# The Nansen Icebreaker

A newsletter from the Nansen Arctic Drilling Program

Winter 1996, Number 8


## ARCTIC OCEAN '96: Pilot deep sea drilling in the central Arctic Ocean


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During Fridtjof Nansens's famous drift with *Fram*, O.B. Bøggild was entrusted with examining the first four sediment samples ever recovered from the deep Arctic Ocean basin. He published his results "in the hope that a tolerably clear idea thereby be obtained of the lithology of the bottom of the North Polar Sea." One hundred years later, after more than 600 sediment cores (mostly 2 to 5 m long) have been recovered and analyzed, we are still totally missing the stratigraphic representation of a 40 million year interval in the Cenozoic. This interval holds clues to the paleoceanographic response of the Arctic Ocean to Cenozoic global cooling. In many ways, our scientific progress with respect to the pre-Pleistocene history of the deep Arctic Ocean has reached a plateau over the past decade, except for the exciting data coming from the tireless effort of Art Grantz and the USGS group investigating the Chukchi Borderland.

The objective of the Nansen Arctic Drilling Program (NAD) is to reach the stratigraphic and paleoenvironmental treasures beyond the range of a gravity corer. We have put a substantial effort into defining targets in the *NAD Science Plan* and in earlier proposals to ODP by Peta Mudie and others. We have listened respectfully to engineers regarding the technical issues and learned that, "Yes, it is possible but it will cost a lot of money."

NAD has taken a phased approach to the problem by concentrating first on the continental margins. Specifically, NAD has taken interest in a potential deep borehole into the Beaufort-Mackenzie sedimentary basin to be drilled in collaboration with the oil industry, as well as a series of holes drilled from fast ice in the Laptev Sea (see the 7/95 *Icebreaker*). A phased approach to exploring the deep ocean is also needed, before we call on tools of the size of *JOIDES Resolution*. We have observed the great practical issues that arise whenever the drillship is near the ice edge. The inevitable conclusion is that the JOIDES planning structure is unlikely to make a firm commitment for deep Arctic Ocean drilling because of all the hazards involved. Therefore, the simplest way forward is to explore if we can advance and build experience in a way that is less resource demanding than the engineers originally perceived.

ARCTIC '91, when *Oden* and *Polarstern* penetrated into the central Arctic Ocean, was a breakthrough. Excellent seismic data was obtained using the same method Art Grantz had in 1987 from *Polar Star* over Northwind Ridge. New drilling sites were defined on the Lomonosov Ridge where Eocene (probably) and younger sediments are exposed by erosion at the ridge

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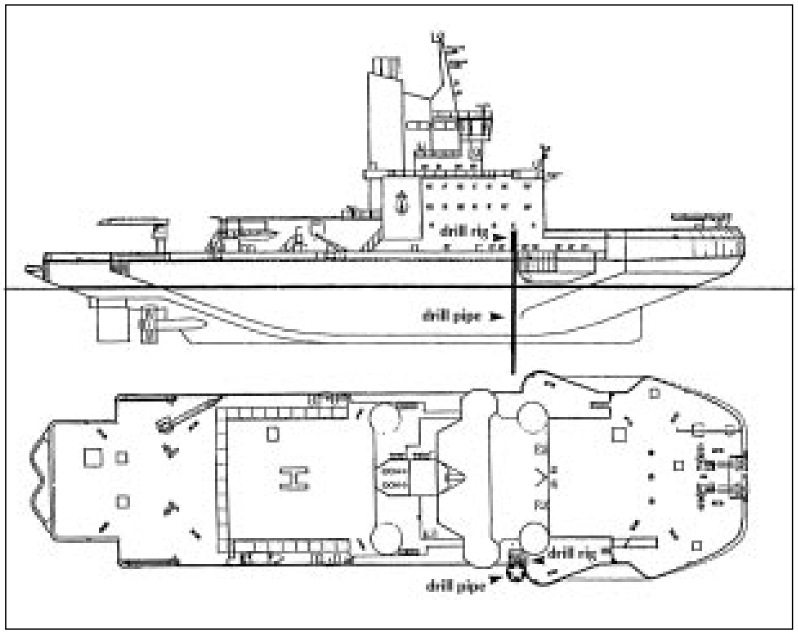


**Figure 1. Sketch of icebreaker *Oden* and the position of the drill rig.**

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# NAD begins breaking ice

The past year has been an important one for the evolution of the Nansen Arctic Drilling Program (NAD). In July 1995, a proposal written by Dr. G. Leonard Johnson (Chair, NAD Executive Committee) and Dr. Garrett Brass (NAD Technology Committee), was presented to the JOIDES Executive Committee (EXCOM). JOIDES (Joint Oceanographic Institutions for Deep Earth Sampling) is the advisory structure for the international Ocean Drilling Program (ODP). This proposal aimed to build cooperation with ODP which would provide NAD with an infrastructure of management, science advice and coordination, and a potential working system of repositories and databases, through access to those aspects of the Ocean Drilling Program structure, at cost.

JOIDES EXCOM enthusiastically endorsed the exploration of closer ties between NAD and ODP in a consensus statement which includes the following, "EXCOM recognizes that NAD addresses fundamental scientific problems in regions of the world, and requires facilities beyond ODP capability." Subsequently, the NAD proposal was reviewed by the JOIDES Planning Committee (PCOM) in August 1995. PCOM, the highest JOIDES scientific planning body, strongly encouraged further discussion and exploration of common interests and possible linkages between the management and planning processes of NAD and ODP/JOIDES. By motion, PCOM also recommended a framework to EXCOM for linkage to other programs. EXCOM addressed this subject and the PCOM motion at its January 1996 meeting. By motion, EXCOM "strongly endorses closer ties with international groups involved in studying the Earth using drilling or coring platforms or proposing to use such platforms, including the *JOIDES Resolution*. Initiation and strengthening of such ties must be without prejudice to the scientific goals and legal mandates of the JOIDES enterprise." This statement echoed the general PCOM endorsement.

There have been two NAD meetings since the last issue of the *Icebreaker*. The first was a general interest meeting held during the May 1995 American Geophysical Union meeting in Baltimore, USA. The second was an open NAD business meeting held in October 1995 during the Fifth International Conference on Paleoceanography (ICP-V) in Halifax, Canada. At the first meeting it became clear that a "NAD Implementation Plan" is needed and the second meeting affirmed the idea.

The purpose of a *NAD Implementation Plan* will be to outline the strategy and steps necessary to achieve NAD's scientific goals. Because of the difficult and costly nature of scientific ocean drilling in the Arctic, the endeavor will require close multinational cooperation and funding. The *Implementation Plan* will be the action plan to mobilize the NAD member and observer countries to pursue the objectives outlined in the *NAD Science Plan*. Creating an *Implementation Plan* aims to establish international consensus and support. The plan is intended to be international in scope and plans for individual member country activities can be embedded in it. It is also essential for the *NAD Implementation Plan* to consider the next step in establishing a relationship with JOIDES.

A strawman *NAD Implementation Plan* is currently being developed by the chairs of the NAD committees. This plan will be discussed and finalized at a workshop that is currently being planned for May 1996. If you wish to be on a special mailing list in order to review the draft plan or to receive a workshop notice, contact the NAD Secretariat at JOI (ajohnson@brook.edu; fax: 202-232-8203). Expressions of interest must be received by April 1, 1996. ■

## Russia proposes Arctic drill sites

Russia is proposing several drill sites in the Russian Arctic for collaborative international drilling in the future. These sites are in the Barents, Kara and Laptev seas. Relatively easy access—as well as oil and gas potential—makes the Barents Sea interesting. Scientifically, drilling in the Barents Sea would provide data on the late Cenozoic evolution of the western Russian Arctic. In contrast, drilling in the Kara Sea will explore Triassic rifts and grabens as well as a rich Cenozoic record with high terrigenous inputs. The Laptev Sea sites are the same sites that were promoted at the NAD Laptev Sea drilling workshop in late 1994. These sites would penetrate a rift system filled with thick layers of Cenozoic sediments. ■

## Russia considers ODP membership

A special workshop was held in Moscow on November 26, 1995 to discuss the future collaboration of the Russian scientific community with the Ocean Drilling Program (ODP). The workshop was organized by the Institute of the Lithosphere, Russian Academy of Sciences. Dr. Dave Falvey, Director of the Ocean Drilling Program, attended and met with the Directors of Russia's major earth science institutions (including the Academy of Sciences, the Shirshov Institute, and the Institute of Geology), the Russian Ministry of Geology, as well as representatives of the Russian oil and gas industry. Russian scientists have both a strong interest in Arctic science and experience with Arctic drilling. All participants were pleased to see the developing connection between the Nansen Arctic Drilling Program and ODP. All involved in the meetings and workshop are optimistic and excited about Russia's possible future participation in ODP. ■

## Arctic map and wall chart are available

A full color map titled "Tectonic Elements of the Arctic" and a detailed wall chart titled "Stratigraphic distribution of oil and gas deposits in the former Soviet Union" are available from the Cambridge Arctic Shelf Programme (CASP). The map, designed for wall display, shows the principal tectonic elements of the circum-Arctic region presented on a polar stereographic projection. It includes West Siberia, the Alaskan North Slope and Timan-Pechora and has been prepared jointly by CASP (Cambridge, UK) and Aerogeolgiya (Moscow). This map is part of CASP's Regional Arctic Project which is an ongoing geological synthesis of the Late Paleozoic and Mesozoic sedimentary basins of the Arctic.

The wall chart includes data on the stratigraphy, depositional environments and hydrocarbon occurrence in 80 areas of the major oil and gas provinces of the former Soviet Union (FSU). It includes all period, stage and area names in both English and Russian (Cyrillic script) plus a map of all FSU provinces producing oil and gas. For an order form and price information please contact: CASP, West Building, Gravel Hill, Huntingdon Road, Cambridge, CB3 0DJ, UK Fax: +44 1 223 27 6604. ■

## Contributions to the *Icebreaker* are welcome!

The submission deadline for the next issue of *The Nansen Icebreaker* is 1 July 1996. Send your text (and graphics) to: Andrea Johnson, Editor, *The Nansen Icebreaker*, Joint Oceanographic Institutions, Inc., 1755 Massachusetts Ave., NW, Suite 800, Washington, DC 20036-2102, USA. Tel: (202) 232-3900 ext. 213; Fax: (202) 232-8203; Internet: ajohnson@brook.edu. Text submitted by e-mail or on computer disk is appreciated. ■

perimeter (see 4/93 *Icebreaker*). With the keen interest of Captain A. Backman, icebreaker *Oden* performed a test of its ability to keep position in 2.5 m thick sea ice drifting at several hundred meters per hour. After the vessel broke through a pressure ridge using a 30 m run to pick up momentum, it had no problems keeping within 50 m of the location as the 2 km wide flow passed over the site (see the 3/92 *Icebreaker*).

After looking for a suitable drill rig for several years, one of us (Kristoffersen) contacted an Icelandic drilling company while attending a JOIDES Technology and Engineering Development Committee meeting in Reykjavik in the fall of 1993. He learned that drilling rigs suitable for our objectives were actually available in Norway. A $900 drilling platform was built and, in May 1994, tested from the University of Bergen research vessel in a fjord with a 130 m water depth. Much was learned from an operational point of view, but not a grain of sediment was recovered because the vessel did not hold position well enough relative to the water depth. Several trials were scheduled in 1995 and the approach is being truly tested on the continental shelf in Antarctica by drilling in 400 m water depth from the Finnish research vessel *Aranda* in January-February 1996.

Sweden is planning a scientific expedition to the central Arctic Ocean in July-September 1996 in cooperation with the Alfred Wegener Institute for Polar and Marine Research (ARCTIC OCEAN '96). The Swedish Polar Science Committee responded very positively to a proposal for a comprehensive geological sampling program on the Lomososov Ridge using the diamond drilling concept. Selcore, the newly-developed hydrostatic corer will serve as a backup system. The effort will focus on obtaining Paleogene and Neogene pelagic sediments for paleoceanographic studies. During Leg 1, fourteen days of ship time will be devoted to geological sampling in addition to conventional coring on Leg 2. Scientific crew rotation is planned from the Eurasia Basin using long-range Russian helicopters after about 40 days.

The ice-covered sea surface has no vertical motion which eliminates the need for heave compensation of the drilling platform. During Leg 1, geological sampling is proposed for the Lomonosov Ridge using diamond drilling with a light wireline rig mounted on the side of the icebreaker (Figure 1). The strategy is to drill a transect of up to 50 m deep holes from the shallowest part of the ridge (840 m water depth) to the maximum capacity of the drill string (1400 m). The purpose is to capture much of a >500 m thick Eocene and younger section of pelagic sediments that were deposited on the ridge and exposed by erosion at the ridge perimeter (Figure 2). Drilling deeper than 50 m will be pursued if feasible. At each site, the upper 10-15 m of sediment will be recovered with Selcore.

The drill rig is a conventional land exploration wireline rig which can handle a 1400 m drill string and produce a 43 mm

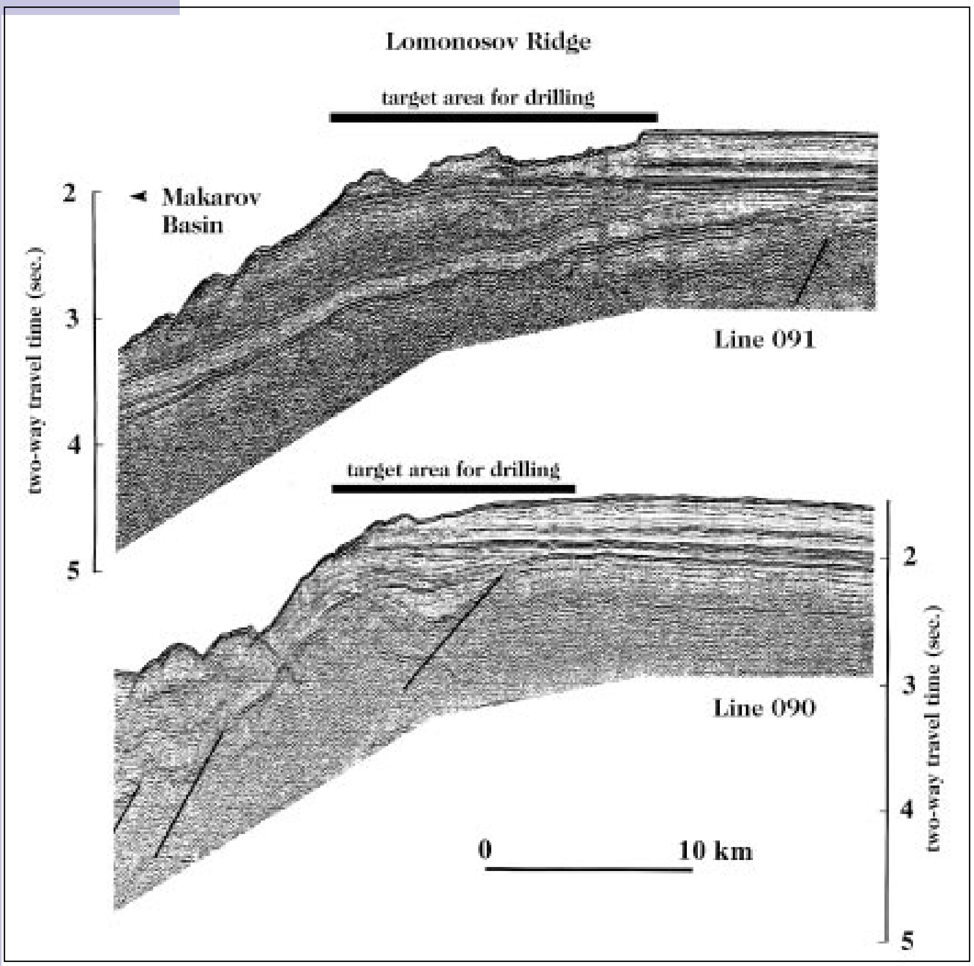


**Figure 2. Target area for drilling on the Alaska-facing side of the Lomonosov Ridge.**

diameter core. Weight of the rig is 5 tons plus the 17.5 ton weight of the drill string out of which 9.6 tons is supported by the winch wire. The weight of the whole rig rests on the deck and the drill string runs into the water in a protected chute attached to the hull of the vessel. First an outer string (outer diameter 73 mm) will be lowered to serve as casing. The casing is secured by the deep sea winch wire attached to the bottom end and clamped to the pipe at regular intervals. This setup will prevent the drill string whipping in the water during rotation and will serve as a safety measure against accidental loss of equipment. A drill string of outer diameter 63 mm is then lowered inside the casing. If the latter is accidentally lost, it is still contained within the casing and can be retrieved by a standard fishing operation. The sediment core is retained by an inner 3 m long core barrel and brought to the surface inside the drill string by a wire line whenever the diamond drill bit has advanced 3 m.

A critical point will be protecting the drill string below and above the water line as the vessel is breaking ice to maintain position in a polar icepack of 2 to 3 m thickness while drifting. The icebreaker *Oden* has a Thyssen-Waas bow design which has a reamer wider than the hull forward of the bridge (Figure 1). The idea is to let the drill string go into the water just behind the reamer where the ice stress against the side of the ship is relieved. The Swedish Icebreaker Administration will design and implement an ice protection system. This system will be tested in ice in Gulf of Bothnia during the winter of 1995/96. Further opportunities to improve on the ice protection will be available during station work on the week-long transit from the ice edge to the Lomonosov Ridge at the beginning of the expedition.

The Norwegian drilling contractor TERRABOR A/S provides two decades of diamond drilling experience (6 to 8 rigs) which include marine sediment sampling by wireline drilling from anchored barges in water depths up to 115 m for geotechnical studies for most of the major bridges in Norway. The company will be involved in all the planned tests and the drilling in Antarctica in early 1996.

The proposed drilling is a high risk endeavor, but we feel a capable backup system is available in the Selcore hydrostatic corer (Figure 3). Originally, incentive for this development was sediment coring from ice station FRAM-I in 1979 where <1 m core was recovered (and provided the data for the first published sedimentation rates on the Gakkel Ridge). Selcore operates as a pile driver after the initial penetration by free fall. More than 20 times the energy is available for sea bed penetration compared to a conventional gravity corer of the same weight. This feature is important when the primary goal is to obtain the pre-Pleistocene material. Selcore has been developed by Selantic Industrier A/S, Ågotnes in cooperation with University of Bergen with partial support of Elf Aquitaine, Norway and is now in commercial use on the global market for sea bed surveys.

**Figure 3. The first commercial version of Selcore.**

The NAD feasibility study for drilling operations in the Arctic Ocean concluded that the best approach would be to use an icebreaker to clear the way and to drill from another vessel or a barge. We have considered this, but another vessel means large added costs. A barge deployed from a single icebreaker is too cumbersome and probably is more a safety risk than an advantage.

We consider the proposed pilot drilling on Lomonosov Ridge a contribution to the Nansen Arctic Drilling initiative and hope that a successful operation during ARCTIC OCEAN ‘96 will open for a cost-effective approach to new advances in our understanding of the role of the Arctic Ocean in global climate evolution. If aluminum pipe is used, we will be able to access the crest of the Alpha Ridge with this rig size in the future. ■

# *Polarstern* returns to the Eurasian margin: Report of the geology program

*contributed by R. Stein, F. Niessen, M. Behrends, M. Bourtman, K. Fahl, M. Mitjajev, E. Musatov, N. Norgaard-Petersen, V. Shevchenko, and R. Spielhagen*

The polar research vessel *Polarstern* made its second cruise (ARK-XI/1) to the Eurasian continental margin and adjacent deep-sea from July 7 to September 20, 1995. Scientists on board studied oceanographic circulation patterns, the marine ecosystem, sea-ice characteristics, and the depositional environment and its change through the late Quaternary (Rachor et al., in press). The main goal of the marine geological program was to perform high-resolution studies of changes in paleoclimate, paleocirculation, paleoproductivity, and former sea-ice distribution. Of major interest was the significance of the Arctic Ocean for the global climate system, the correlation of paleoenvironmental data from different depositional environments, and the correlation of marine and terrestrial climatic records. Accordingly, detailed sedimentological, geochemical, mineralogical, and micropaleontological investigations will be performed.

Research will focus on:

- high-resolution stratigraphy (isotopes, AMS-$^{14}$C-datings, amino-acids, and magnetic susceptibility);
- river run-off and corresponding surface-water salinity changes (stable isotopes);
- terrigenous sediment supply (grain size; clay-, light-, and heavy minerals; organics; geochemical tracers);
- organic carbon fluxes (total organic carbon, C/N ratios, hydrogen and oxygen indices, carbon stable isotopes, maceral composition, biomarkers);
- reconstruction of paleoproductivity by tracer analyses (biomarkers, barium, biogenic opal);
- reactions of biota to environmental changes;
- physical properties (magnetic susceptibility, wet bulk density, porosity, shear strength);
- specific depositional environments with PARASOUND echo-sounding surveys.

The research program will also investigate aerosols, water column particles (using sediment traps and *in situ* pumps), surface sediments, and long sediment cores. During the *Polarstern* expedition ARK-XI/1, geologic sampling took place in the western East Siberian, Laptev, and eastern Kara seas as well as the adjacent continental slope and deep-sea (Figure 1). When possible, coring positions were carefully selected using PARASOUND to avoid areas of sediment redeposition and erosion.

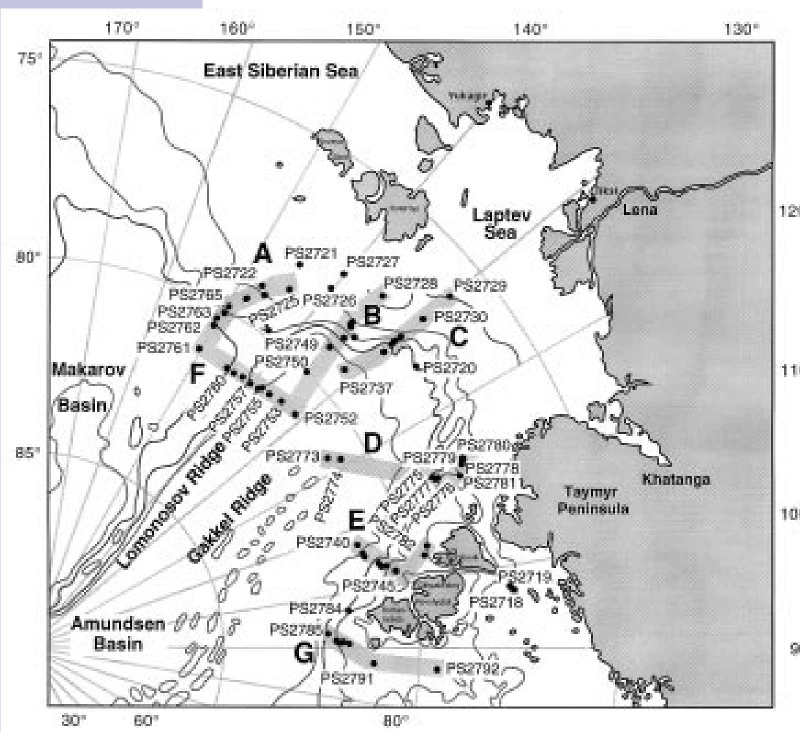


**Figure1.** ***Polarstern*** **cruise ARK-XI/1 (1995), geological stations and transects.**

**Lithostratigraphy and sediment characteristics**

All surface sediments obtained during ARCTIC'95 indicated well-oxygenated surface layers. On the shelf and on the upper slope, sediments were described as ranging from sandy silty clay to silty sand, while on the lower slope and in the deep sea, silty clays were predominant. One exception was the Lomonosov Ridge's eastern flank (Transect F) and the adjacent Makarov Basin (Transect A), where surface sediments contained significant amounts of sand — even in water depths greater than 1000 m. Currents across the Lomonosov Ridge may be winnowing the fine material.

In general, ice-rafted gravel was rare. However, gravel up to 5 cm in diameter was common in the cores taken north and northeast of Severnaya Zemlya (200 to 1000 m water depth) reflecting major iceberg rafting.

One exceptional discovery was five flat manganese nodules (4 to 7 cm diameter, 1 to 2 cm thick) on the surface of box core PS2726-5 from the shallow Eastern Laptev Sea (48 m water depth).

These nodules were also observed in several Agassiz trawls from this area suggesting a significant regional distribution.

The long sediment cores taken from the Eurasian continental margin and the deep sea are dominated by terrigenous silty clays. Sandy lithologies as well as biogenic components are rare. The sedimentary sequences show distinct variations in sediment color and the degree of bioturbation, indicating major changes in the depositional environment through time.

In general, the shelf cores from the western East Siberian Sea and the Laptev Sea consist of gray partly-bioturbated silty clays. High Fe-sulphide amounts in many of the cores may be due to the decay of marine organics by sulphate-reducing bacteria activity. Occasional well-preserved bivalves and shell debris will allow AMS-$^{14}$C dating of the sedimentary sequences.

The continental slope and deep-sea cores, in contrast, are mainly composed of brown silty clays. Most fine-grained material was probably transported in suspension by currents and/or sea ice. Athough transport by turbidity currents becomes very important on the lower slope.

Sedimentary sequences recovered from the Amundsen Basin, across the Lomonosov Ridge, and into the Makarov Basin are shown in Figures 2 and 3. On this transect (F), ten stations were sampled using a giant box corer, a multicorer, and a gravity/kastenlot corer. The long cores have lengths between 4.9 and 9.1 m. A correlation across the ridge is possible between the cores using the degree of bioturbation, specific silty-sandy layers, and a prominent thick dark-gray interval. This correlation is also supported by magnetic susceptibility records (Figure 4). Changes in sediment composition suggest major variations in source-rock areas, transport processes, and/or biological productivity, probably related to climatic (glacial/interglacial) variations.

The shipboard data is still being interpreted and is preliminary. The $^{14}$C ages for absolute age control—as well as more detailed sedimentological, mineralogical, and geochemical studies—must be completed before sedimentary processes and their correlation to climate change can be precisely reconstructed.

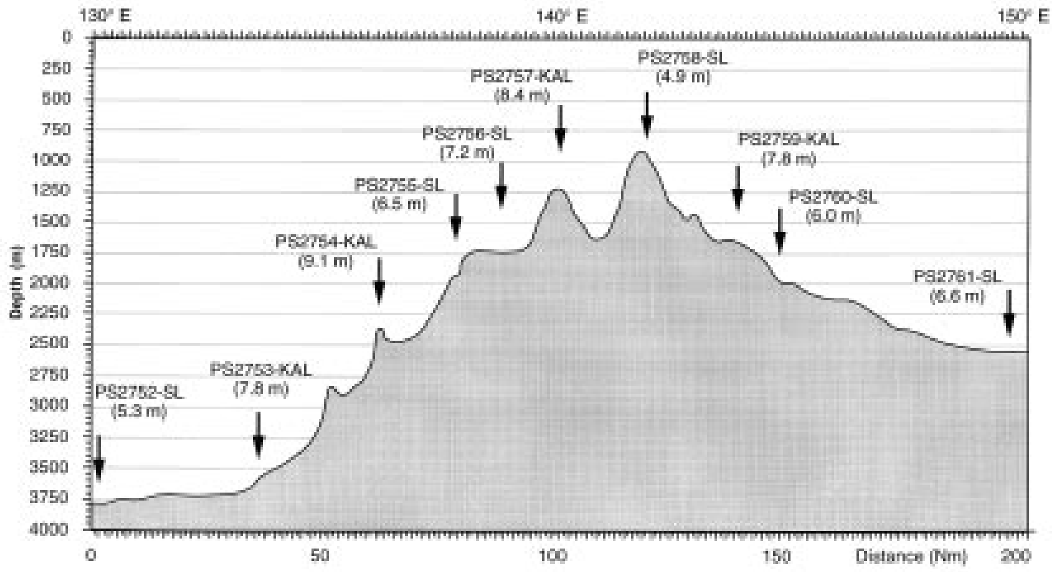


**Figure 2. Transect across the Lomonosov Ridge (Transect F in Figure 1, 81°N), geological stations and recovery. *Polarstern* cruise ARK-XI/1, 1995.**

**Sediment echosounding and physical properties**

During ARK-XI/1 the ice conditions allowed nearly-continuous profiling and quality results using the hull-mounted sediment echosounding system PARASOUND (4kHz). Generally, the reflection pattern along the continental slope shows a strong gradient of increasing sediment thicknesses towards the continental shelf indicating a predominance of terrigenous sediment input. However, on a more regional scale, different reflection patterns suggest major temporal and spatial changes of the depositional character. Based on interpretation of the PARASOUND profiles, five major areas can be distinguished. Discussion of each area follows:

**(1) Laptev Sea Shelf**

On the Laptev Sea shelf, PARASOUND can penetrate 20 m subbottom showing well-stratified sediments of probable Pleistocene age, which commonly dip gently eastward. In places, strong

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reflectors cut these well-stratified units roughly parallel to the sea floor (10 to 20 m sediment depth), indicating their post-depositional origin. One possible explanation for the significant contrast in acoustic impedance at these horizons is the onset of sub-surface permafrost. A second possibility is a higher concentration of sedimentary gas at this depth.

**(2)Eastern Laptev Sea Continental Slope**

In the central to eastern Laptev Sea, the continental slope along Transect C down to 3200 m water depth can be characterized as a deep-sea fan facies. On the upper fan (down to about 1200 m) typical channel and levee deposits appear. Several channels (up to 100 m deep) are observed which cause high acoustic backscatter—probably because of the coarser channel fill. In contrast, levee deposits are well-stratified. Sound penetration down to 50 m sediment depth can be observed. The beginning of the lower fan (about 2300 m) is characterized by diffraction hyperbolae. This can be explained by small-scale morphological features, such as numerous small channels, which form the transition to the morphologically flat turbidite deposits of the Amundsen Basin. During the ARK-IX/4 cruise in 1993, similar profiles were interpreted as river channels which were eroded during glacial times when sea level was lower and river mouths were near the present-day shelf edge. This entire pattern indicates a continuing sediment supply from the Eurasian continent into the Arctic deep sea during the last glacial (stage 2).

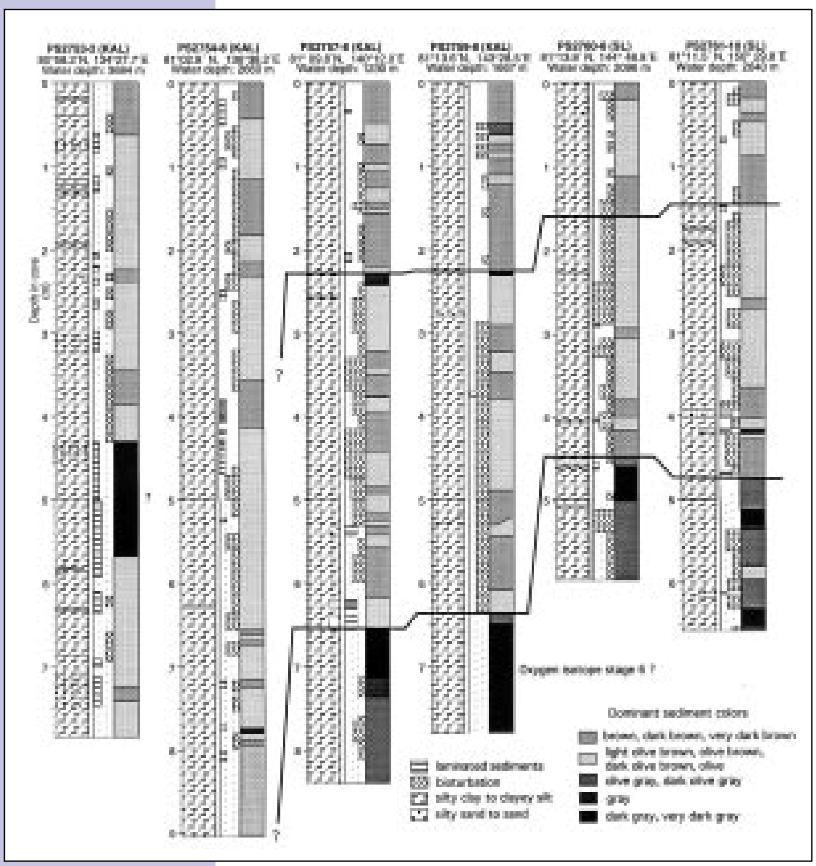

**Figure 3. Lithological profile Amundsen Basin - Lomonosov Ridge - Makarov Basin (Transect F in Figure 1).**

**(3) Western Laptev Sea Continental Slope**

The continental slope west of 120°10′E (between 2000 m and 3250 m water depth) is characterized by a large number of debris flow deposits. Typically, they appear in PARASOUND profiles as lenticular-shaped bodies (each about 30 m thick) which are acoustically transparent. They are mostly draped by a few meters of stratified sediments. The debris flows indicate that, at the time of their deposition, there was a strong downslope movement of sediments over a large area of the western continental slope of the Laptev Sea and off Severnaya Zemlya. Further analysis and dating of sediment cores is necessary to determine whether their formation might have been controlled by a larger glaciation along the Taymyr-Severnaya Zemlya shelf.

**(4) Gakkel Ridge**

The deep-sea area of Transect D is dominated by the geology of the Gakkel Ridge. There are two crests seen along profile G (at 80°50.5′N, 122°05′E and at 80°36.8′W, 121°01′E). West of 122°E there is evidence for several faulted blocks, more or less vertically displaced by up to 200 m. The blocks are probably related to oceanic crust sheared by seafloor spreading. The blocks are draped by well-stratified sediments which allow sound penetration to about 20 m sediment depth. West of 120°45′E, PARASOUND profiles indicate the transition into the Nansen Basin. Several smaller blocks of bedrock (ca. 1 km across and elevated up to 100 m above the sea floor) alternate laterally with sediment fills of more than 30 m in thickness. It is assumed that the bedrock represents the older, more distal parts of the fractured crust of the Gakkel Ridge. The blocks are increasingly buried by sediments towards the Nansen Basin. This is indicated by reflectors which show the increase of sediment thickness to the west. The onlap geometry of the fill is typical for turbidite deposits.

**(5) Lomonosov Ridge**

Along the transects across the Lomonosov Ridge and the continental slope of the western Makarov Basin (Transects A and E), the PARASOUND profiles are characterized by well-stratified sediments which drape subsurface morphologies. This implies a predominance of more pelagic conditions and thus relatively low sedimentation rates. Penetration is generally up to about 50 m. For most of the area, an upper seismic unit (A) of stronger backscatter can be distinguished from a lower unit (B) which shows a higher degree of acoustic transparency (Figure 5). This subdivision is more pronounced near the crest of the Lomonosov Ridge and in the Makarov Basin and is less distinct towards the Amundsen Basin. The thickness of unit A varies between 4 and over 30 m. The thinnest units are observed on and near the crest of the ridge. Also, there is a significantly higher thickness of unit A toward the Amundsen basin compared to the Makarov side of the slope, which implies relatively low sedimentation rates on the eastern (Makarov) part of the transects. This is consistent with the correlation of both lithology (Figure 3) and magnetic susceptibility (Figure 4) as determined by 1 cm-interval core logging. In the susceptibility records the occurrence of dark gray and very dark gray sediments is characterized by strong fluctuations and high amplitudes of up to 100 x $10^{-5}$ SI. These units are also indicated by increased wet bulk densities (up to 1.9 g/$cm^3$) and significantly higher P-wave velocities (ca. 1600 $ms^{-1}$). In general, the lateral core correlation across the Lomonosov Ridge using magnetic susceptibility is consistent with those of wet bulk density and P-wave velocity. There is, however, some uncertainty in the correlation toward the westerly end of the profile in the Amundsen Basin (Figures 3 and 4, cores PS2753-2 and PS2754-8). ■

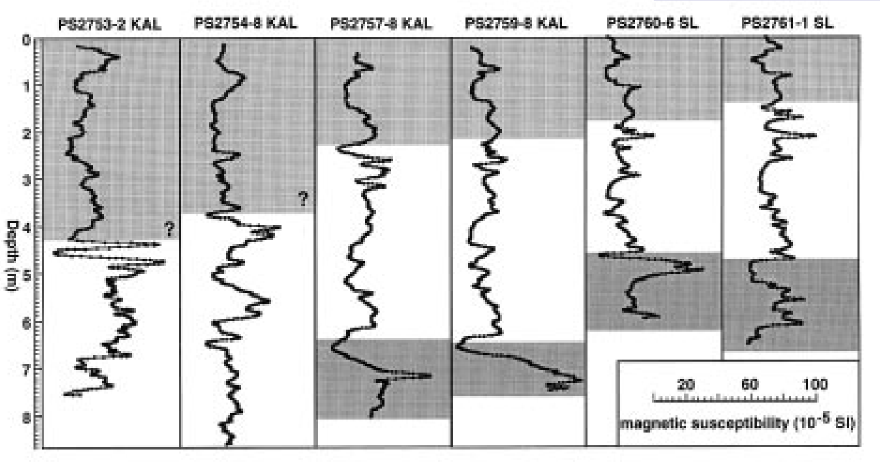


**Figure 4. Correlation of core-logging results Amundsen Basin - Lomonosov Ridge - Makarov Basin (Transect F in Figure 1).**

***Reference:***
Rachor, E. (ed.) The Expedition ARCTIC '95, Leg ARK-XI/1 of RV *Polarstern* 1995. Reports on Polar Research, Alfred Wegener Institute, Bremerhaven (in press).

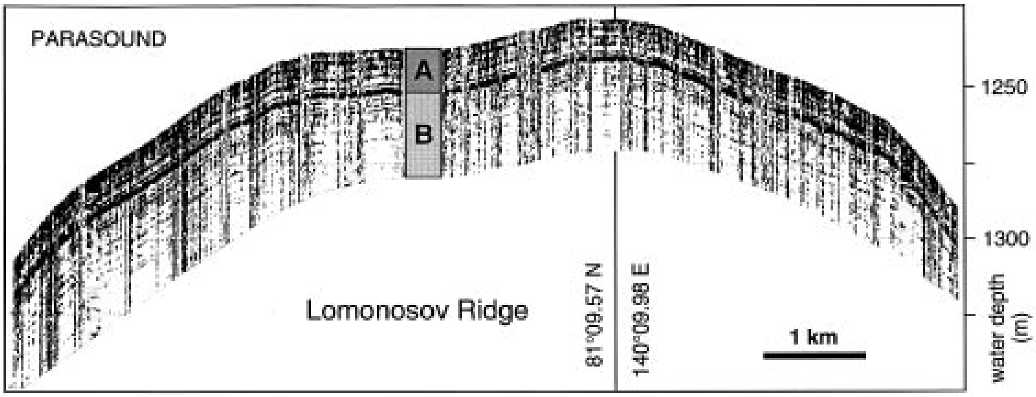


**Figure 5. PARASOUND profile across the crest of the Lomonosov Ridge and seismic units A and B.**

# TRANSDRIFT III expedition studies Laptev Sea

*contributed by Heidemarie Kassens, GEOMAR*

Although the impact of the polar regions on global climate is recognized, there is much to learn about the impact of climate on the Arctic Ocean. For instance, limited knowledge of how climate changes influence sea-ice formation makes it difficult to predict possible future global climate changes. This is true for the Siberian shelf seas where large amounts of Arctic sea ice are formed and which, for logistical and political reasons, have been inaccessible to the international scientific community. The Laptev Sea is of particular interest because it's a source area for both the Transpolar Drift and sediment-loaded sea ice. In the Laptev, it might be possible to demonstrate the extent to which global ocean circulation and climate development are influenced by extremely large influxes of freshwater from the Siberian river systems. Current oceanographic models have not yet considered such a direct terrestrial impact on the global climate.

The Russian scientific community has long worked on the Siberian shelf seas because of their oil, gas and mineral resources as well as the economic advantages of the Northern Sea Route. Unfortunately, only a few of many Russian scientific reports have been translated to other languages. U.S. data from the 1960s and some recent studies also clearly point to the central importance of the Siberian shelf seas for the Arctic. However, little was known about the complex geosystem of the Laptev Sea.

In 1994, a major multidisciplinary research program 'Laptev Sea System' was designed by Russia and Germany to understand the Arctic environment and its significance for the global climate. Ongoing bilateral research activities include land and marine expeditions to the Laptev Sea area during different seasons of the year as well as workshops and the exchange of scientists. The GEOMAR Research Center for Marine Geosciences in Kiel, Germany and the State Research Center for Arctic and Antarctic Research in St. Petersburg, Russia, are jointly responsible for organizing and coordinating the multidisciplinary project, which is funded by the Russian and German Ministries of Science and Technology.

The successes of the pilot phase (AMEI'91 to Kotelnyy, ESARE'92 to the Lena Delta and the New Siberian Islands, and TRANSDRIFT I to the Laptev Sea in 1993) as well as the LENA'94 expedition to the River Lena and the TRANSDRIFT II expedition to the Laptev Sea on board RV *Professor Multanovsky* in 1994 were very encouraging. This prompted the next expedition, TRANSDRIFT III, to be planned for the autumn to study freeze-up processes in the Laptev Sea; a first for this time of year. Consequently, the expedition logistics were extremely difficult. The expedition out of Murmansk on the Russian icebreaker *Kapitan Dranitsyn* had 50 scientists from Russia and Germany and took place from 1 to 30 October 1995.

The TRANSDRIFT III expedition mainly targeted the eastern Laptev Sea, e.g., the Lena Delta and the region of the Laptev Sea polynya. The highest priority program objectives were to study:

- the extent and composition of sea ice,
- incorporation processes of various particulates into new ice,
- alteration of oceanographic and hydrochemical processes during ice formation,
- impact of ice cover on the biological productivity.

The TRANSDRIFT III cruise was joined by the second land expedition to one of the main source areas of the eastern Laptev Sea, the Lena and Yana rivers. The work here specifically concentrates on:

- identification of riverine geochemical and mineralogical tracers,
- qualification and quantification of sediment transport. ■

# Joint U.S. and Russian survey of Laptev and East Siberian seas conducted

*contributed by G. Leonard Johnson, GERG, Texas A&M University*

During the summer of 1995, the RV *Y. Smirnitsky* made a reconnaissance survey in the Laptev and East Siberian seas. With support from the U.S. Office of Naval Research's Arctic Nuclear Waste Assessment Program, the Geochemical and Environmental Research Group (GERG) of Texas A&M University conducted the survey jointly with several Russian institutes. The primary Russian institutes involved were: the Arctic and Antarctic Research Institute (AARI), the State Enterprise All-Russia Research Institute for Geology and Mineral Resources of the World Ocean (VNII Okeangeologia), and the Research Institute for Nature Conservation of the Arctic and the North (RINCAN), and the Tiksi Nature Reserve.

The survey program focused on the interaction of Arctic Ocean water with the discharge from major Siberian rivers. Sampling (Figure 1) included CTD, nutrients, oxygen, as well as water samples for contaminants and radionuclides and seafloor samples for physical properties, radionuclides, contaminants, organic carbon, paleostratigraphy and benthic fauna. Samples of fish (carnivorous and bottom feeders) and other local fauna were obtained to determine their contaminant levels. Of NAD interest were two cores taken at the proposed NAD sites for Laptev Sea drilling (Figure 1). Both cores are being analyzed for physical properties and for hydrocarbon traces.

Southerly winds created the area's lightest ice year since 1945 and allowed good access. This opportunity was optimized with ice forecasting by on-board AARI scientists using U.S. and Russian real-time satellite data. Of special interest was an immense surface freshwater lens (salinity: 10-15 ppt; surface temp: 10°C; thickness: 5-10 m) extending north from the coast to the latitude of Novaya Sibir Island.

The chartered Russian research vessel, *Y. Smirnitsky*, was excellent and the captain and crew were very cooperative. Permits were coordinated by the GERG Moscow Office, and the charter was handled by VICAAR, a logistic support company located in St. Petersburg, Russia. ■

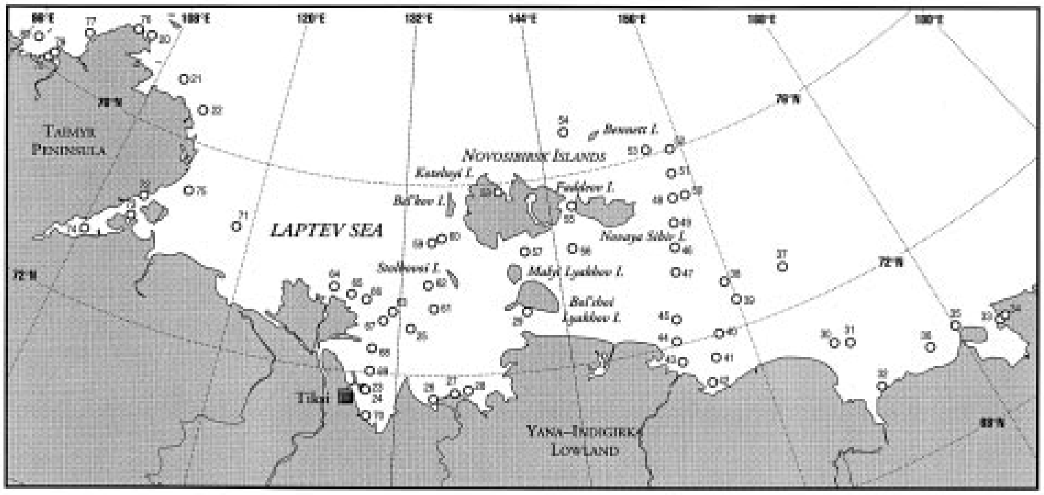


Figure 1. 1995 Laptev and East Siberian Seas sampling stations. Stations 59 and 60 are proposed NAD sites (DS-3: 74°48'N, 134°15'E and DS-7: 73°54'N, 135°E)

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*The Nansen Icebreaker* is issued twice a year by Joint Oceanographic Institutions, Inc. (JOI). JOI serves as the Nansen Arctic Drilling Program (NAD) Secretariat. NAD is supported by contributions from its member nations: Canada, France, Germany, Japan, Norway, Sweden, the United Kingdom, and the USA. Denmark, Iceland, Russia, and The Netherlands participate as observers.

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The sidebar photo is used courtesy of the Scott Polar Research Institute. Close inspection of the photo reveals the *Polar Bjørn* during the MIZEX ‘84 expedition.