreto Viejo, and Huaracane farther inland. One of the earliest styles of ceramic pottery in the coastal Osmore is the "Olla sin cuello" assemblage, which is dominated by neckless jars. Stylistically, Olla sin cuello are globular, neckless, and with rounded bottoms. The Olla sin cuello style was found in excavations of terraces at El Algodonal and Loreto Viejo, and in surface collections at 10 other sites (Owen 1993). Midden deposits associated with Olla sin cuello show a higher density of maize cobs, husks, and flowers than the Late Intermediate period middens. In his comparison of food production from Olla sin cuello and Late Intermediate periods, Owen (1993) identified a reliance upon maize, yucca, beans, and crayfish among Early Ceramic period populations. Conversely, Late

Intermediate Period populations relied upon pacay, molle, lucuma, and guayaba, all of which are less common or absent in Olla sin cuello phase assemblages. Olla sin cuello farming focused on a few select crops with contributions from marine resources, and camelid use was probably important for wool rather than meat or hides.

Lithics during this period are scarce, though projectile points are known to exist from Omo, El Algodonal, and Wawakiki. Published articles usually only refer to the presence of lithic material and their geologic type. Goldstein (1993) suggests that the three points found in a single structure (M12) were imported from the Tiwanaku heartland because there was no evidence for manufacturing debris.

2.4.3. Middle Horizon (A.D. 600 – 1000)

During the Middle Horizon, the Wari and Tiwanaku had both established outposts within the middle Osmore drainage. Wari and Tiwanaku were the two most geographically extensive polities prior to the Inka in Andean South America. Their art styles and some aspects of their ideology were quite similar yet they differed fundamentally in their economic bases, settlement patterns, and probably their economic and political organizations (Owen 1994). The peak of centralization and political power in the Osmore valley occurred circa A.D. 800, when Wari controlled the upper valley, and the Tiwanaku the middle valley (Sims 2006). The Moquegua area was an integral part of the Tiwanaku sphere, while the ruins atop Cerro Baúl, which can be seen from some Moquegua Tiwanaku sites, were an extremely defensible Wari center.

Unlike the Tiwanaku state, whose agricultural technologies and water management techniques were well suited to flat lands and pampas, Wari had refined steep-slope terrace and canal technologies to make previously barren zones very productive (Sims 2006). In addition, with no defensible Tiwanaku sites in the area, it does not look like the two states were ever in significant conflict. This leaves the scenario that the Tiwanaku and Wari were in "peaceful" coexistence occupying distinct geographic areas, although the Wari sites were in consistently defensible locations and fortified. The Wari sites could have been located in defensible position to control traffic and trade between the coastal and middle Osmore drainage and the Altiplano. This role could have been peaceful with the Tiwanaku, or it could have been hostile, designed to cut Tiwanaku off from the coast (Owen 1994). Owen (2001) suggests that Tiwanaku should be looked at as a "multicomponent" society, in which the Tiwanaku polity was a federation or alliance between two or more distinct altiplano groups. These groups might have come together for shared projects such as canal building, land reclamation, or building monuments.

Unlike the middle and upper valley Middle Horizon records, the lower and coastal portions of the Osmore drainage exhibit a very ephemeral record where no significant occupation has been identified between about A.D. 500 and A.D. 800/900. Owen (1993) suggests that the potential cause of this was due to an increase of irrigation systems in the middle valley by the Tiwanaku, which reduced the flow of water to the coast. This reduced the carrying capacity, and settlement shifted towards lomas and marine resources outside the valley bottom.

2.4.4. Late Intermediate Period (A.D. 1000 – 1476)

After the collapse of Tiwanaku and Wari, three distinct cultures flourished in partially overlapping times and places in the Osmore drainage, from around A.D. 1000 up to the Inka conquest around A.D. 1476 (Owen 1995). The Tumilaca phase people were physical and cultural descendents of the Tiwanaku populace located in the Moquegua region from A.D. 950 to A.D. 1200. The Chiribaya culture appeared in the coastal and middle elevation of the valley shortly before the Tumilaca phase began (A.D. 900) until A.D. 1375. The Estuquiña culture developed in the middle and upper drainage around A.D. 1200 and persisted through the Inka conquest into early historic times (Owen 1995).

The Chiribaya culture appears to have had a long period of development, yet the extension of its remains outside of the coastal valley remains somewhat unknown. Formal and decorative trends in Chiribaya ceramic production become more standardized through time, suggesting a growing unification amongst lower valley populations (Jessup 1991). Geographically, Chiribaya was concentrated around the lower Osmore drainage with later unification in distinct environmental zones. Animal husbandry by Chiribaya was present at both Chiribaya Alta and along the coast, demonstrated by the presence of camelid bone in middens and mortuary contexts in both areas.

In spite of its deserts, the coastal region was rich in marine, agricultural, and lomas resources. Rostworowski (1999) states that, in contrast to the highland polities, prehispanic coastal cultures did not expand into the altiplano to obtain complimentary resources from other economic niches; rather, they developed independent of highland influence. These coastal polities, called *señoríos*, were autonomous political and economic groups, under the control of their own lords. The two fundamental ethnic groups that served as a basis of late prehispanic coastal societies were the fishermen, or *pescadores*, and farmers, or *labradores* (Lozada 2005). The archaeological record of the coast of Ilo demonstrated almost no highland colonization, indicating that the populations that inhabited the coast of Ilo, such as the Chiribaya, are more likely to represent purely coastal societies. However, while some lower valley communities may have participated in some degree of specialized production, Chiribaya community organization likely varied considerably throughout the lower and coastal reaches of the drainage (Zaro 2007).

A major flooding event around A.D. 1350 may have brought an end to the Chiribaya culture (Jessup 1991; Satterlee 1993; Moseley et al. 1991). Large Chiribaya settlements were abandoned, irrigation systems were destroyed, and decorated ceramics disappeared from the archaeological record. More than 77% of all Classic period Chiribaya valley sites were abandoned after the disaster (Reycraft 2000). This event likely weakened the Chiribaya, disrupting power along the coast, which rearranged the political power within the entire valley.

Even less is known of stone tools during the Late Intermediate than earlier periods. To date, research on Chiribaya coastal settlements has focused on ceramics, domestic architecture, mortuary remains, and agricultural practices; there has been little to no research pertaining to lithic resource procurement and manufacture, though Umire and Miranda (2001) note that Chiribaya exploited lithic resources for harpoon tips for marine resource procurement and hand axes for farming.

2.4.5. Late Horizon (A.D. 1476 – 1534)

The Late Horizon in the Osmore region is characterized by Inka occupation in the upper drainage. It is unclear as to the extent of Inka colonists in the area but two sites are known; Torata Alta and "Moquehua" (presumably under a portion of modern Moquegua) (Stanish and Rice 1989). Throughout the Osmore drainage, and particularly in the upper drainage, Inka agricultural terrace systems can found, which serves to support ethnohistoric information of direct Inka intervention in the region (Kuon Cabello 1981).

The lower Osmore valley and coast is poorly documented for the Late Horizon. Hoever, Covey (2000) notes that Inka occupation for the region is divided into direct control (through settlement) and indirect control (where sites have evidence of Inka artifacts but no settlement). Under Inka influence, coastal elites would have controlled small mixed economies of marine resources and small-scale agriculture (Covey 2000). The Inka did not have direct control in Ilo, but rather relied on local elites who played a role in defining the nature of Inka presence.

2.4.6. Post Spanish Contact (A.D. 1534 – present)

Initial colonial occupation created a change in economic systems and general cultural lifeways. Early development of wine production was the primary motivation for Spanish settlement in the Osmore drainage and was one of the mainstays of Colonial economy in South Central Andes (Rice and Ruhl 1989). Along the coast, quebrada drainages and the lower valley were (and continue to be) used for olive production. Olive groves are quite resilient and are able to survive with little water. However, while coastal quebradas continued to be farmed in the colonial and post colonial periods, patterns of settlement changed significantly from the late Prehispanic to Colonial period. While small villages and farmsteads were situated along the Tambo Ilo coast several centuries prior to European arrival, Spanish colonists established residences at a few select haciendas along the coast, while most were situated in the main river valley (Zaro 2005).

2.5. The Cola de Zorro Archaeological Site

The site of Cola de Zorro is an abandoned agricultural complex situated along the Tambo-Ilo coast. A 2006 archaeological survey of this intervalley coast documented evidence for complex land use and resource management that spanned at least five centuries (Zaro 2006). A preliminary evaluation of the site suggests that it was farmed during the pre-Hispanic Chiribaya period (A.D. 900-1400), the late pre-Hispanic / Spanish colonial transition (A.D. 1400-1600), the Spanish colonial period (A.D. 1600-1821), and possibly into the 20th century (Zaro 2006). The site shows signs of flooding and debris flows in the surrounding quebrada drainages in addition to the pediment surface. This creates difficulties in conducting an accurate surface survey of the area due to the amount of outwash present. However, in some regions elevated landscape and local vegetation display evidence of surface scatters of cultural materials (Figure 2.4).

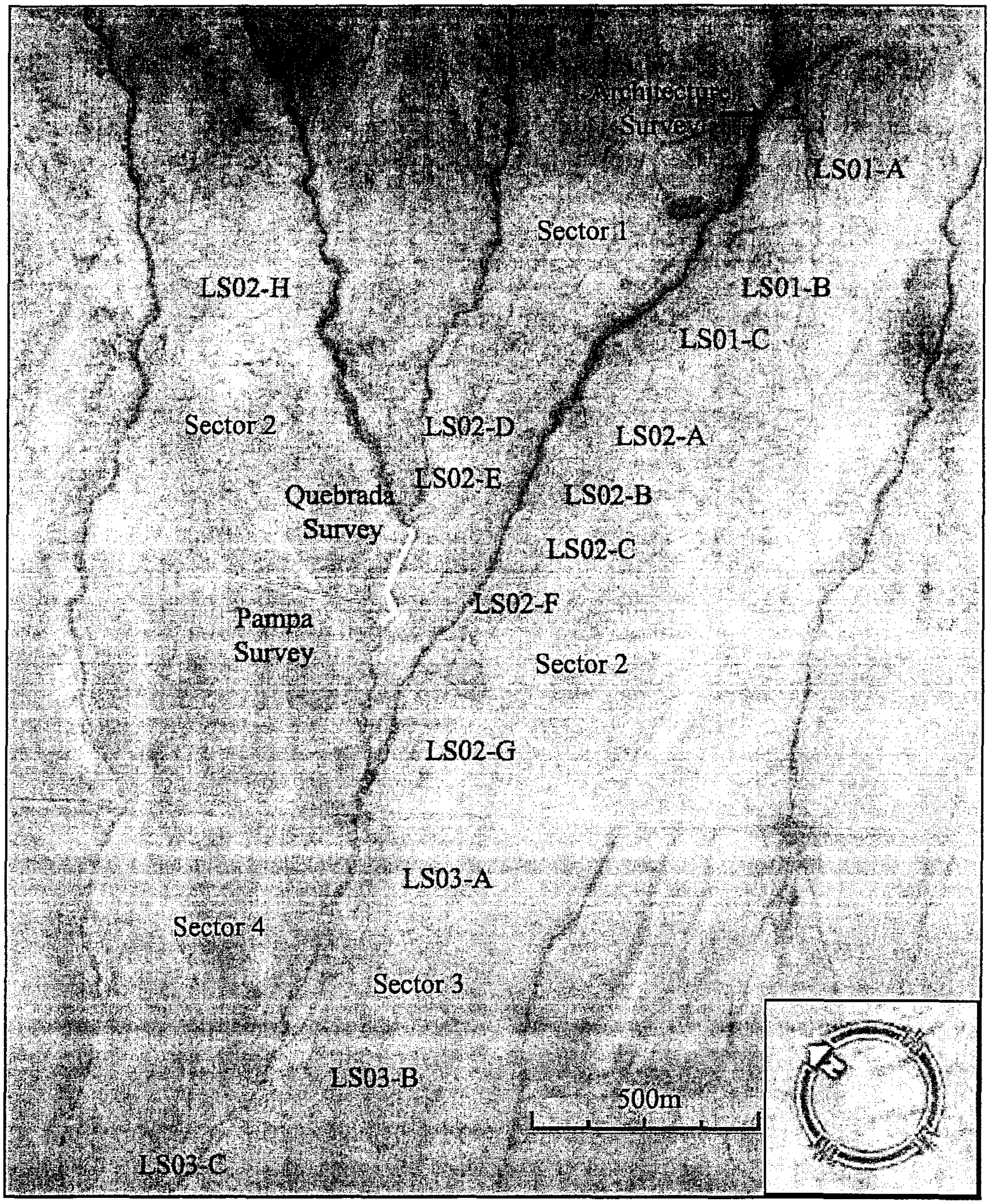

Figure 2.4: Map of Cola de Zorro with surface survey locations, which were established on the presence of visible surface scatters of cultural materials.

The site contains surface scatters of marine shell, ceramics, lithics, and ash in Sectors 1 – 3 (see Figure 2.4). These surface scatters are throughout the site and aid in understanding the occupation sequence, and more so with respect to the late prehispanic colonial-era surface scatters. The agricultural landscape includes perimeter walls, stone-faced terraces, canals and poorly preserved furrows across the site. Agricultural terraces and canals stretch intermittently along two kilometers of the dry wash. Also in Sector 3, circular depressions and overturned slab stones provide evidence for the location of three cemeteries, all within the lower southwestern sector of the site and likely associated with Late Intermediate / Late Horizon occupation of the site.

Sector 4, the southwest region of the site, contains a number of archaeological structures or "recintos." However, initial surface survey of the sector 4 *recintos* in 2006 revealed no artifact assemblages (Zaro, personal communication). Cultural material may have been buried due to debris flow and sediment transportation across the pampa, but further archaeological investigation is required.

CHAPTER 3

RESEARCH QUESTIONS, HYPOTHESES, AND METHODS:

3.1. Research Questions

The primary goal of this thesis is to develop a standard methodology to assess local and regional geologic variability, and lithic resource procurement and utilization in the archaeological record. Survey of both cultural and geologic materials can be used to understand if a viable geologic source is present for lithic tool manufacture, and whether there is a preference for some geologic sources over others in the manufacture of tools and other cultural uses of lithic materials (e.g., construction material). A number of questions arise as to how resources are acquired. What is the local geologic variability surrounding an archaeological site, and are there suitable materials for tool manufacture and other cultural uses? Are people exploiting raw materials from their immediate vicinity, or are they traveling long distances or trading for other materials not locally available? From how far away are people obtaining materials? Was material transported as blanks and reduced on site, or did reduction of material take place largely off site? Expanding the study to a regional perspective aids in creating a clearer picture of lithic resource procurement, lithic variability, and tool manufacture.

3.2. Hypotheses

If the inhabitants of Cola de Zorro were simply exploiting lithic raw material in their immediate surrounding, then artifact assemblages should correspond to local geologic material. Alternatively, people may have been exploiting non-local material, in which case imported material should be present. Most likely, the inhabitants of Cola de

Zorro had access to both local and more distant resources, which should be reflected in artifact assemblages by a variety of local and non-local geologic material. If non-local material is present, then it is expected that lithic reduction would have occurred at the geologic source (for ease of transport), resulting in less lithic debris at the site (Close 1996). The development of a standard methodology to recognize which of these scenarios likely characterizes Cola de Zorro will aid in determining the degree to which geologic resources were procured from various distances on the landscape.

Here, local and regional geologic variability is defined and subsequently compared to cultural lithic material variation identified on site and more regionally along the Tambo-Ilo coast. The analysis of geologic material from Quebrada Honda in the lower Osmore drainage will also help to generate a more regional picture of geologic variability and potential resource utilization in the study area.

Understanding the lithic exploitation of a site should include the procurement, transport, manufacture, and reduction process of lithic resources. In most cases, lithic tools recovered from the archaeological record represent the end of a process that involves raw material extraction, shaping, use, and possible re-sharpening or retooling (Henry 1989). Besides the tool assemblage, debitage helps in our understanding of how the stone tool was created (Shott 1994). Analysis of varying proportions of different quality stones will aid in identifying settlement activity within an area (Andrefsky 1994). If a greater amount of flaking debris for particular material is present onsite, then it is likely that the stone tools were created onsite, or that the geologic source is nearby. However, flake size and reduction sequence need to be taken into account in order to accurately describe the scenario. In the case of imported material, reduction flakes would be on average smaller in size as a byproduct of late-stage reduction or tool retouch rather than tool manufacture. In lithic tool production, Ahler (1989) discusses two observations: 1) due to its reductive nature there are predictable and repetitive size constraints on the by-products, and 2) variations in load application through percussion produces variations in flake size and shape.

3.3. Methodology

Data Collection was completed through multiple phases to assess local lithic raw material availability for human exploitation. The raw material survey and cultural material survey contained identification sheets that included select attributes that allowed the sheets to be linked together for comparative study during data analysis.

3.3.1. Local lithic raw material availability

Systematic linear surveys were completed in order understand variability in geologic material present at and around Cola de Zorro. The systematic survey of local raw material was completed with the assistance of Dr. Martin Yates of the Geology Department (University of Maine). Relative frequencies of raw material type were determined by the use of linear surveys completed within the quebrada bed of the site drainage and along the pediment surface.

3.3.1.1. Cola de Zorro Formal Survey. Two 200 meter transects were laid consisting of a string placed on the surface. Geologic specimens in contact with the string at meter intervals were measured and described. GPS coordinates were taken at the onset and completion of each survey. Two hundred samples were recorded from both the quebrada and pampa. If no rock was in contact with the string at the meter interval then the closest clast was taken for measurement. Only clasts greater than or equal to 5 cm in length were analyzed and recorded. In addition, if clasts were over 1 meter in length, the measurement was recorded twice. Within the quebrada bed, the string was placed in a straight line until the quebrada changed direction. Placement was based on the availability of material within the quebrada. Due to data collection at meter intervals, it was important for the string to come in contact with as many rocks as possible, thereby decreasing the chance of an interval having no rock on which to collect data. This would allow for an unbiased sampling and the averaging of material during the survey. During data collection, a rock identification sheet was used when presented with a new rock type not previously described (Figure 3.1). Referencing each rock type to characteristics on a separate sheet saved time and unnecessary repetition (rather than describing individual samples). It also created a comparative sample that could be correlated to the geologic type of tools, thus identifying whether stone tools were potentially created with local resources.

Rock Name: ____________

☐ Igneous --- ☐ Volcanic ☐ Plutonic

☐ Felsic ☐ Intermediate ☐ Mafic

☐ Sedimentary ---

☐ Clastic --- ☐ Arenite ☐ Wacke ☐ Mudstone

☐ Chemical --- ☐ Limestone

Weathered Surface: Color: __________

☐ Chemical --- ☐ Dark Patina ☐ Glossy Patina ☐ White Patina ☐ Desert Varnish

☐ Mechanical --- ☐ Joint Fracture ☐ Water Worn ☐ Weathered Crust

Grain Size:

☐ VC: >50mm ☐ C: >5 to <50mm ☐ M: >1 to <5mm

☐ F: >.1 to <1mm ☐ VF: .01 to >.1mm ☐ G: <.01mm

Figure 3.1: Sample identification sheet used during systematic geologic survey.

Survey of the pediment/pampa surface was completed away from the site but within an area that contained similar geologic properties as found on site. Due to local raw materials containing a weathered surface, the lithic identification process entailed fracturing the rock in order to geologically identify it with certainty. In order to preserve the site, the identification process was performed away from the site but in close proximity to represent the same geology. Pediment surface survey was methodologically the same as the quebrada bed survey, where a string was used and rock types were analyzed at meter intervals. In contrast to the quebrada survey, measurements and string placement were completed in a northerly direction away from the quebrada. To expedite the process, the tape measure and string were laid out at a length of roughly 50 meters, with markers placed at meter intervals (this method was used in the quebrada survey as well). This allowed for multiple samples to be completed over a set distance instead of using the tape measure and string after each rock identification and measurement. In addition, the same identification sheets were used to characterize any unique material found.

Any time a sample was collected that was identified as being a new rock type, an identification sheet was used to describe the sample. On the identification sheet, attributes analyzed included rock category, weathered surface color, weathered surface type, grain size, constituent structure, fabric, grain-size texture, internal rock color, mineralogy, and mineralogical form.

- Rock category was labeled as igneous, metamorphic, sedimentary, metasomatic, or other.
    - Igneous rocks are either volcanic or plutonic. Volcanic rocks form close to the Earth's surface, whereas plutonic rocks form at least 1km beneath the surface. These are further recorded as felsic to mafic.
    - Metamorphic rocks are rocks that have been metamorphosed from pre-existing rocks; these are divided into rock types that include gneiss, hornfel, marble, quartzite, schist, skarn, slate, and other.
    - Sedimentary rocks are compressed sediments that have been converted into rocks through lithification.
    - Metasomatic rocks form through a chemical alteration by hydro-thermal or other fluids from an igneous or metamorphic source (Thompson and Turk 1993).
- Weathered surface was divided into surface color, chemical properties, and mechanical properties.

- Surface colors were classified based off of a Munsell Rock Color chart.
- Chemical properties include dark/glossy/white patina, desert varnish and oxidation. Differences in patina are results of chemical processes on silica rich clasts, mainly chalcedony and chert for this survey (Luedtke 1992). Material from the quebrada bed and pediment surface predominately lacked chemical processes with some oxidation.
- Mechanical properties at Cola de Zorro include joint fracture, water worn, and weathered crust. Most samples contained weathered crust; however, as expected, the clasts from the quebrada bed contained a water worn surface as well.

- Grain size was classified from very coarse to glassy: very coarse (VC) +50mm, coarse (C) 50 – 5mm, medium (M) 5 – 1mm, fine (F) 1 – 0.1mm, very fine (VF) 0.1 – 0.01mm, glassy (G) –0.01mm.
- Constituent structure refers to the formation structure of the sample (i.e. massive, porphyritic).
- Fabric denotes a describable pattern that is present throughout a rock. Massive means no pattern is present, planar refers to flat basal layers, and linear defines long tubular instances (Sinha 2006).
- Grain-size texture refers to the variability in grain-sizes present. Equigranular are grains of the same size and grains of all sizes are seriate. Bimodal grains are of two different sizes and trimodal are three sizes.

- Internal rock color was labeled through use of the Munsell Rock Color chart, in order to standardize color schemes (i.e. Light brown, 5YR 6/4).
- Mineralogy refers to minerals present in the sample. These include, but are not limited to, horneblende, biotite, plagioclase, and quartz.
- Mineralogical form identifies the crystalline structure of the minerals. Euhedral describes crystals whose shape is well formed, reflected in its crystal faces. Anhedral crystals have no defined form and subhedral refers to the intermediary between the two.

Two hundred samples were recorded for both the quebrada bed and along the pediment surface. For both surveys, rock name, number of flat surfaces, roundness, dimensions, and break were recorded.

- Rock name refers to the lithic identification sheets, where rock type and rock properties are previously defined.
- Flats refer to the number of flat surfaces present. An ordinal scale from 0-6 was used, where 0 contains no flat surfaces and 6 contains all flat surfaces.
- Roundness is an ordinal scale variable whose variates include all whole numbers from 0-5. Zero represents an angular rock and 5 a perfect sphere.
- Dimension includes three variables: long, short, and intermediate. All measurements were rounded to the nearest centimeter.
- Break is an ordinal scale variable whose variates include all whole numbers from 0-5. Zero refers to a rough break and 5 a clean break.

3.3.1.2. Informal Pampa Dispensilla Survey. An informal survey of the local bedrock outcrops on Pampa Dispensilla was completed and compared to material analyzed during the survey of the quebrada bed and pediment surface. Cross-referencing surveyed material to bedrock allowed for an interpretation of past environmental erosional processes, which aided in understanding the distribution of the local geology across the site. Informal survey emphasized bedrock outcrops surrounding Cola de Zorro. At each location, the bedrock was analyzed for geologic composition, mineralogy, and orientation. Observations were then compared to geologic maps of the area (i.e., Bellido and Guevara 1963) to assess the congruence of this newly generated data with previously published maps.

3.3.1.3. Informal Coastal Survey. The cobble beach and coastal outlets of Pampa Dispensilla were informally surveyed to investigate their viability as a geologic source for lithic tool production at Cola de Zorro. Informal survey took place to the south of Cola de Zorro on the coast from Las Almas Point to Cocotea Point. The survey followed the coastal cliff face documenting any changes in geology from that of the nearby bedrock outcrops farther inland. A distance of 100m was informally surveyed within coastal drainages to document geologic material. On the cobble beach, variability in geologic material was recorded, as were any potential rocks that were very-fine grained and large enough to be used in tool manufacture.

3.3.1.4. Broader Tambo-Ilo Informal Survey. Expanding on the coastal and Pampa Dispensilla surveys, informal survey was completed west of Cola de Zorro at and around Cocotea point and southward along the coast from Cola de Zorro, just south of Platanal beach. Roadside survey was completed at Cocotea point, where descriptions were recorded at visible transitions in bedrock geology in order to understand changes in lithology. South of Pampa Dispensilla, geology was recorded between Platanal beach and Wawakiki. Survey was completed on foot following the road to Ilo. The main purpose was to record the geology and find the transition between the Cretaceous/Tertiary grano-diorite formation and the Jurassic volcanic chocolate formation.

3.3.1.5. Informal Quebrada Honda Survey. While conducting an archaeological survey along Highway 10 from Ilo to Moquegua, Peruvian archaeologist Adán Umire Alvarez identified a potential source of chert in Quebrada Honda (personal communication, 2007). The informal survey was meant to re-identify the location of the source, its extent, and material variability in both size and color. In order to find the extent of the source, roadside survey was completed both north and south of Quebrada Honda as it crossed Highway 10. At periodic locations, survey was completed of the area surrounding the road to identify the presence of chert, and if material was diminishing in intensity. This strategy continued until the presence of chert diminished.

3.3.2. Cultural Material

Cultural geologic material at Cola de Zorro is defined as lithic material that has been modified in some way by people. This includes stone tool manufacture, the byproducts of stone tool manufacture (debitage), and the use and modification of granite slabs for the construction of terraces, dwellings, and other structures.

3.3.2.1. Cola de Zorro. To determine the local inhabitants' use of raw material, a surface survey was completed in all domestic debris locations visible on the surface of

Cola de Zorro. Domestic debris areas are characterized by dark soil deposits that visibly contain marine shell, ceramics, lithics, and ash. Surface survey was completed by walking in transects 3-5 meters apart across the domestic scatters. Culturally modified lithic material included projectile points, debitage, and ground stone, and it was examined and analyzed in order to identify the range of lithic material utilized at Cola de Zorro. Material was measured and recorded in an inventory catalog (Table 3.1). Importantly, the same attributes measured during the raw material surveys were also measured during the cultural lithic material surveys. Within the inventory catalog, "rock type" for all culturally modified lithic material is cross referenced to the raw material survey. If the clast is the same, then the rock identification sheet will correlate to the lithic tool. This becomes an important factor in understanding local strategies of resource transportation, and in particular whether inhabitants acquired material locally from bedrock outcrops and coastal outlets or regionally from more distant sources or via trade (Andrefsky 1994).

Table 3.1: Biface section of lithic identification sheet for culturally modified material.

1	2	3	4		5	6	7	8	9	10	11
PN	**LBIF**	**Point**	**Spnshld**	**1**	Diamond / Foliate	**Time period**	**portion**	**%**	**length**	**width**	**thickness**
	(Lithic Biface)	(final stage	(spine-shouldered)	**2**	Pentagonal						
		production)	**angshld unst**	**3**	Foliate						
		Prefrm	(angular-shoulder unstem)	**4**	Diamond / Rhomboid						
		(stage 1 / 2 of	**rndshld unst**	**5**	Pentagonal						
		production)	(round-shoulder unstem)								
			unst unsh fol	**6**	wide contracting haft w/						
			(unstemmed unshouldered		Straight base						
			foliate)	**7**	Edge modified foliate w/						
					strght to contr haft margins						
				8	contracting to parallel-sided						
					foliate w/o edge modification						
			Stem	**9**	triangular-bladed, broad						
			(stemmed forms)		stem w/ contracting haft						
				10	Small, narrow, broad-stem						
					w/ contracting haft						
				11	squat, narrow stem w/						
					contracting haft						
				12	elongated, narrow stem						
					w/ barb shoulders						
				13	Small, broad stem w/						
					Parallel-sided haft						
			Unstem	**14**	Ovo-triangular						
			(unstemmed forms)	**15**	Straight-based to convex						
					Based triangular						
				16	Large triangular w/						
					concave base						
				17	Small triangular w/ concave						

3.3.2.2. Architecture Survey. A small systematic survey was completed on the structure present in Sector 1 of Cola de Zorro. For the survey the longest wall was used. The survey entailed identifying five categories:

- Rock type put a name for the lithic in the rock identification sheet (attributes see above).
- Dimensions consisted of long, short, and intermediate lengths measured in cm.
- In place or out of place describes if the rock was or was not touching the architectural wall.
- Broken to fit determined if the rock present showed signs of break patterns to fit more securely.
- Flat sides were identified by whether the outside, upside, or inside faces were flat.

Informal observations were collected in the surrounding area of the structure for any colonial material in addition to an earlier prehispanic presence.

3.3.2.3. 2006 Tambo-Ilo Survey Material. Cultural material was collected during an intervalley coastal survey by Gregory Zaro and colleagues in 2006. Survey was completed from Quebrada Agua Buena in the south to Quebrada Iñane in the north, from the coast up to about 800 m.a.s.l. For my research, all lithic material collected during this survey was analyzed. However, during survey there was a bias toward the collection of projectile points; debitage was not generally collected. For analysis, the inventory catalog used for Cola de Zorro artifacts was also used for these artifacts. This allowed for a standard methodology to be used to compare material from the intervalley coastal region to material identified at Cola de Zorro.

3.3.2.4. Projectile Point Classification. Due to the lack of knowledge regarding the coastal projectile point chronology, Klink and Aldenderfer's (2005) south-central highland chronology was used as a starting point, to compare and contrast the coastal projectile points to those of the south-central highlands.

Klink and Aldenderfer (2005) present a number of point location sites relatively close to the fieldwork area. Projectile point characteristics were given for points at Yara (Rasmussen 1998) on the southern Peruvian coast near Ilo, including a number of middle and upper Osmore drainage sites that included Omo (Goldstein 1993a, 1993b), Toquepala (Ravines 1972), and Asana (Aldenderfer 1998). Bifaces are categorized into stages of production, with "point" being the final stage and "preform" being the first and second stage. In addition, main characteristics include spine-shouldered, angular-shoulder unstemmed, round-shoulder unstemmed, unstemmed unshouldered foliate, stemmed, and unstemmed.

- For lithic uniface typology a generic classification of attributes is used to gain an understanding of the unifaces present at Cola de Zorro, these include endscrapers, side scrapers and "other" (Table 3.2).
- Lithic modified refers to any material that does not fit into the other categories but has been clearly modified, this includes graver, spur, notch, unifacial edge, bifacial edge and an "other" category for miscellaneous characteristics.

- Lithic core is material from which flakes have been removed. This includes single, double, poly platforms and other.
- Lithic debitage are flakes removed from a core. Main attributes include flake, fragment, blade, and platform flake.
- Ground stone refers to material that has been pecked or ground smooth. Main attributes include abraded, plumb, and other.

Table 3.2: Lithic identification sheet for unifaces, lithic modified, cores, debitage, and ground stone.

1	2	3	4	5	6	7	8	9	10	11
PN	**LUNIF**	**End**	**Triang**		**time period**	**portion**	**%**	**length**	**Width**	**Thickness**
	(Lithic	(end scraper)	**Ovoid**							
	Uniface)		**Para**							
		Side	**Bicnvx**	**sing**						
		(side scraper)	(biconvex planar form)	(single uni edge)						
			Bicncv	**doub**						
			(biconcave planar)	(double uni edge)						
		Other	(attributes)							
	LMOD	**Gravr**								
	(Lithic	**Notch**								
	Modified)	**Unifedge**	**Uniface**							
		unifacial edge w/ retouch								
		bifedge	**Biface**							
		Bifacial edge w/ retouch								
		Other								
	LCOR	**Sing**	**Blade**							
	(Lithic	(sing. Platform)	**Flake**							
	Core)	**Doub**	**Undef**							
		(two platforms)	**Irreg**							
		Poly	**Biface**							
		Other								
	LDEB	**Flake**	(flake count)					< 1 cm	1 - 3 cm	> 3 cm
	(Lithic	**Frag**	(fragment count)							
	Debitage)	**Blade**	(blade count)							
		Pltfrm	(platform flake count)							
	LGRST	**Abraded**								
	(Ground	**Plum**								
	Stone)	**Other**								

CHAPTER 4

RESULTS

4.1. Raw Material

4.1.1. Quebrada and Pampa Formal Survey

Through survey of Cola de Zorro's quebrada and pampa surface, the site was found to have similar lithology to that of the surrounding bedrock (Figure 4.1). The quebrada contained granites that were either green or pink. Color variations depended on the amount of potassium feldspars present; if there was an abundance of potassium feldspar then the granite was pink, if the granite contained more plagioclase and hornblende then it was green. Porphyritic basalt was present but in less frequent intervals and smaller in size. The basalt had rounded, weathered surfaces with fracturing on FeOx irregularities. All material was water worn to some extent due to its position in the quebrada drainage. The pediment surface contained a similar lithology to that of the quebrada with some exceptions. Higher amounts of FeOx erosion was present on granites, and in some instances the type of granite was indiscernible due to the amount of erosion. Small angular nodules of aplite are present on the pediment surface. Due to aplite's resilience to local erosion, it is likely that as the granite eroded, the veins of aplite were freed from their surrounding matrix and deposited on the pediment surface free of any granite constituents.

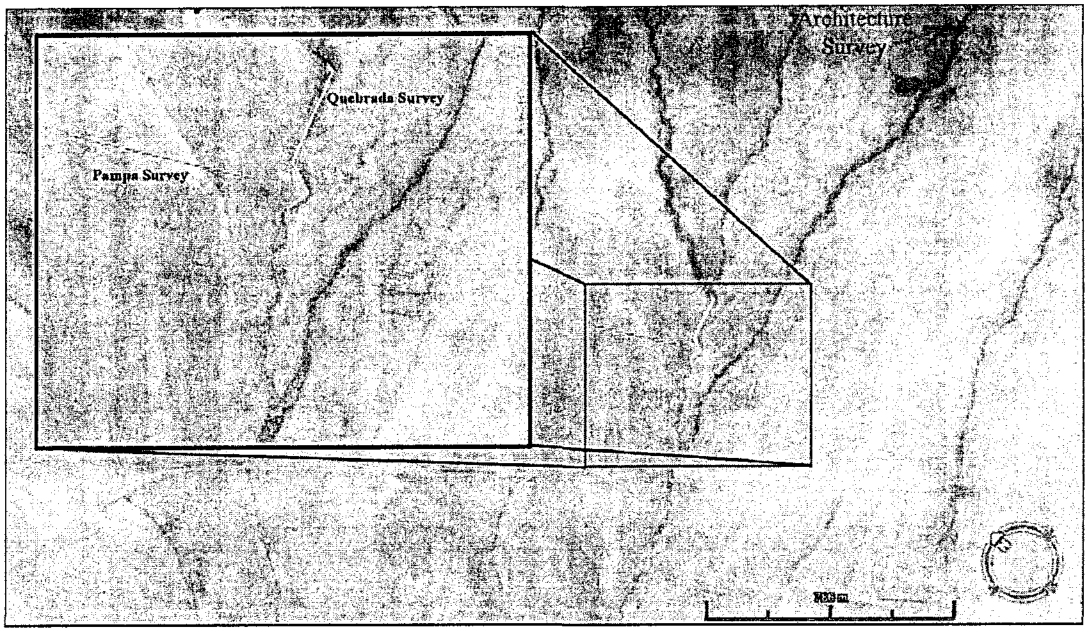

Figure 4.1: Location of Quebrada and Pampa surveys at Cola de Zorro.

Table 4.1: Counts and percentages of rock types identified during systematic survey at Cola de Zorro.

Quebrada	#	%
Green Granite	140	70
Pink Granite	47	23.5
Porphyritic Basalt	5	2.5
Light Pink Granite	3	1.5
Green Dacite	4	2
Aplite	0	0
Gabbro	0	0
Oxidized Granite	1	0.5
Total:	200	100

Pampa	#	%
Green Granite	103	51.5
Pink Granite	35	17.5
Porphyritic Basalt	16	8
Light Pink Granite	1	0.5
Green Dacite	18	9
Aplite	15	7.5
Gabbro	1	0.5
Oxidized Granite	11	5.5
Total:	200	100

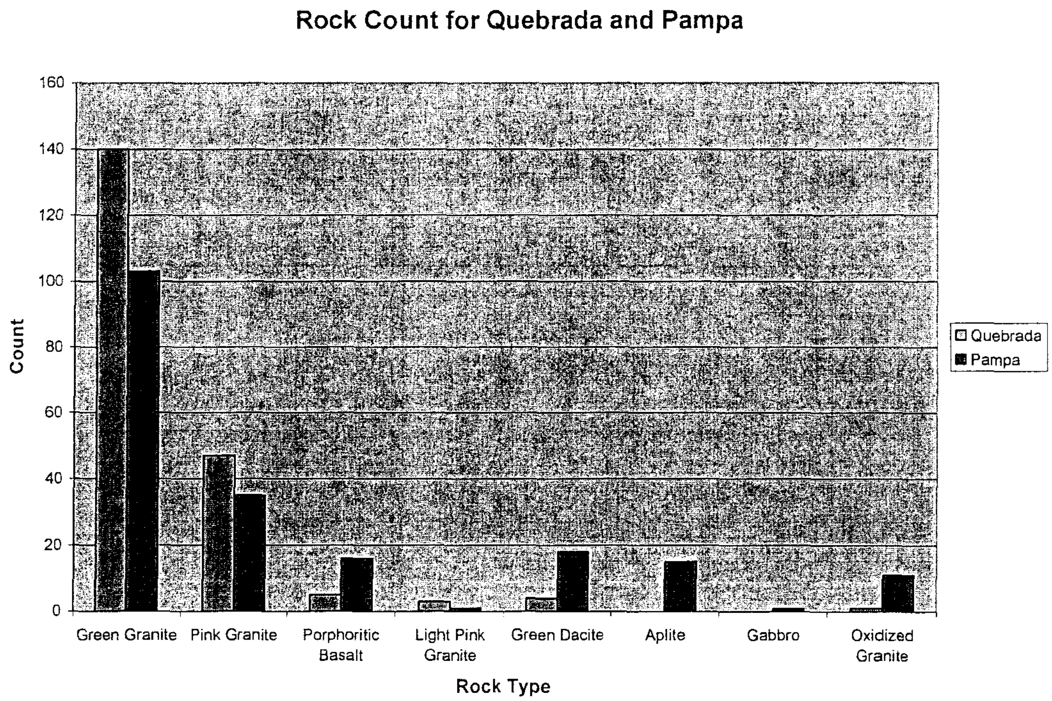

Figure 4.2: Bar chart comparing the counts of rock types from the quebrada survey versus the pampa survey.

Table 4.2: Average number of flat sides by rock type.

Average Flat Sides

Quebrada	Flats
G. Granite	3.03
P. Granite	2.66
P. Basalt	2.00
L.P. Granite	3.00
G. Dacite	2.50
Aplite	0.00
Gabbro	0.00
Ox. Granite	2.00

Average Flat Sides

Pampa	Flats
G. Granite	2.65
P. Granite	2.91
P. Basalt	3.25
L.P. Granite	1.00
G. Dacite	1.83
Aplite	2.67
Gabbro	5.00
Ox. Granite	2.36

According to rock type, green granite is the dominant material in both quebrada (70%) and pampa (51.5%) surveys (Table 4.1; Figure 4.2). The average for flat surfaces for green granite varies from 3.03 in the quebrada and 2.65 on the pampa (Table 4.2;

Figure 4.3). A t-test preformed on these two samples at 95% confidence limits suggests no significant difference between them with respect to the number of flat surfaces (p-value = 0.2701). Consequently, there was likely no preference in location for the selection of construction material between the quebrada channel and the pampa. However, average size of all material surveyed shows that the quebrada contains material over 3 times larger than that on the pampa (Table 4.3; Figure 4.4).

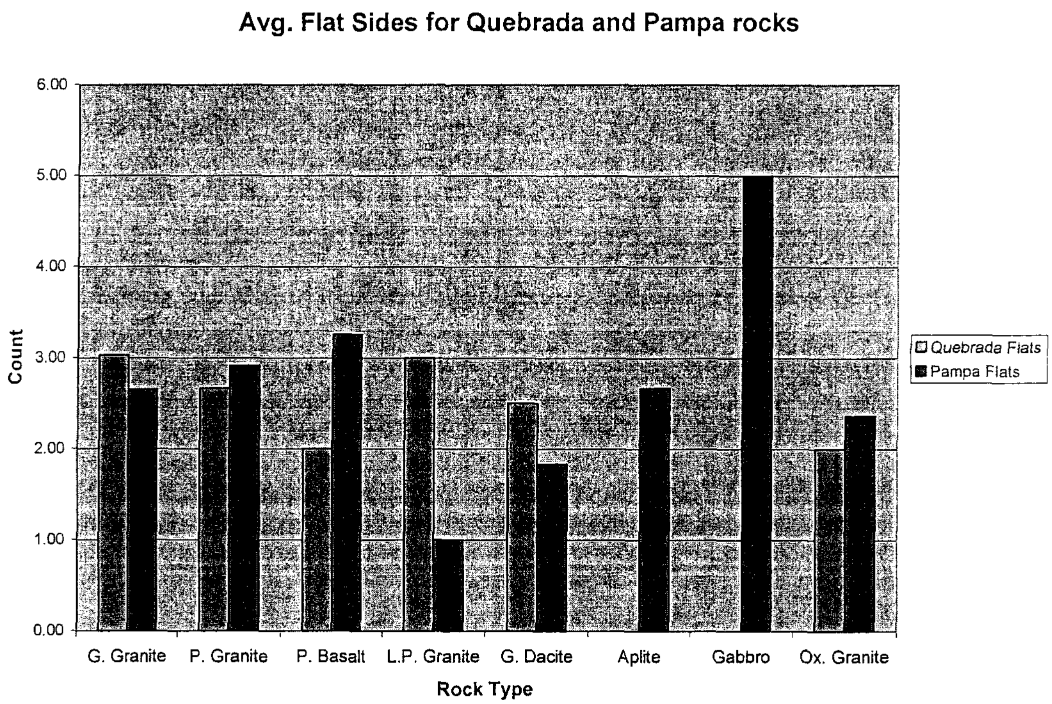

Figure 4.3: Bar chart comparing the average number of flat sides per rock type in quebrada versus pampa surveys.

Table 4.3: Average dimensions of Quebrada and Pampa rocks.

		Quebrada	Pampa	Total Avg.
Dimensions	Avg. Long	38.67	11.965	25.3175
	Avg. Short	17.92	5.145	11.5325
	Avg. Inter.	26.28	7.88	17.08

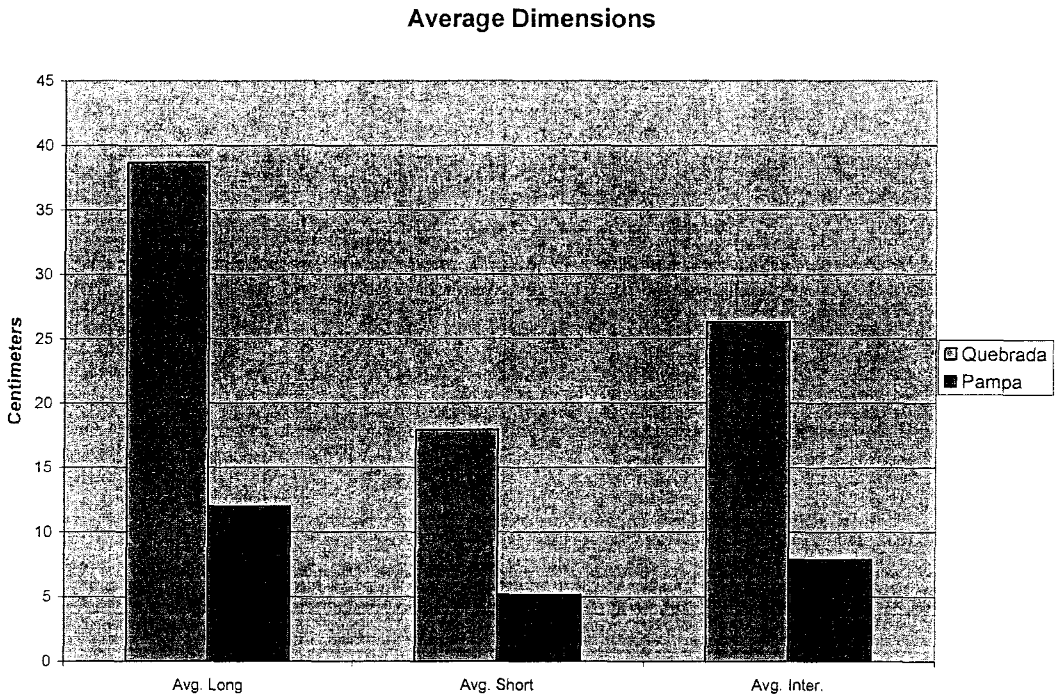

Figure 4.4: Bar chart displaying the average dimensions of rocks from the quebrada and pampa.

The results from quebrada and pampa surveys allow us to understand more clearly the geologic processes and history that have occurred. In the 200 samples identified during the quebrada survey, none contained aplite and only 1 piece (0.5%) of oxidized granite was found. In contrast, the pampa survey contained 15 samples (7.5%) of aplite and 11 samples (5.5%) of oxidized granite (Table 4.1). Granite appears to be more susceptible to surface weathering than other rock types found, and the smaller pieces are likely to become oxidized more quickly due to smaller surface areas. All samples of oxidized granite were relatively small (the largest being only 7cm in length), suggesting their small size is a factor in the speed of their oxidation. Throughout the bedrock outcrops and in larger boulders of granite there are aplite veins, which are more resistant to weathering. As the granite becomes oxidized and fragile, the aplite loosens from its surrounding matrix, which would explain why there is a larger abundance of aplite on the pampa than in the quebrada.

4.1.2. Pampa Dispensilla Informal Survey

Geologic information pertaining to details on outcrops, geologic composition, jointing, and geologic activity, is a compilation of Dr. Yates' field notes and my own from the informal Pampa Dispensilla survey.

Elevation increases rapidly due to Jurassic volcanics approximately one hundred fifty meters to the northeast of Cola de Zorro. The granite contains hornblende as its main mafic constituent and is medium grained and equigranular. The outcrop contains a mild iron oxidized cortex with no hydro-thermal alteration. Jointing surfaces are iron oxide (FeOx) stained with FeOx quartz veins. Outcrops contained sparsely distributed mafic enclaves. These are ovals 5cm to 10cm in size and contain 60% mafic minerals. One kilometer to the northwest, there is unconsolidated tuffa and debris flow in fragmented rock, and the material is silica rich and glassy. Infrequent veins in the tuffa are hydro-thermally altered and compressed to create a glassy material similar to chert but not suitable for use in tool manufacture.

Cretaceous / Tertiary intrusive volcanic rocks (grano-diorites) lie 3km to the west and 0.5km east-southeast of Cola de Zorro. A bedrock traverse lies to the west of Cola de Zorro on outcrops that extend to the sea. Boulders are subangular and have an FeOx weathered surface. Granite blocks have a speckled green-grey appearance with oval mafic enclaves similar to outcrops to the north. Mafic enclaves are rounded to sub-rounded with 60-70% fine-grained equigranular mafic minerals. Outcrops contain aplite veins with fine-grained quartz-feldspar and sharp contacts.

4.1.3. Dispensilla Coastal Informal Survey

Between Cola de Zorro and its immediate coastline are multiple outcroppings of bedrock. However, periodic outcroppings of hydro-thermally altered material is present. One large outcropping consisted of chloritized granite crosscut by quartz veins and silification. The rock contained a silicified brecciated material with copper stained magnetite bearing replacement quartz veins. Material is tan with an actinolite green color possibly from copper oxide staining. Interestingly, silicified granite and basalt are intermixed, with angular granite rocks surrounded by silicified basalts, suggesting that this outcrop is a basalt dike serving as a medium for hydro-thermal solutions. Structure is very fine-grained with the potential use as a geologic source in tool manufacture.

The coast near Cola de Zorro contains a cobble beach and shear rock cliff faces. It contains a mixed aggregate of geologic types. The granite found in the local bedrock with its veins of aplite and mafic enclaves is found scattered across the beach in rounded stones ranging in size from pebbles to boulders. Coastal lithology also contains silicified basalt with hydro-thermally altered quartz veins. Most fine-grained basalt rocks are small and contain disconformities that make it inadequate to use for stone tool production. Coastal lithology also contains large very fine-grained boulders similar in material to the hydro-thermally altered rock found in the basalt dike up from the coast. However, material is much darker than the silicified outcropping previously mentioned and is predominantly a silicified quartzite that has potential for tool manufacture.

Material is dark green with fine flaking suggesting high silica content, and sporadic small inclusions of magnetite are seen across the surface. These boulders are sub-angular with many cleavage faces but internal structure contains few irregularities making tool manufacture possible.

Coastal lithology varies due to geologic activity; however, the predominant material is granite in the form of outcrops. In most outcrops there are veins of material consisting of aplite and quartz. Small localized outcrops of fine-grain quartz that have the potential to be used in lithic tool production were also found along the coast. In fact, one bifacial point made from quartz was found 200 meters away from an outcrop (Figure 4.6). For the most part, quartz vein material and chert are distinct and have very little in common with one another. However, the one variation of chert is milky white and not as glassy as its counterparts. Without closer inspection (i.e., use of a lupe), this material could be confused with the coastal white quartz.

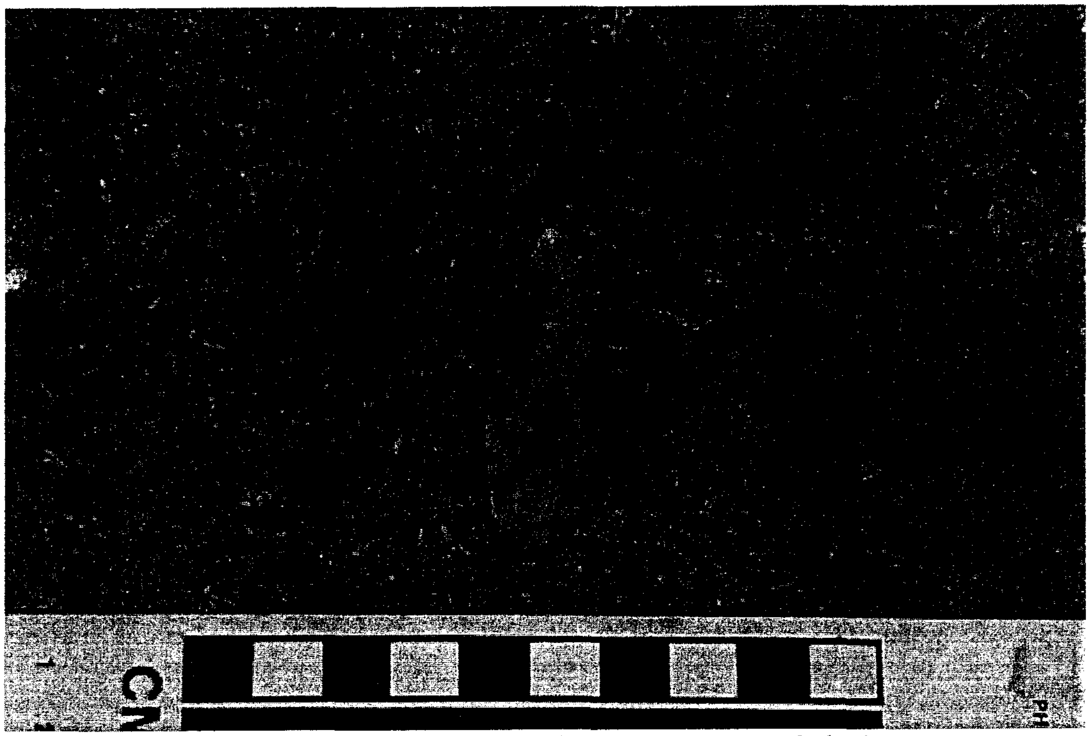
Figure 4.5: Quartz biface observed along the coast near Cola de Zorro.

4.1.4. Broader Tambo-Ilo Informal Survey

Toward Punta de Bombón, the geology changes into non-mafic granites with a transition back into mafic. Initially, granite becomes noticeably greener with an equigranular medium-grained massive structure. Granite is mafic free and contains only quartz and green stained plagioclase, in which the green appears to be epidote altered into plagioclase. Progressing farther south to the coast, granite becomes medium gray and is 30% mafic. Structure continues to be equigranular and massive, however plagioclase becomes light gray with dark quartz and pink potassium feldspars. Mafic enclaves become more abundant and larger with high angle jointing. The geology contains light colored, leucogranite dikes at random orientations, where some are fractured with quartz filling.

The area between Cola de Zorro and Ilo is characterized by several inactive fault lines: Salinas, Clemesí, Infiernillo, and Chololo. Each fault provides an opportunity to better understand the geologic history through regional geomorphologic transitions. To the north of the Clemesí fault and San Jose fundo is a contact region between the Cretaceous / Tertiary grano-diorites and the Jurassic volcanics. However, field survey showed contact to be farther south near the Clemesí fault where the younger grano-diorites are subducted into the older Jurassic volcanics with contact being much flatter than first thought (Figure 4.6). Contact of the Jurassic volcanics and grano-diorites can be seen south of quebrada Chololo on the road leading to Platanal beach. The outcropping contains rounded green and angular light-green fragments of rhyo-dacite / dacite in rock with an aphanitic porphyritic matrix. The rock has a spotted appearance from zoned plagioclase being altered to epidote.

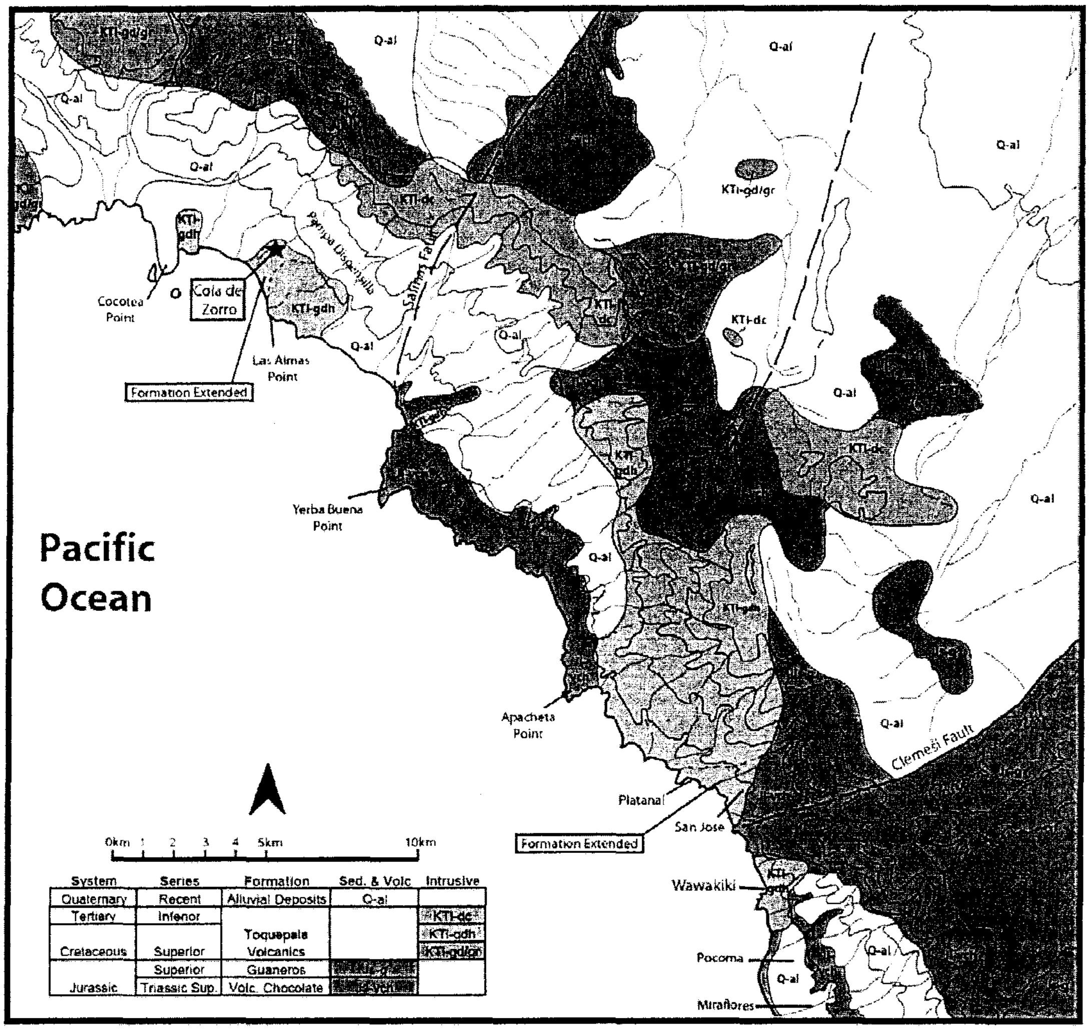

Figure 4.6: Geology of Tambo-Ilo with survey modifications.

Farther south, Wawakiki is classified as containing Cretaceous / Tertiary grano-diorites; however, upon inspection it was found that the geology was gabbro cut by basalt dikes, much different from Cola de Zorro's grano-diorite. The gabbro is equigranular with medium to coarse grains in a massive structure. It contains magnetite and pyroxene inclusions with coarse plagioclase. The basalt dikes are several meters thick, are porphyritic, and very fined grained with zoned plagioclase, potassium feldspar, magnetite, and pyroxene.

4.1.5. Quebrada Honda Informal Survey

The informal roadside survey found the location of a sizable deposit of chert and a potential source for regional tool manufacture. Along the Tambo-Ilo coast, including Cola de Zorro, lithic artifacts are present and manufactured from chert with similar geologic attributes as that found at Quebrada Honda. The main deposit was found 30km northeast of Ilo in a tuffaceous layer and scattered across the top layer of alluvial sand. Its location lies off highway 10 leading to Moquegua, at a road bend that cuts through 0.5 kilometer of deformed white tuff and FeOx sand gravels. All chert flakes found looked to have been naturally broken and not altered culturally. Chert is distributed along erosional slopes and in clusters on the surface. The road cut bank of the layer of tuff shows a faulted contact between itself and the sand. In some instances, chert is partially formed within the tuff, suggesting hydro-thermal activity and compression was present to create the chert. The source is at least 6.5 kilometers long and 1.5 kilometers wide. However, only roadside survey was completed; additional survey of the tuff is needed to understand the extent of the source.

Samples collected across the informally surveyed area are highly variable in color. Chert was white, gray, black, tan, red, and clear. Samples that are clear to gray are free of any internal inclusions. Grain size is cryptocrystalline. Chert samples that were milky white were inclusion bearing. These included milky white spherules, a chalky appearance, oxides with FeOx halos, and black dendrites. Grain size is very fine. Cortex for all samples varied from resinous, to chalky white, to dark and pitted. These cortexes correspond to Luedtke's (1992) description of cortexes present for chert. White patinas are created when silica is removed from the surface while buried in alkaline soils. A dark patina is the result of oxidation rather than the leaching of iron. A glossy patina is created due to surface silica deposition.

4.2. Cultural Material

4.2.1. Cola de Zorro

Sector 1, the northeast region, shows signs of post-Chiribaya activity that includes a colonial structure and colonial-era domestic debris. Domestic debris indicates more recent activity with the presence of metal tins. In addition, Spanish colonial-era glass is present in scatters of shards that look to have been retouched for utilitarian purposes. Structures exhibit the use of granite, which erodes from outcrops along the northern slope into relatively flat-faced pieces, ideal for construction. Some granite slabs were intentionally modified for construction, ranging from the rounding of corners to the flattening of faces.

Domestic debris zones were surveyed for lithic material across three sectors of the site (Figure 4.7). Bifaces were analyzed based on attributes used by Klink and Aldenderfer (2005). For unifaces only a hand full were recovered from the domestic debris. However, unifaces that were modified in some way were abundant and outnumbered unmodified unifaces almost six to one. In fact, the modified lithics category had the second most lithics, second only to debitage which dwarfed all other categories (Figure 4.8).

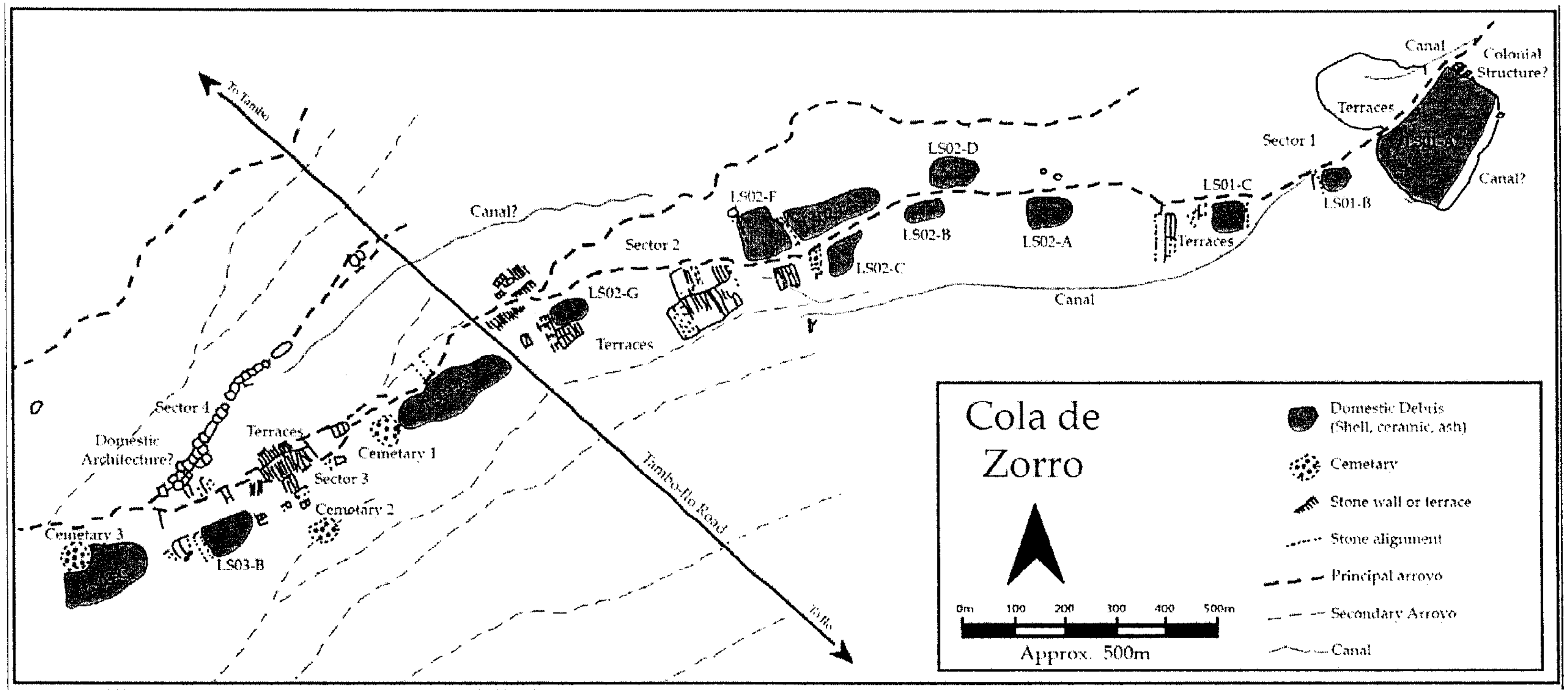

Figure 4.7: Map of Cola de Zorro

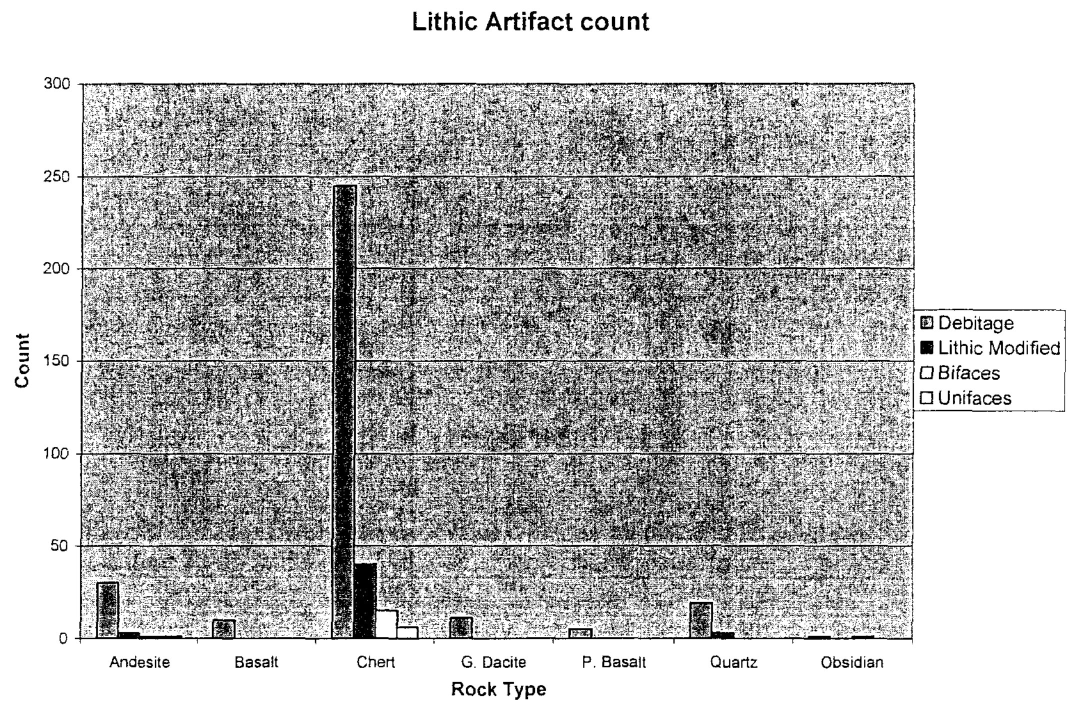

Figure 4.8: Bar chart displaying counts of lithic artifacts based on rock type.

As depicted in Figure 4.8, there was a preference toward chert. All categories (debitage, bifaces, unifaces, and modified lithics) have higher material counts in chert than any other rock type. Depending on the quantity and density of marine shell, chert may have been differentially collected. Higher densities of marine shell make it difficult to identify light colored chert on the surface. Conversely, in areas where little marine shell was present, chert is more easily spotted on the surface.

4.2.1.1. Bifaces. Seventeen bifaces were recorded from Cola de Zorro (Table 4.4). Of the seventeen bifaces, 15 or 88.24% were chert, 1 (5.88%) was andesite, and 1 (5.88%) was obsidian. Chert was primarily white to grayish white in color with a few pieces exhibiting some degree of transparency.

Table 4.4: Table of bifaces at Cola de Zorro.

		#	%
Bifaces	Andesite	1	5.88
	Chert	15	88.24
	Obsidian	1	5.88
	Total:	17	100

4.2.1.2. Unifaces. Only seven unifaces were collected from Cola de Zorro, where chert accounted for 85.71% and the only other uniface present was made of andesite (Table 4.5).

Table 4.5: Table of unifaces at Cola de Zorro.

		#	%
Unifaces	Andesite	1	14.29
	Chert	6	85.71
	Total:	7	100

Table 4.6: Table of unifacial and bifacial lithic modified artifacts.

		Unifacial	%	Bifacial	%	Total
Lithic Modified	Andesite	2	5.00	1	16.67	3
	Chert	36	90.00	4	66.67	40
	Quartz	2	5.00	1	16.67	3
	Total:	40	100	6	100	46

4.2.1.3. Lithic Modified. Lithics that were modified were broken up into two categories: unifacial and bifacial. Chert once again is the dominant category making up 90% of modified unifaces and 66.67% of modified bifaces (Table 4.6). Other geologic material present in modified lithics included andesite and quartz.

4.2.1.4. Lithic Cores. Cores were the least abundant cultural lithic material at Cola de Zorro, where only 5 were recorded (Table 4.7). The 5 cores included 4 (80%) manufactured from chert and 1 (20%) manufactured from quartz.

Table 4.7: Table of lithic cores at Cola de Zorro

		#	%
Lithic Cores	Chert	4	80.00
	Quartz	1	20.00
	Total:	5	100.00

Table 4.8: Table of debitage at Cola de Zorro

		>3cm	%	1-3cm	%	<1cm	%	Total
Debitage	Andesite	16	20.78	14	6.22	0	0.00	30
	Basalt	5	6.49	5	2.22	0	0.00	10
	Chert	41	53.25	186	82.67	18	100.00	245
	G. Dacite	10	12.99	1	0.44	0	0.00	11
	P. Basalt	0	0.00	5	2.22	0	0.00	5
	Quartz	5	6.49	14	6.22	0	0.00	19
	Total:	77	100	225	100	18	100	320

4.2.1.5. Debitage. The most abundant rock type was chert, accounting for 76.56% of the debitage, whereas Andesite was second, accounting for 9.38% (Table 4.9). As can be seen in Table 4.8 and Figure 4.9, material in the 1-3cm range is the most abundant, and chert has the largest rock type count. Debitage is also the most variable of categories with 6 rock types compared to 3 rock types in bifaces, 3 rock types in lithic modified, and 2 rock types in unifaces.

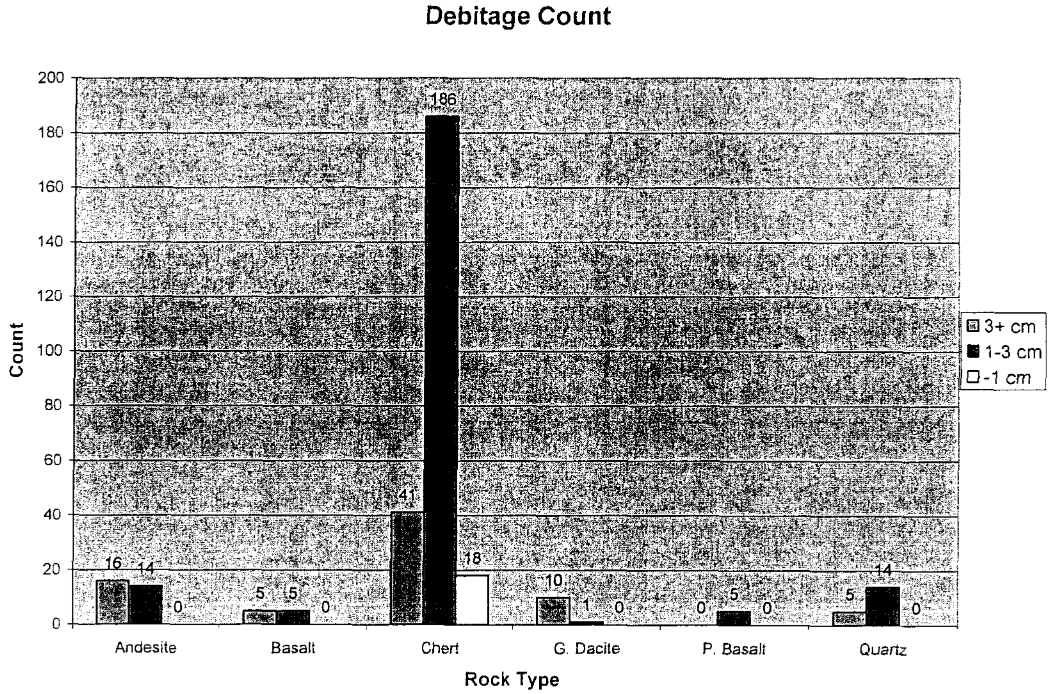

Figure 4.9: Bar chart displaying counts and size of debitage by rock type at Cola de Zorro.

Table 4.9: Table of total debitage at Cola de Zorro

		#	%
Debitage	Andesite	30	9.38
	Basalt	10	3.13
	Chert	245	76.56
	G. Dacite	11	3.44
	P. Basalt	5	1.56
	Quartz	19	5.94
	Total:	320	100.00

4.2.1.6. Architecture. The architecture results show a predominant use of granite for the creation of the colonial structure within the northeast corner of Sector 1. Since the quebrada and pampa surveys defined the characteristics of local geologic deposits, they should be reviewed and compared for relevance in the creation of the colonial structure.

The most important attribute was rock type (Table 4.10). Due to the placement of rocks on the wall, dimensions and number of flats could not all be accurately measured, since all parts were not visible. Rock types present in the architecture survey include green granite, pink granite, and porphyritic basalt. Green granite constitutes 178 of the 187 samples recorded, or 95.19% of the assemblage, whereas pink granite included only 8 samples, or 4.28%. In addition, only 1 piece of porphyritic basalt, or 0.53%, was identified (Table 4.10). Initial analysis suggests a preference for green granite in the construction of the colonial structure surveyed, though green granite was also about three times more common in both the quebrada channel and on the pampa surface than pink granite (see Figure 4.2).

Table 4.10: Rock count of structure wall.

Architecture Survey

	#	%
Green Granite	178	95.19
Pink Granite	8	4.28
Porphyritic Basalt	1	0.53
Total:	187	100

The locations of the quebrada and pampa surveys were completed almost 1km down slope from the architecture survey (Figure 2.4; 4.1). Originally, the purpose of the geologic survey was to define the variability in geologic material present; hence, locations were chosen in a quebrada drainage and on the pampa / pediment surface. They were not originally chosen to define optimal collection strategies of local geologic material for the construction of buildings. The pampa survey location is on the western side where little debris flow from flooding events has occurred. On the other hand, the eastern side of the quebrada and site contains larger deposits and more abundant material from debris flows. In addition, upslope from the colonial structure is a bedrock outcrop of green granite where slabs have eroded down slope, making it a likely source for construction material. However, in future projects, a pampa survey should be completed closer to the architectural structures throughout the site for a clearer understanding of whether or not materials chosen for its construction are in proximity.

4.2.2. Tambo-Ilo Material.

Geologic materials used in the creation of the tool assemblages in the Tambo-Ilo survey were also dominated by chert (Figure 4.10, Table 4.10). Table 4.10 depicts rock type to be divided into 8 types, where 3 of these types (andesite, basalt, chert) represent 89.58% of the total count.

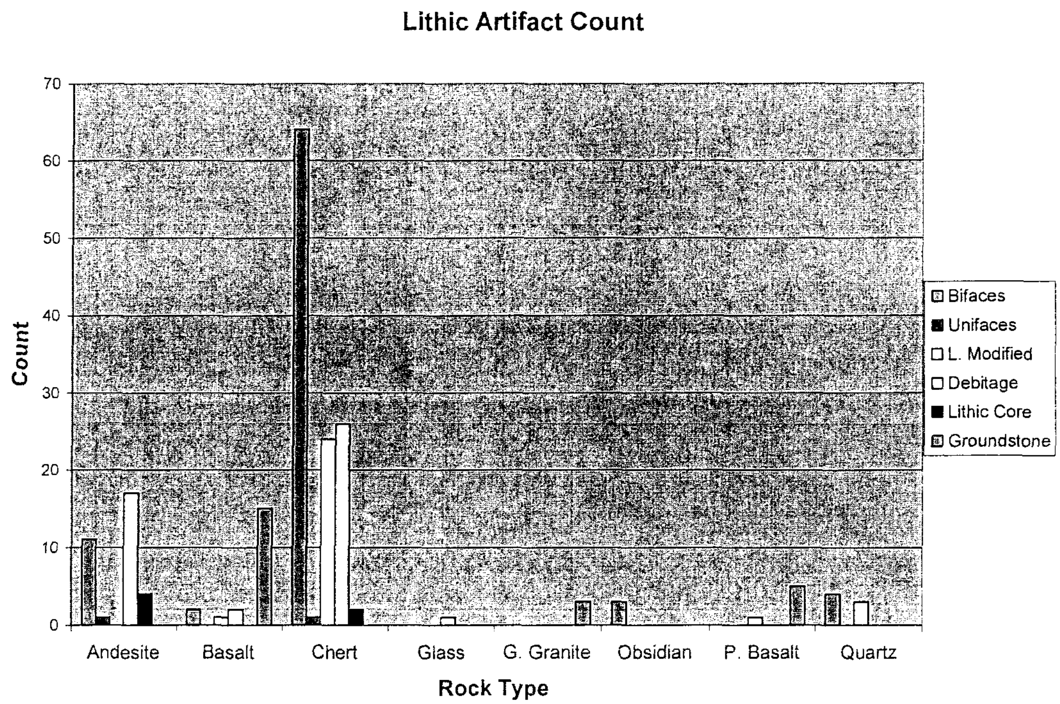

Figure 4.10: Bar chart displaying counts of lithic artifacts based on rock type from the Tambo-Ilo survey.

Table 4.11: Variations in rock type from the Tambo-Ilo survey.

		#	%
Rock Type	Andesite	36	18.75
	Basalt	20	10.42
	Chert	116	60.42
	Glass	1	0.52
	G. Granite	3	1.56
	Obsidian	3	1.56
	P. Basalt	6	3.13
	Quartz	7	3.65
	Total	192	100.00

4.2.2.1. Bifaces. A statistically higher amount of bifaces were recorded during the Tambo-Ilo survey over that of Cola de Zorro (one factor being the larger survey area).

Five rock types were recorded for bifaces, where 64 chert bifaces and 11 andesite bifaces dominate the assemblage at a combined 89.29% (Table 4.12). From the perspective of the entire survey, chert bifaces make up 64 of the 192 lithics recorded, or 33.33%. Basalt is usually a more difficult stone from which to manufacture bifaces, however fine-grained basalt is quite usable and appears to have been utilized along the Tambo-Ilo coast.

Table 4.12: Table of bifaces from the Tambo-Ilo survey.

		#	%
Bifaces	Andesite	11	13.10
	Basalt	2	2.38
	Chert	64	76.19
	Obsidian	3	3.57
	Quartz	4	4.76
	Total:	84	100.00

4.2.2.2. Unifaces. Unifaces contained the lowest count for the Tambo-Ilo survey with a total of 2; this included 1 chert uniface and 1 andesite uniface (Table 4.13).

Table 4.13: Table of unifaces from the Tambo-Ilo survey.

		#	%
Unifaces	Andesite	1	50.00
	Chert	1	50.00
	Total:	2	100.00

4.2.2.3. Lithic Modified. Lithic modified artifacts were broken into unifacial and bifacial categories. Chert dominates the unifacial category at 70% and the bifacial category at 89.47% (Table 4.14). The only other geologic type of bifacially modified lithics was quartz with a count of 2, or 10.53%.

Table 4.14: Table of lithic modified artifacts from the Tambo-Ilo survey.

		Unifacial	%	Bifacial	%
Lithic Modified	Basalt	1	10.00	0	0.00
	Chert	7	70.00	17	89.47
	P. Basalt	1	10.00	0	0.00
	Quartz	1	10.00	2	10.53
	Total:	10	100.00	19	100.00

4.2.2.4. Lithic Cores. Only 6 lithic cores were recorded from the Tambo-Ilo survey; 4 were andesite, or 66.67%, and 2 chert, or 33.33% (Table 4.15). This is one of the few instances when chert does not have the highest rock type count, though not by a great margin.

Table 4.15: Table of lithic cores from the Tambo-Ilo survey.

		#	%
Lithic Core	Andesite	4	66.67
	Chert	2	33.33
	Total:	6	100.00

4.2.2.5. Debitage. The most abundant rock type was chert, accounting for 56.52% of the debitage, whereas Andesite was second, accounting for 36.96% (Table 4.16). The Tambo-Ilo survey contained fewer pieces of debitage compared to the Cola de Zorro survey since larger lithics and points were actively sought over smaller pieces. Almost twice as many pieces of debitage over 3cm were collected compared to the 1-3cm debitage (Table 4.17). In addition, andesite and chert dominate the debitage over 3cm, whereas the 1-3cm debitage is 76.47% chert and only contains 3 pieces, or 17.65% of andesite.

Table 4.16: Table of total debitage from the Tambo-Ilo survey.

		#	%
Debitage	Andesite	17	36.96
	Basalt	2	4.35
	Chert	26	56.52
	Glass	1	2.17
	Total:	46	100.00

Table 4.17: Table of debitage from the Tambo-Ilo survey.

		>3cm	%	1-3cm	%
Debitage	Andesite	14	48.28	3	17.65
	Basalt	2	6.90	0	0.00
	Chert	13	44.83	13	76.47
	Glass	0	0.00	1	5.88
	Total:	29	100.00	17	100.00

4.2.2.6. Lithic Groundstone. Medium-grained to coarse-grained material is better for groundstone tools compared to fine-grained due to fine-grained rocks being more susceptible to fracturing. Here, basalt is the dominant rock type at 65.22%, used primarily for the manufacture of fishing weights (Table 4.18). In fact, 16 of the 23 groundstone lithics were used as fishing weights, the other 7 were either abraded for grinding or were mortar upon which to grind.

Table 4.18: Table of lithic Groundstone from the Tambo-Ilo survey.

		#	%
Groundstone	Basalt	15	65.22
	G. Granite	3	13.04
	P. Basalt	5	21.74
	Total:	23	100.00

4.2.3. Projectile Point Classification

As previously mentioned Klink and Aldenderfer's (2005) article on the southern highland typology was used as a foundation to compare biface typologies. However, it cannot be stressed enough the exploratory phase of this point chronology. Even Cynthia Klink upon further research has found that their original 2005 article has proved to be more of a rough guide than something definitive (personal communication, 2008). In this perspective, coastal typologies should be looked upon comparatively to the highlands, in order to find differences between the two and create a larger database of point characteristics for southern Peru as a whole.

4.2.3.1. Cola de Zorro. Nine of the seventeen bifaces collected were obtained from Sector 1 of Cola de Zorro (Table 4.19). In addition, only two bifaces were made of something other than chert (andesite, obsidian). Length / width ratios varied from 0.65 to 2.67; however, each biface should be looked at based on the form of each rather than differences in ratios as a whole. Reviewing the bifaces to Klink and Aldenderfer's form attributes, only a few of the Cola de Zorro bifaces can be placed in their sequence (Table 4.20). However, one must bear in mind that only 7 of the 17 Cola de Zorro bifaces are 100% complete in form, making it a challenge to place the remaining 10 accurately into Klink and Aldenderfer's typology.

Table 4.19: Bifaces present at Cola de Zorro.

Location	Form	Period	K&A Type	%	Length	Width	Thickness	Haft Length	Length/ Width	Rock type
LS01-A	unst unsh fol	mArc	3B	55	43.25	30.71	9.54		1.41	And
LS01-A	unst unsh fol	eArc – Efor	3D	100	46.28	20.03	8.68	19.51	2.31	Ch
LS01-A	Stem	lArc	4D	60	37.37	17.55	11.78		2.13	Ch
LS01-A	Stem	mHor	4E	35	10.58	16.36	3.3		0.65	Ch
LS01-A	Unstem	tArc – lHor	5D	90	26.44	10.76	3.48	10.23	2.46	Ch
LS01-A	Unstem	tArc – lHor	5D	75	19.71	9.76	5.09		2.02	Ch
LS01-A	Spnshld	eArc	1B	40	16.1	19.78	6.14		0.81	Ch
LS01-B	Spnshld / stem	eArc	4A	60	26.24	17.09	4.67	20.83	1.54	Ch
LS01-C	Stem	eArc – Efor	3D	100	30.4	11.37	6.82	14.1	2.67	Ch
LS02-D	unst unsh fol	mArc	3B	100	34.85	15.39	4.42	11.12	2.26	Ch
LS02-D	unst unsh fol	mArc	3B	100	21.38	8	4.04	8.17	2.67	Ch
LS02-E	unst unsh fol	eArc – Efor	3D	100	25.34	13.88	7.03	7.73	1.83	Ch
LS03-A	unst unsh fol	eArc – Efor	3D	65	30.41	17.02	5.95		1.79	Ch
LS03-A	Stem	eArc	4A	60	24.8	23.29	7.04		1.06	Ch
LS03-A	Unstem	tArc – lHor	5D	100	25.55	19.52	5.18	8.06	1.31	Ob
LS03-B	Unstem	tArc – lHor	5D	100	26.61	17.65	4.88	5.07	1.51	Ch
LS03-B	Stem	mHor	4E	90	25.62	14.89	6.25	10.31	1.72	Ch

Table 4.20: Klink and Aldenderfer's point form attributes.

Klink & Aldenderfer Statistics

Form	Length	Width	Length/Width
1B	27-53	16-25	1.50-1.94
3B	38-61	18-22	1.90-2.77
3D	39-53	14-22	2.61-2.79
4A	28-35	18-23	1.27-1.94
4D	35-37	14-19	1.83-2.21
4E	14-35	8-13	1.75-2.69
5D	15-27	9-16	1.06-1.91

4.2.3.2. Tambo-Ilo. Material collected during the 2006 survey of the Tambo-Ilo coast varied both geologically and stylistically compared to that of Cola de Zorro. Predominantly bifaces were collected during survey, including a number of ground stone tools and fishing weights. In contrast to Cola de Zorro where all bifaces collected were made of chert (with the exception of one obsidian point), the Tambo-Ilo survey contained points made of chert, andesite, quartz, and fine-grained basalt. Stylistically, most points fell into two categories: they were either a stemmed form (series 4 form by Klink and Aldenderfer 2005) or an unstemmed form with a concave base (series 5 form).

A comparison of stemmed forms collected during the Tambo-Ilo survey (Figure 4.11) with stemmed forms in Klink and Aldenderfer's study (Table 4.20) indicated that all those from Tambo-Ilo are beyond their size constraints of 28-35mm in length: point A = 46mm, B = 36mm, C = 48mm, D = 38mm(est.), E = 37.5mm(est.), and F = 47.5mm in length. Age for this stemmed form is considered to be Preceramic (9000 – 7000 BCE). Point D fits most form parameters given by Klink and Aldenderfer with the exception that it is just outside their 14-19mm width range at 21mm in width and length as previously stated. Point E stylistically resembles a form found at Omo-M12 (Goldstein, 1993a). Sizes are similar, with the Omo point being 35mm long and 13mm wide, whereas point E from Tambo-Ilo site 181 is 38mm long (estimate) and 15mm wide. Age range of the Omo point is A.D. 500 – 650. Point E also shows some similarity to Paijan points from the Peruvian north coast (Chauchat 2006). Point F's length to width ratios fall within range for stemmed points, however the dimensions far exceed those given by Klink and Aldenderfer. Dimensions for point F from Tambo-Ilo site 121 are 48mm long and 35mm wide, whereas the El Panteon points (Late Formative, 2000 – 1300 BCE) described by Klink and Aldenderfer are 26 – 27mm long and 18 – 24mm wide (Aldenderfer 1998).

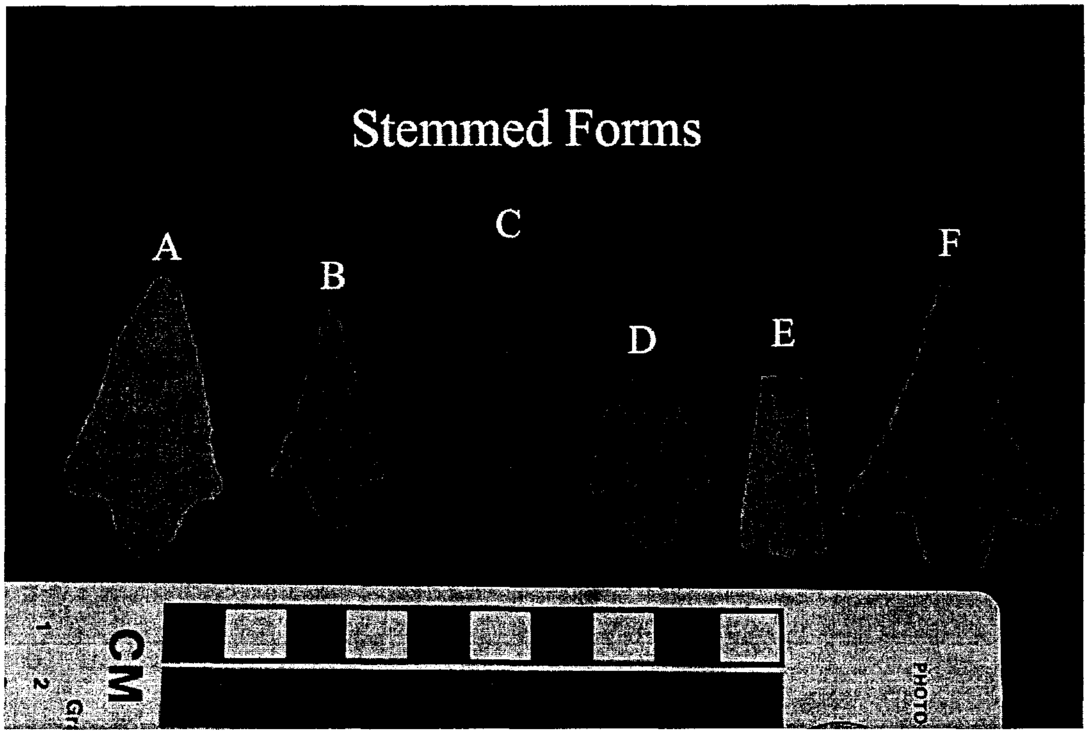

Figure 4.11: Stemmed forms collected during Tambo-Ilo 2006 survey.

Table 4.21: Table of attributes from stemmed forms in Figure 4.11.

	Site (Ti-)	Sector	%	Length	Width	Thickness	Haft Length	Weight	Rock Type
A:	195	4	100	46.08	26.20	9.28	10.28	8.00	Ch
B:	113	N/A	100	35.92	18.78	4.73	7.09	2.40	Ch
C:	139	N/A	100	47.91	21.24	5.73	10.68	5.20	Ba
D:	147	N/A	75	28.45	20.69	5.65	9.18	2.80	Ch
E:	214B	1	80	30.08	14.56	3.55		1.80	Ch
F:	121	1	100	47.51	34.72	8.44	10.07	7.30	Ch

Unstemmed bifaces found during the Tambo-Ilo survey show similarities to Klink and Aldenderfer's series 5 forms, namely 5C and 5D, which are large/small triangular forms with concave bases (Figure 4.12). Most fall into the range of 16 – 35mm long and 9 – 29mm wide, with the exception of point G, which is 46mm long (Table 4.22). Both styles show up during the Early Ceramic period (1800 B.C.), with the large triangular forms phasing out during the Middle Horizon (A.D. 400) and the smaller forms during the Late Horizon (A.D. 1532).

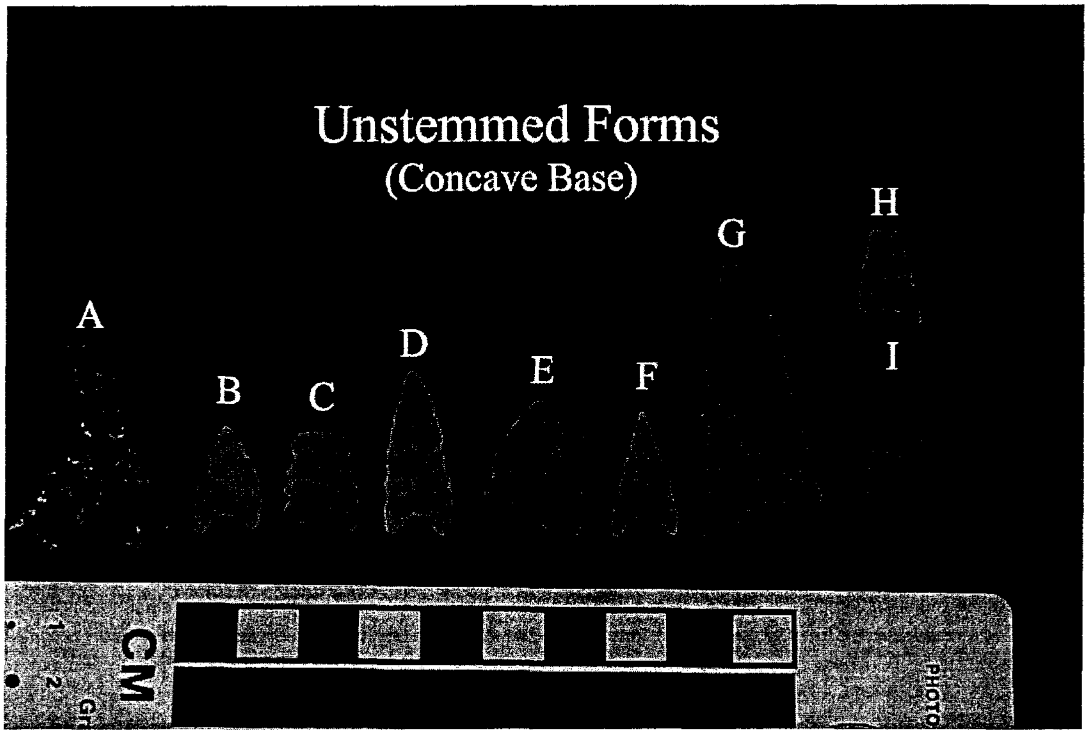

Figure 4.12: Unstemmed concave base points found during the 2006 Tambo-Ilo survey.

Table 4.22: Table of attributes from unstemmed forms in Figure 4.12.

	Site (Ti-)	Sector	%	Length	Width	Thickness	Haft Length	Weight	Rock Type
A:	134	N/A	100	34.03	27.81	5.70	8.89	2.90	Ob
B:	185	1	100	17.53	11.38	3.56	4.14	0.80	Ch
C:	64	N/A	65	16.09	12.40	3.77		0.80	Ch
D:	122	N/A	100	26.65	11.73	2.71	6.18	0.90	Ch
E:	217	N/A	80	21.82	17.38	6.75		2.00	And
F:	204	1	100	20.30	10.76	3.90	2.93	0.60	Ch
G:	103	N/A	95	45.98	20.69	5.76	13.39	4.50	Ch
H:	160	N/A	85	16.00	10.12	3.99	6.02	0.50	Ch
I:	122	N/A	100	26.65	11.73	2.71	6.18	0.90	Ch

CHAPTER 5

DISCUSSION AND CONCLUSION

5.1. Geologic Material Variability and Resource Utilization

Geologic materials surveyed during pampa, quebrada, and Dispensilla surveys are considerably different in distribution than cultural material collected. As can be seen in Figure 4.2 compared to Figure 4.8, granite (both green and pink) dominated the raw material surveys, whereas chert was the dominant rock type among cultural material utilized (at least among surface scatters). Lithic material collected in the Tambo-Ilo survey was also predominantly chert, but had high percentages of andesite and basalt due to a larger groundstone assemblage. Lithic resource potential between Cola de Zorro and the wider Tambo-Ilo coast is similar in some respects due to their similar coastal environments and geologic formations. Differences were due to both the size of the survey areas and the intensity of surface survey completed at each. A more intensive surface survey over a smaller area was completed at Cola de Zorro, compared to the larger Tambo-Ilo surface survey where only larger, more noticeable lithic tools were collected.

5.1.1. Cola de Zorro

Through geologic surveys of the quebrada and pampa, variations in lithic resources were identified in addition to those that had the greatest potential for tool manufacture and other cultural uses. Materials of interest include granite from the surrounding bedrock outcrops, and a coastal hydro-thermally altered quartz. The dominant geologic material utilized at Cola de Zorro was chert (78.5%), followed by andesite (9%), and quartz (5.6%).

While there is considerable variability in the local geology surrounding Cola de Zorro, the geologic surveys conducted in the quebrada channel and pampa indicate that granite was the dominant material type (95% and 75%, respectively). While formal survey of construction material was limited to the colonial structure, informal observations of other structures (i.e., prehispanic structures and agricultural terraces) suggest local granites were utilized for their construction as well. Granite in the tool assemblage was restricted to ground stone artifacts, as seen in the debitage. It should be noted that tool use is not limited to projectile points, but includes unifaces, other bifaces, modified flakes, debitage, and ground stone. Material identified during the quebrada and pampa surveys shows that local material was not used in tool manufacture with the exception of ground stone tools. Some debitage found during the surface surveys of Cola de Zorro was granite. Flakes tend to be rough on one side and smooth on the other, suggesting they were broken from a ground stone tool. The area surrounding Cola de Zorro contains sporadic outcrops of granite bedrock, which fill most of the raw material assemblage. Granite from the outcrops erodes into blocks onto the alluvial pampa, which then become ideal material for use in structures. Due to the coarse grains in granite, it is not a suitable material for precision flaking.

Chert, andesite, and quartz appear to have been utilized on-site. None were identified in the geologic surveys of the area, suggesting they are non-local resources being acquired from elsewhere beyond the Tambo-Ilo coast. Chert has the potential to be from Quebrada Honda as previously mentioned, though chemical testing would need to be completed for this to be confirmed. Chert was the dominant rock type at Cola de Zorro in bifaces, unifaces, lithic modified tools, debitage, and lithic cores. Andesite is not found in the local environment but was second in bifaces, unifaces, and debitage counts, suggesting the possibility that a source is nearby, at least as close as the Quebrada Honda source, or that access to andesite was at least fairly common. Quartz, the third most abundant rock type, is as common as andesite with 3 lithic modified tools, and 1 lithic core (no andesite cores were present). The quartz core was the smallest at 9.9g and 35mm in length, and it may have been utilized to its maximum extent before being discarded. No quartz sources were located during survey, except for the occasional small quartz veins found in bedrock. Potentially, quartz could have been acquired from larger quartz veins that eroded out of the bedrock; however, the few veins identified in this study were relatively small and isolated and likely not suitable for significant exploitation.

5.1.1.1. Cola de Zorro Coast. Granite was the dominant geologic material along the coast. Coastal bedrock outcrops of granite erode toward the coast as debris flows on the pampa surface and in the quebrada drainages. Due to these coastal drainages, a variety of geologic materials are deposited on the beaches. The cobble beach near Cola de Zorro contained a geologic assortment of material, some of which had the potential for use in the manufacture of tools. During the formation of the geologic material on the coast (Cretaceous / Tertiary period), veins of water interlaced with sections of bedrock to create hydro-thermally altered quartz. This quartz can be commonly found along the coast in different shapes and sizes, with its cryptocrystalline grain structure very suitable for stone tool manufacture (Figure 5.1). However, no hydro-thermally altered quartz was identified in cultural materials at Cola de Zorro or in the Tambo-Ilo survey. This suggests that access to a better quality chert at Quebrada Honda was perhaps consistent enough to neglect the more localized source of hydro-thermally altered quartz.

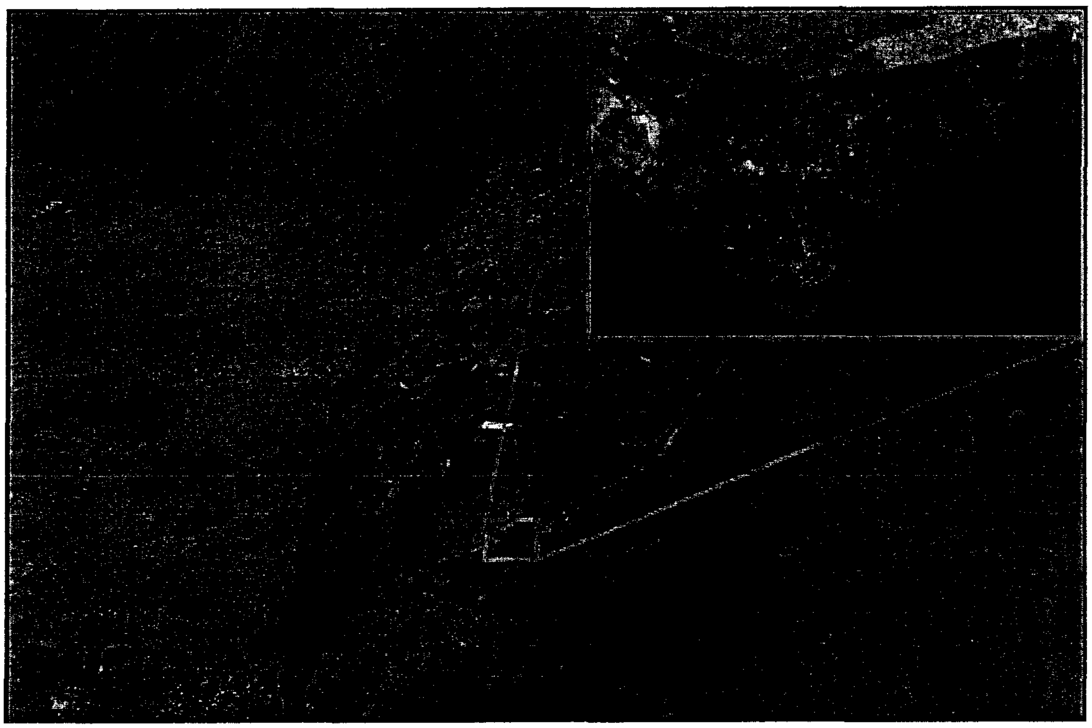

Figure 5.1: Hydro-thermally altered quartz on the coast

5.1.2. Tambo-Ilo Survey Area

The geologic formations of the Tambo-Ilo survey are similar to that surrounding Cola de Zorro.. Lithic resources potentially utilized in tool manufacture within the Tambo-Ilo survey are andesite, granite, basalt, porphyritic basalt, and sporadic outcrops of hydro-thermally altered quartz (as seen on the coast of Cola de Zorro). Dominant cultural lithic material included: chert (60.4%), andesite (18.8%), basalt (10.4%), quartz (3.6%), and porphyritic basalt (3.1%). Granite and basalt are both found locally: granite is common on the pampa, wile basalt cobbles are found in quebrada drainages. Both rock types, in addition to porphyritic basalt, were used to manufacture groundstone tools (represented predominantly by fishing weights in survey collections). Andesite, although very workable and present in the cultural assemblages, was not identified in the geologic surveys of the coastal environment. However, large tan andesite cores were collected in the survey, suggesting there may be a local source somewhere. Andesite had the largest amount of cores present, with a 2:1 ratio over chert (andesite 4, chert 2). In addition, andesite was represented in 11, or 13.10%, of all bifaces in the survey. The regular occurrence of andesite bifaces and cores may suggest a source along the coast, but informal survey in this study failed to identify one. Finally, chert and quartz appear to be non-local (i.e., not from the immediate Tambo-Ilo coast) geologic material utilized along the coast. Some of the chert artifacts found during the Tambo-Ilo survey look very similar to that of Quebrada Honda; however, others are similar to fine-grained quartz and may be mistakenly identified unless looked at under higher magnification.

Most coastal sites contain some form of chert in their lithic assemblage. Sites such as Quebrada Tacahuay and Kilometer 4 both exhibit a predominant use of chert / chalcedony in their assemblage (deFrance 2001; Keefer et al. 1998; Sievert and Wise 2001). However, previous investigations of these coastal sites do not mention the large chert source found at Quebrada Honda, but rather they note that all geologic material, with the exception of obsidian, can be found locally (Sievert and Wise 2001, pg. 99)[1]. In the informal geologic survey conducted in this study to the south of Cola de Zorro, no localized sources of chert were found. Rather, as previously noted, small outcrops and

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[1] Alternatively, this discrepancy may hinge on different conceptualizations of what constitutes "local." Here, "local" is considered to be along the immediate Tambo-Ilo coast; the concept of "local" may or may not be more restricted in these previous studies. In any case, Quebrada Honda is mentioned neither by name nor by location when previous studies suggest that coastal chert stems from a "local" source.

cobbles of fine-grained hydro-thermally altered quartz were identified. It is possible that certain white chert artifacts collected from Cola de Zorro and Tambo-Ilo are in fact made of hydro-thermally altered quartz from these localized outcrops. At other sites like Kilometer 4 and Quebrada Tacahuay, the identification of chalcedony remains uncertain. It also remains unclear if the outcrops near those sites are in actuality a similar fine-grained quartz. If this is the case, then coastal occupants had a localized lithic source for more of their tool manufacture than previously thought. Reviewing the local geologic formations of the area would suggest that the creation of chert could be possible farther inland from the coast. Furthermore, coastal geology suggests that other outcroppings of fine-grained quartz may be present along the coast, in addition to the potential for chert, if the local lithology and past geologic activity is similar to that of coastal Cola de Zorro.

5.1.3. Quebrada Honda

Among archaeological sites along the Tambo-Ilo coast, including Cola de Zorro, chert dominates the lithic assemblage of cultural lithic material, yet no local sources are available for resource extraction. The closest known location is Quebrada Honda, located 30km inland along the principal Osmore drainage. A number of pieces from Cola de Zorro have similar characteristics, signifying the potential extraction from this quebrada. Both have similar grain sizes (very fine to cryptocrystalline) and colors, though Quebrada Honda contains a larger range of color. The Cola de Zorro assemblage showed a preference toward grayish white to slightly transparent colors, and does not (at least with respect to surface remains) exhibit all colors present at Quebrada Honda. However, in order to provide more conclusive evidence that Quebrada Honda chert is present at Cola de Zorro and along the coast, chemical testing needs to be completed in order to link the two; visual similarities alone in chert types may not indicate a single geologic source.

5.1.4. Limitations

The problem with the analyzed material from Cola de Zorro and the Tambo-Ilo archaeological survey is that they both only include surface deposits. In order to create a larger and more accurate database of resource variability and utilization, further survey would be needed. Intensive geologic investigation along the coast between Las Almas point and Platanal beach would be needed to complete the survey of the coastal region from Cola de Zorro to Wawakiki and identify more accurately the range of lithic raw material available in the region. Furthermore, collection of cultural material during the 2006 archaeological survey was shaped by visibility of surface deposits and may not be representative of the range of lithic material present. Additionally, chronological assignment of surface deposits is difficult at best, limiting the degree to which diachronic studies of lithic resource procurement can be carried out. In the hyper-arid desert of south coastal Peru there can be very little deposition with significant surface deflation. Cultural stratigraphic layers can merge together, conflating thousands of years of cultural material into a single surface deposit. This may pose problems for conducting a study of diachronic change within the Cola de Zorro site. Surface scatters may in fact be chronologically isolated, but there is no way to gauge this without excavation and independent dating. To strengthen this research design, excavations at multiple sites would be needed to increase sample size from good spatial and temporal contexts to better explain why some materials were emphasized (i.e., chert) over others (i.e., hydrobetter explain why some materials were emphasized (i.e., chert) over others (i.e., hydrothermally altered quartz), and whether or not particular materials were variably emphasized through time.

5.2. Debitage and Distance

Regional selection of chert would suggest that inhabitants of Cola de Zorro were traveling to Quebrada Honda (or some other unknown chert location) for extraction of resources. Distances would suggest that inhabitants would reduce material at the source of the deposit for easier transportation. However, a number of cores and debitage representing local geologic material as well as non-local chert were present at Cola de Zorro. A comparison of chert bifaces to that of bifaces made from others materials demonstrates that chert dominates the assemblage. A comparison of chert debitage to other types of material also demonstrates that the ratio of chert debitage to projectile points is much smaller than that of other materials, suggesting material was not significantly reduced on-site, but retouched.

Andesite represents 20% of all debitage over 3cm at Cola de Zorro and 48% of all debitage over 3cm in the Tambo-Ilo survey. This may suggest that an andesite source might exist somewhere along the Tambo-Ilo coast, since larger pieces of andesite debitage may indicate a local source. However, sample size in this study is quite small and from surface deposits only; a much larger sample size from good excavated contexts is required to test this hypothesis. Andesite is a very viable resource, and sites closer to the source should exhibit greater amounts of artifacts and debitage manufactured from it.

Additionally, a more intensive geologic survey towards the south may also identify a localized source of andesite.

Very few pieces of obsidian were found along the coast. Only two were found at Cola de Zorro and 3 during the Tambo-Ilo survey. Obsidian sources are not situated along the coast, signifying long distance transportation from locations in the highlands. Since only a few bifaces of obsidian were present, inhabitants were likely not directly exploiting obsidian sources but rather acquiring the material through trade. Conversely, given the frequency of chert at Cola de Zorro and outcrops within the general lower Osmore region (e.g., Quebrada Honda), it was more actively sought in tool manufacture.

5.3. Projectile Typology

The lithic artifact assemblage at Cola de Zorro and the Tambo-Ilo region contain a variety of point types, with greater variability represented at Cola de Zorro than along the Tambo-Ilo coast, but this may be due to intensive survey at Cola de Zorro. Few biface forms can be perfectly situated within the size criteria of Klink and Aldenderfer's typological classifications. Common forms along the coast include the stemmed points with barbed shoulders (form 4E) that date to the Middle Horizon (A.D. 400 – 1100) and the unstemmed triangular points (forms 5C/D), which have a much larger range lasting from Terminal Archaic through Late Horizon (3300 BC – A.D. 1532). However, these dates are based on a small projectile point assemblage. Klink and Aldenderfer suggest these unstemmed points extend to A.D. 1532, yet the points are only securely dated to about 400 BC (Quelcatani points, Klink and Aldenderfer 2005, 52).

5.3.1. Limitations

Clearly, additional archaeological data needs to be generated from good contexts to sort out the chronology of highland and coastal projectile points. Few artifacts fit neatly within Klink and Aldenderfer's (2005) study, and the applicability of their typology to coastal material is inconclusive. In most instances, biface dimensions were not within range. As mentioned before, surface points identified here may stem from a wide array of temporal affiliations, especially since rates of deposition and deflation may conflate thousands of years of the archaeological record into a single stratum. However, without excavation, good contexts, and independent dating, this current study cannot confirm this typology.

5.4. Conclusion

Specifically, the goal of this thesis is to create and refine a standard methodology for geologic survey and analysis of raw material availability. Lithic materials constitute the majority of artifact investigations throughout much of the preceramic period of Peru, but they generally receive little attention after the introduction of ceramic technology, and especially during later periods of interest. This study helps to shed light on a relatively under-explored perspective within human-environment interaction through geologic exploitation. Understanding lithic resource procurement strategies used by coastal inhabitants allows us to discern their knowledge of the local environment and distances they would travel to acquire resources.

The local geology of Cola de Zorro and Tambo-Ilo provided a resource base for the construction of local structures, terraces, and the manufacture of ground stone tools, whereas foreign materials (chert, quartz, and andesite) were used in the manufacture of bifaces, unifaces, and lithic modified tools. Quebrada Honda contains a viable chert source that could have been used along the coast, and it shares similarities with chert artifacts identified at Cola de Zorro and along the coast. On the other hand, hydro-thermally altered quartz, quite suitable for tool manufacture and found locally along the Tambo-Ilo coast, does not appear to have been utilized. Unfortunately, all data generated in this study stem from surface materials only. Consequently, this study would be significantly strengthened and able to provide more sound conclusions with the addition of a much larger sample size excavated from good spatial and temporal contexts. Nevertheless, the methodological strategy developed here to compare raw and cultural lithic resource variability should be robust enough to investigate resource procurement at multiple scales.

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APPENDICES

Appendix A

QUEBRADA SURVEY RESULTS TABLE

Table A.1: Quebrada Survey Results

Survey Spreadsheet						Dimensions			
Location	Date	Rock Name	Flats	Roundness	Long	Short	Intermediate	Break	Comments
GS01	7/6/2007	Green Granite	5	1	26	11	19	0	
GS01	7/6/2007	Green Granite	5	1	27	11	18	0	
GS01	7/6/2007	Green Granite	2	0	49	16	16	0	
GS01	7/6/2007	Green Granite	6	1	24	12	13	0	not cube, angled
GS01	7/6/2007	Green Granite	5	1	9	5	7	0	Sample 01
GS01	7/6/2007	Pink Granite	3	0	9	4	7	0	clean break, Sample 02
GS01	7/6/2007	Porphyritic Basalt	1	0	22	14	17	0	Sample 03
GS01	7/6/2007	Green Granite	0	4	67	40	40	0	
GS01	7/6/2007	Pink Granite	3	1	39	10	24	0	
GS01	7/6/2007	Green Granite	4	3	30	15	16	1	
GS01	7/6/2007	Green Granite	1	3	21	9	15	1	
GS01	7/6/2007	Green Granite	2	4	28	5	20	1	
GS01	7/6/2007	Green Granite	4	0	17	8	12	1	
GS01	7/6/2007	Green Granite	4	0	30	17	23	1	
GS01	7/6/2007	Green Granite	2	3	33	15	20	1	
GS01	7/6/2007	Pink Granite	2	2	18	5	10	1	
GS01	7/6/2007	Green Granite	4	0	25	10	12	1	
GS01	7/6/2007	Green Granite	2	0	18	9	10	0	
GS01	7/6/2007	Green Granite	2	0	14	4	9	0	
GS01	7/6/2007	Green Granite	5	1	57	12	32	1	
GS01	7/6/2007	Green Granite	4	2	30	20	21	1	
GS01	7/6/2007	Pink Granite	2	3	18	8	13	1	
GS01	7/6/2007	Pink Granite	3	2	24	11	15	1	
GS01	7/6/2007	Porphyritic Basalt	3	1	23	5	19	2	
GS01	7/6/2007	Green Granite	2	1	32	11	26	1	
GS01	7/6/2007	Pink Granite	1	2	8	4	7	1	
GS01	7/6/2007	Pink Granite	4	3	19	14	14	1	
GS01	7/6/2007	Pink Granite	1	1	38	13	29	1	

Table A.1: Quebrada Survey Results (continued)

GS01	7/6/2007	Pink Granite	2	1	29	13	21	1	
GS01	7/6/2007	Green Granite	0	2	20	7	17	1	
GS01	7/6/2007	Pink Granite	3	1	38	18	22	1	
GS01	7/6/2007	Pink Granite	2	2	10	3	4	1	
GS01	7/6/2007	Green Granite	5	1	55	15	29	1	
GS01	7/6/2007	Green Granite	4	1	9	5	6	1	
GS01	7/6/2007	Green Granite	1	1	11	4	9	1	
GS01	7/6/2007	Green Granite	5	1	33	12	28	1	
GS01	7/6/2007	Pink Granite	2	2	17	8	10	1	
GS01	7/6/2007	Pink Granite	3	2	11	6	6	1	
GS01	7/6/2007	Pink Granite	3	2	66	41	49	1	
GS01	7/6/2007	Green Granite	2	1	11	7	9	1	
GS01	7/6/2007	Pink Granite	1	3	22	15	18	1	
GS01	7/6/2007	Green Granite	6	1	33	15	33	1	Rhomboid
GS01	7/6/2007	Porphyritic Basalt	1	1	17	7	11	2	
GS01	7/6/2007	Pink Granite	4	1	24	8	14	1	
GS01	7/6/2007	Green Granite	3	1	14	4	5	1	
GS01	7/6/2007	Pink Granite	1	2	10	6	6	1	
GS01	7/6/2007	Pink Granite	3	1	16	5	11	1	
GS01	7/6/2007	Pink Granite	1	1	12	5	9	1	
GS01	7/6/2007	Green Granite	2	1	10	4	10	1	
GS01	7/6/2007	Green Granite	2	3	40	30	un	1	
GS01	7/6/2007	Green Granite	1	1	6	2	4	1	
GS01	7/6/2007	Green Granite	2	3	28	16	27	1	
GS01	7/6/2007	Green Granite	2	4	38	26	34	1	
GS01	7/6/2007	Green Granite	3	2	30	19	20	1	
GS01	7/6/2007	Green Granite	3	1	33	11	17	1	
GS01	7/6/2007	Green Granite	2	1	45	10	28	1	
GS01	7/6/2007	Green Granite	2	0	54	20	20	1	
GS01	7/6/2007	Pink Granite	2	1	14	4	10	1	

Table A.1: Quebrada Survey Results (continued)

GS01	7/6/2007	Green Granite	5	1	24	13	15	1	
GS01	7/6/2007	Green Granite	2	1	10	8	9	1	
GS01	7/6/2007	Green Granite	4	1	24	9	16	1	
GS01	7/6/2007	Pink Granite	1	2	11	6	8	1	
GS01	7/6/2007	Pink Granite	3	2	12	5	9	1	
GS01	7/6/2007	Green Granite	5	1	9	4	6	1	
GS01	7/9/2007	Green Granite	3	2	26	11	12	1	
GS01	7/9/2007	Green Granite	4	3	26	18	20	1	
GS01	7/9/2007	Pink Granite	2	3	43	20	33	1	
GS01	7/9/2007	Green Granite	1	3	36	28	34	1	
GS01	7/9/2007	Light Pink Granite	3	1	32	25	27	1	Rock sample #4
GS01	7/9/2007	Green Granite	1	3	6	4	4	1	
GS01	7/9/2007	Green Granite	3	1	14	4	5	1	
GS01	7/9/2007	Pink Granite	3	3	33	22	27	1	
GS01	7/9/2007	Green Granite	0	3	74	46	53	1	
GS01	7/9/2007	Green Granite	1	3	50	26	36	1	
GS01	7/9/2007	Green Granite	3	1	44	21	21	1	
GS01	7/9/2007	Green Granite	4	2	41	20	20	1	
GS01	7/9/2007	Green Granite	3	1	17	10	14	1	
GS01	7/9/2007	Green Granite	4	1	34	13	21	1	
GS01	7/9/2007	Green Granite	3	2	23	16	17	1	
GS01	7/9/2007	Green Granite	3	2	36	24	31	1	
GS01	7/9/2007	Pink Granite	3	1	7	5	5	1	
GS01	7/9/2007	Pink Granite	3	1	13	4	8	1	
GS01	7/9/2007	Green Granite	4	1	23	10	19	1	
GS01	7/9/2007	Green Granite	2	1	9	3	5	1	
GS01	7/9/2007	Green Granite	1	3	51	27	36	1	
GS01	7/9/2007	Green Granite	5	1	37	12	29	1	
GS01	7/9/2007	Green Granite	3	1	31	10	28	1	
GS01	7/9/2007	Green Granite	2	3	270	150	220	1	Large sample

Table A.1: Quebrada Survey Results (continued)

GS01	7/9/2007	Green Granite	2	3	270	150	220	1	(recorded twice)
GS01	7/9/2007	Green Granite	3	1	180	80	120	1	Large sample (recorded
GS01	7/9/2007	Green Granite	3	1	180	80	120	1	twice)
GS01	7/9/2007	Green Granite	4	1	8	4	7	1	
GS01	7/9/2007	Oxidized Granite	2	3	8	5	6	1	
GS01	7/9/2007	Green Granite	4	1	16	7	8	1	
GS01	7/9/2007	Green Granite	3	0	10	2	8	1	
GS01	7/9/2007	Green Granite	3	1	17	9	12	1	
GS01	7/9/2007	Green Granite	2	2	14	5	13	1	
GS01	7/9/2007	Green Granite	4	1	42	13	25	1	
GS01	7/9/2007	Pink Granite	2	1	11	4	11	1	
GS01	7/9/2007	Green Granite	5	1	12	6	7	1	
GS01	7/9/2007	Green Granite	4	2	25	8	16	1	
GS01	7/9/2007	Green Granite	3	2	143	84	117	1	
GS01	7/9/2007	Green Granite	3	2	10	3	6	1	
GS01	7/9/2007	Green Granite	3	2	44	23	23	1	
GS01	7/9/2007	Green Granite	2	2	25	16	21	1	
GS01	7/9/2007	Green Granite	4	1	43	9	16	1	
GS01	7/9/2007	Green Granite	2	3	31	15	27	1	
GS01	7/9/2007	Green Granite	1	2	59	35	22	1	
GS01	7/9/2007	Green Granite	2	2	43	27	33	1	
GS01	7/9/2007	Green Granite	2	2	159	46	54	1	
GS01	7/9/2007	Green Granite	3	1	9	4	6	1	
GS01	7/9/2007	Green Granite	3	2	21	6	10	1	
GS01	7/9/2007	Green Granite	4	1	31	14	15	1	
GS01	7/9/2007	Green Granite	4	2	18	11	15	1	
GS01	7/9/2007	Green Granite	4	2	16	5	6	1	
GS01	7/9/2007	Pink Granite	4	2	24	9	17	1	
GS01	7/9/2007	Green Granite	2	1	23	9	17	1	
GS01	7/9/2007	Green Granite	2	4	72	37	49	1	

Table A.1: Quebrada Survey Results (continued)

GS01	7/9/2007	Green Dacite	3	1	8	3	5	1	Rock Sample #5
GS01	7/9/2007	Pink Granite	4	1	14	4	7	1	
GS01	7/9/2007	Pink Granite	3	1	22	8	22	1	
GS01	7/9/2007	Green Granite	1	2	31	10	20	1	
GS01	7/9/2007	Green Granite	0	3	10	6	8	1	
GS01	7/9/2007	Green Granite	3	2	27	10	12	1	
GS01	7/9/2007	Pink Granite	1	1	10	3	6	1	
GS01	7/9/2007	Green Granite	3	2	23	10	14	1	
GS01	7/9/2007	Green Granite	1	2	13	7	10	1	
GS01	7/9/2007	Pink Granite	1	2	23	11	14	1	
GS01	7/9/2007	Green Granite	2	3	63	18	42	1	
GS01	7/9/2007	Porphyritic Basalt	4	0	19	7	14	3	
GS01	7/9/2007	Light Pink Granite	5	2	10	3	8	1	
GS01	7/9/2007	Green Granite	2	3	164	53	140	1	
GS01	7/9/2007	Green Granite	4	2	68	29	30	1	
GS01	7/9/2007	Pink Granite	2	3	18	11	14	1	
GS01	7/9/2007	Pink Granite	1	2	6	2	3	1	
GS01	7/9/2007	Green Granite	5	1	17	5	8	1	
GS01	7/9/2007	Pink Granite	4	2	10	4	6	1	
GS01	7/9/2007	Green Granite	3	1	12	5	8	1	
GS01	7/9/2007	Green Granite	3	1	14	4	12	1	
GS01	7/9/2007	Green Granite	2	1	7	3	3	1	
GS01	7/9/2007	Pink Granite	4	2	7	3	4	1	
GS01	7/9/2007	Green Dacite	3	1	21	9	14	1	
GS01	7/9/2007	Green Granite	3	2	154	34	126	1	
GS01	7/9/2007	Green Granite	5	1	27	13	17	1	
GS01	7/9/2007	Green Granite	4	1	15	6	9	1	
GS01	7/9/2007	Porphyritic Basalt	1	1	28	14	15	3	
GS01	7/9/2007	Pink Granite	3	2	32	11	13	1	
GS01	7/9/2007	Green Granite	2	1	64	19	39	1	

Table A.1: Quebrada Survey Results (continued)

GS01	7/9/2007	Green Granite	1	3	63	21	47	1	
GS01	7/9/2007	Green Granite	2	2	49	20	28	1	
GS01	7/9/2007	Green Granite	4	2	139	41	104	1	
GS01	7/9/2007	Green Granite	0	1	9	4	6	1	
GS01	7/9/2007	Green Granite	2	1	15	9	12	1	
GS01	7/9/2007	Green Granite	4	2	54	27	34	1	
GS01	7/9/2007	Green Dacite	2	1	9	5	6	3	
GS01	7/9/2007	Green Granite	3	2	37	11	26	1	
GS01	7/9/2007	Green Granite	2	2	11	4	10	1	
GS01	7/9/2007	Green Granite	5	1	21	6	14	1	
GS01	7/9/2007	Pink Granite	6	1	35	16	18	1	
GS01	7/9/2007	Green Granite	3	1	14	4	8	1	
GS01	7/9/2007	Light Pink Granite	1	1	12	4	8	1	
GS01	7/9/2007	Green Granite	3	3	64	32	44	1	
GS01	7/9/2007	Green Granite	4	1	61	22	48	1	
GS01	7/9/2007	Green Granite	5	1	96	31	54	1	
GS01	7/9/2007	Green Granite	4	0	70	23	37	1	
GS01	7/9/2007	Green Granite	5	1	30	8	13	1	
GS01	7/9/2007	Green Granite	2	2	11	5	9	1	
GS01	7/9/2007	Green Granite	4	2	37	9	34	1	
GS01	7/9/2007	Green Granite	4	2	83	46	55	1	
GS01	7/9/2007	Green Granite	2	2	60	46	48	1	
GS01	7/9/2007	Green Granite	5	1	62	30	40	1	
GS01	7/9/2007	Green Granite	3	1	12	3	7	1	
GS01	7/9/2007	Green Granite	0	3	5	3	4	1	
GS01	7/9/2007	Green Granite	2	2	15	6	7	1	
GS01	7/9/2007	Green Granite	5	2	60	35	40	1	
GS01	7/9/2007	Pink Granite	4	2	22	8	11	1	
GS01	7/9/2007	Green Granite	5	2	50	40	40	1	
GS01	7/9/2007	Green Dacite	2	0	17	5	10	3	

Table A.1: Quebrada Survey Results (continued)

GS01	7/9/2007	Pink Granite	3	2	26	13	22	1	
GS01	7/9/2007	Green Granite	3	2	12	8	10	1	
GS01	7/9/2007	Pink Granite	4	1	14	8	10	1	
GS01	7/9/2007	Green Granite	3	2	12	6	10	1	
GS01	7/9/2007	Pink Granite	4	2	33	17	24	1	
GS01	7/9/2007	Green Granite	4	1	61	32	41	1	
GS01	7/9/2007	Green Granite	2	2	63	31	54	1	
GS01	7/9/2007	Green Granite	4	3	391	244	274	1	Large sample (recorded
GS01	7/9/2007	Green Granite	4	3	391	244	274	1	twice)
GS01	7/9/2007	Green Granite	3	1	126	57	88	1	
GS01	7/9/2007	Green Granite	3	3	13	8	10	1	
GS01	7/9/2007	Pink Granite	4	1	19	8	13	1	
GS01	7/9/2007	Pink Granite	1	2	6	4	4	1	
GS01	7/9/2007	Green Granite	4	1	55	16	44	1	
GS01	7/9/2007	Green Granite	6	1	45	10	19	1	
GS01	7/9/2007	Pink Granite	3	2	74	21	39	1	
GS01	7/9/2007	Green Granite	4	2	22	12	18	1	
GS01	7/9/2007	Pink Granite	4	1	9	3	7	1	
GS01	7/9/2007	Green Granite	4	1	22	9	16	1	
GS01	7/9/2007	Green Granite	3	1	11	5	8	1	
GS01	7/9/2007	Green Granite	4	2	15	8	9	1	
GS01	7/9/2007	Pink Granite	2	3	13	7	11	1	GPS #06

Appendix B

PAMPA SURVEY RESULTS TABLE

Table B.1: Pampa Survey Results

Survey Spreadsheet						Dimensions			
Location	Date	Rock Name	Flats	Roundness	Long	Short	Intermediate	Break	Comments
GS02	7/9/2007	Green Granite	6	2	17	7	10	1	GPS #07
GS02	7/9/2007	Pink Granite	0	0	14	5	10	1	
GS02	7/9/2007	Green Granite	5	2	37	14	35	1	
GS02	7/9/2007	Green Granite	1	3	12	8	10	1	
GS02	7/9/2007	Pink Granite	3	1	19	10	12	1	
GS02	7/9/2007	Pink Granite	3	1	8	3	7	1	
GS02	7/9/2007	Green Dacite	0	0	6	4	5	3	
GS02	7/9/2007	Green Granite	1	1	8	4	4	1	
GS02	7/9/2007	Green Dacite	1	0	6	3	4	1	
GS02	7/9/2007	Green Granite	2	1	9	5	8	1	
GS02	7/9/2007	Green Granite	1	0	10	3	7	1	
GS02	7/9/2007	Light Pink Granite	1	1	9	2	5	1	
GS02	7/9/2007	Aplite	2	0	8	3	6	3	Rock Sample #07
GS02	7/9/2007	Green Granite	2	2	10	4	9	1	
GS02	7/9/2007	Pink Granite	1	2	16	5	6	1	
GS02	7/9/2007	Green Granite	2	2	6	4	5	1	
GS02	7/9/2007	Green Dacite	1	0	14	6	10	2	
GS02	7/9/2007	Green Granite	1	0	12	4	10	1	
GS02	7/9/2007	Green Granite	1	1	8	4	5	1	
GS02	7/9/2007	Green Granite	4	1	5	2	3	1	
GS02	7/9/2007	Pink Granite	4	1	15	4	8	1	
GS02	7/9/2007	Green Granite	2	1	16	7	12	1	
GS02	7/9/2007	Pink Granite	4	1	19	10	14	1	
GS02	7/9/2007	Green Dacite	4	1	5	3	4	1	
GS02	7/9/2007	Green Dacite	2	1	5	2	3	2	
GS02	7/9/2007	Green Granite	4	2	6	3	5	1	
GS02	7/9/2007	Green Granite	4	1	29	10	18	1	

Table B.1: Pampa Survey Results (continued)

GS02	7/9/2007	Green Granite	3	1	10	8	9	1	
GS02	7/9/2007	Pink Granite	1	2	8	3	5	1	
GS02	7/9/2007	Green Granite	4	1	15	4	8	1	
GS02	7/9/2007	Pink Granite	2	2	5	4	4	1	
GS02	7/9/2007	Green Granite	2	2	14	5	9	1	
GS02	7/9/2007	Green Dacite	1	3	7	3	5	1	
GS02	7/9/2007	Porphyritic Basalt	3	2	10	4	8	2	
GS02	7/9/2007	Green Granite	1	3	6	4	4	1	
GS02	7/9/2007	Pink Granite	4	1	23	9	12	1	
GS02	7/9/2007	Porphyritic Basalt	6	2	7	4	5	3	
GS02	7/9/2007	Aplite	2	1	6	3	5	2	
GS02	7/9/2007	Aplite	3	0	4	2	2	2	
GS02	7/9/2007	Porphyritic Basalt	4	0	14	3	11	1	
GS02	7/9/2007	Green Granite	4	2	10	5	6	1	
GS02	7/9/2007	Green Granite	1	2	3	2	2	1	
GS02	7/9/2007	Porphyritic Basalt	1	1	7	3	5	1	
GS02	7/9/2007	Pink Granite	2	0	9	4	5	1	
GS02	7/9/2007	Porphyritic Basalt	2	1	5	1	3	2	
GS02	7/9/2007	Aplite	4	1	4	1	3	1	
GS02	7/9/2007	Pink Granite	3	1	4	2	3	1	
GS02	7/9/2007	Green Granite	4	1	9	5	6	1	
GS02	7/9/2007	Green Granite	1	2	4	3	3	1	
GS02	7/9/2007	Green Granite	6	2	6	2	3	1	
GS02	7/9/2007	Green Granite	3	1	4	2	2	1	
GS02	7/9/2007	Green Granite	5	1	5	3	3	1	
GS02	7/9/2007	Green Granite	4	1	93	25	43	1	
GS02	7/9/2007	Pink Granite	1	2	4	2	3	1	
GS02	7/9/2007	Green Granite	2	1	43	17	26	1	
GS02	7/9/2007	Aplite	3	1	5	2	3	2	
GS02	7/9/2007	Green Dacite	1	0	4	1	3	1	

Table B.1: Pampa Survey Results (continued)

GS02	7/9/2007	Green Dacite	3	2	7	4	5	2	
GS02	7/9/2007	Green Granite	3	2	6	4	5	1	
GS02	7/9/2007	Green Dacite	3	1	6	4	5	3	
GS02	7/9/2007	Green Granite	3	1	10	3	7	1	
GS02	7/9/2007	Pink Granite	5	1	13	5	9	1	
GS02	7/9/2007	Green Granite	2	2	8	3	5	1	
GS02	7/9/2007	Pink Granite	1	2	4	3	3	1	
GS02	7/9/2007	Green Dacite	2	0	6	3	3	1	
GS02	7/9/2007	Green Granite	3	3	16	7	7	1	
GS02	7/9/2007	Oxidized Granite	1	2	5	3	4	1	
GS02	7/9/2007	Green Granite	3	1	4	2	3	1	
GS02	7/9/2007	Porphyritic Basalt	4	2	9	5	7	0	
GS02	7/9/2007	Pink Granite	3	1	6	4	4	1	
GS02	7/9/2007	Pink Granite	4	2	19	4	11	1	
GS02	7/9/2007	Green Granite	4	3	12	5	8	1	
GS02	7/9/2007	Green Granite	4	2	13	4	9	1	
GS02	7/9/2007	Green Granite	4	3	12	6	8	1	
GS02	7/9/2007	Green Granite	2	2	7	4	6	1	
GS02	7/9/2007	Green Granite	3	1	4	2	3	1	
GS02	7/9/2007	Green Granite	4	0	14	5	8	1	
GS02	7/9/2007	Pink Granite	5	0	12	3	7	2	
GS02	7/9/2007	Green Granite	6	0	7	4	5	1	
GS02	7/9/2007	Oxidized Granite	4	1	4	2	4	1	
GS02	7/9/2007	Green Granite	3	2	12	6	9	1	
GS02	7/9/2007	Green Granite	4	1	7	4	6	1	
GS02	7/9/2007	Porphyritic Basalt	5	2	19	8	16	3	
GS02	7/9/2007	Green Granite	3	1	5	2	3	1	
GS02	7/9/2007	Green Dacite	0	0	5	4	5	3	
GS02	7/9/2007	Green Granite	0	0	7	3	3	1	
GS02	7/9/2007	Green Granite	2	0	18	4	5	1	

Table B.1: Pampa Survey Results (continued)

GS02	7/9/2007	Porphyritic Basalt	1	2	7	4	6	3	
GS02	7/9/2007	Aplite	2	0	8	3	4	2	
GS02	7/9/2007	Green Granite	3	1	56	13	40	1	
GS02	7/9/2007	Green Granite	2	1	8	3	3	1	
GS02	7/9/2007	Green Granite	0	2	4	3	3	1	
GS02	7/9/2007	Green Granite	1	0	6	2	3	1	
GS02	7/9/2007	Green Granite	3	1	42	20	30	1	
GS02	7/9/2007	Green Granite	2	1	7	2	6	1	
GS02	7/9/2007	Green Granite	1	1	6	4	5	1	
GS02	7/9/2007	Green Dacite	1	2	8	5	7	2	
GS02	7/9/2007	Green Granite	2	1	5	2	3	1	
GS02	7/9/2007	Pink Granite	2	1	9	3	6	1	
GS02	7/9/2007	Green Granite	1	0	7	3	4	1	
GS02	7/9/2007	Green Granite	3	2	12	6	9	1	
GS02	7/9/2007	Aplite	4	0	5	2	4	2	
GS02	7/9/2007	Aplite	1	0	4	2	2	2	
GS02	7/9/2007	Green Granite	2	1	9	4	8	1	
GS02	7/9/2007	Aplite	3	0	9	3	6	3	
GS02	7/9/2007	Porphyritic Basalt	4	0	10	5	7	2	
GS02	7/9/2007	Green Dacite	2	1	13	5	6	3	
GS02	7/9/2007	Green Granite	4	2	10	5	8	1	
GS02	7/9/2007	Green Granite	2	1	16	8	11	1	
GS02	7/9/2007	Green Dacite	4	0	5	2	3	2	
GS02	7/9/2007	Pink Granite	3	2	38	28	37	1	
GS02	7/9/2007	Green Granite	5	1	59	20	40	1	
GS02	7/9/2007	Porphyritic Basalt	4	1	14	6	10	3	
GS02	7/9/2007	Green Dacite	1	2	7	3	5	2	
GS02	7/9/2007	Green Granite	2	1	8	3	7	1	
GS02	7/9/2007	Green Granite	4	1	42	21	29	1	
GS02	7/9/2007	Pink Granite	5	1	49	23	31	1	

Table B.1: Pampa Survey Results (continued)

GS02	7/9/2007	Green Granite	3	1	39	22	28	1	
GS02	7/9/2007	Green Granite	4	2	9	3	5	1	
GS02	7/9/2007	Green Granite	2	2	19	5	17	1	
GS02	7/10/2007	Green Granite	3	1	10	2	3	1	
GS02	7/10/2007	Pink Granite	3	2	17	6	9	1	
GS02	7/10/2007	Green Dacite	1	1	10	3	5	1	
GS02	7/10/2007	Green Granite	3	1	25	12	14	1	
GS02	7/10/2007	Pink Granite	5	2	48	39	36	1	
GS02	7/10/2007	Green Granite	1	2	12	8	10	1	
GS02	7/10/2007	Green Granite	2	2	16	6	11	1	
GS02	7/10/2007	Green Granite	3	0	5	2	3	1	
GS02	7/10/2007	Green Granite	1	0	37	10	27	1	
GS02	7/10/2007	Green Granite	3	1	9	3	4	1	
GS02	7/10/2007	Porphyritic Basalt	2	0	5	2	3	1	
GS02	7/10/2007	Green Granite	2	2	6	3	4	1	
GS02	7/10/2007	Green Granite	1	1	5	2	3	1	
GS02	7/10/2007	Green Granite	0	3	6	4	5	1	
GS02	7/10/2007	Green Granite	2	1	10	5	6	1	
GS02	7/10/2007	Green Granite	3	1	7	3	4	1	
GS02	7/10/2007	Aplite	1	0	6	3	5	2	
GS02	7/10/2007	Pink Granite	1	0	6	3	3	1	
GS02	7/10/2007	Pink Granite	2	2	6	3	5	1	
GS02	7/10/2007	Oxidized Granite	3	1	7	3	5	0	
GS02	7/10/2007	Aplite	2	1	6	3	3	2	
GS02	7/10/2007	Pink Granite	3	1	10	5	7	1	
GS02	7/10/2007	Green Granite	4	1	6	2	3	1	
GS02	7/10/2007	Oxidized Granite	3	0	4	2	3	0	
GS02	7/10/2007	Green Granite	3	2	6	3	4	1	
GS02	7/10/2007	Green Granite	3	0	6	3	5	1	
GS02	7/10/2007	Green Granite	4	1	9	4	6	1	

Table B.1: Pampa Survey Results (continued)

GS02	7/10/2007	Pink Granite	3	0	11	4	8	1	
GS02	7/10/2007	Porphyritic Basalt	3	0	5	2	4	2	
GS02	7/10/2007	Aplite	2	0	4	2	2	3	
GS02	7/10/2007	Green Granite	4	1	20	9	9	1	
GS02	7/10/2007	Green Granite	3	1	4	2	2	1	
GS02	7/10/2007	Pink Granite	4	1	8	3	4	1	
GS02	7/10/2007	Green Granite	1	1	18	7	8	1	
GS02	7/10/2007	Green Granite	1	4	12	6	10	1	
GS02	7/10/2007	Green Granite	1	1	5	3	4	1	
GS02	7/10/2007	Green Granite	2	1	7	2	4	1	
GS02	7/10/2007	Green Granite	3	2	10	6	7	1	
GS02	7/10/2007	Green Granite	3	2	14	8	10	1	
GS02	7/10/2007	Oxidized Granite	1	0	5	3	4	0	
GS02	7/10/2007	Green Granite	4	2	13	4	7	1	
GS02	7/10/2007	Green Granite	2	1	15	5	8	1	
GS02	7/10/2007	Green Granite	1	1	8	2	4	1	
GS02	7/10/2007	Green Granite	2	3	34	12	15	1	
GS02	7/10/2007	Pink Granite	2	1	14	5	9	1	
GS02	7/10/2007	Gabbro	5	2	40	12	17	1	Rock Sample #08
GS02	7/10/2007	Green Granite	1	2	7	4	5	1	
GS02	7/10/2007	Green Granite	4	1	17	7	9	1	
GS02	7/10/2007	Porphyritic Basalt	2	1	14	5	9	1	
GS02	7/10/2007	Oxidized Granite	1	2	5	3	4	0	
GS02	7/10/2007	Green Granite	1	2	5	2	3	1	
GS02	7/10/2007	Green Dacite	6	1	7	3	6	2	
GS02	7/10/2007	Oxidized Granite	2	1	5	2	3	0	
GS02	7/10/2007	Oxidized Granite	1	2	5	2	3	0	
GS02	7/10/2007	Green Dacite	0	2	5	3	3	0	
GS02	7/10/2007	Green Granite	4	1	5	1	3	1	
GS02	7/10/2007	Pink Granite	3	1	9	5	5	1	

Table B.1: Pampa Survey Results (continued)

GS02	7/10/2007	Green Granite	1	2	6	3	4	1	
GS02	7/10/2007	Green Granite	1	0	7	1	4	1	
GS02	7/10/2007	Green Granite	3	2	6	3	5	1	
GS02	7/10/2007	Aplite	2	0	5	2	5	2	
GS02	7/10/2007	Oxidized Granite	2	3	7	4	6	0	
GS02	7/10/2007	Green Granite	4	2	6	3	4	1	
GS02	7/10/2007	Pink Granite	4	0	7	3	5	1	
GS02	7/10/2007	Green Granite	4	0	5	1	4	1	
GS02	7/10/2007	Aplite	5	1	5	3	4	2	
GS02	7/10/2007	Pink Granite	3	2	13	7	8	1	
GS02	7/10/2007	Pink Granite	3	1	6	3	4	1	
GS02	7/10/2007	Porphyritic Basalt	3	0	5	2	4	1	
GS02	7/10/2007	Pink Granite	2	3	45	24	28	1	
GS02	7/10/2007	Oxidized Granite	3	1	5	2	3	0	
GS02	7/10/2007	Pink Granite	4	1	6	3	4	1	
GS02	7/10/2007	Pink Granite	4	0	17	5	10	1	
GS02	7/10/2007	Green Granite	1	2	5	3	4	1	
GS02	7/10/2007	Porphyritic Basalt	5	0	8	3	5	1	
GS02	7/10/2007	Aplite	4	1	6	2	3	3	
GS02	7/10/2007	Oxidized Granite	5	1	5	2	2	0	
GS02	7/10/2007	Green Granite	5	2	39	15	27	1	
GS02	7/10/2007	Green Granite	4	1	38	16	23	1	
GS02	7/10/2007	Porphyritic Basalt	3	1	6	3	5	1	GPS #08

Appendix C

COLA DE ZORRO SURVEY RESULTS TABLE

Table C.1: Cola de Zorro Survey Results

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Foto #	PN	Sector	Lithic	sub1	sub2	sub3	time period	portion	%	length	width	thickness	haft length	count	weight	rock type	m-cortex	c-cortex	%	Status	Comments	Nota Bene	Date
149, 150	001	LS01-A	LDEB	pltfrm									3+	3	29.6	And				COL			7/11/2007
146 - 148	002	LS01-A	LDEB	pltfrm									3+	2	16.4	GD				COL			7/11/2007
142, 143	003	LS01-A	LDEB	flake									3+	5	38.6	Ch				COL			7/11/2007
144, 145	003a	LS01-A	LDEB	blade									3+	1	5.9	Ch				COL			7/11/2007
140, 141	004	LS01-A	LDEB	pltfrm									3+	1	5.2	Ch				COL			7/11/2007
137, 138	005	LS01-A	LDEB	flake									3+	1	7.3	Qtz				COL			7/11/2007
134, 135	006	LS01-A	LDEB	pltfrm									3+	1	4	Qtz				COL			7/11/2007
132, 133	007	LS01-A	LDEB	flake									1 - 3	5	11.7	And				COL			7/11/2007
128, 129	008	LS01-A	LDEB	pltfrm									1 - 3	3	11.4	Ch				COL			7/11/2007
127	009	LS01-A	LDEB	flake									1 - 3	27	28.9	Ch				COL			7/11/2007
125	010	LS01-A	LDEB	frag									1 - 3	30	56.3	Ch				COL			7/11/2007
124	011	LS01-A	LDEB	frag									1 - 3	3	3.1	Qtz				COL			7/11/2007
122, 123	012	LS01-A	LDEB	frag									1 - 3	1	5.5	Qtz*				COL	Silicified granite		7/11/2007
118	013	LS01-A	LDEB	flake									< 1	10	3.1	Ch				COL			7/11/2007
116, 117	014	LS01-A	LDEB	frag									< 1	8	4	Ch				COL			7/11/2007
112, 113	015	LS01-A	LCOR	poly	irreg					40.5	35.66	23.14		1	35	Ch				COL			7/11/2007
108, 109	016	LS01-A	LCOR	poly	irreg					50.68	39.2	26.56		1	46.5	Ch				COL			7/11/2007
114, 115	017	LS01-A	LCOR	poly	irreg					34.17	25.47	12.66		1	9.9	Qtz				COL			7/11/2007
40-42	018	LS01-A	LMOD	unifedge						44.53	32.42	13.25		1	15.6	Ch				COL			7/11/2007
43, 44	019	LS01-A	LMOD	unifedge						21.01	15.86	5.14		1	2.4	And				COL			7/11/2007
61, 62	020	LS01-A	LMOD	unifedge						30.47	23.75	8.49		1	6.9	Ch				COL			7/11/2007
46, 47	021	LS01-A	LMOD	unifedge						35.84	17.74	11.8		1	10.7	Ch				COL	Jasper		7/11/2007
98, 99	022	LS01-A	LMOD	unifedge						16.78	14.07	4.06		1	0.8	Ch				COL			7/11/2007
87, 88	023	LS01-A	LMOD	unifedge						15.72	15.52	3.96		1	1	Ch				COL			7/11/2007
59, 60	024	LS01-A	LMOD	unifedge						42.89	33.74	9.57		1	10.9	Ch				COL			7/11/2007
51, 52	025	LS01-A	LMOD	unifedge						27.63	23.4	10.95		1	6	Ch				COL	Pink in color		7/11/2007

Table C.1: Cola de Zorro Survey Results (continued)

77, 78	026	LS01-A	LMOD	unifedge						23.85	16	5.51		1	1.8	Ch				COL			7/11/2007
94, 95	027	LS01-A	LMOD	unifedge						17.09	14.04	3.81		1	1.2	Ch				COL			7/11/2007
48, 49	028	LS01-A	LMOD	unifedge						31.86	20.57	11.05		1	6.4	Ch				COL	Dark Jasper		7/11/2007
67, 68	029	LS01-A	LMOD	unifedge						28.02	20.64	10.64		1	4.9	Ch				COL			7/11/2007
69, 70	030	LS01-A	LMOD	unifedge						25.34	22.63	7.54		1	3.3	Ch				COL			7/11/2007
85, 86	031	LS01-A	LMOD	unifedge						16.7	12.67	5.61		1	1	Ch				COL			7/11/2007
100, 101	032	LS01-A	LMOD	unifedge						14.49	9.99	3.84		1	0.5	Ch				COL			7/11/2007
96, 97	033	LS01-A	LMOD	unifedge						18.64	8.78	4.73		1	0.8	Ch				COL			7/11/2007
79, 80	034	LS01-A	LMOD	unifedge						17.86	16.38	5.83		1	1.7	Ch				COL			7/11/2007
92, 93	035	LS01-A	LMOD	unifedge						14.89	13.29	5.58		1	0.9	Ch				COL			7/11/2007
73, 74	036	LS01-A	LMOD	unifedge						26.74	14.79	5.75		1	2.6	Ch				COL			7/11/2007
63, 64	037	LS01-A	LMOD	unifedge						24.57	22.51	11.8		1	6.3	Qtz				COL			7/11/2007
81, 82	038	LS01-A	LMOD	unifedge						17.72	14.04	7.32		1	2.1	Qtz				COL			7/11/2007
75, 76	039	LS01-A	LMOD	unifedge						22.09	16.98	7.25		1	2.7	Ch				COL			7/11/2007
57, 58	040	LS01-A	LMOD	unifedge						34.94	24.87	9.23		1	8.6	Ch				COL			7/11/2007
71, 72	041	LS01-A	LMOD	unifedge						18.06	17.68	8.4		1	3.2	Ch				COL			7/11/2007
65, 66	042	LS01-A	LMOD	unifedge						29.32	20.37	9.04		1	5	Ch				COL			7/11/2007
83, 84	043	LS01-A	LMOD	unifedge						16.86	12.9	5.19		1	1.4	Ch				COL			7/11/2007
90, 91	044	LS01-A	LMOD	unifedge						14.55	11.07	4.64		1	1.2	Ch				COL			7/11/2007
37, 38	045	LS01-A	LMOD	bifedge	biface					14.14	19.62	7.41		1	1.9	Ch				COL			7/11/2007
27, 28	046	LS01-A	LMOD	bifedge	biface					21.08	24.37	7.04		1	3.5	Ch				COL			7/11/2007
31, 34	047	LS01-A	LMOD	bifedge	biface					14.51	17.18	8.44		1	2.4	Qtz				COL			7/11/2007
35, 36	048	LS01-A	LMOD	bifedge	biface					23.9	12.56	7.63		1	2.4	And				COL			7/11/2007
1, 2	049	LS01-A	LBIF	point	unst unsh fol	7	mArc	Proximal	55	43.25	30.71	9.54		1	12.6	And				COL			7/11/2007
3, 5	050	LS01-A	LBIF	prefrm	unst unsh fol	8	eArc - Efor	All	100	46.28	20.03	8.68	19.51	1	7.3	Ch				COL		X	7/11/2007
15,16	051	LS01-A	LBIF	point	stem	12	lArc	Proximal	60	37.37	17.55	11.78		1	7.2	Ch				COL			7/11/2007
17, 19	052	LS01-A	LBIF	point	stem	13	mHor	Medial	35	10.58	16.36	3.3		1	0.7	Ch		WP	5	COL			7/11/2007
20, 21	053	LS01-A	LBIF	point	unstem	18	tArc - lHor	Most	90	26.44	10.76	3.48	10.23	1	0.8	Ch				COL	Missing 1 barb	X	7/11/2007
22, 23	054	LS01-A	LBIF	point	unstem	18	tArc - lHor	Medial	75	19.71	9.76	5.09		1	0.8	Ch		WP	30	COL			7/11/2007
25, 26	055	LS01-A	LBIF	point	spnshld	2	eArc	Medial	40	16.1	19.78	6.14		1	1.9	Ch				COL		X	7/11/2007

Table C.1: Cola de Zorro Survey Results (continued)

153, 154	056	LS01-B	LDE B	pltfrm									3+	1	3.3	Ba				COL	Fine Grained		7/11/2 007
155, 156	057	LS01-B	LDE B	frag									3+	1	18.8	Ch		DV	1 0	COL			7/11/2 007
159, 161	058	LS01-B	LDE B	frag									1 - 3	2	5.1	Ch				COL			7/11/2 007
162, 164	059	LS01-B	LDE B	frag									1 - 3	1	6.3	Qtz				COL			7/11/2 007
166, 167	060	LS01-B	LMO D	unifed ge						29.5 6	14.5 9	6.21		1	2.6	And				COL			7/11/2 007
170, 171	061	LS01-B	LBIF	point	spnshld / stem	1 / 9	eArc	Medial	60	26.2 4	17.0 9	4.67	20.83*	1	1.9	Ch				COL	Re-evaluate	X	7/11/2 007
173, 174	062	LS01-C	LDE B	frag									3+	2	18.3	And				COL			7/11/2 007
175, 177	063	LS01-C	LDE B	frag									3+	1	7.1	Ch		WP	2 0	COL			7/11/2 007
180, 181	064	LS01-C	LDE B	pltfrm									3+	1	4.4	Ch				COL			7/11/2 007
185, 186	065	LS01-C	LDE B	flake									3+	1	3.6	Ba				COL			7/11/2 007
187, 188	066	LS01-C	LDE B	pltfrm									1 - 3	2	5.4	PB				COL			7/11/2 007
189, 190	067	LS01-C	LDE B	flake									1 - 3	3	3.5	Ba				COL			7/11/2 007
192, 193	068	LS01-C	LDE B	flake									1 - 3	3	4.8	And				COL			7/11/2 007
195, 196	069	LS01-C	LDE B	flake									1 - 3	4	3.7	Ch				COL			7/11/2 007
198	070	LS01-C	LDE B	frag									1 - 3	9	24.2	Ch				COL			7/11/2 007
199, 200	071	LS01-C	LDE B	frag									1 - 3	1	2.3	Qtz				COL	Rose Quartz		7/11/2 007
202, 203	072	LS01-C	LCO R	*sing*	*flake*			*Proximal*	60	23.0 1	21.4 3	14.1		1	6.6	Ch		WP	5	COL		X	7/11/2 007
204 - 206	073	LS01-C	LMO D	bifedg e	biface					33.0 4	21.7 2	9.14		1	6.1	Ch				COL	Jasper		7/11/2 007
207, 208	074	LS01-C	LUN IF	cnvx	sing			Basal/Me dial	80	16.6 3	19.4 2	4.02		1	1.5	Ch				COL			7/11/2 007
211, 212	075	LS01-C	LBIF	prefrm	stem	?	?	All	10 0	30.4	11.3 7	6.82	14.1	1	2.6	Ch				COL	Re-evaluate	X	7/11/2 007
213, 216	076	LS02-A	LDE B	flake									3+	1	3.3	Ch				COL			7/11/2 007
217, 218	077	LS02-A	LDE B	frag									3+	3	23.3	Ch				COL			7/11/2 007
221, 222	078	LS02-A	LDE B	frag									3+	2	19.5	And				COL			7/11/2 007
223, 224	079	LS02-A	LDE B	flake									1 - 3	1	3.4	GG				COL	*check rock type		7/11/2 007
226, 227	080	LS02-A	LDE B	flake									1 - 3	5	5	Ch				COL			7/11/2 007
228, 229	081	LS02-A	LDE B	frag									1 - 3	2	6	Qtz				COL			7/11/2 007
232, 233	082	LS02-A	LDE B	frag									1 - 3	5	10.3	ch				COL			7/11/2 007
234, 235	083	LS02-A	LMO D	unifed ge						33.6 3	23.5 4	5.57		1	4.1	Ch				COL			7/11/2 007
237, 238	084	LS02-A	LUN IF	cnvx	*sing / pnt*			Basal/Me *dial*	95	32.2 2	23.5	5.72		1	4	And				COL			7/11/2 007
239, 240	085	LS02-B	LDE B	pltfrm									3+	1	8.5	Ba		WW	4 5	COL			7/11/2 007

Table C.1: Cola de Zorro Survey Results (continued)

241, 242	086	LS02- B	LDE B	flake									1 - 3	1	1.4	Ch		WP	5	COL			7/11/2 007
243, 244	087	LS02- B	LDE B	frag									1 - 3	4	10.4	Ch				COL	1 frag similar to Marty sample		7/11/2 007
245, 246	088	LS02- C	LDE B	pltfrm									3+	2	13.5	GD				COL	1 shattered platform		7/11/2 007
247, 248	089	LS02- C	LDE B	flake									3+	1	10.2	And		WW	3 5	COL			7/11/2 007
249, 250	090	LS02- C	LDE B	frag									3+	1	6	Qtz				COL			7/11/2 007
251, 252	091	LS02- C	LDE B	frag									1 - 3	1	3.4	And				COL			7/11/2 007
253, 254	092	LS02- C	LDE B	frag									1 - 3	1	1.9	Ch				COL			7/11/2 007
255, 256	093	LS02- D	LDE B	pltfrm									3+	1	6.4	GD		WW	3 0	COL			7/12/2 007
257 - 258a	094	LS02- D	LDE B	frag									3+	2	17.7	Ch				COL			7/12/2 007
259, 260	095	LS02- D	LDE B	pltfrm									1 - 3	1	1.6	Ch		DP	1 0	COL			7/12/2 007
261	096	LS02- D	LDE B	flake									1 - 3	12	17.3	Ch				COL			7/12/2 007
262	097	LS02- D	LDE B	frag									1 - 3	19	41.6	Ch				COL			7/12/2 007
263, 264	098	LS02- D	LDE B	frag									1 - 3	1	5.6	Qtz				COL			7/12/2 007
265, 266	099	LS02- D	LDE B	frag									1 - 3	1	2.8	GD		WW	4 5	COL			7/12/2 007
267, 268	100	LS02- D	LMO D	unifed ge						27.7 1	24.0 4	7.41		1	6.3	Ch				COL			7/12/2 007
269, 270	101	LS02- D	LMO D	unifed ge						27.1 7	13.2 6	6.21		1	2.5	Ch				COL			7/12/2 007
271, 272	102	LS02- D	LMO D	unifed ge						27.0 7	15.2 7	5.98		1	2.4	Ch				COL			7/12/2 007
273, 274	103	LS02- D	LMO D	unifed ge						19.1 4	19.1 6	8.32		1	3.6	Ch				COL			7/12/2 007
275 - 277	104	LS02- D	LUN IF	side	cncv / vx	sing				26.0 4	12.2 9	5		1	1.6	Ch				COL			7/12/2 007
278, 279	105	LS02- D	LBIF	point	unst unsh fol	7	mArc	All	10 0	34.8 5	15.3 9	4.42	11.12	1	2.5	Ch				COL			7/12/2 007
280, 281	106	LS02- D	LBIF	point	unst unsh fol	7	mArc	All	10 0	21.3 8	8	4.04	8.17	1	0.9	Ch				COL			7/12/2 007
282, 283	107	LS02- E	LDE B	frag									3+	1	10.6	GD		WW	4 0	COL			7/12/2 007
284, 285	108	LS02- E	LDE B	frag									3+	3	53.5	Ch				COL	Re-evaluate		7/12/2 007
286, 287	109	LS02- E	LDE B	pltfrm									1 - 3	2	2.7	Ch				COL			7/12/2 007
288, 289	110	LS02- E	LDE B	pltfrm									1 - 3	1	1.7	And				COL			7/12/2 007
290	111	LS02- E	LDE B	flake									1 - 3	10	11.3	Ch				COL			7/12/2 007
291	112	LS02- E	LDE B	frag									1 - 3	9	24.7	Ch				COL			7/12/2 007
292, 293	113	LS02- E	LDE B	frag									1 - 3	1	3.2	Qtz				COL			7/12/2 007
294, 295	114	LS02- E	LMO D	unifed ge						17.6 6	13.3 4	4.12		1	0.9	Ch				COL			7/12/2 007
296, 297	115	LS02- E	LMO D	unifed ge						15.5 1	12.6 7	3.5		1	0.9	Ch				COL			7/12/2 007

Table C.1: Cola de Zorro Survey Results (continued)

298, 299	116	LS02- E	LMO D	unifed ge						32.9 3	23.2 2	7.66		1	5.2	Ch				COL			7/12/2 007
300, 301	117	LS02- E	LUN IF	side	bicnvx	doub / pnt			80	28.0 1	18.2 4	6.48		1	3.4	Ch				COL			7/12/2 007
302, 303	118	LS02- E	LUN IF	side	bicnvx	sing / end			10 0	22.8 9	22.6 4	3.49		1	2.6	Ch				COL			7/12/2 007
304, 305	119	LS02- E	LBIF	prefrm	unst unsh fol	8	eArc - Efor	All	10 0	25.3 4	13.8 8	7.03	7.73	1	2	Ch		WP	5	COL	Jasper		7/12/2 007
306, 307	120	LS02- F	LDE B	frag									3+	3	56.8	Ch				COL	Re-evaluate		7/12/2 007
308, 309	121	LS02- F	LDE B	flake									3+	1	5.6	And				COL			7/12/2 007
310, 311	122	LS02- F	LDE B	flake									3+	1	3.7	GD				COL			7/12/2 007
312, 313	123	LS02- F	LDE B	frag									1 - 3	1	2.6	Qtz				COL			7/12/2 007
314, 315	124	LS02- F	LDE B	flake									1 - 3	1	3.3	And				COL			7/12/2 007
316, 317	125	LS02- F	LDE B	flake									1 - 3	3	3.8	Ch				COL			7/12/2 007
318, 319	126	LS02- F	LDE B	frag									1 - 3	8	12	Ch				COL			7/12/2 007
320, 321	127	LS02- F	LUN IF	side	bicnvx	sing / pnt			90	22.8 2	13.1 8	4.27		1	1.7	Ch				COL			7/12/2 007
322, 323	128	LS02- G	LDE B	pltfrm									3+	1	11.6	GD				COL			7/12/2 007
324, 325	129	LS02- G	LDE B	flake									3+	1	5.3	And				COL			7/12/2 007
326, 327	130	LS02- G	LDE B	flake									3+	1	4.1	Ch				COL			7/12/2 007
328 - 330	131	LS02- G	LDE B	flake									3+	1	15.9	Ch		WP	1 5	COL	Fried Egg		7/12/2 007
331, 332	132	LS02- G	LDE B	pltfrm									1 - 3	2	7.2	Ch				COL			7/12/2 007
333, 334	133	LS02- G	LDE B	flake									1 - 3	2	2.7	Ch				COL			7/12/2 007
335, 336	134	LS02- G	LDE B	frag									1 - 3	5	6.1	Ch				COL			7/12/2 007
337, 338	135	LS03- A	LDE B	pltfrm									3+	1	7.8	Ch				COL			7/12/2 007
339, 340	136	LS03- A	LDE B	pltfrm									3+	1	9.7	And				COL			7/12/2 007
341, 342	137	LS03- A	LDE B	flake									3+	1	3	And				COL			7/12/2 007
343, 344	138	LS03- A	LDE B	flake									3+	1	5.2	GD				COL			7/12/2 007
345, 346	139	LS03- A	LDE B	flake									3+	2	20	Qtz2				COL	Quartz from coast	X	7/12/2 007
347, 348	140	LS03- A	LDE B	flake									3+	1	3.4	Ch				COL			7/12/2 007
349, 350	141	LS03- A	LDE B	frag									3+	1	7.4	Ba				COL			7/12/2 007
351, 352	142	LS03- A	LDE B	frag									3+	4	29.4	Ch				COL			7/12/2 007
353, 354	143	LS03- A	LDE B	pltfrm									1 - 3	1	2.3	And				COL			7/12/2 007
355, 356	144	LS03- A	LDE B	flake									1 - 3	5	8.8	Ch				COL			7/12/2 007
357, 358	145	LS03- A	LDE B	flake									1 - 3	2	4.5	Ba				COL			7/12/2 007

Table C.1: Cola de Zorro Survey Results (continued)

359, 360	146	LS03-A	LDEB	frag									1 - 3	4	8.5	Ch				COL			7/12/2007
361, 362	147	LS03-A	LMOD	bifedge						27.92	17.84	6.95		1	3.7	Ch				COL			7/12/2007
363, 364	148	LS03-A	LMOD	unifedge						29.39	25.85	5.69		1	4.9	Ch				COL			7/12/2007
365, 366	149	LS03-A	LMOD	unifedge						34.55	21.99	6.88		1	4.4	Ch				COL			7/12/2007
367, 368	150	LS03-A	LMOD	unifedge						39.47	33.59	13.24		1	16.6	Ch				COL			7/12/2007
369, 370	151	LS03-A	LUNIF	end	para	doub / end			100	30.54	17.9	7.76		1	4.6	Ch				COL			7/12/2007
371, 372	152	LS03-A	LBIF	point	unst unsh fol	8	eArc - Efor	Proximal	65	30.41	17.02	5.95		1	3.5	Ch		WP / DV	10	COL	Jasper		7/12/2007
373, 374	153	LS03-A	LBIF	point	stem	9	eArc	Basal/Medial	60	24.8	23.29	7.04		1	3.7	Ch				COL			7/12/2007
375, 376	154	LS03-A	LBIF	point	unstem	18	tArc - lHor	All	100	25.55	19.52	5.18	8.06	1	2.2	Ob				COL	Obsidian	X	7/12/2007
377, 378	155	LS03-B	LDEB	pltfrm									3+	1	7.6	Ba				COL			7/13/2007
379, 380	156	LS03-B	LDEB	flake									3+	1	4.7	GD				COL			7/13/2007
381, 382	157	LS03-B	LDEB	flake									3+	1	6.5	Ch				COL			7/13/2007
383, 384	158	LS03-B	LDEB	flake									1 - 3	7	12.3	Ch				COL			7/13/2007
385, 386	159	LS03-B	LDEB	frag									1 - 3	1	2.9	Ch				COL			7/13/2007
387, 388	160	LS03-B	LCOR	sing	flake					56.78	37.49	15.27		1	36.6	Ch		WP	10	COL	Fried Egg	X	7/13/2007
389, 390	161	LS03-B	LMOD	unifedge						42.74	26.18	5.88		1	5.4	Ch				COL			7/13/2007
391, 392	162	LS03-B	LBIF	point	unstem	18	tArc - lHor	All	100	26.61	17.65	4.88	5.07	1	1.9	Ch				COL			7/13/2007
393, 394	163	LS03-B	LBIF	point	stem	13	mHor	Basal/Medial	90	25.62	14.89	6.25	10.31	1	1.8	Ch				COL			7/13/2007
776, 777	164	LS03-C	LDEB	flake									3+	2	39.6	And				COL			7/24/2007
778, 779	165	LS03-C	LDEB	frag									3+	2	19.3	And				COL			7/24/2007
782, 783	166	LS03-C	LDEB	flake									3+	2	24	Ch				COL			7/24/2007
785, 786	167	LS03-C	LDEB	frag									3+	7	75.8	Ch				COL			7/24/2007
787, 788	168	LS03-C	LDEB	flake									1 - 3	11	23.2	Ch				COL			7/24/2007
793, 794	169	LS03-C	LDEB	frag									1 - 3	4	9.5	Ch				COL			7/24/2007
791, 792	170	LS03-C	LDEB	frag									1 - 3	3	4.9	Qtz				COL			7/24/2007
789, 790	171	LS03-C	LDEB	flake									1 - 3	3	7.2	PB				COL			7/24/2007
795, 796	172	LS02-H	LDEB	flake									3+	1	6.9	Ch				COL			7/24/2007
797, 798	173	LS02-H	LDEB	pltfrm									1 - 3	1	1.9	And				COL			7/24/2007
802, 803	174	LS02-H	LDEB	flake									1 - 3	1	3	And				COL			7/24/2007
805	175	LS02-H	LDEB	flake									1 - 3	11	14.2	Ch				COL			7/24/2007

Table C.1: Cola de Zorro Survey Results (continued)

806, 807	176	LS02-H	LDE B	frag									1 - 3	4	10.5	Ch				COL			7/24/2007
810, 811	177	LS02-H	LDE B	flake									1 - 3	1	0.8	Ob				COL		X	7/24/2007

Appendix D

TAMBO-ILO SURVEY RESULTS TABLE

Table D.1: Tambo-Ilo Survey Results

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Foto #	No. de Bolsa	Sitio (TI-)	Sect or	litico	Sub1	Sub 2	Sub 3	Portion	%	Lengt h	Widt h	Thic k	Haft Length	Cantid ad	Peso (g)	Tipo de Piedra	M-Cortex	C-Cortex	%	Statu s	Notas	Nota Bene	Date
534, 535	1	16	N/A	LBIF	point			prox, med	95	36.72	13.4 7	3.90	8.35	1	1.60	Ch	WC		40	MC			8/4/20 07
476, 477	3	21	1	LCO R	poly					75.12	52.2 5	40.6 5		1	124.20	And	WC		40	MC	Tan Andesite		8/4/20 07
478, 479	3	21	1	LDE B	frag								3+	3	30.60	And				MC			8/4/20 07
435, 436	7	21	2	LCO R	sing					74.46	45.0 5	19.4 1		1	68.80	And	WC		20	MC	Tan Andesite		8/4/20 07
437, 438	7	21	2	LDE B	flake								3+	1	10.80	And	WC		95	MC	Tan Andesite		8/4/20 07
439, 440	7	21	2	LDE B	frag								1-3	4	22.30	Ch				MC			8/4/20 07
441, 442	7	21	2	LDE B	frag								1-3	1	3.60	And				MC			8/4/20 07
382, 383	14	29	N/A	LDE B	flake								1-3	1	2.10	Ch				MC			8/4/20 07
384, 385	14	29	N/A	LDE B	flake								3+	1	7.90	Ch		DP	30	MC	Honda		8/4/20 07
344, 345	17	31	N/A	LDE B	frag								3+	1	10.10	Ch				MC	Honda		8/4/20 07
346, 347	17	31	N/A	LDE B	frag								1-3	1	3.00	Ch	WC		50	MC	Honda		8/4/20 07
349, 350	17	31	N/A	LMO D	unifed ge					19.39	17.3 9	5.73		1	2.00	Qtz	WC		10 0	MC			8/4/20 07
630, 631	20	35	2	LDE B	flake								3+	1	2.80	And				MC			8/4/20 07
633, 634	20	35	2	LDE B	frag								3+	1	3.40	Ch				MC			8/4/20 07
635, 636	20	35	2	LMO D	bifedg e	bifac e		proximal	50	28.24	18.9 8	7.31		1	4.30	Ch				MC			8/4/20 07
447, 448	23	41	N/A	LDE B	flake								3+	1	6.00	Ch				MC			8/4/20 07
450, 451	23	41	N/A	LDE B	frag								1-3	2	7.50	Ch				MC			8/4/20 07
452 453	23	41	N/A	LDE B	flake								3+	2	5.40	And				MC			8/4/20 07
377, 378	25	42	2	LDE B	frag								3+	1	10.00	Ch		DV	85	MC			8/4/20 07
622, 623	26	42	2	LDE B	flake								1-3	1	0.70	glass				MC			8/4/20 07
624, 625	26	42	2	LMO D	bifedg e			prox	60	35.47	20.6 1	10.2 8		1	7.40	Ch	WC		45	MC			8/4/20 07
626, 627	26	42	2	LBIF	point			All	10 0	36.32	16.1 7	8.25		1	4.40	Ch		DV	40	MC			8/4/20 07
514, 515	33	49	N/A	LDE B	frag								1-3	1	4.90	Ch	WC		45	MC			8/4/20 07
516, 517	33	49	N/A	LBIF	point			Prox	50	27.63	17.1 5	8.51		1	4.10	Ch	WC		45	MC			8/4/20 07

Table D.1: Tambo-Ilo Survey Results (continued)

414, 415	36	60	N/A	LBIF	point			Prox, med	70	37.36	16.38	5.11		1	3.90	Ch	WC		100	MC			8/4/2007
416, 417	36	60	N/A	LDEB	flake								1-3	2	2.90	Ch				MC			8/4/2007
593, 594	38	61	N/A	LMOD	bifedge	biface		prox	30	19.83	18.25	6.17		1	2.60	Ch		WP	80	MC			8/4/2007
365, 366	41	63	N/A	LDEB	frag								3+	1	15.00	Ch	WC		80	MC			8/4/2007
367, 368	41	63	N/A	LMOD	bifedge	biface		Prox,med	65	32.80	25.40	9.23		1	8.40	Ch		DP	15	MC	Honda		8/4/2007
460, 461	43	64	N/A	LDEB	frag								3+	1	30.80	Ch				MC	Honda		8/4/2007
462, 464	43	64	N/A	LDEB	frag								3+	1	19.30	And				MC			8/4/2007
465, 466	43	64	N/A	LBIF	point			med	65	16.09	12.40	3.77		1	0.80	Ch	WC		35	MC			8/4/2007
467, 468	43	64	N/A	LMOD	unifedge			Bas, med	90	17.77	16.98	6.21		1	2.20	Ba				MC			8/4/2007
469, 470	43	64	N/A	LMOD	unifedge			Prox,med	60	29.37	22.54	9.25		1	4.70	Ch	WC		40	MC			8/4/2007
518, 519	46	64	N/A	LDEB	frag								3+	1	31.60	Ba	JF		25	MC	Juiced		8/4/2007
520, 521	46	64	N/A	LGRST	plum			prox	50	49.15	23.05	21.99		1	30.30	Ba				MC			8/4/2007
492, 495	47	67	1	LDEB	frag								3+	1	20.80	Ch	WC		50	MC			8/4/2007
496, 497	47	67	1	LDEB	flake								3+	1	13.90	Ch		WP	20	MC			8/4/2007
498, 499	47	67	1	LCOR	sing	blade				36.76	28.38	18.27		1	24.30	And							8/4/2007
500, 501	47	67	1	LBIF	prefrm					24.28	22.88	6.85		1	4.80	And				MC			8/4/2007
502, 503	47	67	1	LMOD	bifedge					23.90	19.24	7.08		1	3.10	Ch		WP	10	MC			8/4/2007
504, 505	47	67	1	LMOD	bifedge					37.40	22.38	8.84		1	8.70	Ch	WC		15	MC			8/4/2007
506, 507	47	67	1	LBIF	prefrm					32.97	16.82	10.96		1	6.30	Ch	WC		20	MC			8/4/2007
320, 321	51	67	3	LGRST	plum			basal	45	22.86	17.86	15.38		1	12.70	PB	WC		45	MC			8/4/2007
322, 323	51	67	3	LBIF	point			Bas, med	85	27.45	18.10	6.82	8.20	1	3.40	Ch		GP	60	MC			8/4/2007
324, 325	51	67	3	LCOR	poly	flake		Basal	50	43.90	41.22	21.53		1	43.20	Ch	WC		70	MC			8/4/2007
326, 327	51	67	3	LMOD	unifedge			All	100	38.93	24.27	12.03		1	9.70	Ch	WC		35	MC			8/4/2007
380, 381	52	67	3	LGRST	plum			Basal	45	43.62	28.44	24.67		1	45.90	Ba							8/4/2007
312, 313	57	67	5	LGRST	plum			prox	60	45.83	22.46	19.14		1	26.70	PB	WC		90	MC			8/4/2007
563, 564	58	67	5	LGRST	other	grind stone		All	100	68.61	69.07	34.18		1	292.40	GG	WC		40	MC			8/4/2007
352, 353	60	68	N/A	LMOD	unifedge			All	100	75.08	31.98	12.56		1	32.20	Ch	WC		30	MC	Honda	X	8/4/2007

Table D.1: Tambo-Ilo Survey Results (continued)

647, 648	62	69	N/A	LUNIF	side	sing / pnt		All	100	38.96	32.11	6.53		1	7.70	Ch				MC			8/4/2007
304, 305	65	70	N/A	LBIF	point			prox, med	95	39.72	22.47	7.07	16.19*	1	6.90	Ch	WC		45	MC			8/4/2007
306, 307	65	70	N/A	LBIF	prefrm			prox, med	40	27.73	21.22	8.86		1	4.30	Ch	WC		25	MC			8/4/2007
308, 309	65	70	N/A	LBIF	prefrm			med	60	33.15	29.22	8.40		1	10.80	Ch	WC		50	MC			8/4/2007
310, 311	65	70	N/A	LBIF	point			All	100	30.39	30.69	8.74	13.62	1	8.00	Ch	WC		20	MC			8/4/2007
480, 481	66	70	N/A	LGRST	abraded					79.97	59.00	19.94		1	114.70	GG	WC		45	MC			8/4/2007
482, 483	66	70	N/A	LGRST	abraded					64.15	51.48	13.99		1	60.10	PB				MC			8/4/2007
484, 485	66	70	N/A	LDEB	flake								3+	1	72.10	And	WC		60	MC			8/4/2007
486, 487	66	70	N/A	LMOD	unifedge			All	100	56.32	28.53	9.23		1	13.40	Ch				MC			8/4/2007
488, 489	66	70	N/A	LDEB	point			All	100	28.98	17.91	6.01	10.77	1	3.30	Qtz	WC		50	MC			8/4/2007
490, 491	66	70	N/A	LDEB	flake								3+	2	2.90	Ch				MC			8/4/2007
655, 656	68	70	N/A	LUNIF	side	bicnx	doub	All	100	41.08	53.39	12.99		1	33.60	And				MC			8/4/2007
657, 658	68	70	N/A	LBIF	point			Medial	75	38.96	25.11	8.67		1	10.00	Ch	WC		50	MC			8/4/2007
659, 660	68	70	N/A	LBIF	point			bas, med	45	24.33	15.70	6.13		1	2.10	Ch	WC		45	MC			8/4/2007
661, 662	68	70	N/A	LBIF	point			All	100	33.09	17.48	8.09		1	4.50	Ch	WC		50	MC			8/4/2007
663, 664	68	70	N/A	LBIF	point			prox, med	85	49.21	20.30	6.85		1	8.50	Ch	WC		45	MC			8/4/2007
665, 666	68	70	N/A	LBIF	prefrm			basal	40	24.53	20.65	9.70	16.68	1	2.40	Ch		WP	90	MC			8/4/2007
667, 668	68	70	N/A	LGRST	plum			prox	40	28.61	11.85	9.41		1	3.80	Ba				MC			8/4/2007
370, 371	69	71	N/A	LGRST	plum			med	65	50.99	23.69	17.76		1	33.70	PB				MC	Salt Water crust		8/4/2007
637, 638	70	71	N/A	LGRST	plum			medial	70	78.37	24.23	17.97		1	56.40	Ba				MC			8/4/2007
639, 640	70	71	N/A	LGRST	plum			prox	75	49.80	15.71	11.75		1	12.50	Ba				MC			8/4/2007
641, 642	70	71	N/A	LGRST	plum			All	100	43.67	11.37	6.60		1	4.70	Ba				MC	Has indent from line		8/4/2007
643, 644	70	71	N/A	LGRST	plum			prox	70	39.46	14.75	10.99		1	9.30	Ba				MC			8/4/2007
645, 646	70	71	N/A	LMOD	bifedge			medial	70	30.55	17.17	9.46		1	6.20	Ch				MC			8/4/2007
669, 670	71	71	N/A	LCOR	poly	flake				53.55	45.07	29.10		1	71.00	And	WC		30	MC	Tan Andesite		8/4/2007
672, 673	71	71	N/A	LBIF	point			All	100	49.22	17.60	7.37		1	6.10	And				MC			8/4/2007
674, 675	71	71	N/A	LBIF	point			basal	65	35.18	19.90	6.24		1	5.60	Ch	WC		55	MC			8/4/2007

Table D.1: Tambo-Ilo Survey Results (continued)

443, 444	73	72	N/A	LBIF	point			All	100	33.76	18.04	4.43	7.73	1	2.50	Ch				MC			8/4/2007
445, 446	73	72	N/A	LBIF	point			prox, med	90	32.30	21.98	6.72		1	4.00	Qtz				MC			8/4/2007
676, 677	76	73	N/A	LMOD	bifedge			All	100	34.38	19.18	7.41		1	4.70	Ch	WC		30	MC			8/4/2007
678, 679	76	73	N/A	LMOD	bifedge			basal	60	30.36	19.33	6.99		1	4.10	Ch	WC		45	MC			8/4/2007
512, 513	77	74	N/A	LMOD	unifedge			prox, med	60	24.57	24.69	7.55		1	6.00	Ch		WP	15	MC			8/4/2007
628, 629	79	75	N/A	LBIF	point			medial	85	29.99	15.66	5.68		1	2.90	Ch	WC		45	MC			8/4/2007
399, 400	81	79	N/A	LGRST	plum			med	55	32.79	16.33	13.77		1	12.10	Ba				MC			8/4/2007
354, 355	83	80	N/A	LBIF	prefrm			Basal	50	41.14	35.40	9.31	15.53	1	12.60	Qtz	WC		55	MC	Green, copper		8/4/2007
356, 357	83	80	N/A	LDEB	flake								3+	1	10.40	And				MC			8/4/2007
595, 596	84	80	N/A	LBIF	point			medial	85	46.13	20.53	7.48	15.00*	1	7.20	And				MC			8/4/2007
597, 598	84	80	N/A	LMOD	bifedge			prox, med	70	34.00	13.03	8.52		1	5.40	Ch	WC		55	MC			8/4/2007
599, 600	84	80	N/A	LMOD	bifedge			prox	65	23.38	11.29	8.73		1	2.60	Qtz				MC			8/4/2007
340, 341	85	81	N/A	LBIF	point			prox, med	95	43.00	18.88	7.72	11.00	1	6.40	Ch	WC		50	MC		X	8/4/2007
342, 343	85	81	N/A	LMOD	unifedge			all	100	38.91	21.37	9.09		1	8.40	Ch	WC		15	MC	Honda	X	8/4/2007
473, 474	87	83	N/A	LBIF	point			Prox	50	28.57	19.58	7.70		1	5.40	Ch	WC		50	MC			8/4/2007
577, 578	90	84	N/A	LDEB	frag								3+	1	4.00	Ch	WC		55	MC			8/4/2007
579, 580	90	84	N/A	LDEB	frag								3+	1	8.10	And				MC			8/4/2007
581, 582	90	84	N/A	LBIF	prefrm			medial	60	29.92	18.27	12.02		1	7.50	Ch		WP	30	MC			8/4/2007
680, 681	91	86	N/A	LBIF	point			medial	65	24.27	20.88	6.18	9.93	1	3.60	Ch	WC		40	MC			8/4/2007
682, 683	91	86	N/A	LMOD	bifedge	biface		prox	45	27.52	21.41	6.60		1	4.50	Ch				MC			8/4/2007
587, 588	92	92	N/A	LBIF	prefrm			prox, med	80	31.36	12.63	9.67		1	4.30	Ch		WP	20	MC			8/4/2007
583, 584	93	93	N/A	LBIF	point			All	100	23.02	10.56	3.30	4.52	1	0.70	Ch	WC		15	MC			8/4/2007
565, 566	94	103	N/A	LBIF	point			prox, med	95	45.98	20.69	5.76	13.39	1	4.50	Ch				MC			8/4/2007
372, 373	95	113	N/A	LMOD	bifedge			All	100	40.00	27.53	13.05		1	10.50	Ch	WC		100	MC			8/4/2007
375, 376	95	113	N/A	LBIF	point			All	100	35.92	18.78	4.73	7.09	1	2.40	Ch				MC	Honda		8/4/2007
454, 455	96	117	N/A	LBIF	point			bas, med	80	41.84	18.76	10.24	11.27	1	8.20	Ch	WC		50	MC			8/4/2007
456, 457	96	117	N/A	LBIF	point			All	100	27.18	19.78	6.47	11.57	1	2.90	Ch				MC			8/4/2007

Table D.1: Tambo-Ilo Survey Results (continued)

458, 459	96	117	N/A	LMOD	bifedge	biface		bas, med	95	38.52	21.16	5.10		1	4.30	Ch		WP	80			X	8/4/2007
649, 650	99	119	N/A	LBIF	point			Prox	45	33.22	19.49	11.31		1	7.70	And	WC		45	MC			8/4/2007
601, 602	100	121	1	LDEB	pltfrm								3+	1	20.70	Ch							8/4/2007
603, 604	100	121	1	LBIF	point			Medial	60	22.41	15.68	5.98		1	2.20	Ch	WC		35	MC			8/4/2007
605, 606	100	121	1	LBIF	point			All	100	44.66	13.12	7.73	11.25	1	4.80	Ch	WC		40	MC			8/4/2007
608, 609	100	121	1	LBIF	point			All	100	47.51	34.72	8.44	10.07	1	7.30	Ch		DP	10	MC		X	8/4/2007
684, 685	103	121	3	LBIF	prefrm			basal	55	42.77	14.91	8.74		1	5.30	Ch	WC		15	MC			8/4/2007
686, 687	103	121	3	LGRST	plum			medial	45	46.33	21.88	16.95		1	23.50	Ba				MC			8/4/2007
433, 434	104	121	4	LBIF	prefrm			prox, med	60	48.65	29.95	11.93		1	17.50	And	WC		65	MC			8/4/2007
689, 690	106	121	5	LGRST	other	pestle		All	100	107.65	49.84	47.91		1	475.80	Ba				MC			8/4/2007
429, 430	109	122	N/A	LBIF	point			All	100	19.74	12.09	5.17	6.79	1	1.20	Qtz				MC			8/4/2007
427, 428	109	122	N/A	LBIF	point			All	100	26.65	11.73	2.71	6.18	1	0.90	Ch				MC			8/4/2007
431, 432	109	122	N/A	LBIF	point			All	100	22.38	17.81	6.49	8.55*	1	3.00	Ch				MC			8/4/2007
567, 568	111	127	N/A	LGRST	other	mortar				80.82	73.90	40.06		1	174.90	PB				MC			8/4/2007
569, 570	111	127	N/A	LDEB	frag								1-3	1	7.40	Ch		WP	15	MC			8/4/2007
571, 572	111	127	N/A	LBIF	prefrm			prox, med	75	36.03	24.89	10.22		1	10.30	Ch				MC			8/4/2007
573, 574	111	127	N/A	LBIF	point			prox	70	45.19	27.09	5.76		1	6.30	Ch				MC			8/4/2007
301, 302	112	128	N/A	LBIF	point	unst unsh fol		Basal, medial	55	35.44	21.76	9.07	22.03	1	8.10	Ch				MC			8/4/2007
359, 360	113	130	N/A	LDEB	pltfrm								3+	1	30.50	Ba	JF		25	MC			8/4/2007
361, 362	113	130	N/A	LGRST	plum					46.46	13.03	7.66		1	6.40	Ba	WC		65	MC			8/4/2007
363, 364	113	130	N/A	LBIF	prefrm			All	100	39.47	20.93	5.45		1	4.40	Ch				MC	Honda		8/4/2007
616, 617	115	134	N/A	LGRST	plum			prox	50	55.85	31.71	24.66		1	53.10	Ba				MC			8/4/2007
618, 619	115	134	N/A	LDEB	frag								3+	1	93.80	And	JF		10	MC			8/4/2007
620, 621	115	134	N/A	LBIF	point			All	100	34.03	27.81	5.70	8.89	1	2.90	Ob				MC		X	8/4/2007
335, 336	123	139	N/A	LBIF	point			All	100	47.91	21.24	5.73	10.68	1	5.20	Ba				MC		XX	8/4/2007
337, 338	123	139	N/A	LBIF	prefrm			bas	50	33.23	27.19	9.92		1	9.70	And	WC		100	MC			8/4/2007
418, 419	130	147	N/A	LBIF	point			bas, med	75	28.45	20.69	5.65	9.18	1	2.80	Ch	WC		45	MC	Honda		8/4/2007

Table D.1: Tambo-Ilo Survey Results (continued)

314, 315	132	149	N/A	LBIF	point			basal	55	25.44	24.17	6.21	13.44	1	4.10	Ch	WC		5	MC	Slight weathering		8/4/2007
316, 317	132	149	N/A	LMOD	bifedge	biface		All	100	56.77	34.17	13.38	19.51	1	27.50	Qtz	WC		45	MC	Slight weathering		8/4/2007
318, 319	132	149	N/A	LMOD	unifedge				65	30.35	23.66	6.81		1	4.20	Ch	WC		50	MC	Slight weathering		8/4/2007
386, 387	135	160	N/A	LBIF	point			bas, med	85	16.00	10.12	3.99	6.02	1	0.50	Ch				MC	Honda		8/4/2007
589, 590	136	161	N/A	LMOD	bifedge			All	100	62.33	43.73	20.63		1	43.80	Ch				MC			8/4/2007
591, 592	136	161	N/A	LBIF	point			medial	60	26.89	23.33	5.22		1	4.30	Ch		WP	30	MC			8/4/2007
542, 543	138	166	N/A	LDEB	pltfrm								3+	1	24.70	And				MC			8/4/2007
544, 545	138	166	N/A	LMOD	unifedge			medial	65	81.40	43.92	16.12		1	70.10	PB				MC			8/4/2007
546, 547	138	166	N/A	LBIF	prefrm			medial	60	27.93	18.80	8.72		1	4.20	And				MC			8/4/2007
548, 549	138	166	N/A	LBIF	prefrm			medial	60	22.68	15.77	6.63		1	3.00	And				MC			8/4/2007
550, 551	138	166	N/A	LBIF	prefrm			prox	70	36.92	21.30	11.68		1	9.80	Ch				MC			8/4/2007
553, 554	138	166	N/A	LBIF	point			medial	60	25.22	20.72	7.47		1	6.20	Ch				MC			8/4/2007
555, 556	138	166	N/A	LBIF	point			All	100	22.74	15.17	6.96		1	3.00	Ch				MC			8/4/2007
557, 558	138	166	N/A	LBIF	point			prox	70	36.37	17.87	9.07		1	7.20	Ch	WC		10	MC			8/4/2007
559, 560	138	166	N/A	LBIF	point			prox	25	19.69	19.93	5.04		1	1.60	Ch				MC			8/4/2007
561, 562	138	166	N/A	LBIF	point			basal	50	25.72	24.46	5.39	10.71	1	3.50	Ch	WC		30	MC			8/4/2007
651, 652	140	167	N/A	LMOD	bifedge	biface		prox / bas?	35	23.60	17.67	7.90		1	2.60	Ch		WP	10	MC			8/4/2007
653, 654	140	167	N/A	LBIF	point			prox, med	90	30.59	15.10	7.79	9.32	1	3.10	Ba				MC			8/4/2007
575, 576	142	174	N/A	LDEB	flake								3+	1	51.30	And				MC			8/4/2007
328, 329	144	175	N/A	LBIF	point			bas, med	75	36.88	22.46	8.58	10.37*	1	7.20	And				MC			8/4/2007
330, 331	144	175	N/A	LBIF	point			All	100	31.21	16.36	8.36	11.44	1	3.60	Ch		WP	10	MC		X	8/4/2007
332, 333	144	175	N/A	LCOR	sing	flake				44.02	29.86	16.50		1	19.60	Ch		DP	10	MC			8/4/2007
522, 523	150	185	1	LDEB	flake								3+	1	5.00	And				MC			8/4/2007
524, 525	150	185	1	LDEB	flake								1-3	2	6.70	And				MC			8/4/2007
526, 527	150	185	1	LBIF	point			prox	30	25.23	33.75	9.58		1	7.30	Ch				MC			8/4/2007
528, 529	150	185	1	LBIF	prefrm			All	100	35.18	17.51	6.72	11.96	1	4.40	And				MC			8/4/2007
530, 531	150	185	1	LBIF	point			Medial	50	22.90	14.29	8.27		1	3.60	Ch	WC		20	MC			8/4/2007

Table D.1: Tambo-Ilo Survey Results (continued)

532, 533	150	185	1	LBIF	point			All	100	17.53	11.38	3.56	4.14	1	0.80	Ch	WC		5	MC			8/4/2007
402, 403	154	185	3	LGRST	abraded					72.51	68.08	17.19		1	121.30	GG	WW		50	MC			8/4/2007
404, 405	154	185	3	LGRST	plum			All	100	31.36	9.02	8.42		1	3.20	Ba	WC		65	MC			8/4/2007
406, 407	154	185	3	LBIF	point			All	100	37.98	20.45	9.23		1	5.80	Ch				MC	Honda		8/4/2007
388, 389	161	195	2	LGRST	plum			prox	60	43.94	19.74	18.03		1	20.10	Ba				MC			8/4/2007
393, 394	161	195	2	LBIF	point			pro, med	75	33.06	12.84	5.56		1	2.20	Ch				MC			8/4/2007
395, 396	161	195	2	LBIF	prefrm			prox	45	29.86	27.07	7.15		1	7.00	Ch				MC			8/4/2007
397, 398	161	195	2	LDEB	flake								1-3	1	1.10	Ch				MC			8/4/2007
408, 409	164	195	4	LBIF	point			All	100	46.08	26.20	9.28	10.28	1	8.00	Ch		WP	10	MC			8/4/2007
410, 411	164	195	4	LMOD	bifedge			bas, med	55	31.57	18.94	7.93		1	5.80	Ch		WP	5	MC			8/4/2007
412, 413	164	195	4	LBIF	point			All	100	37.37	15.54	6.21	13.88	1	3.90	Ch				MC			8/4/2007
536, 537	165	204	1	LBIF	point			All	100	42.92	30.58	6.00	8.47	1	9.00	Ch	WC		10	MC			8/4/2007
538, 539	165	204	1	LBIF	point			All	100	20.30	10.76	3.90	2.93	1	0.60	Ch				MC			8/4/2007
508, 509	171	210	2	LDEB	flake								3+	1	77.90	And				MC			8/4/2007
510, 511	171	210	2	LBIF	prefrm			med	80	45.90	23.52	7.80		1	8.40	Ch				MC			8/4/2007
471, 472	181	214B	1	LBIF	point			Medial	80	30.08	14.56	3.55		1	1.80	Ch				MC			8/4/2007
610, 611	185	214B	3	LGRST	other	mortar			20	67.79	64.64	17.32		1	114.50	Ba				MC			8/4/2007
612, 613	188	216	N/A	LBIF	point			medial	85	19.85	11.58	3.69	4.92	1	0.90	Ch				MC			8/4/2007
614, 615	188	216	N/A	LMOD	bifedge	biface		All	100	69.13	42.69	7.32	17.53	1	23.60	Ch				MC			8/4/2007
420, 421	190	217	N/A	LBIF	point			med, prox	80	21.82	17.38	6.75		1	2.00	And				MC			8/4/2007
422, 423	190	217	N/A	LBIF	point			All	100	26.77	17.06	5.95		1	2.70	Ob				MC		X	8/4/2007
540, 541	192	218	N/A	LBIF	point			All	100	37.95	15.63	6.28	4.74	1	3.40	And				MC			8/4/2007
585, 586	194	219	N/A	LBIF	point			Medial	80	18.26	16.92	5.25	9.03	1	1.60	Ob				MC		X	8/4/2007

Appendix E

SURVEY LOCATIONS

Quebrada and Pampa Surface locations:

Start location of Quebrada Survey:
E 0235200
N 8089619
Elevation: 240m

End location of Quebrada Survey:
E 0235037
N 8089570
Elevation: 212m

Start location of Pampa Survey:
E 0235035
N 8089625
Elevation: 221m

End location of Pampa Survey:
E 0234921
N 8089830
Elevation: 227m

Cola de Zorro Survey Locations:

Sector 1: Domestic Debris Zone A
E 0236051
N 8089531
Elevation: 365m

Sector 1: Domestic Debris Zone B
E 0235872
N 8089528
Elevation: 343m

Sector 1: Domestic Debris Zone C
E 0235752
N 8089541
Elevation: 326m

Sector 2: Domestic Debris Zone A
E 0235544
N 8089533
Elevation: 296m

Sector 2: Domestic Debris Zone B
E 0235466
N 8089511
Elevation: 268m

Sector 2: Domestic Debris Zone C
E 0235353
N 8089464
Elevation: 257m

Sector 2: Domestic Debris Zone D
E 0235459
N 8089584
Elevation: 282m

Sector 2: Domestic Debris Zone E
E 0235310
N 8089530
Elevation: 263m

Sector 2: Domestic Debris Zone F
E 0235233
N 8089498
Elevation: 247m

Sector 2: Domestic Debris Zone G
E 0234895
N 8089354
Elevation: 186m

Sector 2: Domestic Debris Zone H
E 0235414
N 8090043
Elevation: 309m

Sector 3: Domestic Debris Zone A
E 0234669
N 8089259
Elevation: 122m

Sector 3: Domestic Debris Zone B
E 0234240
N 8089049
Elevation: 73m

Sector 3: Domestic Debris Zone C
E 0234080
N 8089076
Elevation: 62m

Appendix F

ROCK IDENTIFICATION SHEETS

Rock Name: Green Granite (GG)

☑ Igneous --- ☐ Volcanic ☑ Plutonic

☑ Felsic ☐ Intermediate ☐ Mafic

☐ Metamorphic ---

☐ Gneiss ☐ Hornfel ☐ Marble ☐ Quartzite ☐ Schist ☐ _______

☐ Sedimentary ---

☐ Clastic --- ☐ Arenite ☐ Wacke ☐ Mudstone

☐ Chemical --- ☐ Limestone

☐ Metasomatic --- ☐ Altered ☐ Chalcedony ☐ Chert

☐ Other --- ☐ Petrified Wood ☐ Quartz

Weathered Surface: Color: 10YR 8/4

☑ Chemical --- ☐ Dark Patina ☐ Glossy Patina ☐ White Patina

☑ Oxidized (FeOx)

☑ Mechanical --- ☐ Joint Fracture ☐ Water Worn ☑ Weathered Crust

Rock Color: 5G 7/1

Constituent Structure:

Description: Massive Granite

1) Mineralogy:

Name(s): Hornblende, Biotite, Plagioclase, Potassium Feldspar, Quartz

Shape:

☐ Flakes ☐ Needles ☐ Plates ☑ Multiple minerals, no shape

Form:

☐ Euhedral ☑ Subhedral ☐ Anhedral

1) Grain Size:

☐ VC:>50mm ☐ C:>5 to <50mm ☑ M:>1 to <5mm

☐ F:>.1 to <1mm ☐ VF:.01 to >.1mm ☐ G:<.01mm

Fabric:

☑ Massive ☐ Planar ☐ Linear

Grain-size Texture:

☑ Equigranular ☐ Seriate ☐ Bimodal ☐ Trimodal

Rock Name: __Pink Granite (PG)___

[x] Igneous --- [ ] Volcanic [x] Plutonic

[x] Felsic [ ] Intermediate [ ] Mafic

[ ] Metamorphic ---

[ ] Gneiss [ ] Hornfel [ ] Marble [ ] Quartzite [ ] Schist [ ] _______

[ ] Sedimentary ---

[ ] Clastic --- [ ] Arenite [ ] Wacke [ ] Mudstone

[ ] Chemical --- [ ] Limestone

[ ] Metasomatic --- [ ] Altered [ ] Chalcedony [ ] Chert

[ ] Other --- [ ] Petrified Wood [ ] Quartz

Weathered Surface: Color:__10YR 7/4__

[x] Chemical --- [ ] Dark Patina [ ] Glossy Patina [ ] White Patina

[x] Oxidized (FeOx)

[x] Mechanical --- [ ] Joint Fracture [ ] Water Worn [x] Weathered Crust

Rock Color: __5G 7/2__

Constituent Structure:

Description: __Massive Granite__

1) Mineralogy:

Name(s):__Hornblende, Biotite, Plagioclase, Potassium Feldspar, Quartz__

Shape:

[ ] Flakes [ ] Needles [ ] Plates [x] Multiple minerals, no shape

Form:

[ ] Euhedral [x] Subhedral [ ] Anhedral

1) Grain Size:

[ ] VC:>50mm [ ] C:>5 to <50mm [x] M:>1 to <5mm

[ ] F:>.1 to <1mm [ ] VF:.01 to >.1mm [ ] G:<.01mm

Fabric:

[x] Massive [ ] Planar [ ] Linear

Grain-size Texture:

[x] Equigranular [ ] Seriate [ ] Bimodal [ ] Trimodal

Rock Name: __Porphyritic Basalt (PB)__

[x] Igneous --- [ ] Volcanic [x] Plutonic

[ ] Felsic [ ] Intermediate [x] Mafic

[ ] Metamorphic ---

[ ] Gneiss [ ] Hornfel [ ] Marble [ ] Quartzite [ ] Schist [ ] _______

[ ] Sedimentary ---

[ ] Clastic --- [ ] Arenite [ ] Wacke [ ] Mudstone

[ ] Chemical --- [ ] Limestone

[ ] Metasomatic --- [ ] Altered [ ] Chalcedony [ ] Chert

[ ] Other --- [ ] Petrified Wood [ ] Quartz

Weathered Surface: Color: __10YR 6/2__

[x] Chemical --- [ ] Dark Patina [ ] Glossy Patina [ ] White Patina

[x] Oxidized (FeOx)

[x] Mechanical --- [ ] Joint Fracture [ ] Water Worn [x] Weathered Crust

Rock Color: __5GY 5/1__

Constituent Structure:

Description: __Massive__

1) Mineralogy:

Name(s): __Hornblende, Plagioclase__

Shape:

[ ] Flakes [ ] Needles [ ] Plates [x] Multiple minerals, no shape

Form:

[x] Euhedral [ ] Subhedral [ ] Anhedral

1) Grain Size:

[ ] VC:>50mm [ ] C:>5 to <50mm [x] M:>1 to <5mm

[ ] F:>.1 to <1mm [ ] VF:.01 to >.1mm [ ] G:<.01mm

Fabric:

[x] Massive [ ] Planar [ ] Linear

Grain-size Texture:

[x] Equigranular [ ] Seriate [ ] Bimodal [ ] Trimodal

Rock Name: Light Pink Granite (LPG)

☑ Igneous --- ☐ Volcanic ☑ Plutonic

☑ Felsic ☐ Intermediate ☐ Mafic

☐ Metamorphic ---

☐ Gneiss ☐ Hornfel ☐ Marble ☐ Quartzite ☐ Schist ☐ _______

☐ Sedimentary ---

☐ Clastic --- ☐ Arenite ☐ Wacke ☐ Mudstone

☐ Chemical --- ☐ Limestone

☐ Metasomatic --- ☐ Altered ☐ Chalcedony ☐ Chert

☐ Other --- ☐ Petrified Wood ☐ Quartz

Weathered Surface: Color: 5YR 7/4

☑ Chemical --- ☐ Dark Patina ☐ Glossy Patina ☐ White Patina

☑ Oxidized (FeOx)

☑ Mechanical --- ☐ Joint Fracture ☐ Water Worn ☑ Weathered Crust

Rock Color: 5YR 8/2

Constituent Structure:

Description: Massive

1) Mineralogy:

Name(s): Biotite, Plagioclase, Potassium Feldspar, Quartz

Shape:

☐ Flakes ☐ Needles ☐ Plates ☑ Multiple minerals, no shape

Form:

☐ Euhedral ☐ Subhedral ☑ Anhedral

1) Grain Size:

☐ VC:>50mm ☐ C:>5 to <50mm ☑ M:>1 to <5mm

☐ F:>.1 to <1mm ☐ VF:.01 to >.1mm ☐ G:<.01mm

Fabric:

☑ Massive ☐ Planar ☐ Linear

Grain-size Texture:

☑ Equigranular ☐ Seriate ☐ Bimodal ☐ Trimodal

Rock Name: __Green Dacite (GD)___

☑ Igneous --- ☑ Volcanic ☐ Plutonic

☐ Felsic ☑ Intermediate ☐ Mafic

☐ Metamorphic ---

☐ Gneiss ☐ Hornfel ☐ Marble ☐ Quartzite ☐ Schist ☐ _______

☐ Sedimentary ---

☐ Clastic --- ☐ Arenite ☐ Wacke ☐ Mudstone

☐ Chemical --- ☐ Limestone

☐ Metasomatic --- ☐ Altered ☐ Chalcedony ☐ Chert

☐ Other --- ☐ Petrified Wood ☐ Quartz

Weathered Surface: Color: __5Y 6/2__

☑ Chemical --- ☐ Dark Patina ☐ Glossy Patina ☐ White Patina

☑ Oxidized (FeOx)

☑ Mechanical --- ☐ Joint Fracture ☑ Water Worn ☐ Weathered Crust

Rock Color: __5G 7/2__

Constituent Structure:

Description: __Porphyritic Dacite__

1) Mineralogy:

Name(s):__xxxxx__

Shape:

☐ Flakes ☐ Needles ☐ Plates ☑ Grains too small

Form:

☐ Euhedral ☐ Subhedral ☐ Anhedral

1) Grain Size:

☐ VC:>50mm ☐ C:>5 to <50mm ☐ M:>1 to <5mm

☐ F:>.1 to <1mm ☑ VF:.01 to >.1mm ☐ G:<.01mm

Fabric:

☑ Massive ☐ Planar ☐ Linear

Grain-size Texture:

☑ Equigranular ☐ Seriate ☐ Bimodal ☐ Trimodal

2) Mineralogy:
Name(s): Plagioclase Phenocrysts
Shape:

- [ ] Flakes
- [ ] Needles
- [ ] Plates
- [x] Prisms

Form:

- [x] Euhedral
- [ ] Subhedral
- [ ] Anhedral

2) Grain Size:

- [ ] VC: >50mm
- [ ] C: >5 to <50mm
- [x] M: >1 to <5mm
- [x] F: >.1 to <1mm
- [ ] VF: .01 to >.1mm
- [ ] G: <.01mm

Fabric:

- [x] Massive
- [ ] Planar
- [ ] Linear

Grain-size Texture:

- [ ] Equigranular
- [x] Seriate
- [ ] Bimodal
- [ ] Trimodal

Rock Name: __Aplite (AP)___

☑ Igneous --- ☐ Volcanic ☑ Plutonic

☑ Felsic ☐ Intermediate ☐ Mafic

☐ Metamorphic ---

☐ Gneiss ☐ Hornfel ☐ Marble ☐ Quartzite ☐ Schist ☐ ________

☐ Sedimentary ---

☐ Clastic --- ☐ Arenite ☐ Wacke ☐ Mudstone

☐ Chemical --- ☐ Limestone

☐ Metasomatic --- ☐ Altered ☐ Chalcedony ☐ Chert

☐ Other --- ☐ Petrified Wood ☐ Quartz

Weathered Surface: Color:__10R 6/4__

☐ Chemical --- ☐ Dark Patina ☐ Glossy Patina ☐ White Patina

☐ Oxidized (FeOx)

☑ Mechanical --- ☐ Joint Fracture ☐ Water Worn ☑ Weathered Crust

Rock Color: __5YR 7/4__

Constituent Structure:

Description: __Massive__

1) Mineralogy:

Name(s):__Biotite, Potassium Feldspars, Quartz__

Shape:

☐ Flakes ☐ Needles ☐ Plates ☑ Multiple minerals, no shape

Form:

☐ Euhedral ☐ Subhedral ☑ Anhedral

1) Grain Size:

☐ VC:>50mm ☐ C:>5 to <50mm ☐ M:>1 to <5mm

☑ F:>.1 to <1mm ☐ VF: .01 to >.1mm ☐ G:<.01mm

Fabric:

☑ Massive ☐ Planar ☐ Linear

Grain-size Texture:

☑ Equigranular ☐ Seriate ☐ Bimodal ☐ Trimodal

Rock Name: Gabbro (G)

☑ Igneous --- ☐ Volcanic ☑ Plutonic

☐ Felsic ☐ Intermediate ☑ Mafic

☐ Metamorphic ---

☐ Gneiss ☐ Hornfel ☐ Marble ☐ Quartzite ☐ Schist ☐ _______

☐ Sedimentary ---

☐ Clastic --- ☐ Arenite ☐ Wacke ☐ Mudstone

☐ Chemical --- ☐ Limestone

☐ Metasomatic --- ☐ Altered ☐ Chalcedony ☐ Chert

☐ Other --- ☐ Petrified Wood ☐ Quartz

Weathered Surface: Color: 5YR 4/4

☑ Chemical --- ☐ Dark Patina ☐ Glossy Patina ☐ White Patina

☑ Oxidized (FeOx)

☑ Mechanical --- ☐ Joint Fracture ☐ Water Worn ☑ Weathered Crust

Rock Color: 5GY 5/1

Constituent Structure:

Description: Massive

1) Mineralogy:

Name(s): Pyroxene, Plagioclase

Shape:

☐ Flakes ☐ Needles ☐ Plates ☑ Multiple grains, no shape

Form:

☐ Euhedral ☑ Subhedral ☐ Anhedral

1) Grain Size:

☐ VC: >50mm ☐ C: >5 to <50mm ☑ M: >1 to <5mm

☐ F: >.1 to <1mm ☐ VF: .01 to >.1mm ☐ G: <.01mm

Fabric:

☑ Massive ☐ Planar ☐ Linear

Grain-size Texture:

☑ Equigranular ☐ Seriate ☐ Bimodal ☐ Trimodal

Rock Name: __Quartz (Qtz)___

☐ Igneous --- ☐ Volcanic ☐ Plutonic

☐ Felsic ☐ Intermediate ☐ Mafic

☐ Metamorphic ---

☐ Gneiss ☐ Hornfel ☐ Marble ☐ Quartzite ☐ Schist ☐ _______

☐ Sedimentary ---

☐ Clastic --- ☐ Arenite ☐ Wacke ☐ Mudstone

☐ Chemical --- ☐ Limestone

☐ Metasomatic --- ☐ Altered ☐ Chalcedony ☐ Chert

☑ Other --- ☐ Petrified Wood ☑ Quartz

Weathered Surface: Color:__Varies__

☐ Chemical --- ☐ Dark Patina ☐ Glossy Patina ☐ White Patina

☐ Oxidized (FeOx)

☐ Mechanical --- ☐ Joint Fracture ☐ Water Worn ☐ Weathered Crust

Rock Color: __Varies__

Constituent Structure:

Description: __Massive__

1) Mineralogy:

Name(s):__Quartz__

Shape:

☐ Flakes ☐ Needles ☐ Plates ☑ Grains too small

Form:

☐ Euhedral ☐ Subhedral ☑ Anhedral

1) Grain Size:

☐ VC:>50mm ☐ C:>5 to <50mm ☐ M:>1 to <5mm

☐ F:>.1 to <1mm ☑ VF:.01 to >.1mm ☐ G:<.01mm

Fabric:

☑ Massive ☐ Planar ☐ Linear

Grain-size Texture:

☐ Equigranular ☐ Seriate ☐ Bimodal ☐ Trimodal

Rock Name: __Andesite (And)__

☑ Igneous --- ☑ Volcanic ☐ Plutonic

☐ Felsic ☑ Intermediate ☑ Mafic

☐ Metamorphic ---

☐ Gneiss ☐ Hornfel ☐ Marble ☐ Quartzite ☐ Schist ☐ _______

☐ Sedimentary ---

☐ Clastic --- ☐ Arenite ☐ Wacke ☐ Mudstone

☐ Chemical --- ☐ Limestone

☐ Metasomatic --- ☐ Altered ☐ Chalcedony ☐ Chert

☐ Other --- ☐ Petrified Wood ☐ Quartz

Weathered Surface: Color: __Varies__

☑ Chemical --- ☐ Dark Patina ☐ Glossy Patina ☐ White Patina

☐ Oxidized (FeOx)

☑ Mechanical --- ☐ Joint Fracture ☐ Water Worn ☑ Weathered Crust

Rock Color: __Varies__
Constituent Structure:
Description: __2 with phenocrysts in a matrix__

1) Mineralogy:
Name(s):__Matrix (no shape or form)__
Shape:

☐ Flakes ☐ Needles ☐ Plates ☐ Grains too small

Form:

☐ Euhedral ☐ Subhedral ☐ Anhedral

1) Grain Size:

☐ VC:>50mm ☐ C:>5 to <50mm ☐ M:>1 to <5mm

☑ F:>.1 to <1mm ☐ VF:.01 to >.1mm ☐ G:<.01mm

Fabric:

☑ Massive ☐ Planar ☐ Linear

Grain-size Texture:

☑ Equigranular ☐ Seriate ☐ Bimodal ☐ Trimodal

2) Mineralogy:
Name(s):__Plagioclase Pyroboles__
Shape:

- [ ] Flakes
- [ ] Needles
- [x] Plates
- [ ] Grains too small

Form:

- [x] Euhedral
- [ ] Subhedral
- [ ] Anhedral

2) Grain Size:

- [ ] VC: >50mm
- [ ] C: >5 to <50mm
- [x] M: >1 to <5mm
- [ ] F: >.1 to <1mm
- [ ] VF: .01 to >.1mm
- [ ] G: <.01mm

Fabric:

- [x] Massive
- [ ] Planar
- [ ] Linear

Grain-size Texture:

- [ ] Equigranular
- [x] Seriate
- [ ] Bimodal
- [ ] Trimodal

BIOGRAPHY OF THE AUTHOR

Louis Fortin was born in Lewiston, Maine on May 10, 1983. He was raised in Auburn, Maine and graduated from Edward Little High School in 2001. He attended the University of Maine and graduated in 2006 with a Bachelor's degree in Anthropology. He stayed at the University of Maine and entered the Quaternary and Climate Studies graduate program in the fall of 2006.

Louis is a member of the Society for American Archaeology (SAA), the American Anthropological Association (AAA), and the Lambda Alpha Honor Society for Anthropology. After receiving his degree, Louis will be going to Washington State University for their Ph.D. program in Anthropology. Louis is a candidate for the Master of Science degree in Quaternary and Climate Studies from The University of Maine in August, 2008.