ACCUMULATION AND STABLE-ISOTOPE CONTENT IN THE HINTERLAND OF NEUMAYER STATION, ANTARCTICA, SINCE THE IGY 1957/58

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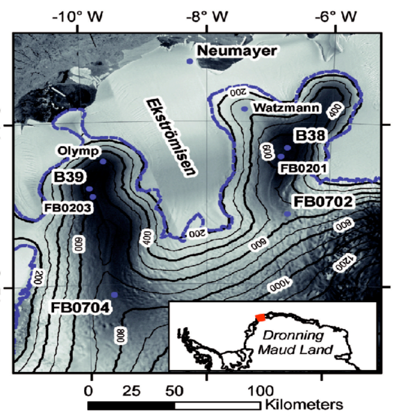
Fig. 1: Location Map



The map shows the location of the drilling sites in January 2007: B38, FB0702 are located on Halvarryggen and B39, FB0704 on Søråsen. Neumayer is the German wintering-over base on the ice shelf Ekströmisen. Olymp and Watzmann are geophysical observatories. The shallow firn cores FB0201 and FB0203 were drilled already in January 2002. Contour intervals are 100 m. Elevation are given with respect to WGS84. The insert map shows the location of the area under investigation (red) in Dronning Maud Land. The length scale is related to 71°S. The grounding line is taken from MODIS mosaic (Haran et al., 2006). The underlying image is from RADARSAT. (map by C. Wesche, AWI).

In January 2007 a German-Swiss team drilled four firn cores. The drilling sites were located on Halvfarryggen and Søråsen, two ice ridges in the hinterland of the German wintering-over base Neumayer (see ***figure 1***). The firn cores were named B38 (84 m), FB0702 (42 m) and B39 (78 m), FB0704 (36 m), respectively. The cores were drilled at elevations of 690 m, 539 m, 655 m, and 760 m, respectively (heights WGS84; pers. comm. C. Wesche). The cores were dated by annual layer counting assisted by tritium data (B38 and B39 only). All cores cover almost the snow accumulation since the IGY (1957/58). The oldest layers were deposited in 1960 (B38), 1959 (FB0702), 1935 (B39), and 1962 (FB0704).

Stable isotope content (oxygen–18) was measured with a depth resolution of 7 cm (B38, B39) and 5 cm (FB0702, FB0704). In addition, oxygen-18 and deuterium were measured on samples with 100 cm (B38, B39) and 50 cm (FB0702, FB0704) length, respectively (see Poster by Fernandoy and others). Di-electric profiling (DEP) was done at all four cores resulting in records for electric conductivity (see ***figure 2c***). The firn density was also calculated from the DEP data.

After the cores had been dated (see ***figure 2a, b, c***) annual means were calculated for oxygen-18 and accumulation rates (see ***figure 3 and 4***). Mean oxygen-18 content and accumulation rate were determined from yearly values for the hydrological **reference period 1961-1990.**

Resulting values are:

	B38	FB0702	B39	FB0704	
Elevation:	690	539	655	760	m WGS84
Oxygen-18:	-20.59 ±1.20	-24.32 ±1.37	-19.94 ±1.30	-22.76 ±1.21	‰ SMOW
Accumulation:	1230 ±323	587 ±180	799 ±216	483 ±109	kg m^{-2} a^{-1}

A strong gradient from the coast to the hinterland is observed for the accumulation rates. This makes it difficult to map surface mass balance in coastal aras. Rotschky et al. (2007) used a value of 173 kg $m^{-2}a^{-1}$, which was determined from a shallow firn core (1964-1995) at the site Watzmann. However, the results from the shallow cores FB0201 and FB0203 (1994-2001) with 1120 and 1110 kg $m^{-2}a^{-1}$, respectively, are in good accordance with this study. The summits of both Halvfarryggen and Søråsen are sites with extremely high accumulation rates, and thus might be suitable locations for deeper drillings. They would provide high resolution records for the past two millennia, one scope of the plans from IPICS (International partnership in ice core science).

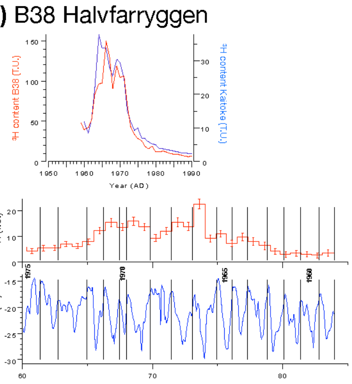
Temporal variation of oxygen-18 and accumulation was studied by linear regression analysis for the common period 1960-2006. It shows that there is no statistically significant change of either parameter in the time series, except for core FB0702. This may be due to local effects or dating ambiguities. Also the 2m air temperature, which has been recorded at Neumayer station since 1982, shows no trend. No trend in accumulation rates or surface mass balance is also in accordance with the findings described by Monaghan et al. (2006) for whole Antarctica.

Further, the annual means of accumulation rates and isotope content are are only weakly correlated with each other. For earlier studies in the area see also Oerter et al. (1999).

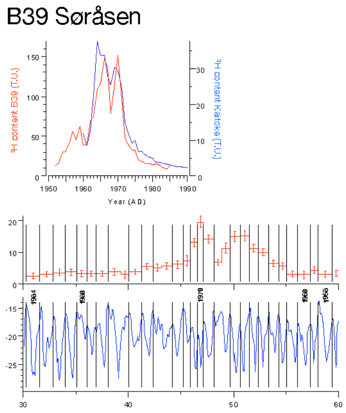
A common pattern of volcanic events was not detected in the DEP profiles (see ***figure 2c***).

Fig. 2: Dating of the cores

a) B38 Halvfarryggen



b) B39 Søråsen



Figures 2a and b are showing in the upper diagram the fit of the tritium depth profile (red curve) of the cores B38 and B39, respectively, to the distribution of the tritium content of precipitation (blue curve) at Kaitoke (New Zealand) (Data from IAEA GNIP). In the lower diagrams the tritium values (and their sdev) of B38 and B39, respectively, are shown as measured on the firn samples (red curve). The blue curve shows the $\delta^{18}O$ record of B38 and B39, respectively. The annual cycles are clearly visible and were used for layer counting. The annual layer boundaries are marked (black) and they indicate the austral summer (Dec/Jan).

c) DEP profiles

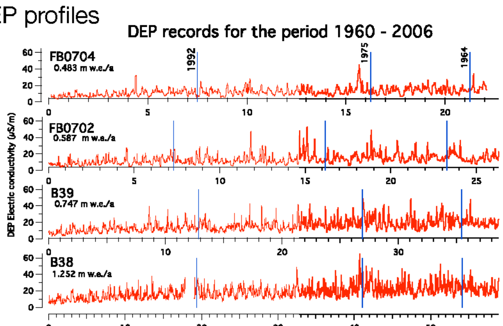


Figure 2c shows the DEP profiles for the four cores, plotted against the depth in metres water equivalent. It displays the coinciding period 1960-2006. The annual variation of the electric conductivity was also used to assist layer counting. There are no peaks from volcanic origin visible, which coincide in all four cores and thus could be used to date the core unambiguously. Well known are the acidic depositions from the eruptions of Mt. Pinatubo in 1991 (deposited 1992) or Mt. Agung in 1963 (deposited 1964). These years are marked in figure 2c. One peak with unknown origin appears around the year 1975. These examples show that it is difficult to use DEP peaks for dating in the coastal area. Comparing the DEP patterns an uncertainty of ±1 year for the dating is likely. However, a greater dating ambiguity has to be assumed for core FB0702, which also shows a larger accumulation gradient than the other cores (cf. figure 4).

Fig. 3: Time series of stable isotopes

Fig. 4: Time series of accumulation

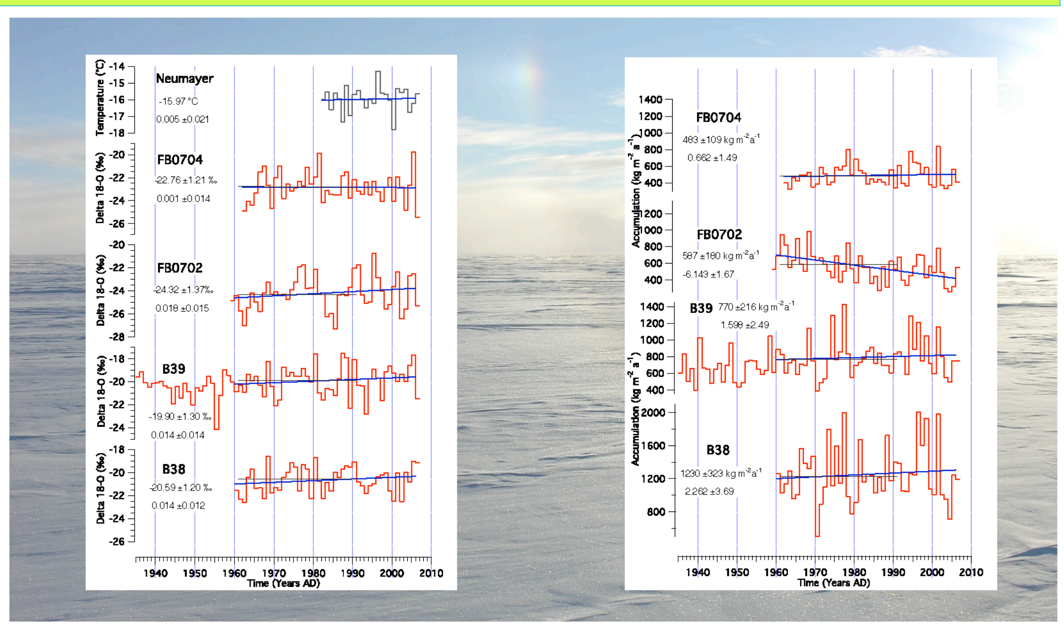


Figure 3 shows annual means of $\delta^{18}O$ and ***figure 4*** annual means of accumulation rates for the four cores. Numbers below the core labels give mean values for the period 1961-1990, also marked by a black line in the respective graph. The blue lines are linear regression lines for the period 1960-2006. The slope (and sdev) of these lines is given as well.

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