

A PRELIMINARY STUDY OF ICE CORE CHRONOLOGY
AT DOME FUJI STATION, ANTARCTICA

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Abstract: A 112.59 m-deep ice core was drilled at Dome Fuji Station by a JARE-34 party in 1993 when a pilot hole was prepared for a deep core drilling operation. A preliminary examination was made for ice core chronology by two signals: one electric conductivity peaks measured in the home laboratory and the other field observation results obtained by JARE-36 party on the deeper part of the core. The electric conductivity peak analyses suggest the same 5 volcanic eruptions, in 1464 AD, 1259 AD, 865 AD, 639 AD and 346 BC, reported for the ice core of Byrd Camp, Antarctica. Field observations for ECM and crystal size distributions suggest that the period 374 m depth level corresponds to the end of Wisconsin ice period. The results suggest that accumulation rate at Dome Fuji Station is between 2.5 and 3.0 cm of water equivalent/year, and the end of Wisconsin-Holocene Transition will be found between depths of 340 and 400 m. The depth-age curves for the core at Dome Fuji Station are obtained from the surface (at present) to 400 m (at 12000 years BP).

1. Introduction

Estimation of a depth-age relationship for the Dome Fuji core is essential for reconstructing the paleoclimate in analyzing the core samples. The first attempt was carried out at Dome Camp (77°00'S, 35°00'E) and an accumulation rate of 3.2 cm of water equivalent/year from 1966 to 1985 was obtained from a study of tritium content in a 5 m-deep surface pit (AGETA *et al.*, 1989).

A 112.59 m-deep ice core was drilled at Dome Fuji Station (77°19'01"S, 39°42'12"E) by a JARE-34 party in 1993 when a pilot hole was made for a deep core drilling operation. The core was analyzed in a cold/warm room laboratory at the National Institute of Polar

Research, Tokyo (WATANABE *et al.*, 1997). The deeper core was obtained by a JARE-36 party in 1995 and the core analyses were carried out in situ in the field station. The results in the laboratory measurements for the pilot core together with in situ results for the deeper cores support a preliminary consideration of a depth-age relationship for the Dome Fuji core, which will help the further research on the deeper part of the core to be recovered.

2. Volcanic Chronology

A continuous ECM (Electric Conductivity Measurement) profile was obtained along the core as shown in Fig. 1 (WATANABE *et al.*, 1997) and compared with detailed results of a comprehensive study of the Byrd Surface Camp ice core (LANGWAY *et al.*, 1994, 1995; HAMMER *et al.*, 1994, 1997). Five major peaks in the ECM profile at depths of 29.1, 37.8, 60.4, 69.2, 97.8 m were identified as the 1464 AD, 1259 AD, 865 AD, 639 AD and 346 BC volcanic eruption signals respectively. The detailed ECM curves for the four deeper peaks are shown in Figs. 2-5. These findings result in averaged accumulation rate values of 2.5, 2.5, 2.9, 2.9 and 2.6 cm of water equivalent/year respectively for the period between the year of core-drilling and each volcanic event year. These values are lower than the value

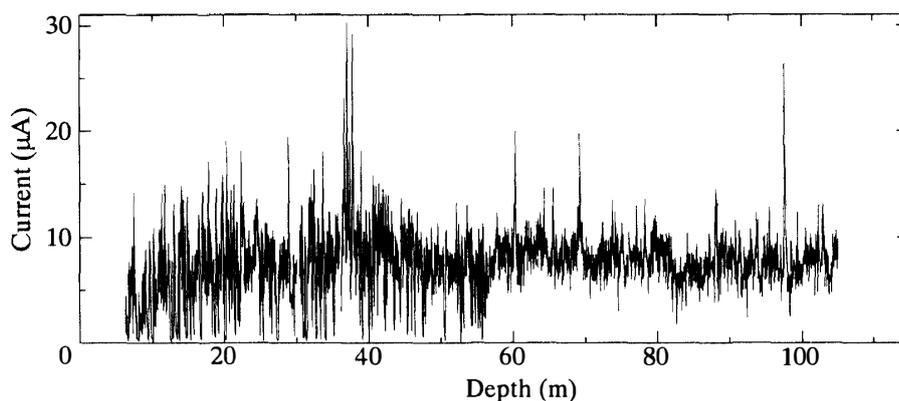


Fig. 1. A ECM profile on the Dome Fuji shallow ice core, Antarctica.

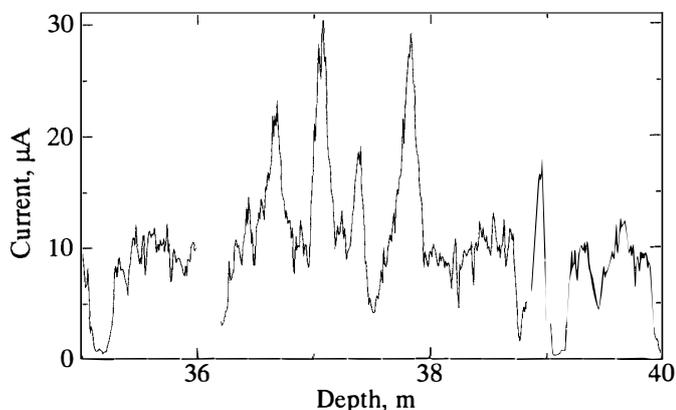


Fig. 2. A detailed ECM curve around a depth of 38 m.

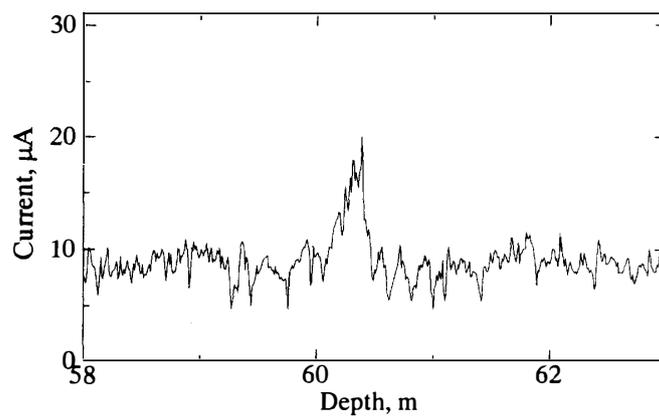


Fig. 3. A detailed ECM curve around a depth of 60 m.

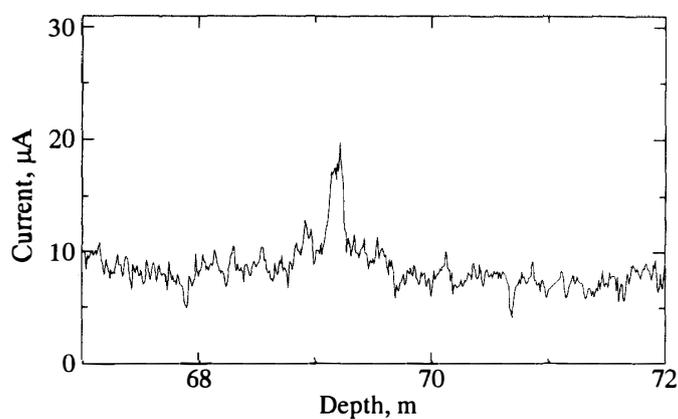


Fig. 4. A detailed ECM curve around a depth of 69 m.

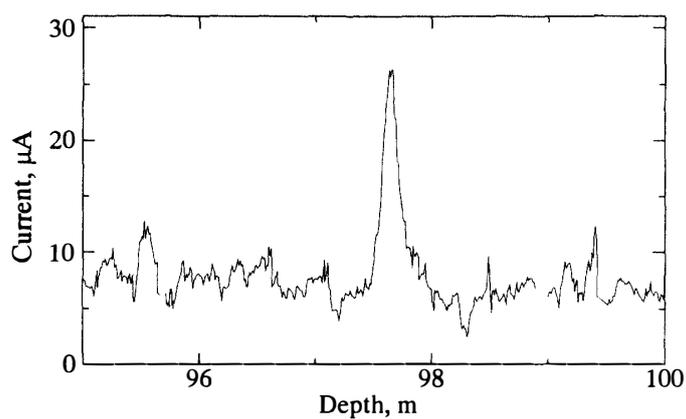


Fig. 5. A detailed ECM curve around a depth of 98 m.

obtained by AGATA *et al.* (1989), suggesting fluctuation in the accumulation rate around Dome Fuji Station. A few of the firn core samples in the upper part were broken and possibly shortened during transportation, which might cause the sedimentation rate to

appear to be smaller than it is.

3. Ice Ages Estimated by Field Measurements by the JARE-36 Party

ECM and crystal size measurements were conducted in the snow trench laboratory at Dome Fuji Station during a deep coring operation by JARE-36 party between 1995 and 1996. The results suggested that the ice core at the end of the Wisconsin ice period occurred around a depth of 374 m and the average accumulation rate was 3 cm of water equivalent/year for the Holocene ice period (AZUMA *et al.*, unpublished). The suggestion is based on comparison of the the results of Dome Fuji ice core with those of Byrd Station and Vostok ice core analyses (HAMMER *et al.*, 1994, 1997; LIPENKOV *et al.*, 1989).

4. Depth-Age Calculation

The results suggested that the accumulation rate at Dome Fuji Station is approximately between 2.5 and 3.0 cm of water equivalent/year between the Wisconsin period and the present. Two curves are calculated by using each accumulation rate above as shown in Fig. 6. The depth-age relationship at Dome Fuji Station will probably be located between these two curves, suggesting that the end of the Wisconsin-Holocene transition will occur between depths of 340 and 400 m.

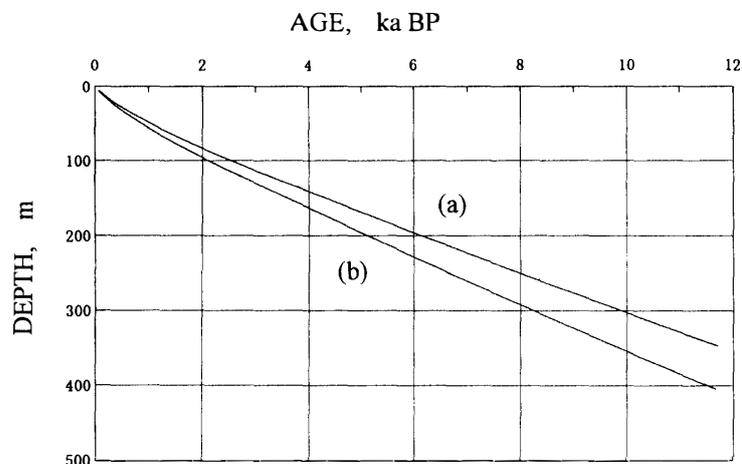


Fig. 6. A depth-age curves calculated with accumulation rate values of 2.5 (a) and 3.0 (b) cm of water equivalent/year.

5. Discussions

Volcanic chronology tentatively obtained from ECM measurements should be studied further with chemistry data, which has not been done yet. However, the ECM peak at a depth of 37.8 m (Fig. 2) indicates a feature similar to that found on the cores from Byrd Surface Camp and South Pole for the 1259 AD event, following a triplet of high peaks (LANGWAY *et al.*, 1995).

Depth hoar layers near the surface were too weak to keep the core shapes during the

drilling operation, core-recovery from the drill and the transportation from the field to Japan. Apparently some portions of the shallower part were damaged, which caused severe difficulty in back-up laboratory processing for the core-depth accuracy. It is difficult to estimate the sedimentation rate though we are able to identify the marked horizons in the core in the shallower parts. Further measurements of core chemistry and studies of the deeper part will bring more detailed information on the core chronology.

Acknowledgments

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