

Stable-isotope records for the past 2000 years from four (five) cores in central Dronning Maud Land, Antarctica

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Climate change during the past 2000 years

What we want: High resolution records - annual to decadal

Where to drill? coastal versus inland sites

150-200 m critical drill depth: dry holes versus drilling liquid

Plateau of the east Antarctic ice sheet low accumulation area
with values below $70 \text{ kg m}^{-2}\text{a}^{-1}$

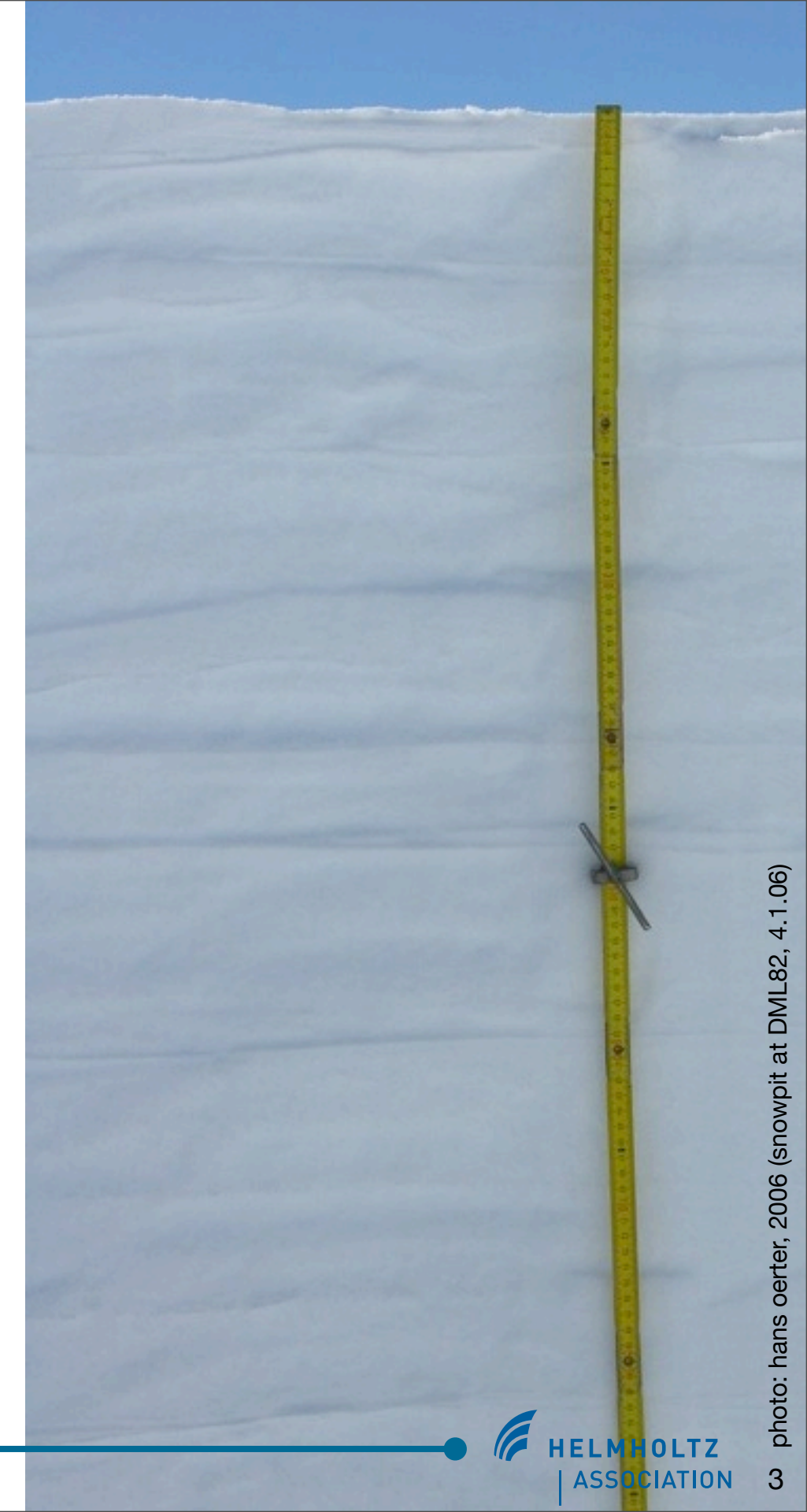
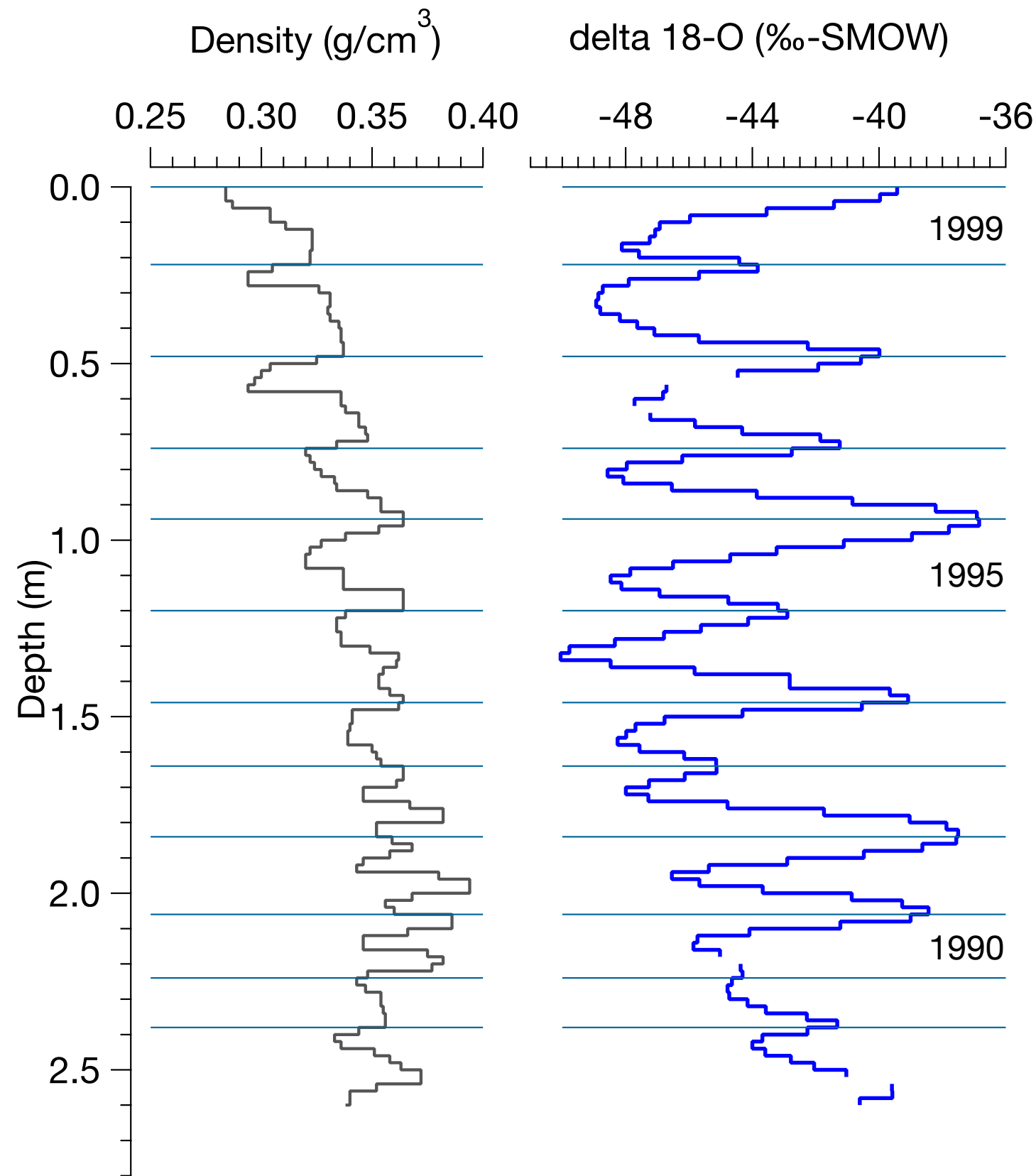
Spatial versus temporal variability

The setting at the surface

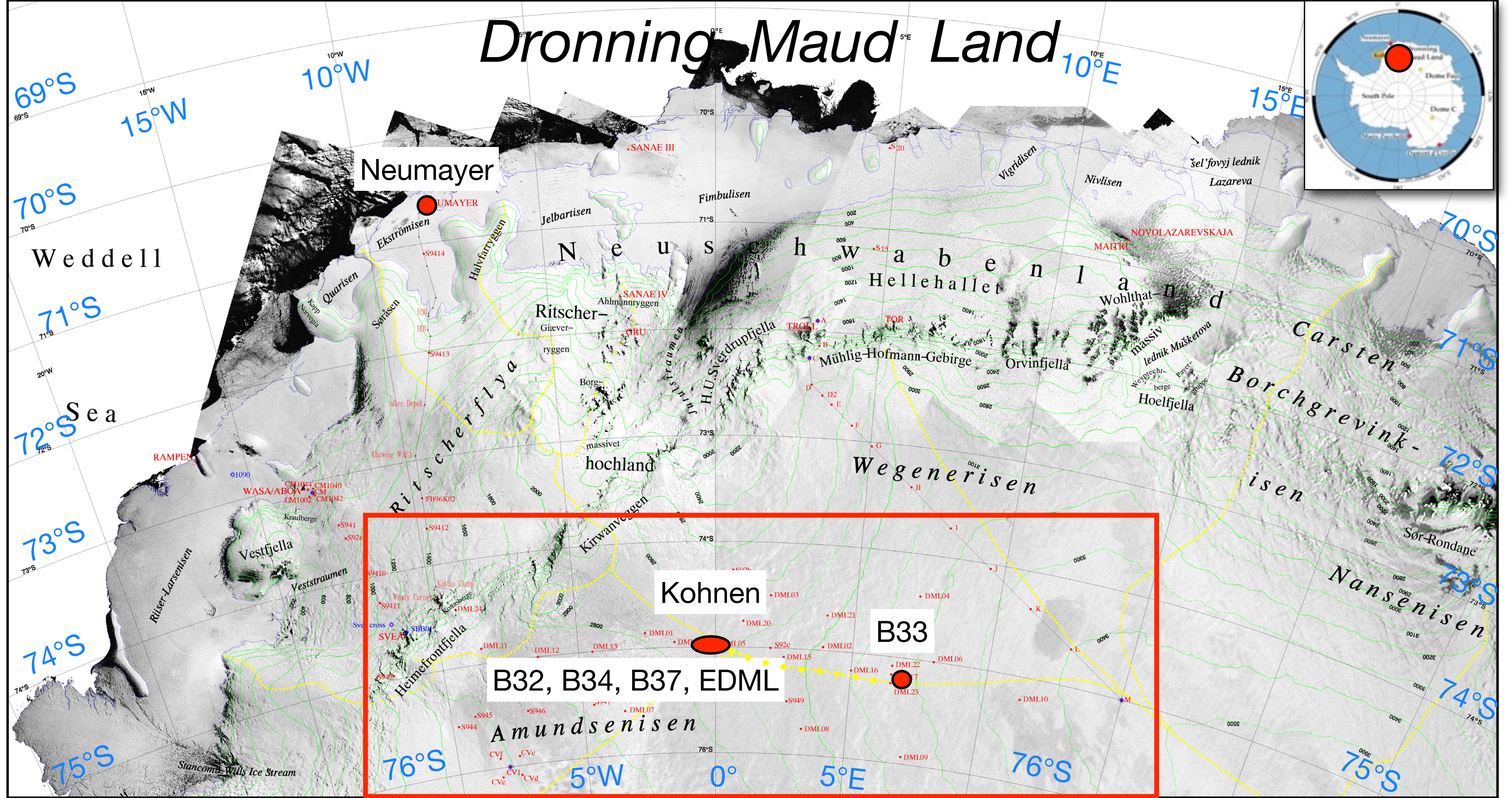
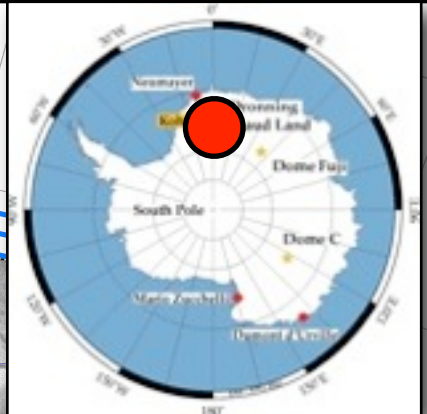
Mean layer thickness at the surface ca. 20 cm

at 165m (ca. 0 A.D.) <10cm

Deposition noise ?



Dronning Maud Land



Satellite Image Map Dronning Maud Land 1:2000000, Draft Vers.4.2, BKG, Frankfurt am Main, Nov.1998 (detail)

Example for ice core measurements: $\delta^{18}\text{O}$ and di-electric profiling (DEP)

Ice core B34

Drilling date: Jan. 2004

Long.: 0.0669° E

Lat.: -75.0008° S

Altitude: 2882 m asl

ca. 200m W of EDML

Depth: 200.5 m

accum. rate: $65\text{mm kg m}^{-2}\text{a}^{-1}$

Mean temperature: -44.6° C

sample length for $\delta^{18}\text{O}$:

0-50m: 10 cm

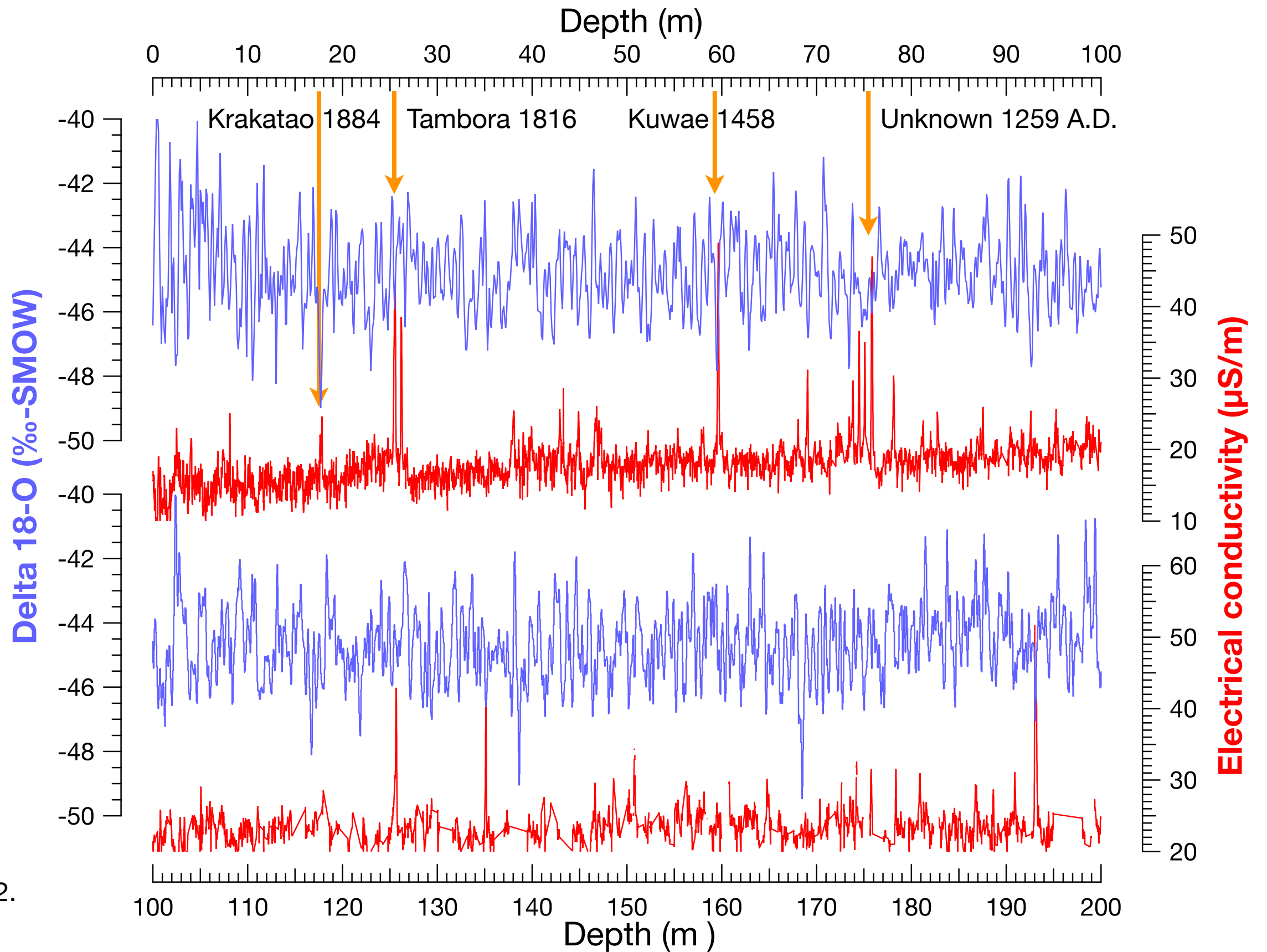
50-100m: 6.67 cm

100-200m: 5 cm

Volcanic deposition chronology after core B32.

Traufetter et al., *J.Glac.* **50**, 137-146 (2004);

[doi:10.1594/PANGAEA.104881](https://doi.org/10.1594/PANGAEA.104881)



grey/red:
DEP
measurements

nss-Sulfate
to proof and supplement
DEP data of B32

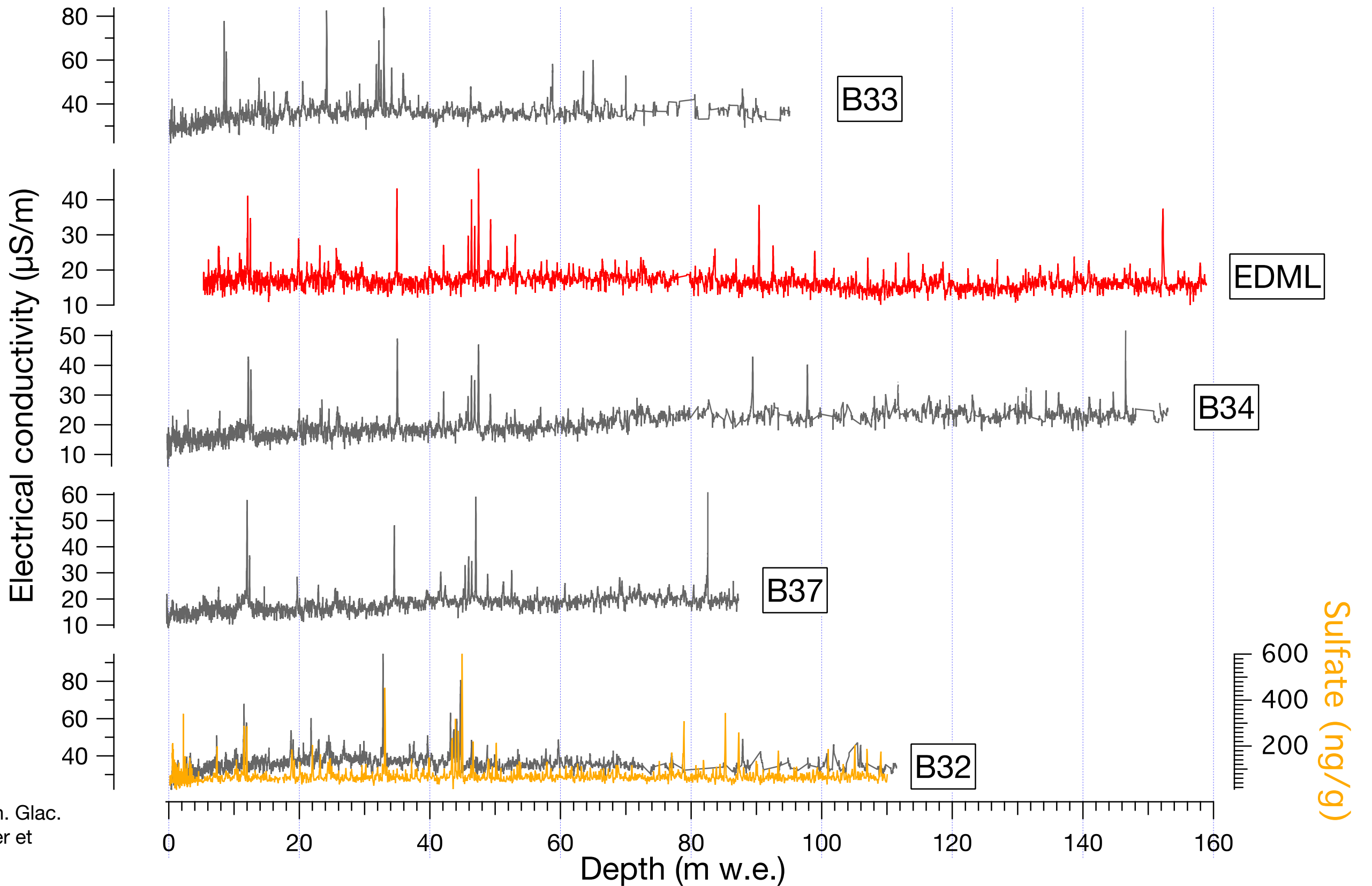
EDML used as
reference profile

All profiles on their own
depth scale.

Depth 0 = Jan. 2001

Depth resolution DEP:
5 mm firn

DEP data B32 & B33 from Oerter et al., Ann. Glac.
30, 27-34 (2000); nss-Sulfate from Traufetter et
al., J.Glac. **50**, 137-146 (2004)

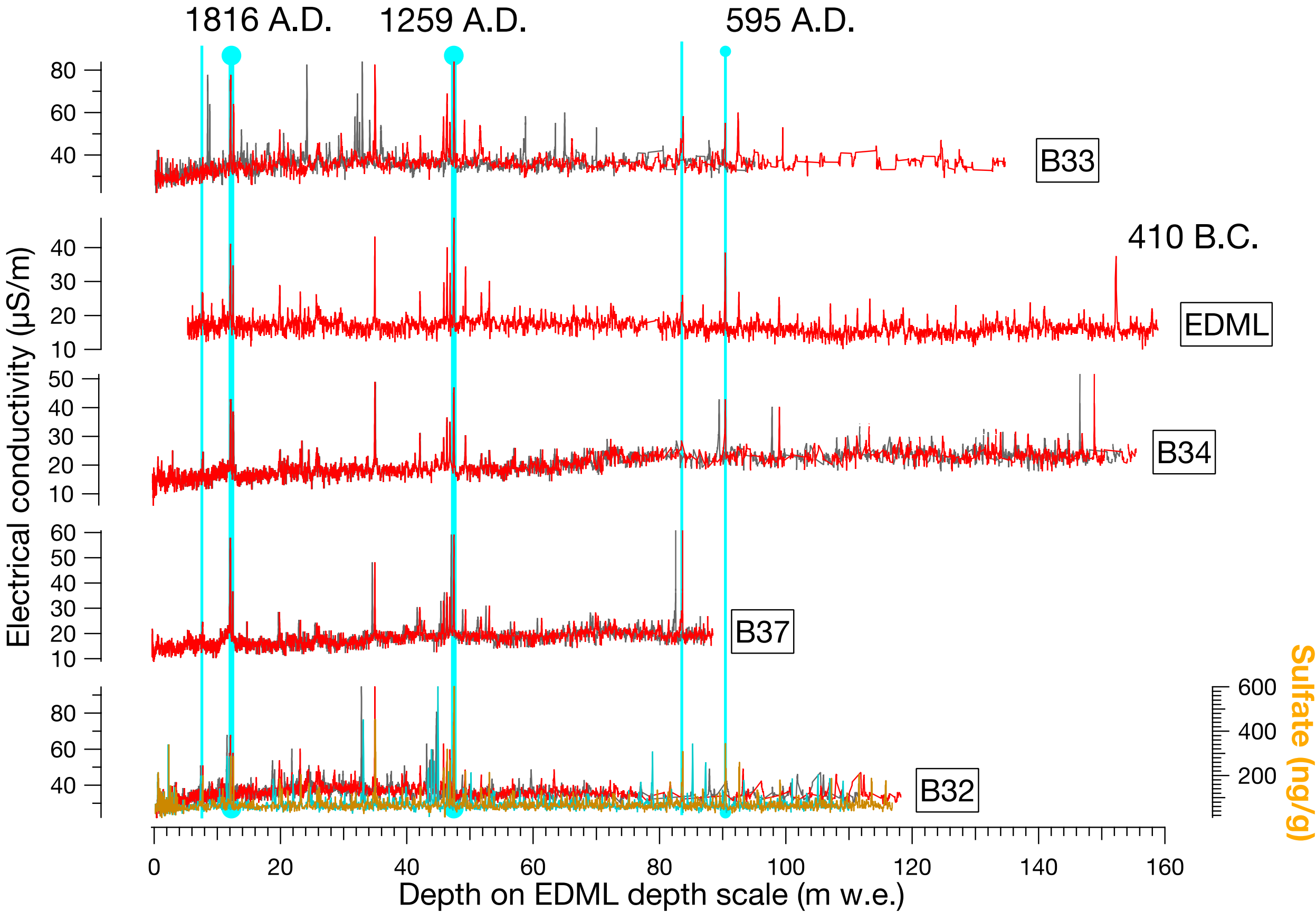


Adjusting the single DEP profiles to the EDML depth scale

main reference horizons:

Tambora 1816 A.D.
Unknown 1259 A.D

next step:
use the adjusted depth scales for the $\delta^{18}\text{O}$ data.



Deviation from mean $\delta^{18}\text{O}$ 1259-1816 A.D.

Original depth resolution:

0-50m:

10cm (35-70mm w.e.)

50-100m:

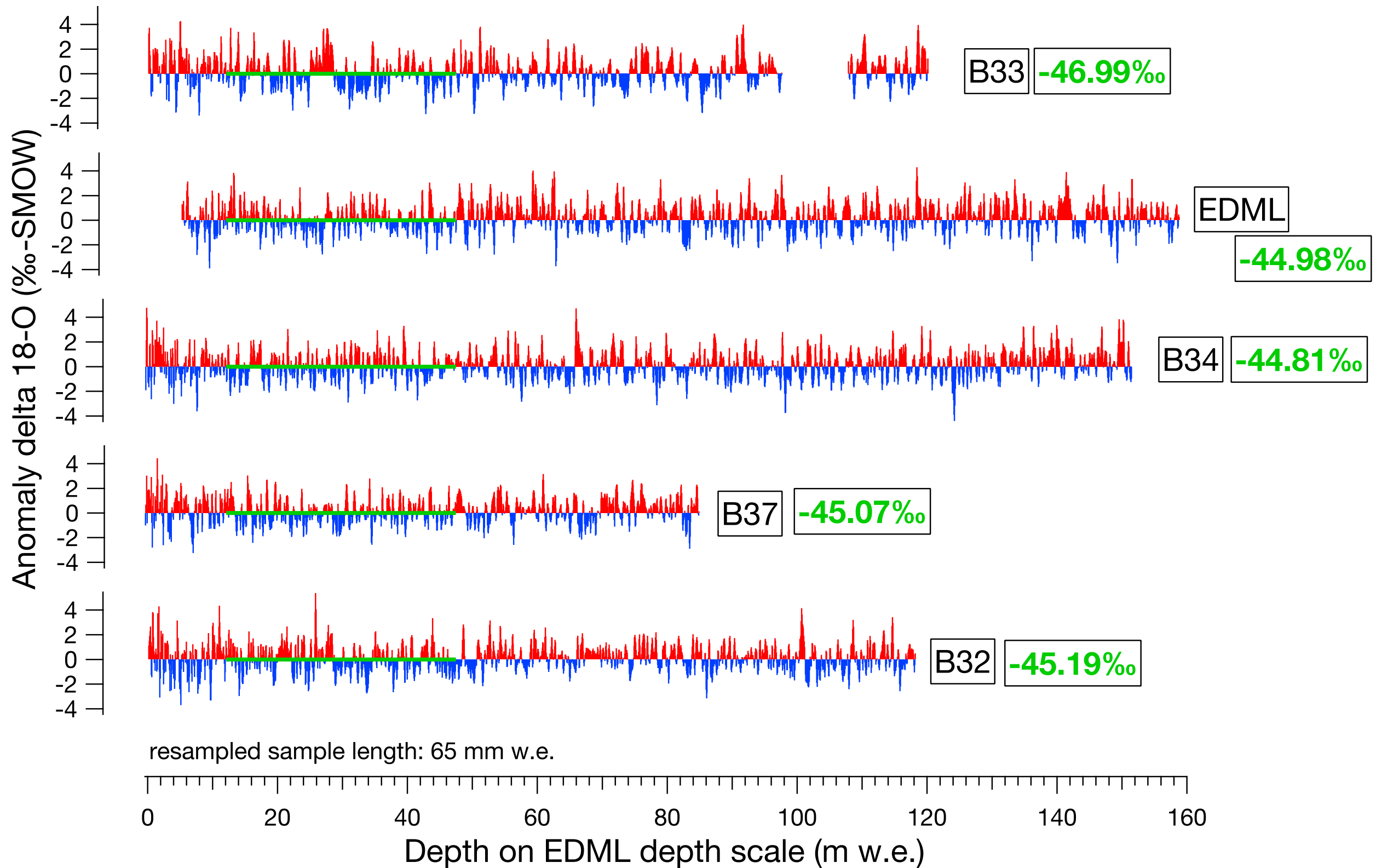
6.7cm (47-56mm w.e.)

>100m:

5cm (42-45mm w.e.)

Resampled 65 mm w.e.

0 = mean 1259-1816 A.D.



^{18}O data B32 from Graf et al., Ann. Glac. **35**, 195-201 (2002); doi:10.1594/PANGAEA.104862.

EDML ice core



DML Composite

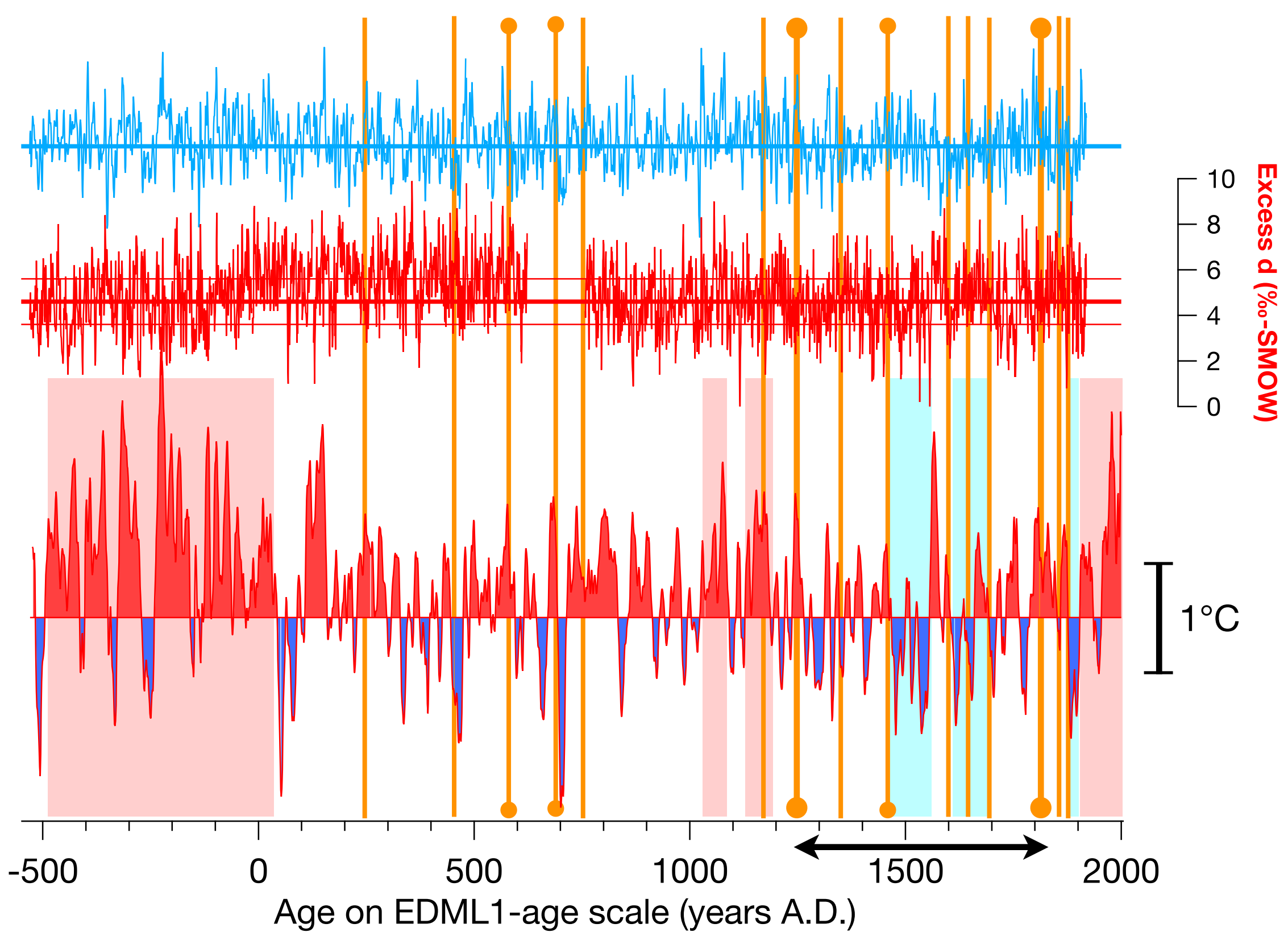
B32, B34, B37,
EDML, B33

0 = mean 1259-1816 A.D.
sample interval 65mm w.e.

moving average **11** samples

Temperature
gradient: 0.7 ‰/°C

Time overlap:



Climate Change - the past 200 years

Stack of annual means
of 10 and 13 firn cores,
resp., from central DML

Deviation of stacked
annual means from
average over 1801-1997

1801-1905:

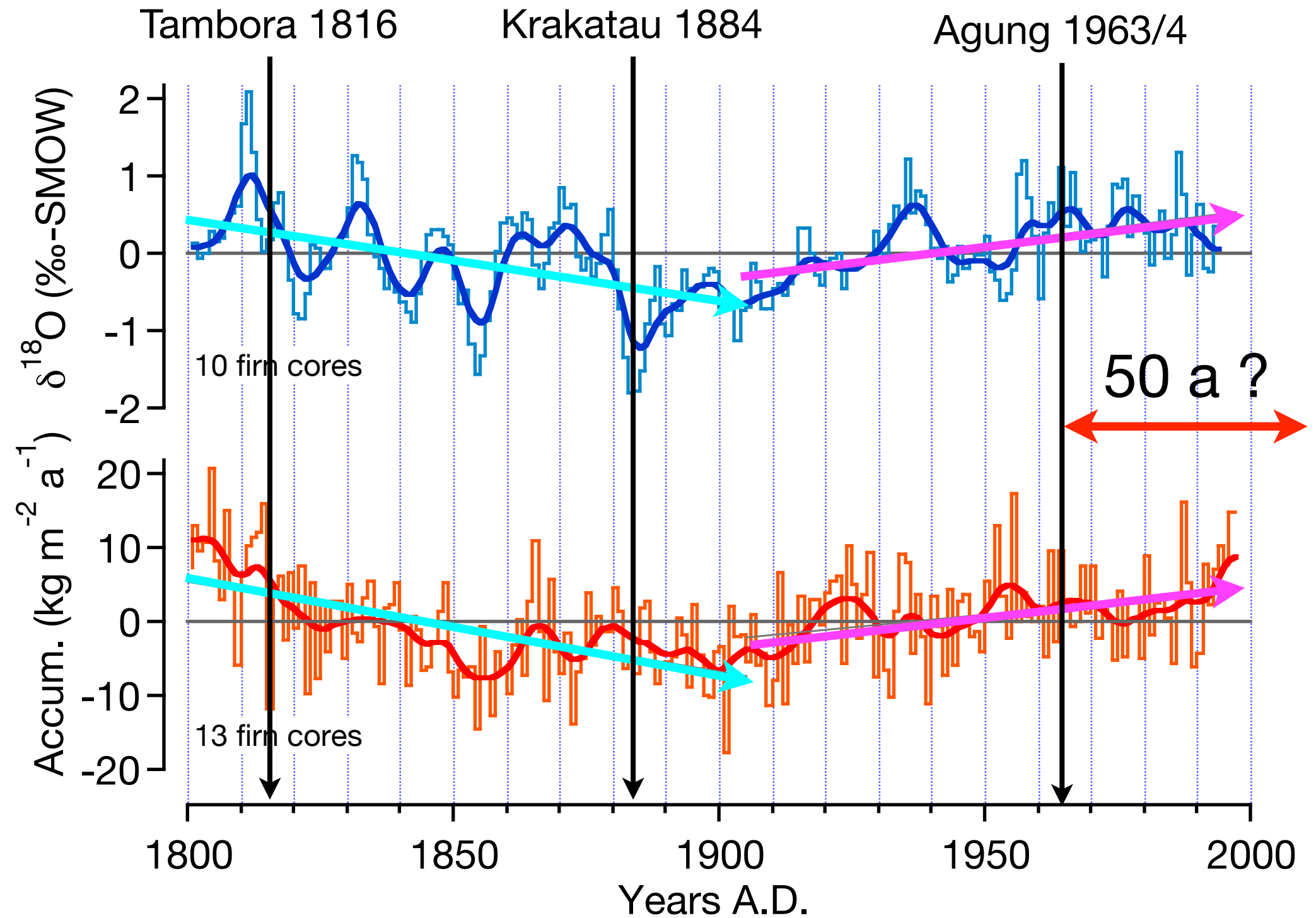
$\delta^{18}\text{O}$: -0.010 ‰/a

Acc.: $-0.120 \text{ kg m}^{-2}\text{a}^{-1}/\text{a}$

1905-1997:

$\delta^{18}\text{O}$: $+0.009 \text{ ‰/a}$

Acc.: $+0.068 \text{ kg m}^{-2}\text{a}^{-1}/\text{a}$



Oerter et al.: Accumulation rates in Dronning Maud Land, Antarctica, as revealed by dielectric-profiling measurements
of shallow firn cores. *Annals of Glaciology* **30**, 27-34 (2000)

Conclusions

A composite $\delta^{18}\text{O}$ record for the past 2000 years was established using five ice cores from central Dronning Maud Land.

Higher $\delta^{18}\text{O}$ values (warmer temperature) appeared before 0 A.D.

A medieval warm period (1000-1200 A.D.) is indicated.

A cool period is displayed between 1500 and 1700 A.D.

$\delta^{18}\text{O}$ / temperature minimum around 1885 A.D.; since then increasing $\delta^{18}\text{O}$ values during the 20th century.

Most of the $\delta^{18}\text{O}$ / temperature minima coincide with major volcanic events.

Thank you for your attention !

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