

THE BYRD ICE CORE: CONTINUOUS ACIDITY MEASUREMENTS AND SOLID ELECTRICAL CONDUCTIVITY MEASUREMENTS

by

C.U. Hammer and H.B. Clausen

(Geophysical Isotope Laboratory, University of Copenhagen, Haraldsgade 6, DK-2200 Copenhagen, Denmark)

and C.C. Langway Jr

(Ice Core Laboratory, Department of Geological Sciences, State University of New York at Buffalo, 4240 Ridge Lea Road, Amherst, New York 14226, U.S.A.)

The 2191.31 m long Byrd core was measured continuously, with 1 mm resolution, for strong acid concentrations. Most of the time was spent in retrieving core tubes from their racks, unpacking, fitting and repacking the core. The actual measurements, including cleaning the old core, only took about 10% of the total time. Two men, working for eight hours per day for seven days a week, completed the work in approximately 2½ months.

The cores were usually measured at -23°C , but a selection of 40 m samples were also measured at -14 and -33°C to infer the activation energy of electrical conduction in solid ice.

The purpose of the project was to investigate volcanic activity in the southern hemisphere and equatorial regions for the time period covered by the Byrd core. Because the Greenland ice record is generally alkaline during the last glaciation, acidity measurements cannot be used for this period although they do work for the Holocene (last 10.4 ka).

The Byrd core acidity data show pronounced seasonal variations over 40 ka. The section from 40 to 65 ka BP was heated during its flow to the core-hole site from the crest of the ice cap, ranging from 0°C for the bedrock core to some -10°C for that at 1700 m depth. This section therefore shows an increasing crystal size towards the bedrock and the seasonal signal is hard to see. It can, however, be estimated from the acidity profile that this section covers some 25 ka.

The main results of the project so far have been as follows.

(1) Dating of the Byrd core.

(2) Evidence of accumulation rates 2.5 times lower than present from 30 to 18 ka BP, increasing towards present values from 18 to 11 ka BP.

(3) Detection of some 20 to 30 major volcanic eruptions which strongly increased ice acidity. The acid peaks are not found in association with the well-known visible ash layers in the core reported by A J Gow of CRREL.

(4) Discovery of a major volcanic event. One of the signals shows an eruptive period of some 150 a with tremendous volcanic acid deposition. The average acidity is 5 to 6 times that of any other section of the core, annual values often reaching 10 to $15 \mu\text{eq H}^+ \text{kg}^{-1}$. This extreme volcanic activity occurs at exactly the time when precipitation and δO^{18} values start to increase, i.e. 17 ka BP. Is it a coincidence that such volcanic activity occurred just when the transition period (from the late glacial to the Holocene) started? Did it trigger the end of the last glaciation?

Further results from the Byrd core analysis will be published later. The work is in progress and the tentative title of the report is "Acidity along the Antarctic ice core - 70,000 years of seasonal changes and southern hemisphere volcanism" by C U Hammer, H B Clausen and C C Langway Jr.