FRAM-2014/15:
50 Weeks of Arctic Science from Drifting Sea Ice

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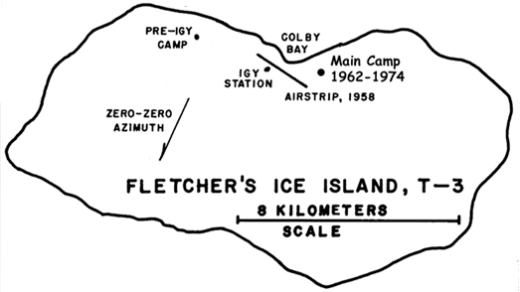
12th Annual GEBCO Science Day
Busan, Republic of Korea
Paradise Hotel, Nov 15, 2017

Aerial view of 1962-74 camp of Fletcher's Ice Island (T-3)



Four periods of Occupation – **7,240** days total **All-Time Record**
U.S Air Force – 19 March 1952 to 14 May 1954 – 768 days
U.S Air Force – 25 April 1955 to 24 Sept 1955 – 153 days
U.S Air Force – 7 March 1957 to 24 Oct 1961 – 1,692 days IGY Station Bravo
U.S. Navy - 17 Feb 1962 to 1 October 1974 4,609 days ONR - NARL

USGS Hydrohut:
Source of FL Cores

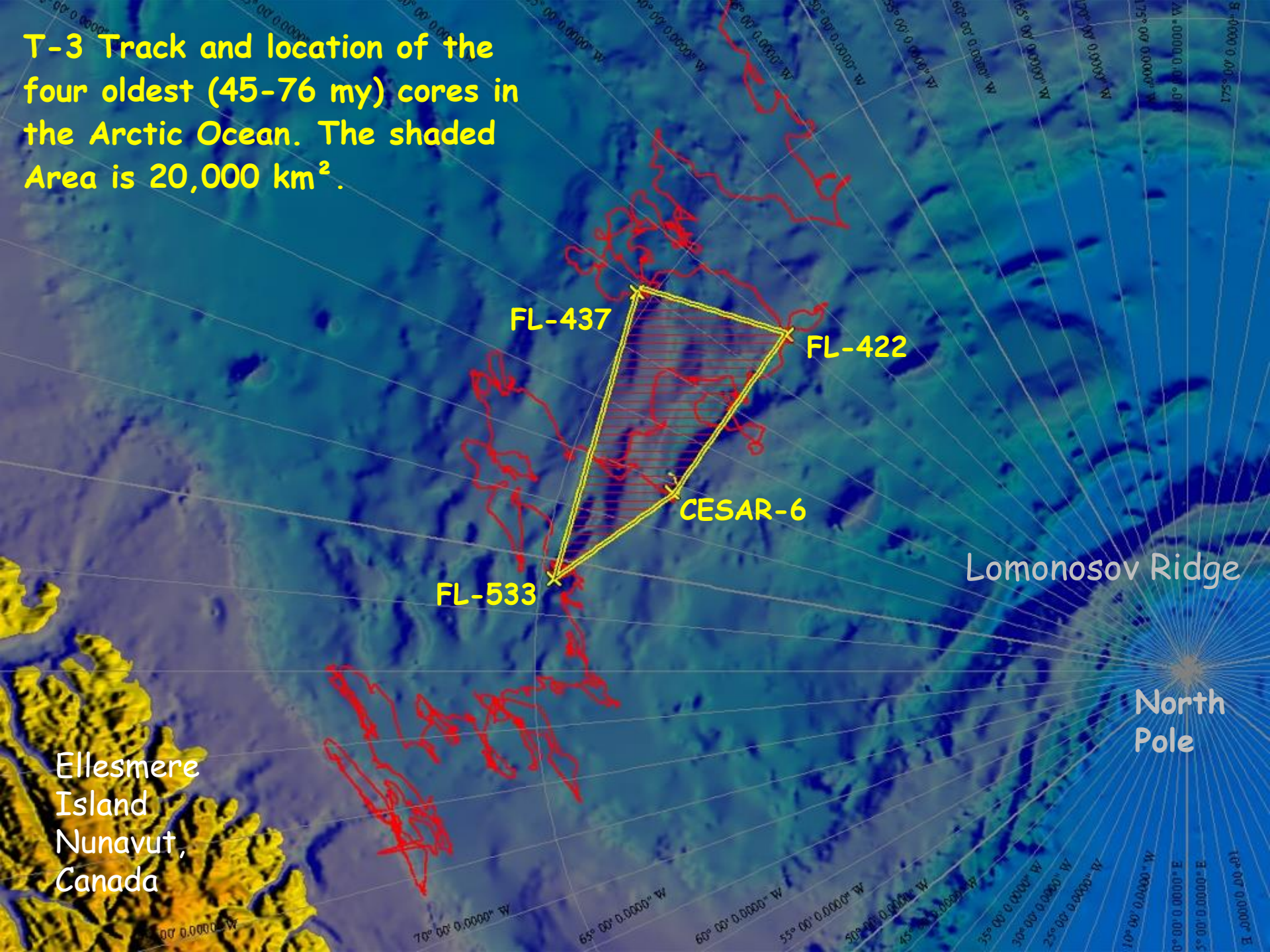
Lamont Hydrohut

Between 14 May 1962 and 15 Sept 1974 (4507 days or 12.34 years) T-3 drifted 23,561 km. The average drift was 5.2 km/day. The cost of the station, run by the US Navy, was quoted as being one million dollars per year – i.e. $524/km in 1967 dollars.

INTERPOLATED DRIFT TRACK - FLETCHER'S ICE ISLAND (T-3)

MAY 1962 TO SEPT 1974

This was the area of my 1970 PhD thesis at Lamont-Doherty Geological Observatory. The data was good, but all my interpretations were WRONG


T-3 Track and location of the four oldest (45-76 my) cores in the Arctic Ocean. The shaded Area is 20,000 km².
FL-437
FL-422
CESAR-6
FL-533
Lomonosov Ridge
North Pole
Ellesmere Island Nunavut, Canada

In 2004 my LDGO classmate Prof Yngve Kristoffersen invited me to bring the original 1966-1974 T-3 seismic profiles to Bergen.

Evidence of an Asteroid Impact in the Central Arctic Ocean?

OS53B-1114

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Healy 0505 Seismic Team: Tore Arthun, Hans Berge, Vibeke Brevoll and Erik Ottesbrell of University of Bergen, Norway; Hedda Breien, University of Oslo, Norway; Dayton Dove, University of Alaska, Fairbanks, Paul Hoskart, Scripps Institution of Oceanography, USA; Nina Ivanova, University of Uppsala, Sweden; Fredrik Ludvigsen, Thor Heyerdahl High School, Lervik, Norway; and Karina Monsen, Alta High School, Alta, Norway.

The Result

ABSTRACT

Reevaluation of single channel seismic reflection data from ice station T-3 (1967-74) acquired over the submarine Alpha Ridge in the central Arctic Ocean supplemented by new multi-channel data, show spatially restricted massive disturbance of sub-bottom sediments within a 200 x 600 km area. Deposits have been locally disrupted down to at least 500 meter below the bottom, and have suffered intensive local erosion. Mass wasting in abundant. We note that: 1) tectonic movements normally involve the whole stratigraphic column and are not depth limited as observed here; 2) ground motion may trigger mass wasting, but is less likely to generate intense bottom current erosion; and 3) enhanced bottom currents are basin-wide phenomena and only disrupt stratigraphic continuity down to the deepest erosion level.
As a working hypothesis, we suggest the spectrum and scale of drastic, spatially restricted and apparently geologically short-lived environmental changes are best explained by the effect of a shock wave from impact of an extra-terrestrial body, the *T3-Healy* asteroid. The time of impact is unknown, but may be Plio-Pleistocene.

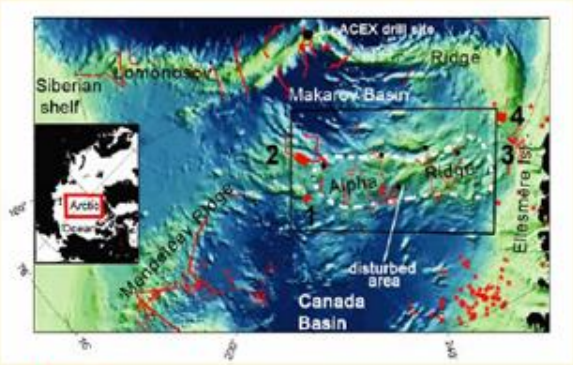


Figure 1 - Bathymetry of the Amerasia Basin of the Arctic Ocean ( ) with outline of the area of sediment disturbance (white dashes) on Alpha Ridge. Tracks of multi-channel seismic lines by icebreakers indicated by thick red lines and drifting ice stations by thin red lines. Sample seismic sections (1-4) are shown in figure 2. Earthquake locations (red stars) are from . Large black dot is location of ACEX drill site and small black dots show locations where slumped Late Cretaceous material has been recovered in short (3-4 m) cores. Polarstern core (PS51/038-4) indicated by black star.

INTRODUCTION

Seismic reflection data collected over five years (1967-71) during the drift of U.S. ice station *T-3* over the Alpha Ridge in the central Arctic Ocean (Fig. 1, thin red lines) revealed a local area of unusual seabed roughness characterized by hyperbolic echo returns and lateral truncation of acoustic horizons (Hall, 1979). The seabed roughness was suggested to indicate a strong paleo-bottom current event. Modern multi-channel seismic surveys from the margins of the margins of the Canada Basin, Eurasia Basin, the Makarov Basin, the Lomonosov Ridge and Mendeleev Ridge all show anti-cyclonic bottom current erosion within the upper ca. 200 m of stratigraphic section. This is also supported by the results of scientific drilling on Lomonosov Ridge. We have reexamined the single channel data from ice station *T-3* used to postulate erosion as well as hitherto unpublished data from the drift during 1967-1974.

DATA

Single channel seismic data was acquired during the drift of U.S. ice station *T-3* (Radar Target # 3, Fletcher's Ice Island, or Ice Station Bravo) over the Mendeleev- and Alpha ridges from 1967 to 1974 using a 9 kJ sparker source. The seismic signals from two single hydrophones were recorded on electro-sensitive dry paper on a direct recorder. Navigation was by transit satellite fixes. New multi-channel seismic data was acquired in August-September 2005 from the U.S. Coast Guard icebreaker *Healy* using an up to 24 channel, 300 meter long streamer and a 2 x 4 liter G-gun source. The preliminary processing included editing, band-pass filtering and stacking.

RESULTS

Bedforms on the western end of Alpha Ridge and near the continental slope north of the Canadian Arctic islands show a laterally uniform and undisturbed sediment drape of nearly 1 km thickness over the ridge (Figs. 1 and 2). The lateral continuity of acoustic horizons contrasts with observations from the crest and south slope of Alpha Ridge. Centered at about 84.7°N, 206°E (Fig. 3 and 4, profile A) is a confined area characterized by irregular short sub-bottom reflection segments with random apparent dip directions. Acoustic horizons become progressive coherent about 0.5 s two-way travel time (TWT) below the seabed in the most disturbed central region, while impedance contrasts are intact and lateral continuity maintained at the northern and southern end of the profile (Fig. 3, profile A). Sediment deformation is most dramatically expressed in an area centered at about 84.5°N, 255°E (Figs. 3 and 4, profile E) where an irregular sea bed associated with completely disrupted sub-bottom stratification changes westwards into an area where the upper sediments are missing (Fig. 3 and 4, profile D and C). More than 500 m of section is lacking and the void partially refilled with non-stratified material (Fig. 3, profile C). Further west, along the slope of Alpha Ridge, debris flows partially infill missing stratigraphy or overlay laterally intact acoustic layering (Fig. 3 and 4, profile B).

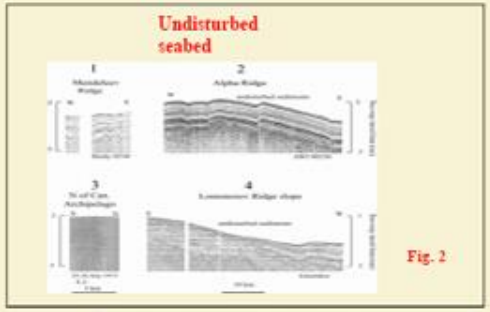


Fig. 2

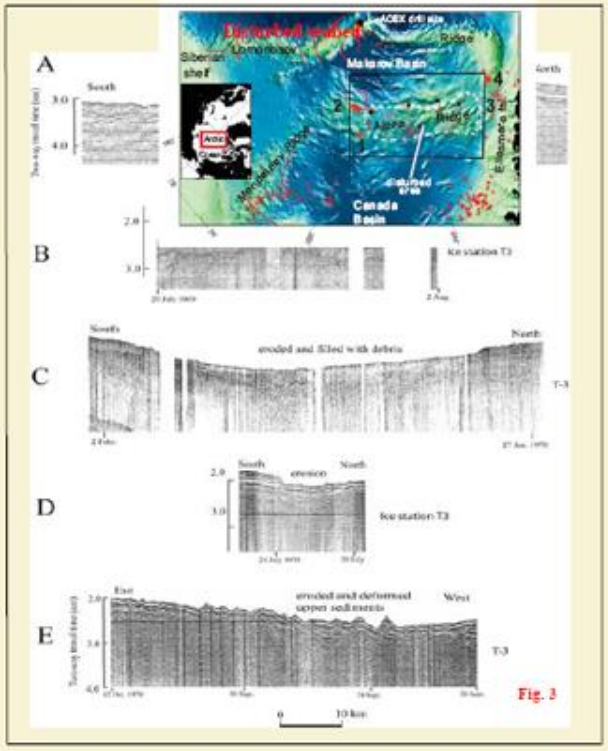


Fig. 3

DISCUSSION

The seismic records from Alpha Ridge show evidence of very strong erosion in a restricted area where measured present day bottom current velocities are 4-6 cm/s (Hunkins et al., 1969). Sediment deposition in an abyssal realm of moderate relief is generally characterized by persistent lateral continuity except in the presence of significant basin-scale bottom currents. The short lateral distances between no erosion and severe erosion (Fig. 3, profiles C and D) argues against sediment removal by a steady-state bottom current. Tidal interaction with bottom topography may induce strong local amplifications of bottom currents, but is not effective for the area in question. Erosion on Alpha Ridge appears to be a locally unique feature within the Arctic Ocean and also has the character of a short lived local event.

The Alpha Ridge appears aseismic (Fig. 1 - http://earthquake.usgs.gov). Tectonism would most likely be manifested as displaced packages of sediment with intact acoustic stratification and not generate a depth-limited chaotic zone as observed here (Fig. 3, profile A). Sediment instability and mass wasting may be generated by footwall erosion or loading events such as sea level changes and earthquakes or an external pressure pulse. A sea level change has a basin-wide effect, while dynamic loading from a point source is site specific.

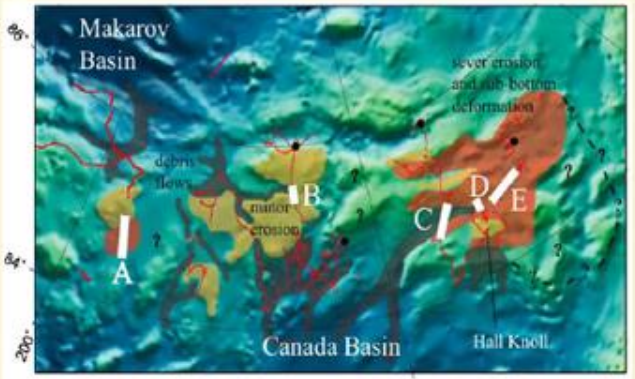


Figure 4 - Outline of zone of sub-bottom depth-limited sediment deformation and heavy erosion (reddish brown), minor seabed erosion (cross), and debris flows (dark gray). Most disrupted sub-bottom sediments are at location of profiles A and E. Locations of seismic profiles (A-E) are shown in Fig. 3. Tracks with seismic data shown in red. Black dots are locations of cores which recovered intervals of Late Cretaceous-Early Cenozoic sediments.

WORKING HYPOTHESIS

We note an apparent westward progression from the most intense sediment deformation at 84.5°N, 255°E (Fig. 3 and 4, profile E) to adjacent sediment removal by strong local currents (Fig. 3 and 4, profile D), and on to an area where abundant mass flows have been triggered (Fig. 3 and 4, profile C and B).
As a working hypothesis we argue that sediment disturbance was most likely created by a local, short-lived presence event which induced local jets of fast bottom flow and dynamically triggered numerous debris flows. An impact of an asteroid in the Arctic Ocean over the Alpha Ridge would have sufficient energy and be site specific . We propose to name the asteroid *T-3 - Healy* in recognition of the platforms from which the seismic documentation was acquired. Simple calculations using a web-based tool suggest an asteroid of diameter 1 km or less may have hit the atmosphere at a very low angle and at a relatively slow speed to generate an elongated ellipse of projectile fragments and induced cratering on the ocean bottom. Historic images across known shallow water impact locations such as Chicxulub or Arctic line striking resemblance to our seismic profile A (Fig. 3). Common features are a sediment section outside the crater characterized by well-defined acoustic stratification changing laterally at the crater rim into an upper incoherent lens underlain by successive intact stratigraphic continuity.

Darby (1968) has reported on mysterious iron-nickel-zinc spherule in ice rafted debris in short cores from the central Artic Ocean, but the age of the spherules is in question.

TIMING OF A POSSIBLE IMPACT ON ALPHA RIDGE

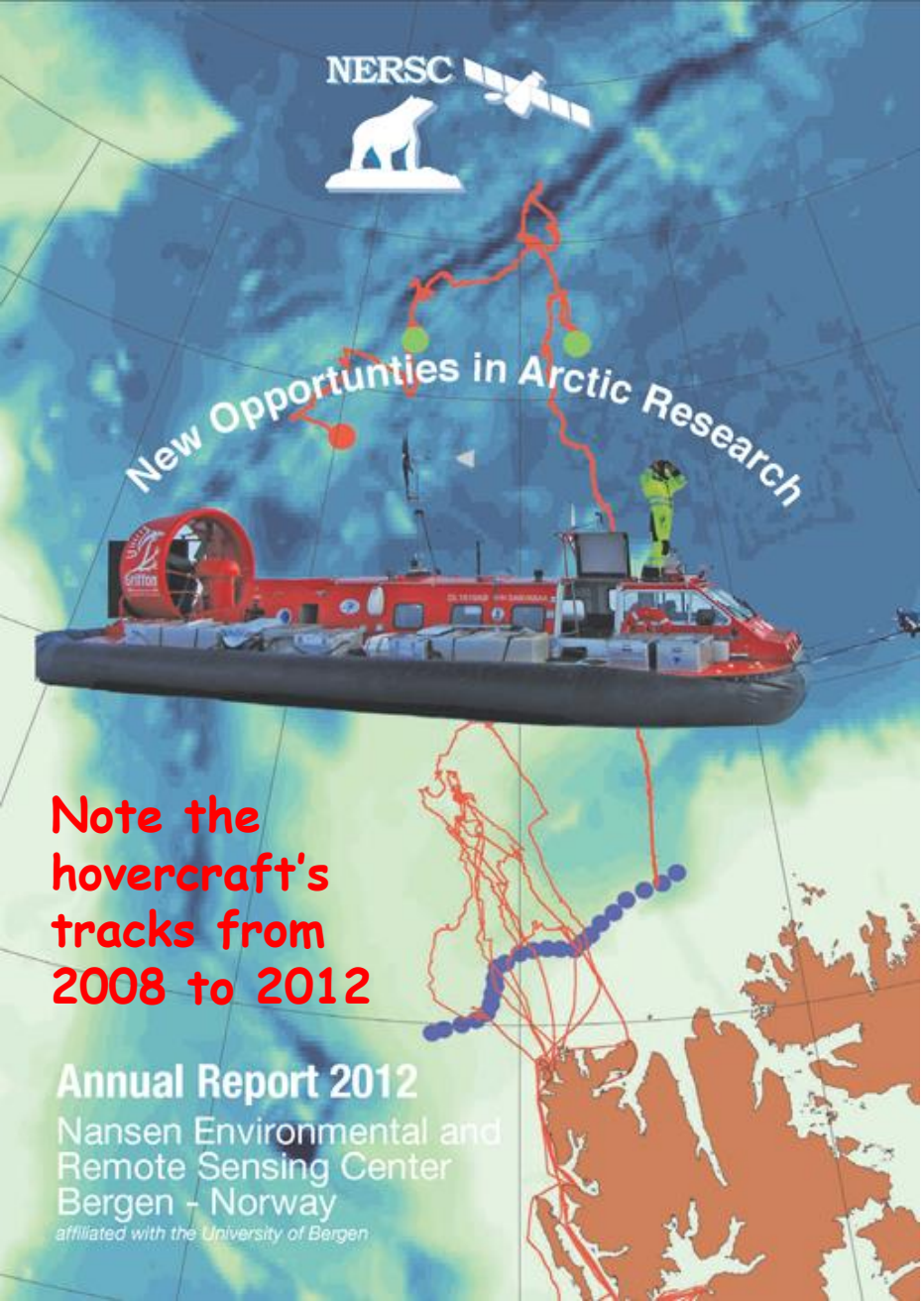
About 95 sediment cores have been raised during the drift of *T-3* from areas on Alpha Ridge where seismic evidence shows sediment removal has taken place. The thickness of post-impact sediments draped over an eroded subsurface appears to be below the resolution in the seismic data (<15 m), but is apparently greater than the removed recovered by the longest available sediment corer (max. 5.5 m). Four cores which have captured intact stratigraphic intervals of Late Cretaceous-early Cenozoic siliceous ooze and black mud within Pleistocene and younger sediments are all located on graben-bounding faults or on a steep slope (Fig. 1 and 4). The older sediments are likely to represent blocks of material emplaced by slumping and covered by later sedimentation. We suggest the slumping is a result of mass wasting triggered by the asteroid impact. The impact event may be of Plio-Pleistocene age.

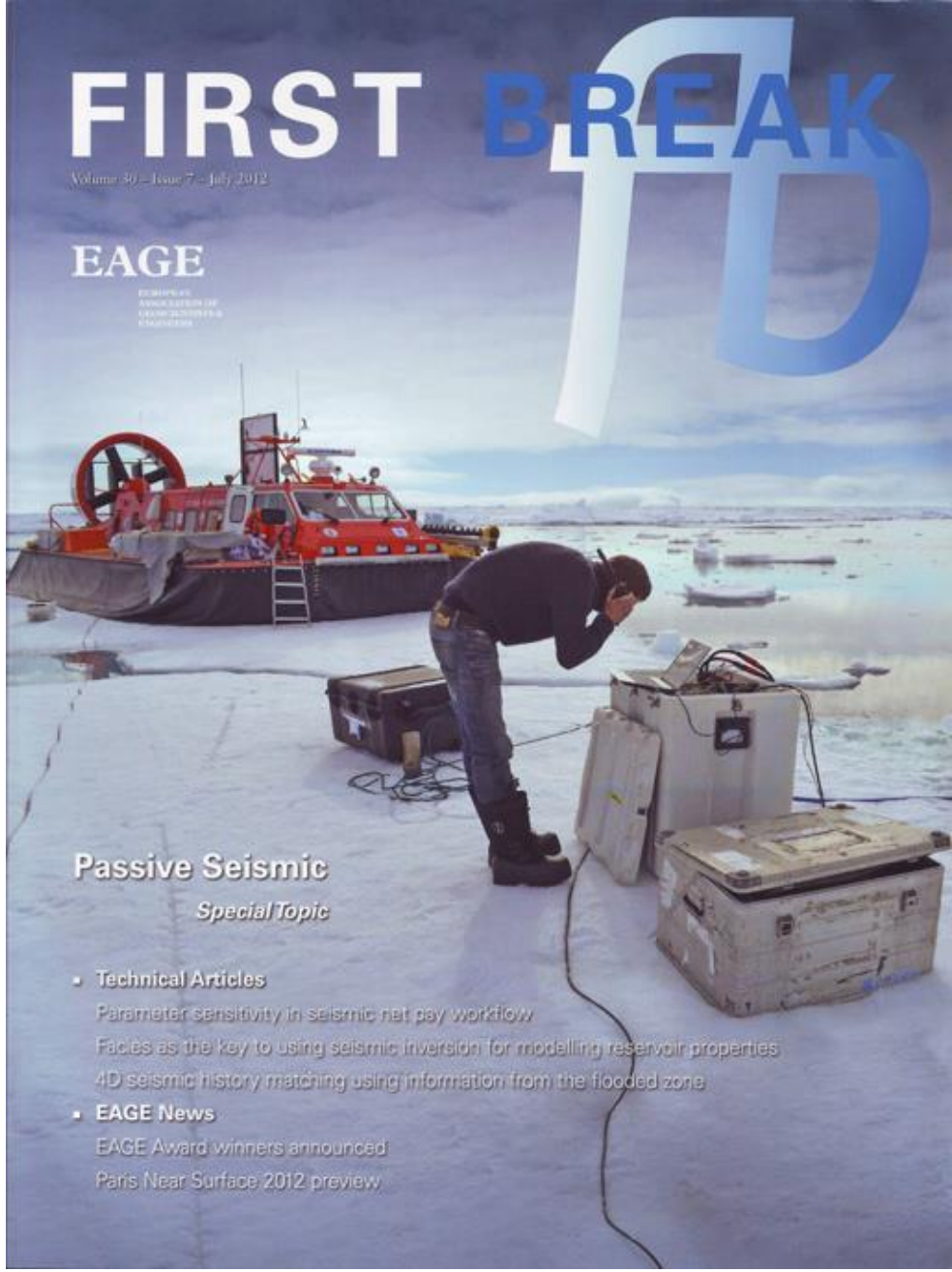
ACKNOWLEDGEMENT

The T-3 geophysical program was supported by contracts 2662(2) and 3050(04-67-A-0108-0010 to Lamont-Doherty Earth Observatory of Columbia University, New York. Healy cruise 0505 by NSF award # 0449898 to Geophysical Institute, University of Alaska, Fairbanks, and # 0447440 to Texas A&M University, College Station, Texas. MCS acquisition and Norwegian participation in Healy cruise 0505 was funded by the Norwegian Petroleum Directorate.

Poster from 2006 Fall AGU Meeting, after examining old 1966-1974 seismic data

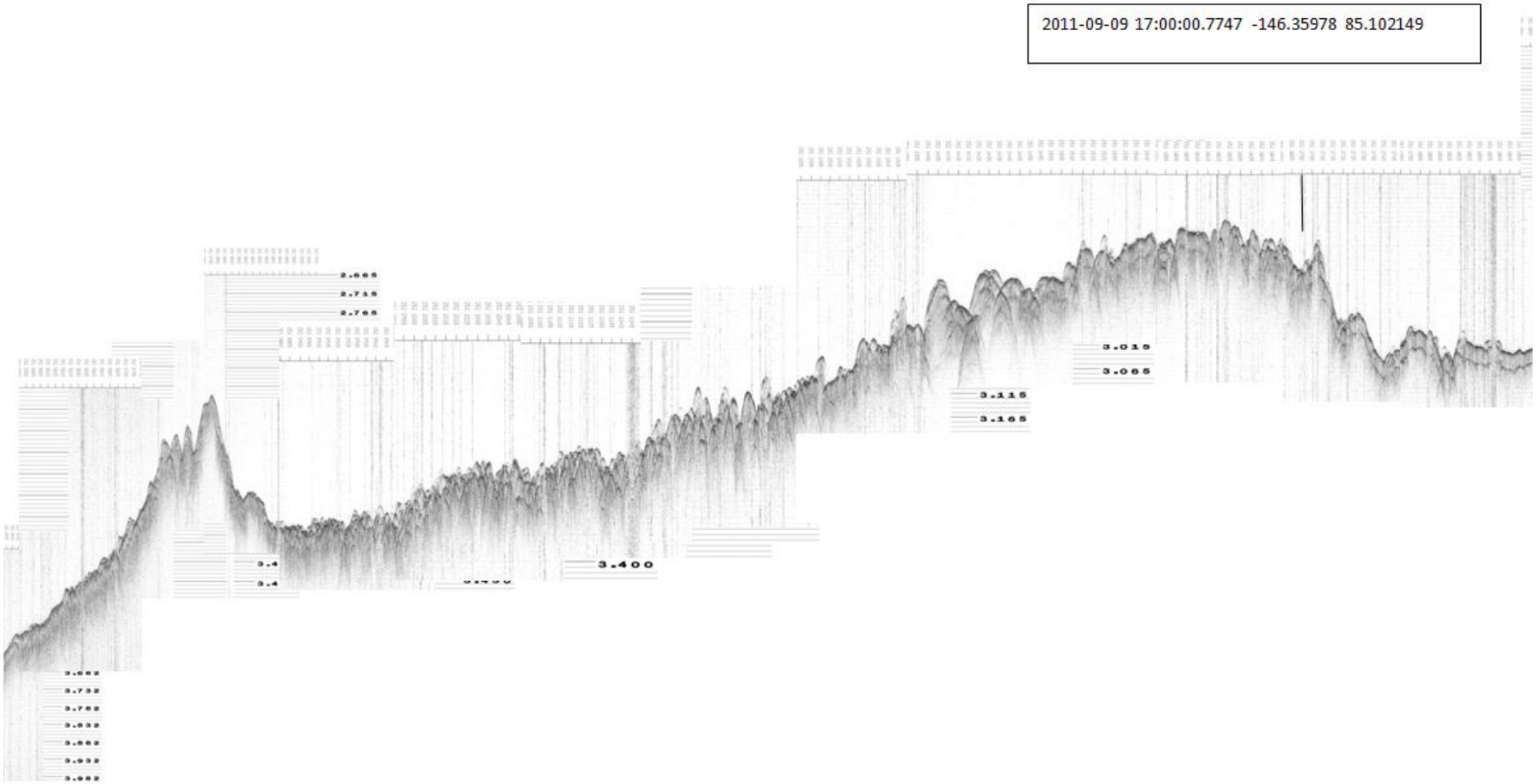
R/H SABVABAA Arrives in Longyearbyen, Svalbard at 79°-14'N in June 2008.



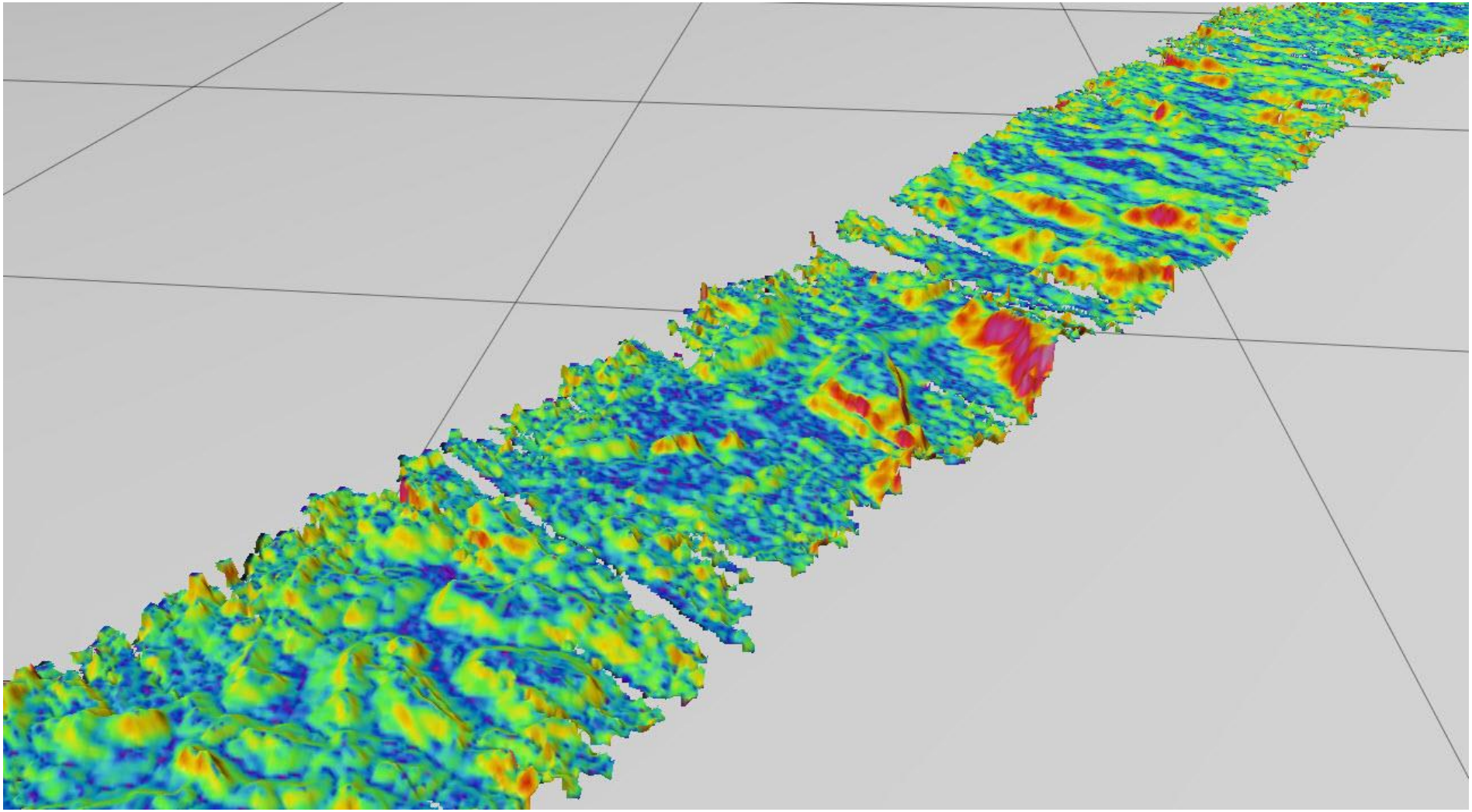


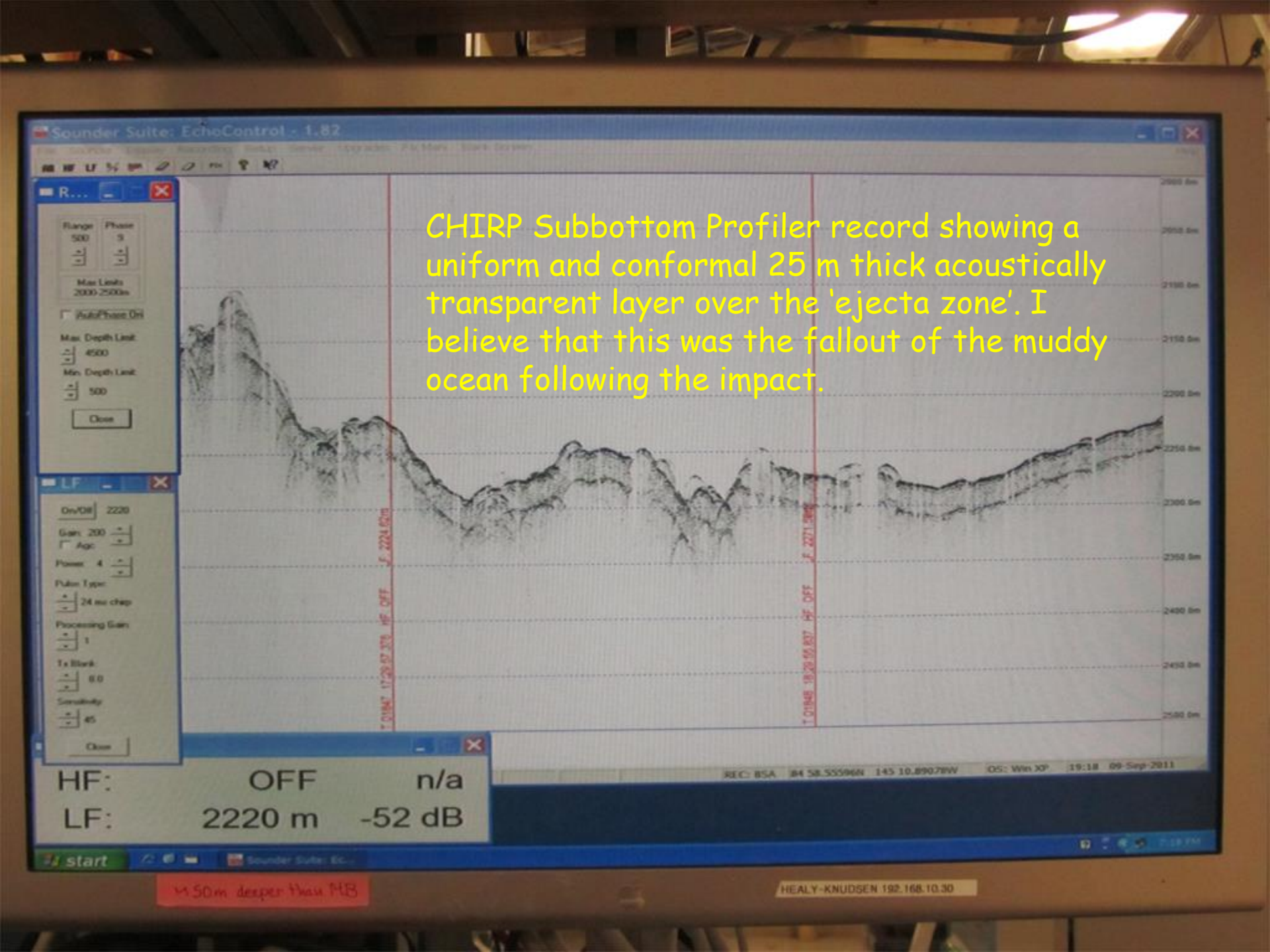
Since its arrival in Longyearbyen, Svalbard (78-14N) in June 2008, the craft has been to the ice over 20 times, and has traveled approximately a distance equal to halfway around the world. Its sexy form has already graced a number of serious publications. A search on SABVABAA on Google has given up to 80 pages.

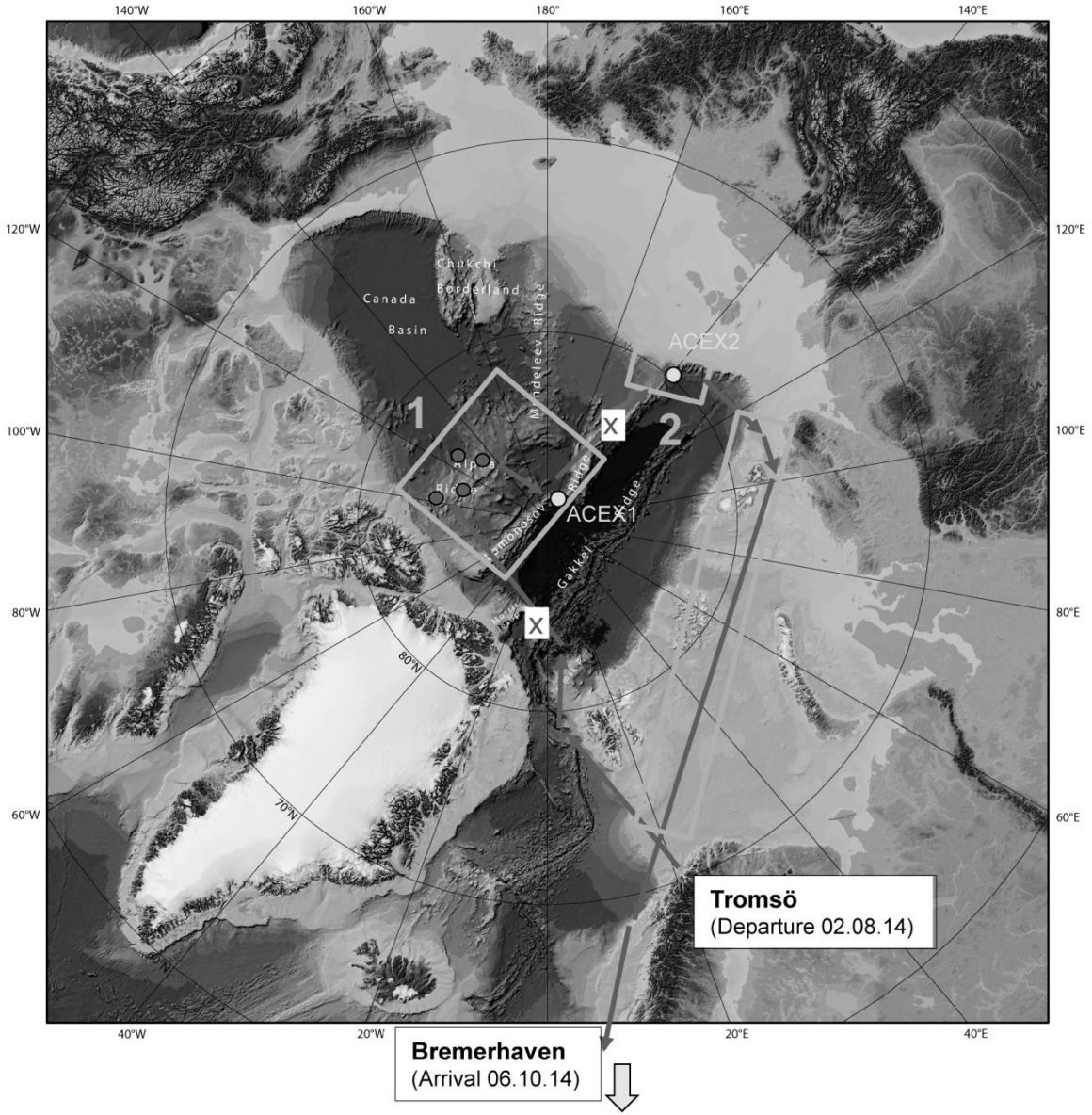
Healy 1102 CHIRP Profile of 'Hyperbolic Echoes' on the Alpha/Mendeleev Ridge

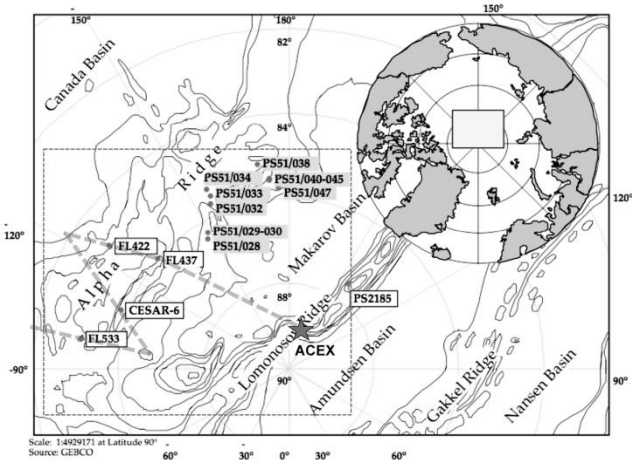


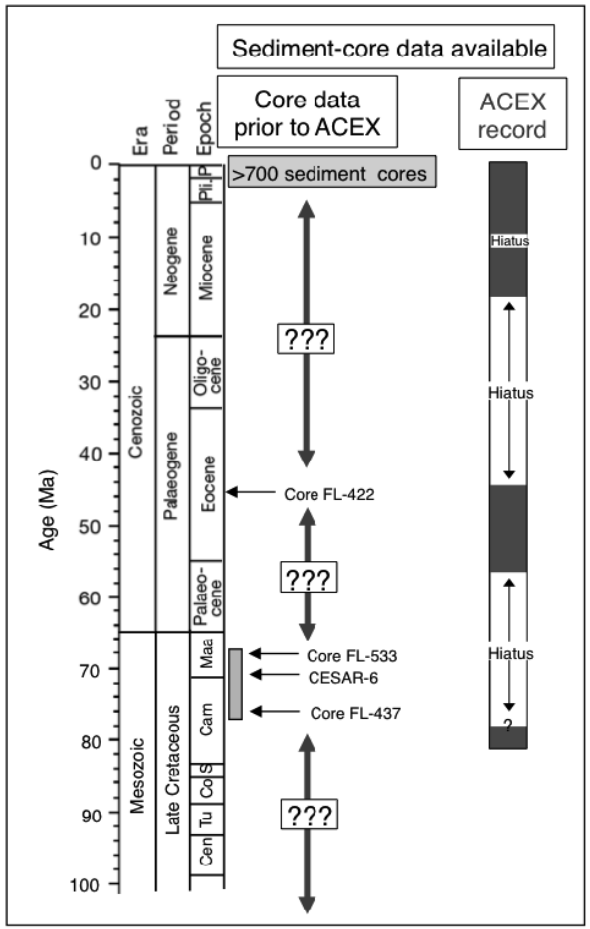
EM122 multibeam 8 km wide swath showing slopes of the Ejecta Zone, red color is up to 40°. *These are not sediment waves.*



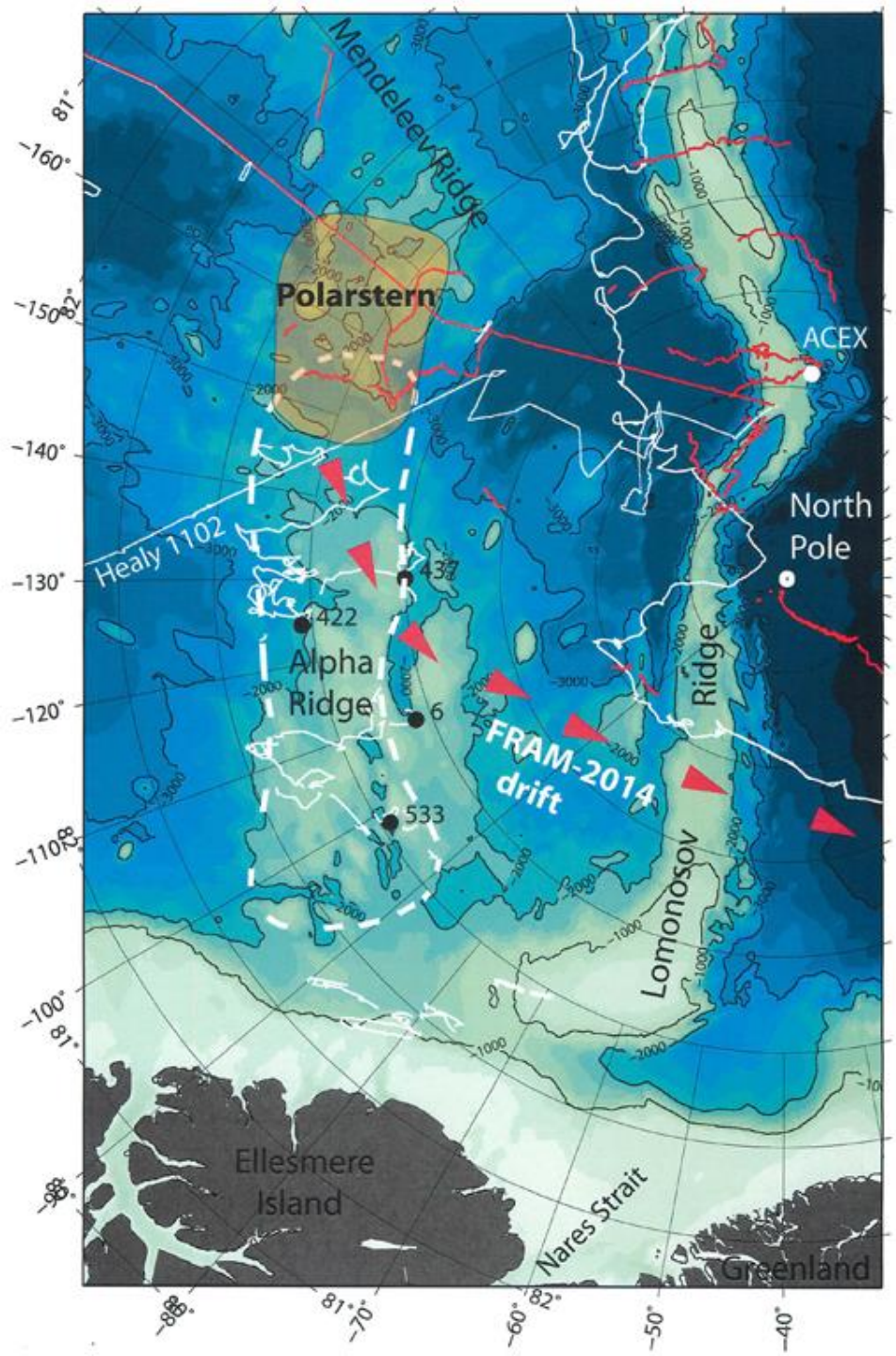

Sounder Suite: EchoControl - 1.82
CHIRP Subbottom Profiler record showing a uniform and conformal 25 m thick acoustically transparent layer over the 'ejecta zone'. I believe that this was the fallout of the muddy ocean following the impact.
HF: OFF n/a
LF: 2220 m -52 dB
start
HEALY-KNUDSEN 192.168.10.30

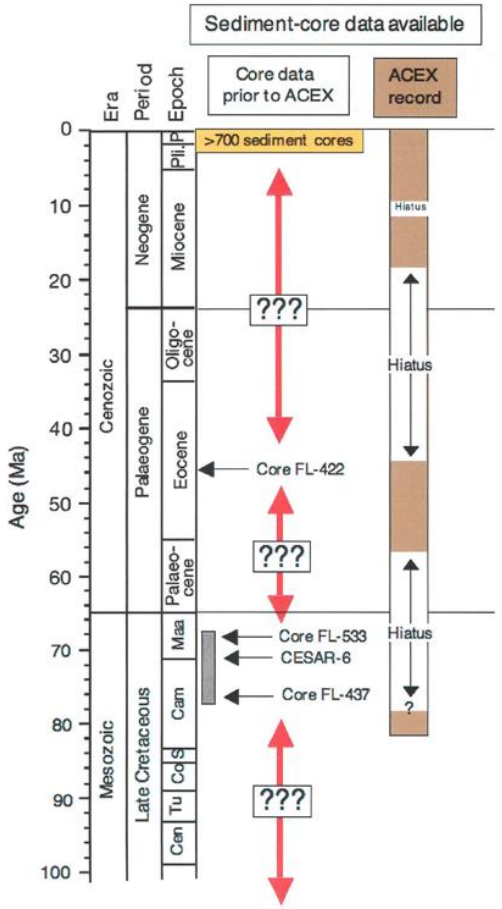






During Healy Cruise in 2011, Yngve and I were invited to bring the hovercraft up to the Alpha Ridge in 2014 aboard the Alfred Wegener Institute (AWI) icebreaker Polarstern.



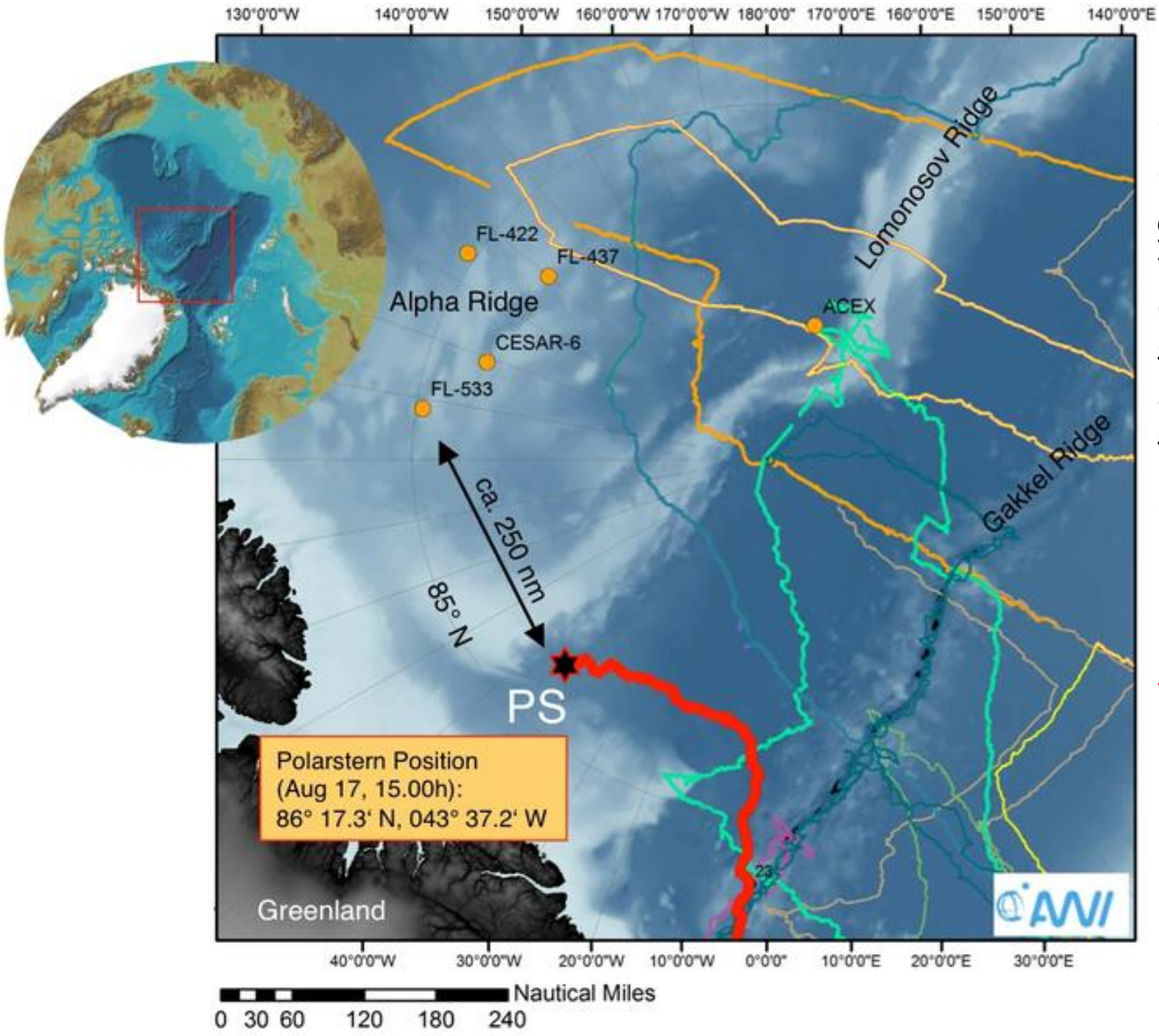


This then set in motion the plan for the next two years (2012-2013) to get the hovercraft ready for work on the Alpha Ridge in 2014. New equipment was to be built, support arranged, rescue plans made, and personnel found for what was expected to be a 500 day drift.

Preparation of specialized light-weight equipment for FRAM-2014/15 in Yngve Kristoffersen's machine shop.

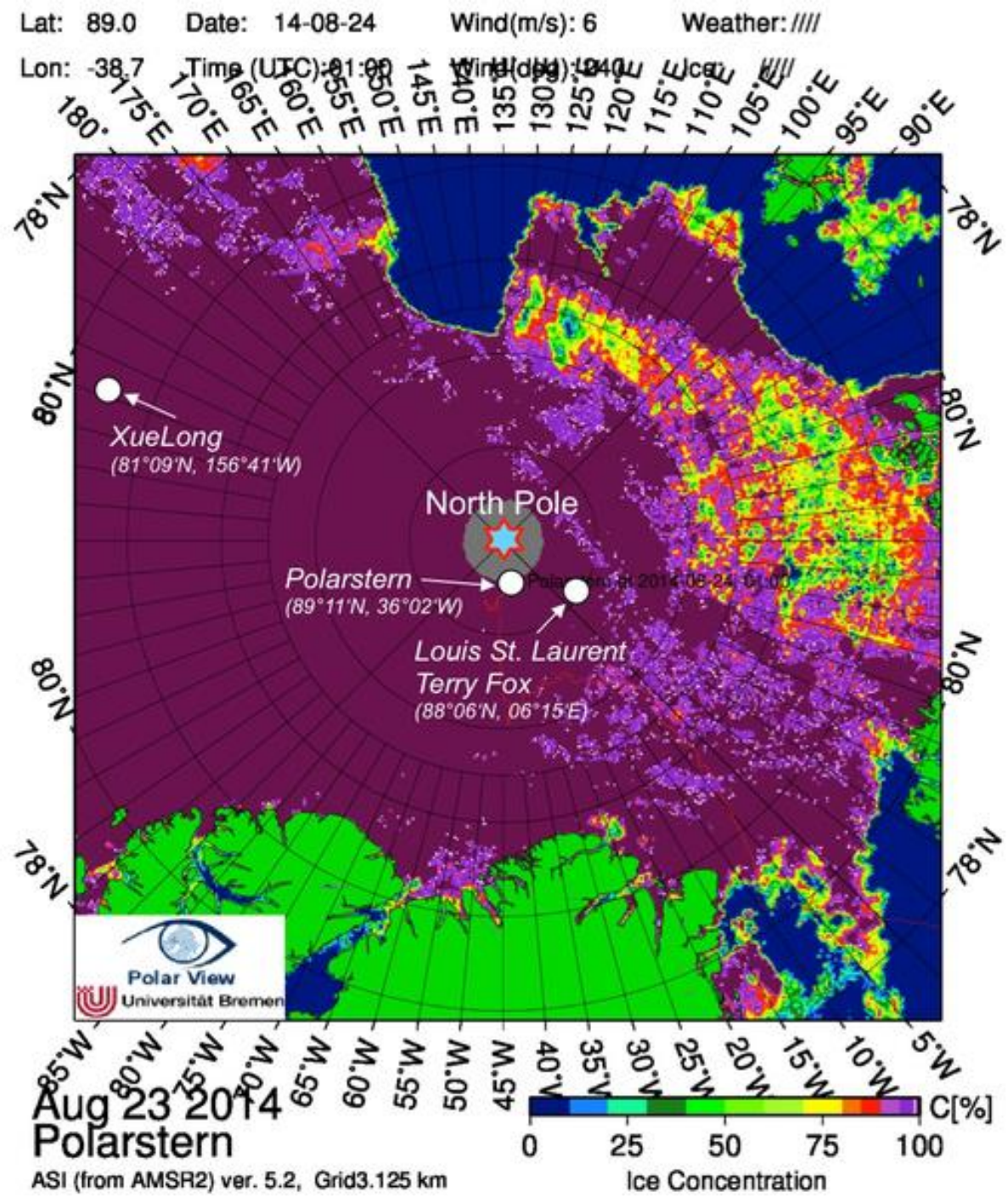
Testing the hydrostatically -boosted corer.

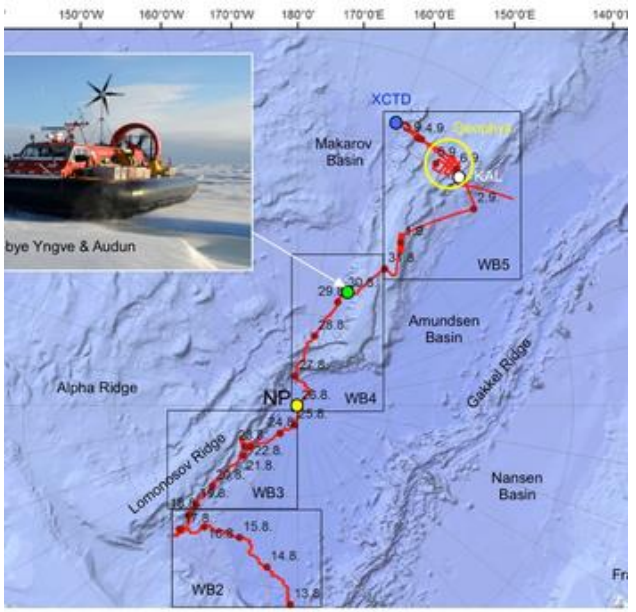
Our intrepid FRAM-2014/15 Arctic Heroes. Prof. Yngve Kristoffersen of NERSC and Emeritus Professor at the University of Bergen, and Audun Tholfsen of Spitzbergen, and various very high Arctic adventures. Tromsø, Norway, 4 August 2014.



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

The obligatory group photo of the 44 member science party for Polarstern Cruise ARK-XXVIII/4 (Expedition PS87) at the North Pole on 26 August. This was the 4th time that Polarstern has been to the North Pole.

This will be the last time as the 34 year old ship will be replaced by a new icebreaker, the Polarstern II in 2017.

Early morning, Saturday, August 30th 2014. the FRAM-2104/15 drift station is set up at 87° 20.7' N, 153° 58.8' E, 296 km from the North Pole

Some of the 12 1000 liter rubber bladders with special Arctic diesel fuel.

The R/H SABVABAA is offloaded from the forepeak of the Polarstern. Note the 100 rubber 'fingers' below the skirt, which confine the air under the craft. The craft is 12 m long and weighs 5 tons. Its official payload is 2,200 kg but the usual load is closer to 3,000 kg.


IMO 8013132
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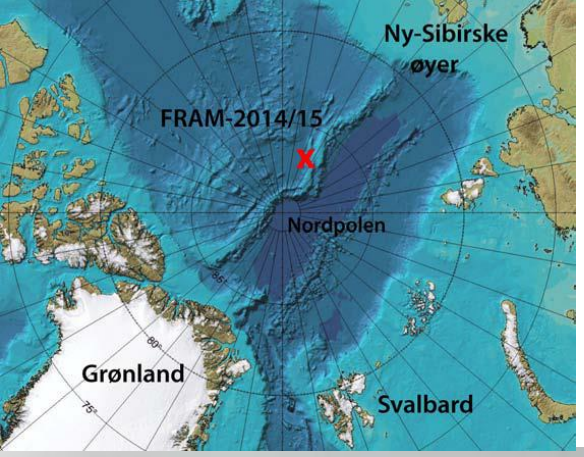
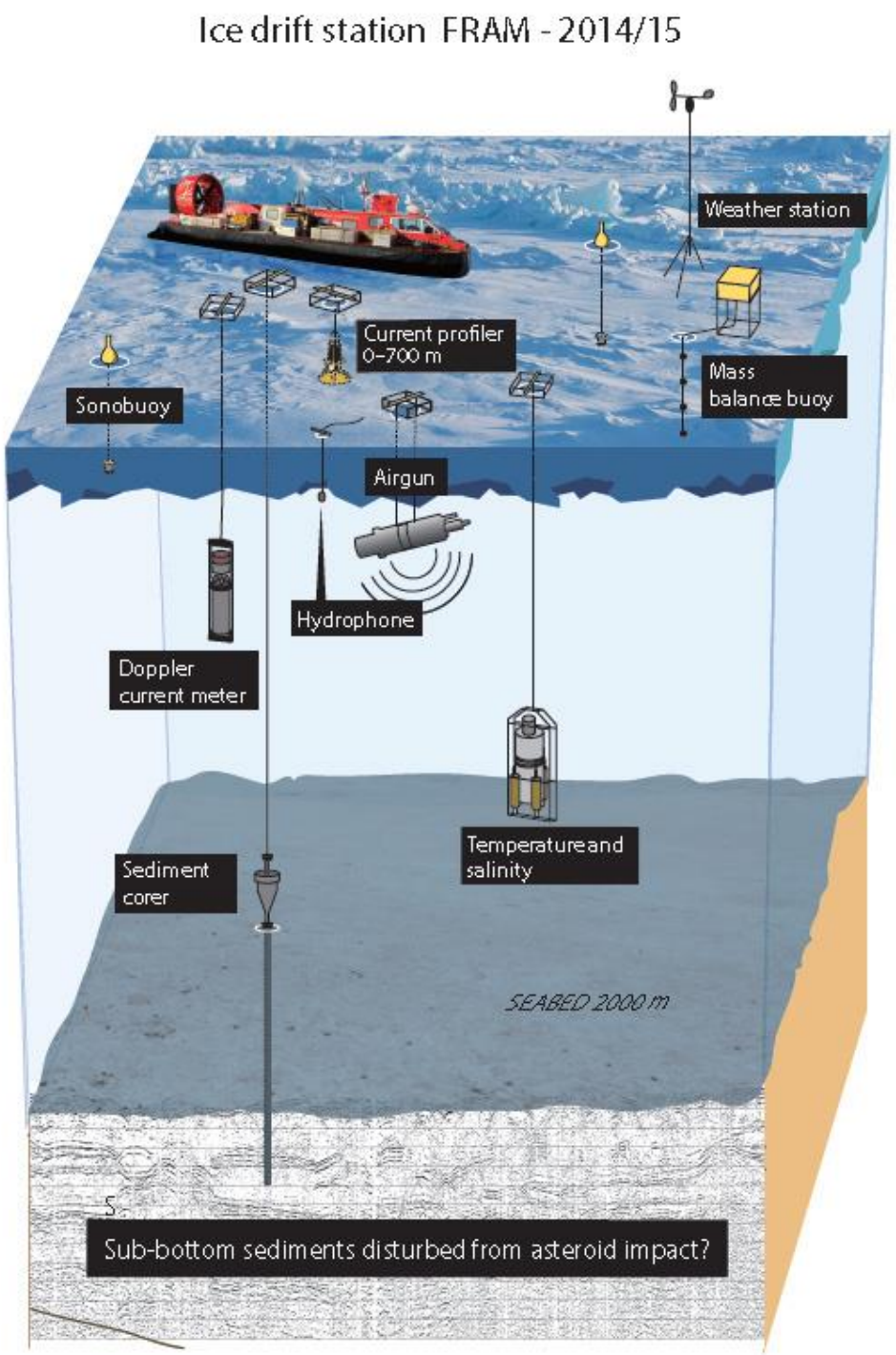


Polarstern's helicopter, crew and scientists worked 10 hours to offload 21 tons of supplies and fuel plus the hovercraft.
After waving goodbye as the icebreaker departed, (First Slide) they were faced with the job of setting up the ice camp and beginning the science program.

Fuel dump with 12 1000 l bladders



The plan for the FRAM-2014/15 rift was multi-disciplinary.

The cartoon shows the many sensors above and below the ice.

Geophysics: Seismic profiling with an airgun and single hydrophone. No gravity or magnetics was planned as aerial surveys have completely covered the Arctic. Echo-sounders from four element CHIRP to 12, 30, and 200kHz. Five autonomous 10kHz E/S buoys from WHOI.

Geology: Hydrostatically boosted sediment and gravity corers. GoPro bottom camera. Dredge.

Oceanography: CTD, ADCP, current meters at 800 and 1200 m, thermistor string.

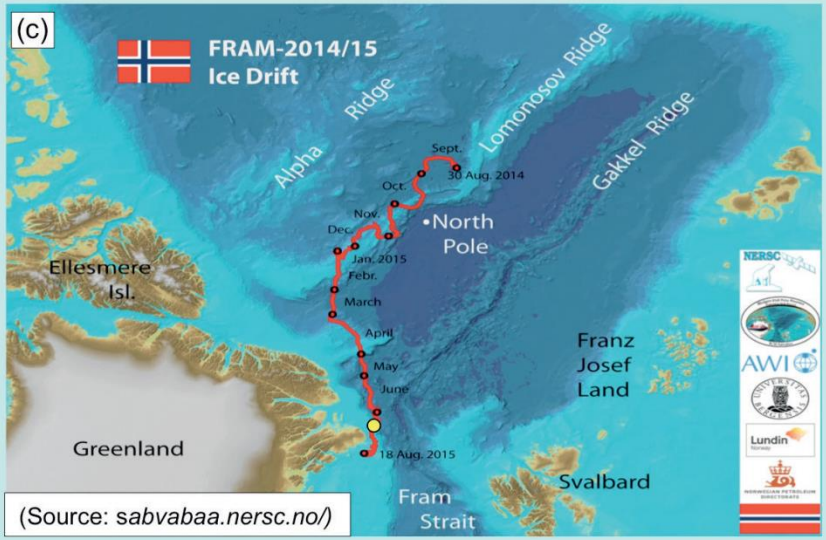
Meteorology: Weather and incident and reflected radiation.

Glaciology: Ice thickness

30 August 2014 (Start of FRAM-2014/15)
Deployment of drift station by
Polarstern during Expedition PS87

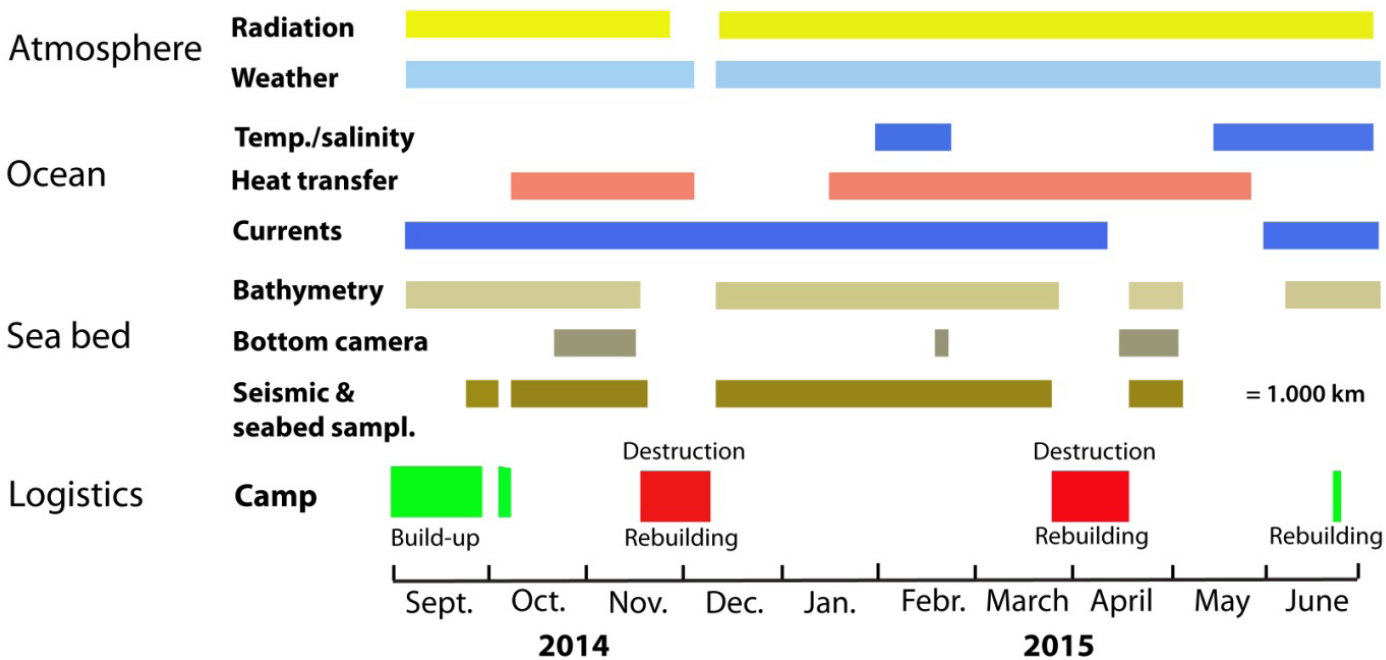
05/06 July 2015
Rendezvous of *Polarstern* and drift station
during Expedition PS93.1

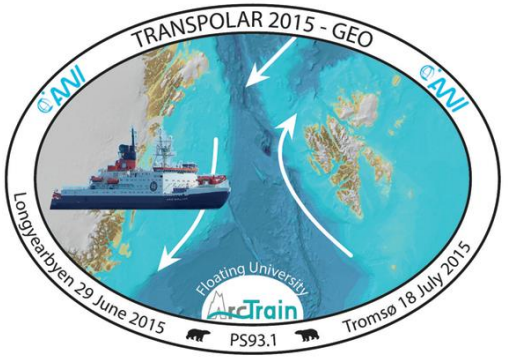
18 August 2015 (End of FRAM-2014/15)
Recovery of the drift ice station
by the sealer *Havsel* and start
of transit back to Longyearbyen



Delivery 30 Aug 2014

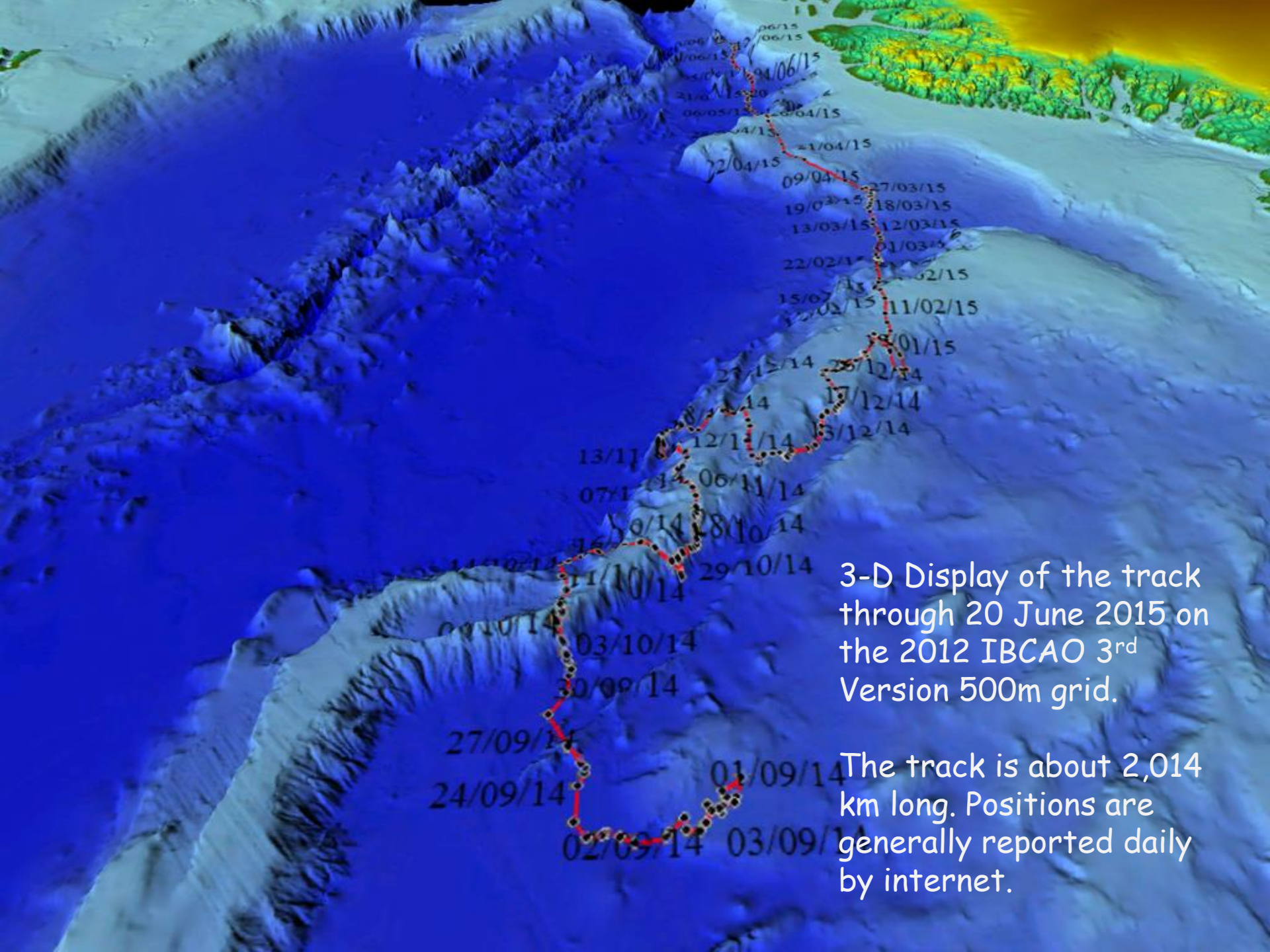
SPOILER ALERT
Overall Summary of the FRAM-2014/15 Drift





Audun leaves 5-6 Jul 2015

Pickup 18 Aug 2015



3-D Display of the track through 20 June 2015 on the 2012 IBCAO 3rd Version 500m grid.

The track is about 2,014 km long. Positions are generally reported daily by internet.

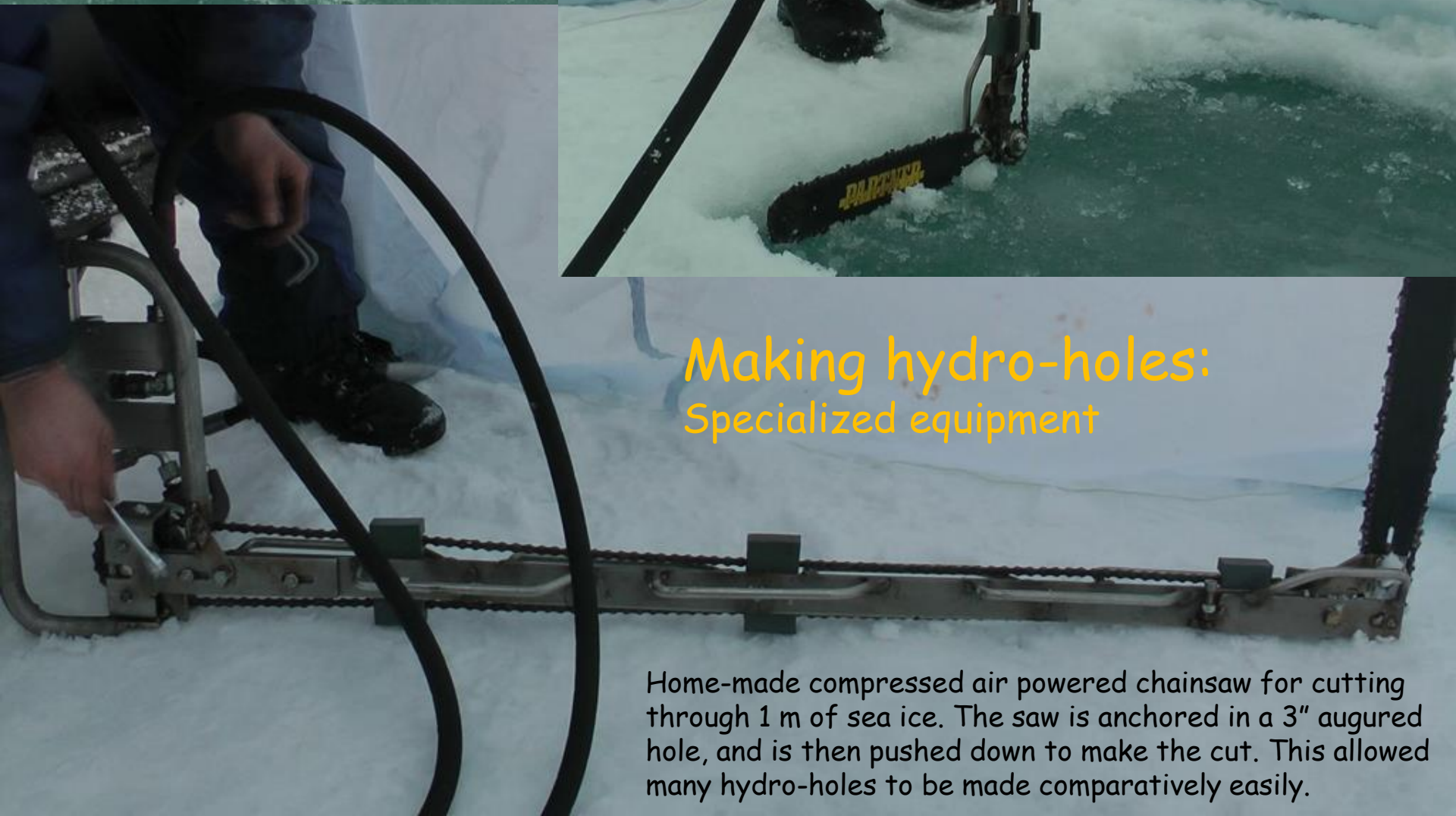
Installation of the Weather Station for the Geophysical Institute (GFI) of the University of Bergen.

Radiation flux Measurements are also recorded for Meteorology Norway.

Setting up the SCIENCE

Making holes through the ice:

Home-made battery-powered auger



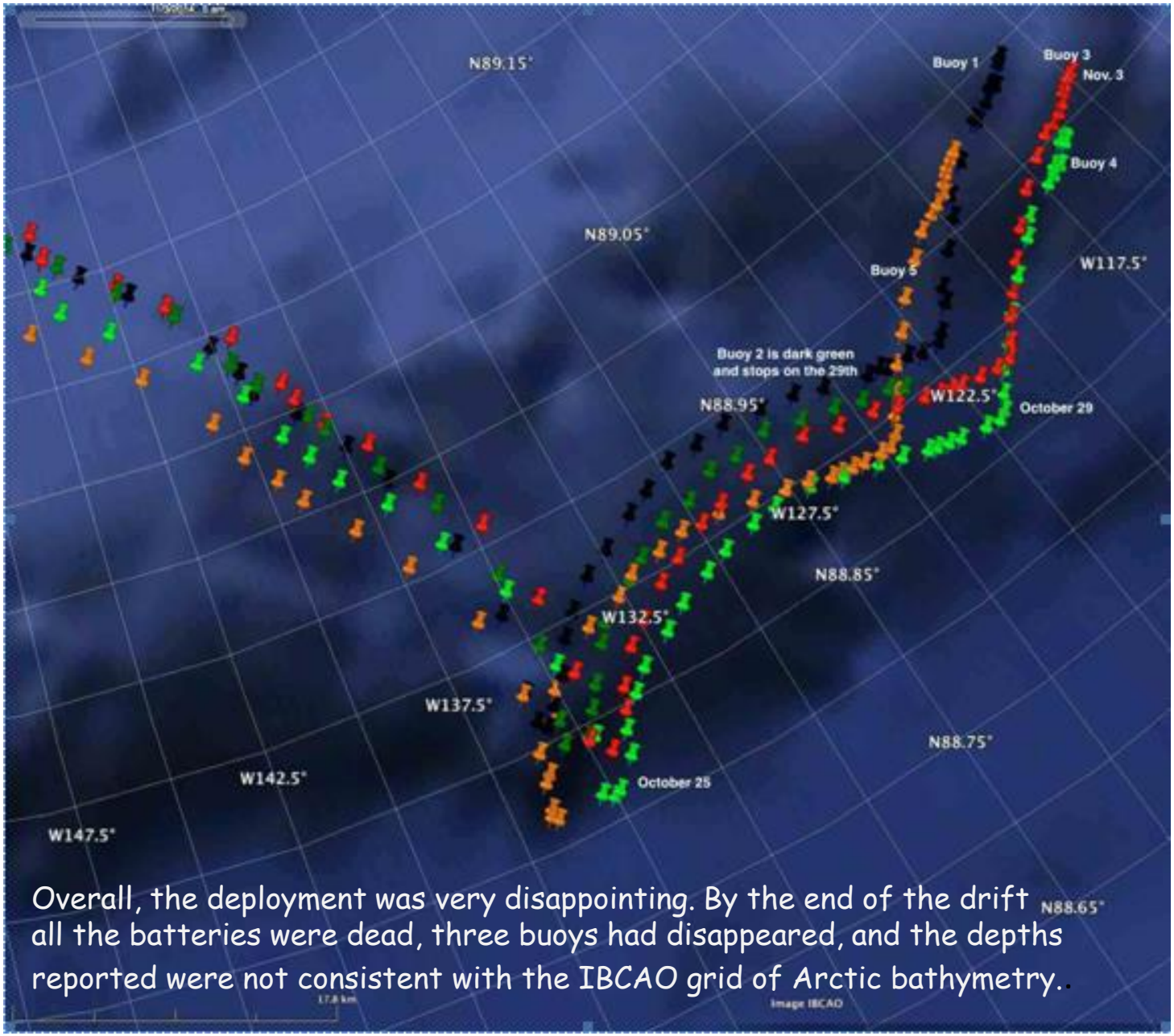
Making hydro-holes:
Specialized equipment

Home-made compressed air powered chainsaw for cutting through 1 m of sea ice. The saw is anchored in a 3" augured hole, and is then pushed down to make the cut. This allowed many hydro-holes to be made comparatively easily.

Emplacement of recording current meter. Note the rectangular hole made with a home-built ice auger powered by an auto starter motor and 12v battery

Making a hydro-hole, within what was to become the ice hanger. The ice was about 1.1 m thick.

Lee Freitag at Woods Hole Oceanographic Institution (WHOI) built five Autonomous Echo-Sounding buoys for the FRAM-2014/15 expedition. The first such deployment ever. Set out at distances of up to 6 km from the main camp they 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.



Overall, the deployment was very disappointing. By the end of the drift all the batteries were dead, three buoys had disappeared, and the depths reported were not consistent with the IBCAO grid of Arctic bathymetry..

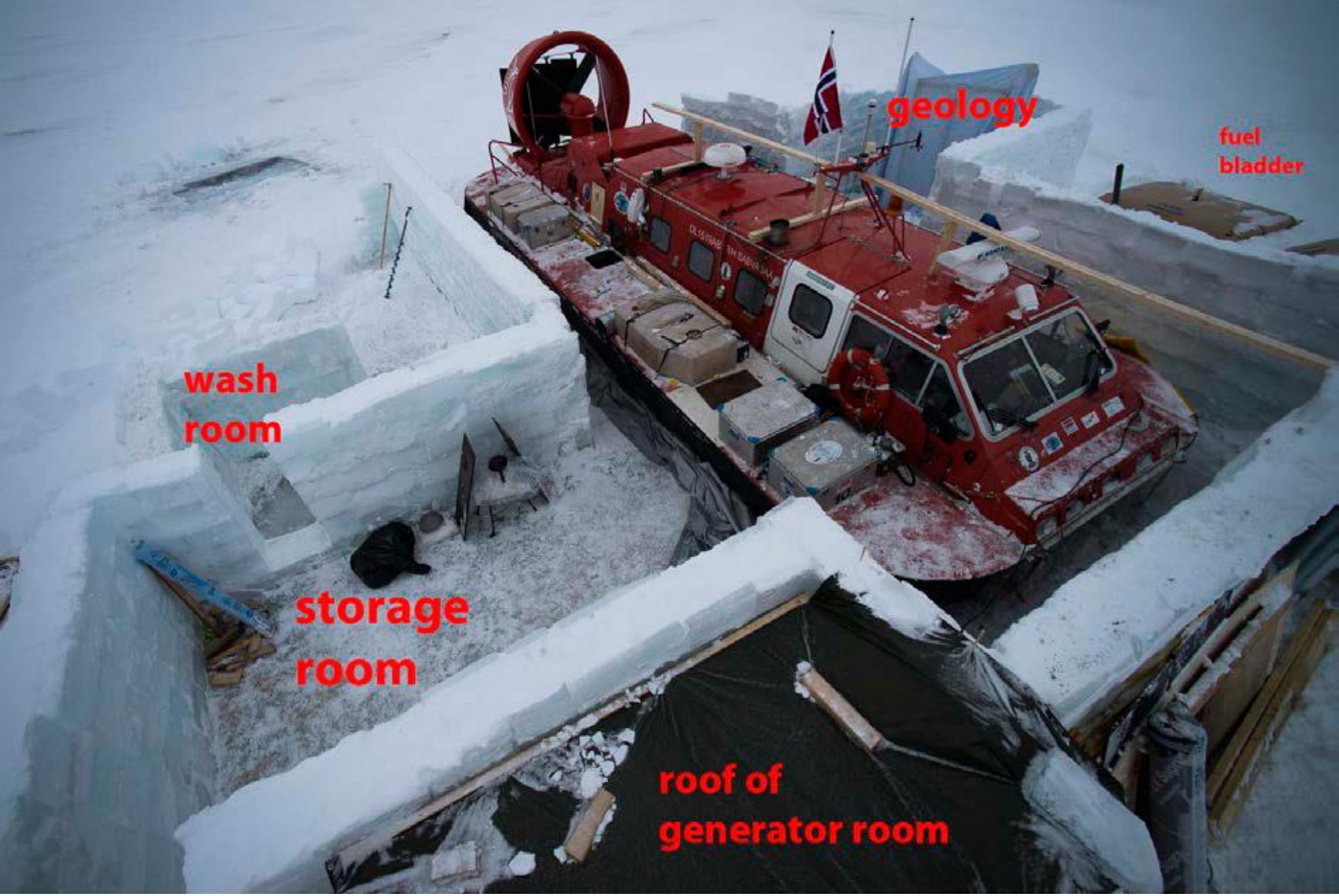
On Nov 4th, WHOI's Lee Freitag e-mailed: 'It appears as though there was an event on Oct 25th and that the floe or set of floes that the buoys are on broke up. Buoy 5 moved relative to the others, and Buoy 2 may have fallen in or been covered by ice.

These events coincided with the breakup of the camp area.

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 he pulled along the seafloor as the ice drifted. LED lights provided excellent illumination.



Layout of the hanger before a fabric cover was put over the whole structure

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

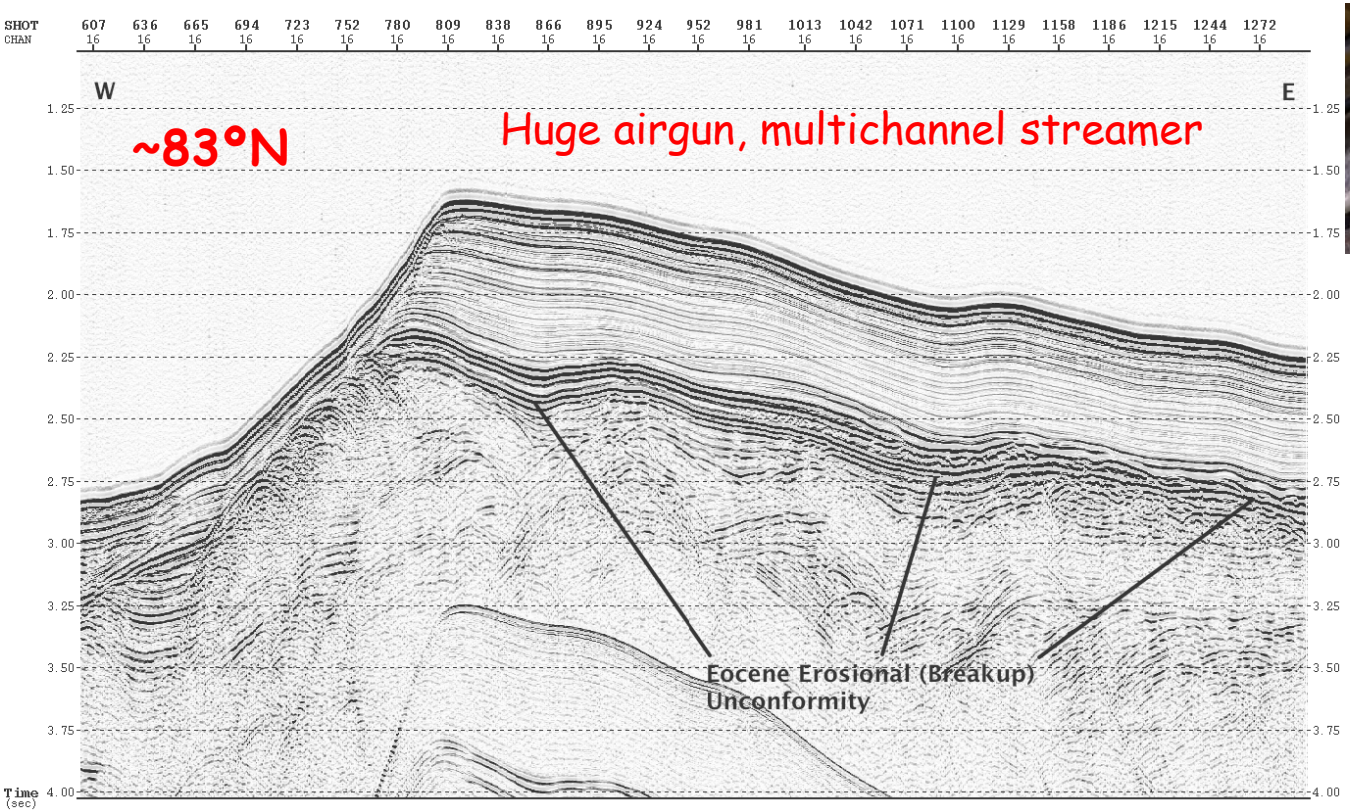
The heavy snowfall with high winds added additional weight to the floe and buried all the equipment and supplies.


The seawater around
the hydro-hole rose up
to 50 cm above the ice.


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.

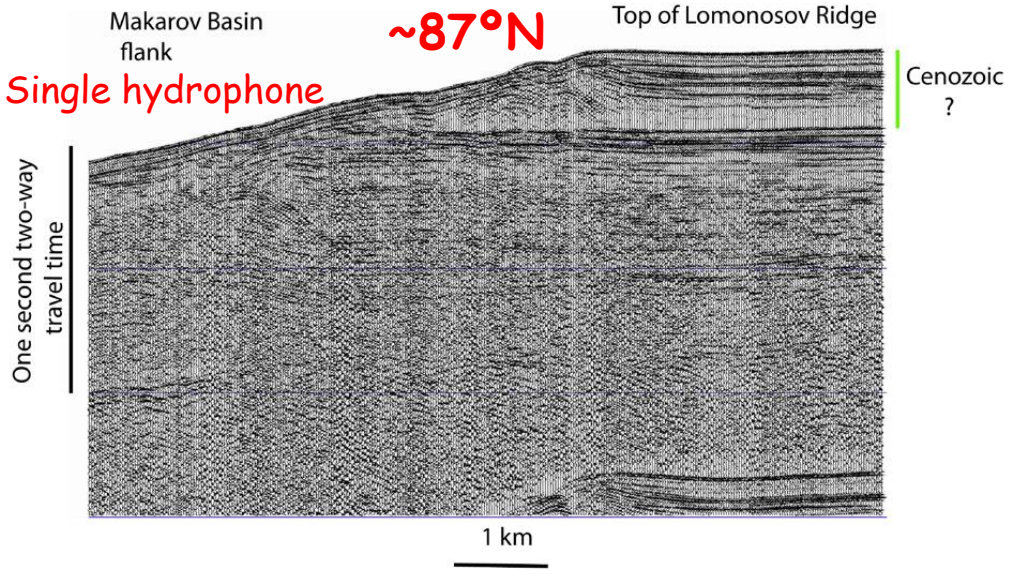
SABVABAA has four Iridium satellite telephones for e-mail and data links.

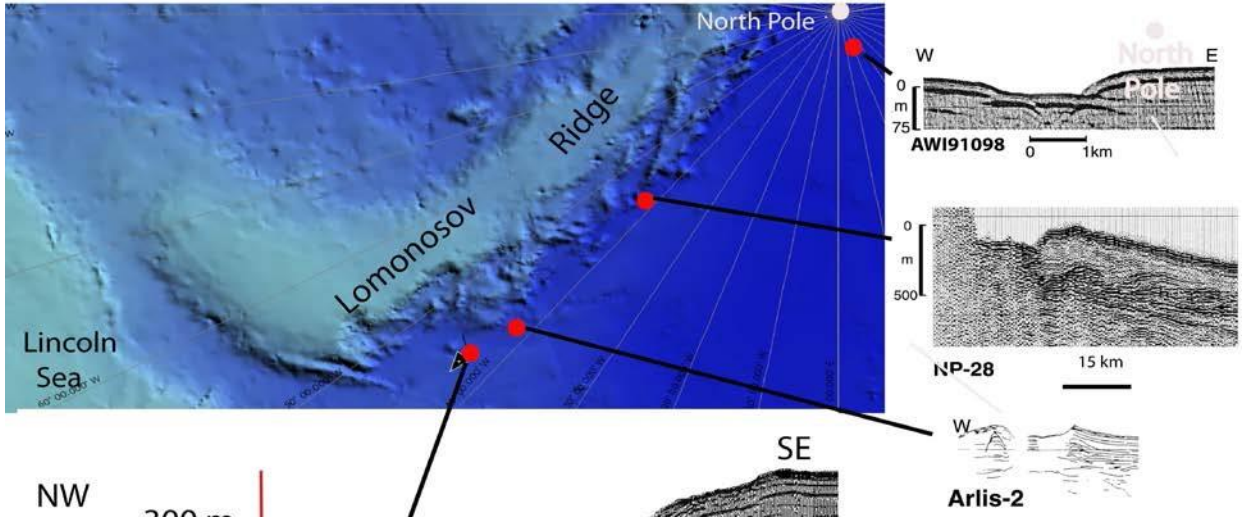


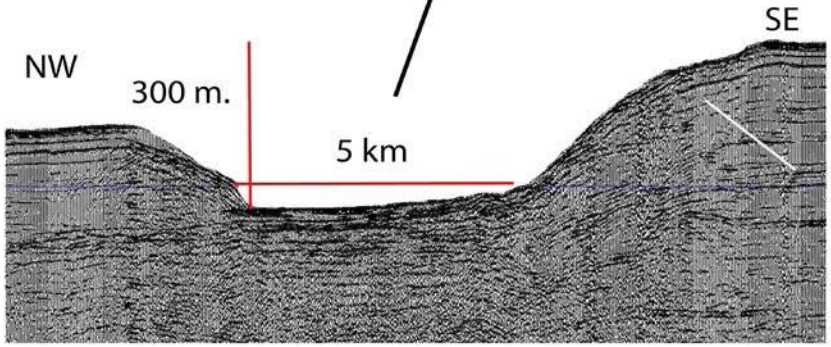
Seismics: The airgun above was fired every 25 m over a distance of 1000 km (40,000 shots).

Left: Comparison of Polarstern profile over the Lomonosov Ridge with multichannel streamer vs the small airgun and a single hydrophone.

The digital data are now being harmonized in Norway at Bergen and Lundin.



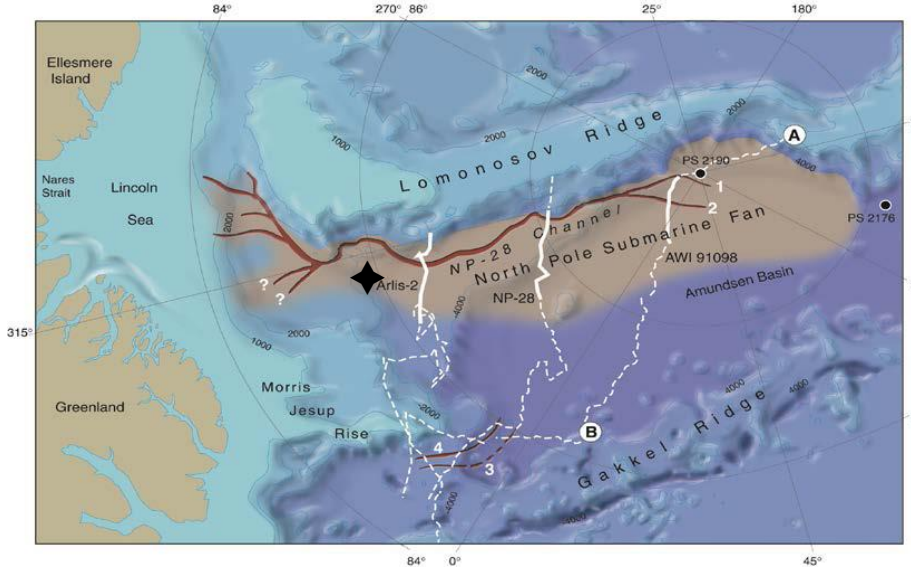


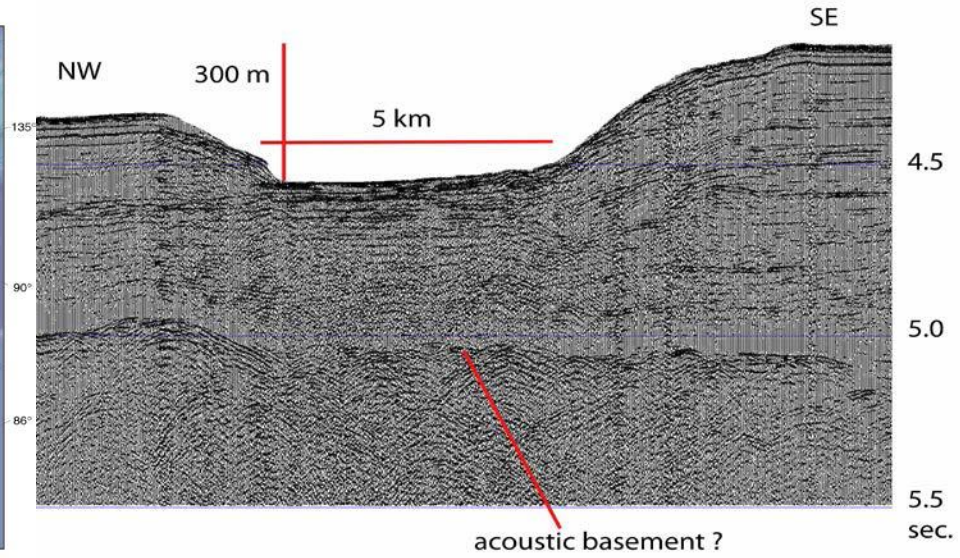


FRAM-2014/15

The seismic data revealed another 5 km wide submarine channel feeding into the NP-28 Channel System.

In addition the crossing of the Morris Jessup Rise cast new light on the provenance of this feature.






Winch system for
coring, CTDs, GoPro
bottom camera etc.


Capstan with Meter
All Hydraulics

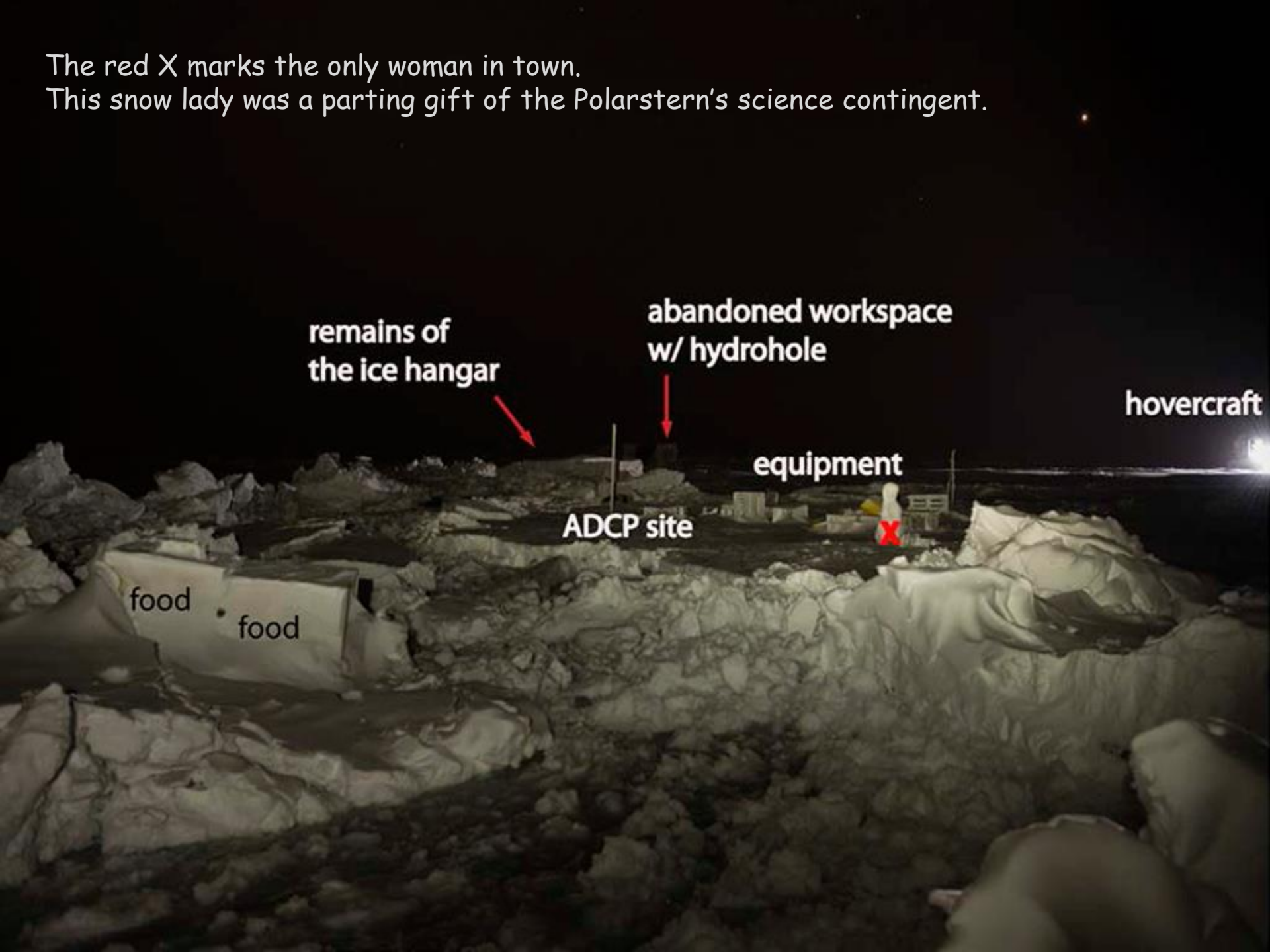

3/8" kevlar aramid rope,
2 ton breaking strength


Ice
Chisel
Hydro-
Hole

The camp was in the polar winter for about 5 months. Moonlight allowed some visibility but generally everything was done with headlamps.

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

The red X marks the only woman in town.
This snow lady was a parting gift of the Polarstern's science contingent.



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

The ice dynamics caught a number of the 1 m^3 (1000 liter) fuel bladders in the crushed ice.
Fuel was moved by pumping between bladders.

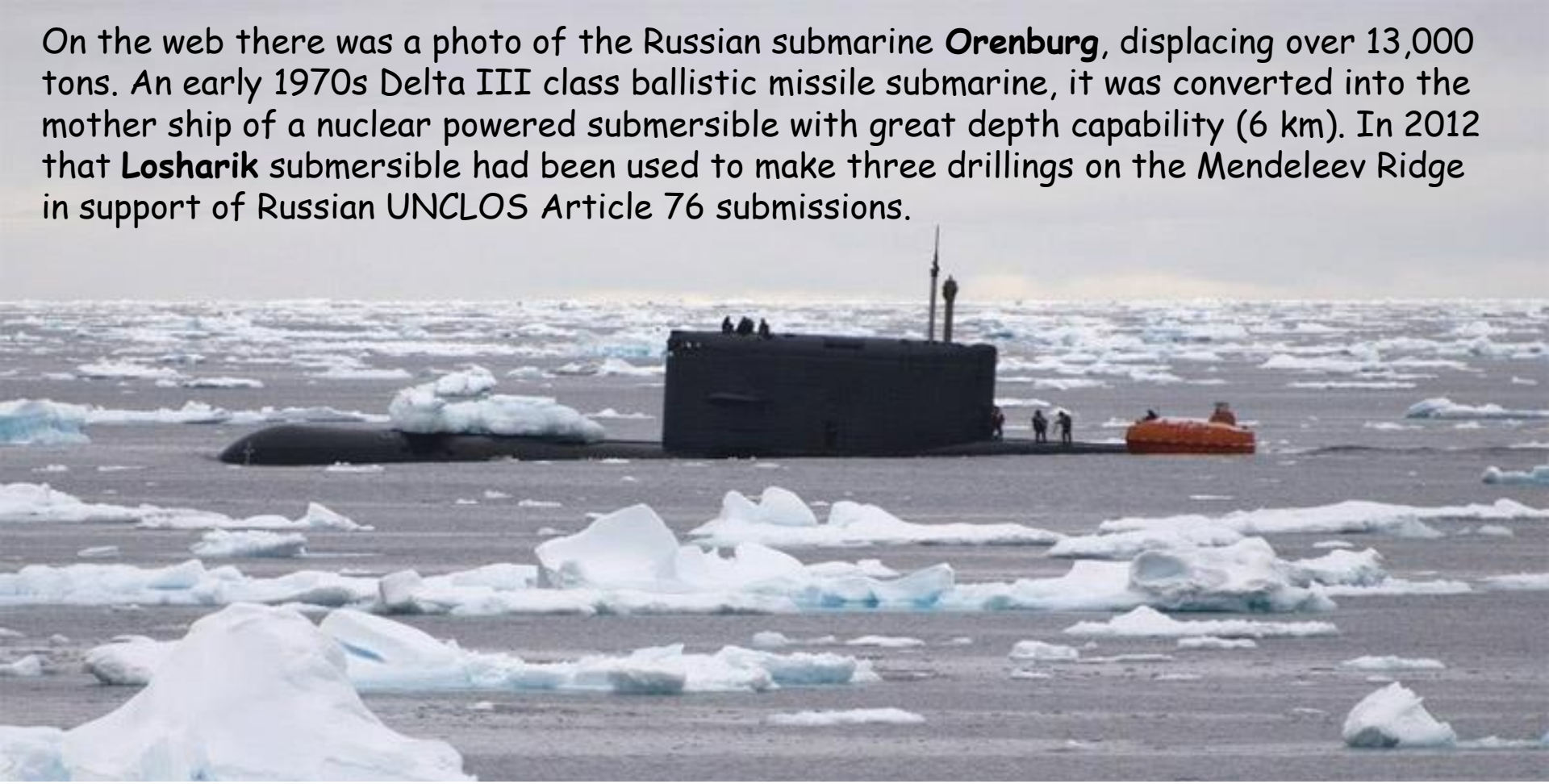
Putting the 100 ft hose into the bladder. Note the bare hands!

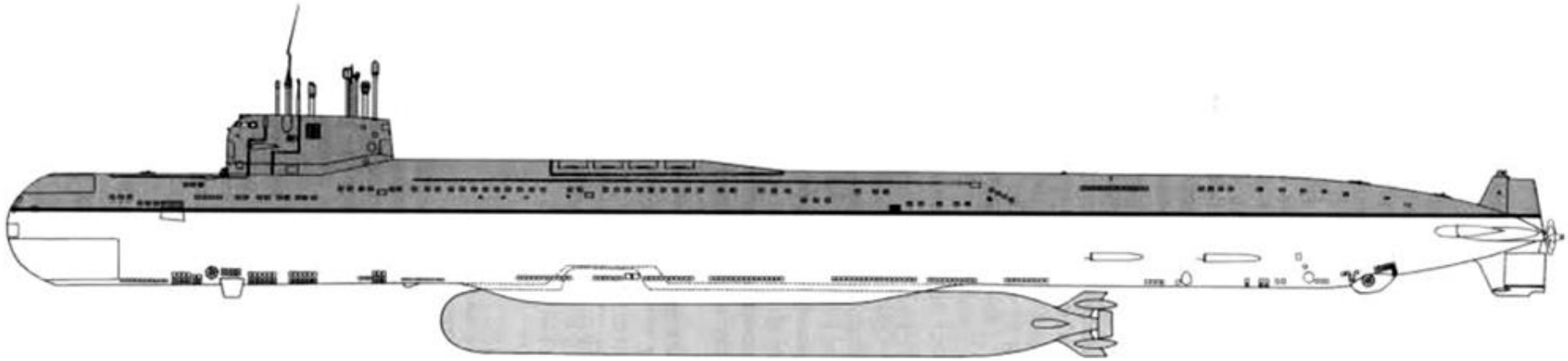
Things that go bump in the night

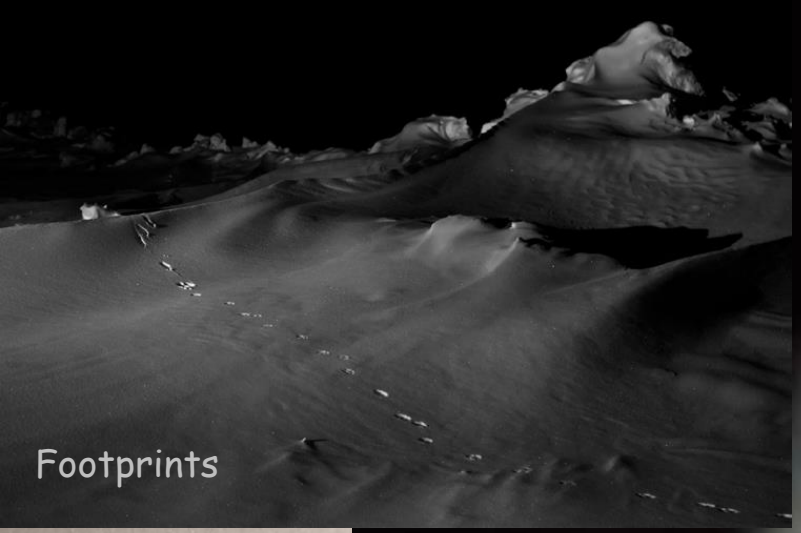
On the evening of 16 October a light was seen. It was on for some 4 hours. The crew walked out some 3 km to see what it was.

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.

On the web there was a photo of the Russian submarine **Orenburg**, displacing over 13,000 tons. An early 1970s Delta III class ballistic missile submarine, it was converted into the mother ship of a nuclear powered submersible with great depth capability (6 km). In 2012 that **Losharik** submersible had been used to make three drillings on the Mendeleev Ridge in support of Russian UNCLOS Article 76 submissions.

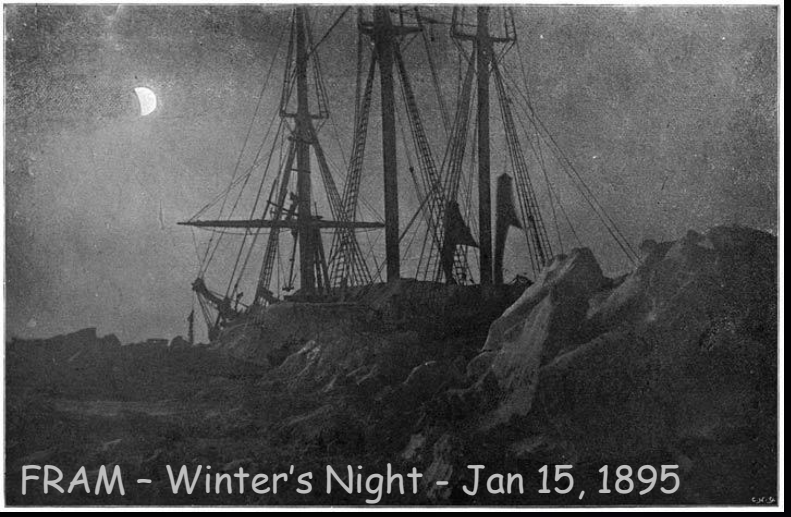






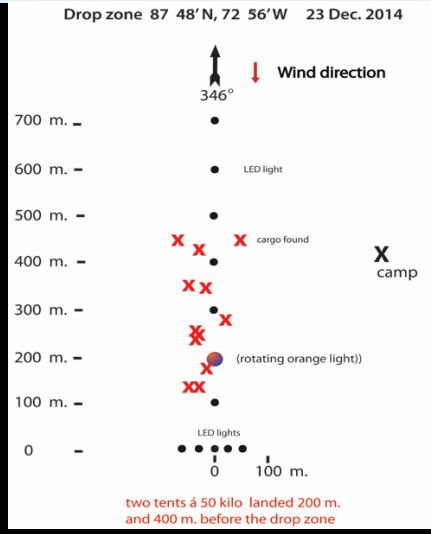
Footprints

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

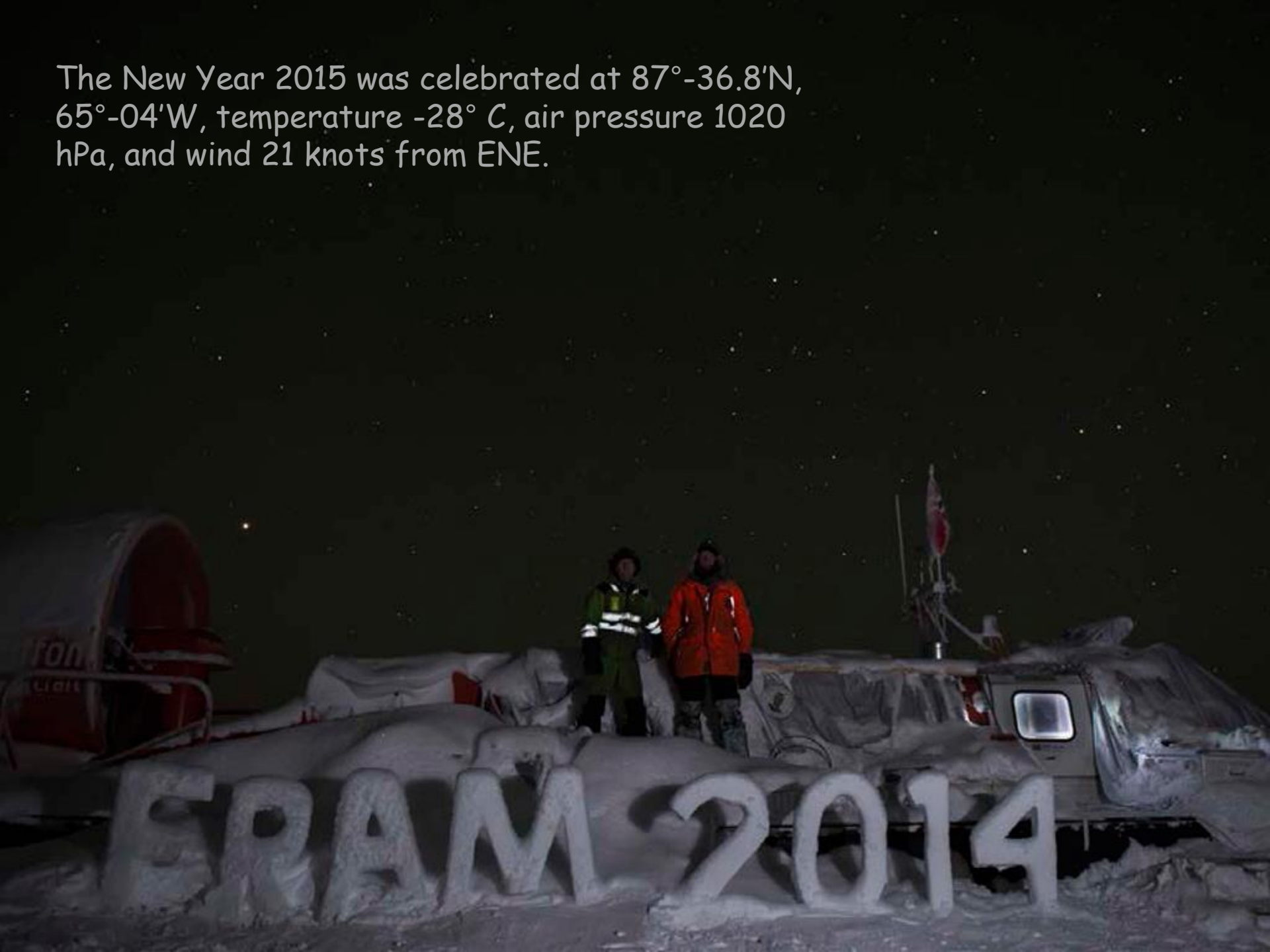

FRAM – Winter's Night - Jan 15, 1895

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

Man-hauling boxes from the rubble ice field drop zone.



CHRISTMAS Airdrop from the 333rd Squadron at 1040 GMT 23 December. A much-needed drop of a supposedly cold-proof tent, stoves, and supplies. A seven hour flight for a four engine aircraft. Temperature -34°C.



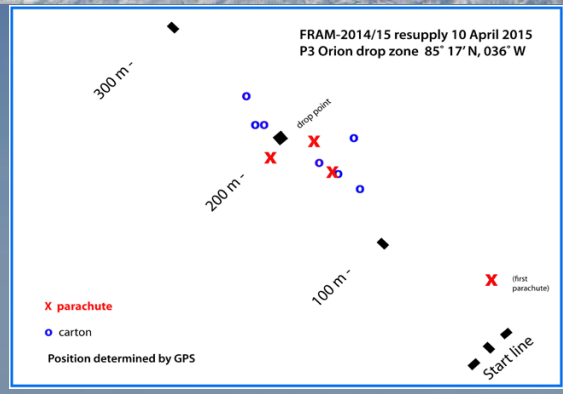
The New Year 2015 was celebrated at 87°-36.8'N, 65°-04'W, temperature -28° C, air pressure 1020 hPa, and wind 21 knots from ENE.

After 1st March there was again daylight for operations outside

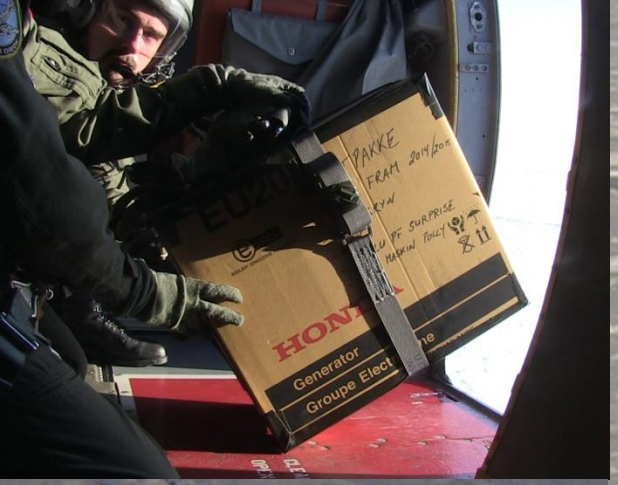
Seabird CTD

As fuel and electrical power became limited, a program of making CTDs every 5 nm was initiated. These lowerings were important additions to a recent paper on layer mixing north of Greenland.

By April 10 the lack of generators and engine problems had reduced the power to one battery for GPS, Iridium, and UHF radio. The 333rd Squadron again made an air drop of generators, spares, and other supplies. This provided the first idea of the camp area.



One high-speed pass and the Orion P3C is on its way back to the island of Andøya the northernmost island in the Vesterålen archipelago, situated about 300 km inside the Arctic circle.



Drop Zone

Camp

Color and FLIR Infrared Imagery from P3C Orion

MARITIME AIR SUPPORT CENTER
MASC
333 SQUADRON

POC
333 SQD
MASC / Etterretning

One of the FLIR color and infrared images taken by the aircraft during the air-drop. GPS navigation, satellite communications, and advanced reconnaissance imagery has removed much of the isolation experienced on the ice stations some 50 years ago.

Unlike this mother polar bear and her three cubs, observed from the Polarstern in 2014, there was little contact with bears during FRAM 2014/15. Footprints of a bear with one or two cubs were seen near the camp October 10. Then, 42 weeks later, a scruffy bear visited the camp June 15, and one or two bears investigated the food stores on June 23. The beginning of July (Week 44) saw visits for seven days running, with one young bear being quite aggressive.

During the previous 6 years the hovercraft had been somewhat of a bear magnet.

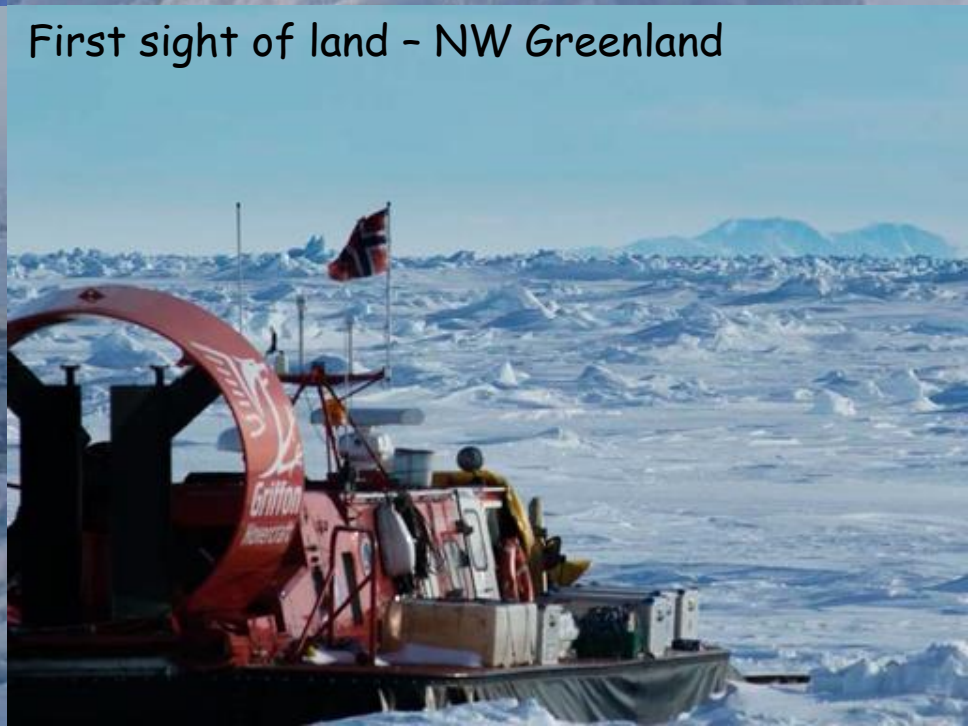
Week 29 saw a second cycle of ice dynamics. Hovercraft engine problems, stiff skirts, and a burnt out electrical winch required heroic efforts to remove the hovercraft from its trench before the parking place was subducted under neighboring ice. That was the craft's brush with disaster.

Ice dynamics at work

Everything moved to a relatively stable area

Leads opened up quite quickly

First sight of land – NW Greenland




10 April 2015
A planned visit by aircraft in the spring was abandoned when the April air-drop showed no suitable landing areas.


23 July 2015


09 August 2015

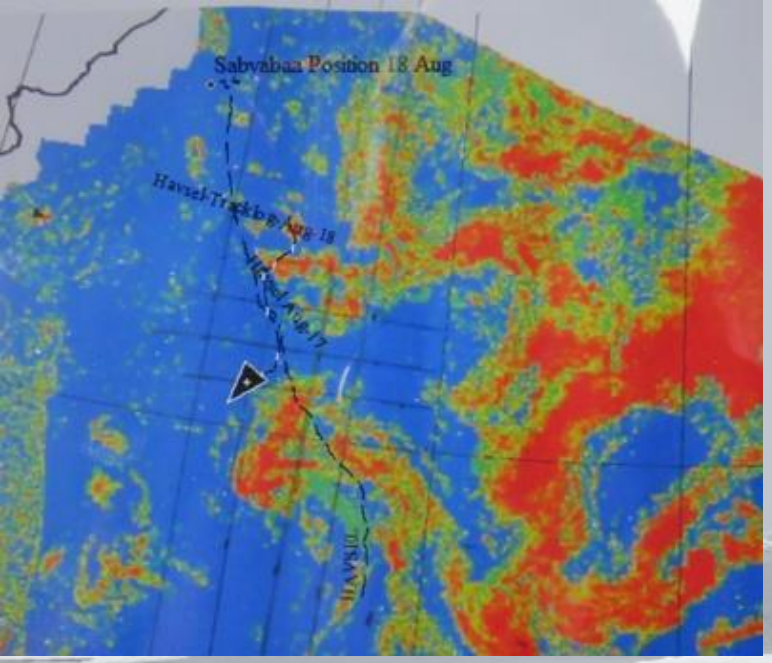

18 August 2015

Audun departs 6 July after 11 months at sea, returning to Tromsø on 18 July with the Polarstern


The pickup – 7:20AM 18 August 2015
81°-11.7'N 10°-17.1'W in the Fram Strait
27 km off NE Greenland

Mission *Almost* Accomplished

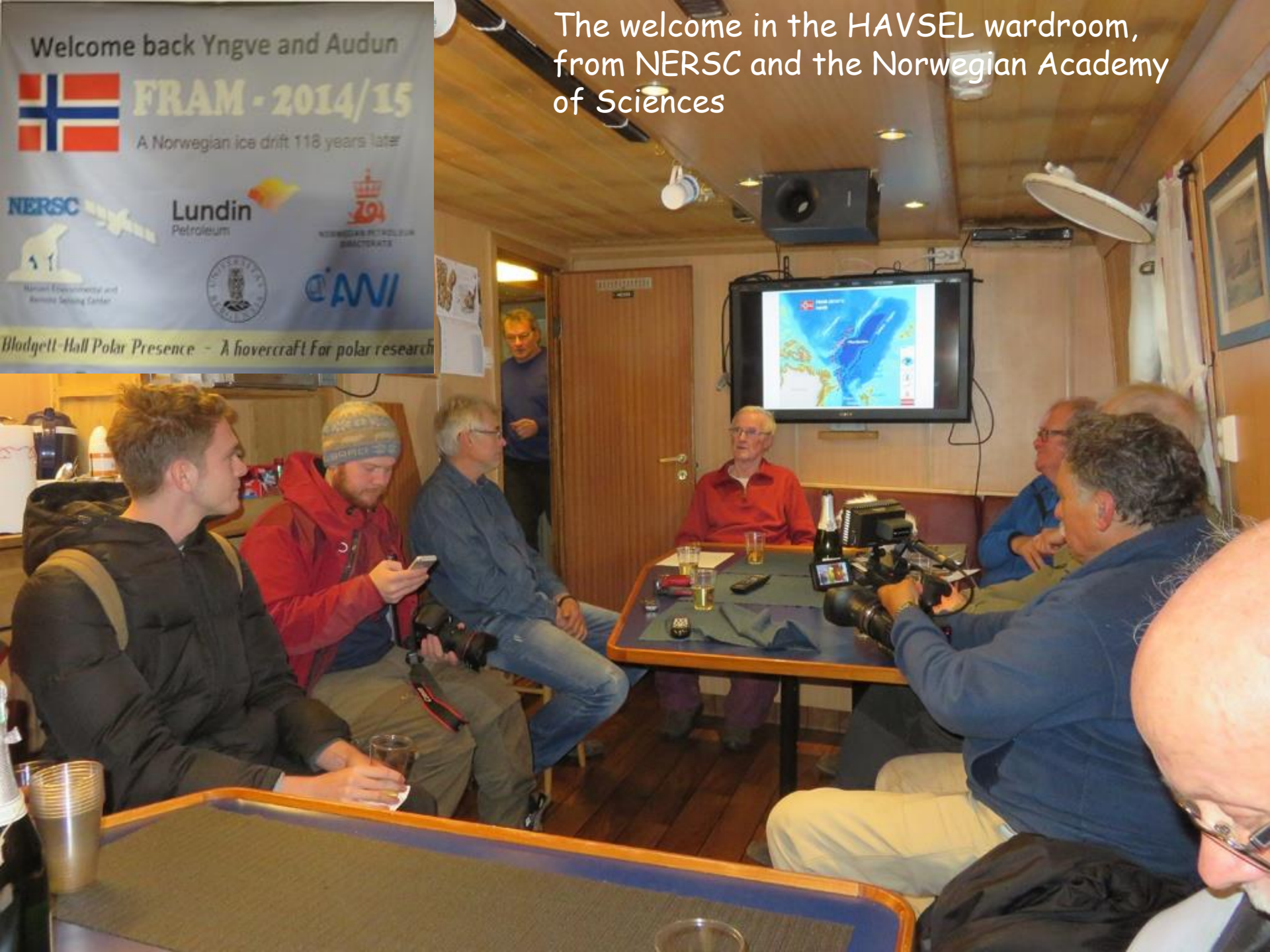
M/V HAVSEL – the last operating sealer in the world



19 August – Navigating the ice fields on the way to Svalbard; SABVABAA's most efficient speed is 25 kts versus HAVSEL's 9.8 kt.

Shortly afterward, while waiting on an ice floe for the HAVSEL to catch up, a strut on the fiberglass propulsion fan shroud broke. This caused one of the propeller blades to break off, and damage to the shroud. The hovercraft then was towed while the lift fan raised it above the water. Luckily the sea was flat all across the Atlantic Ocean.

18:00 LMT 22 August 2015, Longyearbyen, Svalbard.
Home is the sailor, home from the sea



The welcome in the HAVSEL wardroom, from NERSC and the Norwegian Academy of Sciences

Der Tagesspiegel (Berlin) 14 Feb 2015

12 DER TAGESSPIEGEL WISSENSCHAFT AM WOCHENENDE

Nacht am Pol

Von Karl Urban

Nicht nur die Finsternis macht den Forschern zu schaffen

Seit Ende August driften zwei norwegische Forscher auf einer Eisscholle nahe dem Nordpol. Ihre Expedition ist gefährlich – aber viele halten sie trotzdem für notwendig

Expedition 2014/15
Die Route der Sabvabaa

Forschungs-Luftkissenboot Sabvabaa

Die Geräte der Arktisdrifter

Plötzlich bricht ein U-Boot durch das Eis. Und verschwindet

A Norwegian ice drift 118 years later

Weekly Reports

Welcome to the Geonova Diary of the Norwegian scientists Yngve Kristoffersen and Audun Tholfsen who lived and worked on their ice drift station including the hovercraft "Sabvabaa". From August 2014, the team was drifting for 353 days over a distance of 2.200 km along the submarine Lomonosov Ridge.

FRAM-2014/15 reports from the Arctic

Leave a comment!

week 1 | week 2 | week 3 | week 4 | week 5 | week 6 | week 7 | week 8 | week 9 | week 10 | week 11 | week 12 | week 13 | week 14 | week 15 | week 16 | week 17 | Summary 2014 | week 18 | week 19 | week 20 | week 21 | week 22 | week 23 & 24 | week 25 | week 26 | week 27 | week 28 | The Lomonosov Ridge | weeks 29 & 30 | weeks 31 & 32 | week 33 | week 34 | week 35 | week 36 | week 37 | week 38 | week 39 | week 40 | week 41 | week 42 | week 43 | week 44 and 45 | week 46 | week 47 & 48 | week 49 | week 50 | summary

SABVABAA has 4 Iridium satellite phones for almost instantaneous communication with all the world. Weekly reports were sent out via E-Mail to hundreds of followers. In all, the reports take up 780 pages, including 311 photos suitable for reproduction.

www.geonova.no (above) has the full archive and was followed by 800 people during the drift.

Thank you for your attention

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