

Mapping with IBRV ARAON in the Arctic and Antarctic waters

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Abstract

The icebreaker ARAON that is the first Korean research icebreaker and was introduced to the world in Nov. 2009, initiated its first Antarctic cruise on Jan. 12, 2010 after departing from Incheon Port on Dec. 18, 2009. The major missions of ARAON are multidisciplinary scientific research and logistics to the stations in the polar regions. It is equipped with various high-tech scientific devices including Multibeam echo sounder aside from a work boat and helicopter.

ARAON conducted research mainly in the sea-ice area of Ross Sea, Amundsen Sea and at the mid-oceanic ridge. During researches, bathymetric mappings were conducted as well. The total survey area is reached 6,500,000 km².

Following its first cruise to the Antarctic, ARAON took many important missions in the Arctic from 2010 to 2015. Meanwhile, it collected bathymetric data from the sea floor of Chukchi Sea and Beaufort Sea. The data cover about 1,230,000 km².

Icebreaker Research Vessel ARAON



Figure 1. Image of the IBRV ARAON

- Build Period : 2004~2009 (6 yrs)
- Budget : 100 mil USD
- Purpose
 - To execute multidisciplinary research survey in the both polar regions
 - Logistics support for the Antarctic station
- Tonnage : 7,500 GRT
- Manning : 85 persons (25+60)
- Speed : 12 knot (16 knot max.)
- Endurance : 20,000 nm (70 days)
- Classification : KR (=DnV) PL 10
(1 m depth icebreaking in 3 knot)
- Propulsion : Azimuth Thruster
 - Diesel electric plant : 10 MW (5 MW x 2)

Equipment of ARAON

Classification	Equipment
Oceanography	CTD w/Water Sampler, X-BT, Thermo Salinograph, Autosal Salinometer, Wave Meter, ADCP(Hull-mounted & Lowered)
Geophysics	Multi-channel Seismic System, MultiBeam Echo Sounder (EM122), Sub Bottom Profiler, Marine Gravity Meter, Marine Magnetometer, Attitude & Positioning System
Marine Biology	Scientific Fish Finder, MOCNESS, RMT, CPR, Bongo Net, Omni-directional Scanning Sonar
Marine Geology	Long Core System, Gravity corer, Multiple Corer, Box Corer, ITRAX Core Scanner
Chemistry	Sea Water Analyzer, Secondary Evaporation System, pCO2 Meter, Clean Bench, GC/MS, High Speed Centrifuge
Atmosphere	LIDAR, Weather Station, Aerosol Mass Spectrometer, Satellite Receiver, U/V Spectrometer
Support	Deep Sea, Electro Optic, and Coaxial Winchs
ETC	DP2, Helicopter and ROV support

Multibeam (EM122)

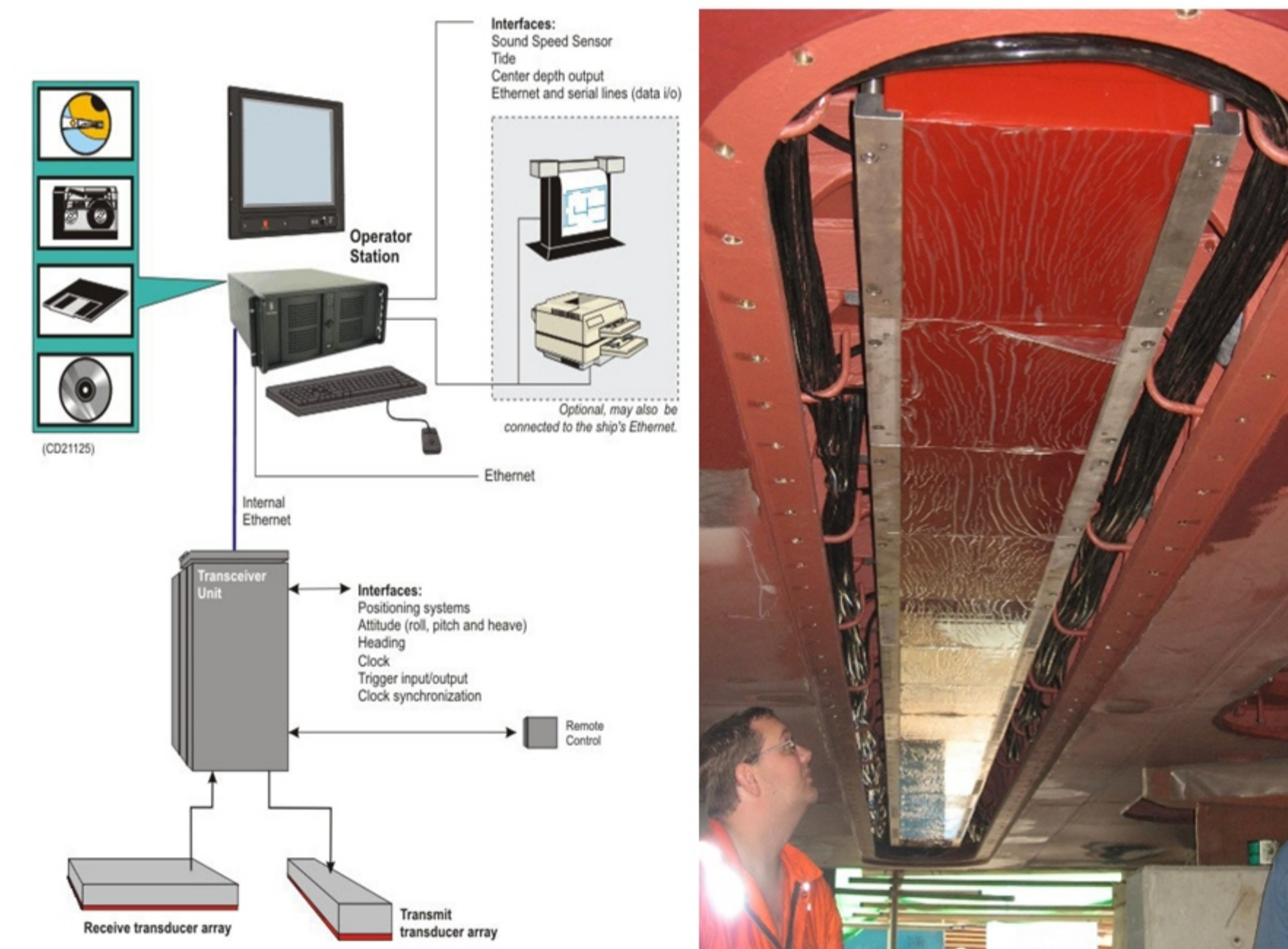


Table 1. Technical specifications of EM122.

Operating frequency	12 kHz	
Depth range	20 – 11000 m	
Swath width	6 × Depth, to approx 30 km	
Pulse forms	CW and FM chirp	
No. of beams	288	
Swath profiles per ping	1 or 2	
Motion compensation	Yaw	± 10 degrees
	Pitch	± 10 degrees
	Roll	± 15 degrees
Sounding pattern	equi-distant on bottom/equiangular	
Depth resolution of soundings	1 cm	
High resolution mode	High Density processing	
Sidelobe suppression	- 25 dB	
Modular design, beamwidth	0.5 to 4 degrees	

The Antarctic

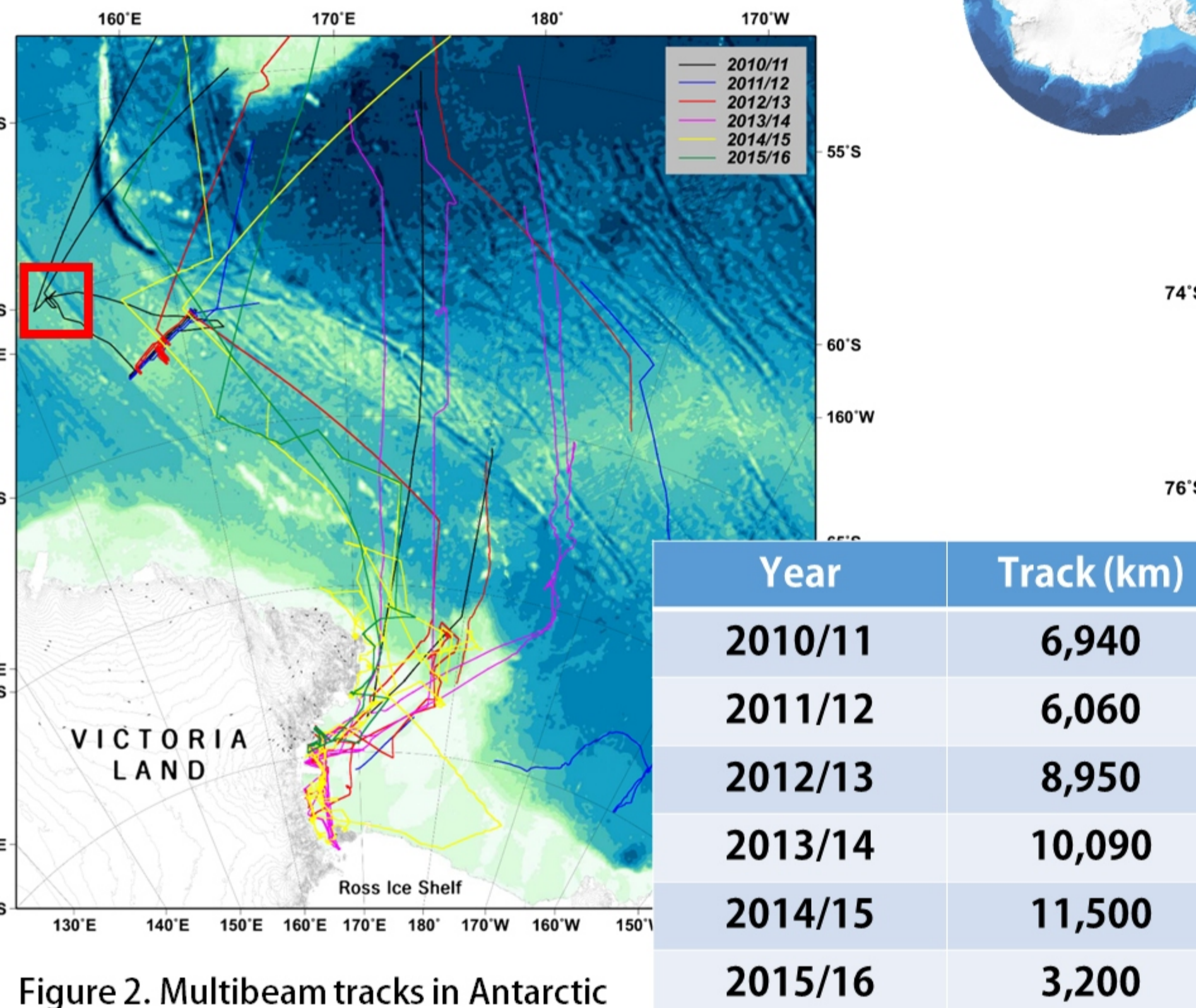


Figure 2. Multibeam tracks in Antarctic Ocean (2011-2014)

Total Area : 6,500,000 km²

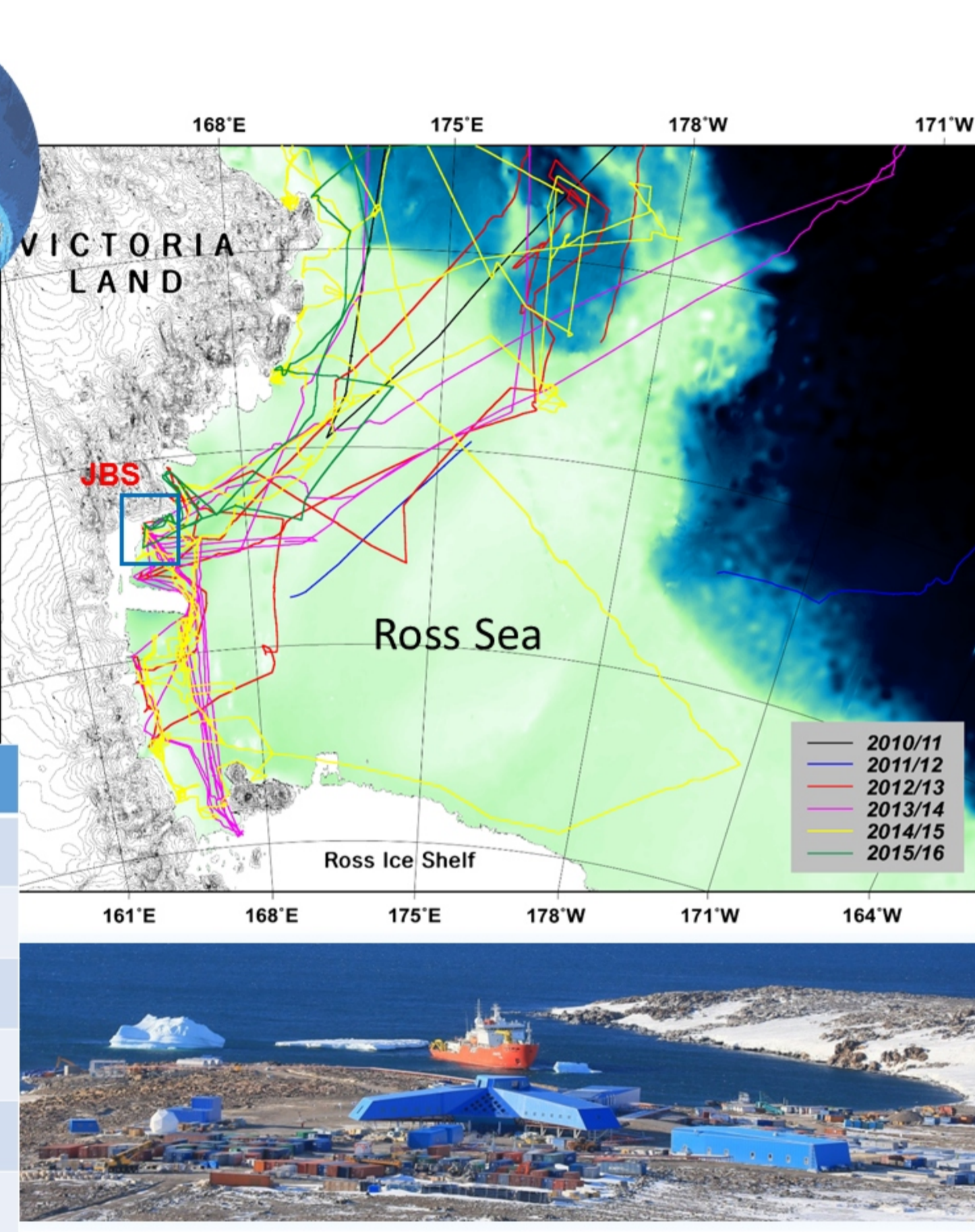


Figure 3. Multibeam tracks in the Ross Sea area(up) and Jang Bogo Research Station which was established on Feb. 12, 2014 in Ross Sea.

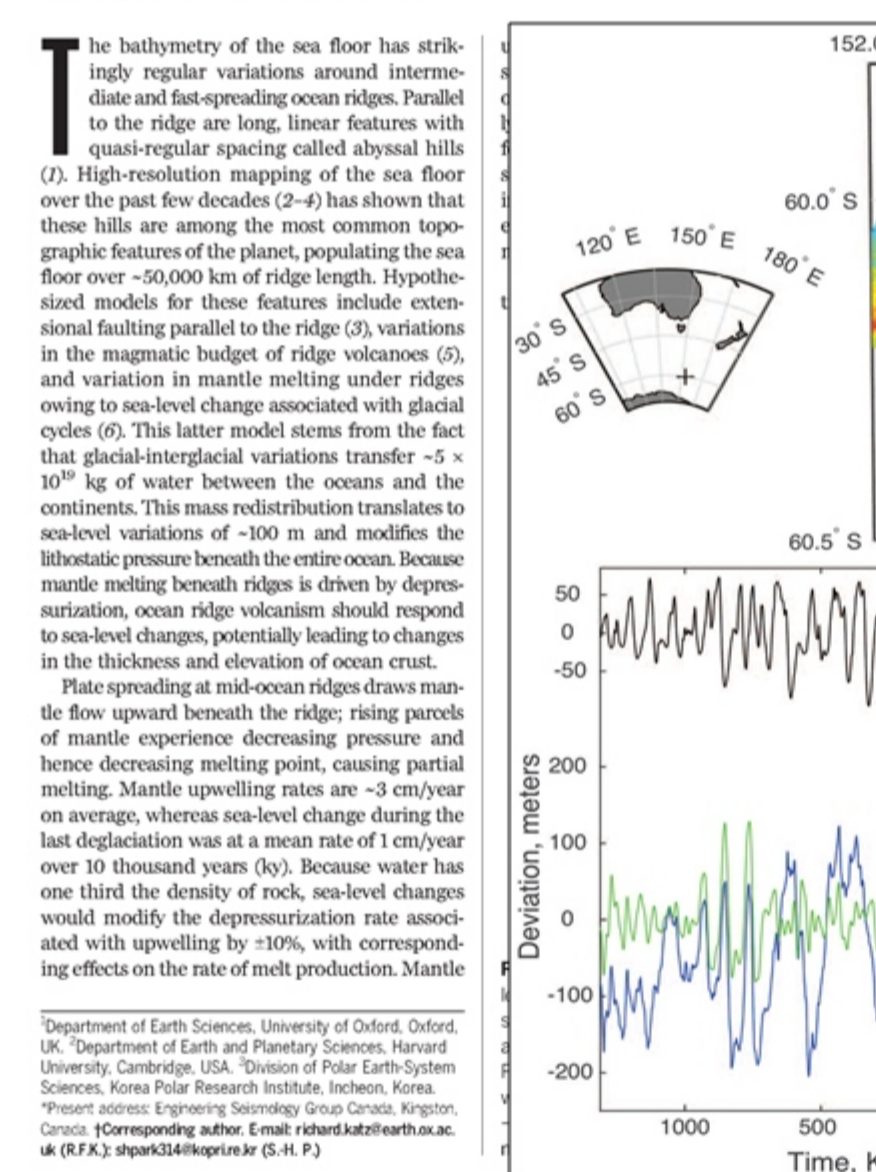
Research Highlight

OCEANOGRAPHY

Glacial cycles drive variations in the production of oceanic crust

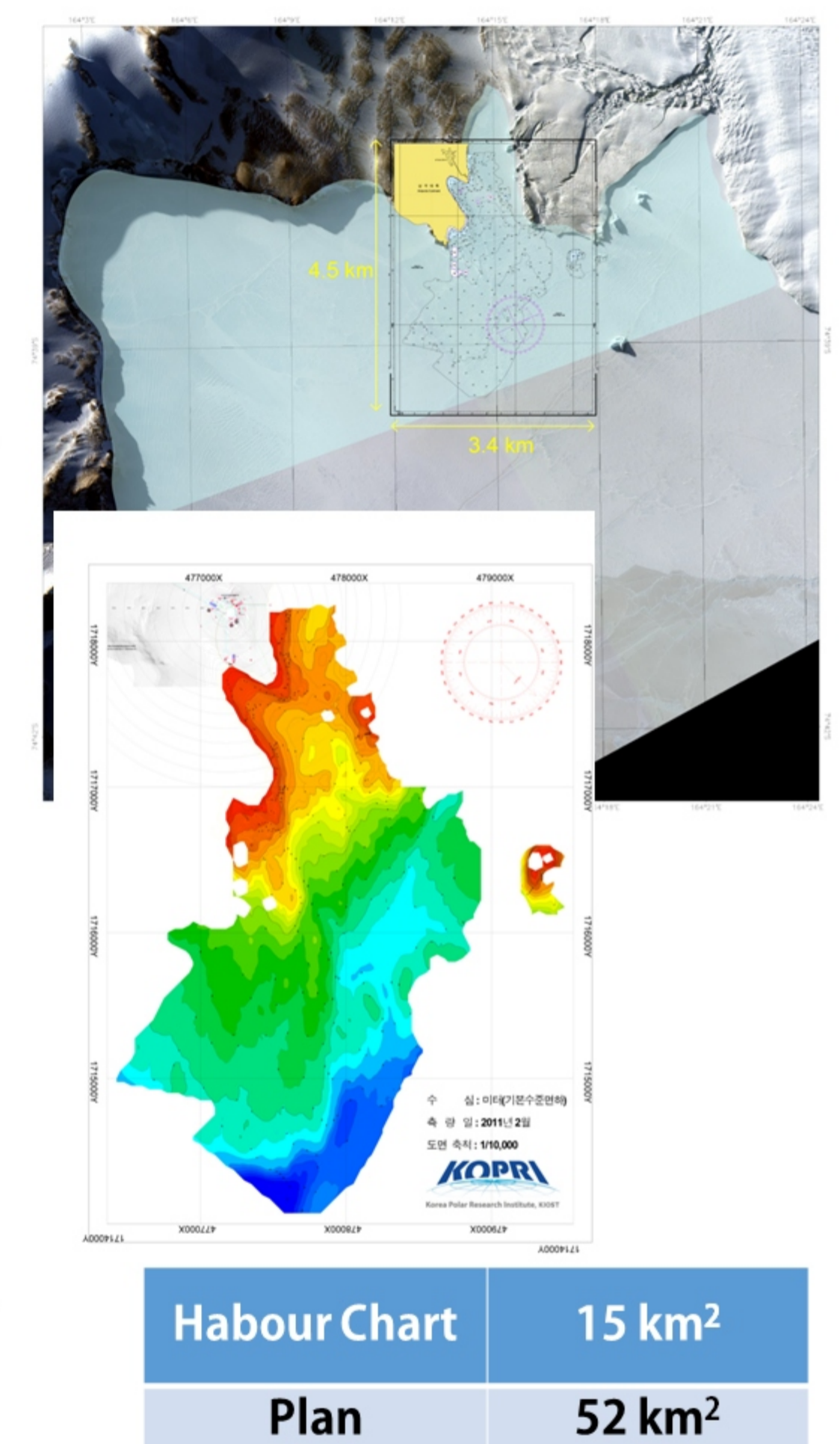
Julia W. Crowder^{1,2*}, Richard E. Katz^{1,2*}, Peter Hübner³, Charles H. Langmuir⁴, Roger Heine^{5,6,7}

Glacial cycles redistribute water between oceans and continents, causing pressure changes in the upper mantle, with consequences for the melting of Earth's interior. Using Mio-Pliocene sea-level variations as a forcing function, theoretical models of mid-ocean ridge dynamics that include melt transport predict temporal variations in crustal thickness of hundreds of meters. New bathymetry from the Australian-Antarctic ridge shows statistically significant spectral energy near the Milankovitch periods of 23, 41, and 100 thousand years, which is consistent with model predictions. These results suggest that alkyd hills, one of the most common bathymetric features on Earth, record the magmatic response to changes in sea level. The models and data support a link between glacial cycles at the surface and mantle melting at depth, recorded in the bathymetric fabric of the sea floor.



(Science, 2015)

Bathymetric and Nautical chart around the JBS (2016-2020)



The Arctic

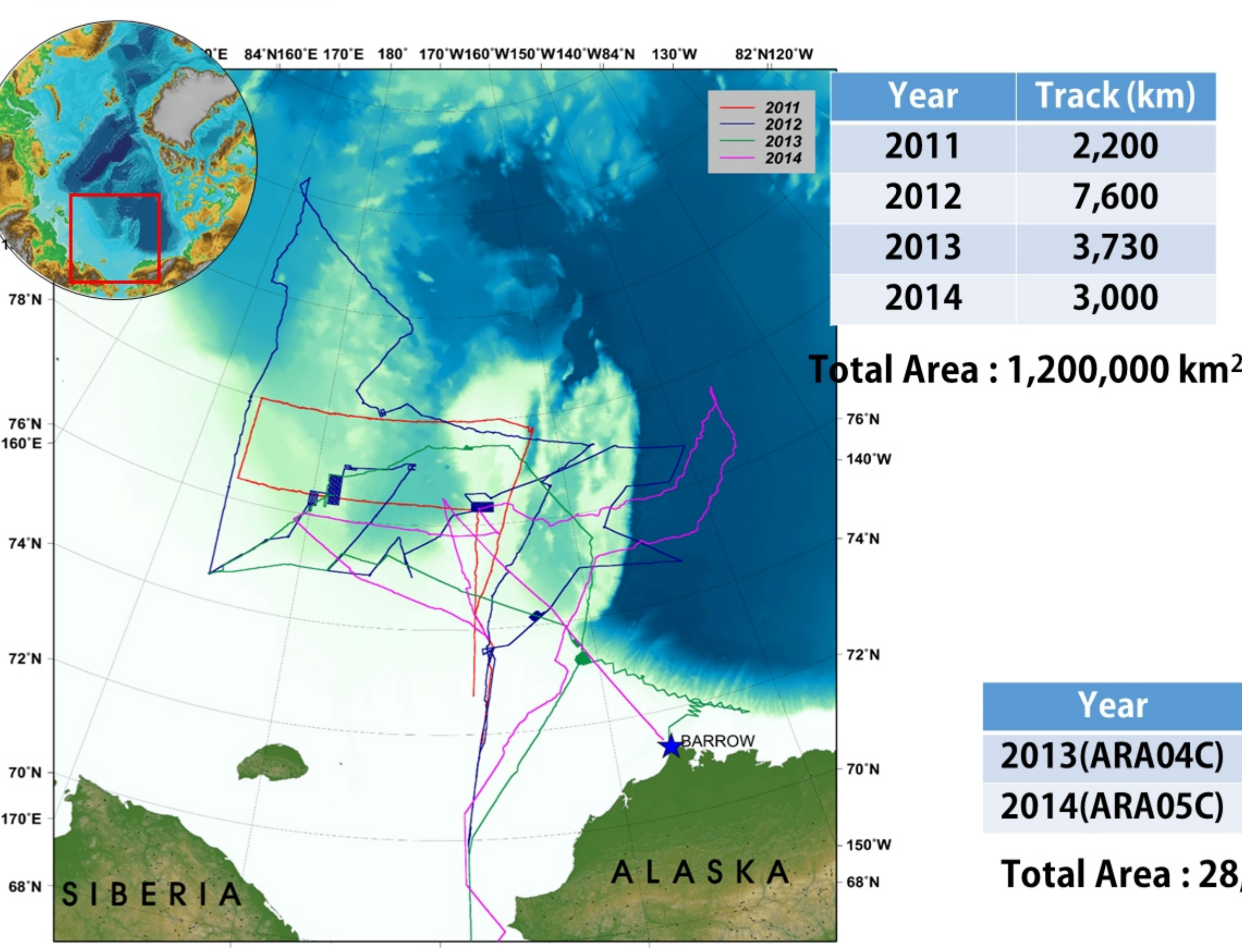
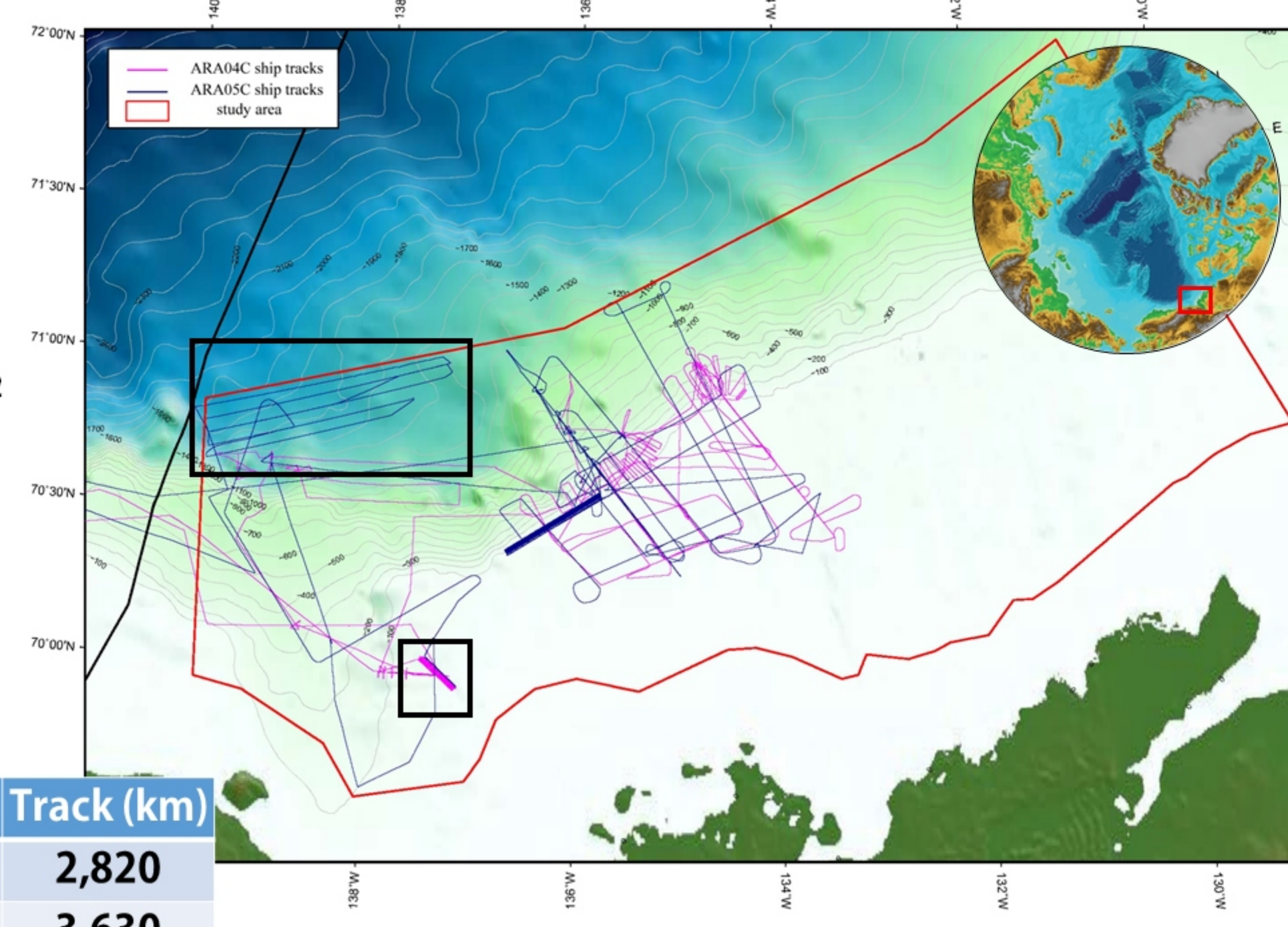


Figure 4. Multibeam tracks in Chukchi Sea (2011-2014)

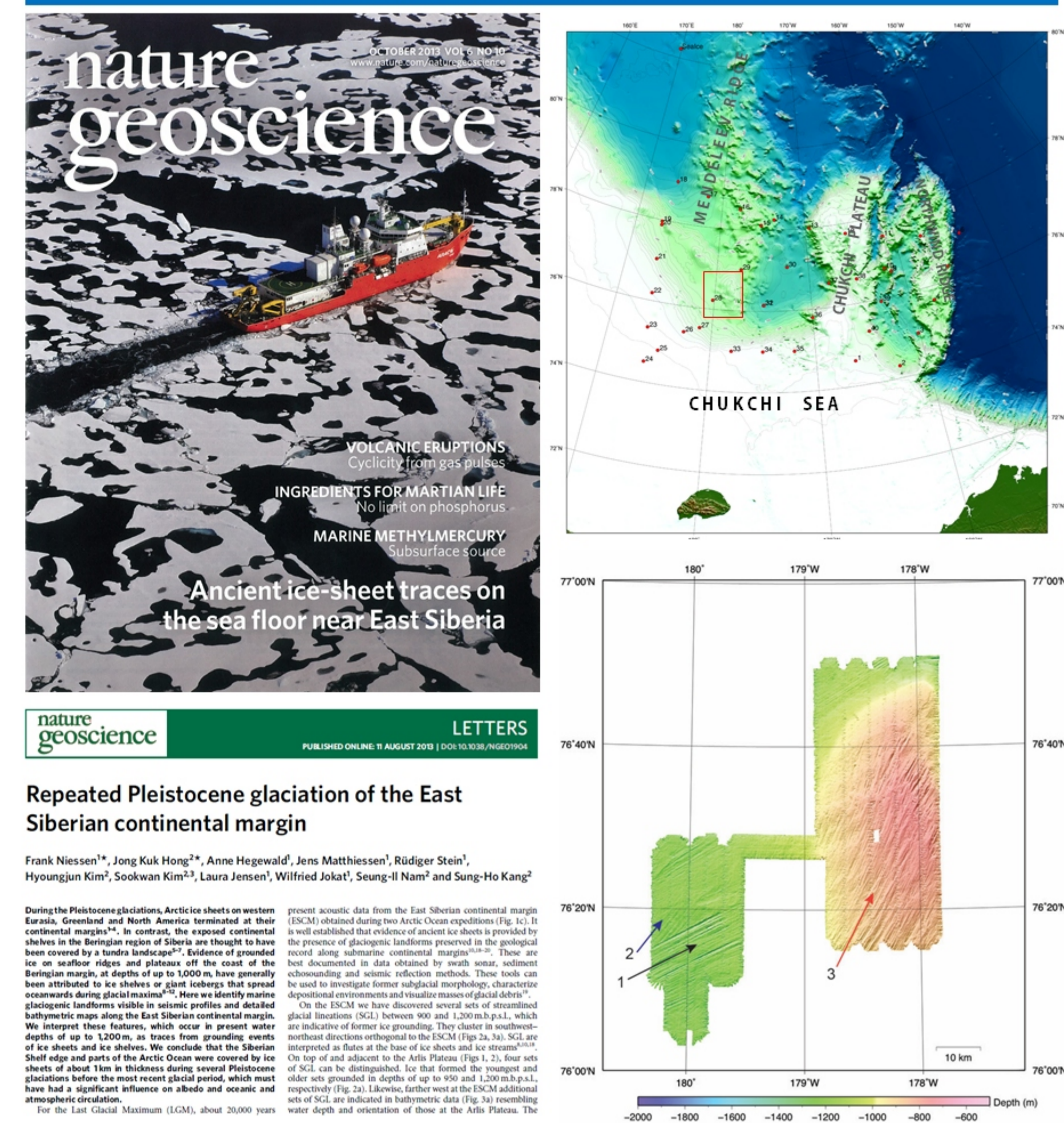
Total Area : 1,200,000 km²



Total Area : 28,290 km²

Figure 5. Multibeam tracks in Beaufort Sea (2013-2014)

Research Highlight



Repeated Pleistocene glaciation of the East Siberian continental margin

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During the Pleistocene glaciations, Arctic ice sheets on western Eurasia, Greenland and North America extended at their maximum extent. In contrast, the eastern continental shelf was covered by a smaller ice sheet. Evidence of glacial erosion on the eastern continental shelf is limited to a few scattered ice-rafted clasts. Here we report on a new ice-rafted clast (IRC) locality near the eastern continental shelf, which contains a well-preserved, multi-layered sequence of glacial till. The till is composed of fine-grained silt and clay, and contains abundant ice-rafted clasts. The clasts are composed of a variety of rock types, including quartzite, gneiss, and granite. The clasts are well-sorted and show evidence of glacial transport. The presence of these clasts indicates that the eastern continental shelf was covered by a large ice sheet during the Pleistocene. This finding provides new evidence for the extent of Pleistocene glaciation in the Arctic region.