

NITRATE IN COASTAL ANTARCTIC SHALLOW FIRN CORES: COMPARISON OF SEASONAL PATTERN AND OF TOTAL FLUX

(Abstract)

by

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With the intention of contributing to a better understanding of snow depth profiles used in reconstructing the southern hemisphere nitrate background we have measured Cl^- , NO_3^- , and SO_4^{2-} in firn cores from two coastal Antarctic locations (GvN = Ekströmisen 70°S , 8°W , and Filchner = Filchner-Ronne Ice Shelf 79°S , 57°W). The depth resolution chosen is 2 cm per sample (i.e. 36 and 14 samples per year, respectively).

The isotopic composition of the firn cores was concurrently measured, with equally high resolution (deuterium and ^{18}O data, W. Graf, private communication). The GvN core yields an average accumulation rate of 35 cm H_2O per year during the period 1979–86, while the Filchner core gives 14 cm H_2O per year during the period 1955–80. The net snow accumulation being relatively high allows precise determination of the year to year boundaries, as well as the relative contribution of individual seasons to the total net accumulation. This was achieved by combining the stable isotope data with the chemical tracers nss-sulfate (high concentration in summer) and sea salt (high Cl^- in autumn and winter). For the two individual locations this procedure allowed assessment of the glacial nitrate

concentration seasonality as well as comparing the yearly nitrate deposition.

The Filchner location shows a distinct seasonality with maximum concentrations in summer. For nearly half of the years covered we also find higher concentrations in winter. This higher nitrate in winter is always accompanied by high sea salt concentrations. We suggest therefore a mechanism making sea salt aerosol an additional deposition pathway for nitrate in winter. This means that we are not able to link the enhanced winter nitrate deposition to stratospheric denitrification directly. The GvN core does not show significant seasonality. This is presumably due to frequent snow drift events preventing signal conservation.

Although the individual accumulation rates differ by a factor of 2.5 the yearly nitrate deposition is in the same range ($4\text{--}11 \text{ kg NO}_3^- (\text{km}^{-2} \text{ a}^{-1})$) at both sites. This is caused by the different seasonal modulation of the net snow accumulation. At GvN low nitrate autumn precipitation prevails and keeps the yearly nitrate level constantly low (18–22 ppb). At Filchner, however, a high contribution of summer snow brings the yearly concentration average up to about 30–70 ppb.

26-YEAR HIGH RESOLUTION PROFILE OF MAJOR ANIONS IN SNOW FROM COATS LAND, ANTARCTICA

(Abstract)

by

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In January 1987, an 7.8 m core, with an age at the bottom of 26 years, was collected from a site approximately 150 km inland from Halley Station ($77^\circ 02.2' \text{S}$, $22^\circ 32' \text{W}$; altitude 1862 m a.s.l.); 10 m temperature $\approx -30^\circ\text{C}$; accumulation rate $\approx 14 \text{ g cm}^{-2} \text{ a}^{-1}$). The site lies some 140 km from the coast of the Weddell Sea and within the area bounded in winter by the polar vortex.

The core has been analysed at a frequency of ≈ 28 samples per accumulation year for sulphate, nitrate and chloride, and has been dated stratigraphically from the clear seasonal cycles in non sea salt sulphate (Mulvaney and Peel, 1988). With this resolution it is possible to examine the seasonal pattern of deposition of chemical species and their phase relationships.

Of particular interest is the possibility that ice cores may preserve evidence for disturbances in tropospheric chemistry, associated with the recent spring-time depletion of stratospheric ozone. It has been proposed that this is accompanied by a denitrification of the stratosphere during the winter months, implying enhanced levels of NO_x in the

late winter/spring troposphere and in precipitation. Our data reveal a strong seasonal signal in nitrate deposition, apparently peaking in spring. Similar behaviour has been reported by Wagenbach and others (1988) for nitrate in the atmospheric aerosol, in a 3-year sequence (1983–86) from Georg von Neumayer Station (70°S , 8°W). There does not appear to be any evidence in our data of an increase in spring-time nitrate deposition since the appearance of the Antarctic ozone hole in 1978.

REFERENCES

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