Stable isotope records for the past 2000 years from ice cores in central Dronning Maud Land, Antarctica

Hans Oerter, Sepp Kipfstuhl, Frank Wilhelms

Alfred Wegener Institute for Polar and Marine Research in the Helmholtz Association, Bremerhaven, Germany

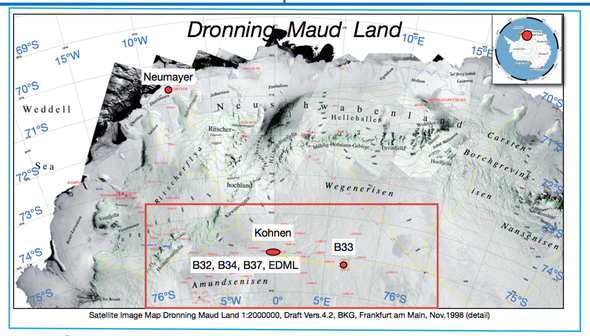

Figure 1: Ice coring on the inland-ice plateau of Dronning Maud Land, Antarctica, took place in the period 1998-2008. The central ice core is the 2774m deep EDML ice core (75.0017 S, 0.0678 E, 2882 m a.s.l.) [1] drilled adjacent to the German Kohnen station [3] in the frame of the European Project for Ice Coring in Antarctica (EPICA). In addition, the ice cores B32 (150m), B34 (200m), B37 (120m), and B33 (130m) had been used for isotope analysis. The mean accumulation rate at EDML is 64 kg/(m²a) at B33 52 kg/(m²a), the mean air temperature -44.6 °C and -46.1°C, respectively. The original depth resolution of the isotope samples was 15-10cm in the upper part and 5cm in the lower parts of the cores.

Summary

The focus of this poster is on the variation of 18-O data during the past 2 kyrs, measured on 5 ice cores (B32, B34, B37, EDML, B33) (Fig.1). Reference horizons for synchronisation are the deposits of the Tambora eruption 1815 and of an unknown event in 1259 as indicated in the DEP profiles. The cores were used to construct a stacked isotope/temperature record for central Dronning Maud Land.The local isotope-temperature relationship to convert isotope content into temperature change is 0.77‰/°C [2]. None of the cores shows an increase of the 18-O content indicating a stable temperature regime during the past 2 kyrs. However, decadal and centennial variations are detectable with a significant increase of the 18-O content since the middle of the 19th century.

References:

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[4] Paillard, D. et al. (1996): Macintosh program performs time-series analysis, Eos Trans. AGU, *77*: 379.

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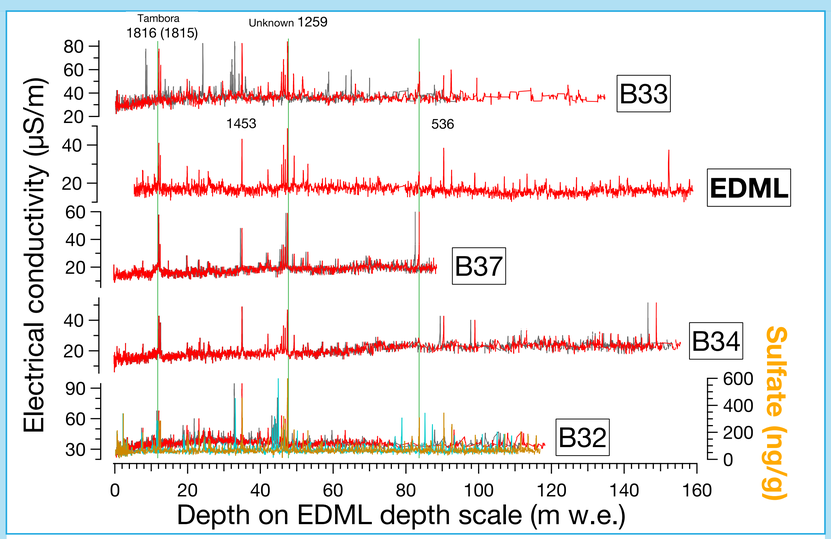

Figure 2: Electrical conductivity (measured by Di-electric profiling, DEP) of the cores B32, B34, B37, EDML, and B33 (location see Fig. 1). The grey curves show the original depth profile, the red curves were adjusted to fit in depth (given in metre water equivalent) or time, respectively, with the dated EDML record. The EDML1 age scale [5] will later be used as the reference age scae. The spikes in the DEP profiles indicate volcanic events (cf. [6]). The blue and yellow curves in the lowest panel show the original and adjusted depth profiles of nss-sulfate concentrations for core B32 [6]. Sulfate peaks on the inland-ice plateau are predominantly caused by volcanic events. The most significant and unique peaks appear in the firn layer deposited in 1816 (Tambora eruption 1815) and 1809 (unknown event) as well as a sequence of 4 peaks with the oldest and strongest deposited in the layer of 1259 (unknown events). Due to bad core quality the DEP signal of B33 is very disturbed below 100 m w.e. depth.The same depth adjustment was later used to synchronize the 18-O profiles (Fig. 3).
DEP data are available in PANGAEA for B32 (doi:10.1594/PANGAEA.58815), B33 (doi:10.1594/PANGAEA.58816). Data for B34, B37, and EDML are so far unpublished.

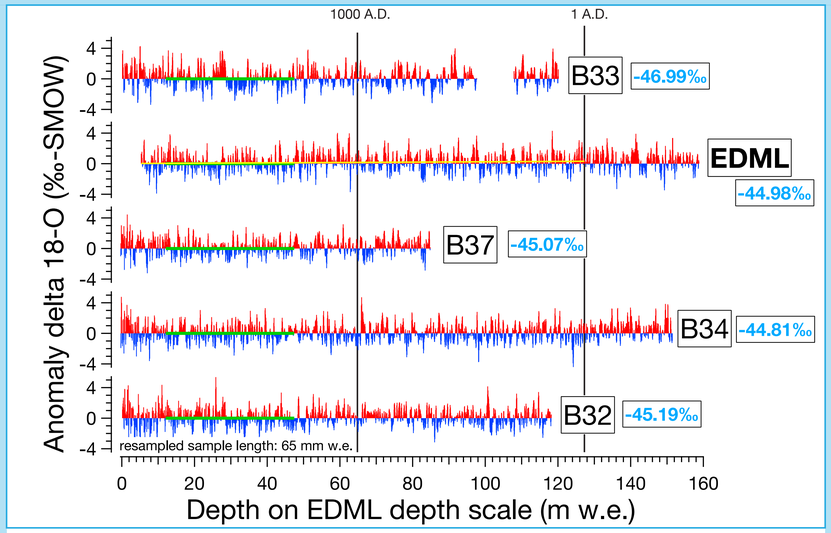

Figure 3: Anomalies of δ18-O content for cores B32, B34, B37, EDML, and B33 (for location see Fig.1). Shown is the deviation from the mean value for the period 1816-1259 A.D. (indicated by green horizontal bars; 12.10-47.45 m w.e.). The numerical value of the mean is displayed in blue. The adjusted depth scale from Fig. 2 was adopted to the isotope records and all data had been resampled to a common depth interval of 65 mm w.e. with the aid of the AnalySeries 2.0 software [4].
The single isotope records are quite different from each others due to the spatial variability of the accumulated snow layers. To overcome this difficulty a composite record was calculated which is displayed in Fig. 4.
Isotope data for B32 (doi:10.1594/PANGAEA.104862) and B33 (doi:10.1594/PANGAEA.728240) and EDML (doi:10.1594/PANGAEA.754444) were taken from the PANGAEA data base www.pangaea.de) The isotope data for B34 (unpubl.), B37 (unpubl.) and the topmost 113m (80m w.e.) of the EDML core were measured within the **HOLOCLIP project (http://www.holoclip.org/)**.

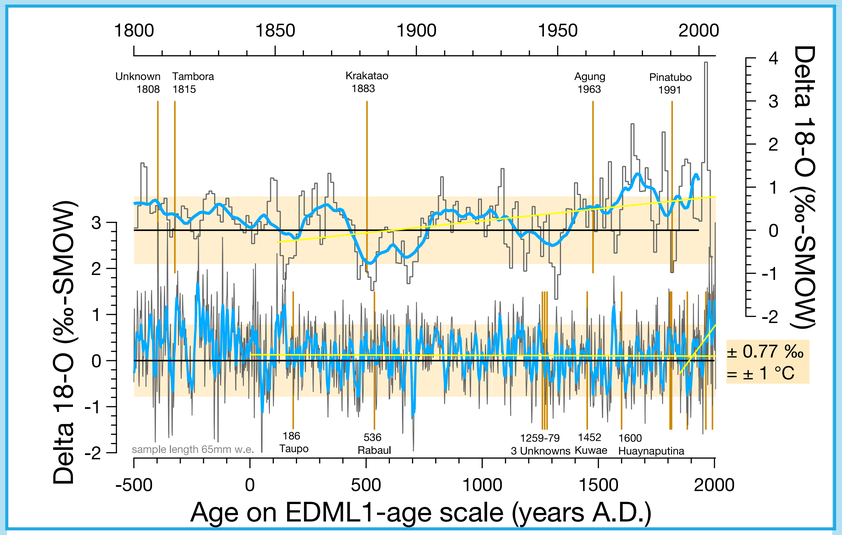

Figure 4: Stacked anomalies of δ18-O content (mean 1259-1816) for the periods 500 B.C.-2005 A.D. (lower axis) and 1800-2005 A.D. (upper axis) on the EDML1-age scale [5]. Shown are in grey colour the composite from 5 cores (B32, B34, B37, EDML, B33; single records see Fig. 3) and with a bold blue line a moving average over 11 samples. Selected volcanic events with eruption date are indicated by vertical bars. The ochre coloured area marks the local isotope-temperature gradient of 0.77 ‰/°C [2].
Periods with positive anomalies occured during the Roman period (before 0 A.D.) and during the medevial times (appr. 1050-1250).
During the 20th century an increase in isotope content/temperature can be observed, only interrupted during the 1940ies.
Most of the volcanic events in low latitudes were followed by a temperature decrease through the next 1-3 years.
The yellow lines show a line fit for 1-2005 A.D. and 1850-2005 A.D., respectively.