12. SITE 743[1]

Shipboard Scientific Party[2]

HOLE 743A

Date occupied: 2 February 1988

Date departed: 3 February 1988

Time on hole: 1 day, 5 hr, 15 min

Position: 66°54.99′S, 74°41.42′E

Bottom felt (rig floor; m, drill-pipe measurement): 999.2

Distance between rig floor and sea level (m): 10.5

Water depth (drill-pipe measurement from sea level, m): 988.7

Total depth (rig floor; m): 1097.3

Penetration (m): 98.1

Number of cores (including cores with no recovery): 14

Total length of cored section (m): 97.3

Total core recovered (m): 21.8

Core recovery (%): 22

Oldest sediment cored:
Depth sub-bottom (m): 98.1
Nature: gravel
Earliest age: Quaternary?
Latest age: Quaternary

Principal results: Site 743 is situated on the upper continental slope of Prydz Bay, eastern Antarctica, above the water depth where the downslope morphology is dominated by slumps (66°54.99′S, 74°41.42′E; 988.7-m water depth). The site is part of the profile across the shelf consisting of Sites 739 through 743. The objectives of coring were to examine types of sediments and the sedimentary processes on a slope associated with a shelf dominated by glaciogenic sediments and to ascertain whether the Quaternary ice cover reached the edge of the continental shelf.

Overconsolidated diamictite of the type found on the shelf (Sites 739–742) was not expected at the site; therefore, in order to obtain undisturbed samples for compaction studies, Hole 743A was spudded with the advanced piston corer (APC). Slow drilling rates and low core recovery forced us to switch to the extended core barrel (XCB) system at 15.8 m below seafloor (mbsf). Glacial boulders in a relatively soft clayey matrix impeded core recovery, which averaged 22.4%, but the last eight cores had <9% recovery. The hole was terminated at 98.1 mbsf.

Three lithologic units are identified in the recovered sequence. Unit I (0–0.46 mbsf) is a moderately well-sorted sand, the upper part of which is mixed with diatom ooze, whereas the lowermost part contains size-sorted foraminifers. Unit II (0.46–15.8 mbsf) is a clayey silt generally with up to 1% gravel, interbedded with 1–132-cm-thick layers of sand and gravel. Some of the sands and one silty clay layer contain foraminifers. Unit III (15.8 to a total depth of 98.1 mbsf), although poorly recovered and represented by little more than an assemblage of stones in several core catchers, appears to be dominated by diamicton, with boulders and possibly (unrecovered) sand layers. The diamicton is a massive, stiff clayey silt with sand and mainly 5%–25% gravel.

All the sediments found are normally consolidated, with no sign of ice loading observed. The diatom and foraminiferal assemblages indicate a Quaternary age for the sequence.

The sequence in Hole 743A represents the uppermost and youngest part of the thick prograding unit forming the outer part of the shelf of Prydz Bay. Site 739 sampled the innermost part of the prograding unit. Based on these observations, diamicton sediments deposited from floating glacier ice seaward of the grounding line near the shelf break probably were the major contributor to the sedimentation on the slope. The presence of these sediments near the top of the prograding unit, interbedded with Quaternary sands, indicates that the ice cover reached the shelf break at least once during this period. The other components of the slope sediment are sand and gravel layers, ranging from well-sorted, clearly transported sands to poorly-sorted gravelly sands, which probably represent lag deposits. The marine biogenic component of the sediment is small, chiefly diatoms and foraminifers; no mollusks were recovered. We are uncertain whether the sand units represent "interglacial" periods, similar to present-day conditions of less extensive ice covers, or are due to intermittent variations in the currents that sweep the slope.

BACKGROUND AND OBJECTIVES

Ocean Drilling Program (ODP) Site 743 is the northernmost site of the profile across the shelf of Prydz Bay, consisting of Sites 739 through 743. The general objectives for this profile are described in "Background and Objectives" sections of the "Site 739" and "Site 740" chapters (this volume). Site 743 is on the upper continental slope of Prydz Bay (66°54.99′S, 74°41.42′E) in 988.7 m of water.

Below a 100- to 200-m-thick cover of nearly horizontal layers, a 35- to 50-km-wide band of inclined reflectors is recognized in the seismic sections across the outer shelf of the bay (Stagg, 1985; Mizukoshi et al., in press). The reflectors are chiefly parallel with the continental slope. This suggests that the reflectors represent a prograding sequence of sediments. Prograding processes may still be active because similar reflectors can be observed a little below the present-day slope surface. The innermost part of the prograding sequence was sampled in Hole 739 between 170 and 313 mbsf (lithologic Units III and IV). These units consist chiefly of diamictites, which in Unit III are stratified and are rich in diatoms. The stratification is partly contorted as a result of slumping, and we see some indications of redeposition by debris flows. On the basis of observations in Hole 739 and in short piston cores elsewhere (Anderson et al., 1979), the bulk of sedimentation resulting in progradation is considered to be redeposition of glacial debris from the melting of an ice sheet, with the grounding line close to the shelf break. This process is only effective near the time of maximum extent of ice cover, whereas current-sorted sediments may have been deposited in the intervening periods.

One objective for Site 743 was to examine the sediment types and sedimentary processes on a slope associated with a shelf dominated by glaciogenic sediments. Also, by coring on the slope and sampling the youngest part of the prograding unit, we expected to ascertain whether the Quaternary ice cover reached the edge of the continental shelf in this sector of Prydz Bay. The sedimentary section was also expected to contain a record of late "glacial-interglacial" periods. We also anticipated that the whole

[1] Barron, J., Larsen, B., et al., 1989. *Proc. ODP, Init. Repts.*, 119: College Station, TX (Ocean Drilling Program).

[2] Shipboard Scientific Party is as given in the list of Participants preceding the contents.

sequence would contain marine fossils because the site location probably has been permanently covered by seawater. Lithologic Units III and IV at Site 739 were clearly overconsolidated, possibly by ice and sediment loading, so a comparison with the physical properties of the corresponding sediments on the slope, which have not been loaded, is of interest.

The site was selected as far seaward as possible on the upper slope in order to maximize the marine influence of the sediments and minimize the amount of boulders dropped from grounded ice. However, the continental slope below a water depth of 1000 m is characterized by many small steps, probably indicating slump scarps. In order to optimize the chance for recovery of an undisturbed stratigraphic sequence, the drilling site was selected at a water depth above 1000 m.

SITE GEOPHYSICS

Site Survey

A survey line (ODP line 119-08) was recorded between Sites 742 and 743 using the standard geophysical gear (see "Explanatory Notes" chapter, this volume) and using Global Positioning System and Transit satellite navigation (Fig. 1). Seas were calm, and only a few icebergs and growlers were encountered. The survey line began at the end of ODP line 119-07 (see "Site Geophysics" section, "Site 738" chapter, this volume), ran northwest across the shelf to Site 739, and then crossed the upper slope to Site 743. The line was located near, and parallel to, the Australian Bureau of Mineral Resources seismic line PB-21. The new survey line was recorded because the resolution of line PB-21, a six-channel stacked line, was inadequate to delineate thin units and to trace reflections between drill sites. The high-frequency (25–250 Hz), water gun single-channel seismic data collected on line 119-08 completed the high-resolution transect of the Prydz Bay shelf and provided a significantly improved view of the geology beneath Prydz Bay.

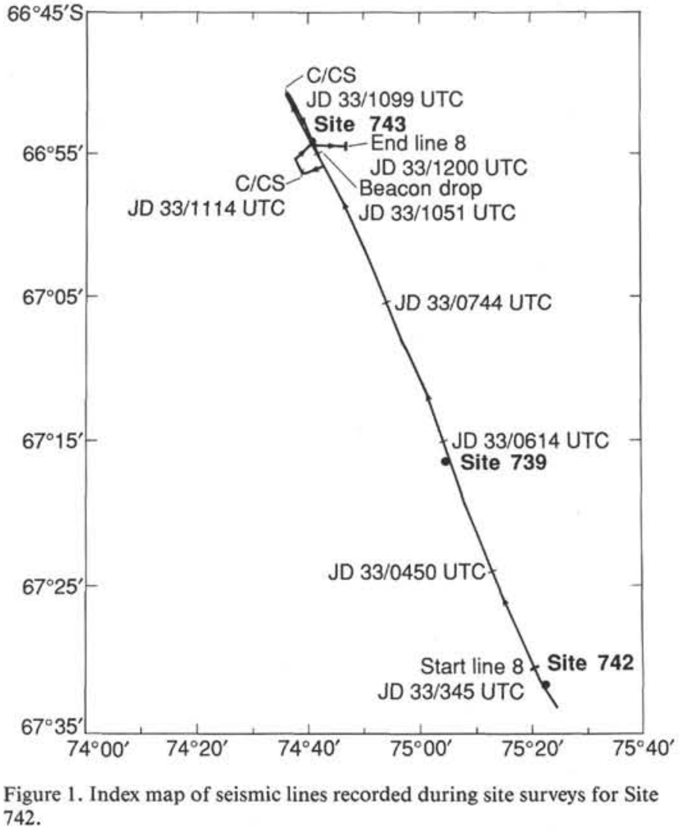

Figure 1. Index map of seismic lines recorded during site surveys for Site 742.

The location for Site 743, on the upper slope of the continental margin (the present-day prograding sediment-wedge), was picked from the seismic data in an area of smooth seafloor (Fig. 2). A tentative site was selected in a water depth of about 1000 m, and the seismic line was continued to water depths of 1500 m to confirm the proper siting. The ship returned to Site 743 on a reciprocal course, and the beacon was dropped. A crossline was run parallel to the slope to confirm the absence of major erosional features. The seismic gear was recovered and the ship returned to the beacon to begin drilling. The seismic results are discussed in "Seismic Stratigraphy" section (this chapter).

Sonobuoy Data

A sonobuoy was not deployed at this site because of the difficulties in recording easily interpretable sonobuoy data across steep slope areas and the limited value of the velocity data to the brief, shallow-penetration drilling operation.

OPERATIONS

Site 743—Antarctic Continental Slope

The final drill site on the southeast-northwest transect of the Prydz Bay area is just seaward of the edge of the continental shelf on a steep northward slope. It is about 69 km northwest of Site 742, but only about 37 km northwest of Site 739. The site area was crossed once, and, after about a 10-km extension of the profile seaward, the beacon was dropped as the ship recrossed the site to the southeast. After a brief crossline, the rig returned to the beacon and took station.

The location was apparently seaward from the grounding line of the Amery Ice Shelf during glacial episodes. We hoped to find an increased amount of marine sediment, with a corresponding decrease in coarse glacial material. The overcompacted diamictites were not expected. For those reasons, the APC/XCB bottom-hole assembly was used in an attempt to achieve better core quality and recovery in the marine intervals.

Hole 743A was spudded with an APC core that found the seafloor at 988.7 m below sea level and recovered 1.3 m of coarse sand and clay. By means of the advance-by-recovery method, five APC cores penetrated to 15.8 mbsf with good recovery (Table 1), including one 7.4-m core with glacial and marine cycles and thin sand beds. Slow progress, short cores, and a failed core liner combined to force the switch to XCB coring.

The first glacial boulder was found in the first XCB core. Coring then continued through a sequence of relatively soft clays, gravels, cobbles, boulders, and (probably) sands. The softer clay lacked the "mortar" quality of the overcompacted diamictite matrix and eroded, allowing the gravel and rocks to fall into the hole. The resulting unstable hole conditions quickly caused drilling problems. By 60 mbsf a mud "pill" had to be pumped with each core, and torquing and sticking were on the increase. First one, then two joints of pipe were set back before cores were recovered. The hard material took its toll on XCB shoes. Core 119-743A-13X required three wireline trips to free an XCB barrel with a belled box connection on the cutting shoe (the result of drilling on a hard boulder). The allotted time for Site 743 expired at the same time drilling conditions became impossible. The drill string was recovered, and the vessel departed after less than 30 hr on site.

LITHOSTRATIGRAPHY AND SEDIMENTOLOGY

Drilling at Site 743 took place in 988.7 m water depth and extended down to 98.1 mbsf. However, because of the presence of boulders in loose sediment, core recovery averaged only 22.4%

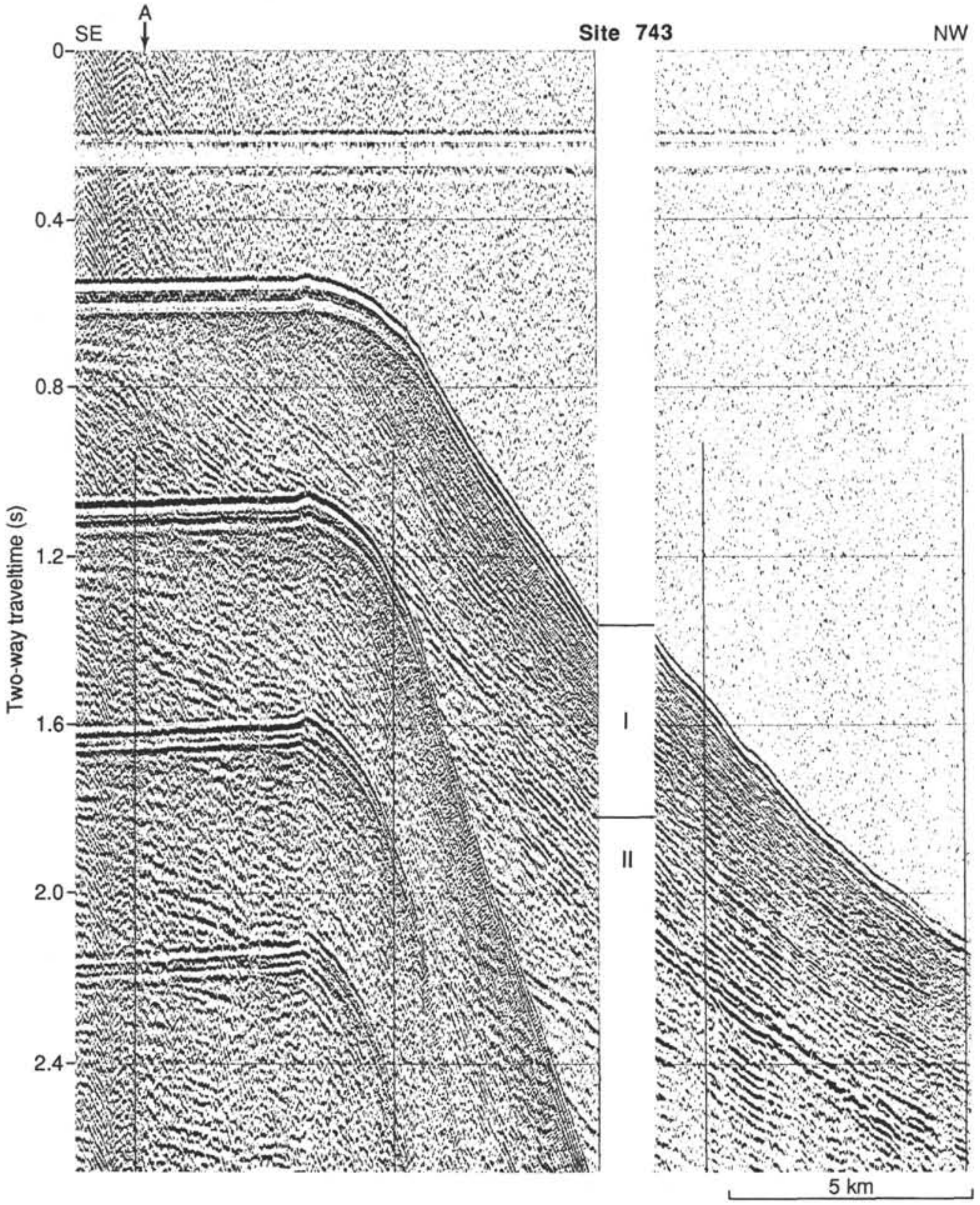

Figure 2. Seismic-reflection profile line 119-08 across Site 743. The seismic lines were recorded during site surveys for Site 742. Point A is discussed in the "Seismic Stratigraphy" section.

and much of the core was disturbed. In view of this, characterization of the sedimentary relationships is difficult, although certain useful conclusions may be drawn from the results.

Three lithologic units are identified in the recovered sequence (Fig. 3 and Table 2). Unit I (0–0.46 mbsf) is a moderately well-sorted sand, the upper part of which is mixed with diatom ooze. Unit II (0.46–15.8 mbsf) is a clayey silt with generally up to 1% gravel, interbedded with sand and gravel. Unit III (15.8–98.1 mbsf) is represented mainly by a few gravel clasts in each core-catcher sample and partially recovered diamictite (clayey silt with gravel). Apart from diatoms in Unit I and thin sands containing foraminifers in Units I and II, the sequence seems to be relatively unfossiliferous. A Quaternary age is indicated by the flora and fauna present.

Smear slide analyses were performed on the finer lithologies in a few cores (Fig. 4). Because discrimination between quartz and untwinned feldspar in these sediments is difficult, the estimates for the two minerals are best considered together. Also, it should be noted that smear slides underestimate the sand and larger fraction considerably.

The sandy beds are tentatively considered to be washed and reworked lag deposits, the result of strong currents acting on the shelf slope. The muddy, gravel-bearing units, including the diamictons, are considered to range from waterlaid till to distal glaciomarine sediment.

Drilling Disturbance

Because of the presence of gravel-sized (>2 mm diameter) material in the sediment, piston coring was not able to retrieve many complete cores. Upon coring, the diamictite tended to be washed of its matrix, and granules, pebbles, cobbles, and boulder fragments became concentrated in the core barrel. Stones of a diameter close to that of the core barrel also tended to disturb the sediment, especially the unconsolidated silty clay near the

Table 1. Coring summary, Site 743.

Core no.	Date (Feb. 1988)	Time (local)	Depth (mbsf)	Length cored (m)	Length recovered (m)	Recovery (%)
119-743A-						
1H	2	2130	0.0–1.3	1.3	1.24	95.4
2H	2	2150	1.3–1.9	0.6	0.54	90.0
3H	2	2220	1.9–4.6	2.7	2.73	101.0
4H	2	2300	4.6–12.0	7.4	7.35	99.3
5H	2	2340	12.8–15.8	3.0	0.79	26.3
6X	3	0125	15.8–21.2	5.4	1.14	21.1
7X	3	0300	21.2–30.7	9.5	0.28	3.0
8X	3	0405	30.7–40.2	9.5	0.22	2.3
9X	3	0530	40.2–49.9	9.7	3.17	32.7
10X	3	0640	49.9–59.6	9.7	2.42	24.9
11X	3	0840	59.6–69.3	9.7	0.55	5.7
12X	3	0950	69.3–78.8	9.5	0.85	9.0
13X	3	1310	78.8–88.4	9.6	0.24	2.5
14X	3	1645	88.4–98.1	9.7	0.28	2.9
				97.3	21.80	22.4

top, which tended to become soupy. Splitting of the soft sediment in the core laboratory created additional disturbance (bowing) of the sediment.

Lithostratigraphy

Unit I

Section 119-743A-1H-1, 46 cm; depth, 0–0.46 mbsf.
Age: Quaternary

Unit I consists of olive gray (5Y 5/2) sand, with up to 50% diatoms in the upper 18 cm, although this percentage may have been a result of the mixing of soupy diatom ooze with sand during the drilling. The sand is loose, medium to coarse grained, and moderately well sorted. It consists of 80% quartz and feldspar, 10% fine-grained amphibolite rock fragments, 7% other rock fragments (including gneisses), 2% biotite, and minor garnet. The rock fragments are subrounded to subangular whereas the quartz and feldspar grains are angular to subangular. From 43 to 46 cm, the sand contains 20% size-sorted foraminifers, and a few gneissic pebbles also occur.

A smear slide analysis of the diatomaceous sand indicated 25% sand, 55% silt, and 20% clay. Compositionally, the sand contains 30% quartz and feldspar, 50% diatoms, 10% clay, 3% opaque minerals, 3% mica, and 1% each of garnet, silicoflagellates, and radiolarians.

Unit II

Sections 119-743A-1H-1, 46 cm, through 119-743A-6X-CC; depth: 0.46–15.8 mbsf.
Age: Quaternary.

This unit is dominated by dark grayish-brown (10YR 4/2) to dark gray (10YR 4/2 and 5Y 4/1) clayey silt or silty clay. In part, it is soft with a high water content (probably as a result of drilling disturbance), but mainly it is a normally consolidated, stiff, and sticky sediment. The sand component is <10%, whereas gravel generally is <1% (maximum 4%). Clasts reach 4 cm in diameter. No bedding features or sedimentary structures were seen, the sediment being entirely homogeneous, even allowing for drilling disturbance. A grayish green (10YR 5/2) silty, clayey sand in Section 119-743A-4H-2 (6.1 mbsf) is liquified.

Interbedded with the clayey silt from 73 cm in Section 119-743A-4H-1 (5.3 mbsf) to 55 cm in 119-743A-4H-2 (6.5 mbsf) is a gravelly sand, consisting from top to bottom of (1) soft, coarse, clayey sand with <1% mainly angular quartz granules and a paler gray color (10YR 5/1); (2) loose, sandy gravel, with 70% gravel, though tending to be less gravelly and olive gray (5Y 5/1) toward the top; and (3) greenish gray (7.5GY 5/2) soft, silty sand with stickiness arising from its clay content. With about 1% gravel, this latter horizon contains angular pebbles up to 3 cm long.

Greenish gray (10GY 4/1, 10GY 5/1, and 5G 5/1) clayey and silty sand with pebbles up to 3.5 cm in length occurs in Section 119-743A-4H-4, which contains foraminifers between 53 and 112 cm (9.6–10.2 mbsf). Several sand layers up to a few centimeters thick, containing foraminifers, also occur between 61 and 99 cm within stiff gray clay in Section 119-743A-4H-5 (11.2–11.6 mbsf). The contacts between the sand and clay are sharp, but internally the sand beds are structureless.

Analyses of five smear slides indicate strong homogeneity in grain size within the fine sediments—5%–15% sand, 60%–75% silt, and 20%–30% clay— although one sample has a greater proportion of clay (60%). The sediment composition (Fig. 4) consists of 65%–75% quartz and feldspar, 15%–20% clay, 5% opaque minerals, 5% mica, a minor amount of garnet, and, toward the top, a trace of diatoms (the somewhat different sample referred to previously has 35% clay).

Unit III

Sections 119-743A-7H-1 through 119-743A-14H-CC; depth, 15.8–98.1 mbsf.
Age: Quaternary.

Although poorly recovered and represented by little more than an assemblage of stones in some of the core catchers, this unit appears to be dominated by diamicton. The diamicton is a clayey silt with sand and gravel. The gravel ranges from 5% to 25% in most sections (40% in one, though this could be a drilling concentrate). This sediment is very dark gray (5Y 3/1), massive, structureless, and very stiff.

Two studies of clast roundness indicate proportions of 4%–6% rounded, 40%–41% subrounded, 41%–44% subangular, and 6%–12% angular. The largest clast recovered is 7 cm in diameter, and many clasts are faceted. The clasts include quartz-feldspar-garnet-amphibole gneiss, medium-grained amphibolite, quartz-feldspar-garnet-biotite layered gneiss, amphibole-pyroxene-feldspar gneiss, garnet-amphibole gneiss, altered coarse-grained feldspar-amphibole gneiss, syenite, and calcareous sandstone. A few clasts have marked weathering rinds. Some clasts of gneiss are broken down to their constituent grains, but others are fresh.

Smear slide studies indicate the following range of grain sizes from three samples: 5%–20% sand, 50%–60% silt, and 30% clay. The main minerals are 65%–70% quartz and feldspar (combined), 20%–25% clay, 3%–5% opaque minerals, 0%–3% pyroxene and amphibole, and 2%–3% mica.

Interpretation

The recovered succession was dominated by glaciogenic deposition, but with periods of sediment reworking by currents in Units I and II. In the absence of ages for the lower sediments, rates of deposition are unknown. However, the net accumulation of these probable Quaternary (Pleistocene) sediments is undoubtedly far greater than on the shelf, where periods of glacial erosion may have been interspersed with depositional events.

Unit I probably represents two separate lithologies mixed during drilling: (1) diatom ooze with only a small influence from ice-rafted material and (2) moderately well-sorted sand that probably represents a reworked deposit derived from underlying glacial sediment and sorted by strong contour or bottom currents. A high degree of sorting is indicated by the sands with size-graded foraminifers. Both these sediments post-date the time

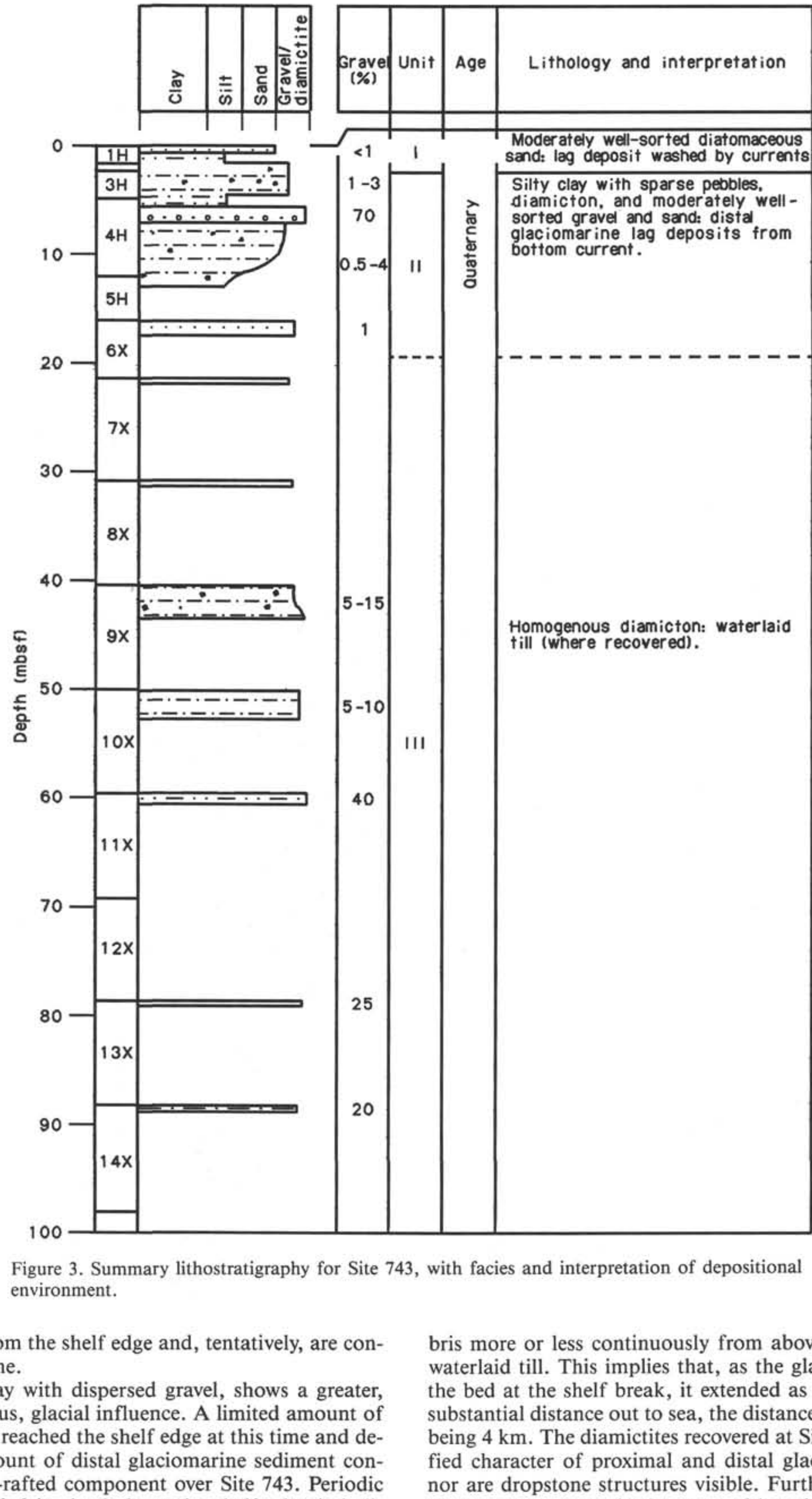

Figure 3. Summary lithostratigraphy for Site 743, with facies and interpretation of depositional environment.

when ice withdrew from the shelf edge and, tentatively, are considered to be Holocene.

Unit II, a silty clay with dispersed gravel, shows a greater, but still not continuous, glacial influence. A limited amount of floating ice may have reached the shelf edge at this time and deposited a limited amount of distal glaciomarine sediment containing a variable ice-rafted component over Site 743. Periodic withdrawal of grounded ice back from the shelf edge is indicated by the presence of reworked sands, as in Unit I.

Unit III is entirely dominated by glacial deposition. The massive, homogeneous nature of the diamicton and the presence of drilling-displaced boulders suggest rain-out of basal glacial debris more or less continuously from above, accumulating as a waterlaid till. This implies that, as the glacier uncoupled from the bed at the shelf break, it extended as a floating ice shelf a substantial distance out to sea, the distance from the shelf break being 4 km. The diamictites recovered at Site 743 lack the stratified character of proximal and distal glaciomarine sediments, nor are dropstone structures visible. Furthermore, no evidence of slumping appears in the cores, although large-scale slumping further downslope is indicated from the seismic records.

Unit III is probably the time-equivalent of part of the bouldery lodgement tills inferred to exist on the shelf ("Lithostratigraphy and Sedimentology" sections, "Site 739" through "Site

Table 2. Summary of lithologic units, Site 743.

Age	Unit	Depth (mbsf)	Cores	Lithology
	I	0–0.46	119-743A-1H, 0–46 cm	Diatom-rich sandy silt
			----- Contact disturbed by drilling -----	
Quaternary	II	0.46–15.8	119-743A-1H, 46 cm, to 119-743A-6X-CC	Clayey silt with lonestones interbedded with sand and gravel
			----- Nonrecovered interval -----	
	III	15.8–98.1	119-743A-7X, 0 cm, to 119-743A-14X-CC	Massive diamicton, but mainly only clasts recovered

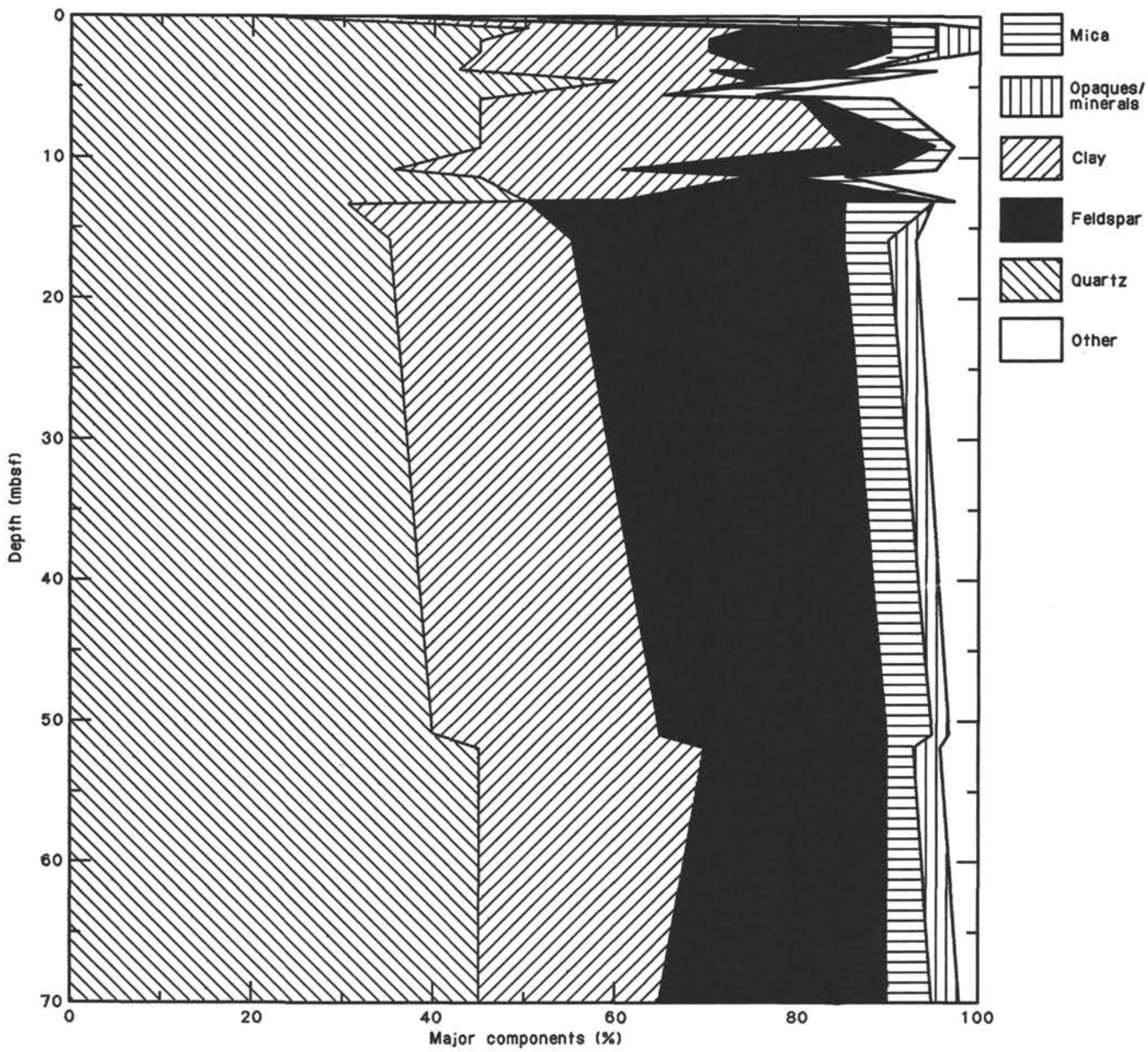

Figure 4. Smear slide compositional data plotted as cumulative percent. Note that there are few data points.

742" chapters, this volume). Sediments formed by the same processes as Unit III are probably represented by similar facies in the lower Cenozoic sediments that form part of the seismically determined prograding sequence beneath the shelf at Sites 739 and 742. The results also indicate that most of the prograding sequence is linked with the presence of grounded ice close to the shelf break; whereas, interglacial sedimentation on the slope seems to have been limited. This may be a reflection of the landward tilt of the shelf under the influence of ice-loading, the shelf, therefore, acting as a sediment trap. Furthermore, benthic life, such as bivalves, is very restricted in the slope environment.

BIOSTRATIGRAPHY

The 98.1-m sequence of marine diamictite drilled at Site 743 is barren of calcareous nannofossils, radiolarians, and dinoflagellates. Diatoms are rare and poorly preserved in the upper 12 m, but absent below. Foraminifers occur in several sandy intervals, indicating local reworking, down to Sample 119-743A-10X-CC (69 mbsf). No foraminifers were found below this level. The age of the foraminifer-bearing interval is between late Miocene and Holocene, based on the presence of the planktonic foraminifer *Neogloboquadrina pachyderma*.

Calcareous Nannofossils

No calcareous nannofossils were recovered from Site 743.

Foraminifers

The most common foraminifer species from Site 743, *Neogloboquadrina pachyderma*, is the only planktonic form recognized. It is abundant in some moderately-sorted foraminifer sand horizons, such as Samples 119-743A-1H-1, 42–43 cm, and 119-743A-4H-4, 83–85 cm, and it also occurs in rare abundance in several moderately- to poorly-sorted intervals down to Sample 119-743A-10X-CC. This indicates an age between late Miocene and Holocene for the upper 60 m of Hole 743A.

The mud-line sample contains a low-diversity benthic foraminifer assemblage, with few specimens of *Trochammina* spp., *Recurvoides scitulus, Cribrostomoides jeffreysi, Eponides tumidulus*, and *Eponides bradyi. Globocassidulina subglobosa* and *Trifarina* sp. are the most common benthic species, occurring in low abundance in several samples with *N. pachyderma*. Sample 119-743A-4H-4, 83–85 cm, yields the most diverse benthic fauna, including specimens of *G. subglobosa, Trifarina* spp., *Cibicides* sp., *Fissurina fimbriata, Pseudobolivina* sp., *Uvigerina* sp., *Nonion* sp., *Ehrenbergina spinea, Pullenia bulloides, Astronion gallowayi, E. bradyi, Oolina* sp., and *Cibicides lobatulus*. Most of the foraminifer assemblages from Site 743 are considered slightly reworked because of the size sorting of the sediments in which they were found.

Diatoms

Rare, poorly-preserved diatoms were found in Samples 119-743A-4H-2, 47 cm, and 119-743A-4H-4, 84 cm, occurring in foraminifer sands. The presence of *Nitzschia kerguelensis* in the latter sample indicates that the upper 12 m of Hole 743 is late Pliocene to Quaternary in age. Diatoms are absent from other samples examined from this hole.

Radiolarians

No radiolarians were found at Site 743.

Dinoflagellates

No dinoflagellates were found at Site 743.

PALEOMAGNETICS

Paleomagnetic sampling and study was very limited for cores from Site 743 because the majority of the sediments showed drilling disturbance or were very poorly consolidated. Half-core cryogenic magnetometer measurements were completed on Cores 119-743A-3H, 119-743A-4H, 119-743A-6X, and 119-743A-9X. The remaining cores were too liquid to be processed in the magnetometer. With the exception of two measurements (Samples 119-743A-3H-2, 130 cm, and 119-743A-3H-2, 140 cm), all of the inclination measurements were negative (most ranging from $-30°$ to $-90°$), indicating normal magnetization in the Southern Hemisphere. The sediments were strongly magnetized, ranging from 10 to 100 mA/m.

Discrete sample, alternating field demagnetization studies were conducted on representative samples from this hole, using peak fields of 30 mT. The samples displayed a large range of magnetic properties. Mean destructive fields varied from 2 to 24 mT, with most falling between 2 and 11 mT. Sixty percent of the pilot samples were directionally unstable and showed large and erratic changes in direction on demagnetization. The remaining samples displayed directional stability, but two components of magnetization. No correlation of the polarity of cores from this site with a reference polarity sequence was attempted because of the paucity of reliably determined magnetic directions.

SEDIMENTATION RATES

The paucity of microfossils prevents the calculation of sediment-accumulation rates at this site.

INORGANIC GEOCHEMISTRY

Three whole-round minicores (5–10 cm in length) were obtained for the purpose of interstitial-water chemical studies. Samples 119-743A-1H-1, 94–99 cm, and 119-743A-3H-1, 145–150 cm, are glacially deposited clayey siltstones from lithologic Unit II, and Sample 119-743A-9X-1, 145–150 cm, is a diamictite from lithologic Unit III (see "Lithostratigraphy and Sedimentology" section, this chapter). The minicores contain 0.1%–0.2% calcium carbonate and 0.2%–0.3% organic carbon (see "Organic Geochemistry" section, this chapter).

Results

Site 743 interstitial-water samples were analyzed for pH, alkalinity, salinity, chloride, sulfate, magnesium, calcium, phosphate, ammonium, and silica using the methods outlined in the "Explanatory Notes" chapter. Hole 743A was cored using the APC and XCB methods. Core recovery was poor (22.4%) and a significant amount of drilling disturbance was noted in the lithologic descriptions (see "Lithostratigraphy and Sedimentology" section). Charge-balance calculations were performed on each of the interstitial-water samples to check for gross irregularities in the data that might result from drilling contamination. Sodium and potassium were calculated by multiplying the ratio of each cation to chloride for average seawater, using the values given by Stumm and Morgan (1981), by the chloride concentration of each sample. All of the samples have charge imbalances of around 2% or less, indicating that drilling contamination was minimal and that the interstitial waters and any contaminants have a seawater origin. All of the data obtained at Site 743 are displayed in Table 3.

An increase in chloride concentrations occurs between 3 and 42 mbsf at Site 743. Samples from lithologic Unit II have chloride concentrations similar to that of seawater. Chloride concen-

Table 3. Interstitial-water geochemical data, Site 743.

Core, section, interval (cm)	Depth (mbsf)	Volume (mL)	pH	Alkalinity (mmol/L)	Salinity (g/kg)	Magnesium (mmol/L)	Calcium (mmol/L)	Chloride (mmol/L)	Sulfate (mmol/L)	Phosphate (μmol/L)	Ammonium (mmol/L)	Silica (μmol/L)	Mg^{2+}/Ca^{2+}
119-743A-													
1H-1, 94–99	0.94	18	7.3	3.12	34.5	50.3	10.6	544	30.5	6	0.08	412	4.7
3H-1, 145–150	3.35	21	7.7	2.97	35.2	49.1	11.4	547	28.5	3	0.06	386	4.3
9X-1, 145–150	41.65	14	7.8	2.59	35.2	36.8	20.9	564	22.5	3	0.23	520	1.8

tration increases 3% between 3 and 42 mbsf. Interpretations of this increase are difficult to support without more data, but the higher chloride concentration at 42 mbsf may represent the composition of seawater prior to the last deglaciation event.

Magnesium and calcium concentrations are well correlated ($r = -0.9999$) in the upper 42 mbsf at Site 743. Magnesium concentrations decrease and calcium concentrations increase with increasing depth. The concentration gradients of these cations in the interstitial waters are probably controlled by diffusion properties between the oceanic magnesium source and calcium sink and a calcium source and magnesium sink at depths below 42 mbsf (McDuff and Gieskes, 1976).

Interstitial-water silica concentrations are variable and elevated well above seawater concentrations in Hole 743A. The average silica concentration of the samples is 439 μmol/L, with a standard deviation of 71 μmol/L. These concentrations are approximately 10 times greater than surface seawater near this site and are a result of the dissolution of biogenic silica in the sediments.

Microbial catabolism is limited by the low abundance of organic matter (<0.5% organic carbon) in the sediments at Site 743. Phosphate and ammonium concentrations are very low (less than 10 μmol/L and 0.3 mmol/L, respectively), and sulfate concentration drops only 24% in the upper 42 mbsf. Ammonium concentrations increase 16% between 3 and 42 mbsf, indicating that the decrease in sulfate is due to microbial sulfate reduction. The high sulfate concentration at 42 mbsf (22.5 mmol/L) indicates that the main zone of sulfate reduction occurs at a greater depth.

Table 4. Total carbon, inorganic carbon, organic carbon, and carbonate carbon, Site 743.

Core, section, interval (cm)	Depth (mbsf)	Total carbon (%)	Inorganic carbon (%)	Organic carbon (%)	$CaCO_3$ (%)
119-743A-					
1H-1, 90–92	0.90		0.01		0.1
1H-1, 94–99	0.94	0.21	0.01	0.20	0.1
1H-CC, 0–1	0.99	0.51	0.00	0.51	0.0
2H-CC, 0–1	1.61	0.33	0.02	0.31	0.2
2H-CC, 16–17	1.77		0.01		0.1
3H-1, 116–117	3.06		0.02		0.2
3H-1, 145–150	3.35	0.30	0.02	0.28	0.2
3H-2, 70–71	4.10		0.02		0.2
3H-CC, 0–1	4.40	0.33	0.02	0.31	0.2
4H-1, 43–44	5.03		0.02		0.2
4H-2, 35–36	6.45		0.29		2.4
4H-3, 119–120	8.79		0.05		0.4
4H-4, 71–72	9.81		0.50		4.2
4H-5, 21–22	10.81		0.02		0.2
4H-CC, 0–1	11.55	0.45	0.06	0.39	0.5
5H-1, 33–34	13.13		0.06		0.5
6X-1, 41–42	16.21		0.05		0.4
6X-CC, 0–1	16.62	0.57	0.08	0.49	0.7
9X-1, 91–92	41.11		0.01		0.1
9X-1, 145–150	41.65	0.32	0.01	0.31	0.1
9X-2, 113–114	42.83		0.02		0.2
9X-CC, 0–1	43.04	0.39	0.06	0.33	0.5
10X-1, 120–122	51.10		0.02		0.2
10X-CC, 0–1	51.91	0.21	0.02	0.19	0.2
12X-1, 20–21	69.50		0.02		0.2

ORGANIC GEOCHEMISTRY

Organic geochemistry was studied on squeeze-cake samples of interstitial-water studies and carbonate samples from Site 743, 0–97.3 mbsf, as outlined in the "Explanatory Notes" chapter. Analyses were performed only on samples from the top 70 mbsf because of the poor core recovery in the interval below.

Hydrocarbon Gases

The headspace procedure was used approximately every 30 m to determine hydrocarbon gases. All of the samples had less than 7 ppm methane. No ethane was detected at Site 743.

Carbon Analysis

Inorganic carbon and total carbon were measured on all of the interstitial-water squeeze-cake and carbonate samples. The difference between total carbon and inorganic carbon is total organic carbon (TOC) (see Table 4 and Fig. 5). Samples from Site 743 have between 0.19% and 0.51% TOC.

Rock-Eval Pyrolysis

Rock-Eval pyrolysis summary is shown in Table 5. Plots of important data and calculations are shown in Figures 6 through 8. Figure 9 is a modified van Krevelen plot of oxygen index vs. hydrogen index.

The carbon at Site 743 is a mixture mainly of reworked type III kerogen. A minor contribution of type II kerogen probably is present. Recent carbon appears to be less than the reworked component of the carbon at Site 743, as T_{max} values are generally high. Only Sample 119-743A-2H-CC, 0–1 cm, has a significant amount of immature carbon (T_{max} = 435°C).

BIOLOGY AND OCEANOGRAPHY

Physical Characteristics of the Marine Ecosystem

Winds were light and the sky was overcast during the occupation of Site 743, 2–3 February 1988 (see Table 6). Surface-seawater temperature at the drill ship was +0.7° to +0.8°C just outside the shelf break in the Prydz Bay region. The top 30 m of the water column was homogeneous and apparently well mixed, and a marked pycnocline was present below that depth (Fig. 10). Lower salinity near the surface could be attributed, in part, to the freshwater runoff from glacial ice. On the service vessel, *Maersk Master*, the Secchi disc disappeared at depths of 11 and 10 m on the sequential days. From these optical observations, the estimated euphotic zones were at about 30.4 and 27.1 m, respectively, which included most of the mixed layer.

Phytoplankton

Phytoplankton was sampled by two horizontal (surface) tows and repeated vertical hauls of opening and closing 35-μm-mesh nets, as well as by vertical hauls of 64- and 80-μm nets from 200 m to the surface both days. Raw water samples were refrigerated for inoculation into a growth medium at Texas A&M University. A hydrocast provided water samples from 0, 10, 25,

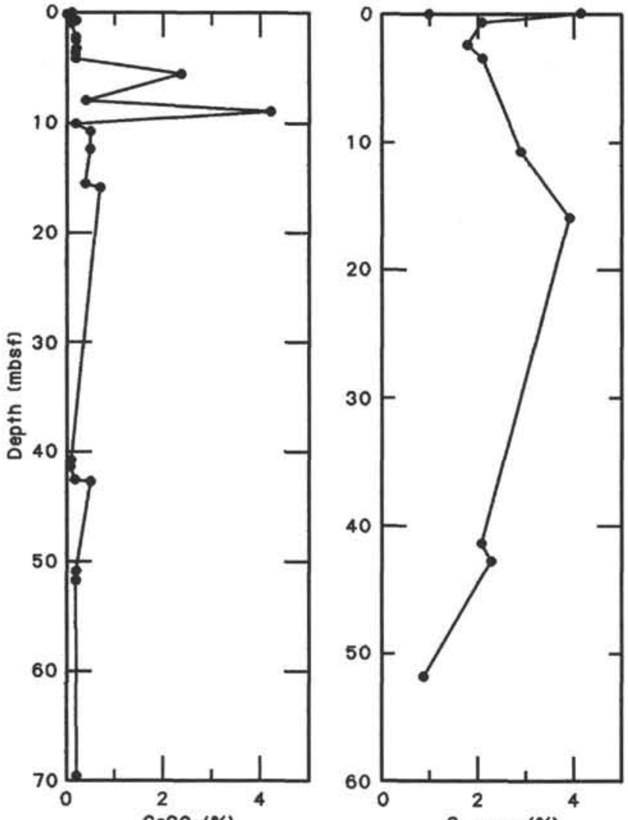

Figure 5. Carbonate carbon and organic carbon, Site 743.

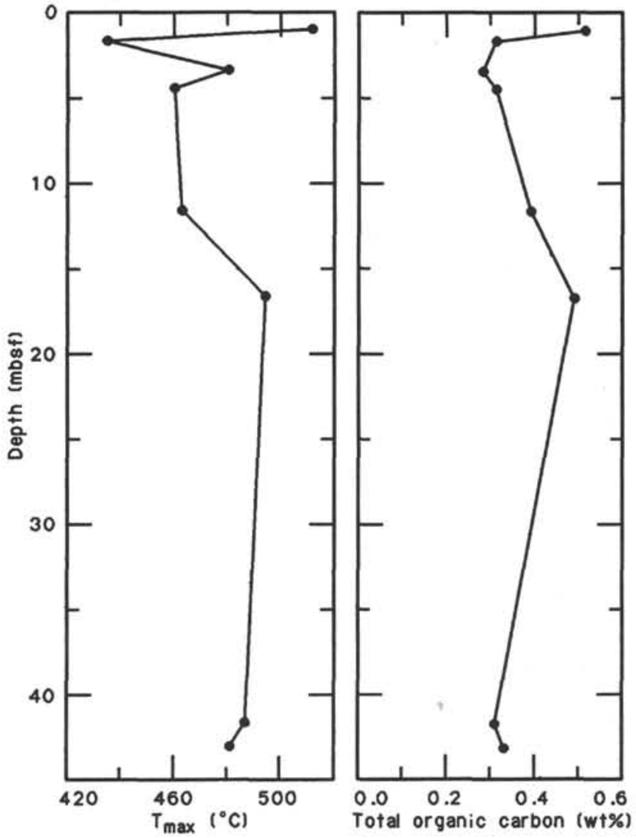

Figure 6. T_{max} and total organic carbon, Site 743.

33, 76, 100, and 200 m in the water column for filtering. These filters were used for chlorophyll estimations and chemical analyses. Phytoplankton cell numbers will be estimated in a shore-based study to provide different information from the net hauls. Although they provide a good estimate of the number of nannoplankton in a discrete parcel of water, the larger-net plankton species are usually not captured in high enough numbers for counts to be statistically reliable.

At this station, especially, the two methods are expected to give augmenting information, combining the differences in the sample contents and the material included in fecal pellets. The net contents were depauperate and full of empty cells. In the top 50 m, the sample was dominated by *Corethron criophilum* and *Corethron inerme* in poor condition, although several *Chaetoceros, Nitzschia, Rhizosolenia, Asteromphalus*, and *Thalassiosira* species were also in the sparse sample that included more than the entire euphotic zone.

The 50–100-m sample was also sparse, but many specimens of *Distephanus speculum*, a cold-water silicoflagellate, were apparent. Long arches of the ice-related diatom, *Nitzschia subcurvata*, were formed by chains of slender, curved frustules connected by their tips. Many grazers were present, although they often can avoid capture in a fine-meshed net that filters water slowly enough that a pressure cone can precede it in the water. The fecal pellets were heavily pigmented, and even the fecal strings of mostly fragmented cells (as krill produce) provided a substrate for the growth of very small cells. The pigmentation could be the result of superfluous feeding on abundant phytoplankton as it was transported offshore, resulting in short gut-retention times and incomplete digestion. Alternatively, since fe-

Table 5. Rock-Eval summary, Site 743.

Core, section, interval (cm)	Depth (mbsf)	Weight (mg)	T_{max} (°C)	S1 (mg HC/g)	S2 (mg HC/g)	S3 (mg CO_2/g)	Productivity index	S2/S3	Pyrolyzed carbon (0.08 [S1 + S2])	Total organic carbon (wt%)	Hydrogen index (mg HC/g C_{org})	Oxygen index (mg CO_2/g C_{org})
119-743A-												
1H-CC, 0–1	0.99	126.5	510	0.07	0.41	0.61	0.15	0.67	0.04	0.51	80	119
H-CC, 0–1	1.61	106.5	435	0.30	0.55	0.17	0.36	3.23	0.07	0.31	177	54
3H-1, 145–150	3.35	127.6	480	0.16	0.39	0.18	0.30	2.16	0.04	0.28	139	64
3H-CC, 0–1	4.40	98.3	460	0.39	0.57	0.26	0.41	2.19	0.08	0.31	183	83
4H-CC, 0–1	11.55	116.5	463	0.30	0.46	0.22	0.39	2.09	0.06	0.39	117	56
6X-CC, 0–1	16.62	104.5	494	0.11	0.40	0.44	0.22	0.90	0.04	0.49	81	89
9X-1, 145–150	41.65	123.1	487	0.17	0.51	0.14	0.25	3.64	0.05	0.31	164	45
9X-CC, 0–1	43.04	114.6	481	0.09	0.08	0.21	0.56	0.38	0.01	0.33	24	63

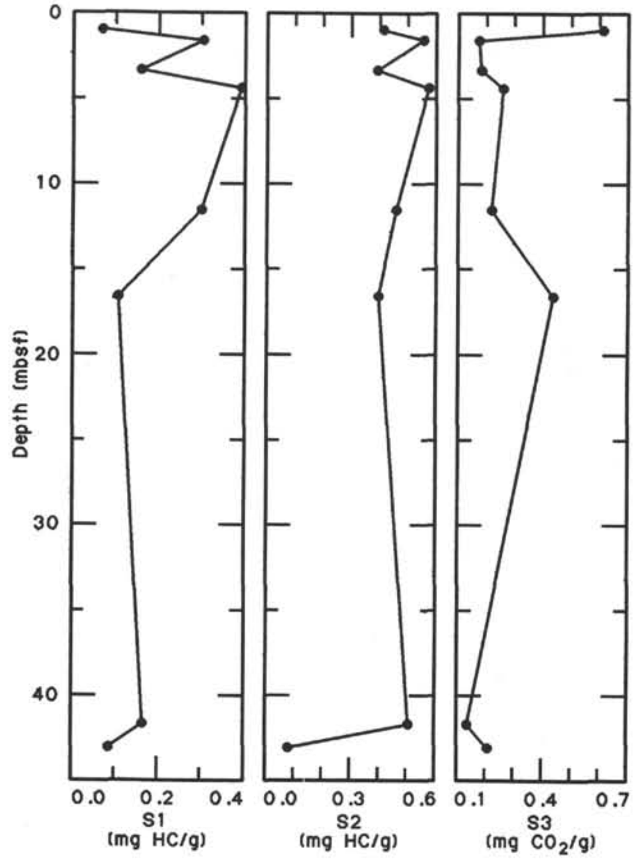

Figure 7. S1, S2, and S3 from Rock-Eval pyrolysis, Site 743.

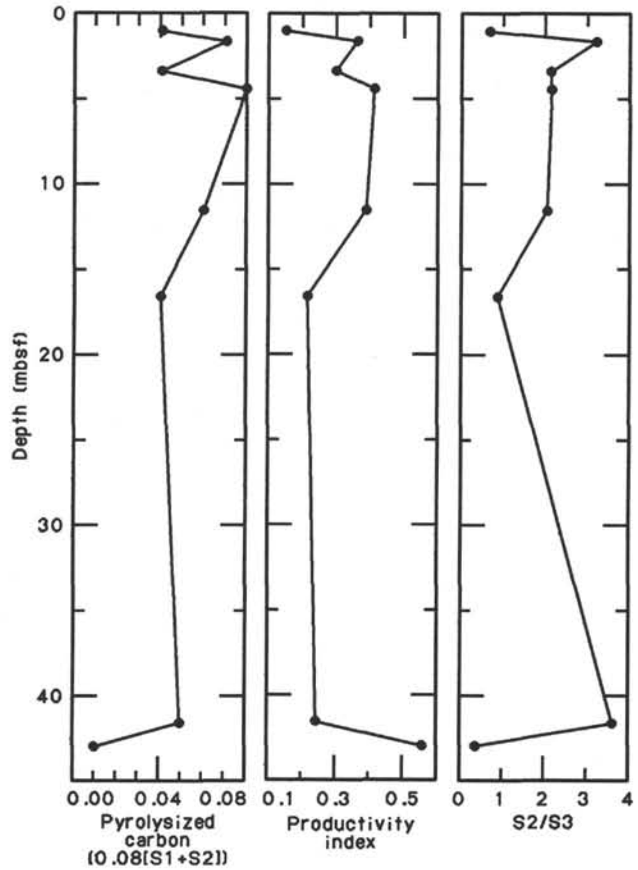

Figure 8. Pyrolysized carbon, productivity index, and S2/S3 calculated from Rock-Eval pyrolysis, Site 743.

cal pellets were sinking slowly in a stable water column, due in part to an increase in meltwaters from the glacier, living cells could have been allowed additional time in the euphotic zone to multiply.

In the 100–200-m sample, grazers again abounded. More centric discoid diatoms occurred, some appearing quite healthy, in contrast to the mostly empty *Corethron* cells. *D. speculum* was also in these depths as well as many *Leptocylindrus mediterraneus* and its accompanying epiphytic cells. Several species occurred in two forms: (1) *Stellarima microtrias* in both the vegetative theca and heavily silicified resting spore and (2) *Thalassiosira ritscheri* and *Thalassiosira tumida* in lightly silicified vegetative thecae, together with heavier, coarser thecae that appear to be produced at the colder depths (−1.8°C; Fig. 10). The fine structure of the processes on these cold-water forms stays the same, although the areola patterns differ markedly. These comparisons will be part of a shorebased study, especially meaningful in this context, because the heavily silicified forms are found in the sediments.

Diatoms in Surface Sediments

The heavy grazing pattern seen in the phytoplankton was consistent with the sparse numbers of fragmented thecae at the mud line (Sample 119-743A-1H-1, 0 cm). Consumers can prefer deeper water but feed on waves of phytoplankton produced inshore. Species found that were not seen at Site 740 include *Azpeitia tabularis, Navicula directa, Stellarima microtrias*, and *Synedra reinboldii*. This assemblage was dominated by heavily silicified *Nitzschia kerguelensis*, although it was not abundant enough to be noted in the preliminary study of net hauls from late austral summer at the shelf break. Long, slender valves (80 μm long, 7.5 μm wide) were mixed at the mud line with shorter, broader forms. Hasle (1965, 1968) recorded similar size ranges (10–76 μm, 5–11 μm wide), but the length/width ratios of valves in the sediment will be interesting to compare with those presently found in the phytoplankton in Prydz Bay and over the Kerguelen Plateau. In addition, cells must be cultured in controlled conditions to understand patterns in coarse and fine structure on valves within the same chain.

PHYSICAL PROPERTIES

Site 743 was drilled to investigate the sediments and sedimentary processes in the slope environment of a high-latitude, glaciated, continental margin. Sedimentary variations in this area, beyond the outer limit of grounded ice, were expected to throw more light on results obtained at Sites 739 and 742 on the outer shelf. The glacially affected shelf and slope environment is poorly known, and coring through one or more glacial-interglacial cycles in Prydz Bay would potentially be of great significance in interpreting similar sequences elsewhere.

The main objective of the physical-properties program at Site 743 was to compare geotechnical parameters of the slope environment with those of the shelf, where glacial loading and erosion had occurred. Furthermore, the geotechnical characteristics of the slope sediments may be essential in determining the importance of erosional processes, in particular through slumping. The latter has been shown to be an important process on the continental slope off Norway and in the Barents Sea (Bugge, 1983; Solheim and Kristoffersen, 1984). The upper slope may be an area of rapid deposition, in particular during early stages of deglaciation, and unstable sediment masses, susceptible to slumping, may accumulate. The Antarctic margin may, how-

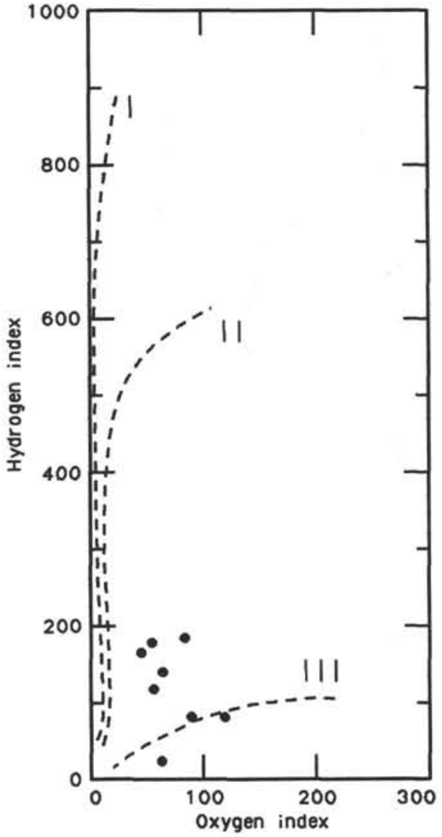

Figure 9. Modified van Krevelen plot of oxygen index vs. hydrogen index, Site 743.

Table 6. Wind and weather summary, Site 743.

2 February 1988/1800 to 2359 (UTC)
Wind: Light and variable.
Sea-surface temperature: 0.7°C.
Waves: 1-2 m.
Sky: Overcast with light snow. Pressure rising.
Air temperature: 0.1°C.

3 February 1988/0000 to 1500 (UTC)
Wind: Variable direction less than 8 kt becoming southeast 8-12 kt by end of the period.
Sea-surface temperature: 0.8°C.
Waves: 2-3 m.
Sky: Mostly cloudy. Occasional snowshowers ending by 0800. Pressure rising slightly then falling by 1200 hr.
Air temperature: Max. 1.0°C at 1200
Min. −0.9°C at 0000

ever, be different, because of its inversely sloping shelf, hampering sedimentation on the continental slope proper.

Physical properties measured were (1) index properties, (2) undrained shear strength, (3) compressional-wave velocity, and (4) thermal conductivity (Table 7). Wet-bulk density was measured both by gravimetrical means and by continuous runs with the GRAPE, with the latter method used on whole-round core sections. The values are referred to as bulk density and GRAPE density, respectively. Undrained shear strength was measured both by Wykeham-Farrance vane shear apparatus and fall cone penetrometer. The compressional-wave velocity was measured both with the continuous *P*-wave logger (PWL) on whole-round core sections and in discrete intervals in the Hamilton Frame Velocimeter. Techniques and laboratory methods used are further discussed in the "Explanatory Notes" chapter.

One hole, 743A, was drilled at the site with the APC to 15.8 mbsf and XCB to total depth at 98.1 mbsf. Because of abundant pebbles and boulders throughout the drilled sequence, the core recovery was very low, averaging only 21.8% (see "Operations" section, this chapter).

Results

The poor core recovery precludes the establishment of a detailed stratigraphic section for this site, but three lithologic units were defined (see "Lithostratigraphy and Sedimentology" section). The different units are Unit I (0-0.46 mbsf)—diatom-rich sandy silt, Unit II (0.46-15.8 mbsf)—clayey silt with clasts, interbedded with sand and gravel, and Unit III (15.8-98.1 mbsf)—diamicton. The entire drilled sequence is of Quaternary age.

These units are best expressed in the index-properties plots, but can also be identified in the the shear strength and velocity profiles. The unsorted character of diamictons usually gives rise to a large scatter in the measured physical properties. To obtain fully representative values of index properties and velocity, measurements of considerably larger samples than those available would be needed. The scatter in the shear strength values is most likely also due to the unsorted character of the sediment. The differences in values between the two types of measurements is a function of the different methods of measurement and their different reactions upon grain-size differences. Two of the lowermost three data points of the fall cone plot are at the upper range for this instrument and may be dubious. However, the most important aspect is that the two profiles show similar depth trends. Minimum, mean, and maximum values for the main geotechnical properties are listed in Table 8. Because of the large scatter of the fall cone shear strength in the lower part of the hole, only vane shear strength is included in this table.

Unit G1

Geotechnical unit G1 (0-9.9 mbsf) covers lithologic Unit I and the upper part of Unit II. It shows overall relatively constant depth trends. Average values are (1) water content, 16.8%; (2) porosity, 32.3%; (3) bulk density, 2.23 g/cm^3; (4) vane shear strength, 24 kPa; and (5) compressional-wave velocity, 1817 m/s (Table 8). Some variations are noticeable, however. The interval of approximately 1.5-3.1 mbsf has low water content and porosity, with a corresponding peak in bulk density, velocity, and shear strength. Other variations occur further down the unit, particularly in the vane shear strength. This mostly reflects different lithologies within the unit, with a low of 3 kPa measured in a loose foraminifer-rich sand. However, drilling disturbance cannot be excluded as a reason for the variations.

Unit G2

This unit (9.9-11.4 mbsf), which is intermediate in lithologic Unit II, is geotechnically the most characteristic in the drilled sequence. It shows a distinctly high water content and porosity, with correspondingly lower values of bulk density and velocity. The continuous GRAPE and PWL measurements both confirm the trends observed in the discrete measurements. However, shear-strength values show no anomalous values within this interval. Average values for the unit are (1) water content, 32.9%; (2) porosity, 56.5%; (3) bulk density, 1.85 g/cm^3; (4) vane shear strength, 36 kPa; and (5) compressional-wave velocity, 1596 m/s (Table 8). There are only four data points within the interval, but all values are consistent and are clearly different from those above and below. Although this interval has not been defined as a lithologic unit, it appears as a more clayey sediment than that found above and below, and part of the interval is classified as a

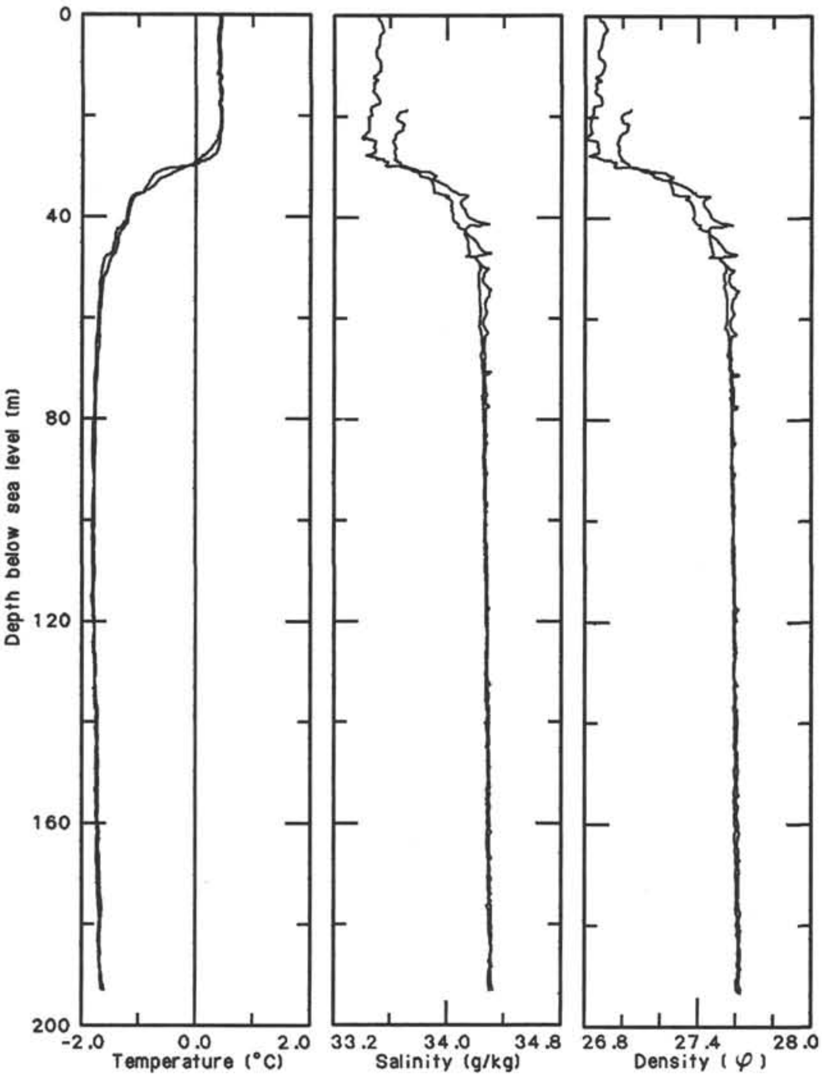

Figure 10. Conductivity, temperature, and depth profiles in the top 200 m of the water column. Both the downtrace and uptrace have been included to show the reliability of the instrument and the variation within the water column. The surface 20 m have been erased from the downtraces because of noise in the system as the unit became equilibrated to the seawater. CTD-16: 2 February 1988, 1600–1610 hr (local time); 66°52.27′S, 74°37.97′E. Fresher, warmer water combined to make a stable water column just beyond the Antarctic shelf break. The top 30 m appears relatively homogeneous in both temperature and salinity, with a marked pycnocline just at the base of the euphotic zone.

stiff, gray clay, with interbedded foraminiferal sand layers (see "Lithostratigraphy and Sedimentology" section). That the unit appears more clayey visually and that the shear-strength values do not change beyond the general scatter indicate that the differences seen in the other physical properties result from grain-size effects. A possible implication of this could be short-term oscillations of the ice front, resulting in different sedimentary facies, or climatic effects, resulting in variations in output of glacial sediment.

Unit G3

Unit G3 (11.4–98.1 mbsf) has few data points, and much variation may be hidden in the low-/no-core-recovery intervals. However, within the constraints set by the core recovery, all geotechnical parameters show relatively consistent depth trends. Water content and porosity decrease slightly, while bulk density and shear strength increase overall. Compressional-wave velocity also shows a general increasing trend, but has a distinct decrease between approximately 41 and 43 mbsf. Average values for this unit are: (1) water content, 15.52%; (2) porosity, 31.8%; (3) bulk density, 2.32 g/cm^3; (4) vane shear strength, 106 kPa; and (5) compressional-wave velocity, 2048 m/s (Table 8).

Thermal Conductivity

Thermal-conductivity values (Fig. 11 and Table 9) show values around 2.0 W/m/°C. There are few data points, and no significant downhole change can be detected. The values are similar to those measured at Site 742 (see "Physical Properties" section, "Site 742" chapter) and are probably representative of unsorted glaciogenic diamictons and diamictites.

Table 7. Physical properties measured at Site 743.

Core, section, interval (cm)	Depth (mbsf)	Water content (%)	Porosity (%)	Wet-bulk density (g/cm³)	Dry-bulk density (g/cm³)	Grain density (g/cm³)	Undrained shear strength W[a] (kPa)	Undrained shear strength F[b] (kPa)	Compressional-wave velocity[c] (m/s)
119-743A-									
1H-1, 90	0.90	17.37	36.00	2.23	1.85	2.72	29.6	30.0	1696.1
1H-CC, 15	1.14	19.50	38.75	2.12	1.71	2.65	32.7	24.0	1713.6
2H-CC, 16	1.77	15.01	33.49	2.38	2.02	2.90	14.1	62.0	
3H-1, 113	3.03							170.0	
3H-1, 114	3.04	12.34	27.58	2.41	2.12	2.75	66.8	123.0	2251.8
3H-1, 116	3.06	11.84	26.43	2.35	2.07	2.72			
3H-2, 6	3.46						14.8	38.0	1702.0
3H-2, 43	3.83	17.40	36.37	2.23	1.84	2.76	16.3	30.0	1828.7
3H-2, 70	4.10	17.89	36.22	2.17	1.78	2.65	13.4	34.0	1850.5
3H-2, 87	4.27	18.80	38.90	2.14	1.74	2.79	11.9	39.0	1809.4
4H-1, 43	5.03	17.73	36.58	2.17	1.78	2.72	7.4	32.0	1837.9
4H-1, 88	5.48	15.36	32.86	2.27	1.92	2.74	30.0	44.0	1851.7
4H-2, 35	6.45	17.11	35.76	2.18	1.81	2.74	3.0		
4H-2, 100	7.10	15.59	33.18	2.27	1.91	2.73	64.6	35.0	1796.9
4H-3, 41	8.01	17.90	37.11	2.17	1.78	2.75	22.3	51.0	1789.4
4H-3, 119	8.79	16.44	35.03	2.26	1.88	2.78	17.1	72.0	1806.3
4H-4, 22	9.32	19.34	40.02	2.18	1.76	2.83		67.0	1743.4
4H-4, 71	9.81	19.79	39.80	2.11	1.69	2.72		11.0	1766.3
4H-4, 93	10.03	32.28	54.87	1.83	1.24	2.59	32.7	36.0	1699.0
4H-4, 142	10.52	34.05	58.58	1.84	1.21	2.78	32.7	48.0	1573.8
4H-5, 21	10.81	33.60	57.77	1.85	1.23	2.74	42.3	54.0	1525.3
4H-5, 71	11.31	31.80	54.89	1.86	1.27	2.64	37.1	46.0	1588.0
4H-5, 94	11.54	16.74	35.01	2.21	1.84	2.72			
5H-1, 33	13.13	17.60	36.72	2.23	1.84	2.76	53.5	48.0	1722.9
6X-1, 3	15.83	24.03	46.52	2.02	1.53	2.79	26.0	27.0	
6X-1, 41	16.21	18.45	38.26	2.18	1.78	2.78	57.9	44.0	1841.8
9X-1, 91	41.11	13.79	30.17	2.28	1.97	2.74	122.9	103.0	2534.6
9X-1, 104	41.24								2457.1
9X-2, 41	42.11	13.67	29.99	2.36	2.04	2.75	127.6	195.0	2054.3
9X-2, 113	42.83	13.48	29.23	2.31	2.00	2.69	92.8	205.0	1908.5
10X-1, 120	51.10	15.11	32.32	2.29	1.95	2.72	160.0	135.0	1922.6
10X-2, 30	51.70						170.5	225.0	2086.7
10X-CC, 26	52.17	13.74	30.12	2.34	2.02	2.75	119.5	370.0	1875.8
12X-1, 20	69.50	12.78	27.93	2.36	2.06	2.69	141.5	235.0	1988.0
12X-CC, 10	69.89	12.59	27.68	2.46	2.15	2.70	93.9	370.0	2133.0

Note: Top of the measured interval (never exceeding 10 cm) is listed.
[a] Measured by the Wykeham-Farrance motorized vane.
[b] Measured by the fall cone apparatus.
[c] Measured in the C direction, parallel to bedding.

Table 8. Physical-properties minimum, mean, and maximum values for the different geotechnical units, Site 743.

Geotechnical unit		Water content (%)	Porosity (%)	Wet-bulk density (g/cm³)	Undrained shear strength W[a] (kPa)	Undrained shear strength F[b] (kPa)	Compressional-wave velocity[c] (m/s)
	min.	11.83	26.43	2.11	3.0	11.0	1696
G1	mean	16.84	32.30	2.23	24.0	54.0	1817
	max.	19.79	40.02	2.41	66.8	170.0	2252
	min.	31.80	54.89	1.83	32.7	36.0	1525
G2	mean	32.93	56.53	1.85	36.0	46.0	1597
	max.	34.05	58.58	1.86	42.3	54.0	1699
	min.	12.59	27.68	2.02	26.0	27.0	1725
G3	mean	15.52	33.09	2.28	106.0	178.0	2048
	max.	24.03	38.26	2.46	170.5	370.0	2535

[a] Measured by the Wykeham-Farrance motorized vane.
[b] Measured by the fall cone apparatus.
[c] Measured in the C direction, parallel to bedding.

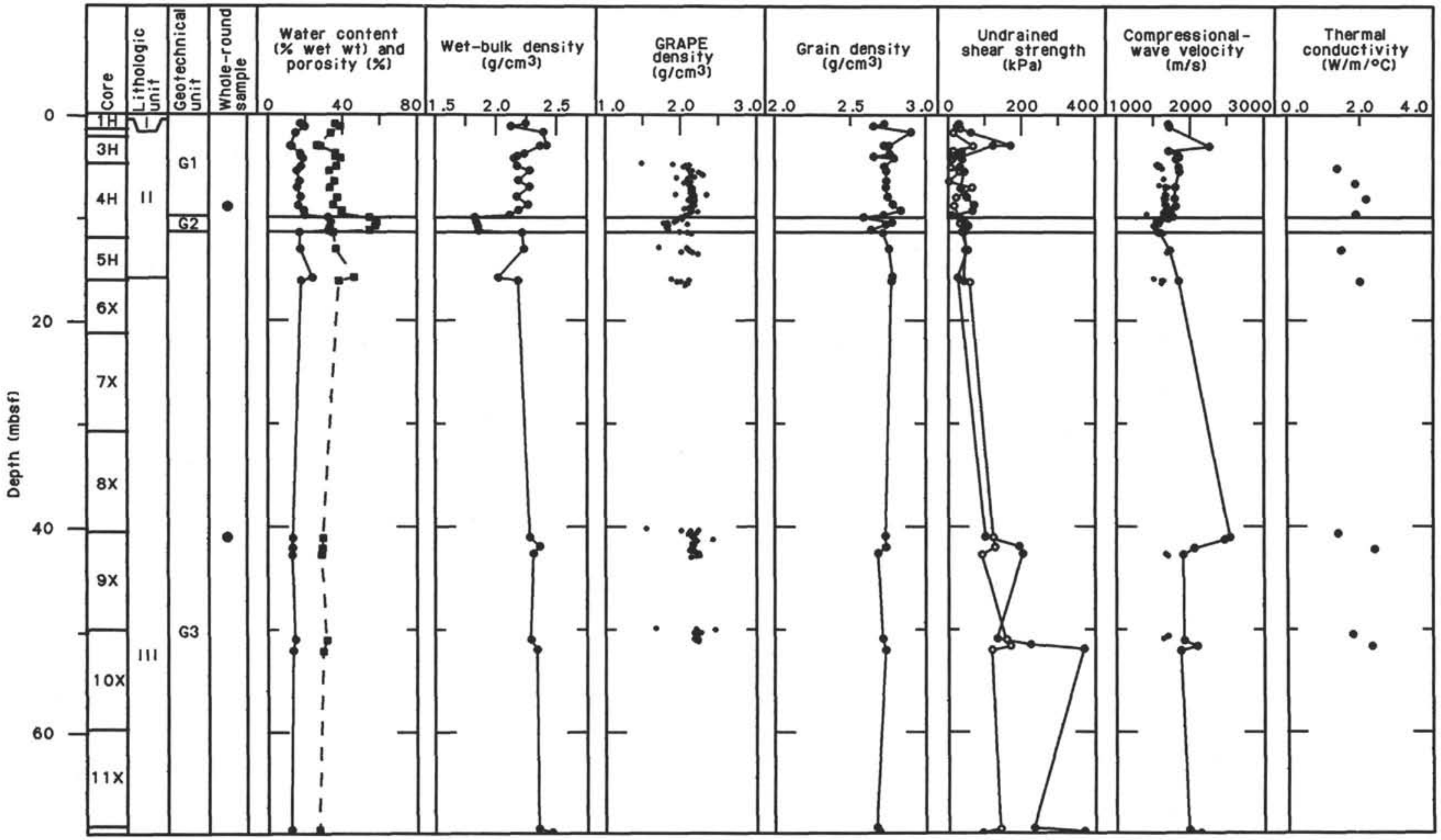

Figure 11. Physical-properties profiles, Site 743. Water content, dots; porosity, solid squares. GRAPE density was measured by continuous runs on whole-core sections. Undrained shear strength measured by the Wykeham-Farrance motorized vane (open circles) and fall cone apparatus (dots). Compressional-wave velocity includes measurements parallel to bedding in discrete intervals (C direction) (filled circles) and continuous *P*-wave-logger measurements blocked into 0.1 averages (small dots).

Table 9. Thermal conductivity measured at Site 743.

Core, section, interval (cm)	Depth (mbsf)	Thermal conductivity (W/m/°C)	Temperature drift rate (°C/min)
119-743A-			
4H-1, 60	5.20	1.414	−0.013
4H-2, 60	6.70	1.939	0.029
4H-3, 60	8.20	2.224	0.041
4H-4, 60	9.70	1.964	0.024
5H-1, 40	13.20	1.558	0.038
6X-1, 40	16.20	2.063	0.046
9X-1, 60	40.80	1.443	0.051
9X-2, 60	42.30	2.458	0.048
10X-1, 70	50.60	1.866	0.055
10X-2, 30	51.70	2.373	0.036

Summary

From the physical-properties profiles at Site 743, the sequence is divided into three geotechnical units, G1, G2, and G3. Of these, geotechnical unit G2 is the most distinct and most likely reflects a higher proportion of fine-grain fractions relative to the diamictons above and below. All geotechnical parameters show relatively constant values in the upper unit, while there is a gradual downhole effect of increased overburden in unit G3.

Two whole-round core samples will be tested for consolidation state. At the present stage, however, the sparse data coverages indicate no overconsolidation indicative of large-scale erosion or slumps removing extensive sediment masses in the drilled sequence. Skempton (1970) established that the ratio of shear strength to effective overburden pressure, as calculated by Richards (1962), ranges between 0.2 and 0.5 in normally consolidated marine clays. Although this relationship may not be exactly the same for the more unsorted sediments present at Site 743, a rough estimate of effective overburden shows that even taking the highest of the fall cone-measured shear strength values, the drilled sequence does not seem to be overconsolidated. Erosion or mass movement cannot be completely excluded, though, because of the large intervals either with no core recovery or with only pebbles recovered.

SEISMIC STRATIGRAPHY

Site 743 is at the northern edge of Prydz Bay, about 5 km seaward of the continental shelf edge. The site lies in 988.7 m of water and is 35 km northwest of Site 739, which lies on the continental shelf.

Site 743 was drilled into the dipping reflector sequence that comprises the uppermost part of the seaward-prograding wedge underlying the outer continental shelf. The reflectors beneath Site 743 are part of Stagg's (1985) unit PD-1, which he identified beneath the upper parts of the entire Prydz Bay continental slope. Site 743 lies on the upper part of the continental slope, which has a relatively uniform dip and smooth surface away from downslope slump bodies. On ODP line 119-08 (Fig. 2), the stratigraphy is relatively straightforward. Two seismic units were chosen for this discussion, although deeper units of differing acoustic character are clearly evident on seismic profiles.

Seismic Units

Seismic Unit I (0–~500 mbsf) encompasses the entire sequence drilled at Site 743 (98.1 mbsf total depth). The unit is composed of uniformly dipping reflections, with highly variable amplitudes and continuity. Glacial sands, silts, gravels, and diamictons of Quaternary age comprise the upper part of this unit (0–98.1 mbsf). At Site 743, reflections can be distinguished within the upper 70–80 m of the seafloor (e.g., within the air gun bubble pulse); whereas, beneath the shelf, few, if any, reflections could be discerned at these shallow depths. Across the entire 6- to 10-km width of the upper continental slope (400–1500-m water depth), the reflections from the upper 0.5 s of the seafloor are uniformly discontinuous, although the overall appearance is one of a well-layered sequence. The detailed stratigraphy indicates that individual reflection segments cannot be traced more than a few hundred meters (in water depths >750 m) or more than 2 km (in water depths <750 m). Individual reflections commonly fade out, pinch out, or terminate at diffractions.

Seismic Unit II (500–900 mbsf) has not been sampled by drilling, but the seismic stratigraphy indicates a significant change in acoustic character and likely lithology. The unit contains relatively continuous, high-amplitude reflections that can be traced normally for 1–2 km and more. Larger amplitudes and lower frequencies distinguish the unit. Regionally, the reflection at the top of the unit can be traced upslope to a point beneath the shelf (A in Fig. 2 and Fig. 12) where the reflection joins a flat-lying topset reflection. This point is a Leg 119 paleoshelf edge that is interpreted to be about 5 km seaward of another paleoshelf edge of possible late Miocene age ("Seismic Stratigraphy" section, "Site 739" chapter). Consequently, seismic Unit II may consist of rocks younger than late Miocene age near the upper part of the unit.

Discussion

The small penetration and low core recovery give only limited information on the composition of rocks causing reflections beneath Site 743. Drilling barely reached depths greater than the 70–80-m depth comparable to the water gun signal pulse. Regardless, several significant points can be inferred:

1. The highly variable reflections from within 70–80 m of the seafloor indicate that the seafloor has not been highly compacted (by grounded ice), as on the shelf. Physical-properties measurements confirm the lower compaction of the seafloor at Site 743.
2. The observation that greater continuity, but lower amplitude, reflections lie at the uppermost, rather than lower, parts of the continental slope in seismic Unit I indicates that different depositional environments exist in the two areas. Reflection character indicates that localized coarse debris is being deposited on the slope and that the deposition of fine debris is occurring on the outermost shelf and uppermost slope.
3. The seismic character of the sequence directly below Site 743 is more like that of the prograding wedge deposits in seismic Unit II at Site 739 than like any other seismic unit at the Prydz Bay drill sites.
4. The seismic character of the uppermost slope (Fig. 12) is similar to that of seismic Unit III at Site 739 and seismic Unit II at Site 742.

Summary

At Site 743, two seismic units are identified in the seaward prograding glacial deposits of the upper continental slope. Seismic Unit I (0–500 mbsf) consists of variable amplitude and continuity reflections from glacial sands, silts, gravels, and diamictons of Quaternary age (0-100 mbsf). Seismic Unit II consists of continuous to semicontinuous reflections that are characterized commonly by very high amplitudes.

Reflections at the top of seismic Unit II can be traced updip to a paleoshelf edge and topset beds beneath the continental shelf. The likely age of this paleoshelf edge (and seismic Unit II) is younger than late Miocene.

Comparisons between the seismic character of contemporary depositional environments (seismic Unit I, Site 743) and paleode-

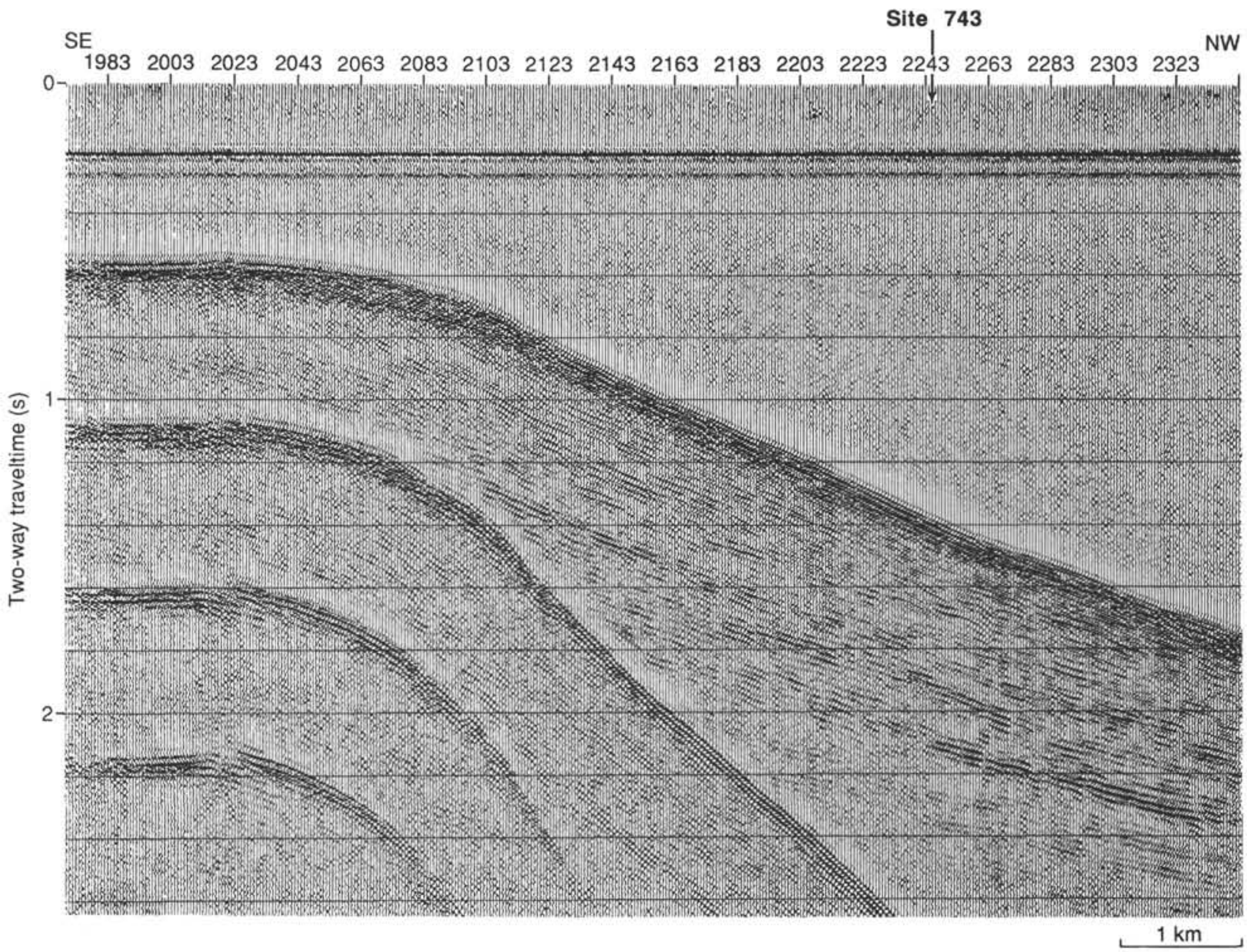

Figure 12. Digital seismic-reflection profile (filtered at 40–130 Hz) across Site 743 (approximate position shown).

positional environments are indicated: (1) upper slope areas in water depths less than 750 m are similar to seismic Unit III at Site 739 and Unit II at Site 742 and (2) upper slope areas in water depths of 750–1500 m are similar to seismic Unit II at Site 739.

SUMMARY AND CONCLUSIONS

Site 743 (66°55′S, 74°41.4′E, in 988.7 m of water) on the upper continental slope of Prydz Bay is the northernmost of the sites in a transect across the shelf. Below a 100–200-m-thick sediment cover of nearly horizontal layers, a 35–50-km-wide band of inclined reflectors is recognized in the seismic sections across the outer shelf of Prydz Bay (Stagg, 1985; Mizukoshi et al., in press). The reflectors are chiefly parallel to the continental slope. This suggests that the reflectors represent a prograding sequence of sediments. The prograding may still be active because similar reflectors are observed close beneath the present-day slope surface. The innermost part of the prograding sequence was sampled at Site 739 between 170 and 313 mbsf (lithologic Units III and IV). These units consist chiefly of diamictite, which in Unit III is stratified and contains diatoms. The stratification is commonly contorted, as a result of slumping and redeposition as debris flows. Based on observations at Site 739 and from short piston cores recovered elsewhere (Anderson et al., 1979), we believe that a major part of the sedimentation leading to progradation was redeposition of glacial debris from the melting of an ice sheet, with the grounding line very close to the shelf-break. Objectives for Site 743 were to examine the sediment types and the sedimentary processes on a slope associated with a shelf dominated by glaciogenic sediments and to date the youngest sediment of the slope.

The site was situated on seismic line PB-21 of Stagg (1985) as far seaward as possible on the upper slope in order to maximize the marine influence of the sediments and minimize the amount of boulders dropped from a grounded ice. However, the seismic line measured by *JOIDES Resolution* while approaching the site showed that the continental slope below a water depth of 1000 m is characterized by many small steps, probably indicating slump scarps. In order to optimize the chance for recovering an undisturbed datable stratigraphic sequence, the drilling site was selected at a water depth of above 1000 m. Survey line 119-08 was recorded using standard geophysical gear. It is part of the seismic transect of eastern Prydz Bay and extends downslope to a depth of 1500 m.

Hole 743A was spudded 5 January 1988 with the APC in order to obtain undisturbed samples for compaction studies and because the hard, overconsolidated diamictons, which caused problems at the other Prydz Bay sites, were not expected at this site. After five APC cores penetrated to 15.8 mbsf with good core recovery, we were forced to switch to XCB coring when the first glacial boulders were found. The softer glacial clays lacked the mortar quality of the hard compacted diamictites, allowing the gravel and rocks to fall into the hole. The resulting unstable hole conditions caused drilling problems and mostly very low core recovery, averaging 22.4%. This is a very valuable experience for the planning of future drilling in glacial deposits. The hole was terminated when the inability to continue coincided with expiration of the allotted day of time.

Results

Three lithologic units were identified in the recovered sequence. Lithologic Unit I (0–0.46 mbsf) is a moderately well-sorted sand, the upper part of which is mixed with diatom ooze. It contains beds with size-graded foraminifers. Lithologic Unit II (0.46–15.8 mbsf) is a rather stiff and sticky clayey silt with mostly less than 1% gravel, interbedded with 1–132-cm-thick layers of sorted sand and gravel. The clayey silts are very homogenous, showing no signs of sedimentary structures. The contacts between the sand and the clayey silts are sharp. The sand and gravel layers vary from well-sorted, clearly current-transported sands with size-graded foraminifers to poorly-sorted gravelly sands, which may represent erosional lags or grain-flow deposits. The description of lithologic Unit III is hampered by very low core recovery in this interval, only exceededing 10% in two of 10 cores. Although represented by little more than an assemblage of stones in several cores, this unit appears to be dominated by diamicton. Where recovered, the diamicton is a very dark gray, massive, clayey silt with 5%–25% sand and gravel.

The carbonate content is generally <0.5% throughout the sequence, except for a few sand layers that contain 2.4% and 4.2% $CaCO_3$. The content of organic carbon is in the 0.2%–0.6% range, consisting of mostly reworked type III kerogen with minor type II. The organic content is thus chiefly detrital; a contribution from the marine environment was not recognized. Microbial catabolism is limited by the low abundance of organic matter. Silica concentrations in the pore water well above seawater concentrations show that dissolution of biogenic(?) silica takes place in the sediment. No concentrations of methane significantly above background levels were detected.

The previous samples from the prograding unit (Site 739, 170–313 mbsf) were clearly overconsolidated, possibly by ice loading. So comparing the physical properties of the corresponding sediment types on the slope, which have not been covered by grounded ice, with those of Site 739 may provide critical information regarding the compaction of the diamictons. From the physical properties at Site 743, the sequence is divided into three geotechnical units—G1 (0–9.9 mbsf), G2 (9.9–11.4 mbsf), and G3 (11.4–total depth 98.1 mbsf). Of these, unit G2 is the most distinct and most likely reflects a higher proportion of fine-grain fraction relative to the adjacent diamictons. All geotechnical parameters show relatively constant values in the upper unit, while a gradual downhole effect of increased overburden occurs in unit G3. The average water contents of the units are 16.8%, 32.9%, and 15.5%, respectively, which indicate rather low contents of clay in the sediment. At the present stage of investigation, the sparse data indicate no overconsolidation, indicative of large-scale erosion or slumps removing extensive sediment masses in the cored sequence.

The samples examined from the site are barren of calcareous nannofossils, radiolarians, and dinoflagellates. Diatoms are rare and poorly preserved in the upper 12 m, but appear to be absent below. They indicate that the upper 12 m is late Pliocene–Quaternary in age. Foraminifers occur in several sandy intervals, down to 69 mbsf. The age of the foraminifer-bearing intervals is late Miocene to Holocene, based on the presence of the planktonic foraminifer *Neogloboquadrina pachyderma*. No magnetic stratigraphy was possible for this site.

The seismic pattern at Site 743 is, in general, similar to that seen in the prograding sequence elsewhere on the seismic transect; consequently, the sediment sequence encountered at the site probably is reasonably representative of the types of sediments represented elsewhere in the prograding sequence, but not necessarily the same proportions. At Site 743, two seismic units were identified as being the two youngest of the seaward prograding sequence of the upper continental slope. Seismic Unit I (0–500 mbsf) is characterized by variable amplitude and continuity reflections from interbedded diamicton and sand layers, which are of Quaternary age at least in the uppermost 60 m. Seismic Unit II (500–900 mbsf) consists of continuous to semi-continuous reflections that are characterized commonly by very high amplitudes. Reflections at the top of seismic Unit II can be traced updip to a paleoshelf edge and topset beds beneath the continental shelf. The age of this paleoshelf edge is younger than late Miocene, based on seismic tracing from dated sequences at Site 739.

The recovered sedimentary successions at Sites 743 and 739 indicate that unsorted clayey silts with gravel and stones (diamictons) are a very important constituent of the sediments of the continental slope, and thus of the prograding unit. The supply and deposition of this unsorted sediment, including boulders, indicates melting of huge amounts of debris-laden ice, presumably from the basal part of a floating glacier, which is grounded very near to the shelf edge (Eyles and Miall, 1984). Direct sedimentation (rain-out) from the floating ice shelf in front of the grounded ice in combination with various slumps and debris flows on the slope are presumably the main depositional processes on the slope. A grounded ice edge will act as a linear sediment source, which explains the extension of the prograding unit along the shelf. The muddy waters and lack of light under the floating ice shelf (proximal glaciomarine environment) offer an explanation to the scarcity or lack of marine fossils in the diamicton. The lack of glacial loading on the glacial sediments on the slope is also consistent with the model. This mode of sedimentation is only effective on the slope during the nearly maximum extent of ice cover, whereas current-sorted sediments or distal glaciomarine sediments may be deposited in the intervening periods.

The other facies of the slope sediment are sand and gravel layers. The well-sorted sand layers containing size-graded foraminifers were clearly transported and deposited by currents. The highly variable, poorly sorted sands with gravel and some clay may be lag sediments, indicative of occasional erosion of the slope. We are uncertain whether the sand units represent sedimentation on the slope in "interglacial" periods, like the present day, or intermittent variations in the current that sweep the slopes without close relation to the glaciations.

The diamictons on the slope are thus indicative of an extensive ice sheet. This, combined with the dating of sand layers in the upper part of Hole 743, indicates that the ice sheet once extended at least to the shelf edge during Quaternary time.

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