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Stable isotope content and snow accumulation between 1964 and 2007/08 along the ice divide from Kohnen-Station towards Dome Fuji, East Antarctica

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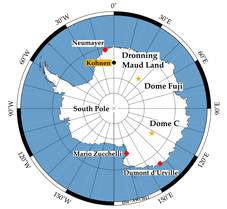
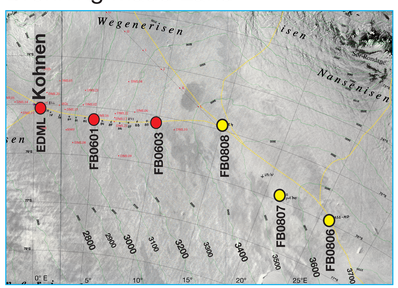


Fig. 1: Location of the firn cores in Dronning Maud Land



Map of Dronning Maud Land.
Detail of Satellite Image Map Dronning Maud Land 1 : 2 000 000, Draft Version 4.2, BKG Frankfurt am Main, Nov. 1998.
AWI firn cores Jan. 2004 & 2006 JASE firn cores Jan. 2008

Methods

The DEP measurements were carried out at AWI (Wilhelms 1998).
Stable isotope measurements were performed with a PICARRO L 1102-i analyser and a FINNIGAN DeltaS mass-spectrometer. Accuracy für δ18O better than 0.1‰, for d appr. 1‰.
Density values are from DEP where available or from bulk density measurements in the field.

Acknowledgement

The work of the Japanese-Swedish field team who drilled the firn cores as well as the assistance of York Schlomann and others for cutting the samples in the cold lab and doing isotope measurements at AWI is gratefully acknowledged.

References

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One IPY activity during the 2007/08 Antarctic field season was the Japanese-Swedish Antarctic Expedition (JASE) across Amundsenisen, Dronning Maud Land. The western end of the traverse route was the Swedish base WASA and the eastern end the Japanese base on Dome Fuji. The aim of this traverse was to get more detailed information from this part of the Antarctic high plateau and the snow accumulation of the past hundred years.
Various glaciological investigations were carried out. Amongst other things the team drilled three 10m firn cores at elevations between 3450 and 3650 m a.s.l. These cores extended the data set of three firn cores already drilled in January 2006 by AWI at elevations between 2892 m (Kohnen-Station) and 3300 m a.s.l. All cores cover at least 90 years of accumulation. The cores had been analysed with respect to di-electric properties (DEP) as well as stable-isotope content (δ18O, D) at AWI Bremerhaven.

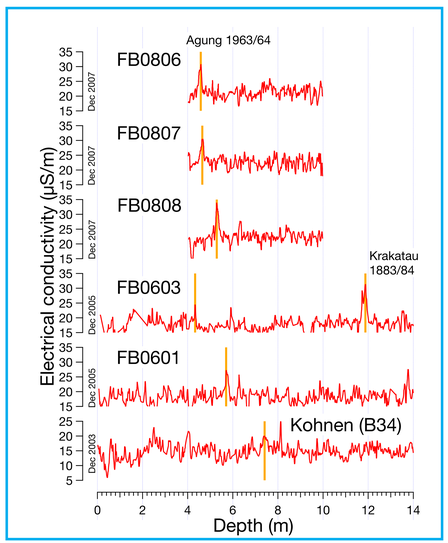

Figure 2:
Profiles of the electrical conductivity (DEP) for the six firn cores (lokation see figure 1). The date of the surface layer is indicated, varying from December 2003 to December 2007. The yellowish bars mark the DEP signal which was contributed to the eruption of Mt. Agung in 1963 (deposition in 1964). FB0603 shows also a DEP signal which can be contributed the eruption of Krakatau in 1883. The 1964 layer was used as reference horizon to calculate means of oxygen-18, deuterium excess d and accumulation rates. (see figures 2 and 3)

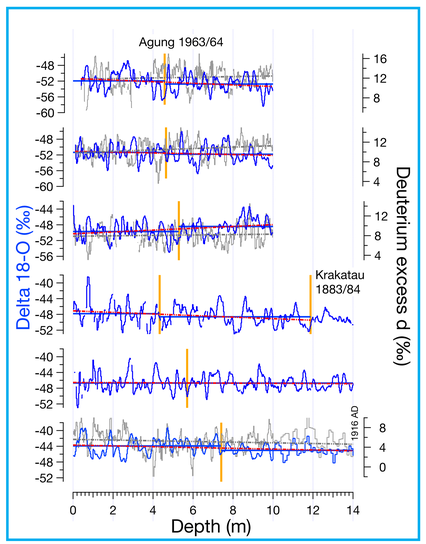

Figure 3:
Profiles of the oxygen-18 content for the six firn cores (blue). Shown are single values (depth resolution 2.5-5cm) and mean values for the time of drilling until 1964 AD (Mt. Agung) and before to the end. For FB0603 the 2nd mean was calculated for 1965-1884 (Krakatau). The red dashed lines show a linear fit for the oxygen-18 profiles.
The grey curves are the profiles of the deuterium excess of four cores. A linear fit is shown by the grey dashed line. Depth of the eruption of Mt. Agung and Krakatau are indicated by yellowish bars as in Figure 1.

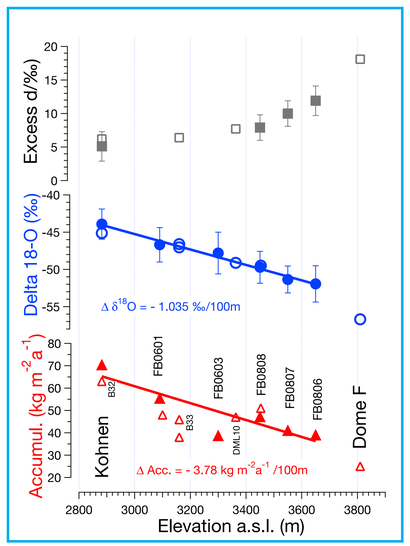

Figure 4:
Mean values for Accumulation rates (red), delta oxygen-18 (blue), and deuterium excess d (grey). The filled symbols show the values for the six firn cores of this study which were used to calculate the linear fits (thick lines). The open symbols indicate values taken from other studies. Values from Dome F and site M (near FB0808) were from the compilation of Masson et al. (2008). DML16, DML23, B32, and B33 are data from earlier AWI studies in this region (Oerter et al., 2000; Graf et al., 2002). The error bars show standard deviation of single oxygen-18 and excess d values.

Conclusions

Mt. Agung eruption in 1963 was used as a common time reference for calculating means of accumulation rates, delta oxygen-18, and deuterium excess d. However, it is not unambigous for FB0603 and FB0601.

During the 20th century the content of delta oxygen-18 is increasing (+) for 4 cores, for 1 it is almost constant and for 1 it is decreasing (-).
B34 +1.03, FB0601 +0.22, FB0603 +2.0, FB0808 -2.32, FB0807 +1.0, FB0806 +2.04 ‰/10m.

No significant change during the past 50 years is visible. However, one has to keep in mind that during the 19th century a decrease was observed. Isotope-temperature relationship: 0.77 ‰/°C. (Graf et al., 2002)

The mean accumulation rates calculated from the six firn cores decrease linearly with elevation.

The mean oxygen-18 content calculated from the six firn cores decrease linearly with elevation.

Deuterium excess d increases with elevation along the ice divide, but not with one linear gradient.

The layers of the Mt. Agung eruption coincide with isotope minima. Cooling by volcanic eruptions?

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