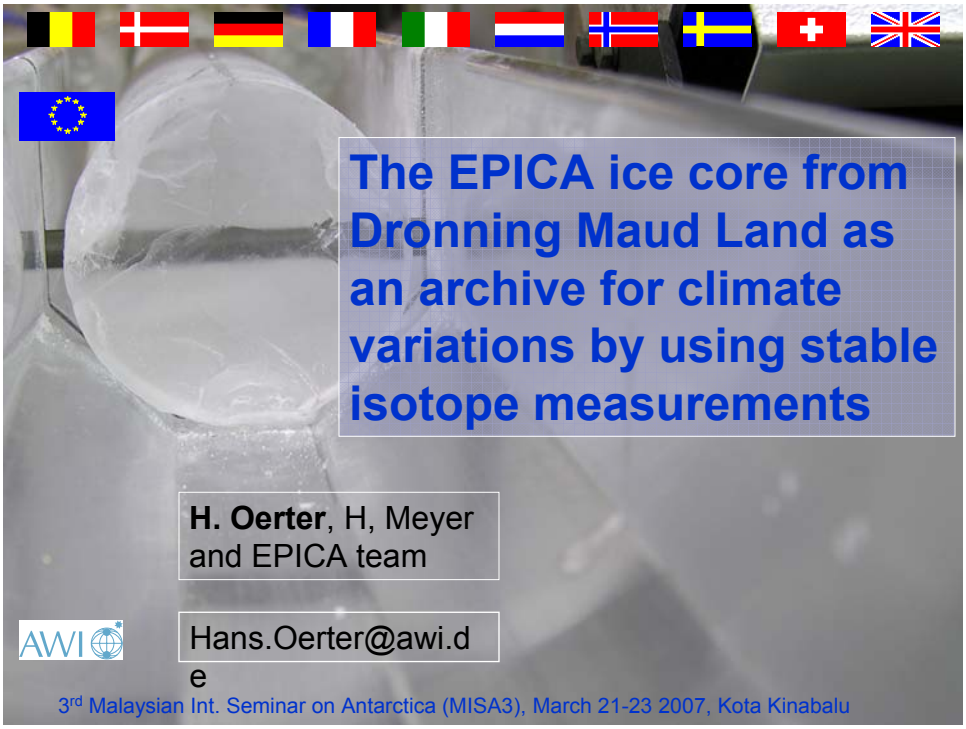

The EPICA ice core from Dronning Maud Land as an archive for climate variations by using stable isotope measurements

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AWI

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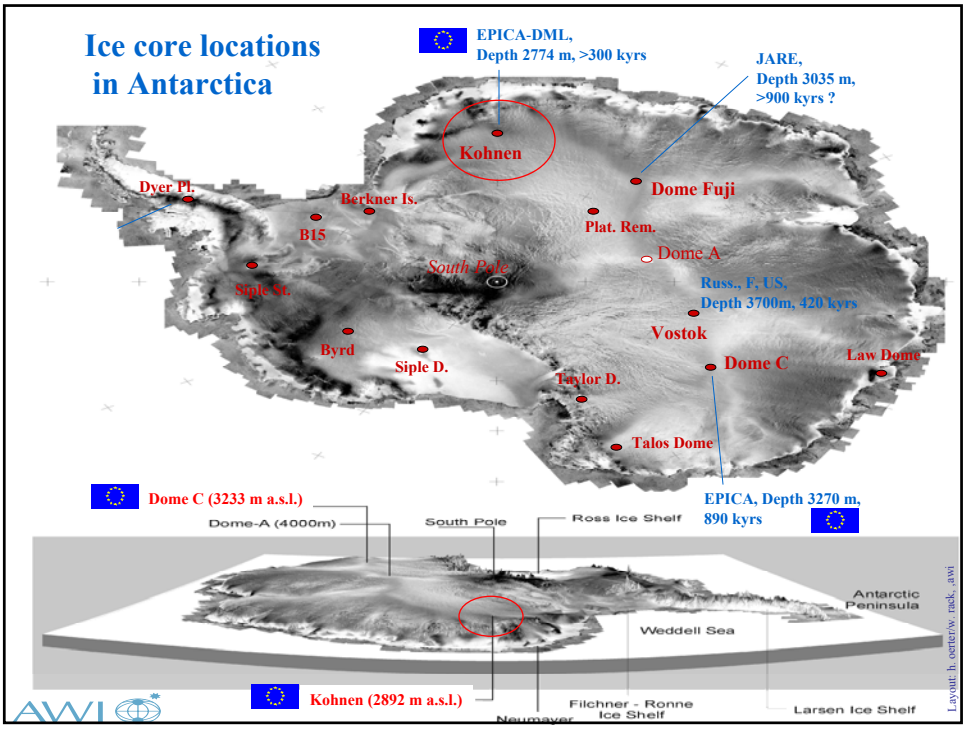
3rd Malaysian Int. Seminar on Antarctica (MISA3), March 21-23 2007, Kota Kinabalu

- **Introduction: Overview EPICA and drilling**
- **The $\delta^{18}O$ - depth profile**
- **Dating and upstream corrections**
- **$\delta^{18}O$ Time series**
- **Comparison with Dome C, Dome F**
- **Comparison with NGRIP D/0 events**
- **Conclusions**



Basic data of the EPICA DML drilling site

Area:	Dronning Maud Land
Station:	Kohnen Station
Co-ordinates:	75° 00'06"S; 00° 04'04"E
Altitude:	2,892 m (WGS84)
Mean annual surface temperature:	-44.6° C (10 m depth temperature)
Mean annual accumulation rate:	64.0 □0.5 kg·m^{-2}·a^{-1} (for last 1000 and last 4000 years)
Surface velocity:	0.74 m a^{-1}
Measured ice thickness:	2,782 □10 m
Notation of ice core:	EDML

Foto: AWI / oerter

Kohnen station, Dronning Maud Land

Drilling depth

2774 m

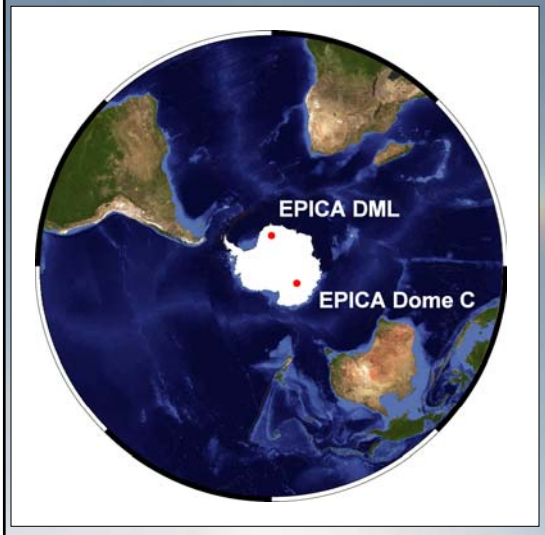
January 17, 2006

Foto: AWI / Traufetter

Kohnen station, Drill trench

AWI

The EPICA Dronning Maud Land ice core (EDML)



- **Drilled in the Atlantic sector of the Southern Ocean**

Direct counterpart of the Greenland ice cores

- **Analysed over one glacial cycle. Bedrock reached in the 2005/06 season, more glacial cycles waiting**
- **2-3 times higher accumulation rate than other deep ice cores from the East Antarctic plateau**

Higher resolution for the last glacial, improved CH_4 synchronisation

Layout: H. Fischer, AWI, 2006

Foto: S. Kipfstuhl, AWI, 2006

Observation of S. Kipfstuhl:
The whitish ice is refrozen meltwater. It is extremely fine grained and contains a lot of air or gas. From the physical conditions at the bottom (200-250 bar) part of this ice may be formed as hydrates. The amount of drilling chips is low as clear fragments (former chips) can hardly be detected in the microphotographs. About 15 % drilling fluid is entrapped in this ice.

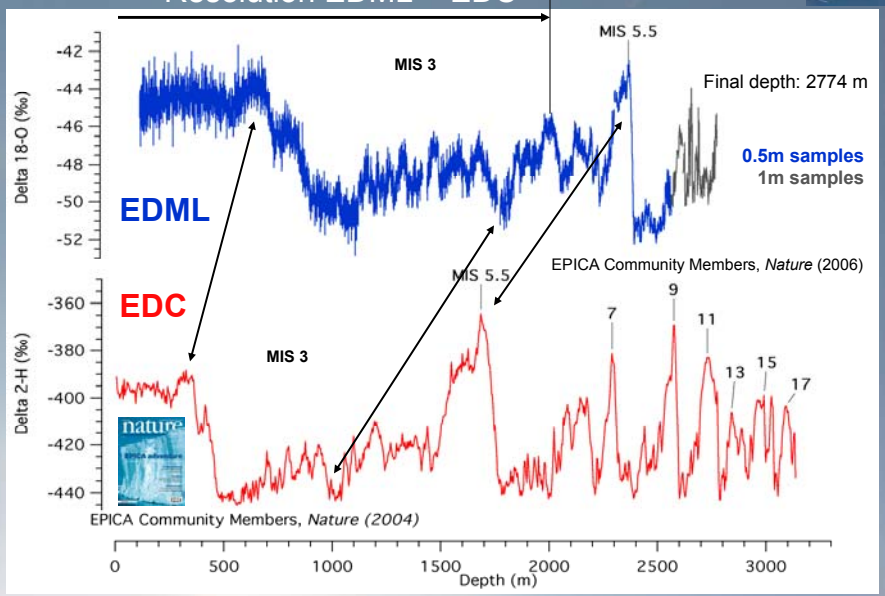
The end of drilling meteoric ice - refrozen water

Drilling into the refrozen water: only ca. 30 cm

fotos: h. oerter, 2005/06

ca. 2000 m / 80,000 years

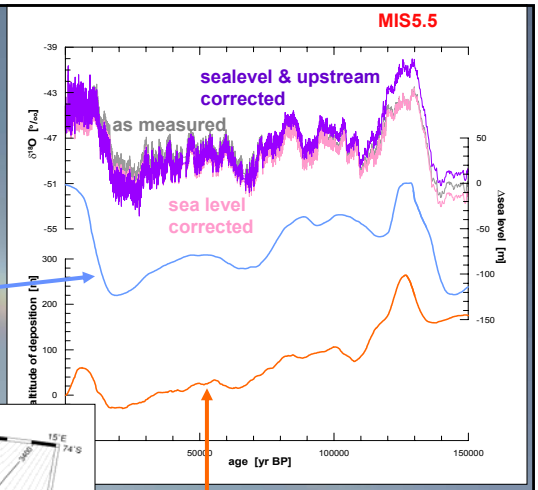
Resolution EDML > EDC



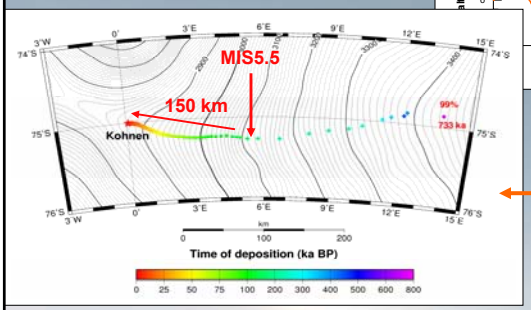
The EDML ice core

$\delta^{18}O$ so far in 0.5 m resolution (<30 yr for the last 50,000 years)

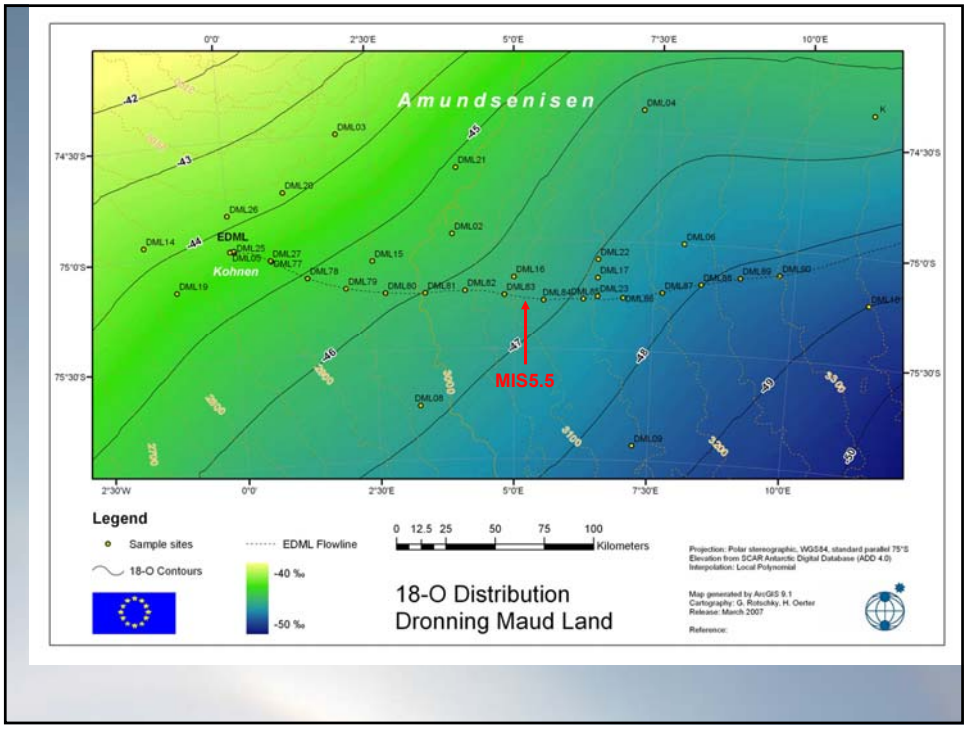
1) Correction for $\delta^{18}O$ changes in sea water



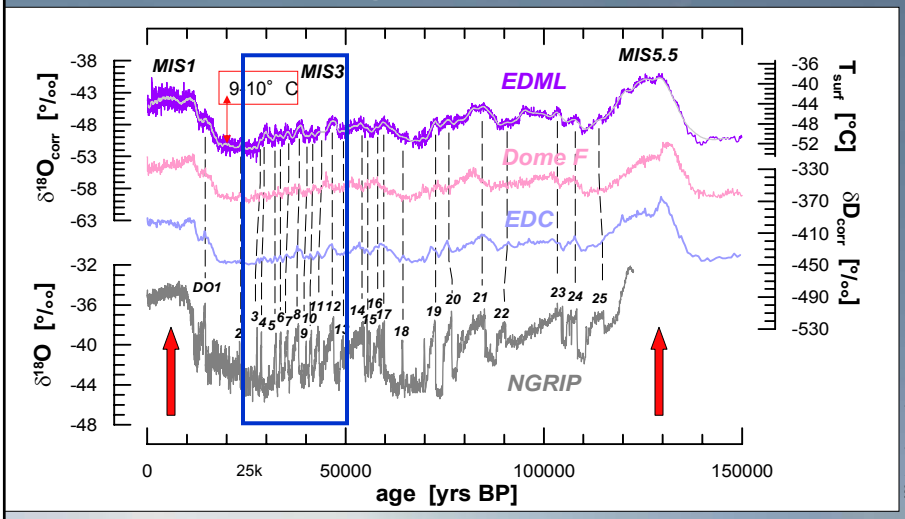
EPICA Community Members, Nature (2006)



2) Correction for upstream and altitude effects using 3D flow model (from *Huybrechts & Rybak, AWI*)



The EPICA Dronning Maud Land ice core (EDML)



Very high covariance between East Antarctic records

More details in EDML with each wiggle corresponding to a DO event!?

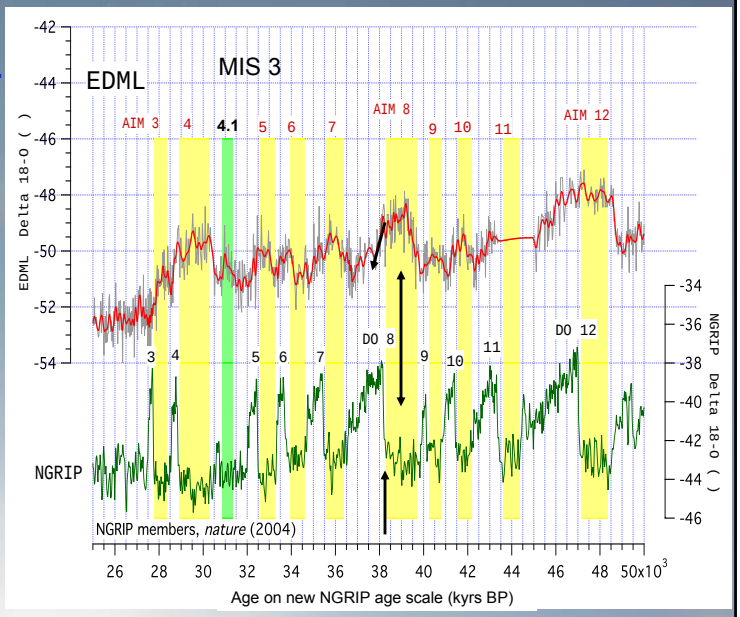
EPICA Community Members, Nature (2006)

NGRIP - EDML synchronisation

Every DO event has a counterpart in an Antarctic Isotope Maximum (AIM)

Antarctic warming starts in the stadial, the cooling in the interstadial

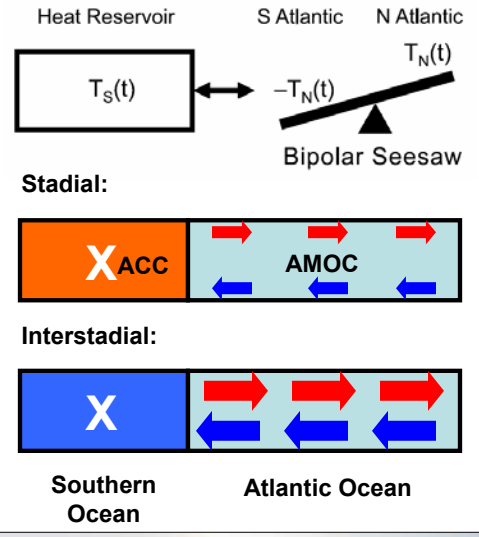
One-to-one bipolar seesaw pattern for each event



EPICA Community Members, Nature (2006)

The bipolar seesaw concept

Stocker & Johnsen, Paleoceanography (2003)



Bipolar seesaw (thermal and freshwater) also found in coupled GCMs (Knutti et al., 2004)

Reduced AMOC:

Southern Ocean warms

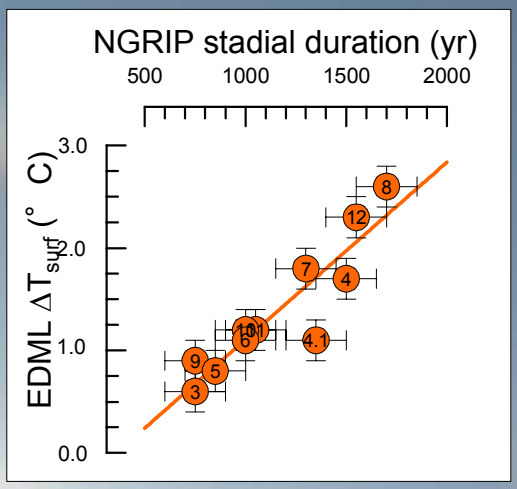
Increased AMOC:

Southern Ocean cools

Layout: H. Fischer, AWI, 2006

Bipolar seesaw coupling

Duration of stadials in the North are correlated with amplitude of AIMs or temperature change in the South, resp.



EPICA Community Members, Nature (2006)

Conclusions

- EDML (and high resolution records of EDC) show millenial climate variability during MIS3.
- CH_4 synchronisation of EDML and NorthGRIP allows for a one-to-one assignment of each Antarctic Isotope Maximum (AIM) to a Dansgaard-Oeschger (DO) event in the North ⇨ new nomenclature
- The amplitude of the AIMs is linearly coupled to the duration of stadials in the North. This implies a direct bipolar seesaw coupling via the Atlantic meridional circulation
- The constant linear relationship indicates a constant oceanic heat flux, thus, a rather uniform turnover rate for all stadials