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OXYGEN-ISOTOPE RECORDS COVERING THE LAST 2 KA AT SOUTH POLE

by

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ABSTRACT

Two cores which had been drilled to a depth of over 200 m were recovered near Amundsen–Scott South Pole Station during the 1980–82 field seasons. A firn core drilled from 3 to 19 m depth was taken in December 1982 from a site about 5 km distant from the two others.

The cores cannot be used to study the seasonal $\delta^{18}O$ cycle, because: (i) detailed sampling (1–2 cm increments) provides evidence of isotopic enrichment in the 1 m core sections during storage, both in the field and in the laboratory cold-room, and (ii) low accumulation (9.2 g cm^{-2} a^{-1}, given by Jouzel and others 1983) led to missing years or parts thereof. Estimates of the proportion of missing years range from 1 in 10 (J.R. Petit, quoted in Mosley-Thompson and Thompson 1982) to 1 in 20 (Jouzel and others 1983).

The cores are still useful for studies on a decadal or longer time-scale. The average $\delta^{18}O$ value of detailed measurements of the upper 40 m of the 1980 firn core differs by only 0.14 ± 0.05‰ from the average of measurements made about 16 months earlier. Thus, although storage in the cold-room changed the isotopic composition of the outer firn layer, the bulk of the firn core was unaffected. The two measurement series of this profile show a high correlation (r^2 = 0.75, $P < 10^{-6}$) when smoothed with a 1 m moving average (equivalent to 4–7 years' accumulation) in order to reduce noise and the effect of enrichment at the ends of the 1 m sections.

In both long cores and in the short core which was taken in 1982 the $\delta^{18}O$ – depth profile shows a long-term trend with superimposed shorter fluctuations. The seasonal signal soon disappears but variability of up to 2‰ on a 3–5 year time-scale persists at depth. Linear-correlation analysis shows a significant correlation between the 1980 firn core and the 1982 short core (r^2 = 0.32, P = 0.011) for a 1 m moving average of samples 0.25 m long. Some correlation is also observed between the deeper ice parts of the 1982 core (106–227 m) and the 1981 core (100–202.4 m) (r^2 = 0.087, P = 0.00043, 1 m moving average), if the relative depths are shifted by 3.75 m. A firm time-scale for both cores is needed to determine whether such a shift corrects for an artefact of the depth logs of the cores, or proves that no real correlation exists between the two cores.

Comparison of the long-term trend of the two South Pole cores with the 2.5 ka isotope climatic record from the 1979 Dome C core (Benoist and others 1982) and with the Law Dome core BHD record (Morgan 1985) again suggests possible correlation, but cannot prove it for lack of a firm time-scale. Collaboration with other investigators which brings together data on visible stratigraphy and density (personal communication from A.J. Gow), solid conductivity (Schwander unpublished), acid horizons (Langway and others 1988, this volume) and microparticles may solve this problem.

REFERENCES

Benoist J P, Jouzel J, Lorius C, Merlivat L, Pourchet M 1982 Isotope climatic record over the last 2.5 ka from Dome C, Antarctica ice cores. *Annals of Glaciology* 3: 17-22

Jouzel J, Merlivat L, Petit J R, Lorius C 1983 Climatic information over the last century deduced from a detailed isotopic record in the South Pole snow. *Journal of Geophysical Research* 88(C4): 2693-2703

Langway C C Jr, Clausen H B, Hammer C U 1988 An inter-hemispheric volcanic time-marker in ice cores from Greenland and Antarctica. *Annals of Glaciology* 10: 102-108

Morgan V I 1985 An oxygen isotope–climate record from the Law Dome, Antarctica. *Climatic Change* 7(4): 415-426

Mosley-Thompson E, Thompson L G 1982 Nine centuries of microparticle deposition at the South Pole. *Quaternary Research* 17(1): 1-13

Schwander J Unpublished Lufteinschluss im Eis von Grönland und der Antarktis; Messung der elektrischen Leitfähigkeit von Eisproben für klimatologische Anwendungen. (PhD thesis, Universität Bern, 1984)

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