

Lomonosov Ridge, Arctic Ocean: New Data for Definition of Targets for Scientific Drilling

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STATUS OF ODP PROPOSAL 533

ODP proposal 533-Full backed by a proponent group of 10 scientists from 7 countries (NAD Regional Working Group on Lomonosov Ridge) has gone through the complete ODP review and received strong support. ODP SCICOM has ranked 533-Full as its highest priority un-drilled proposal.

The primary objective of the proposed drilling leg is to collect a unique paleoclimate record, spanning most of the Cenozoic, from the pelagic muds that drape the ridge top above an unconformity. Drilling below this basal unconformity would sample a Mesozoic passive margin and provide constraints on the development of the Amerasian basin. Existing seismic reflection lines across Lomonosov Ridge were collected by Polarstern in 1991 and 1998 and Oden in 1996, and during SCICEX in 1999.

However, all sites were based on single seismic lines. At the Site Survey Panel meeting in February 2000, the consensus was:

Significant data in support of this drilling proposal have been deposited at the Data Bank. A significant amount of critical data is also known to exist and should be deposited in the near future. However, seismic reflection cross lines for the proposed drill sites have not yet been collected. We encourage the proponents to explore means to collect these important data.

PROCESSING

The data was processed as a crooked line geometry and CDP points were collected in 25 meter bins. The preliminary processing sequence includes, true amplitude recovery, sorting, stacking, deconvolution, tracemixing, bandpassfiltering, muting and display. Lines 3 and 5 represents crosslines to the original line AWI 91091 at the location of the proposed sites.

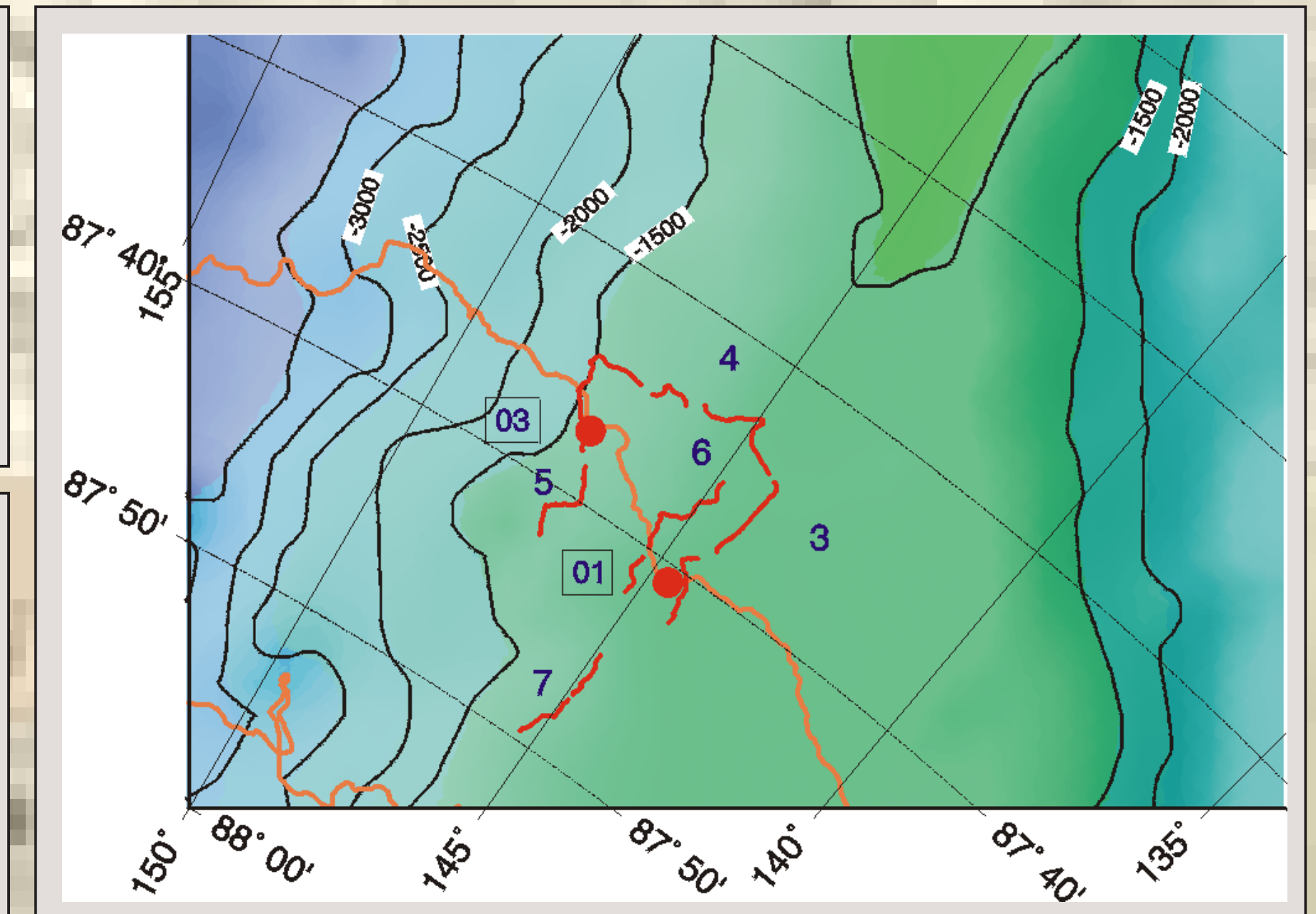
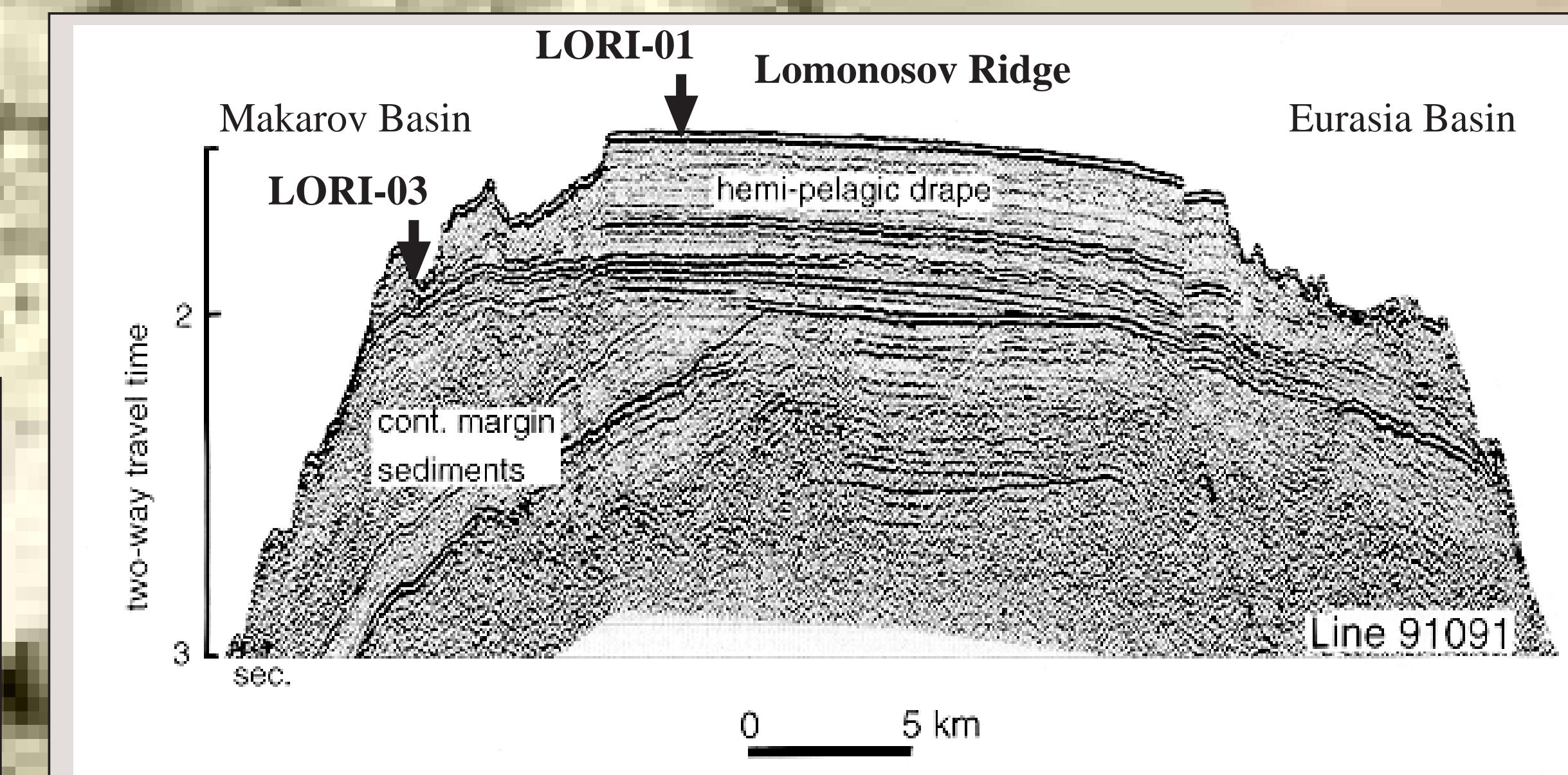
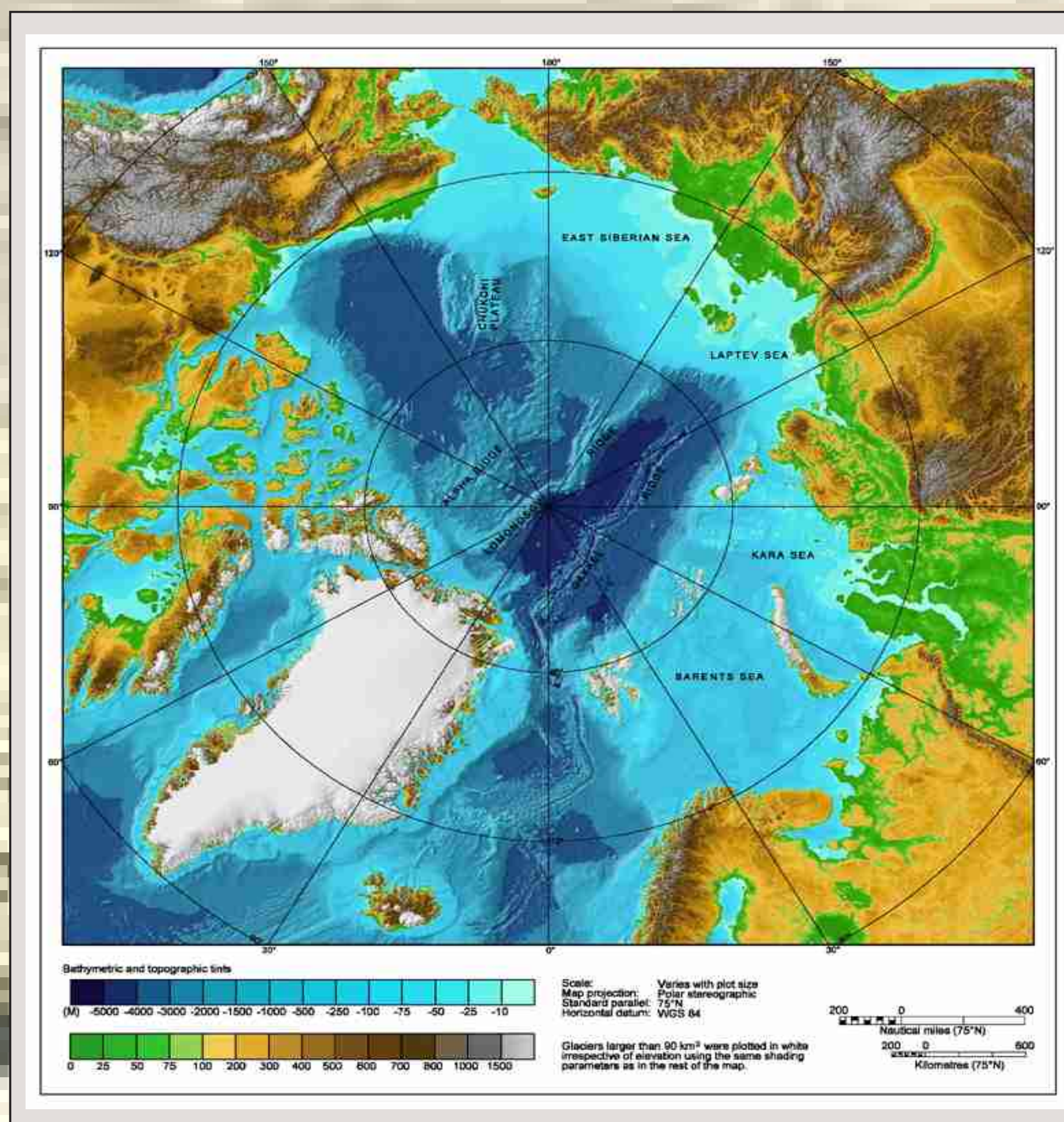
CONCLUSIONS

- The ca. 450 m thick package of hemipelagic sediments (Cenozoic) on top of the ridge is laterally uniform (LORI-01);

- The sedimentary layers (Mesozoic) below the regional erosional unconformity are structured as several synclines and anticlines;

- The proposed location of Site LORI-01 is above a syncline in the sediments below the regional unconformity;

- The proposed location of Site LORI-03 is on the side of a complex mound and should be moved.



BACKGROUND

The 1500 km long and 50-150 km wide Lomonosov Ridge rises more than 3000 m above the adjacent abyssal plains and divides the Arctic Ocean into a Mesozoic basin and a Cenozoic-Recent basin. Multi-channel seismic data collected from icebreakers on four cruises together with swath bathymetry and high resolution chirp sonar data collected by nuclear submarines from the central part of the ridge show a cap of hemipelagic drape (c. 450 m thick) on top of faulted and peneplained sedimentary sequences prograding towards the Canada Basin. ODP Proposal 533 : Paleocceanographic and Tectonic Evolution of the Central Arctic Ocean focus on obtaining the paleocceanographic information of the sediments in the hemipelagic sequence and also constrain the tectonic history of the ridge by drilling into sediments below the regional unconformity.

DATA ACQUISITION

The seismic data was acquired from the Swedish icebreaker ODEN in late July 2001. The seismic source was 2 x 250 cuinch G-guns towed below a depressor at 0-7 m depth. The streamer had 200 m active section with 8 channels and an offset of 100 m to the first channel. The data was recorded at 2 ms. and 4 sec. record length. After two aborted attempts at other locations, conditions permitted.

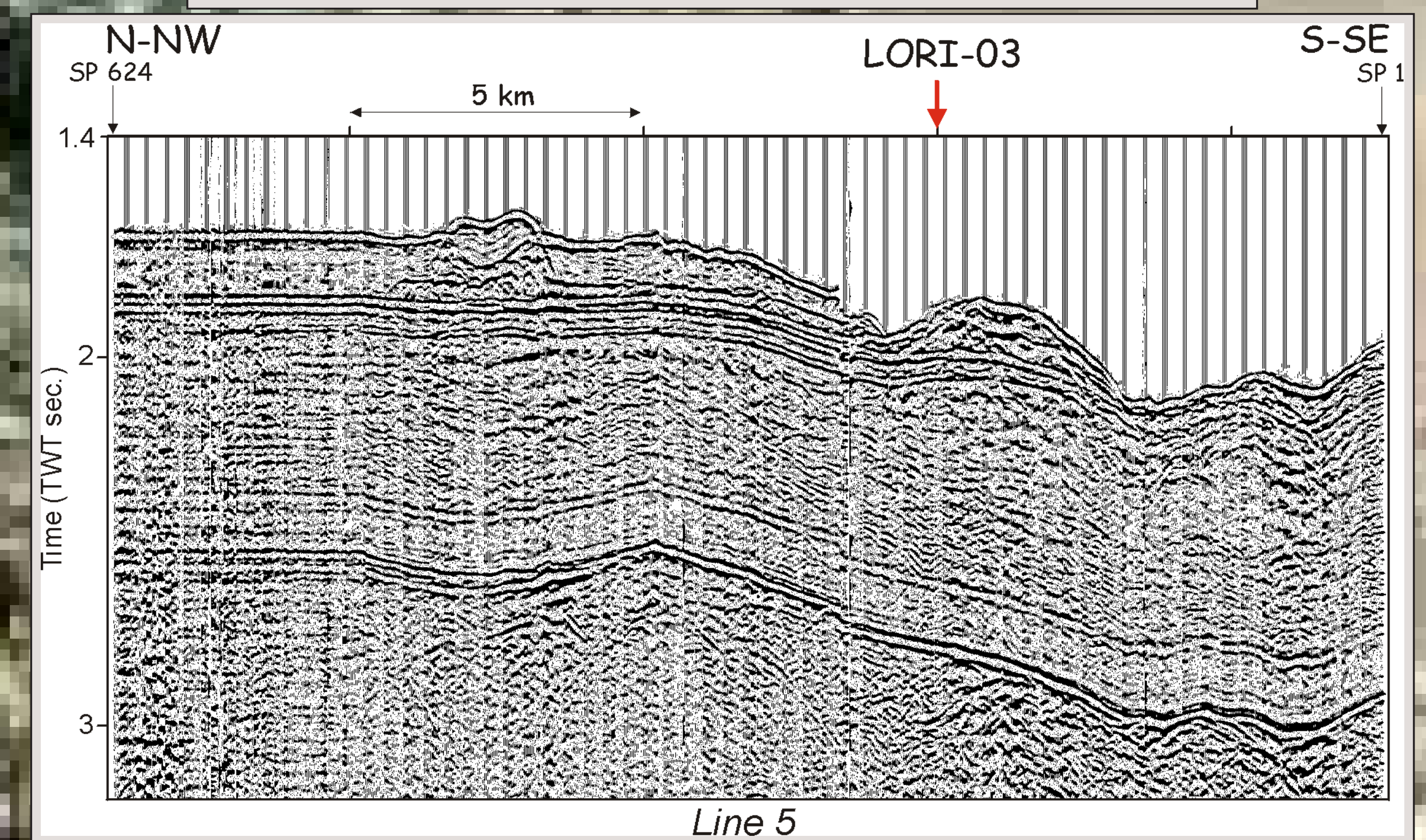
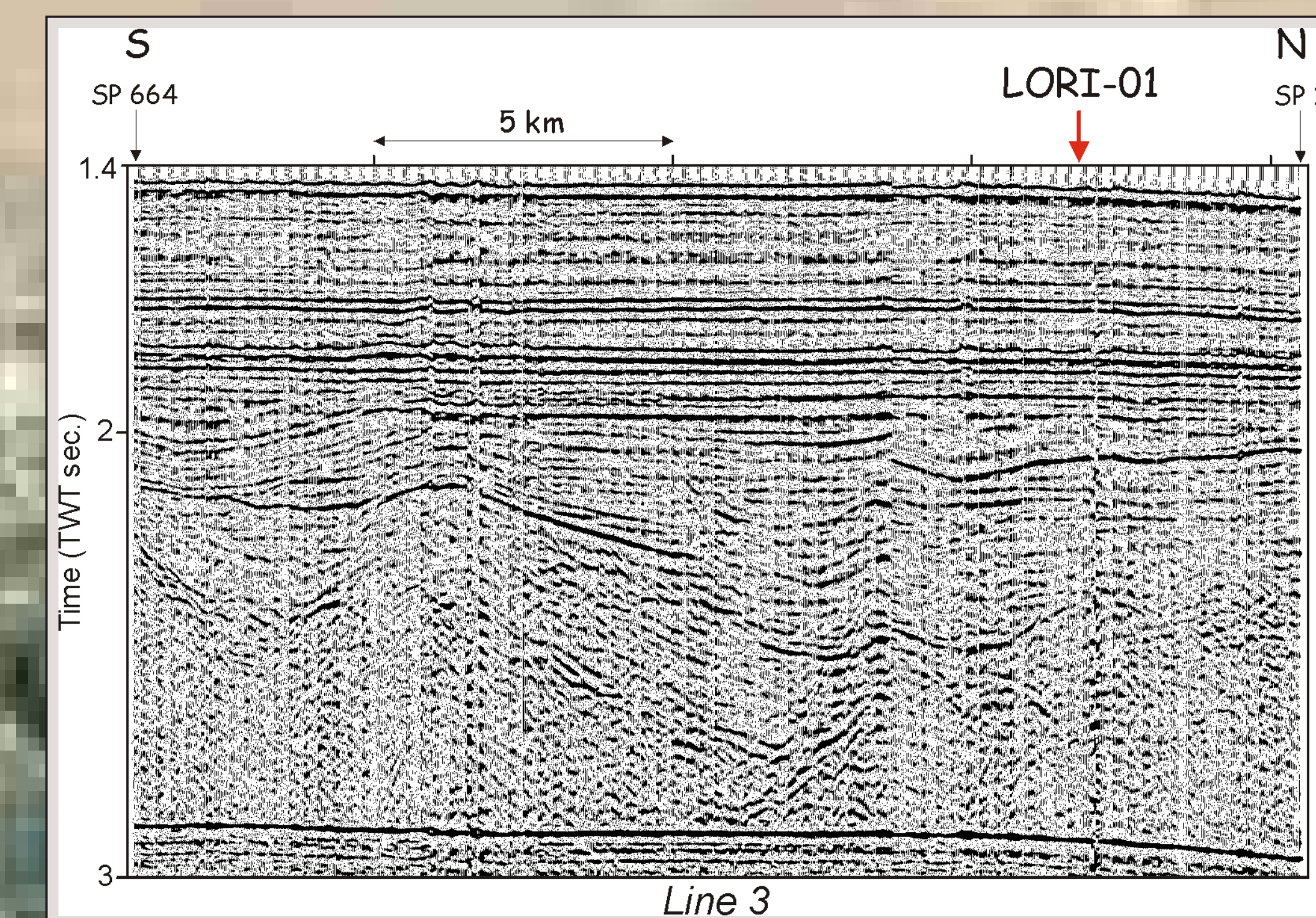
COLLECTING SEISMIC DATA WHILE BREAKING ICE

Normally the vessel follows narrow leads and seismic data is acquired at an average speed of 2-3 knots. It is imperative that the towing cable enter the water as close to the vessel as possible to avoid having towed equipment being forced out of the water by blocks of ice.

The vessel frequently loses momentum (average every 500 m) and do not advance significantly over periods up to half an hour. Several things happens now:

1. The forward thrust is increased to the tolerance level of the towed equipment and maximum use is made of the heeling system and rudder motion;
2. At high thrust the powerful propeller wash force the gun-depressor to the surface and the guns fire at a depth of < 1 m or in the air;
3. The far end of the cable tends to sink and the delayed ghost signals distort the data;
4. At a choke-point or after getting free most often the seismic cable is forced in the air by blocks of ice in several places along the cable.

With no forward movement of ODEN the towed seismic gear can only survive with less than 50% of full forward thrust from 24,500 h.p. If the ice is tight, the wake behind the vessel will completely close and the hydrophone cable end up on top of the ice.



ACKNOWLEDGMENTS

The Swedish Polar Secretariat kindly offered to include a 5 day site survey program into the expedition plan for icebreaker ODEN. Funding for hire of the vessel for the site survey was provided by the Margaret Kendrick Blodgett Foundation (2.5 days), Norwegian Petroleum Directorate (1 day), Statoil (1 day), and JOI/USSP (0.5 days). Data acquisition was funded by the Norwegian Research Council.

