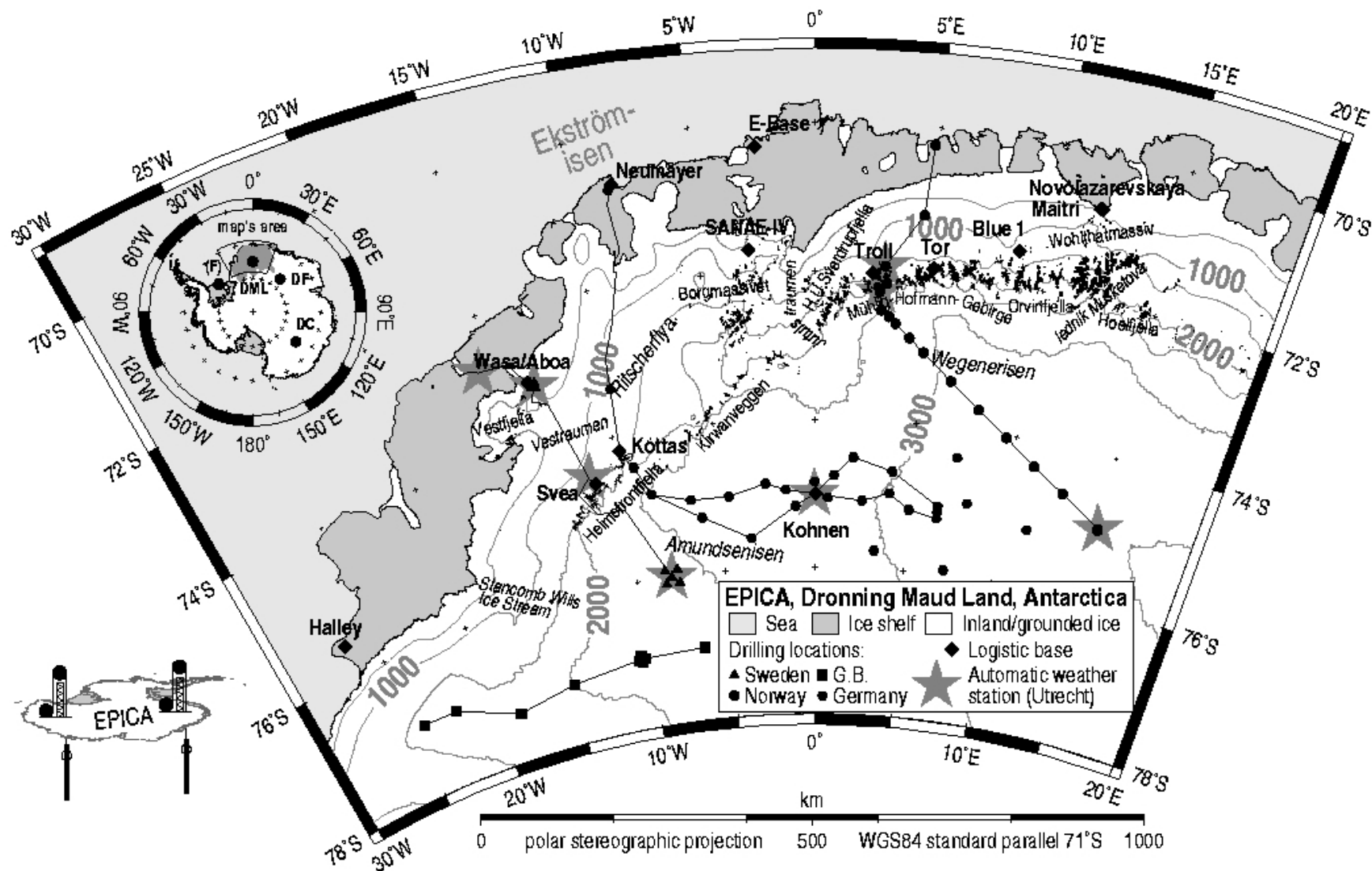


Physical properties of ice sheets – implications for, and findings from deep ice core drilling

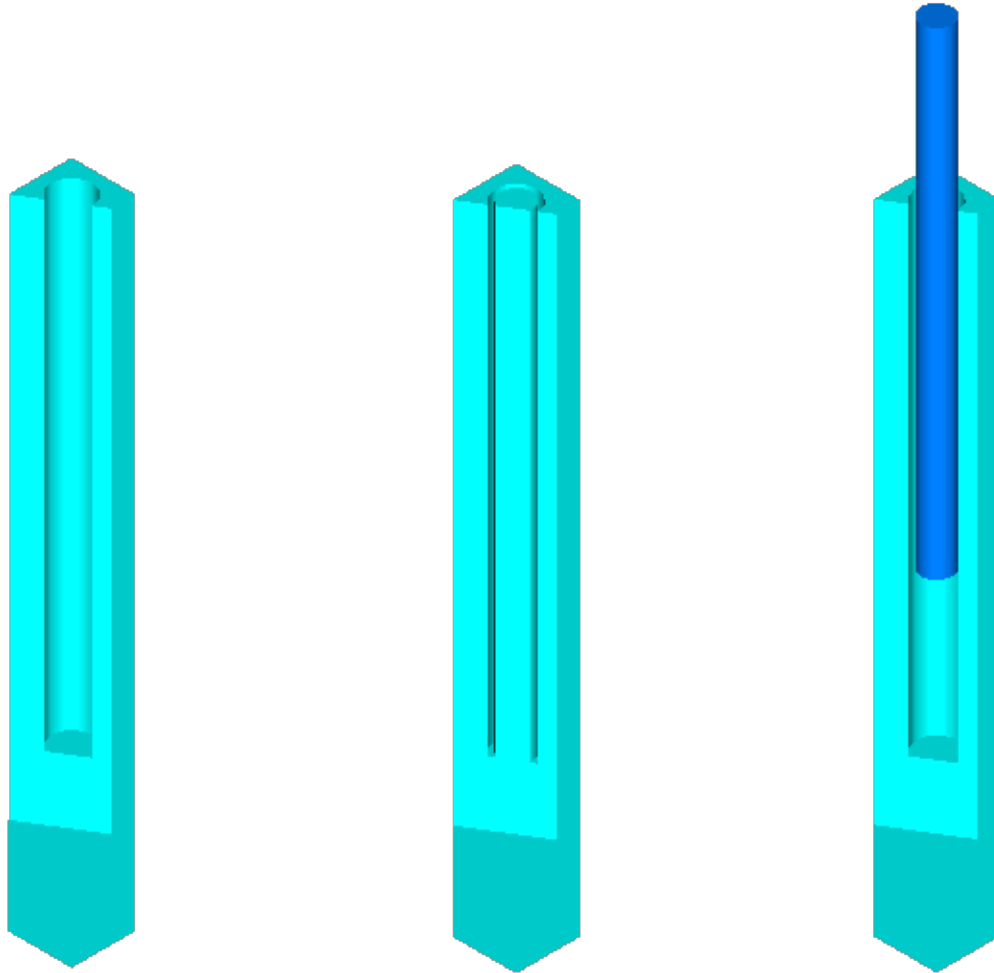


F. Wilhelms, S. Kipfstuhl, S. H. Faria,
I. Weikusat, D. Dahl-Jensen, S. G. Sheldon,
H. Oerter, H. Miller

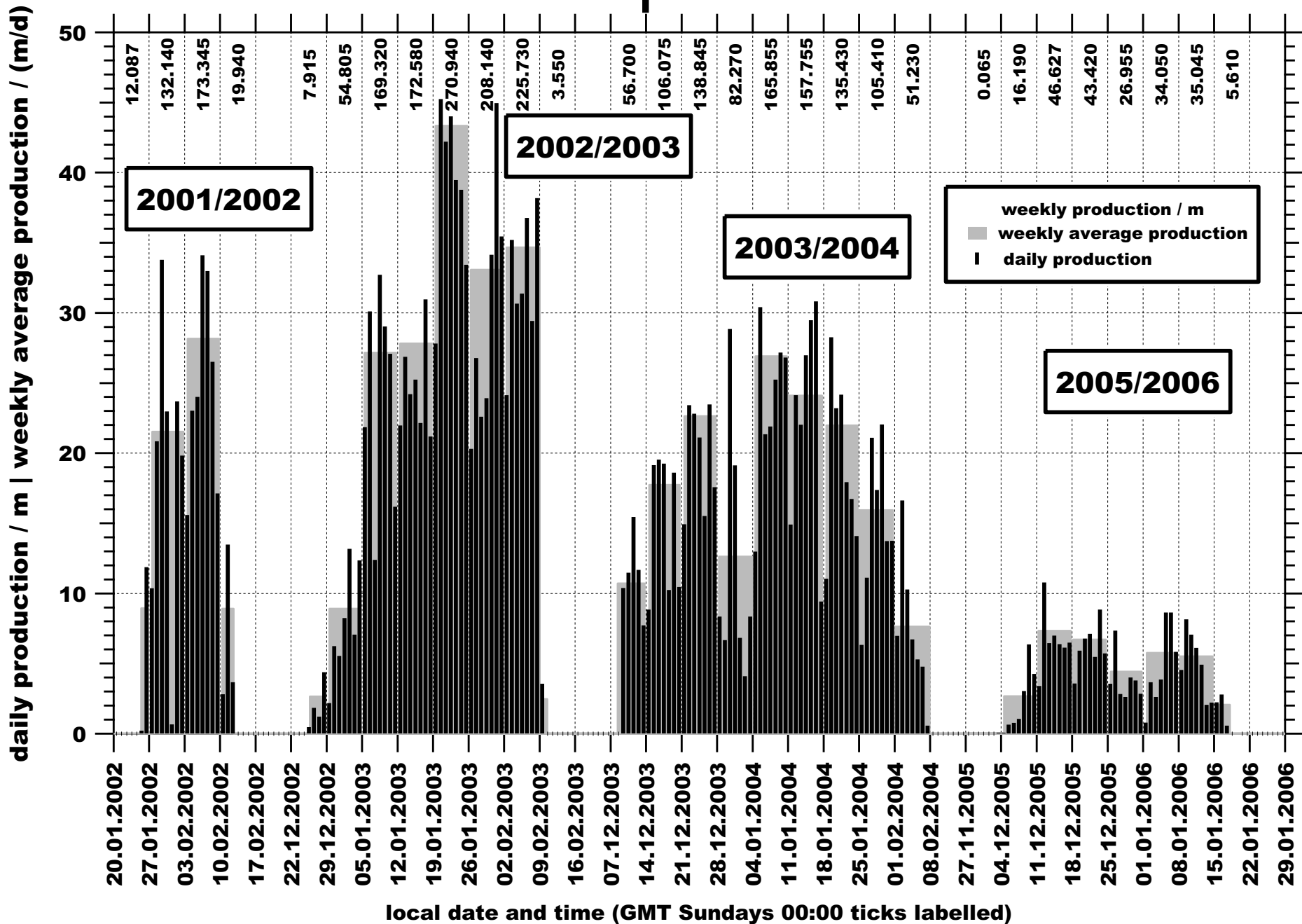
The EDML vicinity

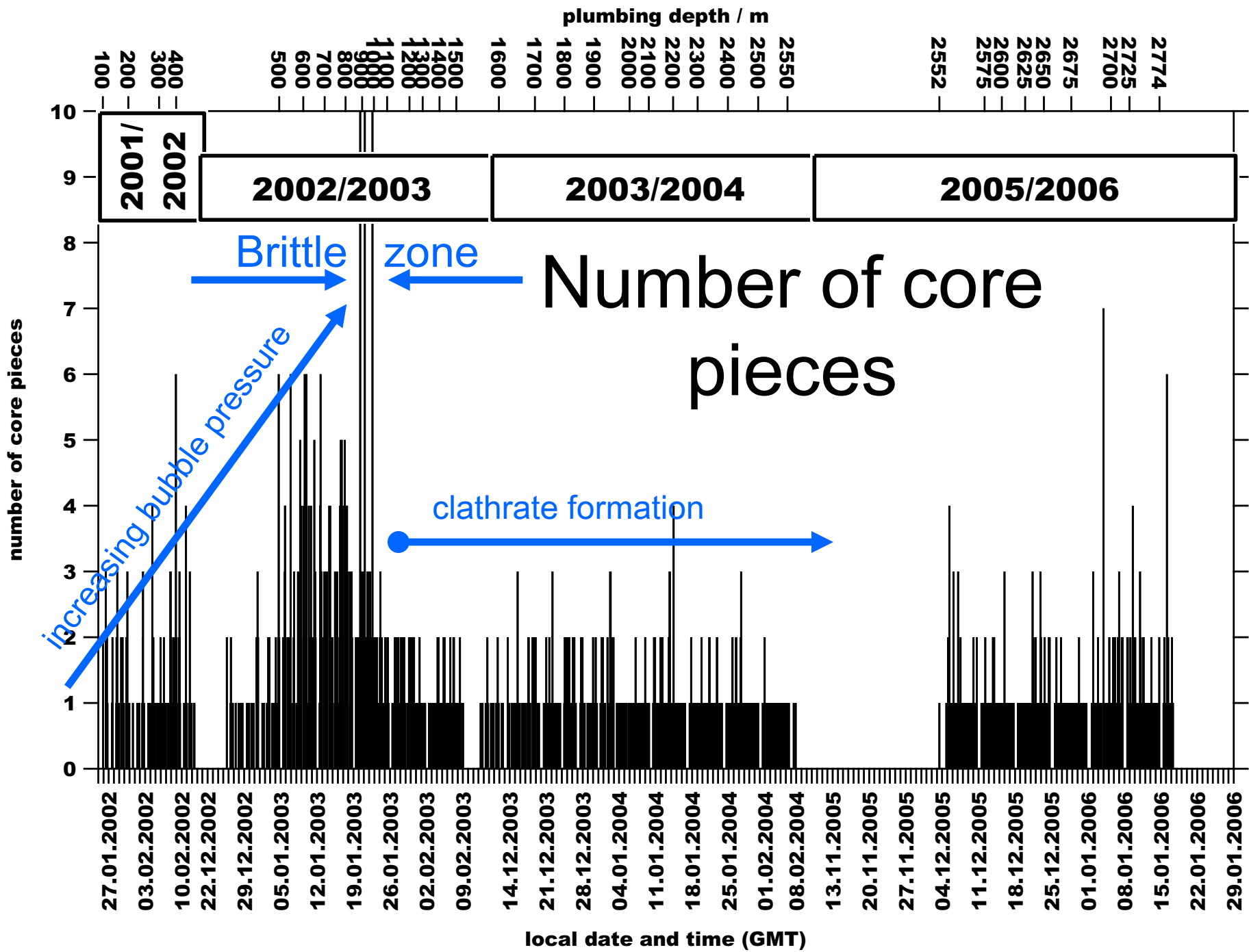


Aim: Drill a hole and bring the core in 3.5 m long sections up



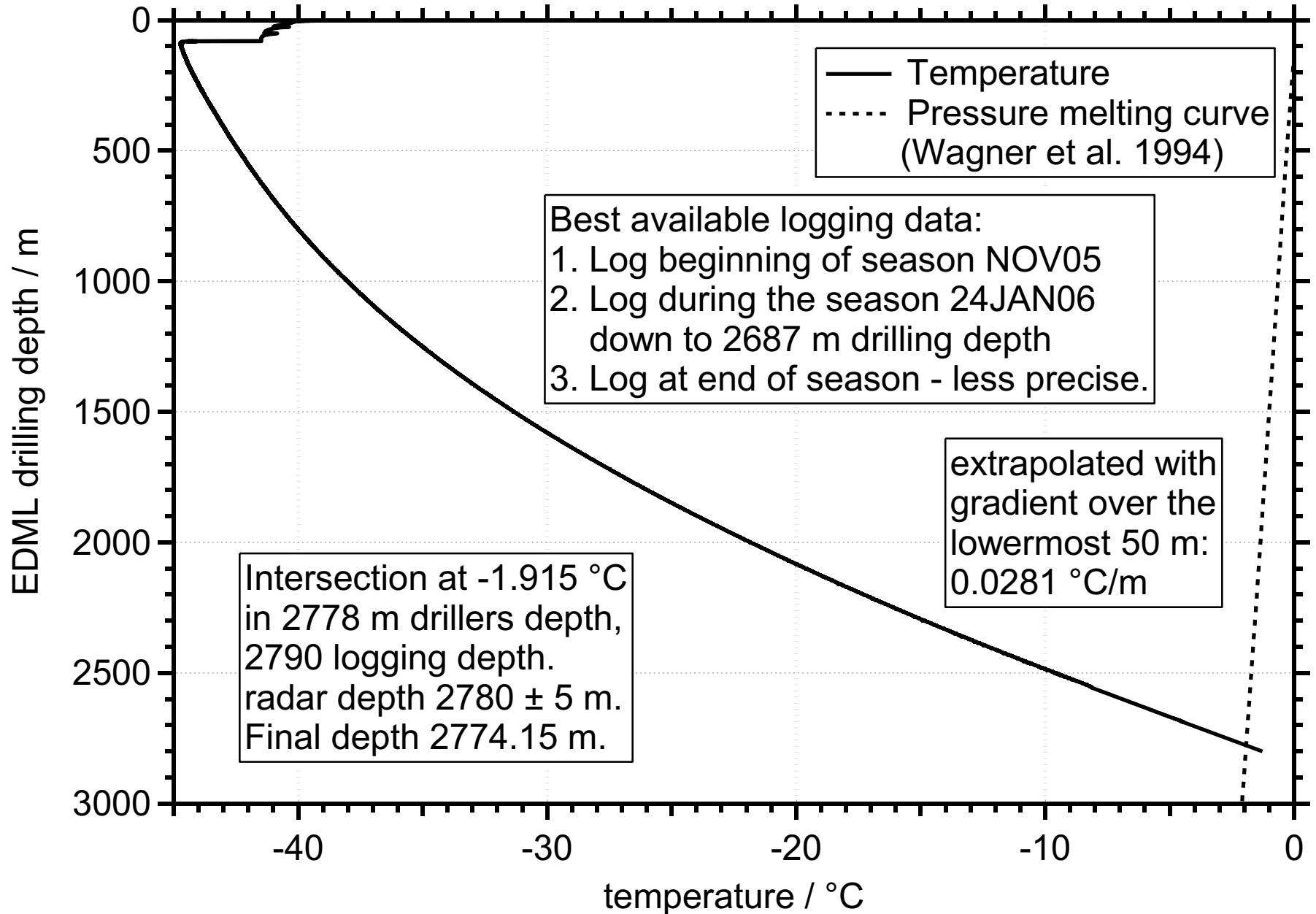
The ice core production rate



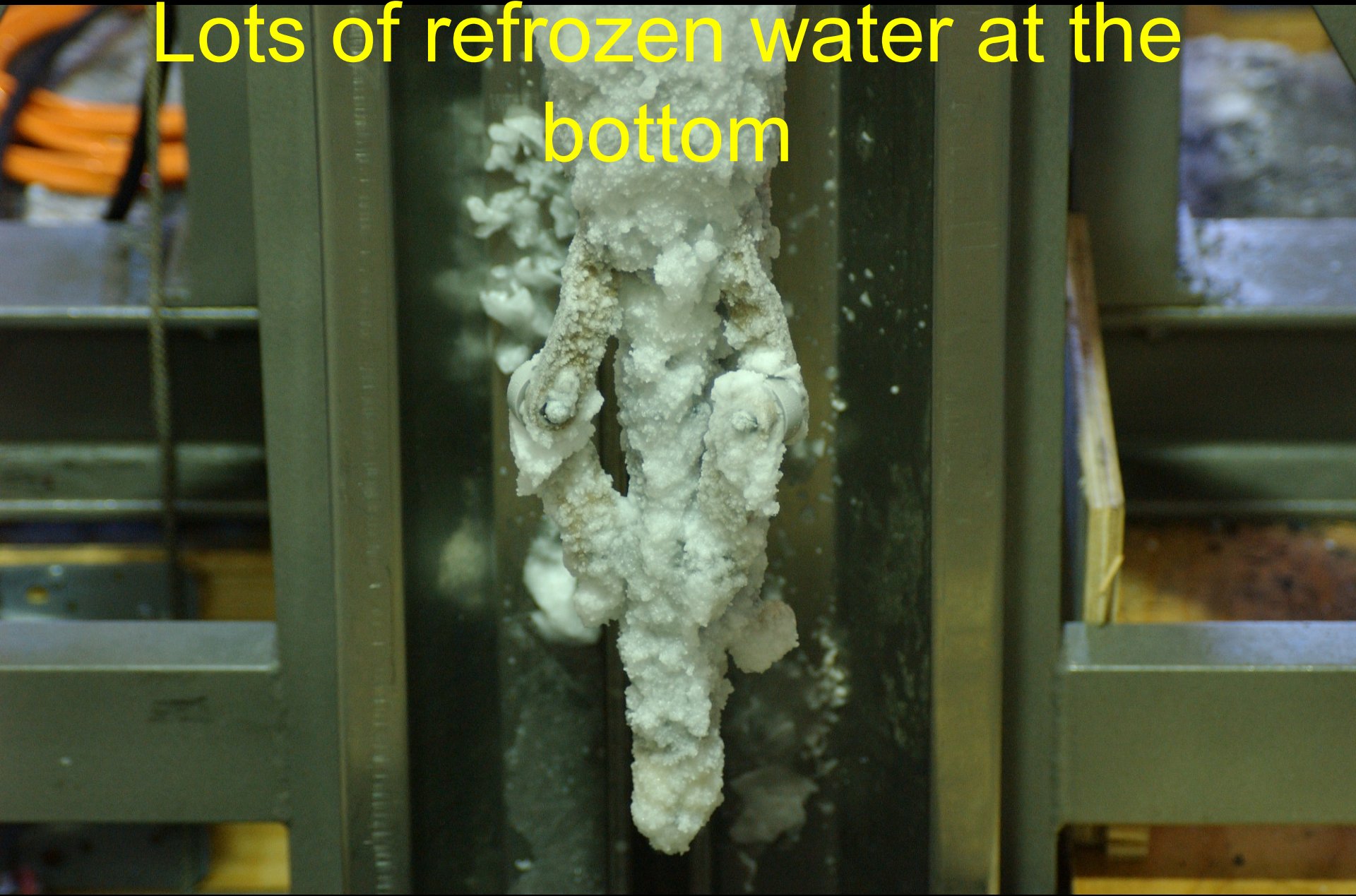




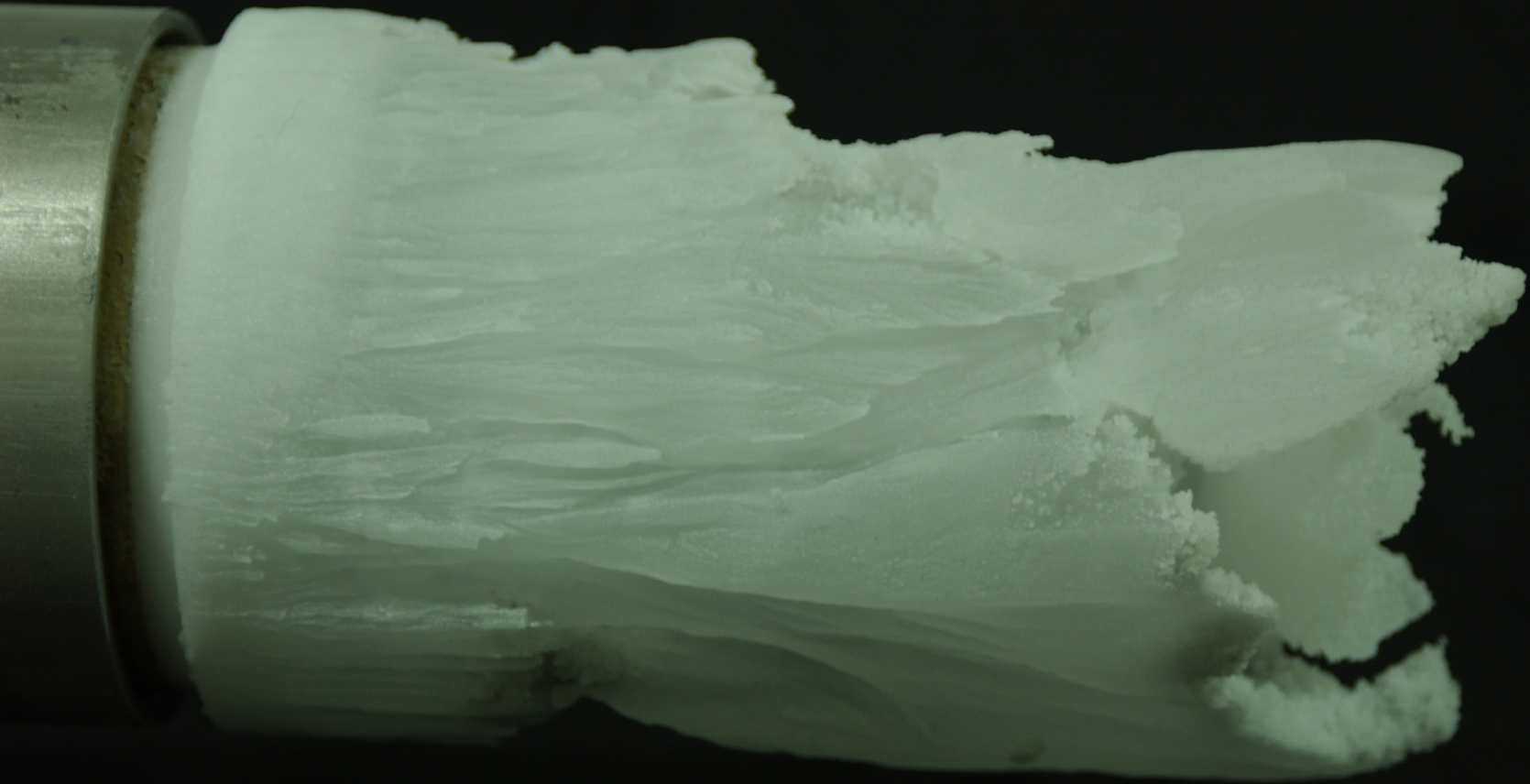
Logging temperature



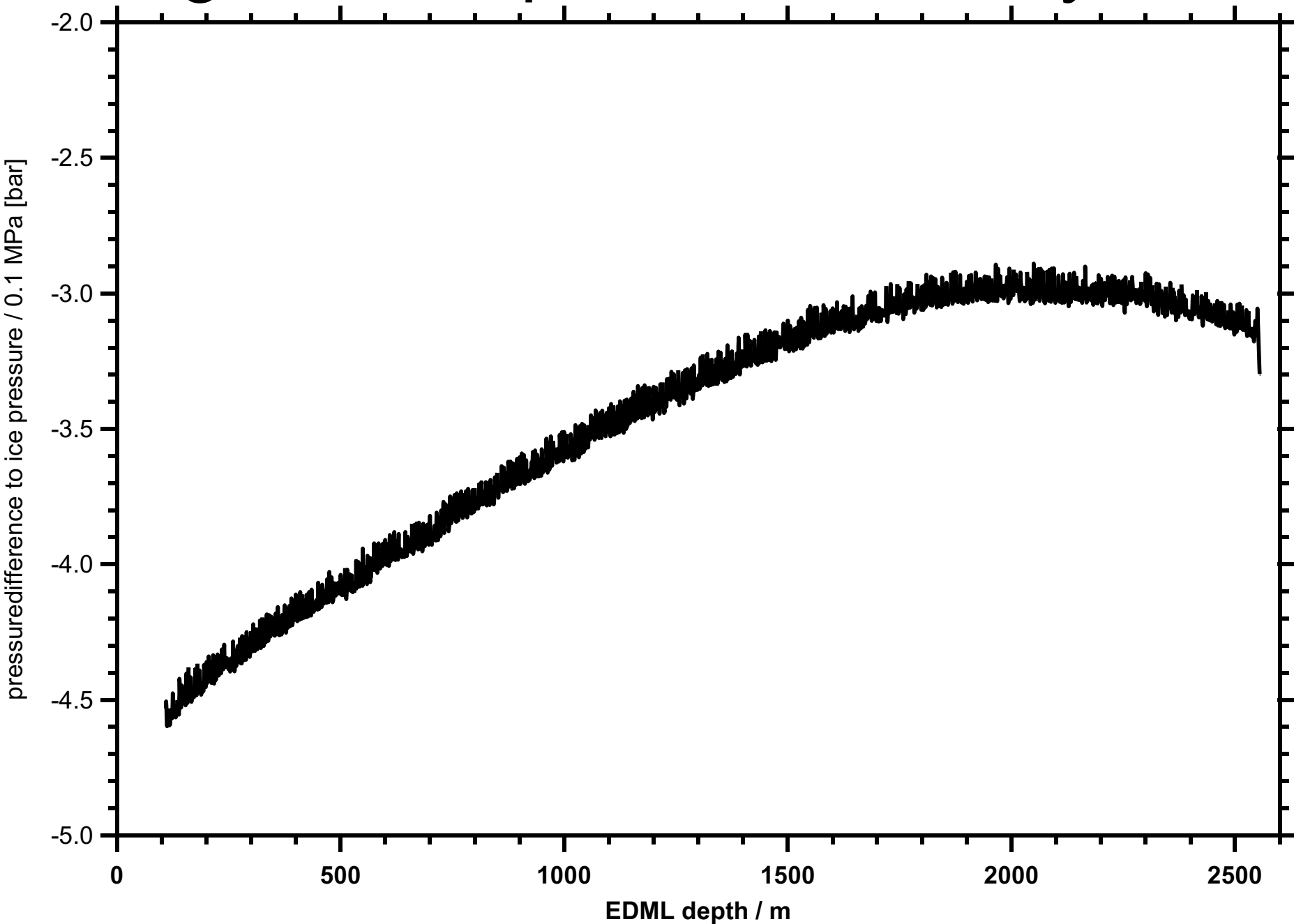
Lots of refrozen water at the bottom



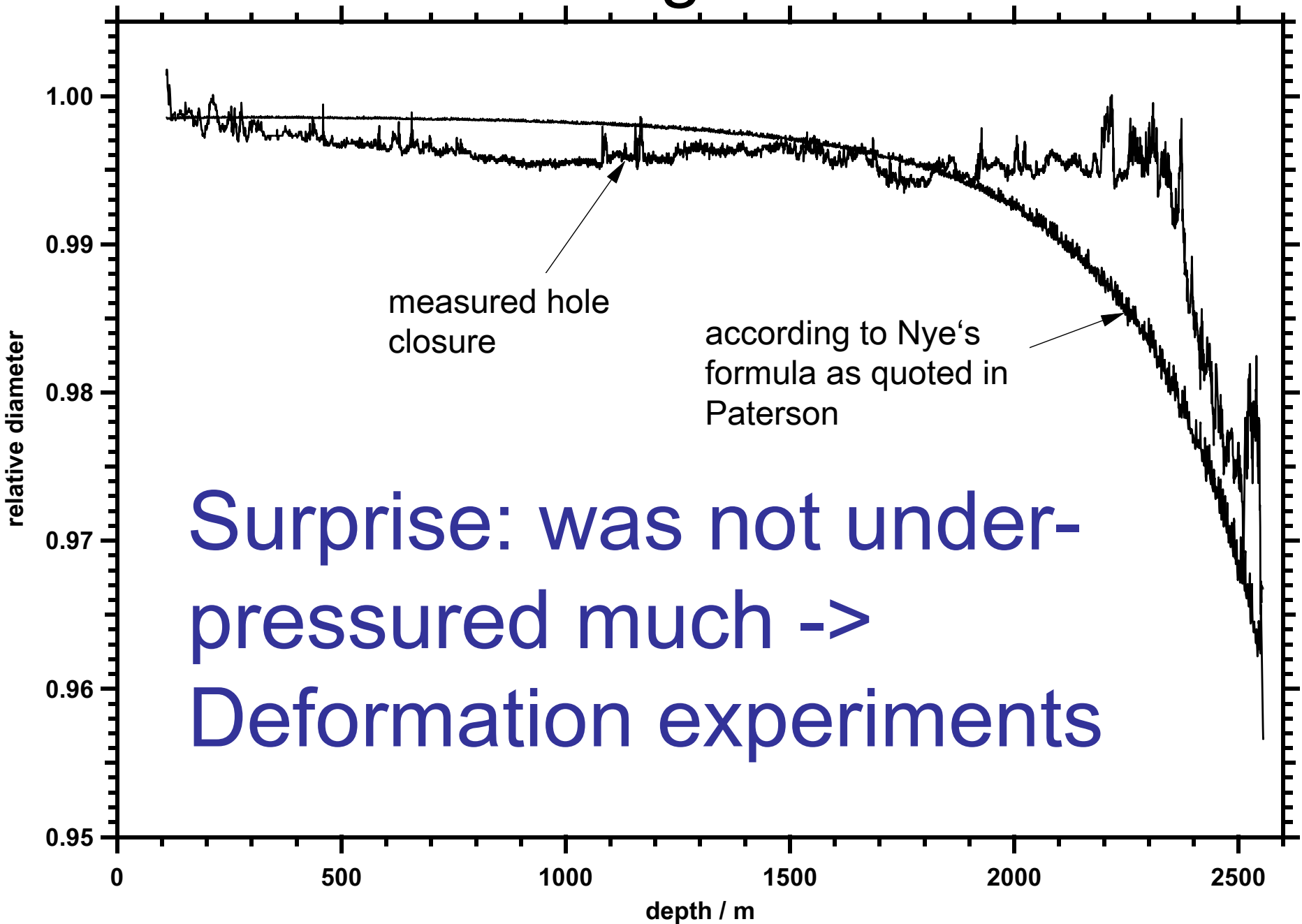
Ice Coring goes arts



Slight under-pressure over 2 years

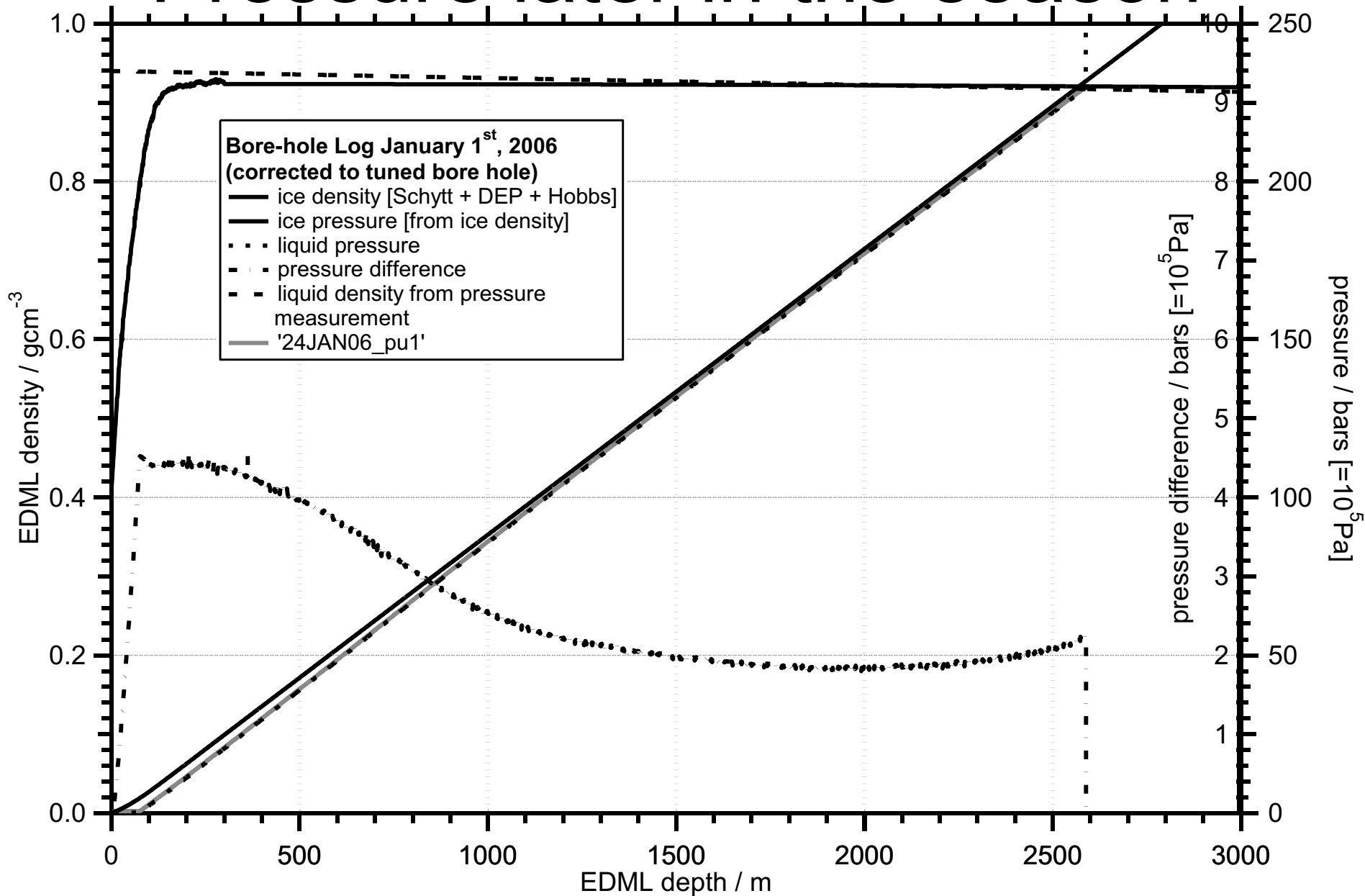


First log the hole

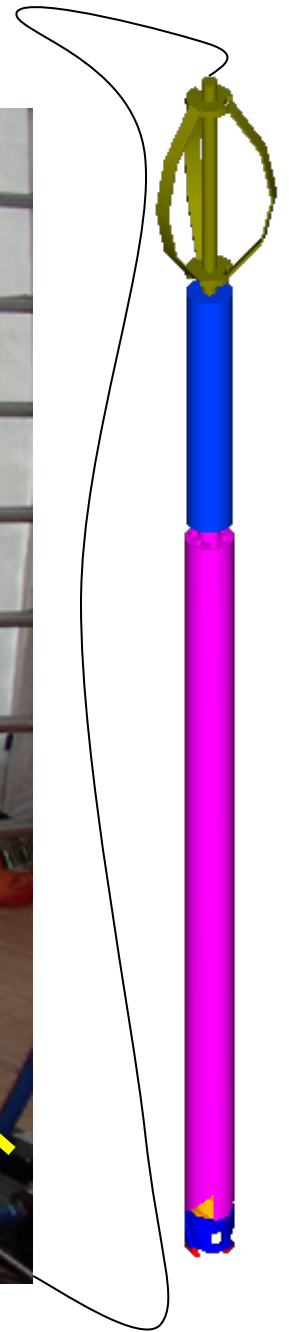


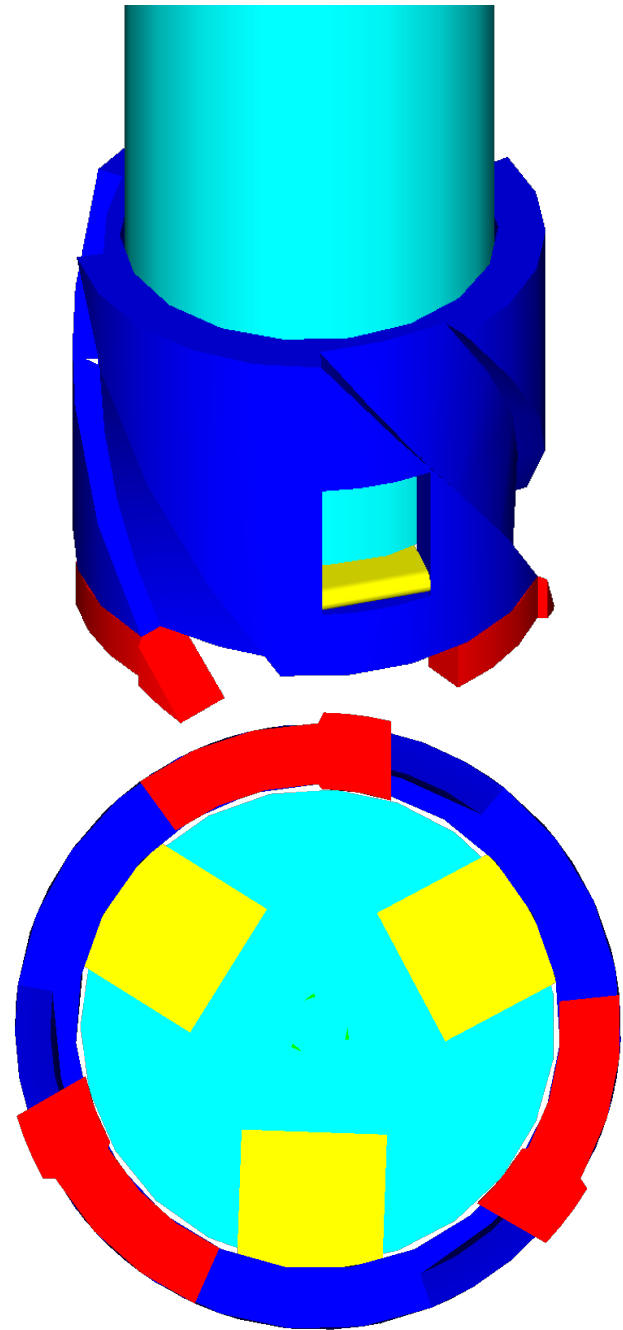
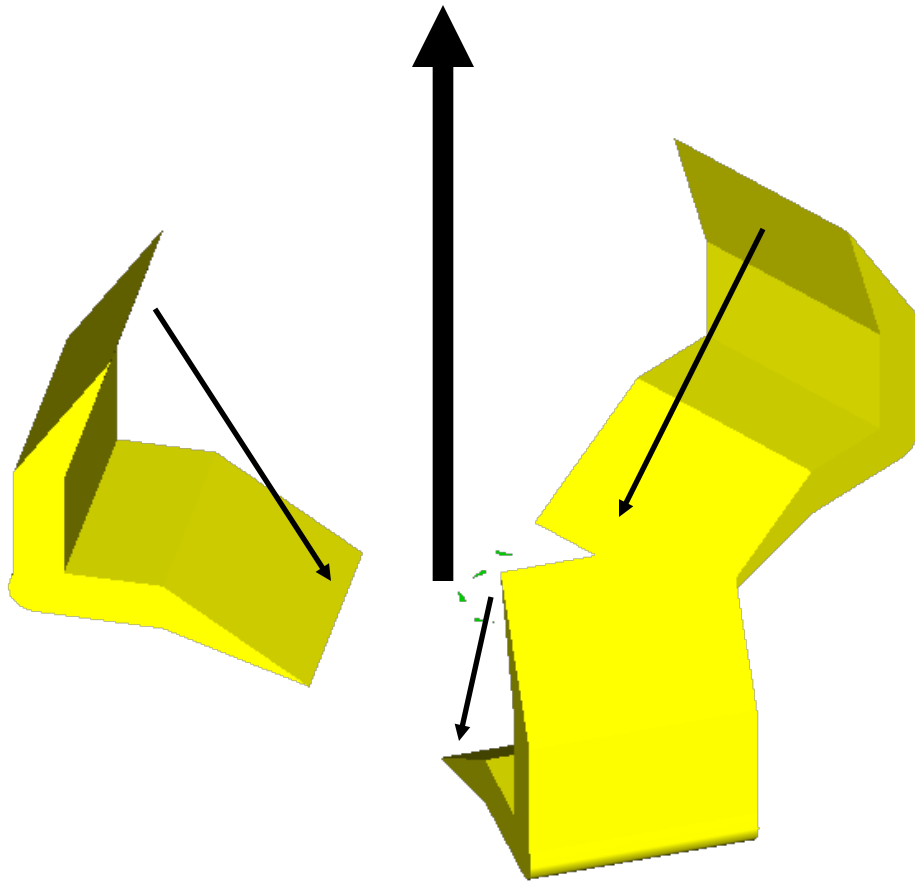
Surprise: was not under-
pressured much ->
Deformation experiments

Pressure later in the season



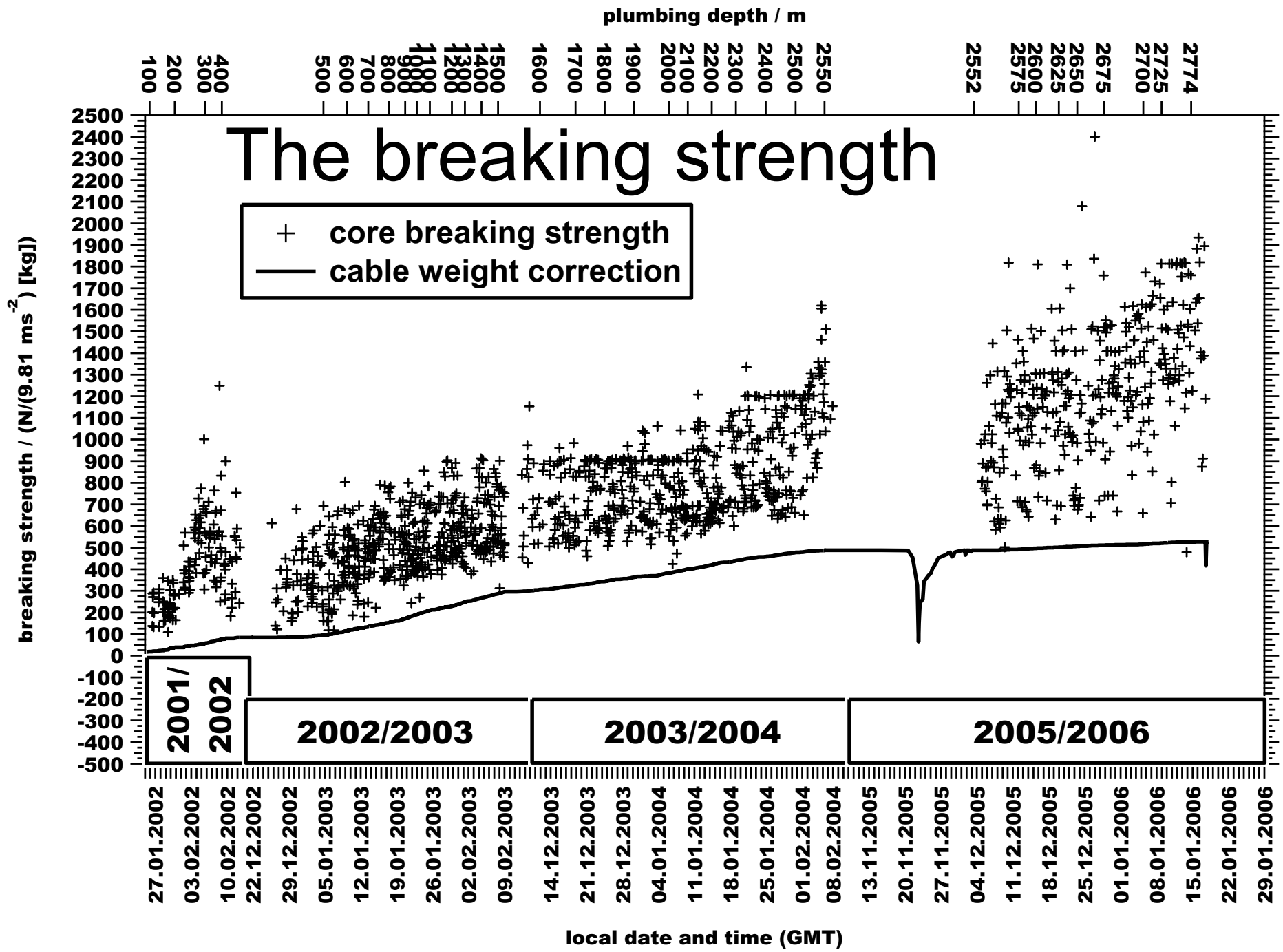
The winch moves the underground unit on a cable



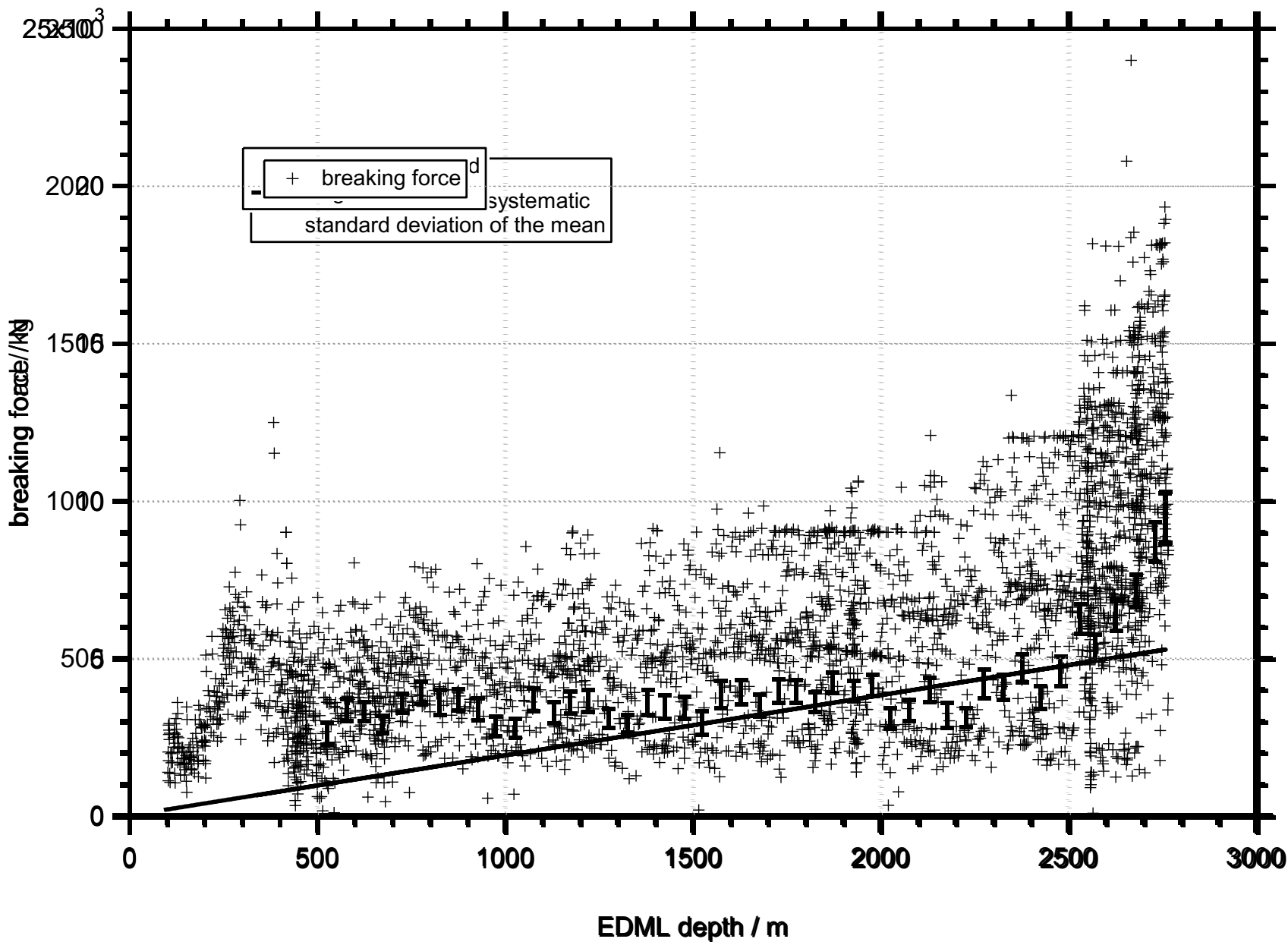


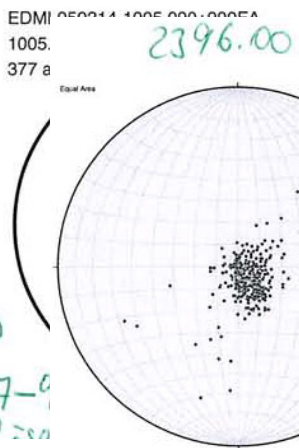
By pulling they are forced into the core, break and hold it (in reality they are much smaller compared to the core)

The breaking strength



The breaking force

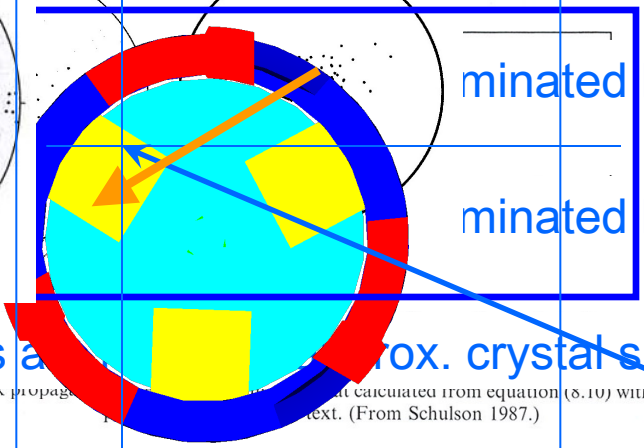




EDML depth / m

524.76
725.18
926.54
1128.1
1324.9
1424.4
1523.4
1626.5
1726.2
1824
1926
2024.3
2129
2225.1
2325.2
2423.9
2476.5
2529.3
2624.2
2678.3
2755.8

Fracture stress

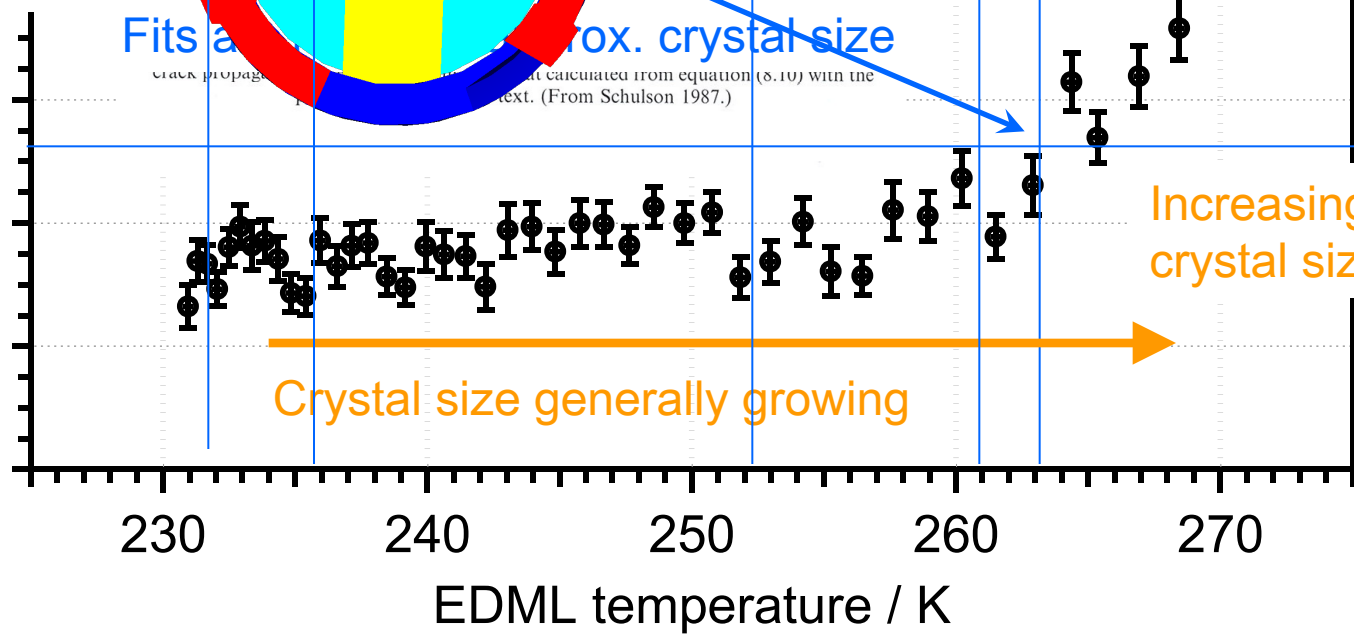


minated by

minated by

Fits a ... approx. crystal size

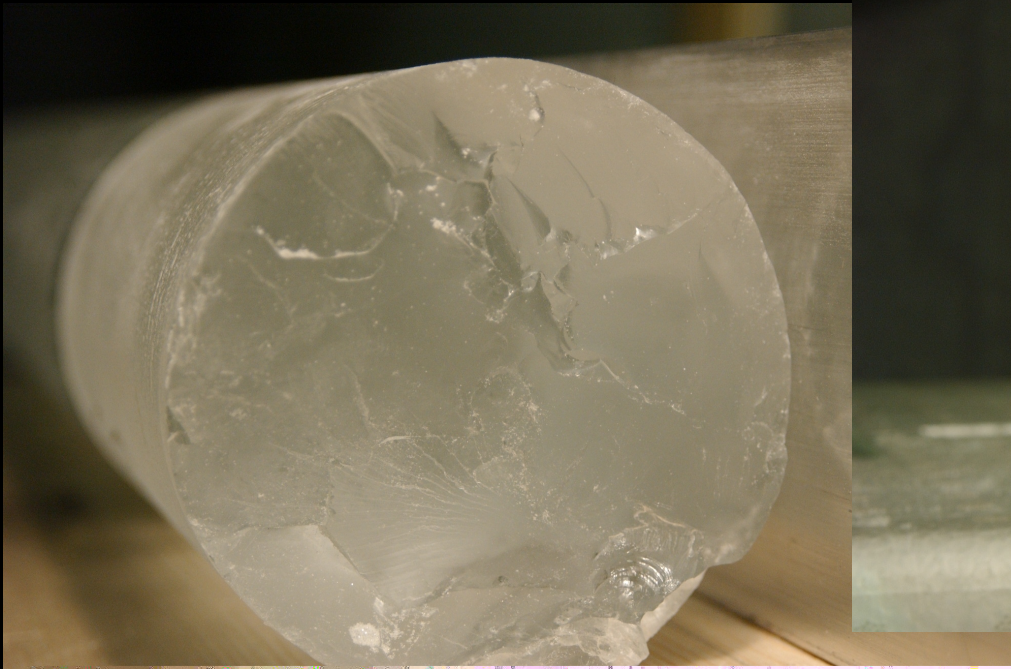
crack propagation ... calculated from equation (8.10) with the ... text. (From Schulson 1987.)

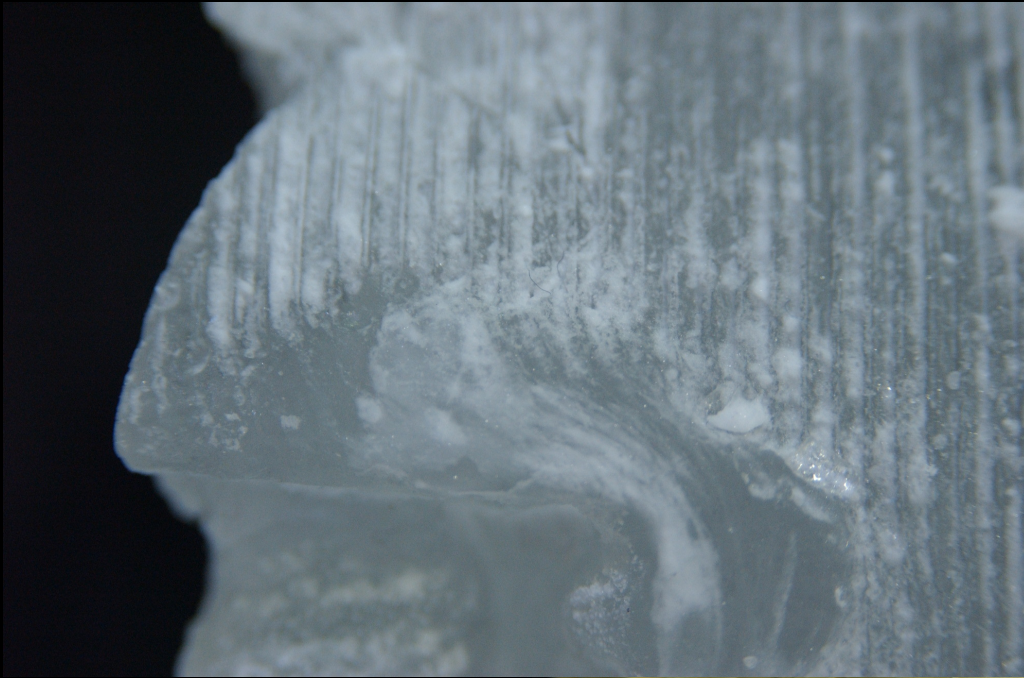


Increasing with crystal size

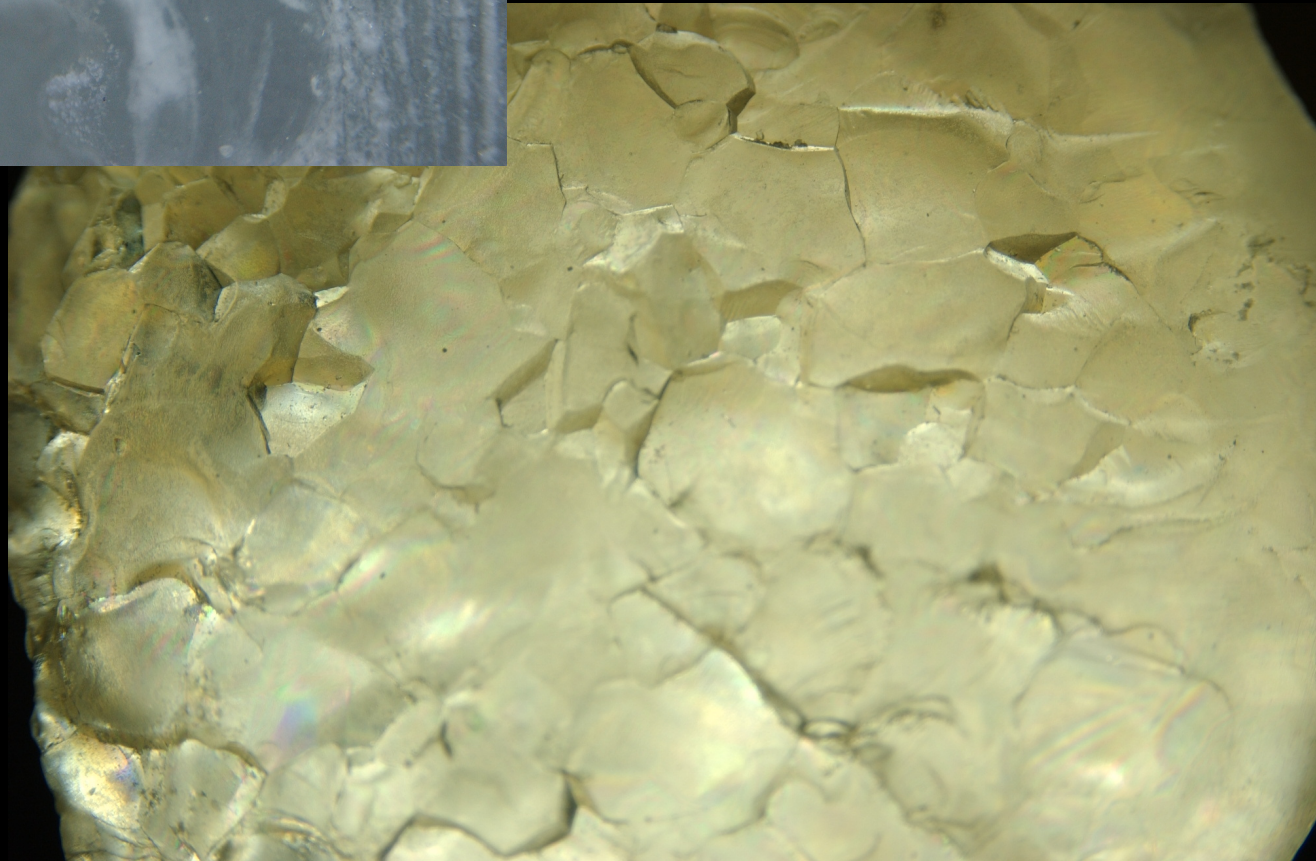
Crystal size generally growing

This fits my practical experience of changing from brittle ...





.... to ductile



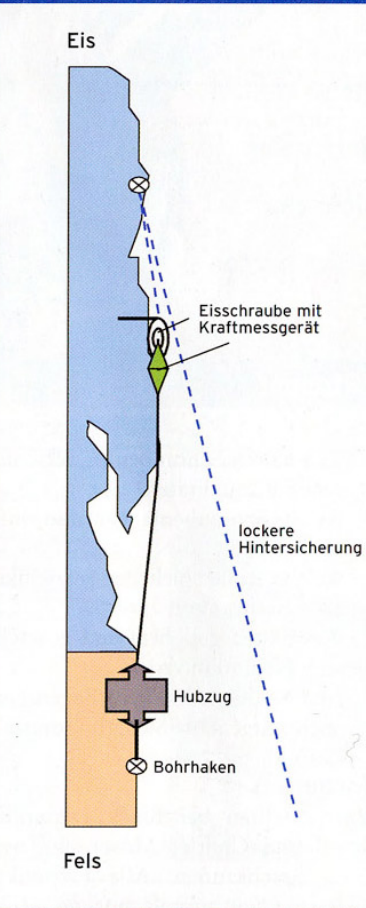
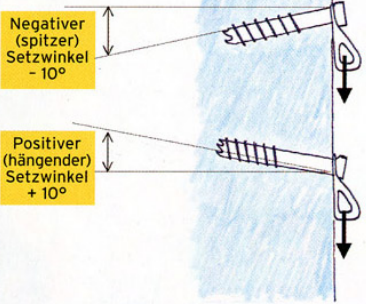


Abb. 3: Der Versuchsaufbau: Mit dem Hubzug ließen sich maximal etwa 20 kN (= 2 Tonnen) erreichen

K

Festigkeiten nach Eisqualitäten

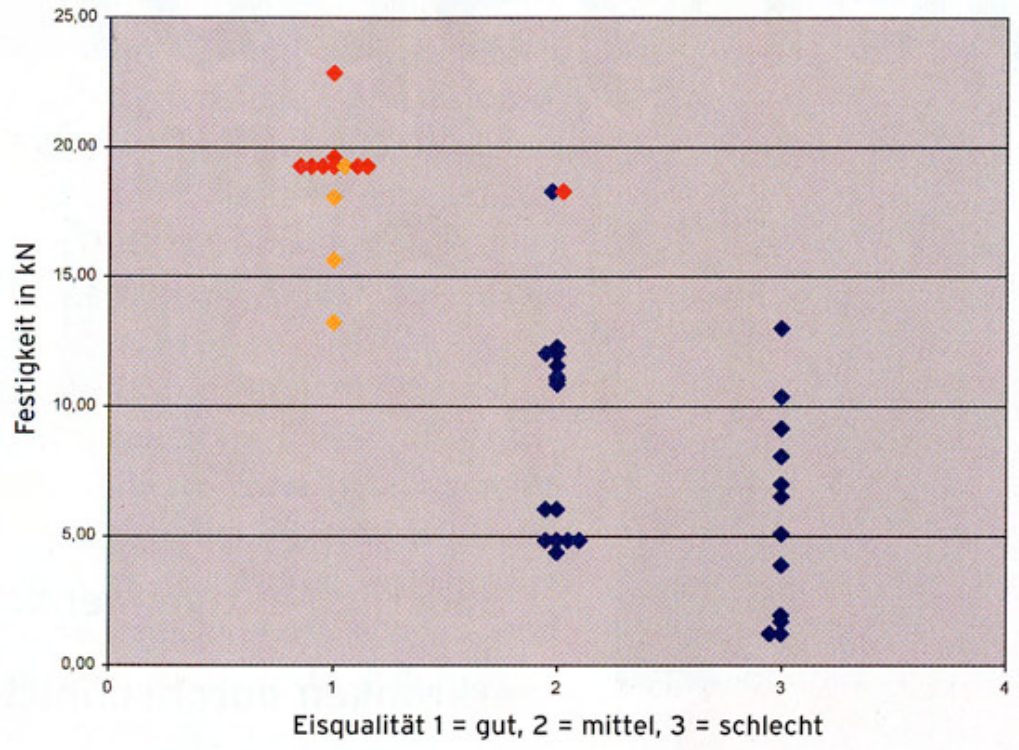


Diagramm 1: Rot: Versuch abgebrochen; gelb: Schraube gebrochen; blau: Eisausbruch.

Zukunft schützen

DAV PANORAMA

Diagramm 2: Optimal gesetzte Schrauben halten etwa dreimal so viel wie Mittelungen des Deutschen Alpenvereins

optimal gesetzte Schrauben

57. Jahrgang Nr. 2, April/Mai 2005, ISSN 1437-5923

Inhaber und Verleger

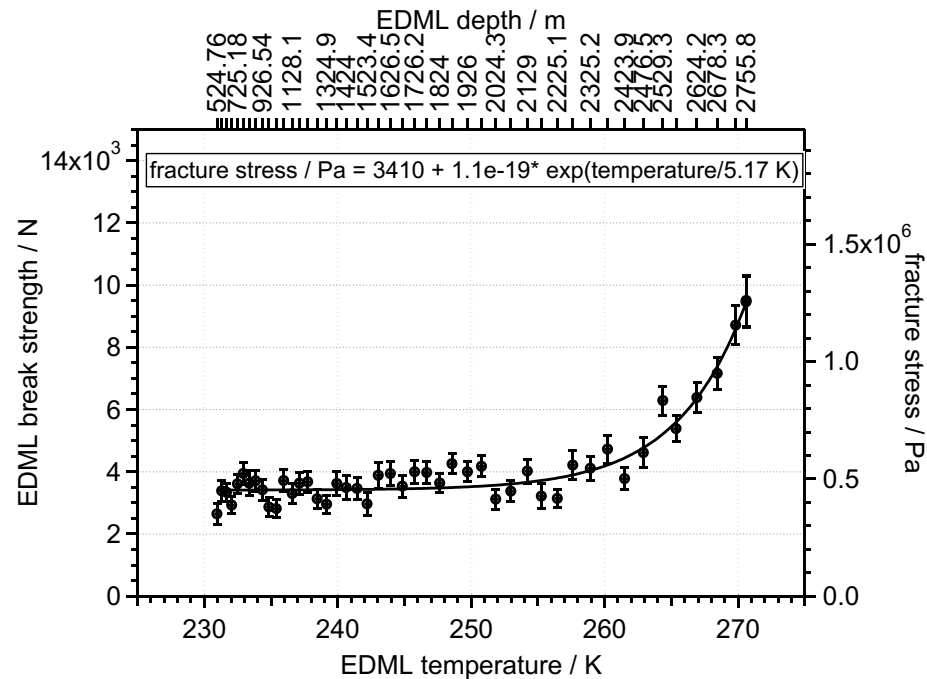
Deutscher Alpenverein e.V. Telefon 089/1 40 03-0
 Von-Kahr-Str. 2 - 4 Telefax 089/1 40 00-316
 80997 München E-Mail: dav-panorama@alpenverein.de
 Internet: www.dav-panorama.de



Conclusions

- Ice Drilling Community: log as much of the parameters as possible: any core break is a stress test, any unbalanced hole is a deformation test
- Physical Properties of Ice Community: discuss mechanical design to get maybe even better defined experimental set-up

Something to take away



Wilhelms, F. , Sheldon, S. G. , Hamann, I. and Kipfstuhl, S. (2007) IMPLICATIONS FOR AND FINDINGS FROM DEEP ICE CORE DRILLINGS AN EXAMPLE: THE ULTIMATE TENSILE STRENGTH OF ICE AT HIGH STRAIN RATES , Physics and Chemistry of Ice (The proceedings of the International Conference on the Physics and Chemistry of Ice held at Bremerhaven, Germany on 23-28 July 2006) The Royal Society of Chemistry Special Publication No. 311, p., pp. 635-639 , <http://epic.awi.de/15765/>

WILHELMS, F. , MILLER, H. , GERASIMOFF, M. D. , DRÜCKER, C. , FRENZEL, A. , FRITZSCHE, D. , GROBE, H. , HANSEN, S. B. , HILMARSSON, S. Æ. , HOFFMANN, G. , HÖRNBY, K. , JAESCHKE, A. , JAKOBSDÓTTIR, S. S. , JUCKSCHAT, P. , KARSTEN, A. , KARSTEN, L. , KAUFMANN, P. R. , KARLIN, T. , KOHLBERG, E. , KLEFFEL, G. , LAMBRECHT, A. , LAMBRECHT, A. , LAWER, G. , SCHÄRMELI, I. , SCHMITT, J. , SHELDON, S. G. , TAKATA, M. , TRENKE, M. , TWARLOH, B. , VALERO-DELGADO, F. and WILHELMS-DICK, D. (2014)

The EPICA Dronning Maud Land deep drilling operation , Annals of Glaciology, 55 (68), pp. 355-366 . doi:10.3189/2014AoG68A189 , hdl:10013/epic.45066 , <http://epic.awi.de/37370/>

Weikusat, I. , Jansen, D. , Binder, T. , Eichler, J. , Faria, S. H. , Wilhelms, F. , Kipfstuhl, S. , Sheldon, S. , Miller, H. , Dahl-Jensen, D. and Kleiner, T. (2017) Physical analysis of an Antarctic ice core—towards an integration of micro- and macrodynamics of polar ice , Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 375 (2086), p. 20150347 . doi:10.1098/rsta.2015.0347 , <http://epic.awi.de/42978/>