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# Examination of the 500,000-Year Climate Record in Ice at Mt. Moulton, West Antarctica


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**Final Report for Period:** 09/2000 - 05/2002**Submitted on:** 09/09/2002**Principal Investigator:** Zielinski, Gregory A.**Award ID:** 0049041**Organization:** University of Maine**Title:**

Examination of the 500,000-Year Climate Record in Ice at Mt. Moulton, West Antarctica

**Project Participants****Senior Personnel****Name:** Zielinski, Gregory**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Mayewski, Paul**Worked for more than 160 Hours:** Yes**Contribution to Project:****Post-doc****Graduate Student****Name:** Carpenter, Kevin**Worked for more than 160 Hours:** No**Contribution to Project:**

Field Assistant with salary support for field time

**Name:** Voisin, Daniel**Worked for more than 160 Hours:** No**Contribution to Project:**

Field Assistant with salary support for field time

**Undergraduate Student****Technician, Programmer****Name:** Sneed, Sharon**Worked for more than 160 Hours:** No**Contribution to Project:**

Laboratory Technician, Ion Chromatography

**Name:** Whitlow, Sallie**Worked for more than 160 Hours:** No**Contribution to Project:**

Laboratory Technician, Ion Chromatography

**Other Participant****Research Experience for Undergraduates****Organizational Partners****New Mexico Tech**

New Mexico Tech was the lead institution in this collaborative research project.

### **Other Collaborators or Contacts**

An additional project to work on the isotopic and gas records available in the Mt. Moulton samples collected in this study was supported by NSF. The two institutions involved in that project were Pennsylvania State University and the University of Colorado. Results were shared among the various institutions as a means of evaluating the reliability of the climatic record available in Mt. Moulton ice.

### **Activities and Findings**

#### **Research and Education Activities:**

This project was a pilot project to determine if the ice on Mt. Moulton provides a reliable record of past climatic conditions. The area of study is a several hundred-meter section of blue ice (Trench A) that spans the time period from approximately the early Holocene to over 492k years ago. Dating control is obtained through radiometrically-dated tephra layers (i.e., air fall deposits) within the section (Figure 1) originating from the adjacent Mt. Berlin. Fieldwork during the 1999-2000 field season included the trenching of the complete section with electric chain saws mounted on a wheeled frame. Blocks were extracted and cut-down to sample a continuous section from the 50-cm depth. Several overlapping trenches, some completed to a depth of 1 meter, were sampled to test the validity of sampling at the 50-cm depth. Individuals from New Mexico Tech, collaborators in the project, developed a detailed map of visible tephra layers using a GPS and collected additional tephra samples with the goal of dating layers not presently dated and for refining existing ages. Once samples were brought back to the lab, a glaciochemistry time series was developed for comparison with other such records from Antarctica as well as from Greenland ice cores. Through the use of an ion chromatograph, concentrations of the major ions found in the atmosphere are determined. The suite of chemical species measured includes  $\text{Na}^+$ ,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{K}^+$ ,  $\text{NH}_4^+$ ,  $\text{Cl}^-$ ,  $\text{SO}_4^{2-}$ , and  $\text{NO}_3^-$ . One sample per 20 cm of ice was analyzed over the last ~150k to obtain a coarsely-resolved record to test the reliability of the record. Figure 1 shows the relationship between the  $\text{Na}^+$  time series and the location of the dated tephra layers, thus the age model developed for Trench A. A similarity in broad trends would suggest that Mt. Moulton ice contains a valid paleoclimatic record thereby warranting more detailed (i.e., a much higher resolution) sampling and analyses than done in this study. As this was a pilot project the only presentations made were at meetings of the U.S. Ice Core Working Group and at meetings for the Siple Dome ice-coring project.

#### **Findings:**

Upon completing the glaciochemical analyses it was concluded that there needs to be further testing of the section to reach an accurate conclusion on the record contained in Mt. Moulton ice. Figure 2 shows the  $\text{Na}^+$  time series for Mt. Moulton compared to that for part of the Vostok record. Similar trends appear to exist; however, there is an offset in the two records. It appears that the dating of the Mt. Moulton record is about 5000 years too old in some places with the need for some minor stretching and compressing in between the dated tephra layers to make an acceptable match with the Vostok record. Isotopic records from some sections of Mt. Moulton, as developed by Penn State and Univ. Colorado, seem to match other ice-core records particularly during the last interglacial. However, isotopic trends in other parts of the Moulton record fail to match the same sections in other ice-core records from Antarctica. Consequently, two additional proposals have been submitted, one to evaluate ice structure through radar analyses, the other to test potential problems with gas measurements. Both of these proposed studies hopefully will provide insight into the possible dating problems of the Moulton record.

#### **Training and Development:**

The two graduate field assistants gained valuable experience in working in the field in Antarctica and the overall process of collecting field data of this type for paleoclimatic research.

#### **Outreach Activities:**

As this study was a pilot project, the opportunity to relay our findings to the general public has not occurred.

### **Journal Publications**

### **Books or Other One-time Publications**

### **Web/Internet Site**

### Other Specific Products

**Product Type:** Physical collection (samples, etc.)

**Product Description:**

Ice collected in this project is available for additional analyses by other investigators

**Sharing Information:**

Other investigators are aware of the availability of these samples through Ice Core Working Group meetings and the like. Once it is established that a viable record is available from this site, there probably will be proposals submitted by the community to work on these samples.

### Contributions

**Contributions within Discipline:**

The equipment developed to sample the Moulton section could be used for other blue ice sampling. Using electric chain saws eliminate the possibility of contamination for glaciochemical studies. The findings of this study still keep the possibility open that the very lengthy records in blue ice areas may be useable for extending our knowledge of the climate system over time periods of several hundreds of thousand years.

**Contributions to Other Disciplines:**

There are no substantial contributions to other disciplines from this pilot project.

**Contributions to Human Resource Development:**

Two graduate students participated in the field program thereby expanding on their knowledge of the techniques involved in this type of paleoclimatic research. They also were able to obtain a first-hand feeling for the Antarctica environment. Several undergraduates assisted in processing the core for laboratory analysis.

**Contributions to Resources for Research and Education:**

There are no other contributions than those previously reported.

**Contributions Beyond Science and Engineering:**

The nature of this project (i.e., pilot project) did not provide the opportunity to contribute beyond the science and engineering fields.

### Categories for which nothing is reported:

Any Journal

Any Book

Any Web/Internet Site

Figure 1

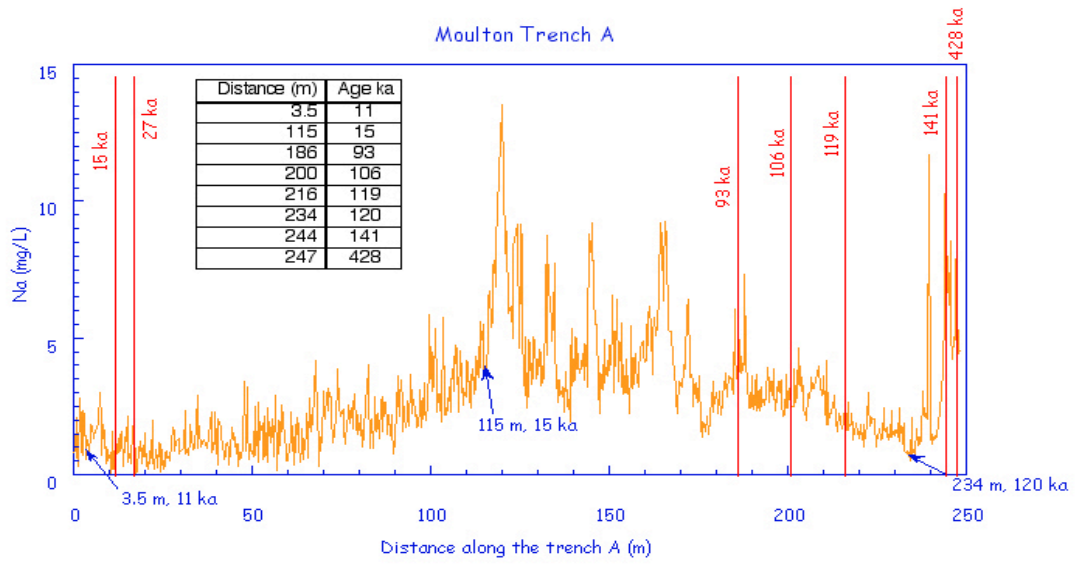


Figure 2

