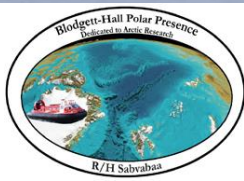


FRAM-2014/15: A 400 day Investigation of the Arctic's Oldest Sediments over the Alpha Ridge with a Research Hovercraft



John K. Hall - Geological Survey of Israel (Retired)

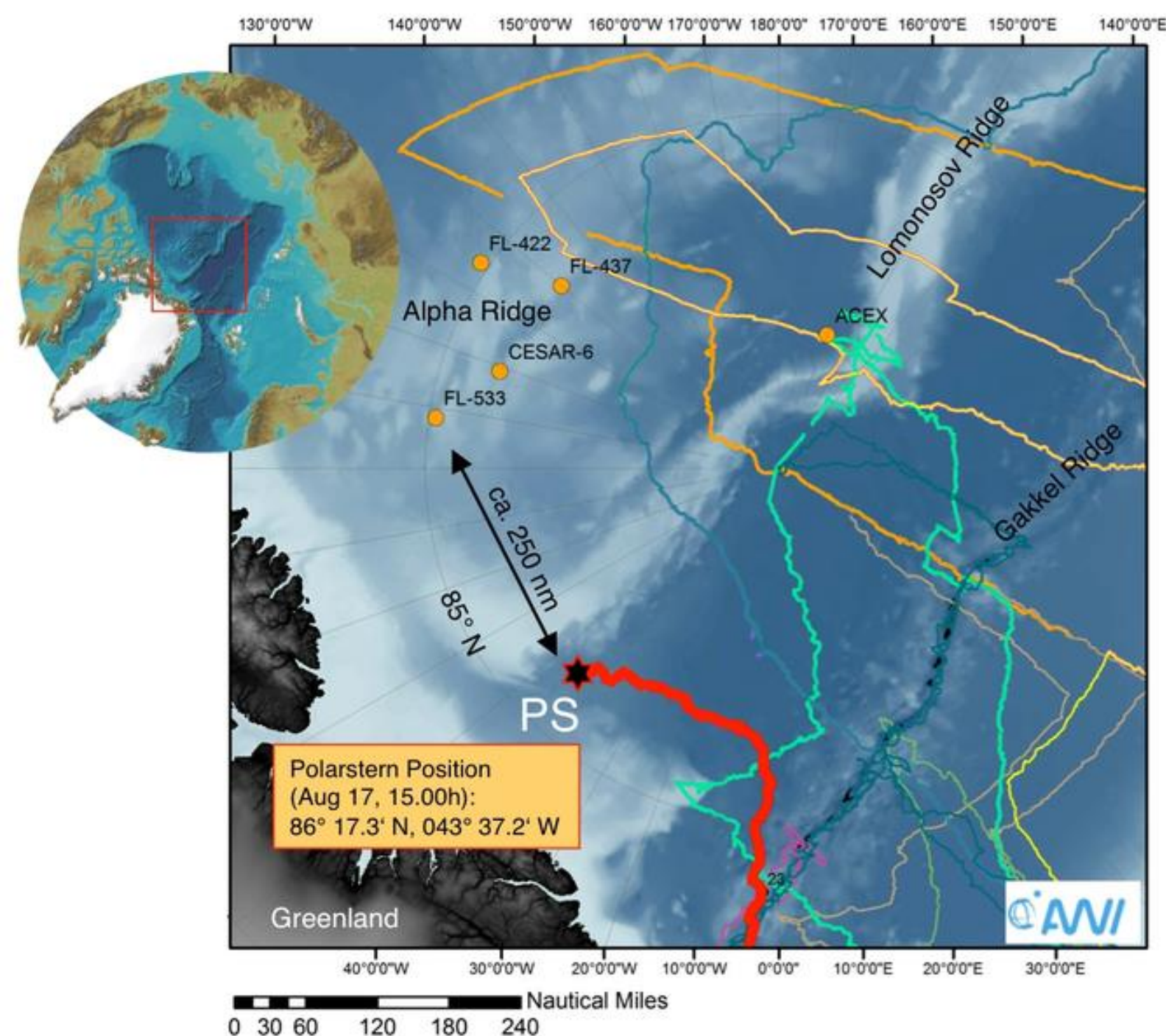
Yngve Kristoffersen - University of Bergen (Retired) and NERSC, Bergen



GEBCO Science Day
AGU Annual Meeting,
San Francisco CA Dec 17, 2014

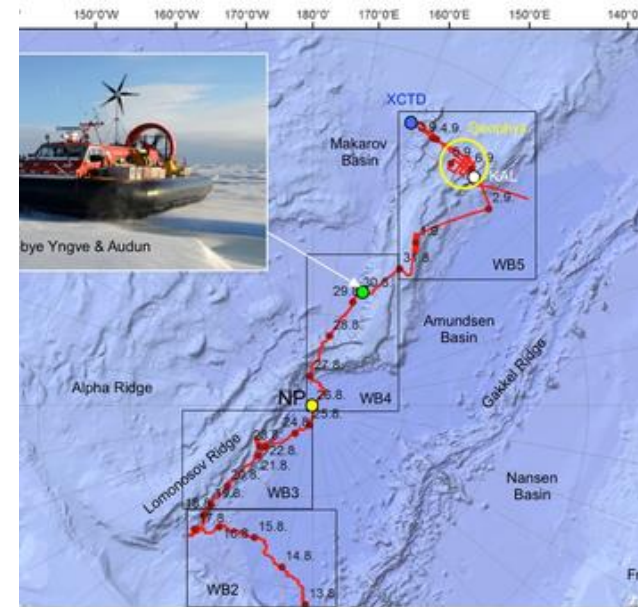
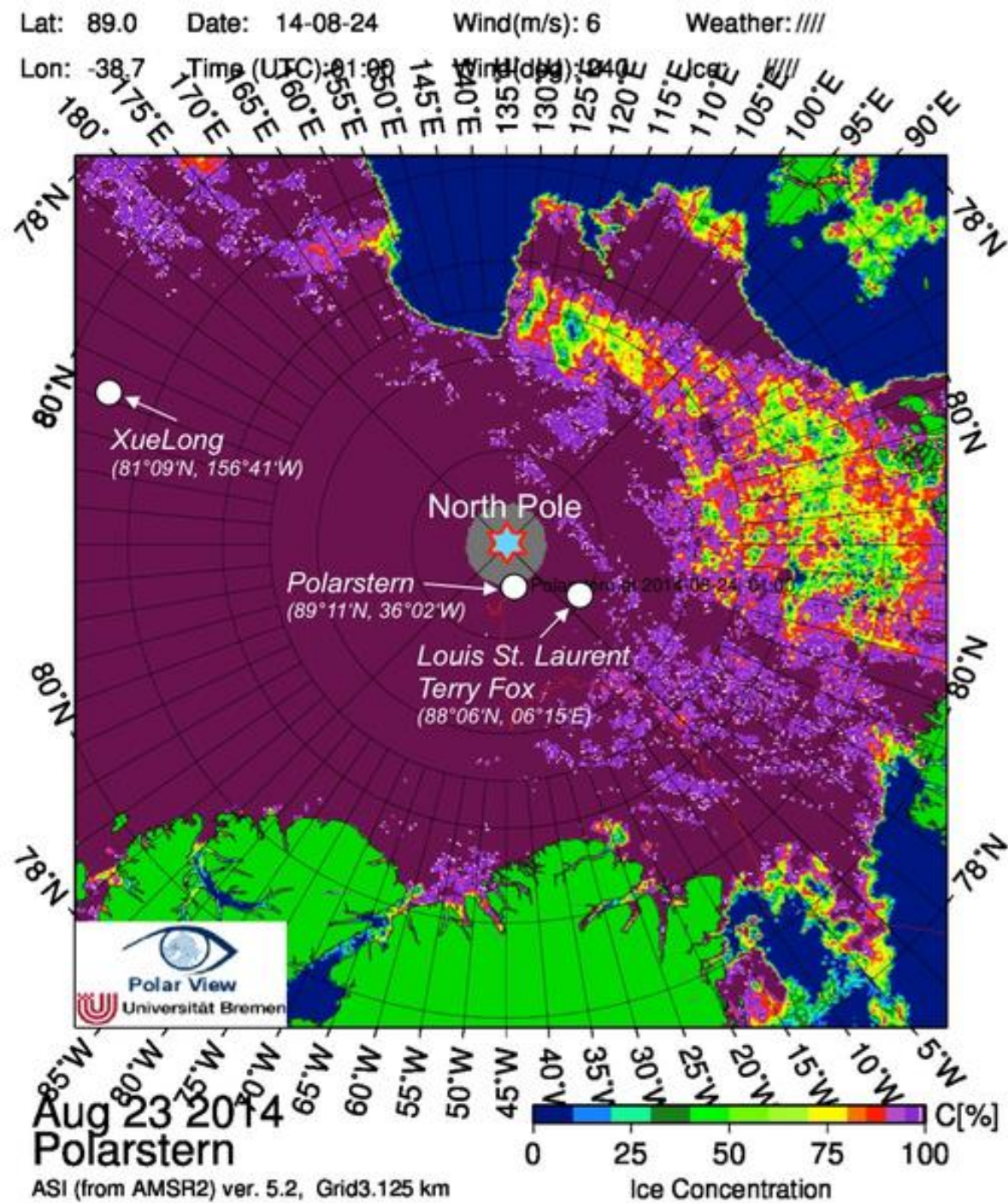


Our intrepid FRAM-2014/15 Arctic Heroes. Prof. Yngve Kristoffersen of NERSC and Emeritus at the University of Bergen, and Audun Tholfsen of Spitzbergen, and various very high Arctic adventures. Tromsø, Norway, 4 August 2014.



The original plan of getting to the Alpha Ridge and the site of the 4 Mesozoic short cores.

Note how the Alpha Ridge is void of icebreaker tracks.



The ice conditions were such that despite much backing and ramming the Polarstern was unable to get to the asteroid impact area on the Alpha Ridge.

A two-icebreaker Canadian effort (Terry Fox and Louis St. Laurent) to do seismic refraction was also stymied by the ice.

Therefore a site (green dot) was selected for offloading FRAM

a

Helicopter with sling



b

Collage courtesy Prof. Ruediger Stein, AWI

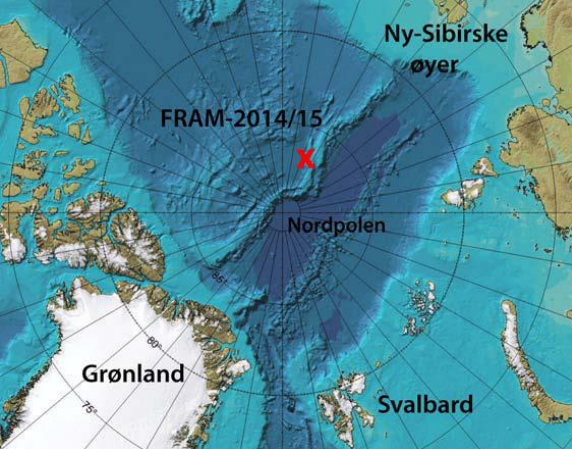


Polarstern's helicopter, crew and scientists worked 10 hours to offload 21 tons of supplies and fuel plus the hovercraft.

c

Good-bye Yngve and Audun and good luck !!!





One last group photo and then alone on the ice for the coming year



Lee Freitag at Woods Hole Oceanographic Institution (WHOI) built five Autonomous Echo-Soundings buoys for the FRAM-2014/15 expedition. This is the first ever deployment of such buoys in the field. They were set out at distances of up to 6 km from the main camp.



The buoys produce soundings from a *single* 10 kHz ping. As recovery seemed possible they were housed in Pelican cases. They send soundings and health messages to WHOI via Iridium, and generally ping once every 6 hours unless the topography is changing, in which case 2 hour intervals were generally used.



AES No 3 on a typical high Arctic Day
shortly before 5 months of darkness.



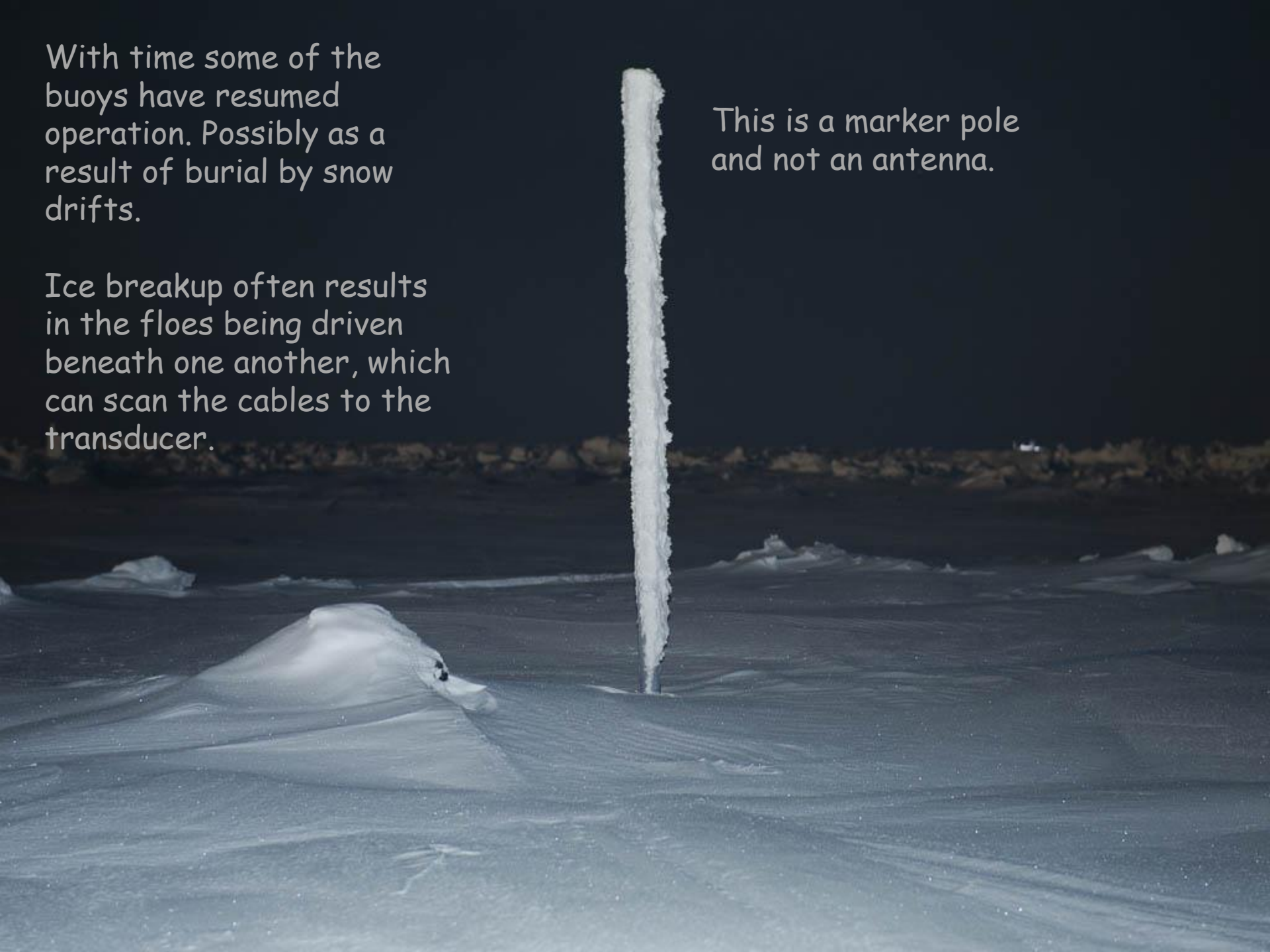
On Nov 4th,
WHOI's Lee
Freitag e-mailed:
'It appears as
though there was
an event on Oct
25th and that the
floe or set of
floes that the
buoys are on
broke up. Buoy 5
moved relative to
the others, and
Buoy 2 may have
fallen in or been
covered by ice.

These events
coincided with
the breakup of
the camp area.

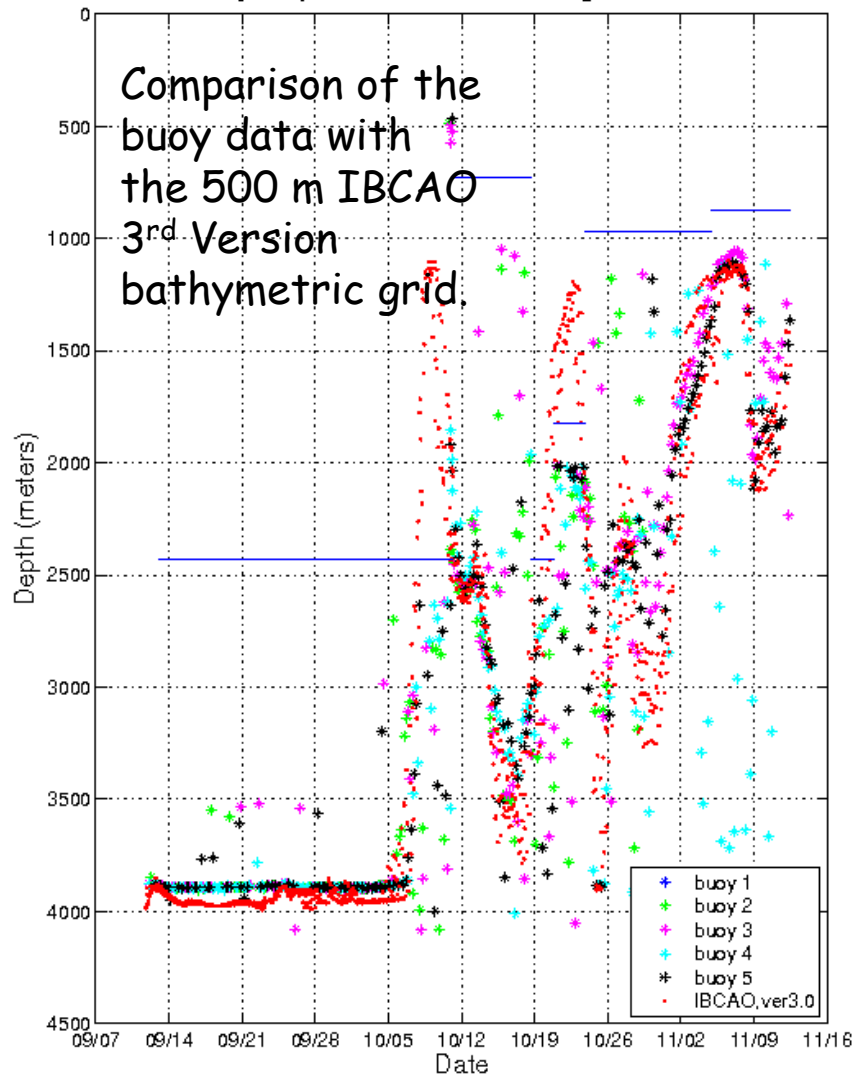
With time some of the buoys have resumed operation. Possibly as a result of burial by snow drifts.

Ice breakup often results in the floes being driven beneath one another, which can scan the cables to the transducer.

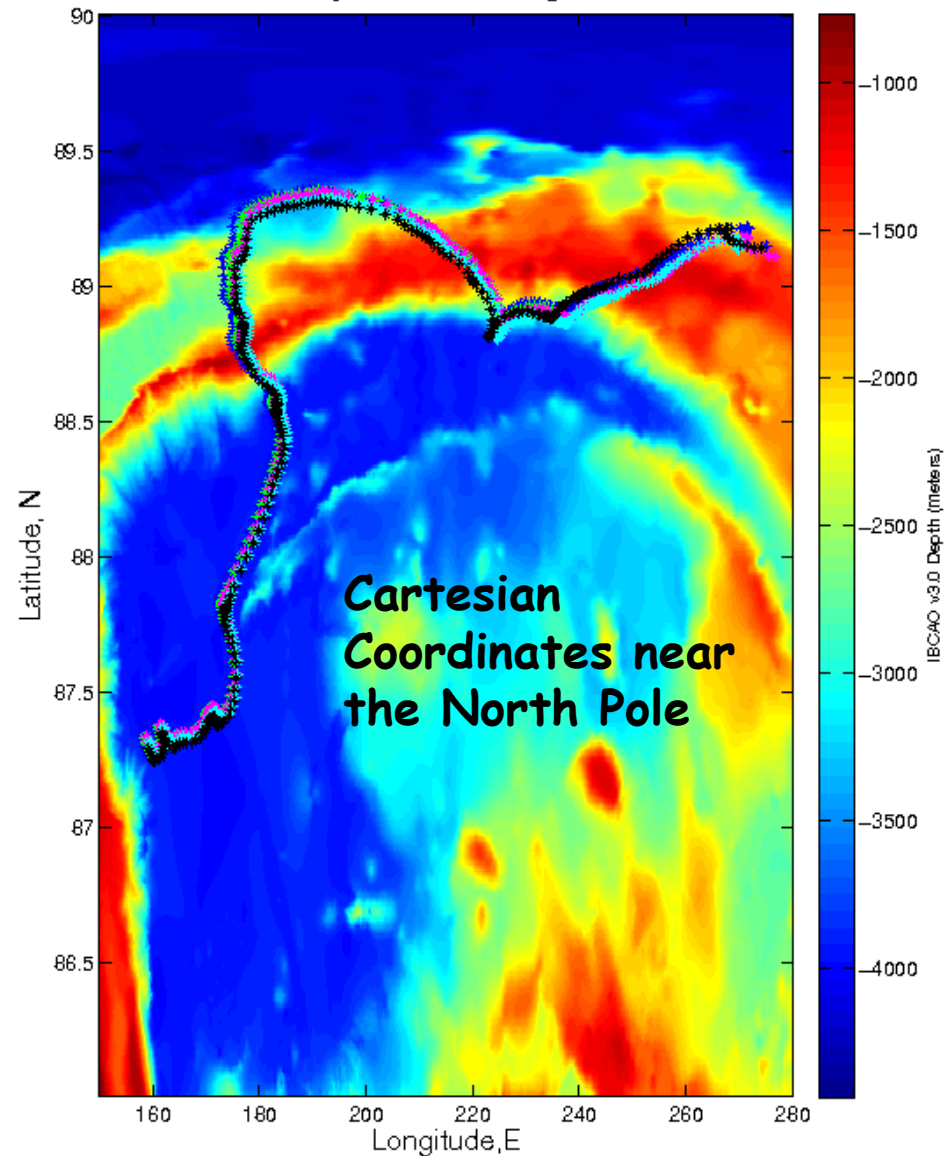
This is a marker pole and not an antenna.



IADS buoy depth estimates through 12-Nov-2014



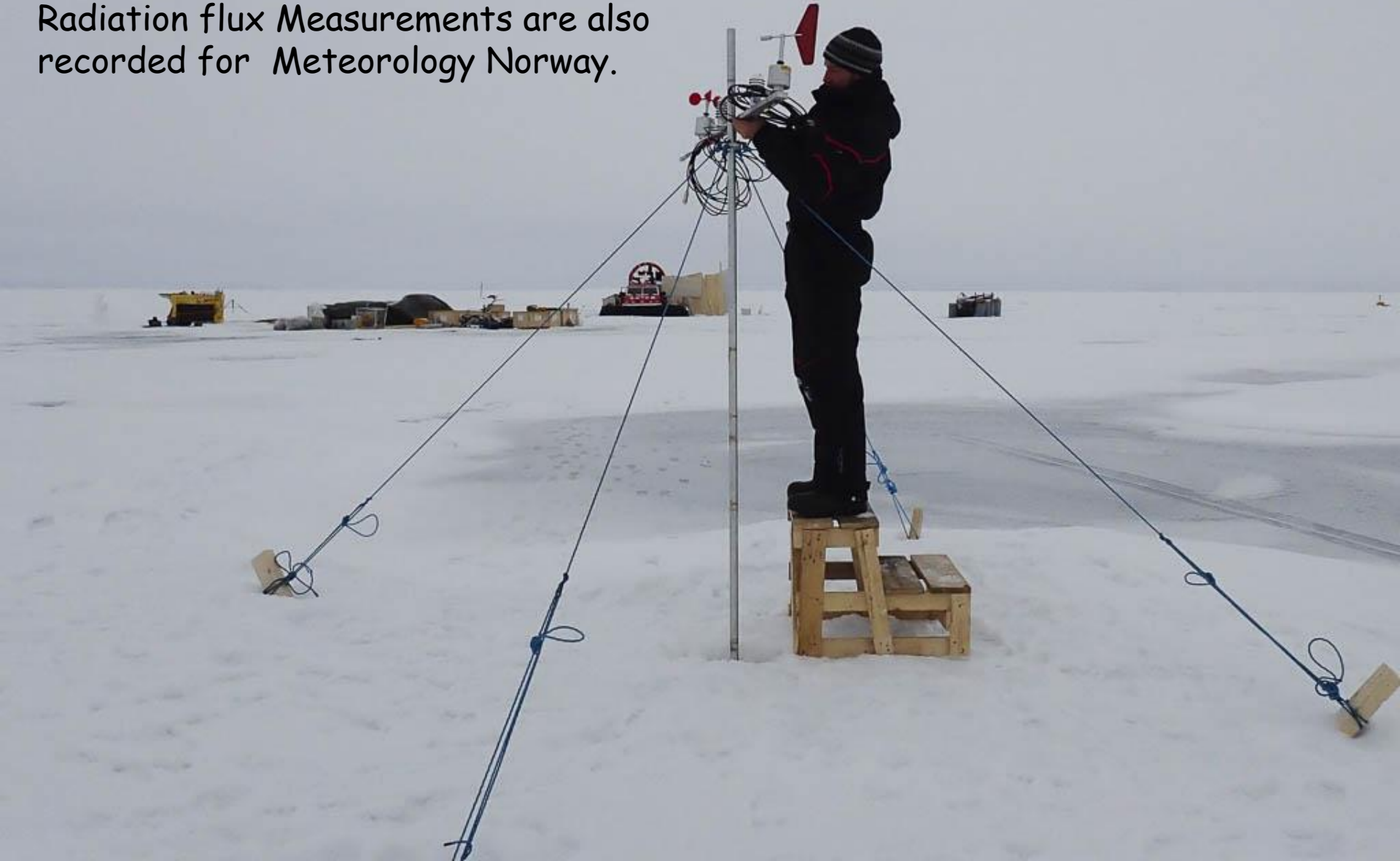
IADS 2014, buoy tracks through 12-Nov-2014



Early buoy performance metrics from WHOI

Installation of the Weather Station for the Geophysical Institute (GFI) of the University of Bergen.

Radiation flux Measurements are also recorded for Meteorology Norway.



Current meters were deployed at 2000 m and 800 m for Bergen's GFI. These are self-recording. And the deepest meter must be raised over the Lomonosov Ridge. A thermistor chain is also deployed.





Making a hydrohole, within what was to become the ice hanger.

Installation of the Acoustic Doppler Current Profiler (ADCP) for observation of currents down to 500 m depth. At present at least two slabs of sea ice have been subducted below this installation and efforts are underway to rescue the instrument.



Note the beginnings
of the ice hanger

Initial storage of drums of JP-6 turbine aircraft fuel, and 100 3m core liners.
Note the skeleton of the self-righting bottom camera sled on top.



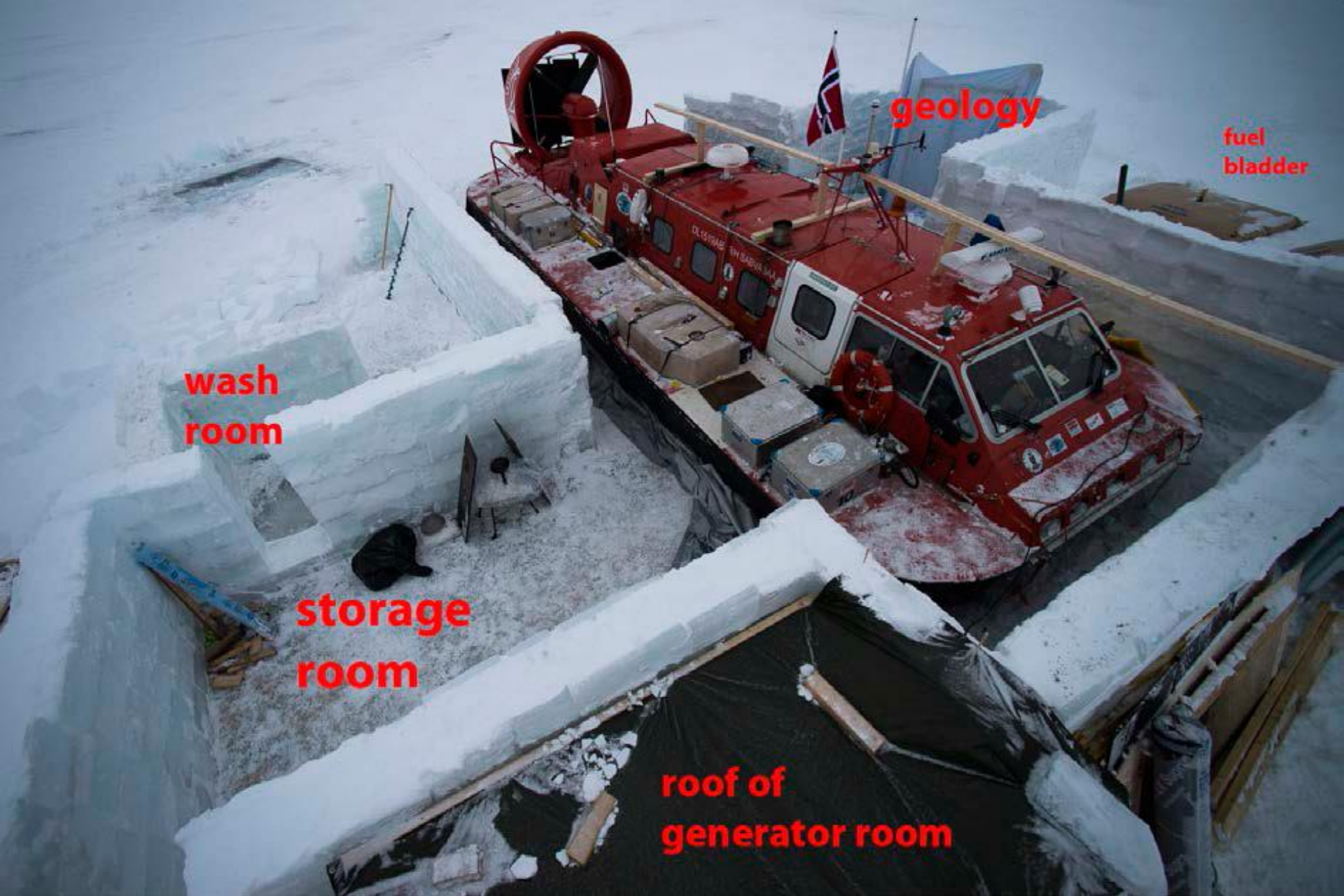


Bottom Camera Lowerings

FRAM brought 6500 m of 3/8" kevlar aramid fiber rope for coring, dredging, and bottom photography. This home-built rig with GoPro camera in a 4000 m pressure housing allowed movies of the seafloor, shrimp, and a half-meter long eel-like fish, as yet unidentified. This video was taken at 1,450m.

The camera sled was self-righting and could be pulled along the seafloor as the ice drifted. LED lights provided excellent illumination.





The short-lived ice hanger whose 30 ton weight caused flooding from the hydrohole, followed by ice cracks which scattered its various sections.

The seawater around
the hydrohole got up to
50 cm deep.





snow drift

water on
the ice

snow drift

snow drift

A heavy snowfall with high winds added to the problems, adding additional weight to the floe and covering equipment and supplies. Temperatures varied from -9C to under -45C, with winds to over 30kts.



'Scaling the snow drift on the east side of the hanger'. The snow load around the camp was estimated at 200-250 tons which further depressed the ice floe.



These are the patented 'hydrostatically boosted' sediment corers that propel the corer into the seafloor.

Food was taken for two persons for
500 days.

Note one of many GoPro cameras
for making videos.



A very warm and cozy cabin for two.





e-mail
echo
sounder

seismics

SABVABAA has four Iridium satellite
telephones for e-mail and data links.

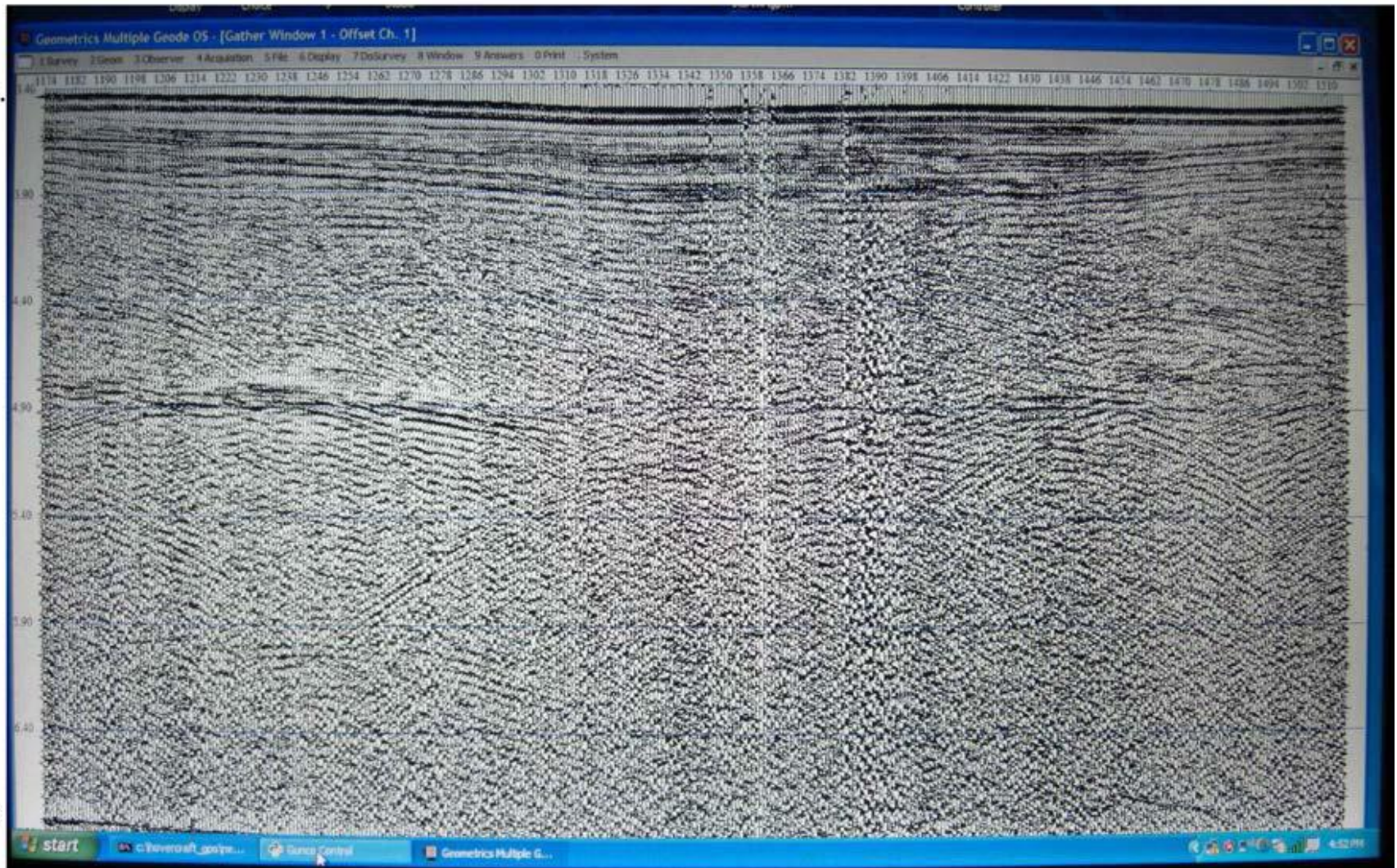
South

8.5 km

North

3.4 sec.

6.9 sec

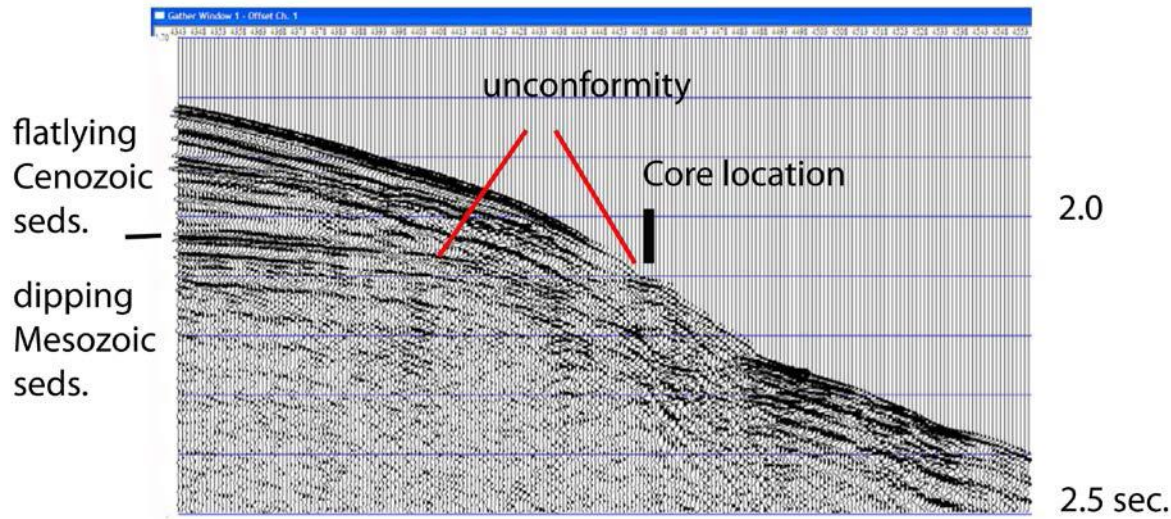


Screen shot from seismic data acquisition across the intra-ridge basin. 20 cu in (0.3 liter) airgun below the ice with single hydrophone.

Lomonosov Ridge

1 km

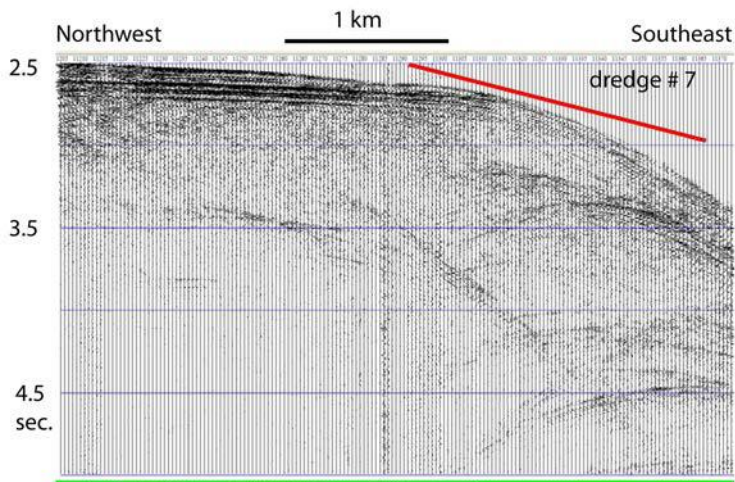
Makarov
Basin



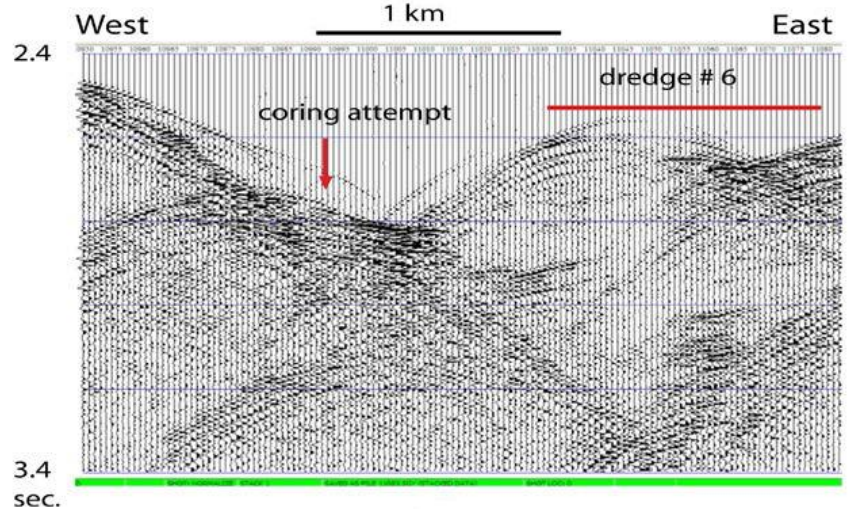
The piston core was used when the seismic profile showed the unconformity at the base of the Cenozoic section. The sediment was quite hard, and this was the specimen obtained.



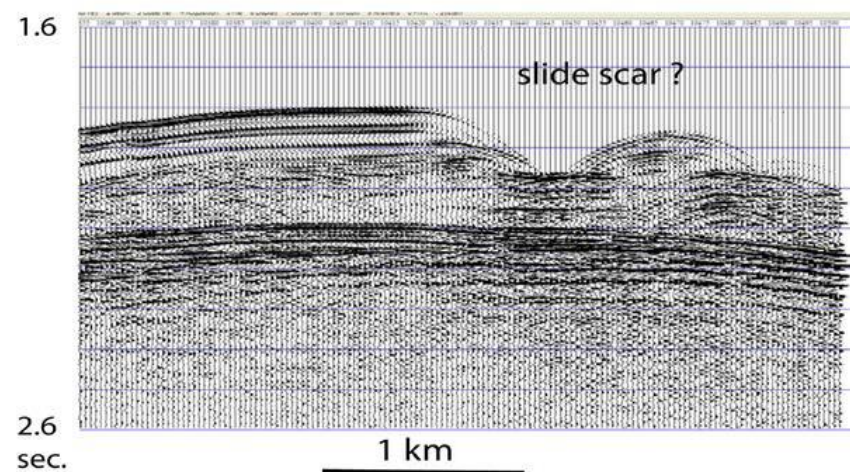
Lomonosov Ridge edge towards Amundsen Basin



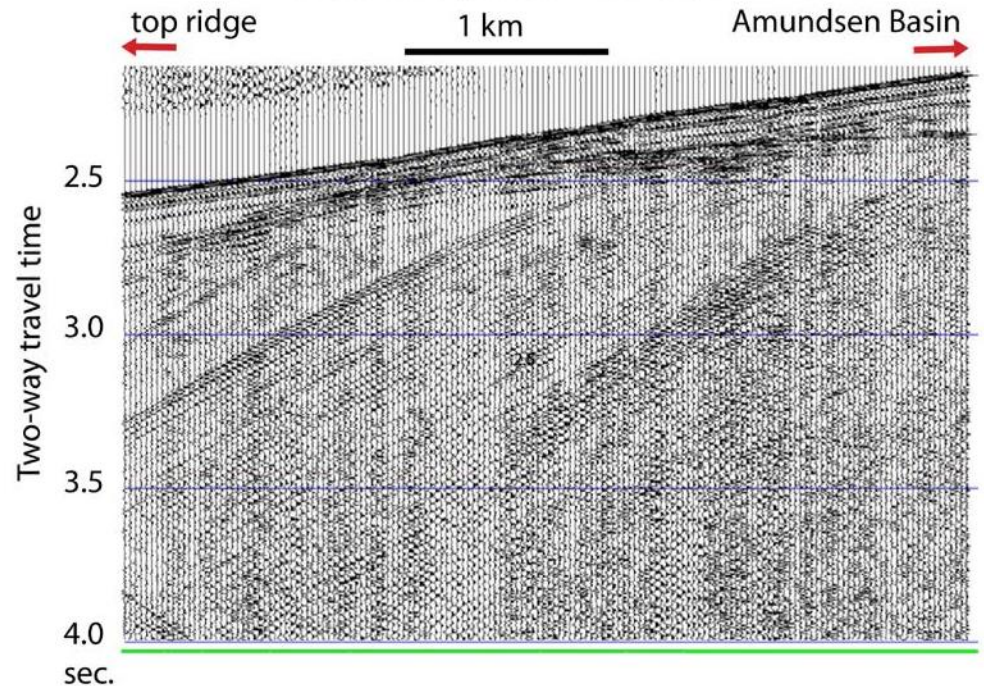
Lomonosov Ridge upper slope, Amundsen basin side



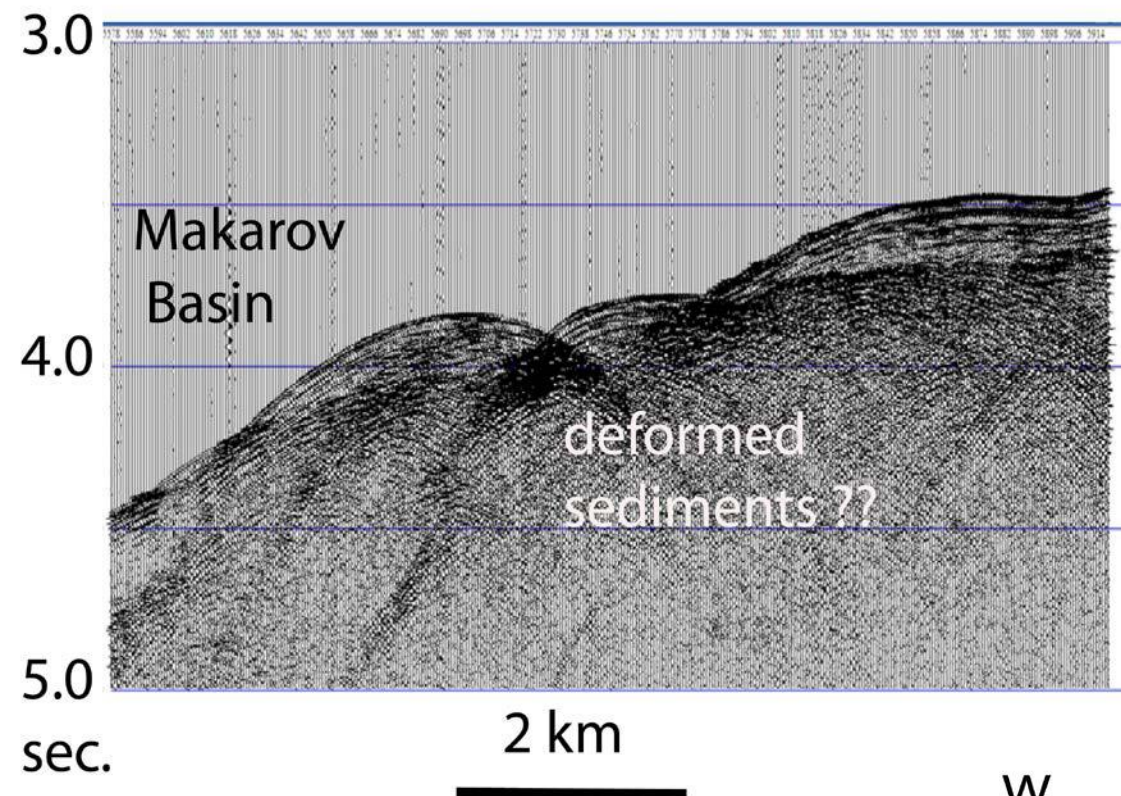
Lomonosov Ridge: Amundsen Basin side



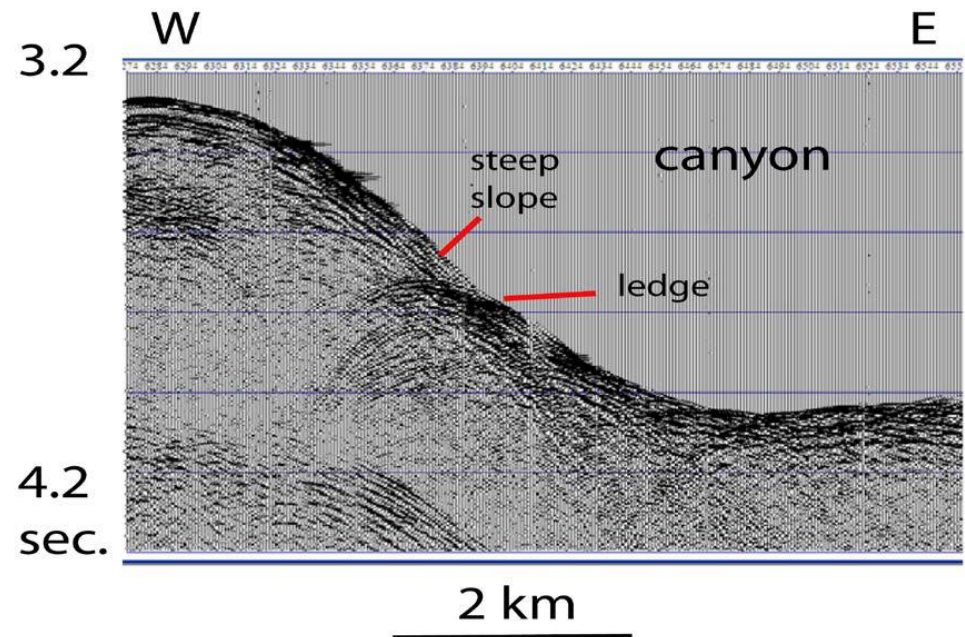
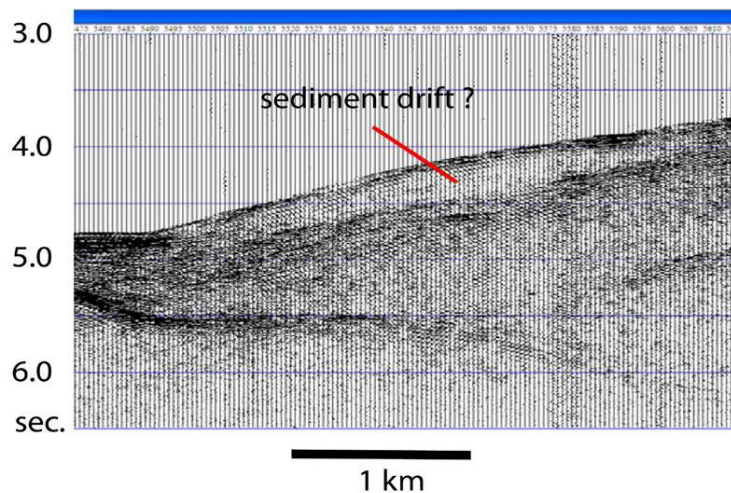
Lomonosov Ridge: Amundsen Basin flank



The seismic profiling continued until the 12th week when the camp had to be moved. Sample profile segments sent in the Weekly Reports.

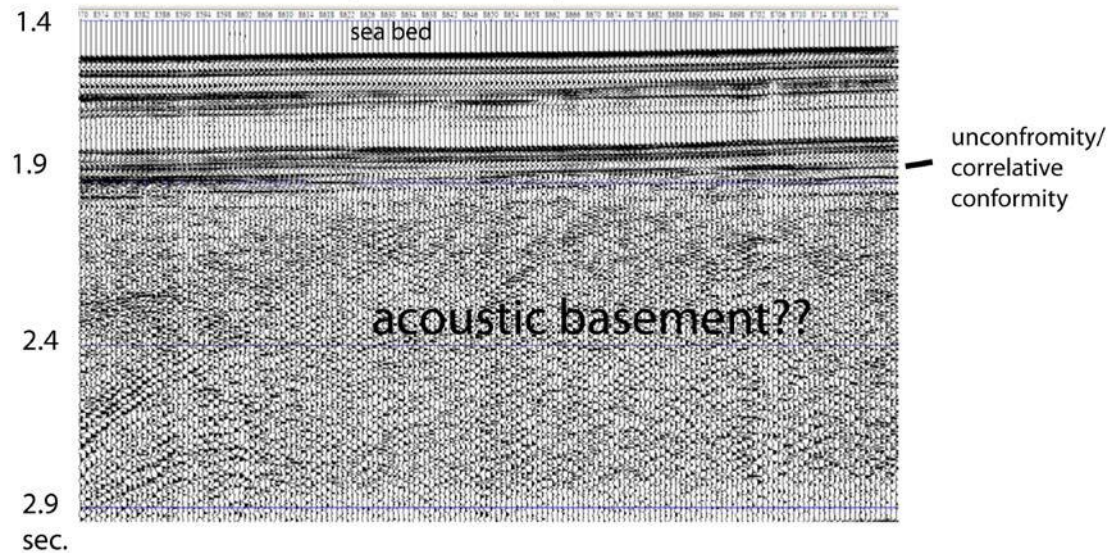


More seismic profile examples. Shots were every 25 m, and often only 16 minutes apart, requiring operation of the hovercraft 440 hp motor to refill the air flasks every 22 shots.

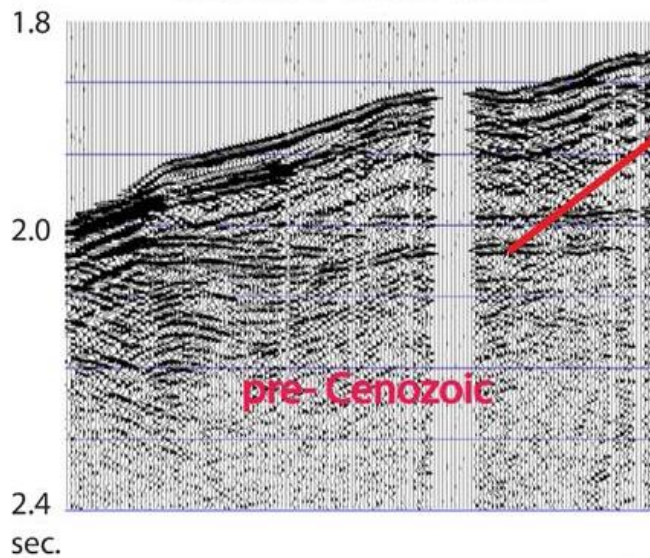


Top of Lomonosov Ridge

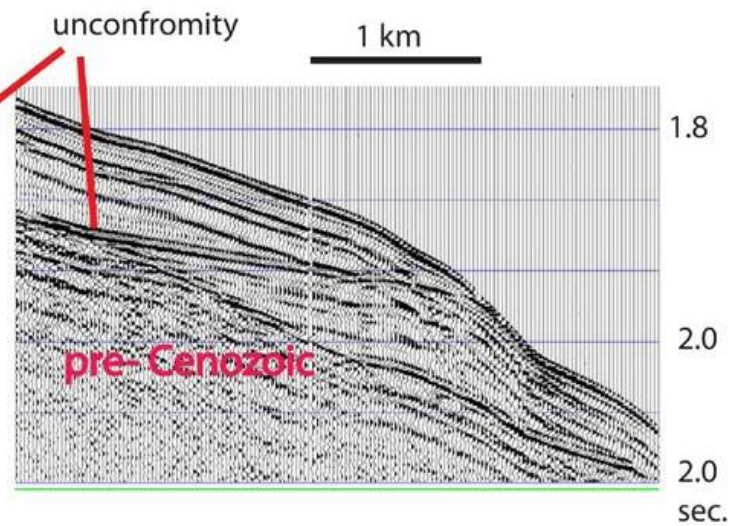
1 km



Makarov Basin flank



Amundsen Basin flank



A chainsaw makes fine building blocks.



The pastoral camp was eventually thrown into disorder by the ice dynamics, occasioning a 300 m move to an undisturbed floe.





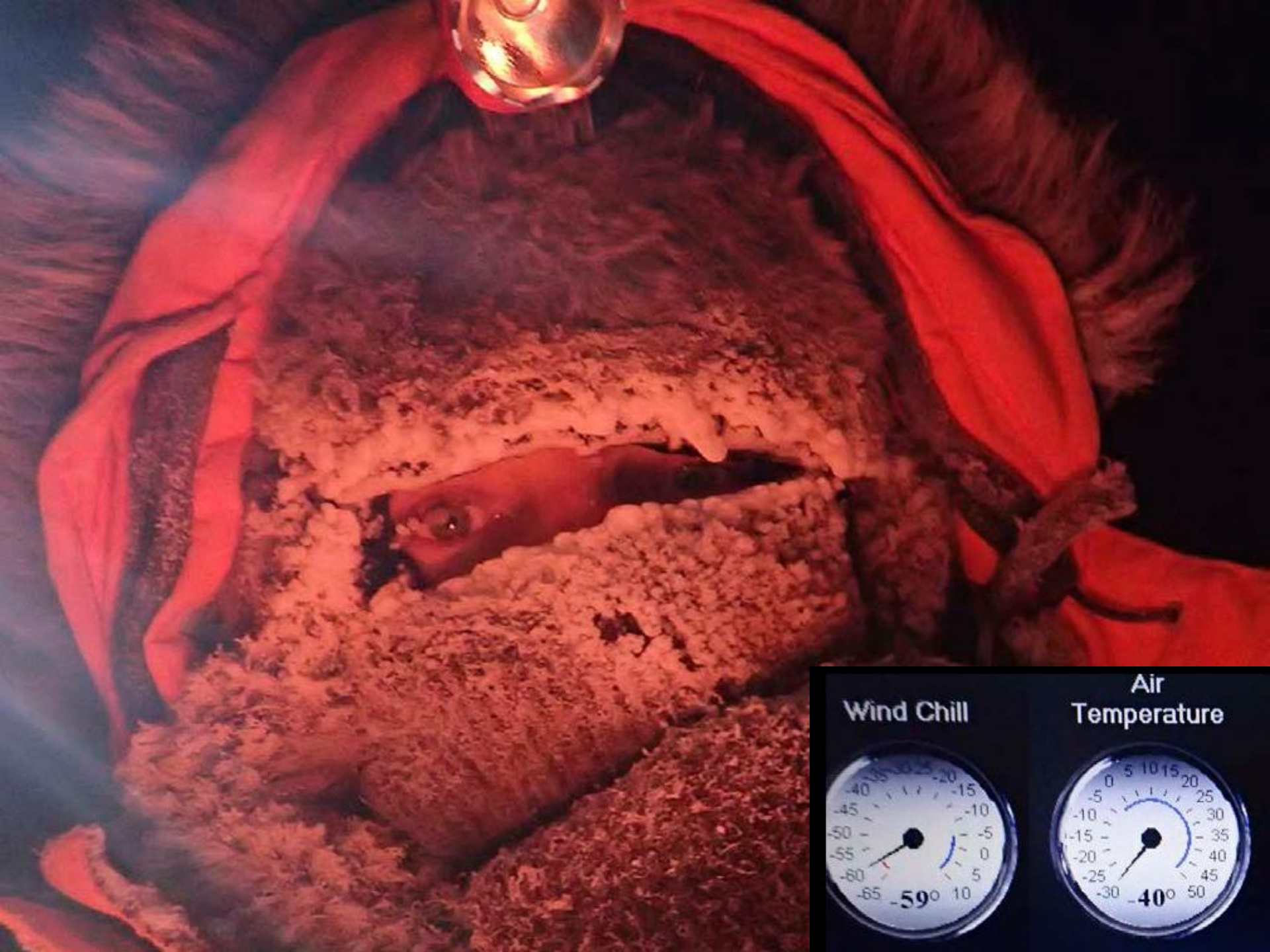
Disruptions of the Camp fuel supply,
stored in 1 cu meter bladders.

fuel bladders



fuel bladder fallen
into a lead





Wind Chill



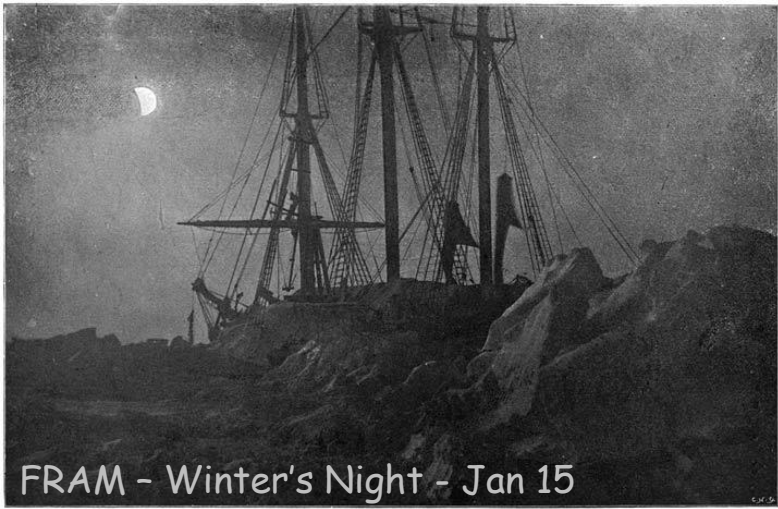
Air
Temperature



The red X marks the only woman in town.

This snow lady was a parting gift of the Polarstern's science contingent.



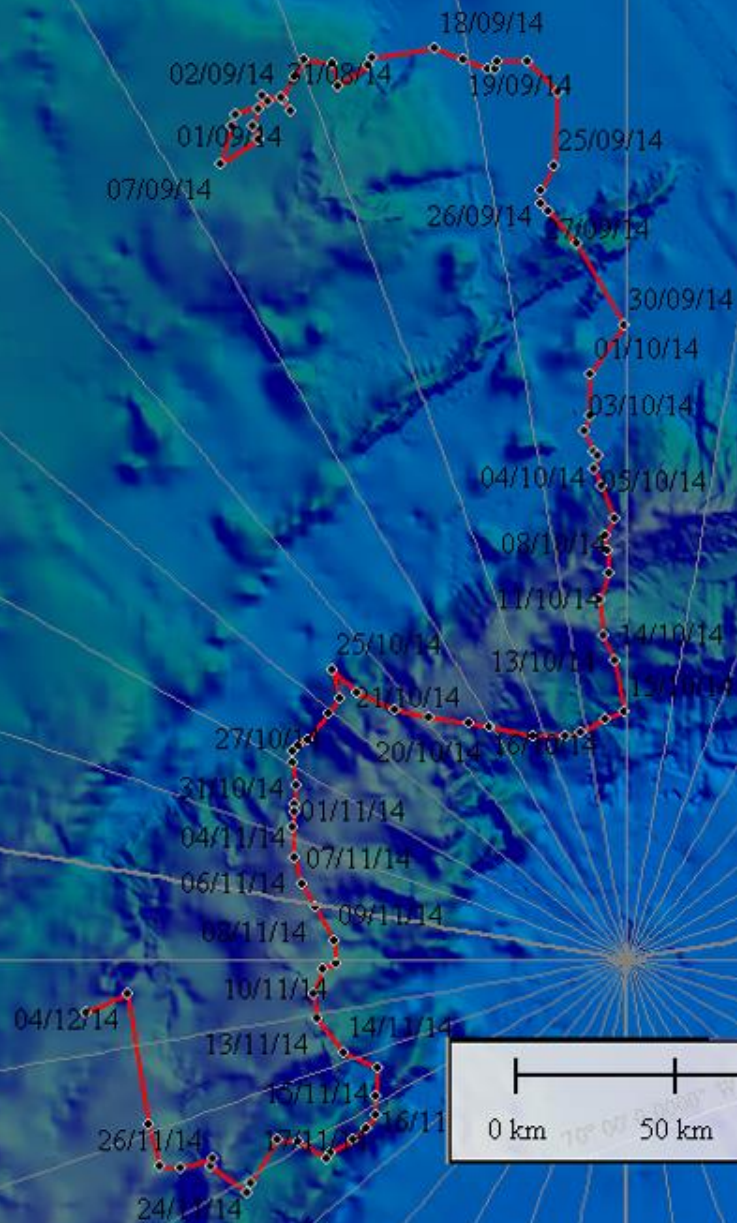


FRAM - Winter's Night - Jan 15
1895



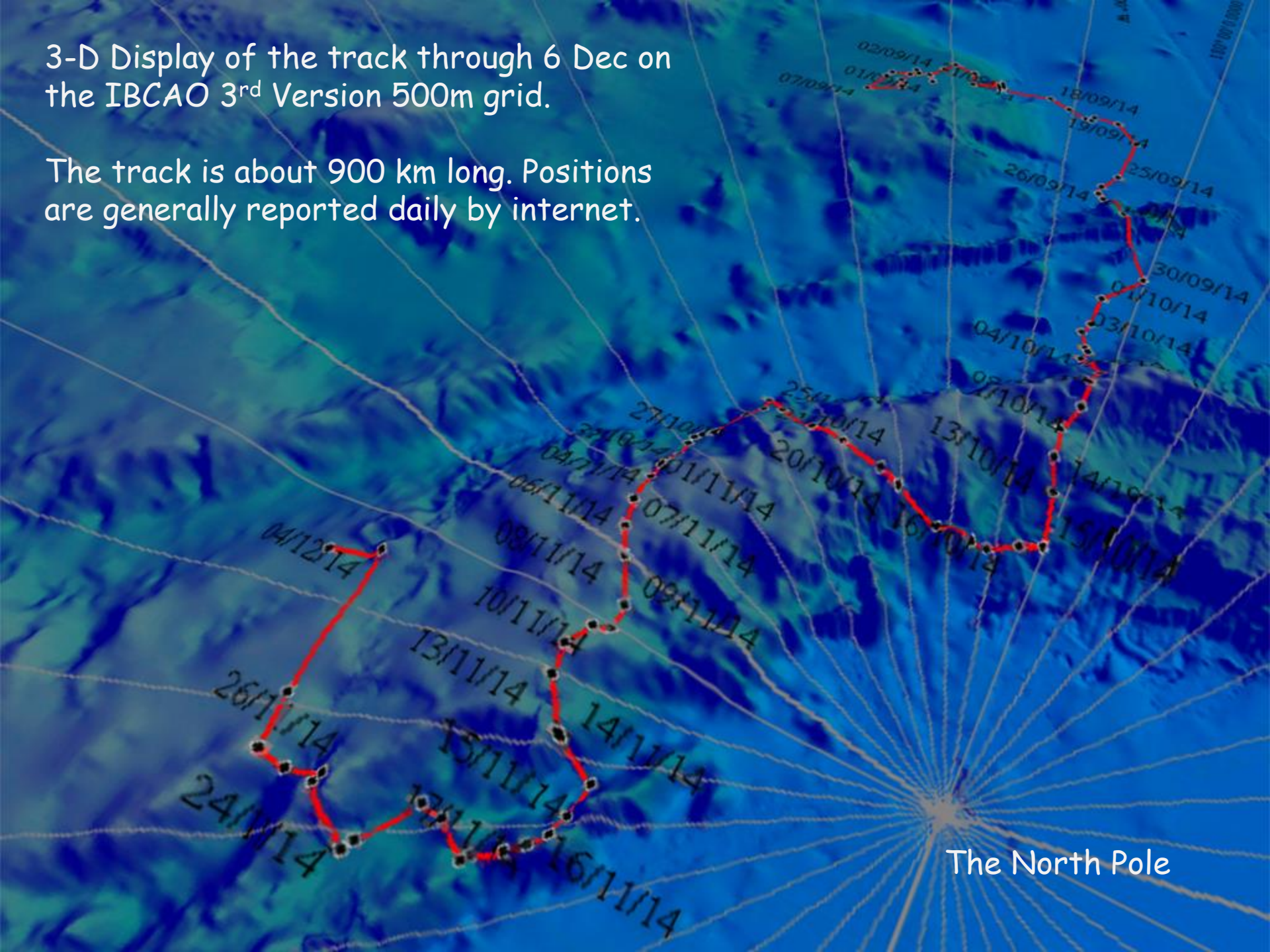
An iconic picture of FRAM-2014/15 versus the original.

The drift track from 30 August to 6 December



3-D Display of the track through 6 Dec on
the IBCAO 3rd Version 500m grid.

The track is about 900 km long. Positions
are generally reported daily by internet.



Things that go bump in the night



On the evening of 16 October a light was seen. It was on for some 4 hours. The crew walked out some 3 km to see what it was.

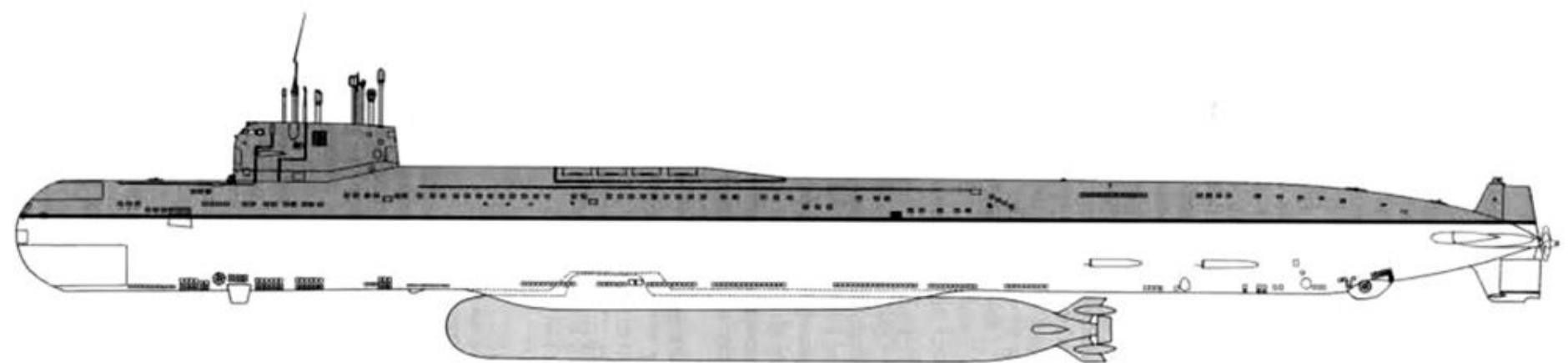


It appeared to be a submarine, with its bow and sail protruding through the rubble ice. On approaching to within 100 m, the light went out, and the submarine submerged.

For a week I worked on finding out what submarine it was. The profile in the photograph was quite distinctive.



On the web there was a photo of the Russian submarine Orenburg, displacing over 13,000 tons. An early 1970s Delta class ballistic missile submarine, it was converted into the mother ship of a nuclear powered submersible with great depth capability. In 2012 the submersible had been used to make three drillings on the Mendeleev Ridge in support of Russian UNCLOS Article 76 submissions.



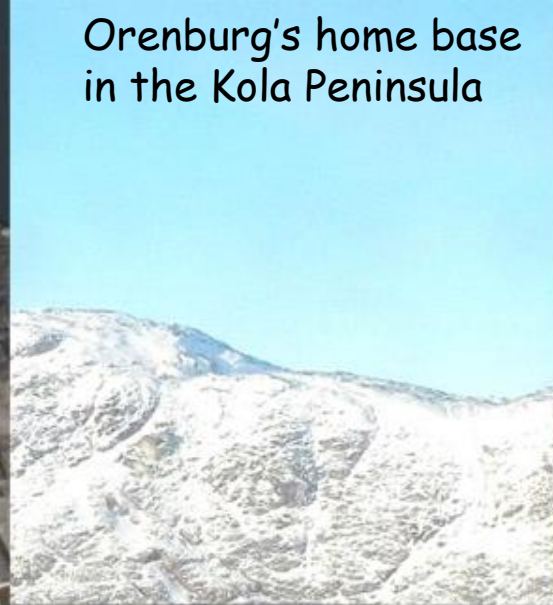


A model of our visitor. The submersible *Kalitka* or *Losharik* is capable of speeds of 30 kts, and operation at depths of 3.7 miles, according to web-posts (above).



Olenya Bay, Murmansk Oblast, Russia, 184670

Orenburg's home base
in the Kola Peninsula



FRAM

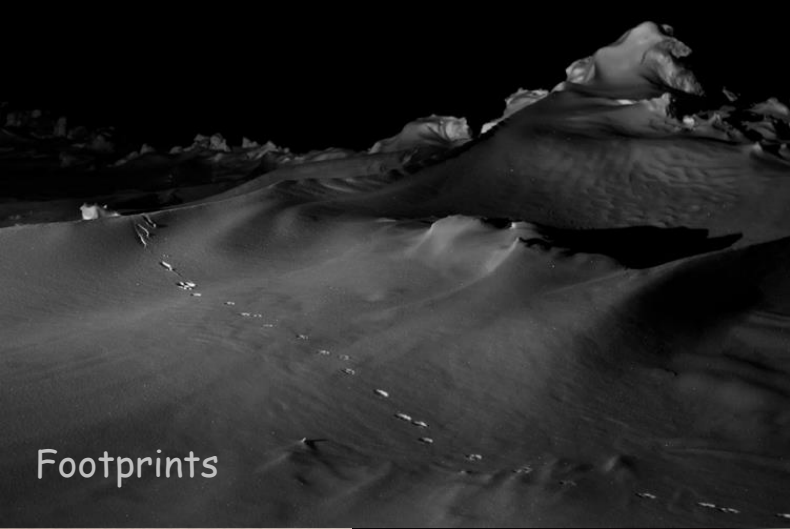


Barents Sea

Оленьей
Рубе Base

1. Russia, 184670

Kandalaksha Image Landsat
US Dept of State Geography



Another visitor, an Arctic Fox
(*Vulpes lagopus*) known as
Terianniaq Qaqortaq in West
Greenland



SCIENCESHOT



YNGVE KRISTOFFERSEN

Alone on an Arctic ice floe, with a hovercraft



By Carolyn Gramling | 12 September 2014 3:00 am | Comments

Somewhere in the Arctic Ocean, two Norwegian scientists are adrift on an ice floe, equipped with a year's worth of food and fuel—and one research hovercraft named *SABVABAA* (Inuit for “flows swiftly over it”). University of Bergen/Nansen Environmental and Remote Sensing Center professor emeritus Yngve Kristoffersen, 72, and crew member Audun Tholfsen established ice drift station FRAM-2014/15 on the 1.1-meter-thick floe on 30 August, when it was 280 kilometers from the North Pole. Over the next few months, they will drift northward along the submarine Lomonosov Ridge, taking sediment cores to learn about the polar environment more than 60 million years ago. It's the hovercraft that makes the setup truly unique: Using *SABVABAA*, the researchers can travel up to 100 kilometers from their floating base, assessing ice properties, currents, and water temperatures. The hovercraft—the brainchild of Kristoffersen and geophysicist John K. Hall, 74, of the Geological Survey of Israel—also makes it possible to conduct a year-round study, Hall says. The

ridge is covered by thick multiyear ice, forbidding to icebreakers, but *SABVABAA* (pictured) “allows you to have boots on the ground.” (There's a video of the hovercraft in action here.)

Posted in Earth, Environment, Technology

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MORE SCIENCESHOTS

Public Outreach



LUFTPUTEBAAT: Professor Yngve Kristoffersen (72) er på vei over Nordpolen i luftputebåt.

Norwegian TV2 had a clip including an Iridium interview with Yngve

Yngve (72) fra Alta skal kjøre luftputebåt over Nordpolen

Thank you for your attention



Photo courtesy Dave Monahan, UNH-CCOM-GEBCO/Nippon