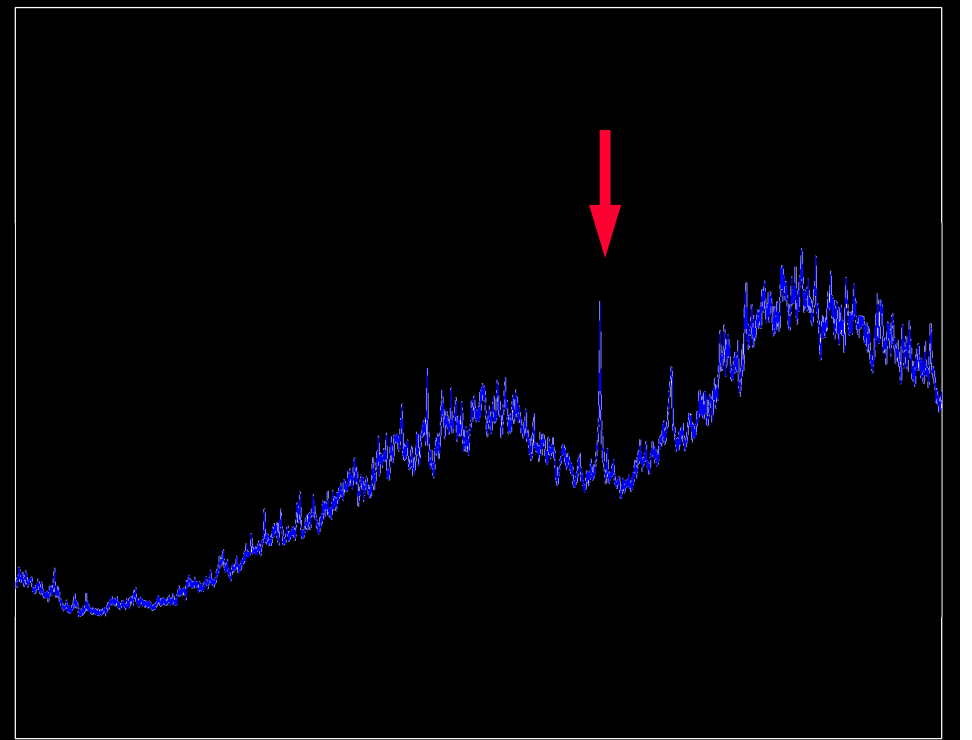
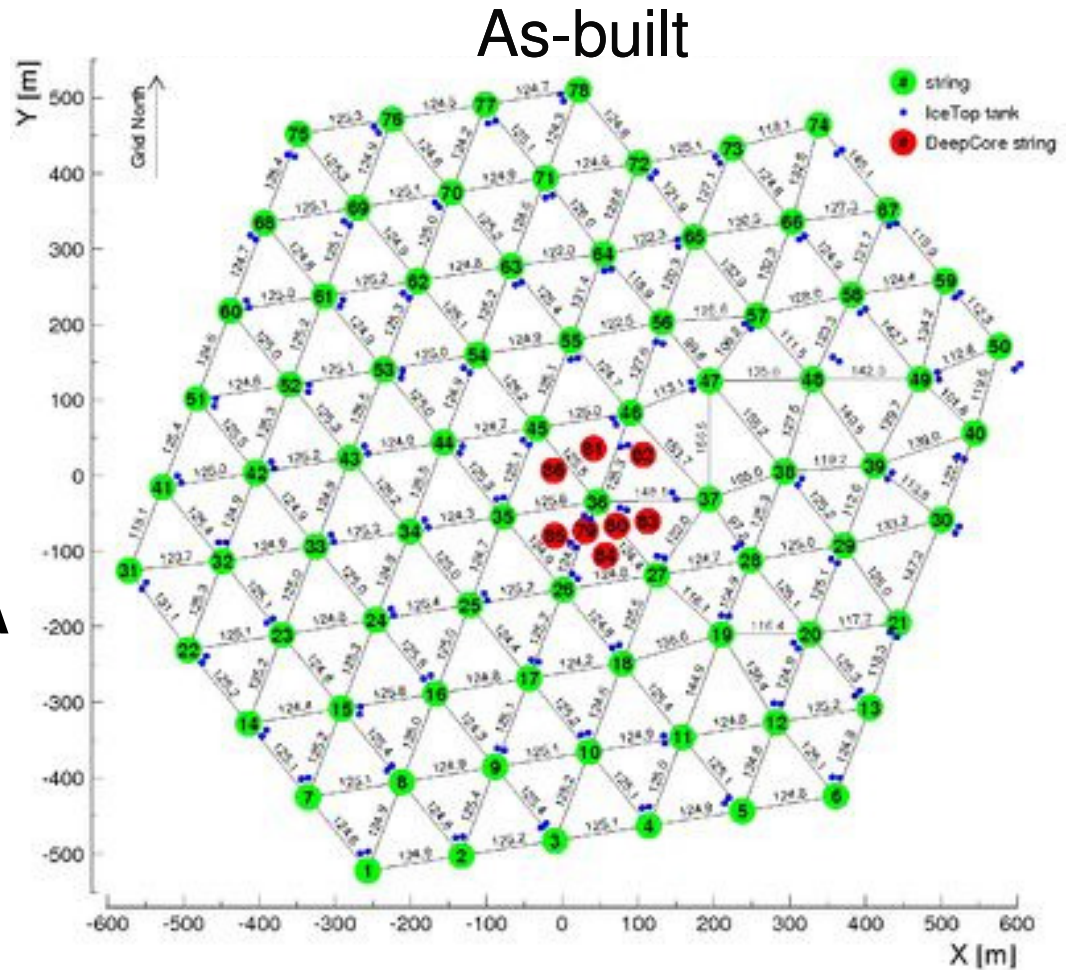
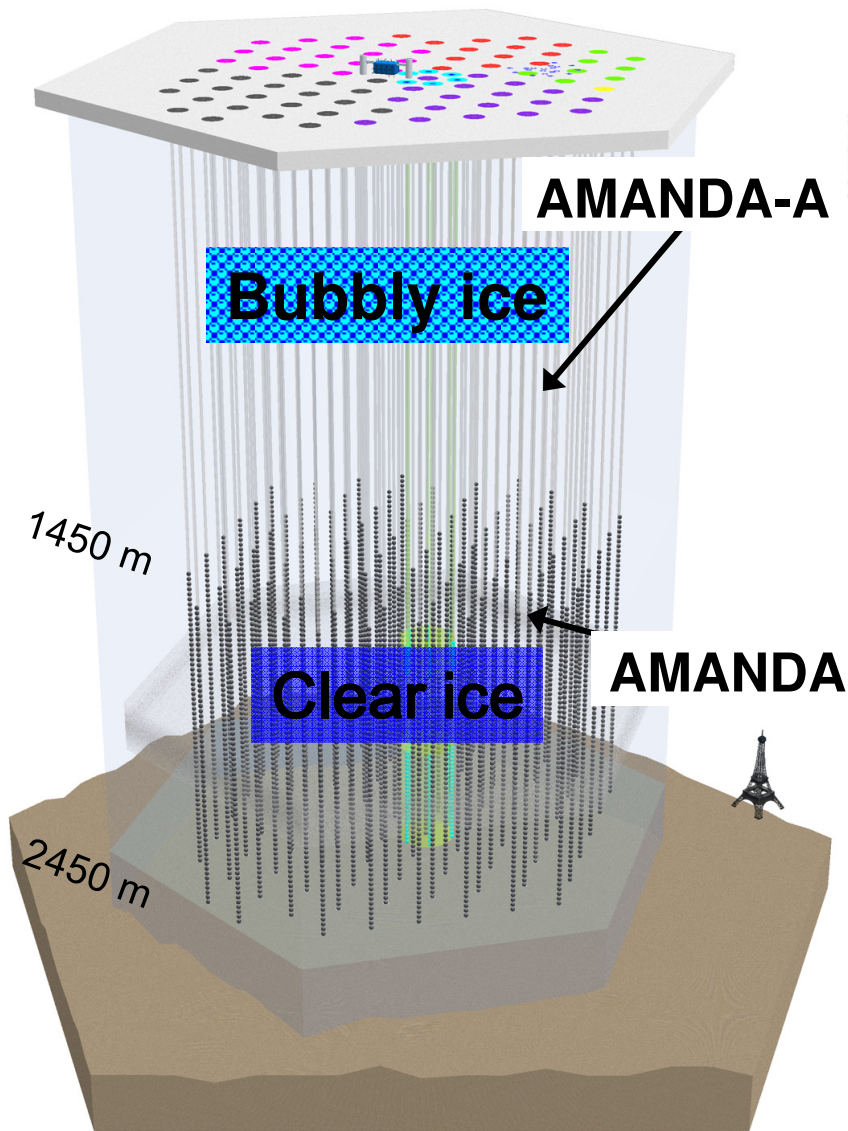


IceCube Glaciology

*Ryan Bay
Antarctic Science meeting
Madison
April 2011*



IceCube completed December 18, 2010



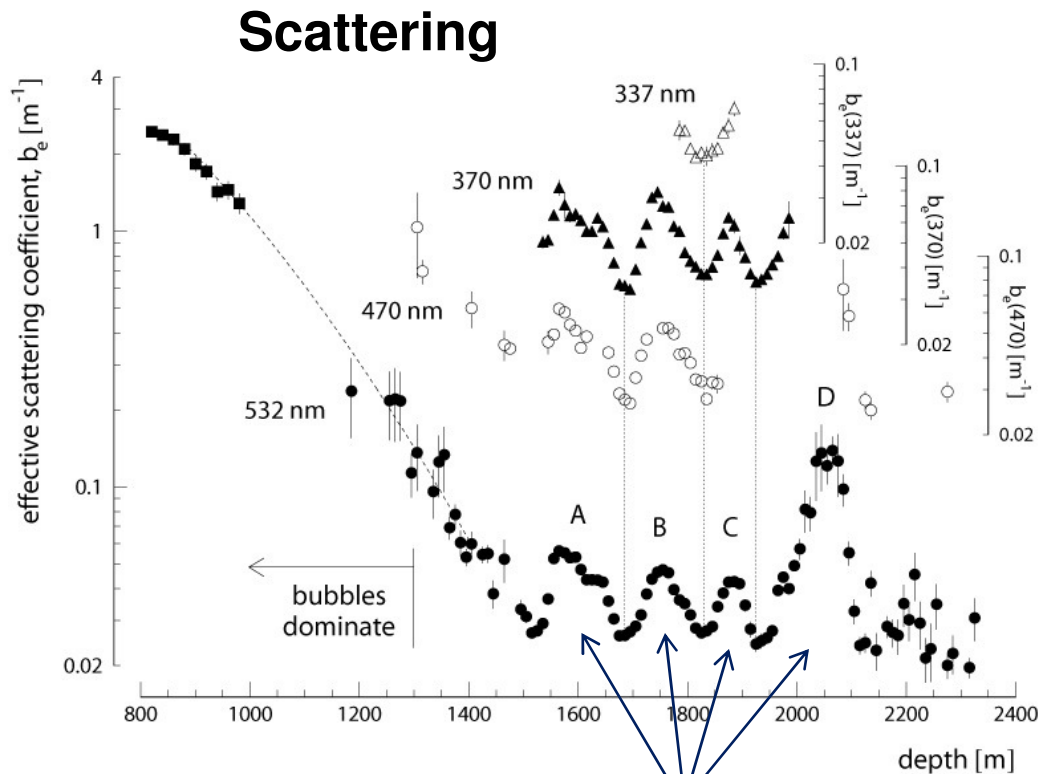
Optics of the most transparent natural solid

Buford Price, Kurt Woschnagg, *et al.*

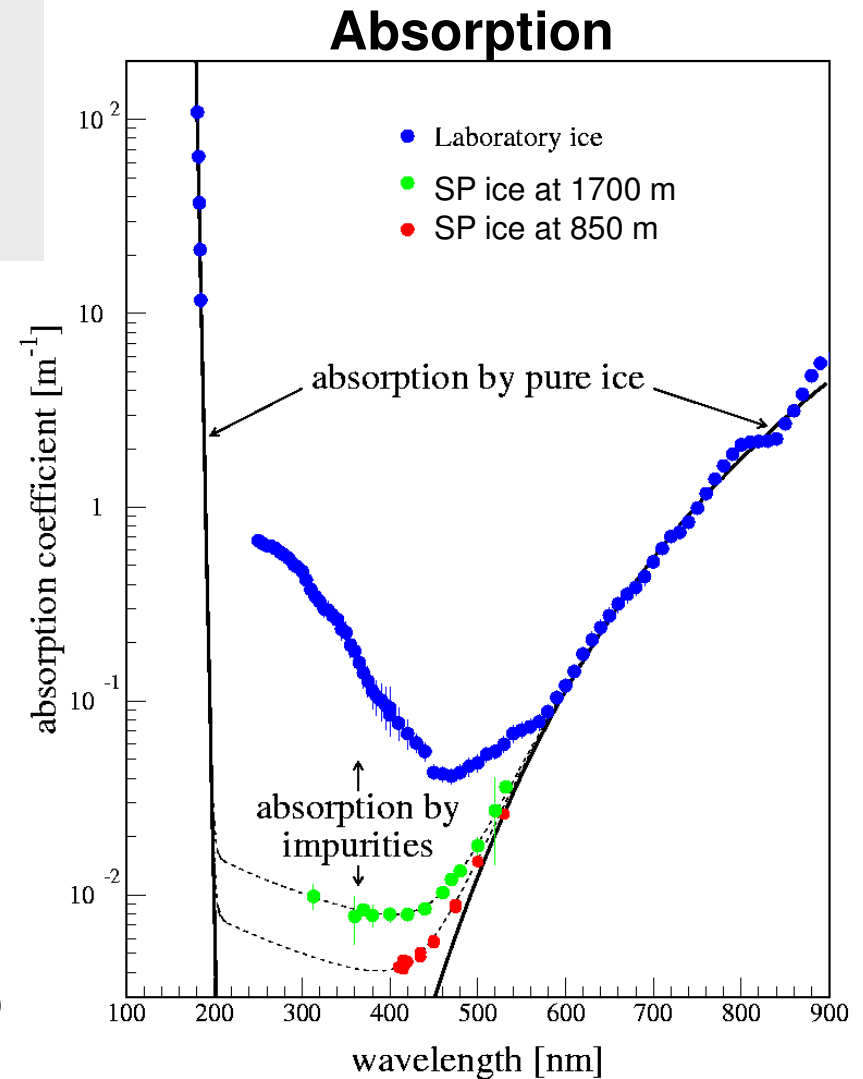
Average optical parameters:

$$\lambda_{\text{abs}} \sim 110 \text{ m @ } 400 \text{ nm}$$

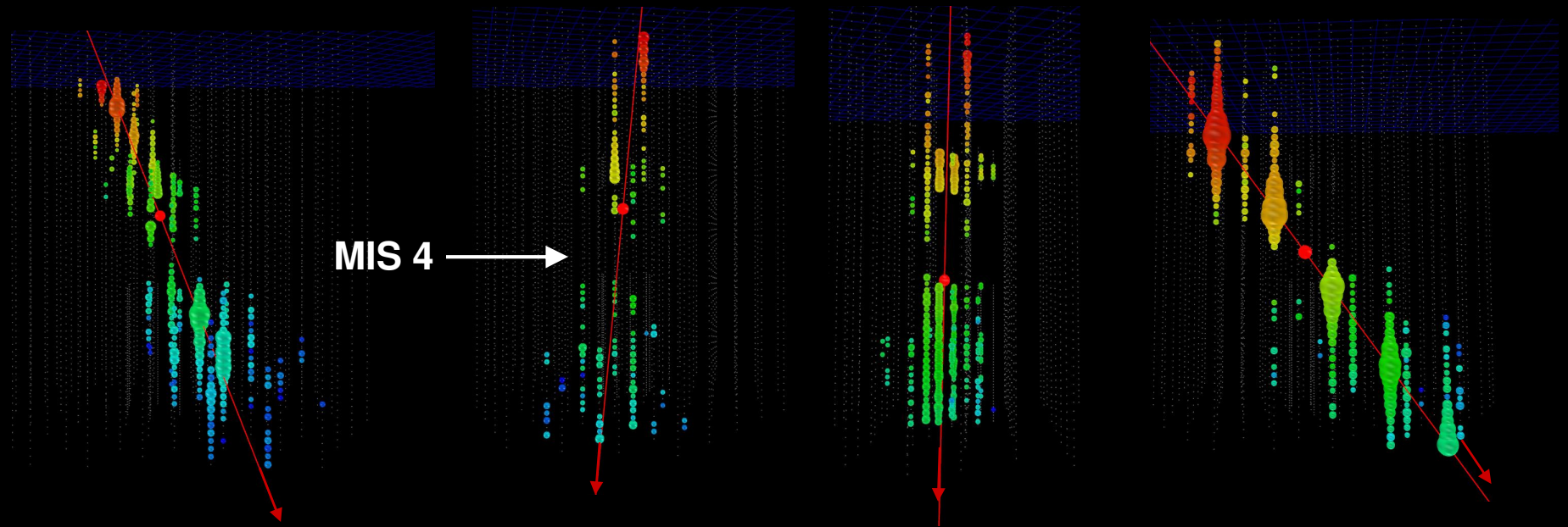
$$\lambda_{\text{scat}} \sim 20 \text{ m @ } 400 \text{ nm}$$



dust peaks during cold periods

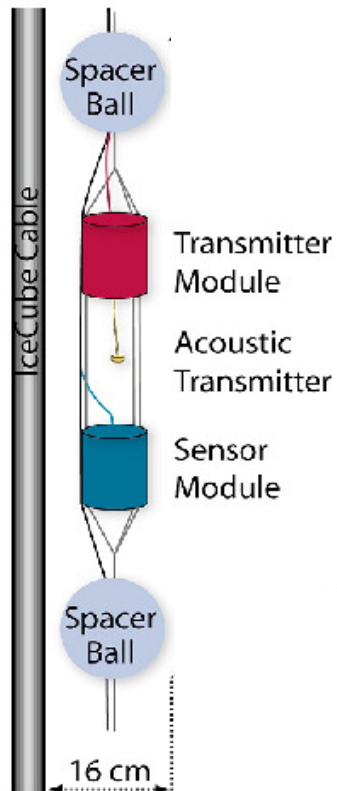


IceCube events and the “dust layer”

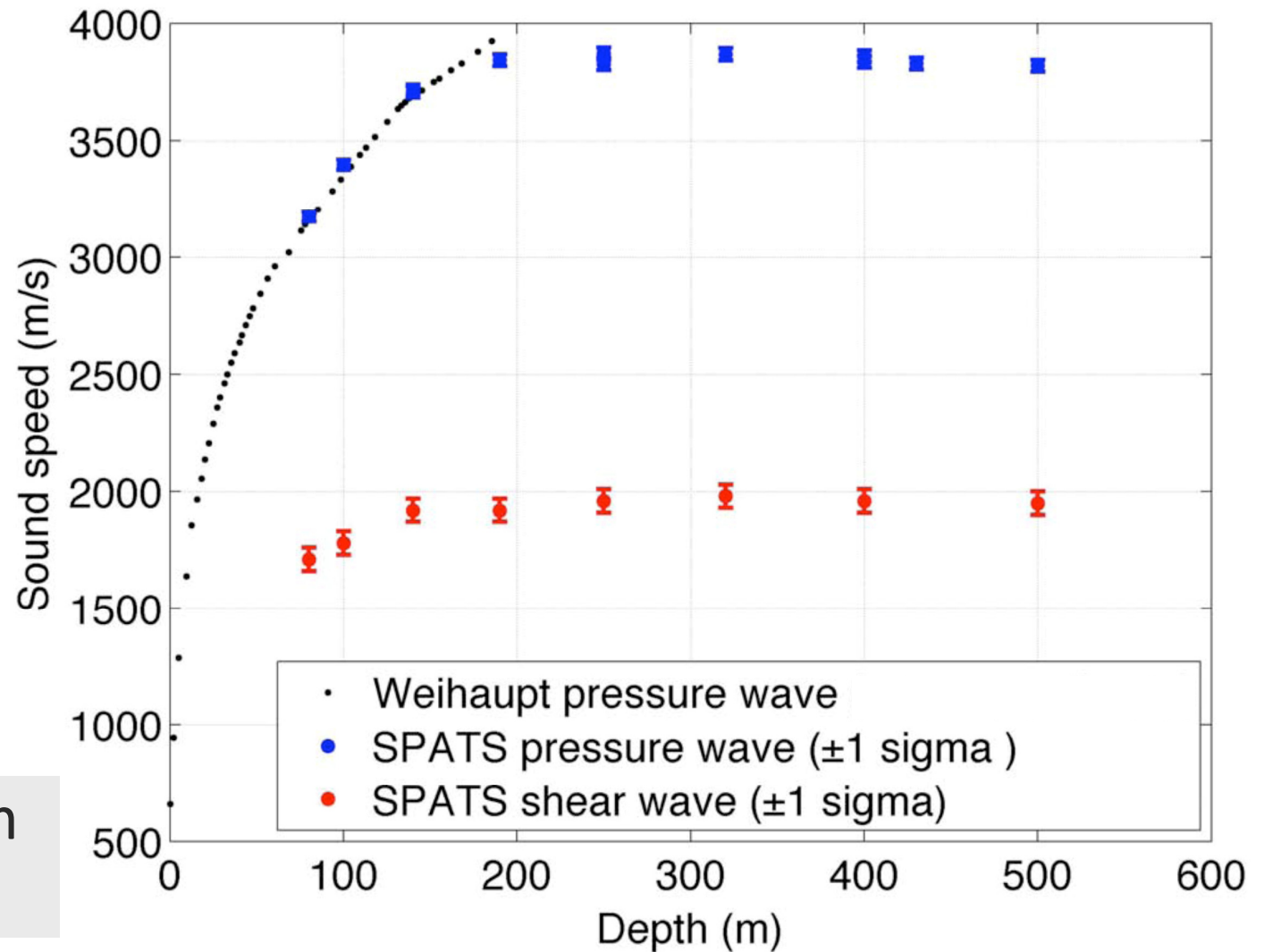


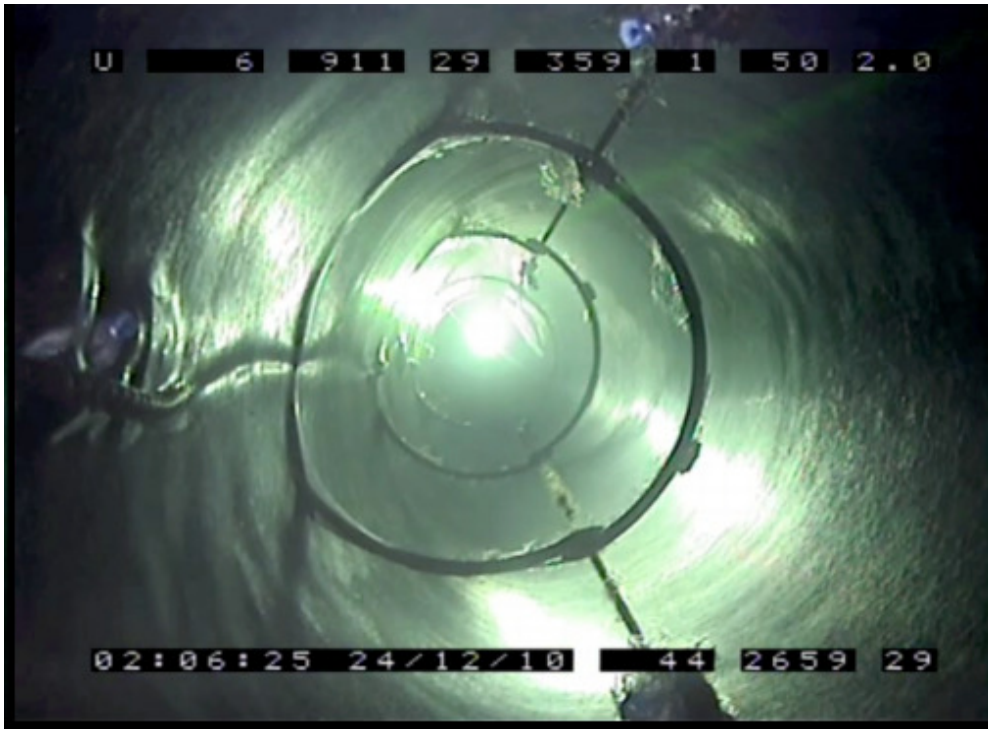
SP Acoustic Test Setup (SPATS)

R. Nahnauer, J. Vandenbroucke *et al.*

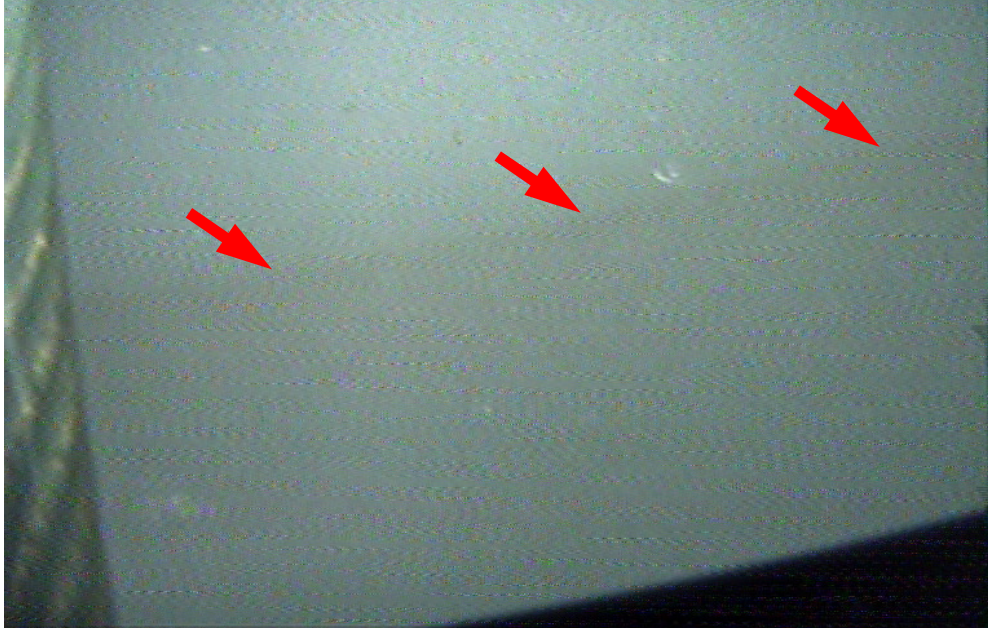


$\lambda_{\text{att}} \approx 300 \text{ m}$
@ 20 kHz

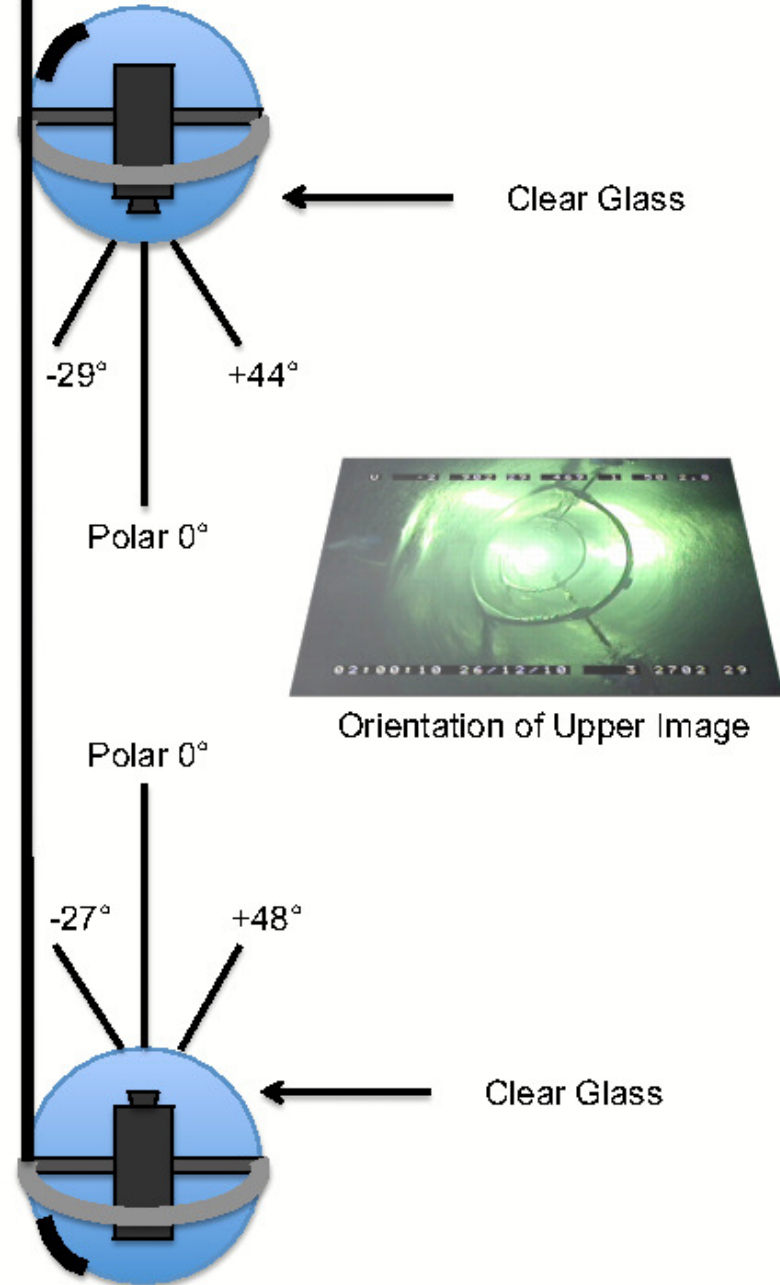




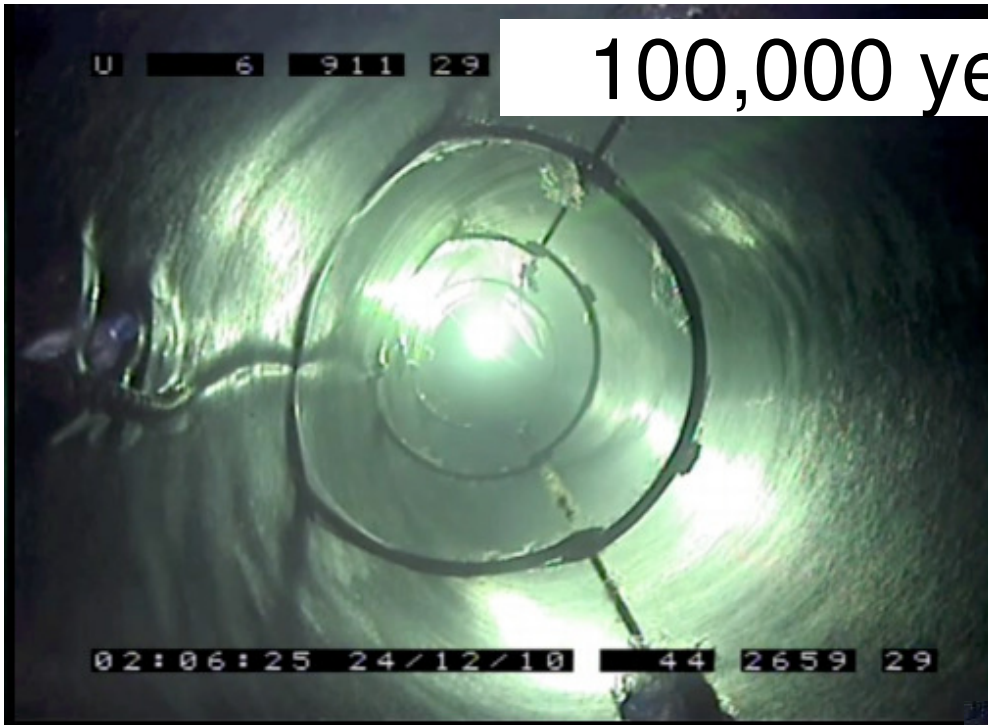
P. O. Hulth & Stockholm Univ.



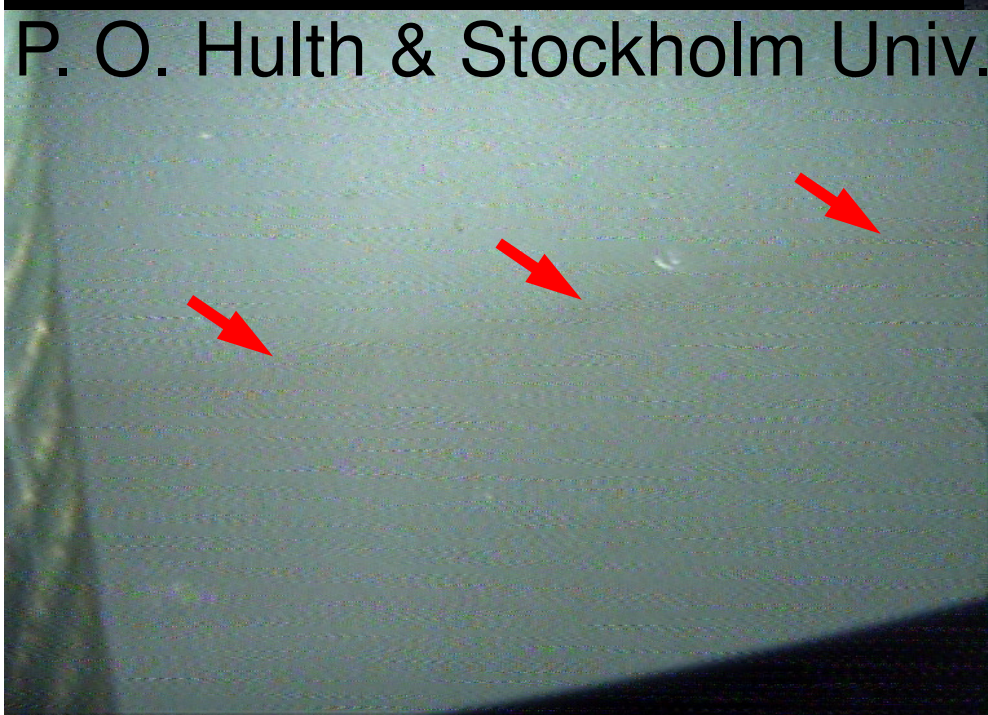
Sweden Camera



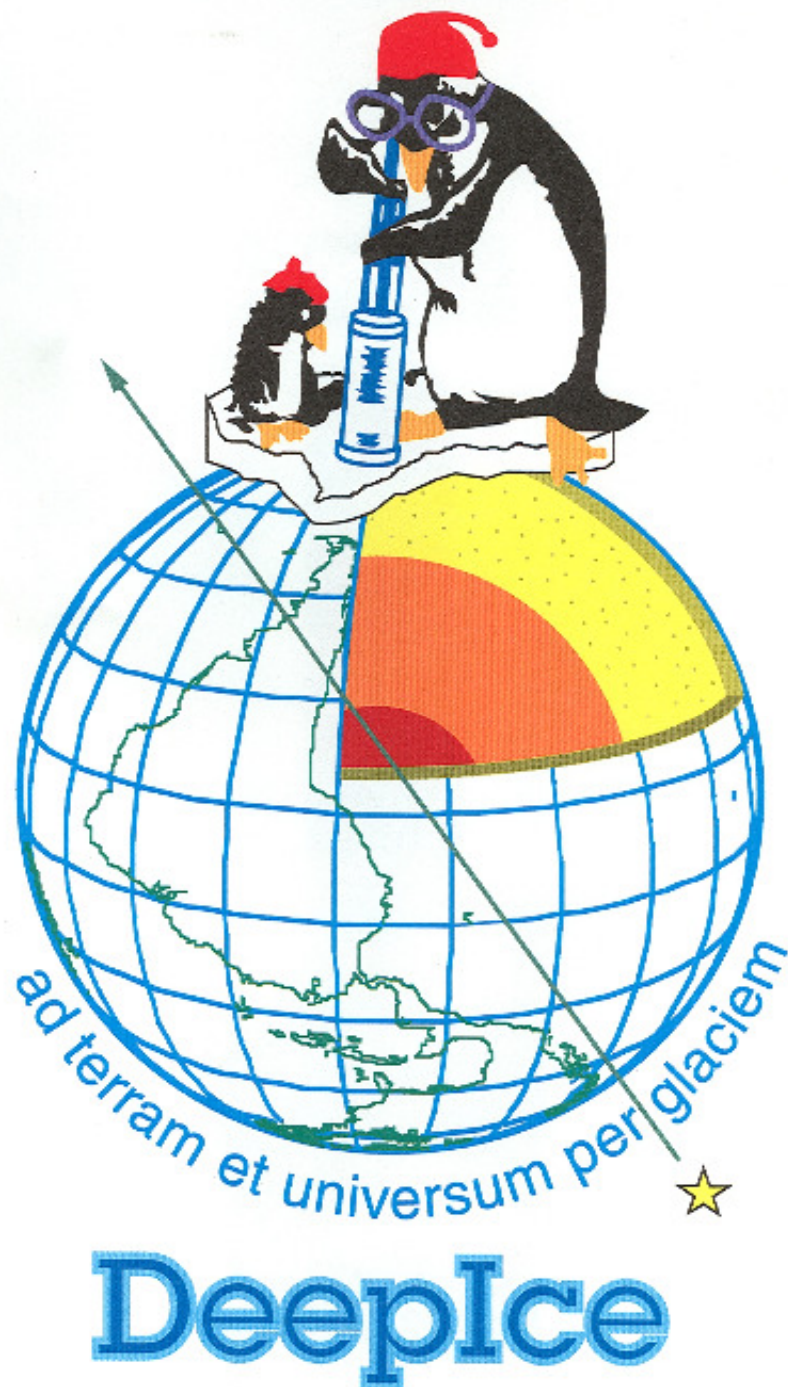
100,000 year snow pit



P. O. Hulth & Stockholm Univ.



Ski tracks?

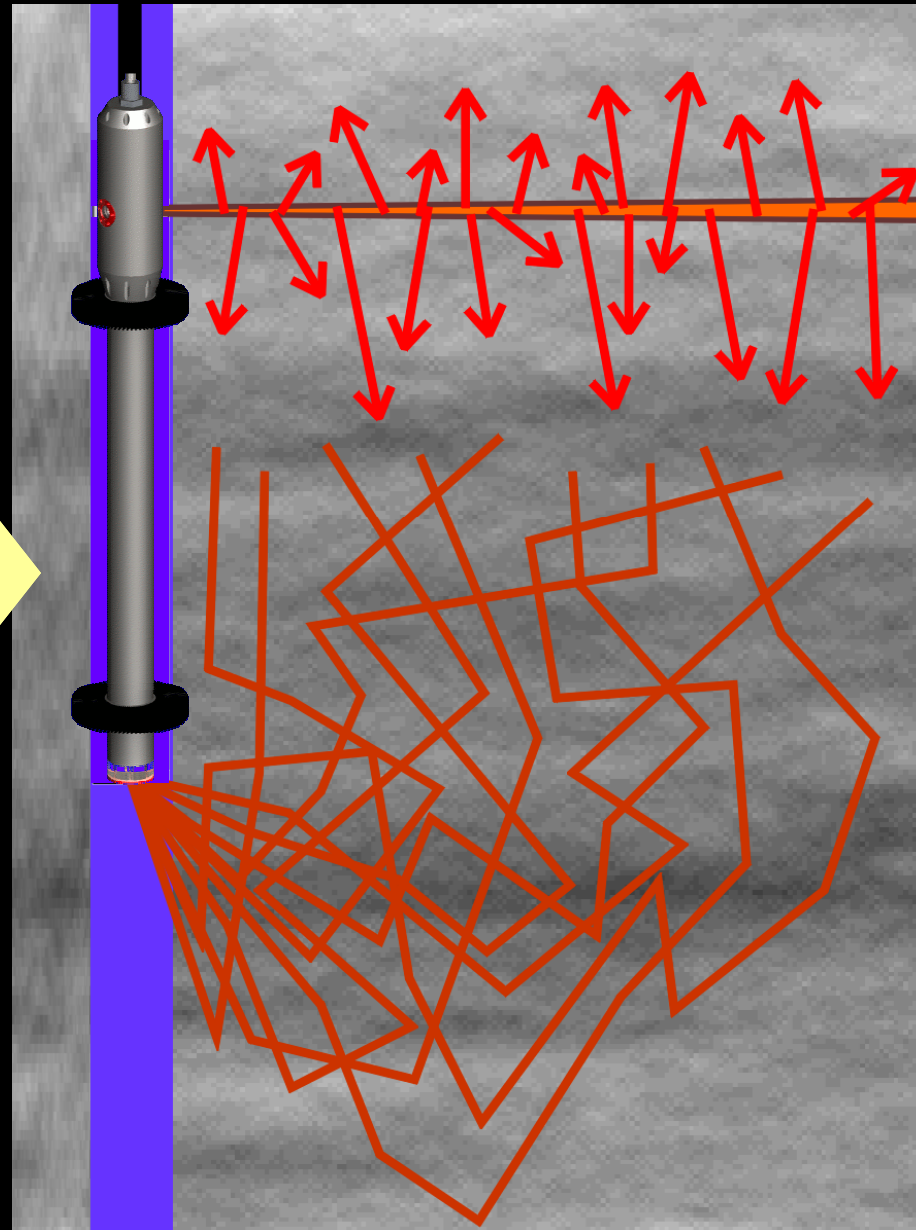
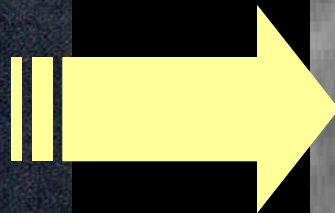
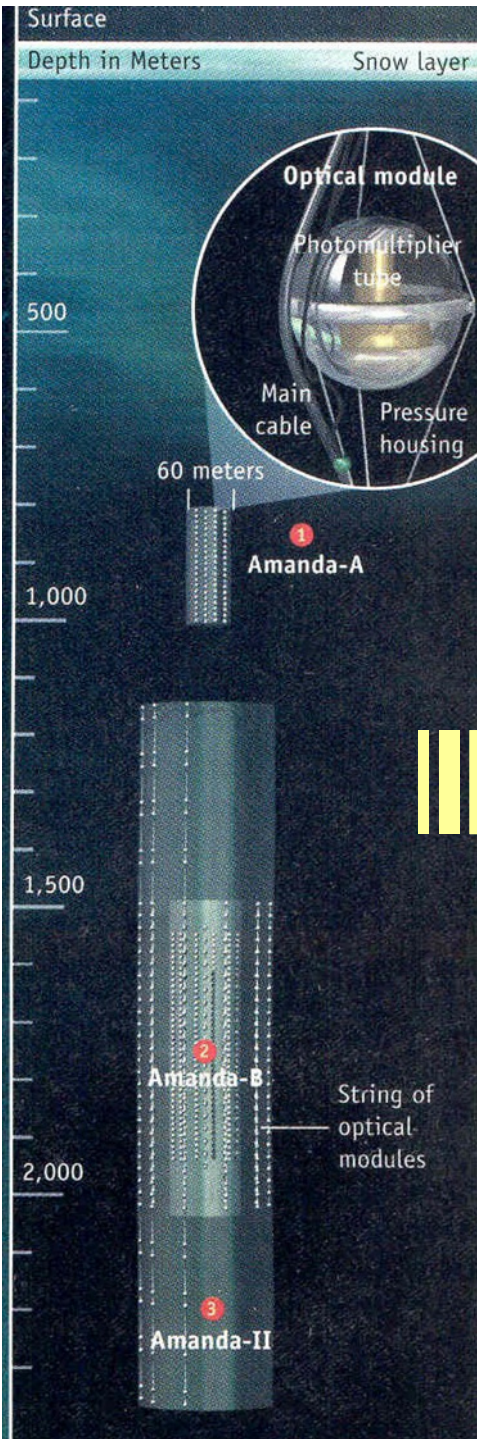


In 1999, Buford proposed the *DeepIce STC*

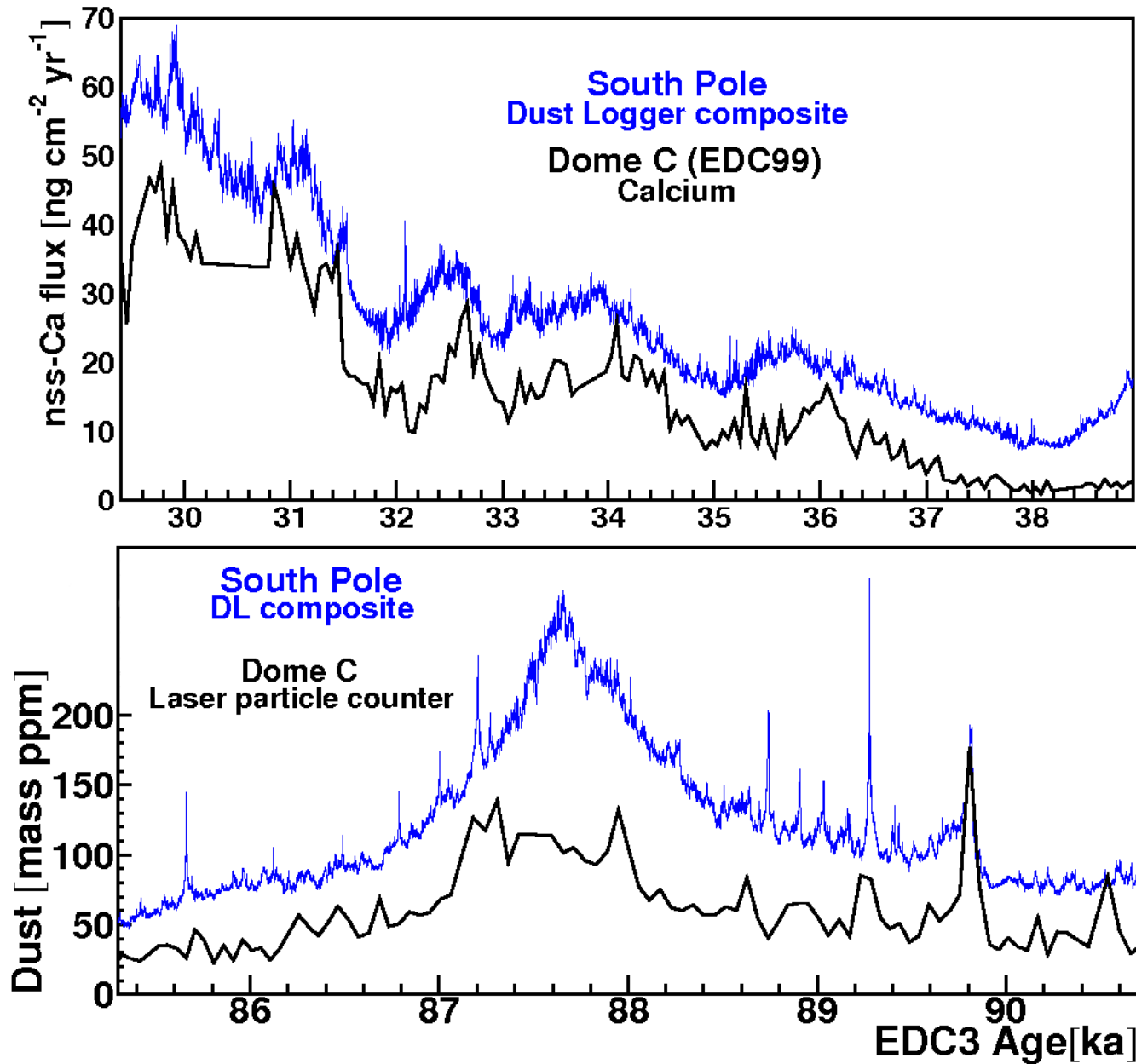
- UHE ν -astronomy
- 3-D seismic array
 - Climatology
 - Glaciology
- Cosmogenic nuclides
 - Microbial life in ice
 - Subglacial lakes
- Interdisciplinary theory

It reached the finals but was not funded.

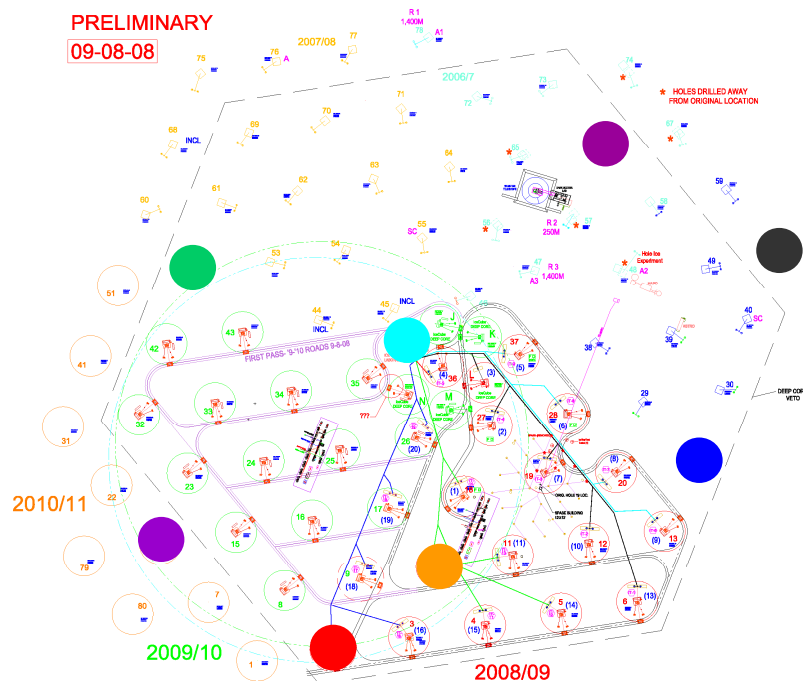
From ice neutrino telescopes... to an optical borehole dust logger



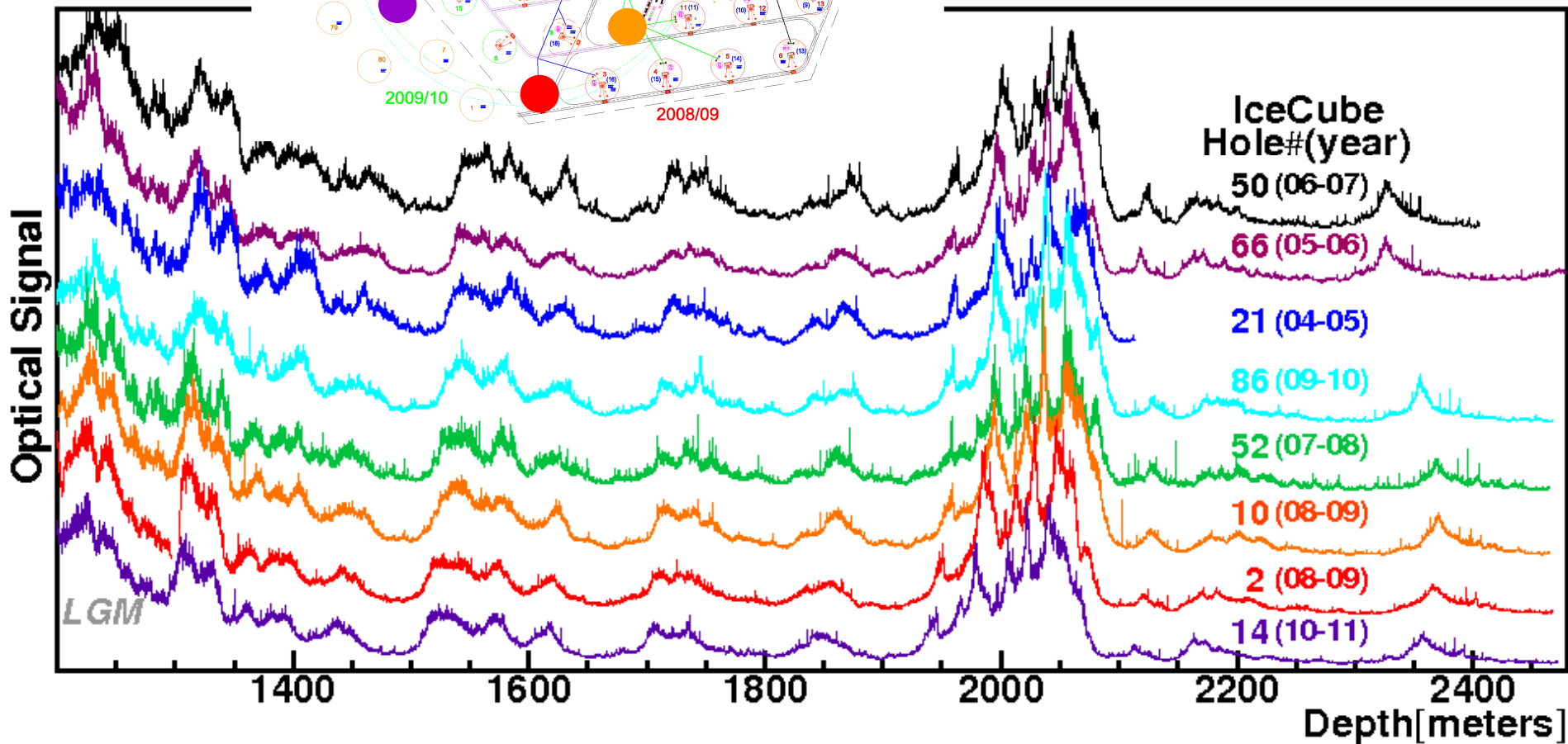
Laser particulate stratigraphy



PRELIMINARY
09-08-08



Ultra High-Def South Pole dust history



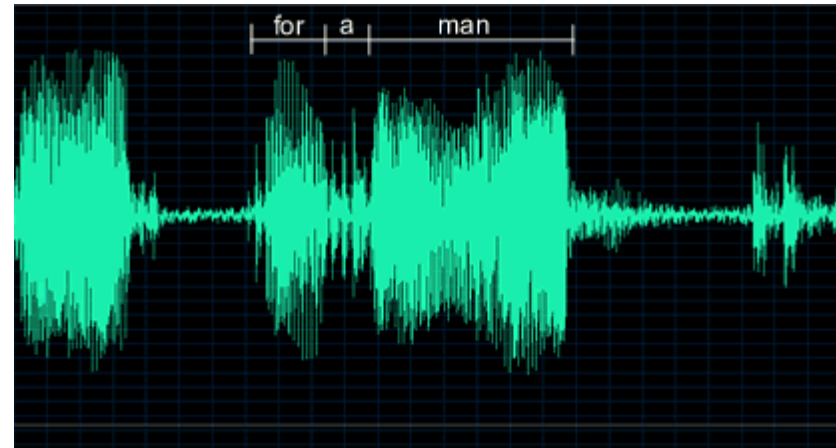
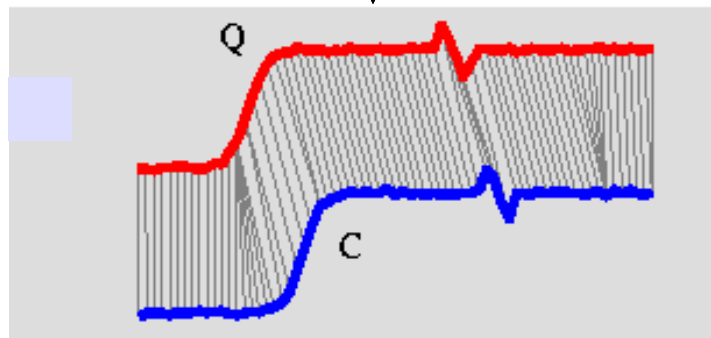
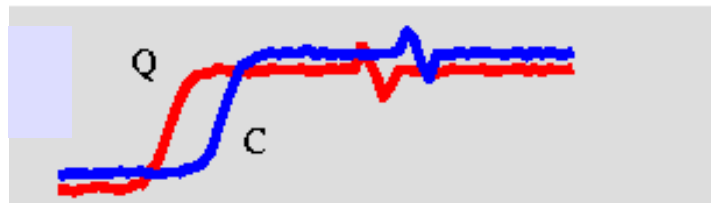
Dynamic Time Warping



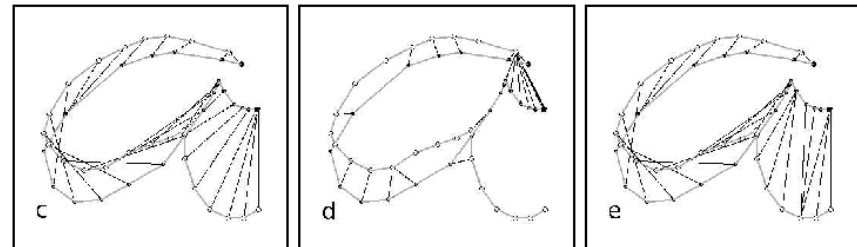
Biometrics

Speech recognition

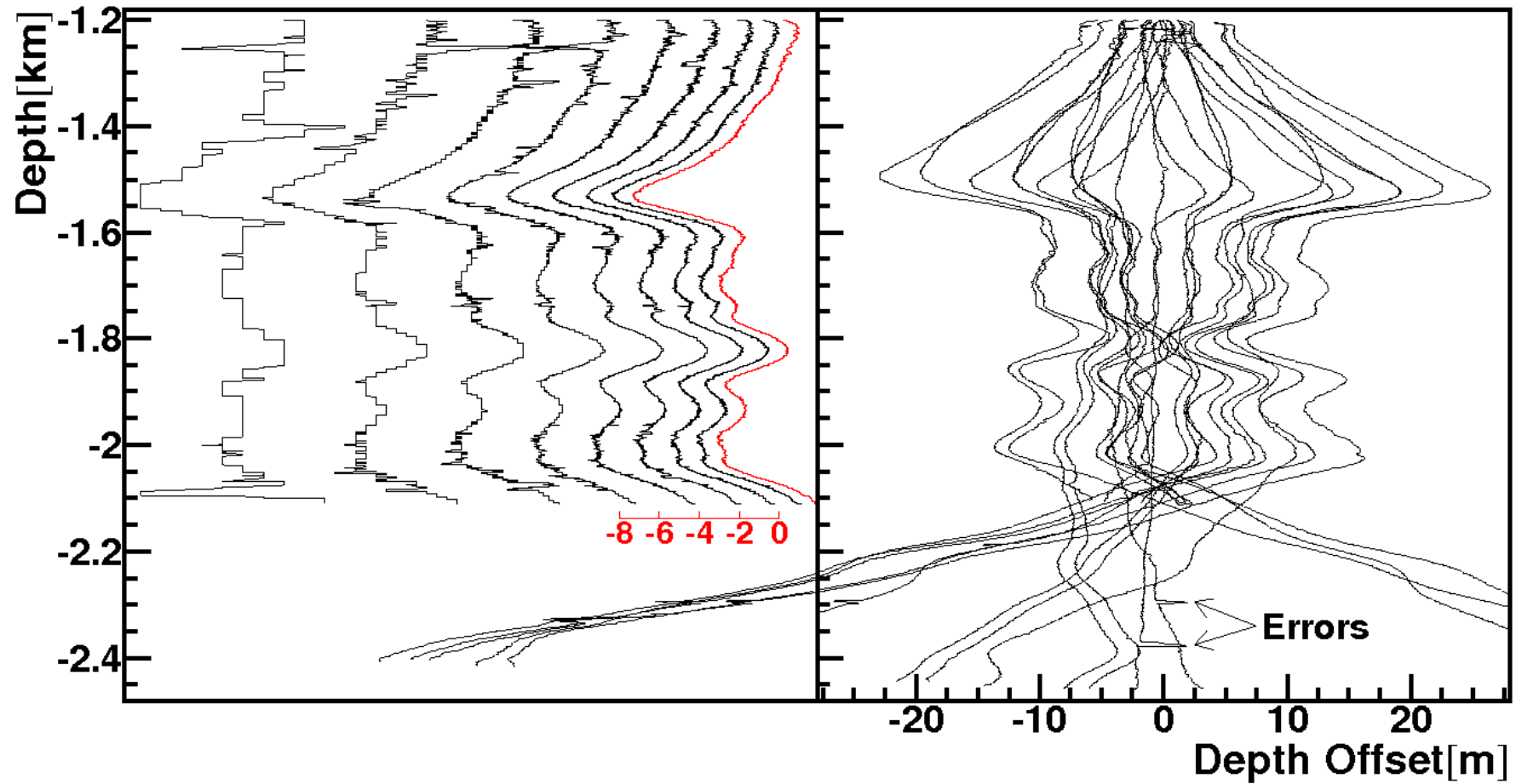
Signal matching



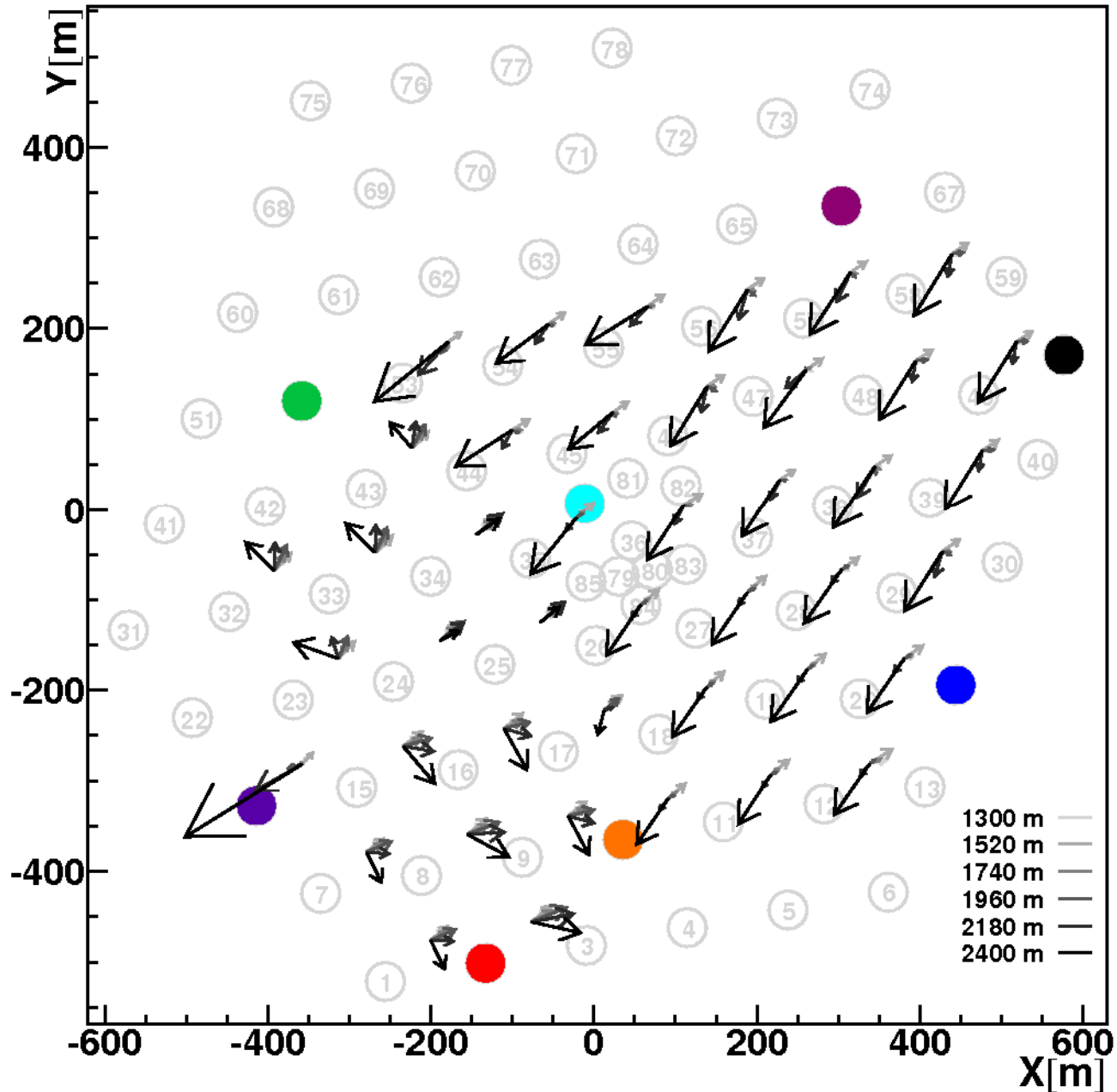
Handwriting



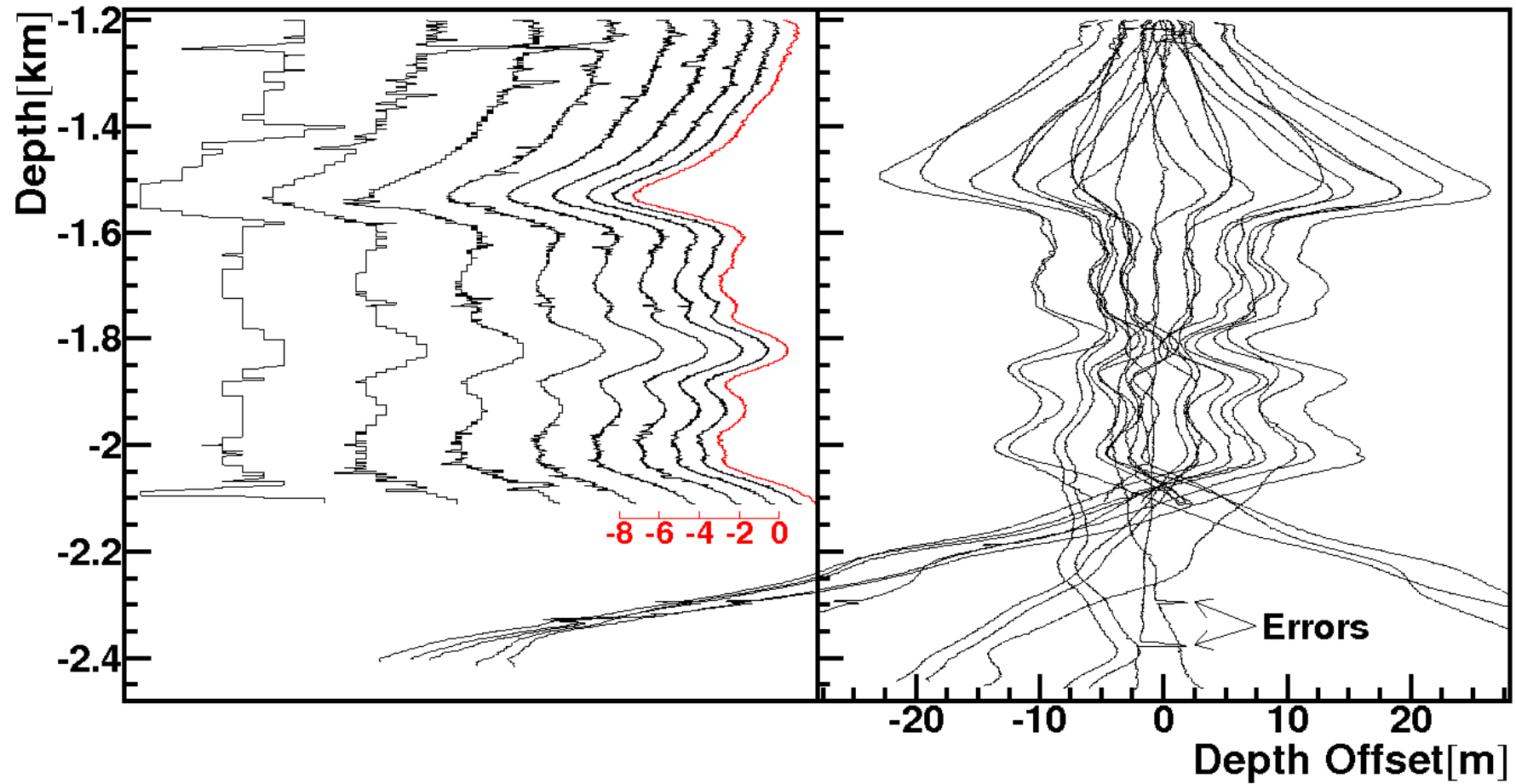
Fully automated, full resolution dust mapping



Dust layer tilting across IceCube



Fully automated, full resolution dust mapping



Wind speed from multiple dust profiles

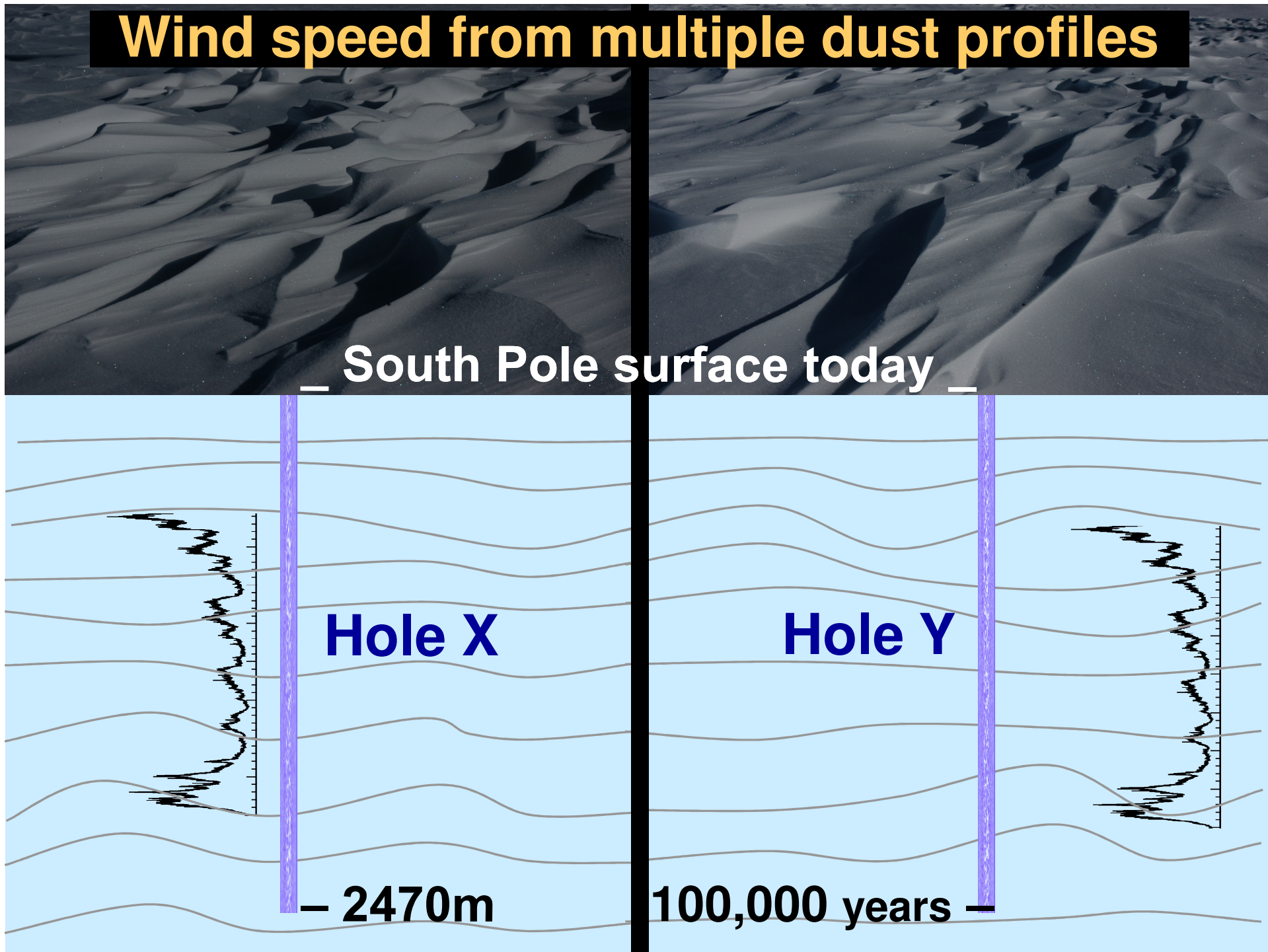
— South Pole surface today —

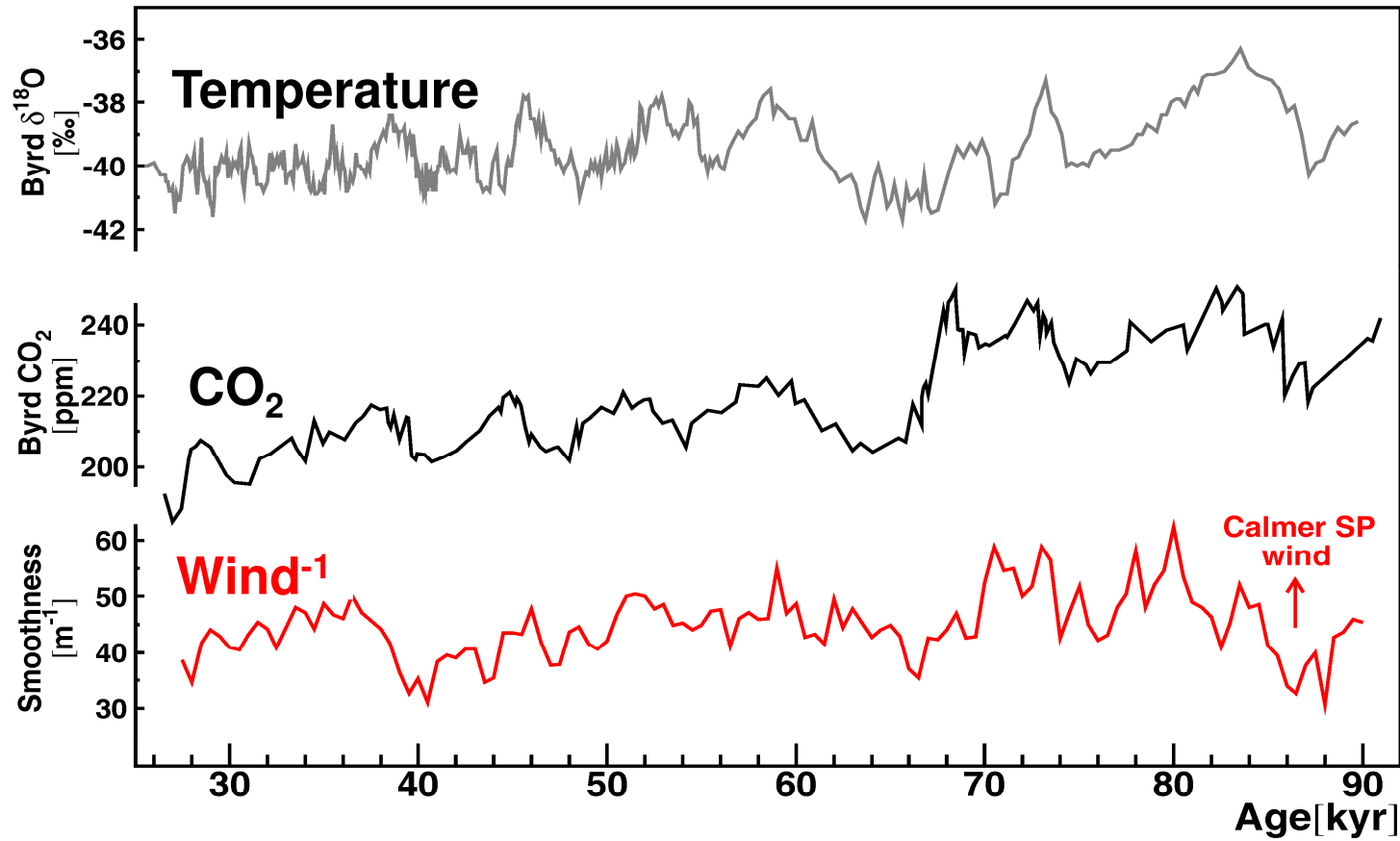
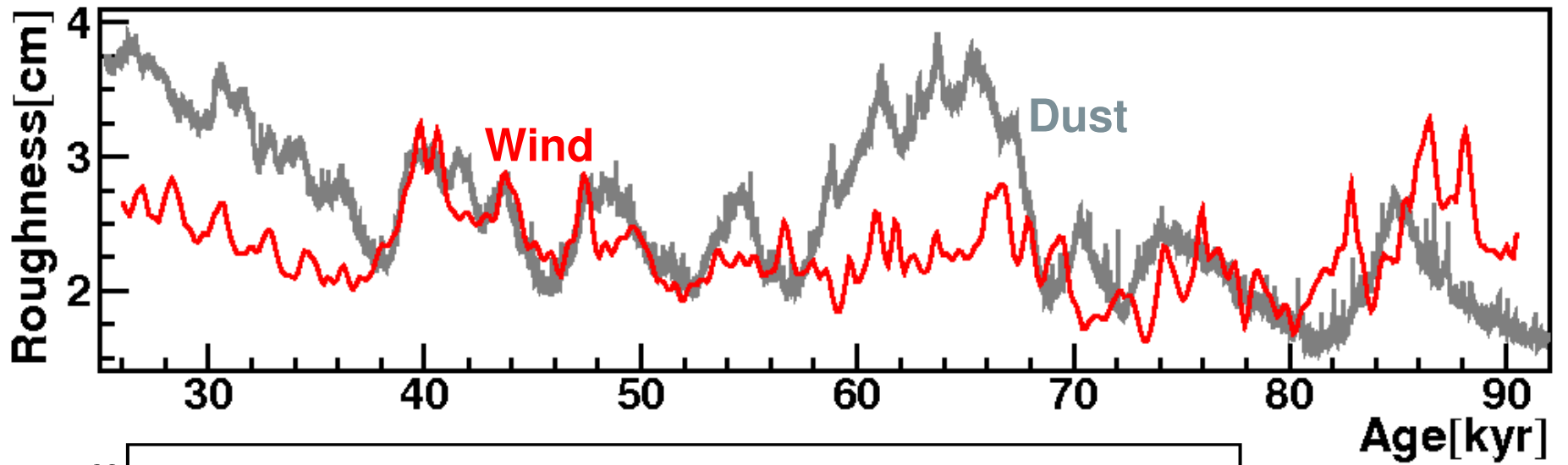
Hole X

Hole Y

— 2470m —

100,000 years —

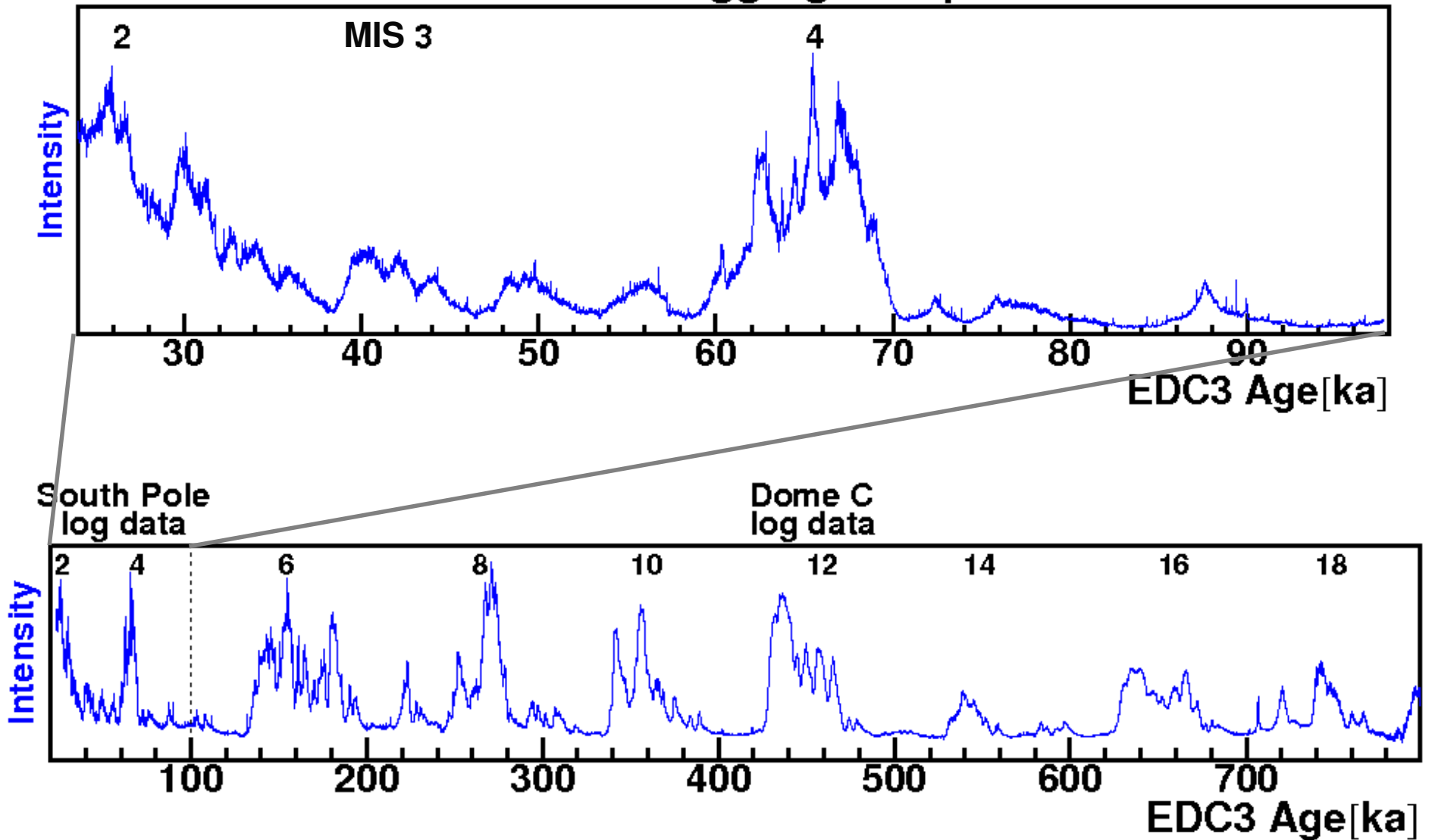




Paleowind
dust
&
climate

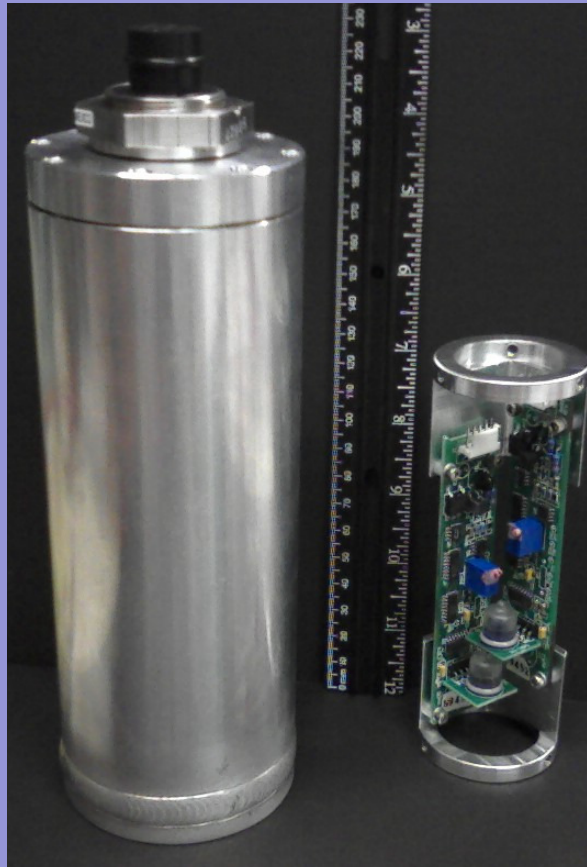
Precision laser dating

South Pole Logging Composite

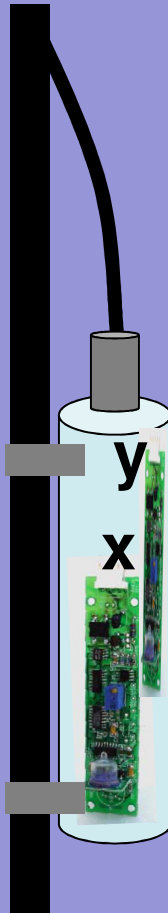


IceCube inclinometers

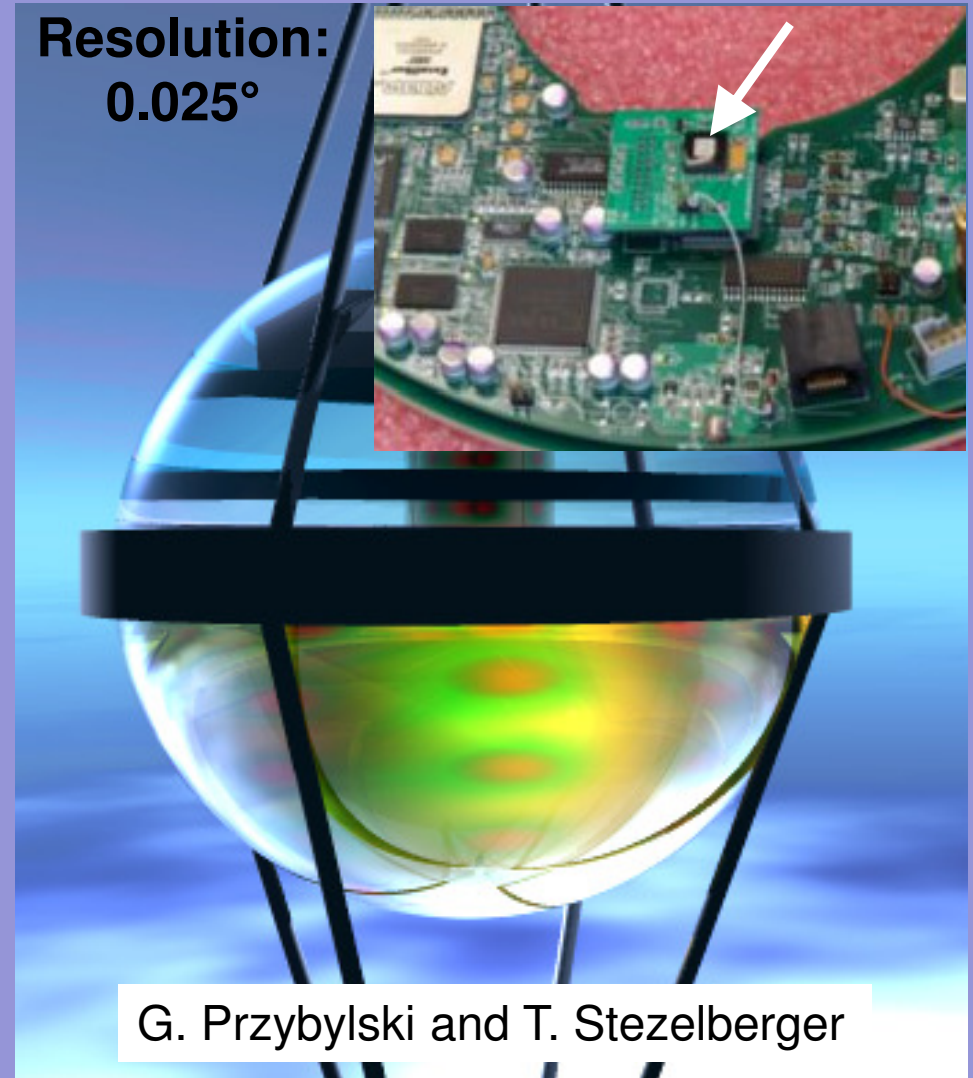
Electrolytic (3)



Resolution: 0.01°

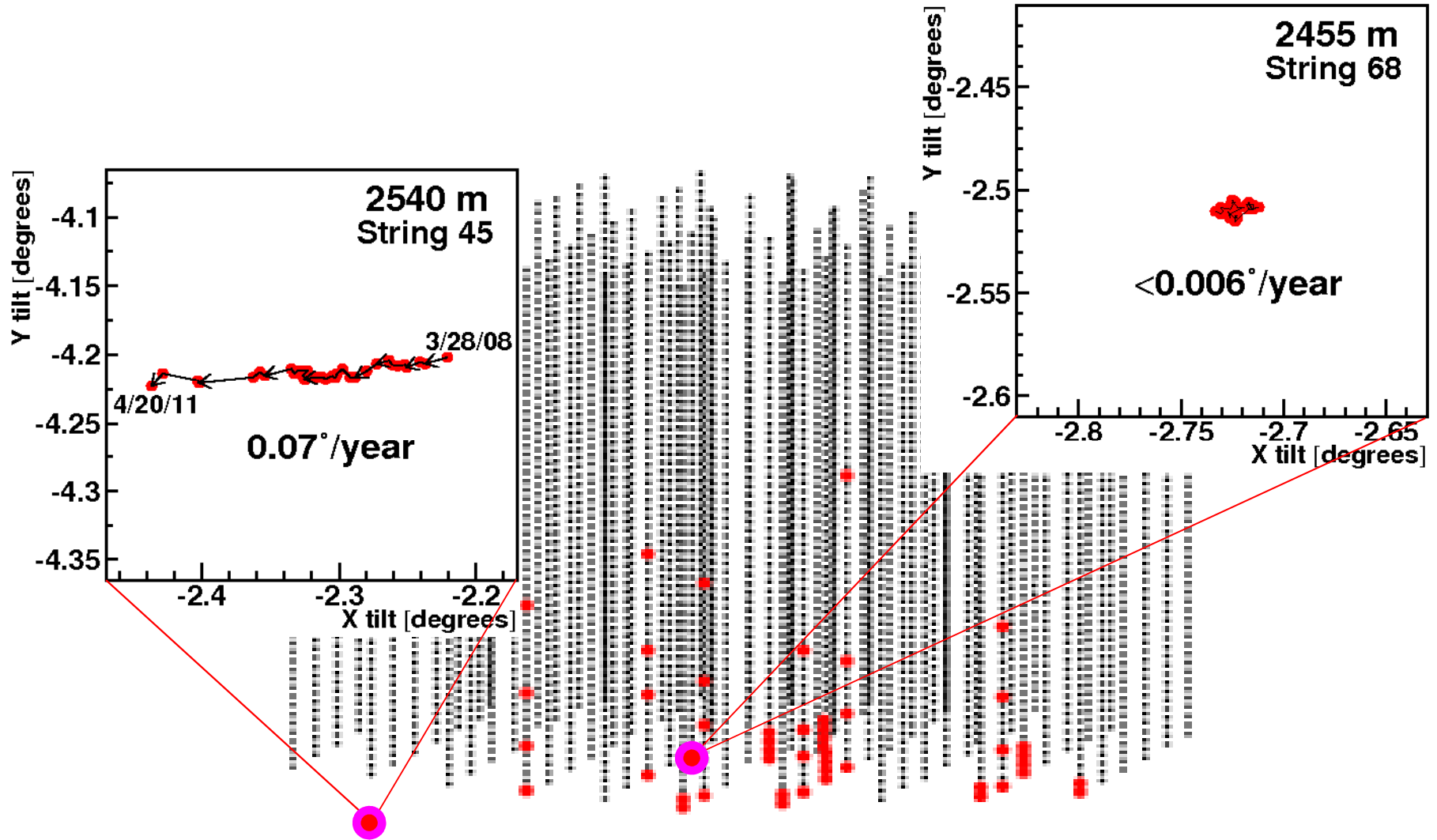


DOM-Embedded
micromechanical (48)

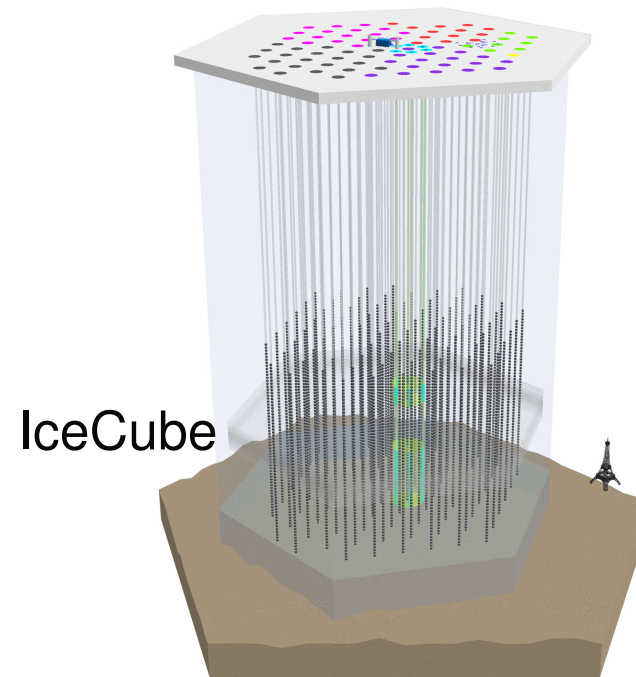
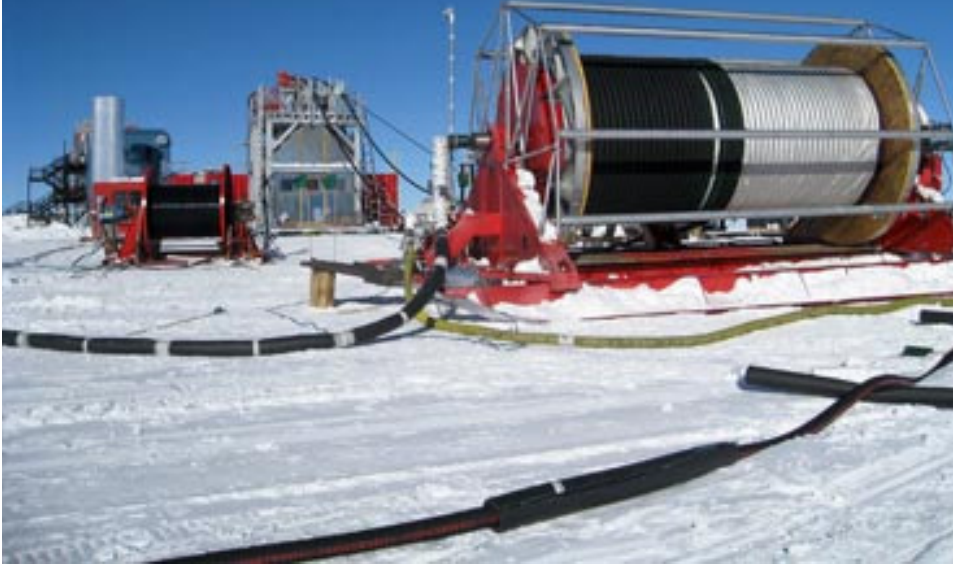


G. Przybylski and T. Stezelberger

IceCube Inclinerometers



IceCube Enhanced Hot Water Drill



- Power: 5 MW
- 50 cm × 2500 m × 30 h holes
- Rate: <48 h per hole
20 per 2 mo. season
- Personnel: 30 drillers
- Good safety record



Fallout layers & millennial cooling

