GISP2 Electrical Conductivity Measurements

REFERENCES:

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DATA DESCRIPTION:

The electrical conductivity measurement (ECM) measures the direct current between two electrodes with a potential difference of 2,100 volts. The electrodes have a surface area of 1 x 2 mm and are 1 cm apart. The electrodes are made of bronze. The current flowing through the electrodes is digitally recorded every millimeter. In an aqueous solution, all the ions can participate in the conduction of an electrical charge. In ice the movement of the ions is restricted by the ice lattice which reduces the ability of the ions to conduct a direct current. The direct current is conducted by the movement of protons associated with the H+ of strong acids; hence, the ECM current is considered to be a measure of the acidity of the ice. The ECM has a spatial resolution of <1 centimeter (cm), yet is rapid enough that it is practical to measure it continuously along the entire core. These attributes make the ECM ideally suited for investigation of short duration phenomena which influence the acid/base balance of the ice.

Two-meter sections of the core were passed under a horizontal bandsaw to remove a 5 cm wide slab along the axis of the core. A rail mounted microtome knife or milling machine was used to shave the saw cut surface to remove surface contamination and surface irregularities. A computer controlled the motion of electrodes along the axis of the core and recorded the ECM current for each millimeter of travel. The operator used a hand switch to identify locations where the electrodes encountered fractures in the core. These data were removed from the data set. A similar system was used on the GRIP core.

Instrument related artifacts adversely influence some aspects of the GISP2 ECM record. The ECM current is influenced by the temperature of the ice when the measurement was made. A correction based on the surface temperature of the ice was made to determine what the ECM current would be at a temperature of -20_C. When an ice core was undergoing a temperature transition, the surface temperature did not represent the temperature of the volume being measured. There may be sections two to 50 m in length that have a several percent variation from the correct ECM current because of the temperature uncertainty. We now hold the ice at a constant temperature for 24 hours prior to measurement to avoid this complication. An error of several percent over hundreds of meters may have occurred due to variations in the surface conditions of the electrodes. Between 1100 m and 1400 m, the core quality was low and there were numerous small pieces of ice per 2 m segment of core. There was also an intermittent problem

with the electrical grounding of the system. Both of these factors reduced the data quality in this section. Better methods of maintaining consistent electrode surface conditions have been instituted. The preamplifier was changed at a depth of 2250 m, which appears to have altered the response of the ECM instrumentation at levels below 0.1 microamps. This results in an artifact which incorrectly suggests that stadial periods have a slightly lower ECM current above 2250 m than below 2250 m. The design of the preamplifier has been stabilized to prevent this from recurring.