UNIVERSITY OF WATERLOO
Faculty of Science

LATE QUATERNARY

FORAMINIFERAL BIOSTRATIGRAPHY

OF

HUDSON STRAIT

Environmental Marine Geology Section
Atlantic Geoscience Centre
Dartmouth, Nova Scotia

prepared by

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89220156
4A Earth Sciences (Geology Option)
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25 August 1993

Dr. R. W. Gillham, Chairman
Department of Earth Science
University of Waterloo
Waterloo, Ontario
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Dear Sir:

This report, entitled "Late Quaternary Foraminiferal Biostratigraphy of Hudson Strait", was prepared as my 3B Work Report for the Environmental Marine Geology Section of the Atlantic Geoscience Centre. This is my fourth work term report.

The Atlantic Geoscience Centre is the division of the Geological Survey of Canada that studies the on and offshore geology of Canada's Atlantic and Arctic waters.

The Environmental Marine Geology Section is headed by Mr. Kevin Robertson and is primarily involved with understanding the seafloor and near surface geology of coastal and offshore areas of Atlantic and Arctic Canada. This report is a study of the Foraminiferal biostratigraphy from the Wisconsinan glaciation and is based upon the analysis of several cores taken from Hudson Strait.

This report has been prepared and written by me and has not received any previous academic credit at this or any other institution. I would like to thank Mr. B. MacLean, Dr. G. Vilks, Mr. J. Ceman and Mr. B. Deonarine for their assistance in preparing this document.

Sincerely,

A. B. Silis
89220156

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Abstract

Hudson Strait has been divided up into five areas for Foraminiferal study. Each area is defined based on geographic locale, bathymetry and current regime. The areas of study include the Eastern, Western and Southwestern Basins, Ungava Bay and Central Hudson Strait. Cores taken from each region are described based upon their Foraminiferal biostratigraphy, lithological characteristics and seismostratigraphy. Foraminifera faunal zones are used to define the Late Quaternary biostratigraphy and paleoenvironment of Hudson Strait. Zones A and B represent ice proximal and distal glaciomarine environments respectively. Zone D is the recent postglacial environment. Zone C is only found in the Eastern Basin and represents an early postglacial environment. A new zone described as a transition from glaciomarine to postglacial conditions exists in the Eastern and Western Basins and Ungava Bay. These transition zones represent an increased influx of higher salinity Labrador Sea water into the area.

Zones A, B and D contain similar Foraminifera species and characteristic features throughout Hudson Strait. Zones A and D are found in each area of study. Eastern Basin cores indicate varying paleoenvironmental conditions with ice proximal conditions still prevalent 8590 y BP. Ungava Bay cores indicate large amounts of meltwater sediment was deposited during the transitional and postglacial periods. This was intermixed with higher salinity Labrador Sea water. The region also experienced deltaic marine environmental conditions. Cores from Central Hudson Strait show good correlation with one another based on magnetic susceptibility and relative abundances of *C. reniforme* and *E. excavatum clavata.*

Ice readvancement occurred in northern Baie Hericart between 8420 and 7940 y BP. Postglacial conditions were already established by 6550 y BP in this area. The Western Basin Foraminifera distribution shows that ice proximal conditions were established by 8470 y BP. An ice distal environment was prevalent 8330-8080 y BP and the transition to postglacial conditions had already occurred by 7970 y BP. Late postglacial conditions were well established 2205 y BP. The Southwestern Basin cores indicate that the close proximity of the ice margin to this area induced ice proximal conditions for most of the areas Late Quaternary history. Glacier retreat was rapid followed by slow sedimentation rates and/or a high amount of erosion during the postglacial.

Introduction

Foraminifera collected from piston cores were used to define the Late Quaternary biostratigraphy in Hudson Strait. Previous studies (Vilks *et al.*, 1989; MacLean *et al.*, 1992) showed that there were four Foraminifera faunal zones found that were used to define glaciomarine ice proximal and distal and early and late postglacial environments. Zonal definition was based upon the analysis of five cores taken in 1985. This report has expanded the number of cores studied and found that Hudson Strait can be divided into five areas of study. A new transition zone of glaciomarine to postglacial conditions has been added to the biostratigraphy of the region.

This report gives a detailed description of each core studied, describing how each zone was determined. The new transition zone is defined and described for each area where it was found. An overall interpretation of the paleoenvironment of each core site is discussed based on Foraminifera, lithology and seismic data.

Each area of study has been described based on the data from 3-6 cores. The combination of a large study area and relatively small number of cores does not provide a detailed representation of the late Quaternary paleoenvironment of Hudson Strait. Postdepositional processes (ie. slumping, turbidite flows etc.) may have influenced each core site on a localized basis. Therefore, this report should only be regarded as an outline or starting point for future studies of Hudson Strait.

Bathymetry

Hudson Strait is an 800 km long channel (Figure 1) that separates Baffin Island from northern Quebec and Labrador. It connects Hudson Bay and the Foxe Basin to the Labrador Sea and averages water depths of 200 m. There are three deep (>400 m) basins within the Strait that are structurally controlled by half graben features. A sill separates the Eastern basin from the Labrador sea. Ungava Bay, located in the southeastern portion of Hudson Strait, has maximum water depths reaching 300 m in the Ungava Trough with averages ranging between 100 and 200 m in the surrounding central platform. The present day bathymetry is mostly controlled by bedrock features and the overlying thick Quaternary sediment deposits (Maclean *et al.*, 1992).

Current Regime

The present day current regime in Hudson Strait has various aspects to it. Water flows out of Hudson Bay and Foxe Basin through Hudson Strait and Ungava Bay to the Labrador Sea (Figure 2). Offshore water enters the Strait near the Meta Incognita peninsula and continues along the Baffin Island coast until Big Island. At Big Island the currents are deflected across Hudson Strait and return to the Labrador Sea, flowing along the coast of Quebec and through Ungava Bay (Drinkwater, 1986). Bottom water currents, which affect Foraminifera distribution, are most likely configured differently than surface water currents.

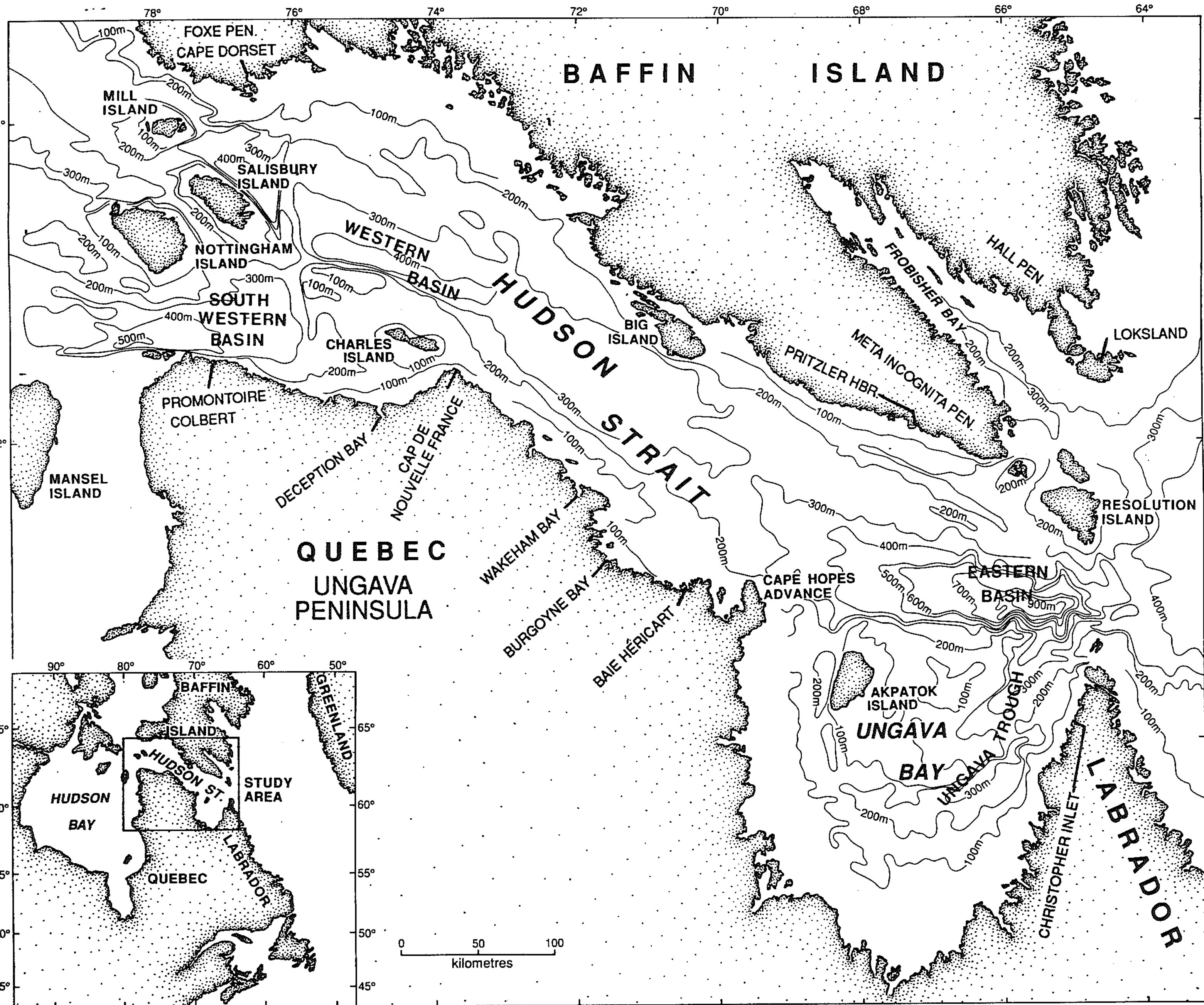

Figure 1: Index Map and Bathymetry of Hudson Strait (MacLean *et al.*, 1991).

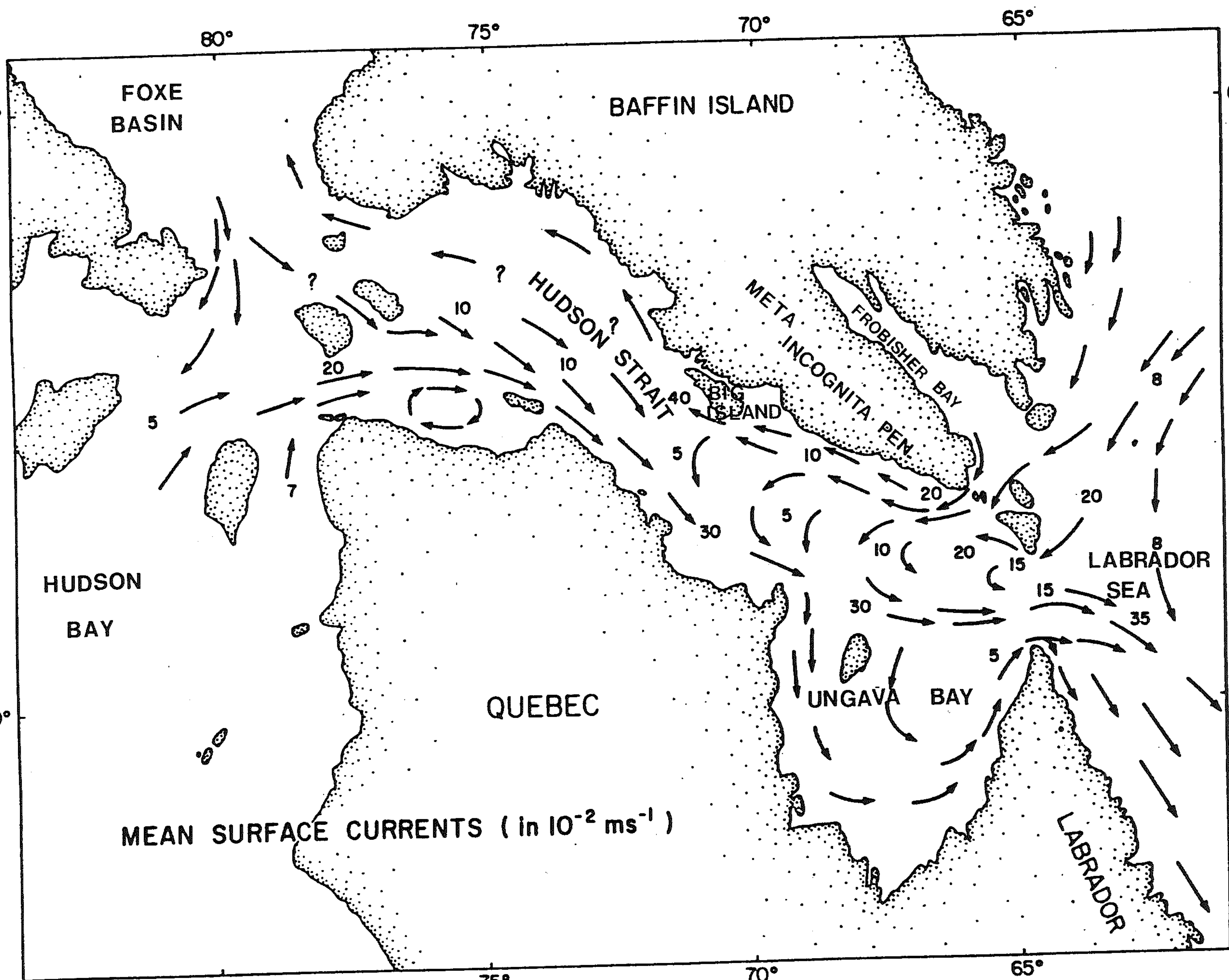

Figure 2: Mean surface currents of present day Hudson Strait (Drinkwater, 1986).

Geology

Hudson Strait is mainly underlain by Late Ordovician carbonate rocks. Silurian strata is found southwest of Charles Island and underlying the Eastern Basin. Precambrian rocks of the Canadian Shield are found in Northern Quebec and Labrador and on Baffin Island. Younger Paleozoic strata may occur locally in the Eastern Basin (MacLean *et al.*, 1986). Hudson Strait was a major glacial ice and meltwater distributory conduit during the Wisconsinan and therefore, Quaternary sediments locally up to 130 m in thickness were deposited over most of the bedrock in the region (MacLean *et al.*, 1986).

Areas of Study

Hudson Strait has been divided into five areas of study (Figure 3). Each area will focus on the Foraminiferal biostratigraphy of that region. The areas were defined based on geographic location, bathymetry and current regime. Area 1 includes the deep Eastern Basin which has water depths in excess of 900 m. Area 4 encompasses the Western Basin, southeast of Salisbury Island whereas, area 5 is found south of Salisbury Island in the Southwestern Basin. Both of these basins have water depths in excess of 400 m. Area 2 includes most of Ungava Bay, with a particular emphasis on the Ungava Trough. Area 3 includes the Baie Hericart and Wakeham Bay region of central Hudson Strait.

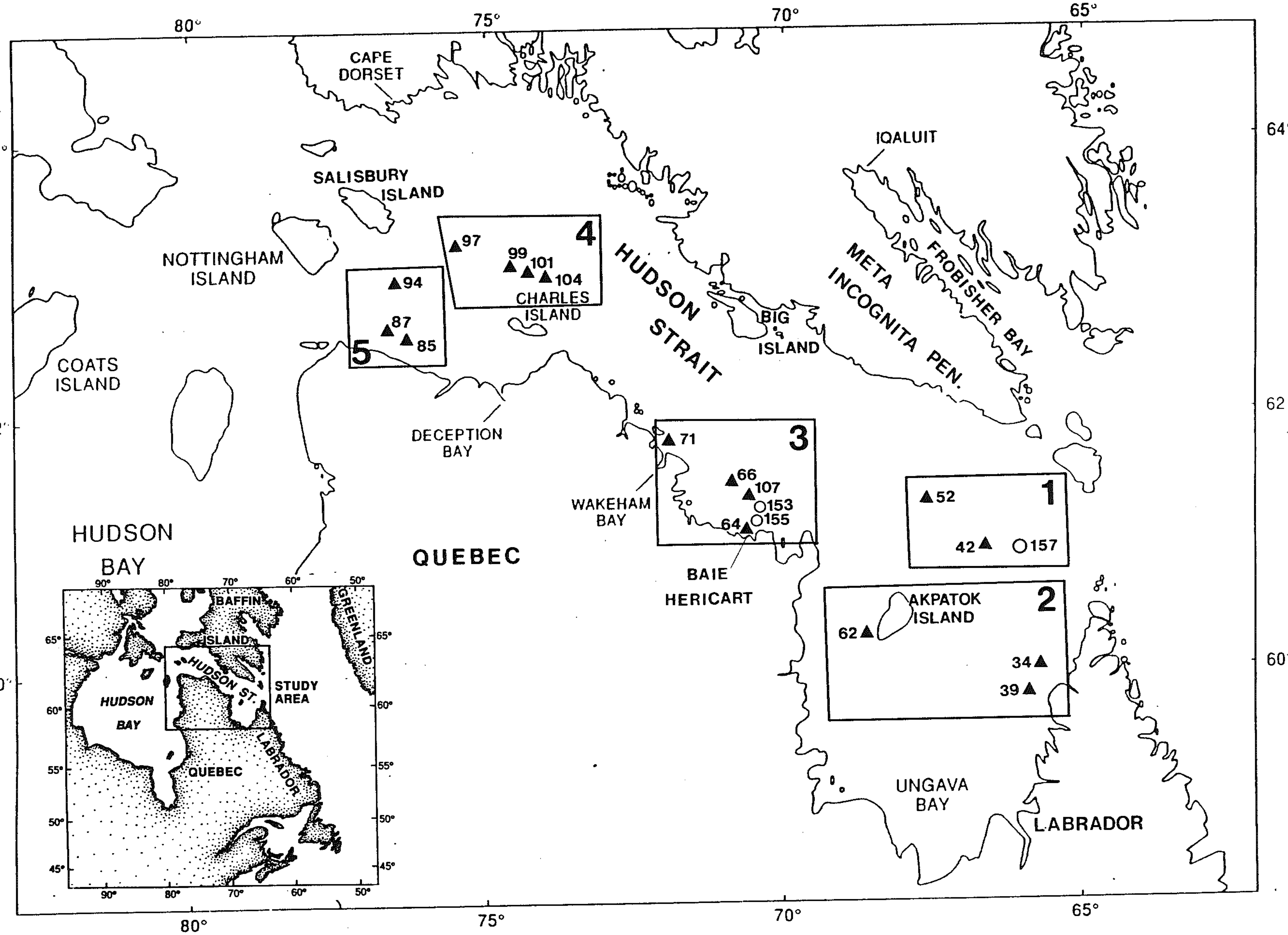

Figure 3: Index Map and Areas of Study in Hudson Strait. Area 1: Eastern Basin, Area 2: Ungava Bay, Area 3: Central Hudson Strait, Area 4: Western Basin, Area 5: Southwestern Basin. Cores were obtained during the 90023 cruise (▲ 62) and 92028 cruise (○153).

Methods

Cores were collected from Hudson Strait during cruises in 1990 and 1992 from the **CSS Hudson**. Cores are referred to in this paper based on the cruise number followed by the specific core number. Therefore, the 90023 and 92028 cruises took place in 1990 and 1992 respectively. The cores for the 90023 cruise were taken using an AGC large diameter corer (9.9 cm Internal Diameter) (MacLean *et al.*, 1991 Cruise report). The cores taken in the 92028 cruise were taken using a Benthos piston corer (6.7 cm Internal Diameter) (MacLean *et al.*, 1992 Cruise report). The Benthos piston corer retrieved more surface sediments and penetrated deeper than the large diameter corer. Seismic data was obtained using the Huntec Deep Tow System. Magnetic susceptibility was measured using a Bartington MS-1 meter. Sediment samples for Foraminiferal analysis were taken from the cores at roughly 20 cm intervals. Wet sediment volumes ranged from 5-40 mL, with most being from 10-20 mL. These sediment samples were washed through a 63 μm sieve and then oven dried for 24 hours @ 140° F.

The dried sample was further sieved using a 125 μm sieve. Foraminifera in the >125 μm and <125 μm portions were picked individually and mounted on slides. In cases where there was a large amount of sediment the sample was split, sometimes several times, to reduce picking time.

Foraminifera on each slide were identified and counted. The original Foraminifera count was then multiplied by the number of times a split had been made. Percent abundances of Foraminifera were calculated using a Lotus 1-2-3 program (Rodrigues, 1990) and graphed.

Faunal diversities were calculated using the Shannon-Wiener Information Function:

$$H\,(S) = -\sum_{i=1}^{s} p_i \ln p_i$$

Where *H(S)* is the diversity, *p* is the proportion of species i and *S* the total number of species in a sample.

Age Dates

Age dates on mollusc and Foraminifera were obtained from the University of Arizona and Isotrace at the University of Toronto using AMS C^{14} dating techniques (Table 1). The age dates based on mixed assemblages appear to give anomalously older ages than were to be expected for this area. This suggests that older Foraminifera were carried into the core site area via current activity and mixed with *in situ* species.

Seismostratigraphy

Seismic units for Late Quaternary sediments in Hudson Strait have been defined according to their acoustic characteristics (Vilks *et al* ., 1989). Seismic units 1 and 2 represent glacial drift. They are acoustically unstratified units usually overlying bedrock. Unit 3 represents a glaciomarine environment. It is strongly acoustically stratified and laterally consistent over a large area. Unit 4 is less acoustically stratified, experiences local thinning and thickening and is not as laterally consistent as unit 3. Unit 5 is weakly stratified and usually is the surface layer in seismic profiles. Units 4 and 5 represent postglacial marine environments.

Table 1: AMS C^{14}Age Dates for Select Cores

Area	Core	Interval (cm)	Description	Age (Corrected for 410/450* yr reservoir effect)
1	90023-42	517-520	mixed Foraminifera	8590±85[UA]
	90023-52	175-177	mixed Foraminifera	8625±75[UA]
3	90023-107	80-82	*Portlandia arctica* valves	8040±70
		236	shell fragments	8390±70
		497-499	Foraminifera	8990±190
		533-535	mixed Foraminifera	10330±85[UA]
	90023-64	195	*Macoma calcarea* valves	6350±70
		225	*Clinocardium ciliatum* frags	6470±70
		250	*Macoma calcarea* valves	6650±70
		460-462	Foraminifera	7750±150
	92028-155	485-490	mixed Foraminifera	7375±75[UA]
		920-922	mixed Foraminifera	10720±100[UA]
	90023-66	21-23	Foraminifera	6550±110
		230	*Portlandia arctica* valve	7940±80
		728	*Portlandia arctica* valves	8440±90
		743	*Portlandia arctica* valves	8420±80

Table 1: AMS C^{14} Dates (continued)

Area	Core	Interval	Description	Age (corrected)
3	90023-71	360-362	*Portlandia arctica* valve	8160±230
		408	*Portlandia arctica* valves	8520±80
		561-565	mixed Foraminifera	10645±110
4	90023-101	2-5	mixed Foraminifera	2205±45^{UA}
		158-160	Foraminifera	7970±510
		318-322	Foraminifera	8330±280
		360-362	Foraminifera	8100±110
		558-560	Foraminifera	8080±270
		743-745	mixed Foraminifera	8470±65^{UA}
	90023-99	150	shell fragments	8140±160
		316-320	Foraminifera	6820±830
	90023-97	340-342	Foraminifera	7530±920

* Dates from Isotrace were corrected for a 410 year reservoir effect whereas, dates obtained from the University of Arizona (^{UA}) were corrected for a 450 year reservoir effect.

Foraminifera Zones

Four Foraminifera faunal zones have been previously identified in Hudson Strait cores. Foraminiferal zones help define changes in water salinity, temperature and sediment grain size, which in turn reflect a change in the paleooceanographic environment of the late Wisconsinan ice age. The zones are time transgressive from east to west (Vilks *et al.*, 1989).

Faunal zone A is characterized by the presence of *Elphidium excavatum clavata* and *Cassidulina reniforme*. Bilodeau *et al.* (1990) found that these species lived in low temperature (-1 to 2 ° C) and low salinity (28-33 ppm) waters in Hudson Bay, where they represented a glaciomarine environment. Rodrigues *et al* (in press) also defined these species as representing a glaciomarine environment in the Gulf of St. Lawrence. When meltwater influx was high the salinity was < 20 ppm and when there was less meltwater the salinity ranged from 25-30 ppm. In the Hudson Strait sediments the species diversity is low and on average is made up of < 100 benthonic tests / 10 cc. It is indicative of a proximal, glacial marine environment (Osterman and Andrews, 1983; Vilks *et al.*, 1989). There are no planktonic tests present in this zone.

Foraminifera faunal zone B includes the zone A species in addition to *Fursenkoina fusiformis*. *F. fusiformis* can tolerate a wide range (32-35 ppm) of salinities (Vilks *et al.*, 1989). It prefers muddy sediments and low dissolved oxygen content environments which associates it with a glaciomarine ice distal setting. This zone is also characterized by the presence of *Fursenkoina loeblichi, Haynesina orbiculare* and *Pseudopolymorphina* *novangliae*. *F. loeblichi* lives in environments similar to *F. fusiformis*, although of a slightly higher salinity (Vilks, personal communication). *H. orbiculare* indicates an increase in oxygen content (Leslie, 1965). It tolerates low salinities and is therefore used as a meltwater influx indicator (Vilks, personal communication). *P. novangliae* was present in negligible amounts in the cores studied for this report and is therefore, not regarded as an indicator species for zone B. In some areas planktonic tests begin to appear in zone B indicating increased exchange of meltwater with higher salinity Labrador Sea water.

Foraminifera faunal zone C includes the zone A and B species in addition to *Cassidulina laevigata, Pullenia osloensis*[1] and *Astrononion gallowayi*. *C. laevigata* is associated with the warmer (> 0°C) (Ostby and Nagy, 1982) and higher salinity (>35 ppm) waters of the Labrador Sea, suggesting an increased offshore marine influence into Hudson Strait. *A. gallowayi* tolerates a wide range of salinities (Vilks, 1989) whereas, *P. osloensis* prefers deep, warm (4-6 °C) high salinity (34.5-34.9 ppm) water (Rodriques *et al.*, in press). Zone C is found only in eastern Hudson Strait suggesting that this early postglaciomarine environment was restricted to the deep Eastern Basin (Vilks *et al*, 1989). This zone is also characterized by an increase in the number of planktonic and benthonic tests relative to zone A and B.

Foraminifera faunal zone D is characterized by the addition of *Nonionellina labradorica, Islandiella helenae, Islandiella norcrossi, Buccella frigida* and *Astrononion gallowayi* to the previous zone species. *I. norcrossi* and *I. helenae* usually appear earlier in

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[1] Upon reexamination of cores 85027-55, 85027-56, 85027-57, it was determined that *Pullenia osloensis* had been misidentified as *Pullenia quinqueloba*. Therefore, earlier references (Vilks *et al.*, 1989) referring to *P. quinqueloba* should be regarded as actually referring to *P. osloensis*.

the core than *B. arctica* and *B. frigida*. Future analysis of zone D may show that it can be further subdivided based on first appearances of *Islandiella* and *Buccella* species. *N. labradorica* and *A. gallowayi* can tolerate a wide range of salinities whereas, *I. helenae* prefers cold temperature waters and salinities ranging from 32.5-33.5 ppm (Vilks and Deonarine, 1988). All three species are common in ocean shelf environments (Vilks *et al*, 1989). *I. helenae* has been associated with ice distal environments around Baffin Island (Osterman and Andrews, 1983), but is classified as a late postglacial marine indicator for the Hudson Strait area (Vilks *et al*, 1989). Rodrigues *et al.*(in press) found that in the Gulf of St. Lawrence *I. helenae* prefers living in temperatures of 0 °C and a salinity range of 30-33 ppm. It prefers fine grained sediments and indicates a dominance of arctic/subarctic, inner shelf type waters (Osterman and Nelson, 1989). *I. norcrossi* also prefers to live in fine grained sediment substrates (Leslie, 1965). A decrease in *F. fusiformis* percentages implies increased oxygenation and overall homogenization of benthic waters (Bilodeau *et al.*, 1990). The combination of these factors suggests a late postglacial marine setting.

The presence of *Melonis zaandamae* throughout zone C and D in basin cores suggests temperatures ranged from 0 to -1 °C and salinities from 33-34.9 ppm at this time (Osterman and Nelson, 1989). It is a deep water indicator in Hudson Bay (Leslie, 1965) and Hudson Strait.

Cibicides lobatulus lives in sandy to gravel environments which are influenced by strong current activity. They are common in transitional periods between glaciated and open shelf environments in the Barents Sea (Ostby and Nagy, 1982). This is also seen in Hudson Strait cores.

The dominant planktonic Foraminifera species found in Hudson Strait is *Neogloboquadrina pachyderma* (sinistrally coiled). It indicates an arctic, cold water marine environment associated with Labrador Sea waters (Vilks, 1989).

Changes in species diversity can reflect changes in the paleooceanographic environment. Low diversities reflect environmental instability, while higher diversities show a stabilization of the environment. Zone A shows the lowest diversities which is to be expected as mixing of high and low salinity water is occurring close to the ice margin. Zone D shows the highest diversity of all zones, which reflects the stabilization of the marine environment (Buzas and Gibson, 1968).

Zone A and D faunas are consistent throughout all cores taken from Hudson Strait with only minor variations based upon regionality. There is a much greater variability with the zone B and C fauna.

This report will expand upon and modify these zones with specific concentration on each area of study. It will take into account the bathymetry, current regimes and proximity to probable ice margins that prevailed during the Wisconsinan in Hudson Strait.

Area 1: Eastern Basin

Area 1 encompasses the Eastern Basin of Hudson Strait (Figure 4). Three cores (92028-157, 90023-42, 90023-52) were studied from this area (Table 2). There is considerable variability of Foraminifera in each core studied. Glacial ice became grounded on the sill separating the basin from the Labrador Sea during the Wisconsinan. This left an ice cover over most of eastern Hudson Strait while the rest of the Strait was being deglaciated. Ice readvances from Ungava Bay and / or Meta Incognita Peninsula may have influenced the paleooceanographic environment at this time (Miller and Kaufman, 1990).

Zone Definitions

Vilks *et al* . (1989) used this region as a type area for classifying the paleooceanographic Foraminifera faunal zones of Hudson Strait. An attempt has been made to expand upon and clarify these zones with data from additional cores.

Zone A and D fauna typical to Hudson Strait are found throughout the cores studied. There was no zone B present in the cores of this study area. A transition zone (T) from an ice proximal glaciomarine zone A to postglacial zone D is found in core 90023-42. It is characterized by the introduction of planktonic tests and an increase in diversity from zone A. Both the diversity and benthonic test numbers are fluctuating. The mixture of zone A (*C. reniforme, E. excavatum clavata*), B (*F. fusiformis, F. loeblichi, H. orbiculare*), C (*C. laevigata. P. osloensis, A. gallowayi*) and D (*N. labradorica, I. norcrossi*) species suggests

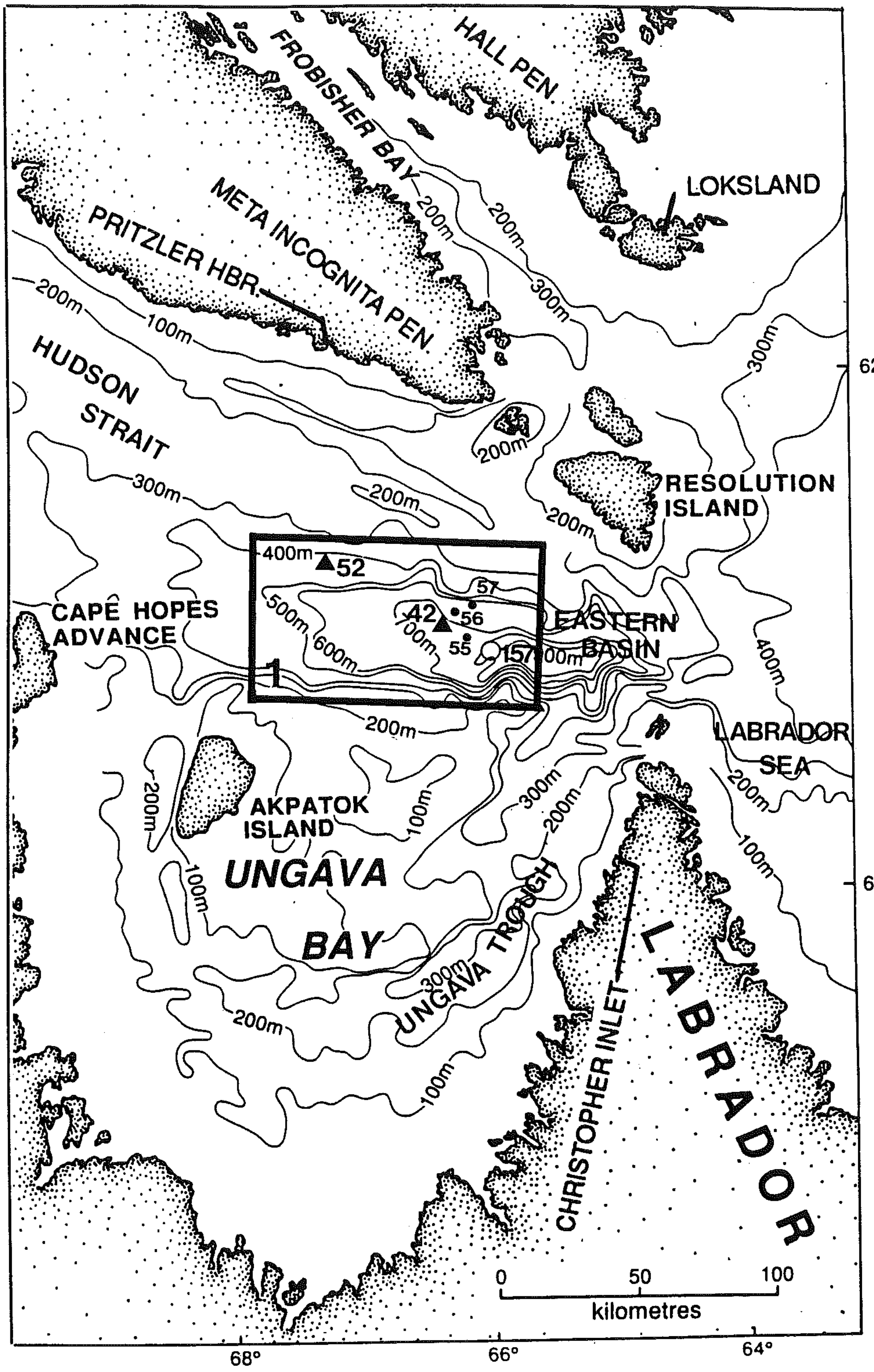


Figure 4: Detailed map of Area 1, The Eastern Basin, showing core sites for the 90023 cruise (▲ 42), 92028 cruise (○ 157) and 85027 cruise (• 56).

Table 2: Eastern Basin Core Information

Core	Length (cm)	Latitude (N)	Longitude (W)	Water Depth (m)
92028-157	561	60 56.83	66 07.86	860
90023-42	881	60 57.01	66 36.95	761
90023-52	275	61 19.48	67 36.21	402

glaciomarine and postglacial conditions prevailed at the same time.

Faunal zones are also subdivided based on diversity (Figure 5). Lowest diversities are found in zone A (<0.767). Zone C diversities range from 1.329-1.915. There is a slight overlap of zone C and D diversities. The highest diversities are found in zone D ranging from 1.626-2.258.

Core 92028-157

Core 92028-157 was collected from a water depth of 860 m, the deepest of all cores studied, on the flank of a depression seen in Figure 6. The postglacial sequences of seismic units 4 and 5 may be thicker than in non depression areas, due to infilling. Unit 3 was not penetrated by the corer.

Zone A and B are not present in core 92028-157. Faunal zone C is found from 300 to 480 cm (Figure 7). There are relatively high numbers of planktonic tests and *Cassidulina laevigata* suggesting a Labrador sea water influence was well established at this time. The high numbers of *C. lobatulus* also indicates an increase in current activity. It is interesting to note that the C/D boundary coincides with an increase in diatom tests in zone C (Figure 8) (Williams, unpublished data). This suggests an influx of nutrient rich waters into the core site location in the early postglacial (Vilks, personal communication). The C/D boundary is marked in the lithology profile (Figure 9) by a change from alternating sandy-silt to silty-clay layers in zone C to a clay matrix with sand pods and mottling in zone D.

Zone D is characterized by the increased presence of *N. labradorica, M. zaandamae,*

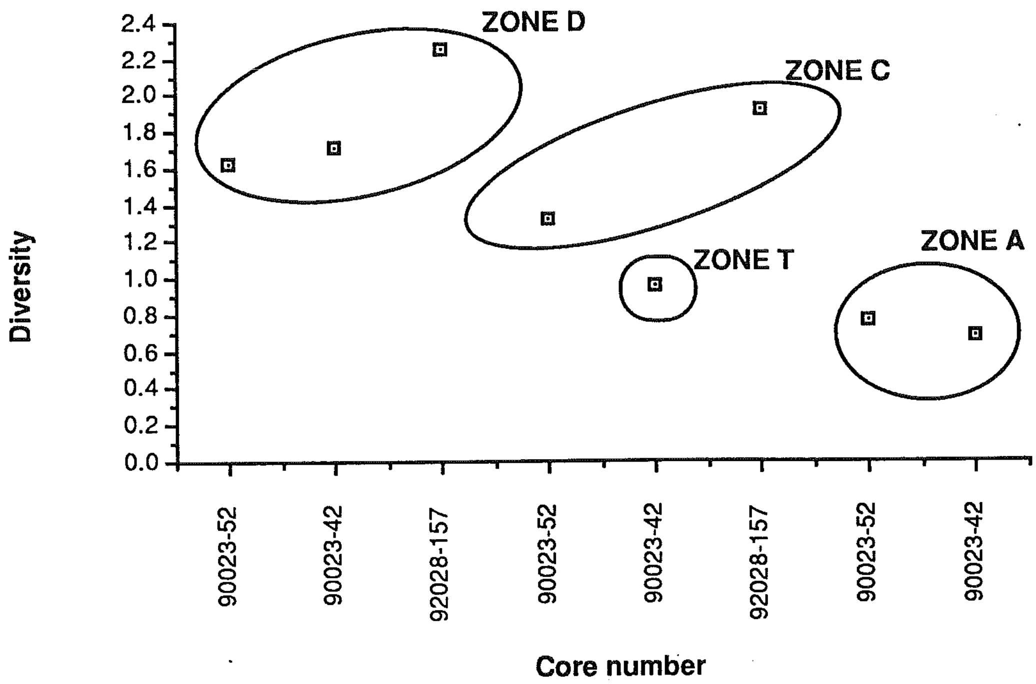


Figure 5: Faunal zone average diversities for Area 1, the Eastern Basin

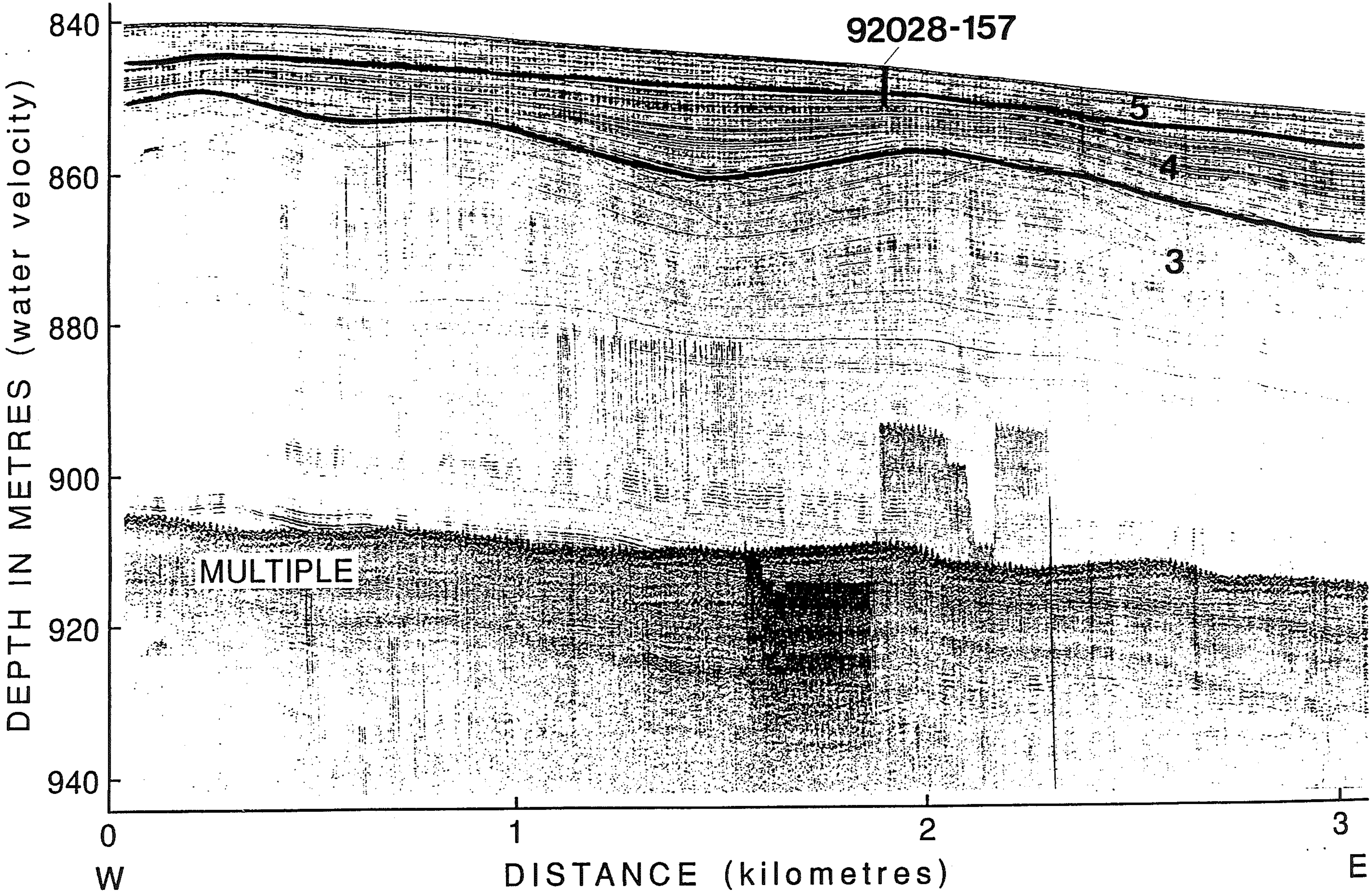


Figure 6: Huntec high resolution seismic profile illustrating glaciomarine (3) and postglacial (4,5) sediment units at core 92028-157 locality.

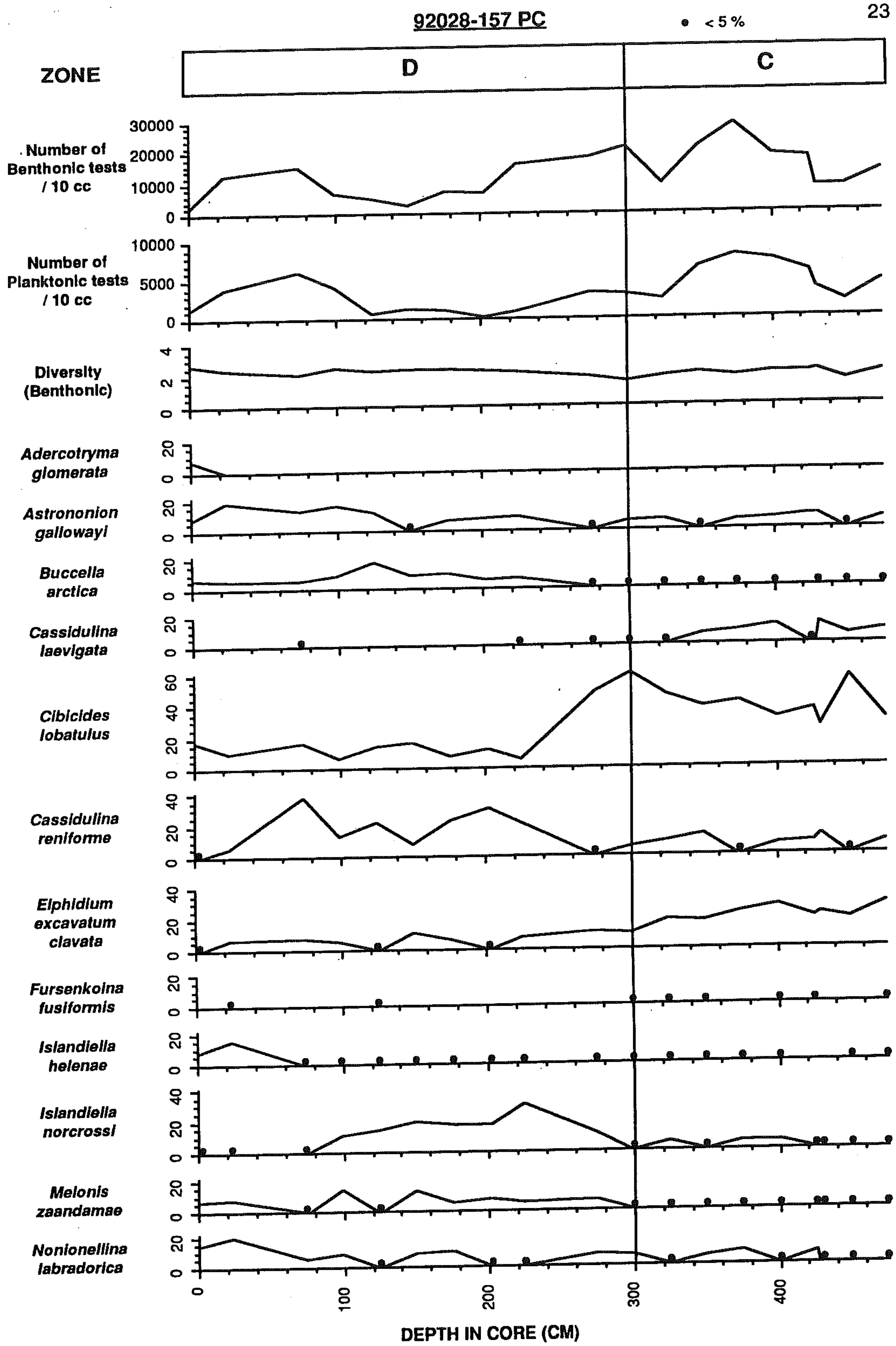


Figure 7: Percent abundances of major benthonic foraminiferal species, numbers of foraminiferal tests, diversity and faunal zones of core 92028-157.

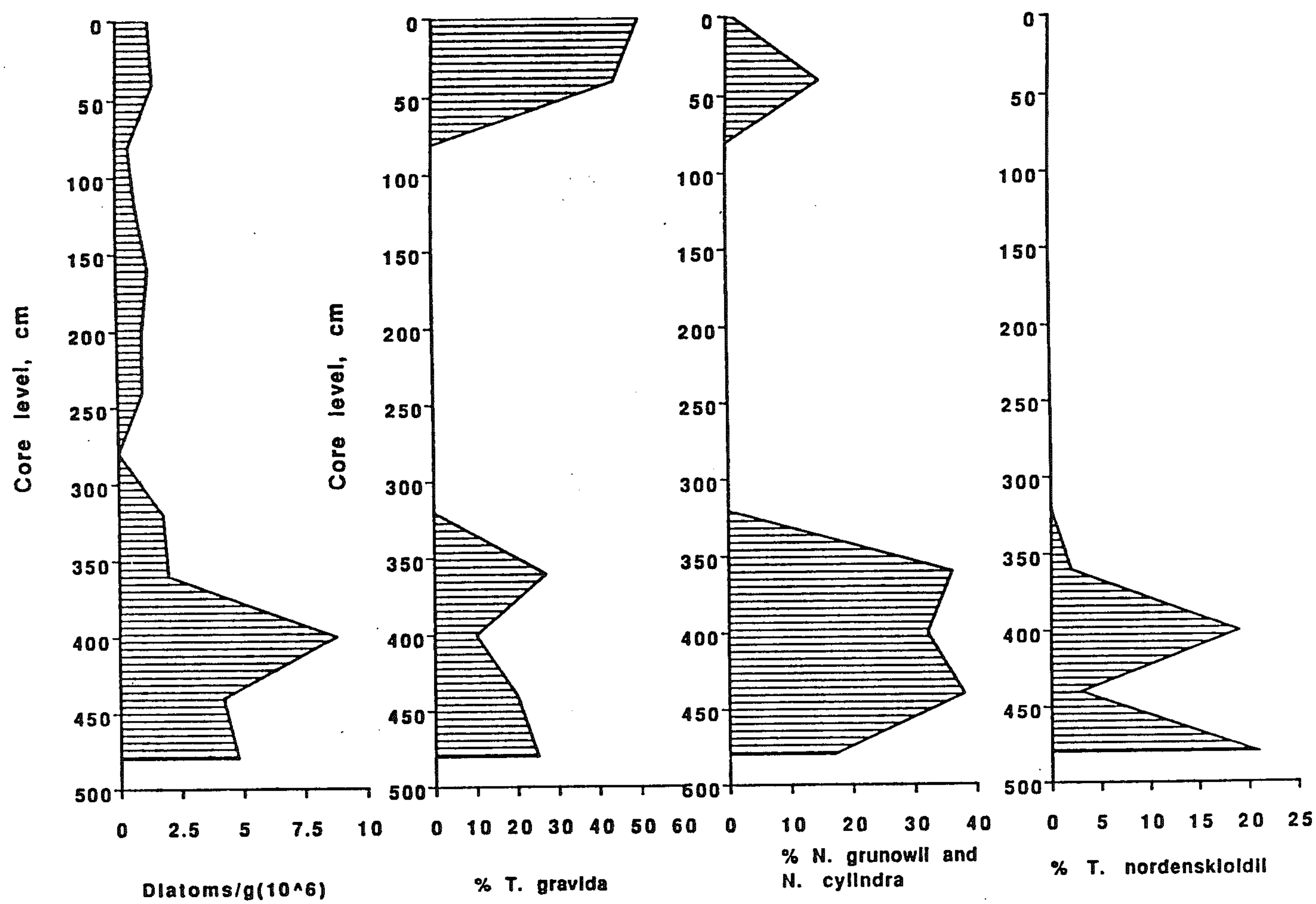


Figure 8: Percent abundances of Diatom tests and species in core 92028-157.

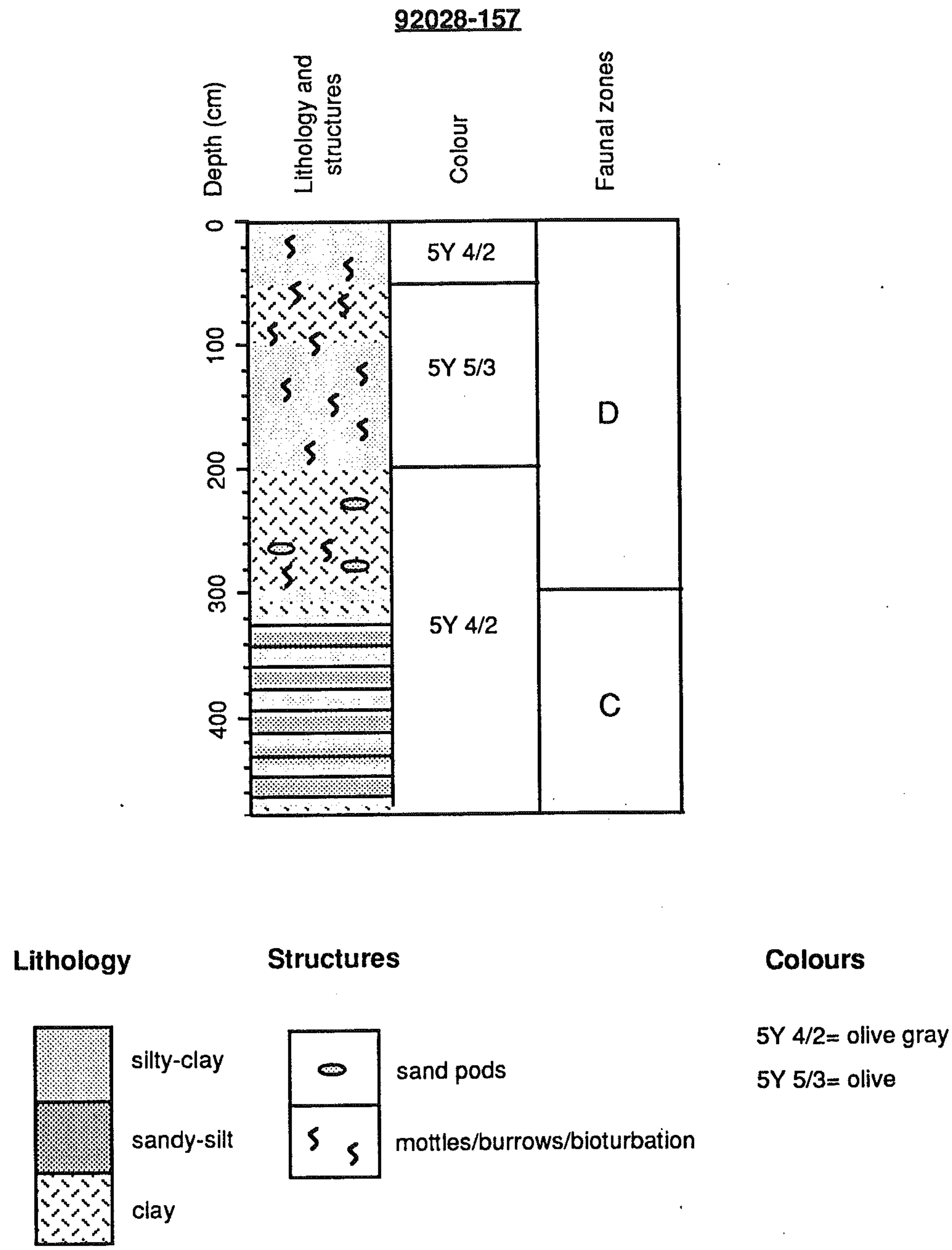


Figure 9: Lithology and Sedimentological structures of core 92028-157

I. norcrossi, I. helenae, C. reniforme, B. arctica and *A. gallowayi*. There is a decrease in the number of *C. laevigata, C. lobatulus, E. excavatum clavata*. Zone D also has a higher diversity (2.258) than zone C (1.915). Planktonic and benthonic test numbers remain constant. This combination of factors suggests an increased arctic offshore water influence in zone D from the previous zone C. *Adercotryma glomerata* is an agglutinated species that is usually found only in sediment surface layers (Schafer and Cole, 1988). Its presence in core 92028-157 indicates that the surface layer was obtained in the coring process.

Core 90023-42

Core 90023-42 is found in the same area (Figure 4) as cores 85027-55, 85027-56 and 85027-57 from which faunal zones were previously defined. There have been different oceanographic and sedimentological influence on Foraminifera at 90023-42 relative to the other core sites. The seismic profile (Figure 10) shows that the core penetrated seismic units 3, 4 and 5. The area to the west of 90023-42 shows pockets of accumulated postglacial sediments. Most of the core was made up of < 100 benthonic tests/10 cc, which makes it difficult to define the faunal zones with any accuracy (Figure 11). This low number of tests may be due to an increase in sedimentation rates.

Zone A is found extending from 390-750 cm. It is defined based on the low numbers of benthonic tests and the low (0.679) fluctuating diversity. The dominant species include *C. reniforme* and *E. excavatum clavata*. There is a peak in *F. loeblichi* and *C. laevigata* at 620-640 cm, suggesting an influx of higher salinity water into this ice proximal environment.

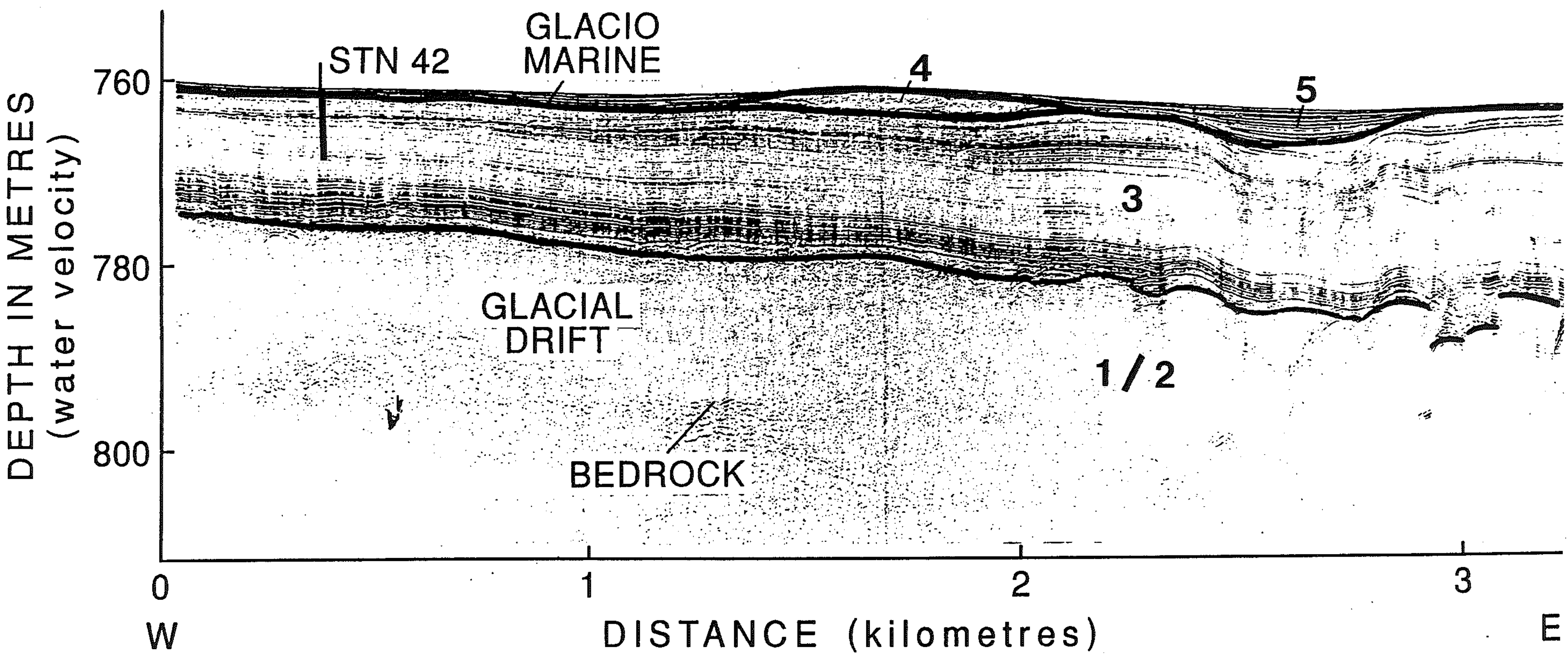


Figure 10: Huntec high resolution seismic profile illustrating glacial drift (1,2), glaciomarine (3) and postglacial (4,5) sediment units at core 90023-42 locality.

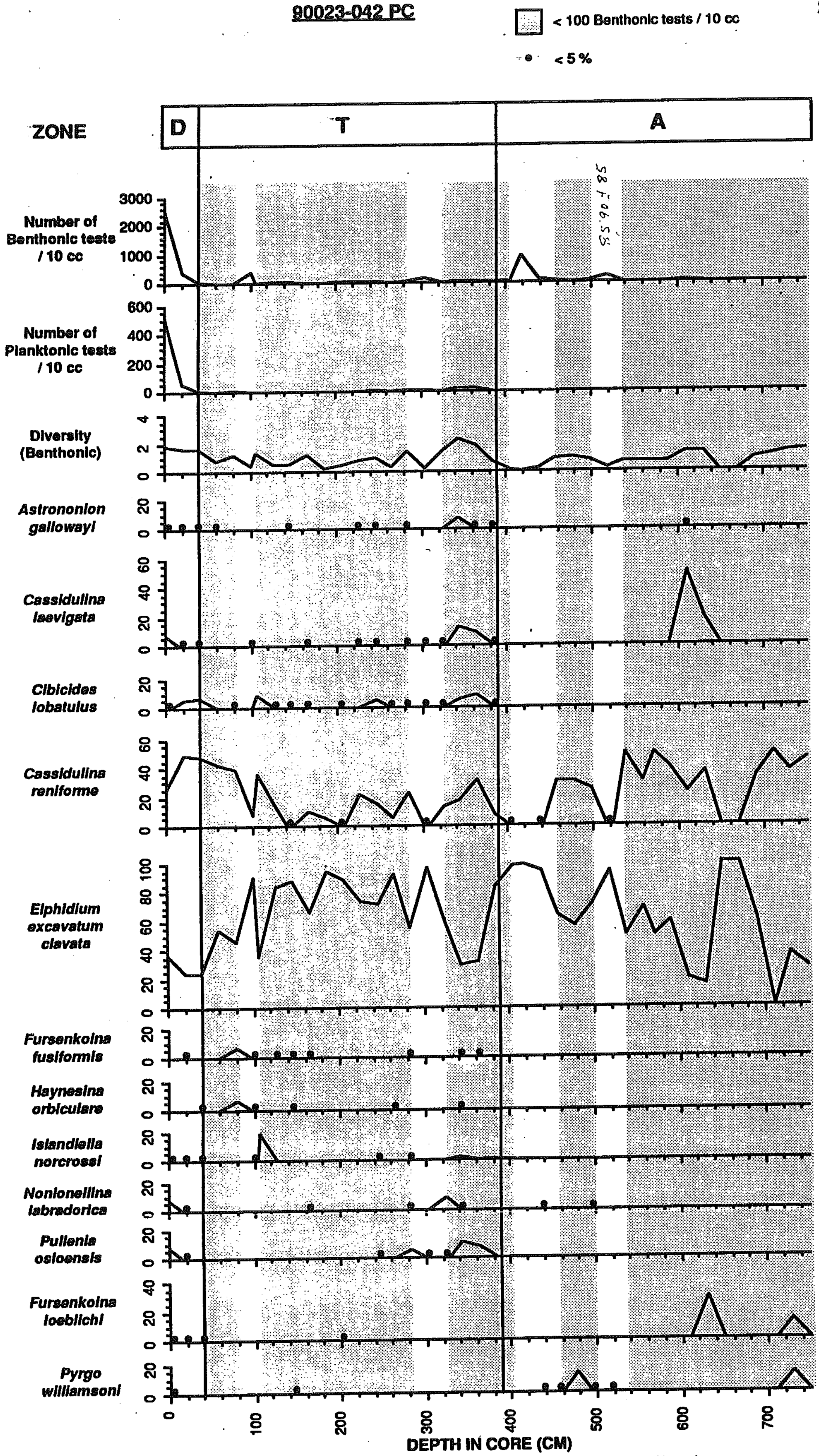


Figure 11: Percent abundances of major benthonic foraminiferal species, numbers of foraminiferal tests, diversity and faunal zones of core 90023-42.

Zone T is found from 40-390 cm. It is indicated by the appearance of *A. gallowayi, C. laevigata, C. lobatulus, F. fusiformis, H. orbiculare, I. norcrossi, N. labradorica* and *P. osloensis*. The diversity has also increased (0.958) relative to zone A and is fluctuating, which suggests alternating stable and unstable periods in the marine environment. Planktonic tests begin to appear and there are still fairly low amounts of benthonic tests. The appearance of *C. laevigata, P. osloensis, A. gallowayi, C. lobatulus* and planktonics suggests an increase in water salinity from zone A, indicating an increased Labrador sea water influence. The increase in *P. osloensis, C. laevigata, A. gallowayi* and N. *labradorica* from about 240-390 cm versus the increase in *F. fusiformis, H. orbiculare* and *I. norcrossi* from 20-240 cm suggests that there initially was a higher salinity environment followed by one of lower salinity, followed again by the higher salinity environment of zone D.

Zone D occurs from 0-40 cm and shows increases from zone T in diversity (1.718), and numbers of benthonic and planktonic tests relative to zone T. There are also increases in *C. laevigata, C. lobatulus, N. labradorica* and *P. osloensis*. *A. gallowayi* and *I. norcrossi* begin occurring in consecutive intervals.

The lithology profile (Figure 12) of core 90023-42 shows a change from pebble and clay clast layers in zone A to a more uniform silty-clay in zone T. There is a suggestion of a fluctuating marine environment in zone T, seen by the various colour changes. The dropstones throughout zone A indicate the presence of glacial ice and icebergs in an ice proximal environment. There are colour changes at the zone A/T and T/D boundaries. Ice proximal glaciomarine conditions were prevalent 8590 years before present (y BP).

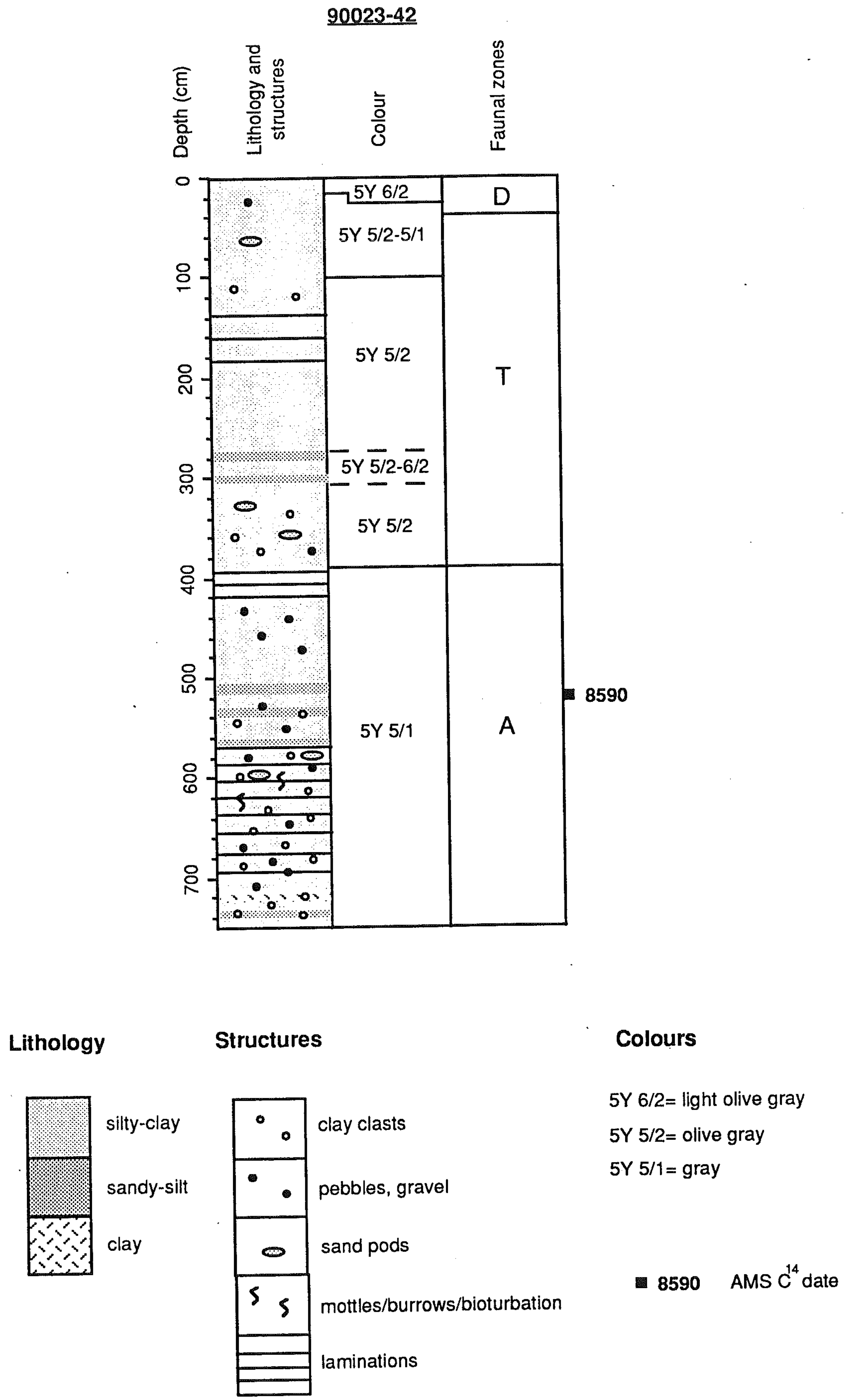


Figure 12: Lithology and Sedimentological structures of core 90023-42

Core 90023-52

Core 90023-52 is found on the flank of the Eastern basin at a water depth of 400 m (Figure 4). Ice readvances from both Meta Incognita peninsula and Ungava Bay may have influenced this area (Miller and Kaufman, 1990). The seismic section (Figure 13) indicates the core penetrated a thin top layer of unit 5, underlain by thicker unit 3 sediments.

Faunal zone A is found from 120-270 cm (Figure 14). It generally has < 100 benthonic tests/10 cc, diversity is low (0.769) and there are no planktonic tests present. The dominant species are *C. reniforme* and *E. excavatum clavata*. There is an increase in diversity and *P. takayanagii, I. norcrossi, H. orbiculare, F. fusiformis* and *A. gallowayi* from 200 to 270 cm. These species are indicative of an ice distal to early postglacial marine environment. A possible explanation for their occasional presence in zone A is that they may represent a temporary retreat in the ice margin which allowed conditions to be favourable for their proliferation. A subsequent readvance of the ice margin once again induced ice proximal conditions (120-200 cm). The ice distal species could have also been carried into this area via current activity.

Zone C is found from 20 to 120 cm. There is an increase in diversity (1.329) relative to zone A. There is also an increase in *A. gallowayi, C. laevigata* and *F. fusiformis* and of planktonic tests. This all suggests an influx of more saline Labrador Sea waters. *C. laevigata* and *F. fusiformis* both appear concurrently in this zone. This may be a zone C characteristic indicative of the Eastern Basin.

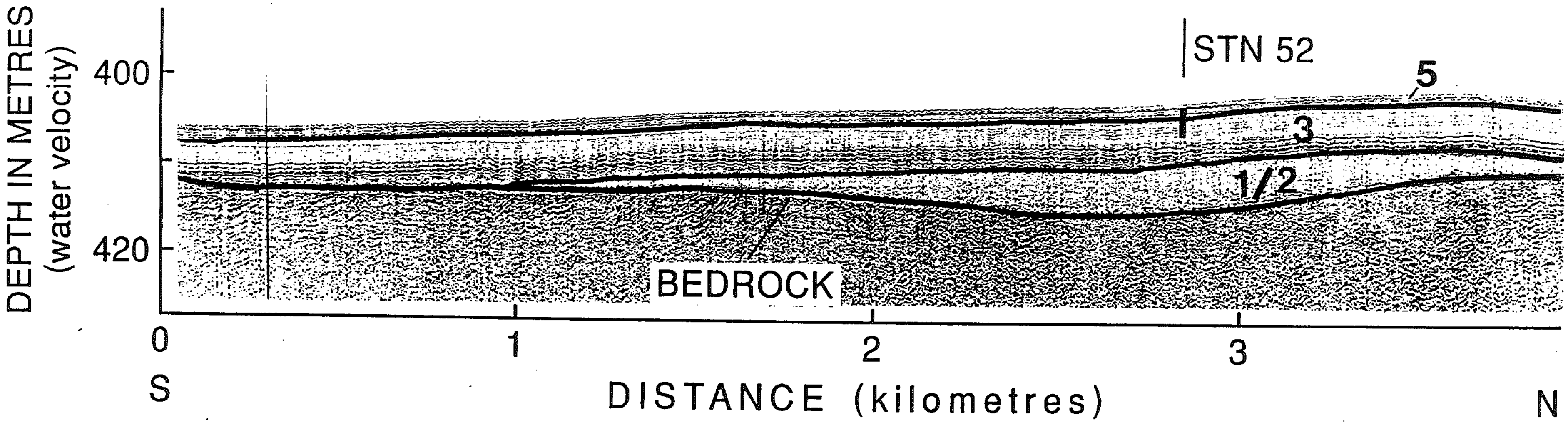


Figure 13: Huntec high resolution seismic profile illustrating glacial drift (1,2), glaciomarine (3) and postglacial (5) sediment units at core 90023-52 locality.

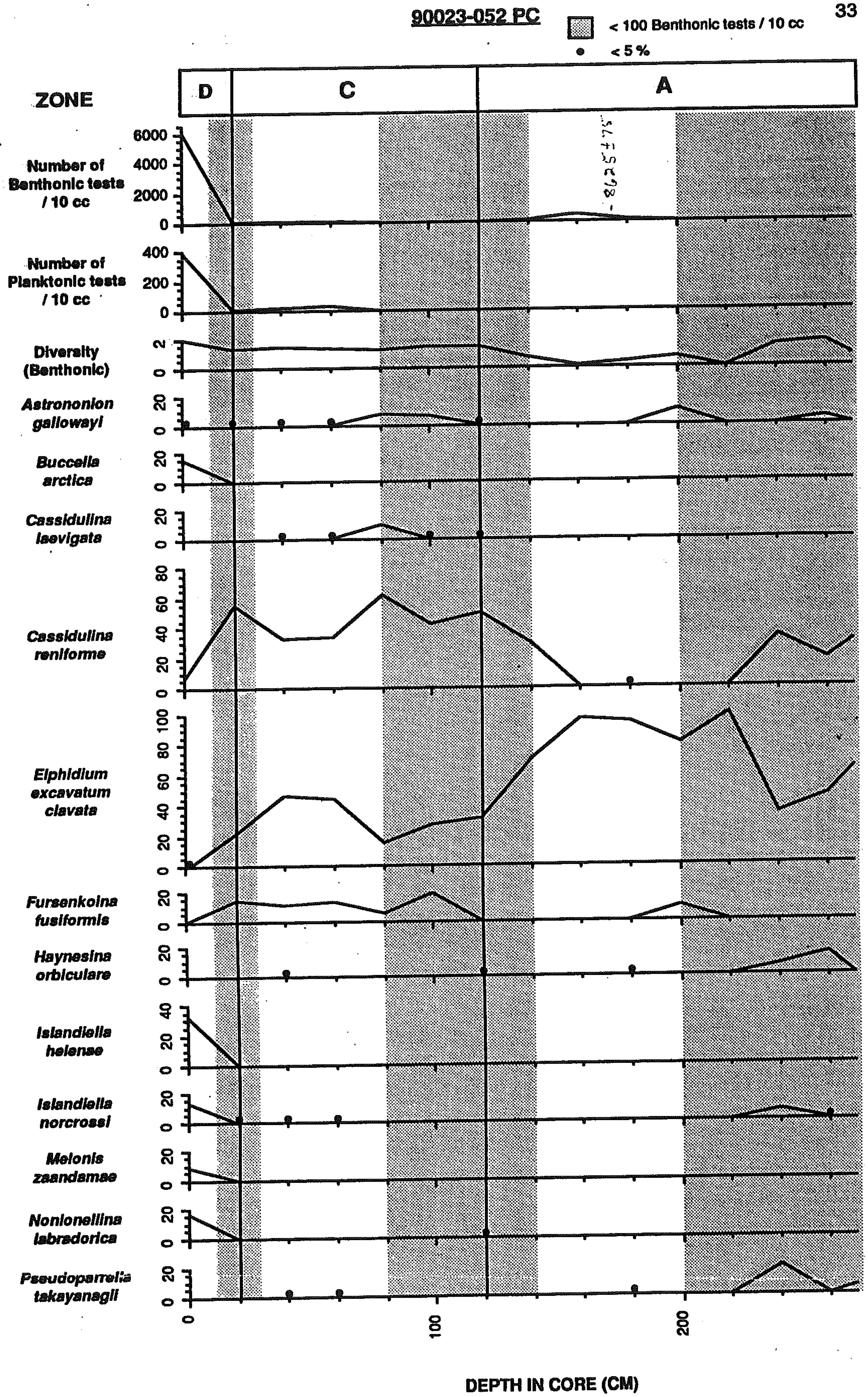


Figure 14: Percent abundances of major benthonic foraminiferal species, numbers of foraminiferal tests, diversity and faunal zones of core 90023-52.

Zone D is found from 0-20 cm. It is indicated by the increase in diversity (1.626) and of benthonic and planktonic tests from the previous zone C. The increase in planktonics suggests an increase in Labrador sea water influx. There is also an increased abundance of *B. arctica, I. helenae, I. norcrossi, M. zaandamae* and *N. labradorica*. The presence of *M. zaandamae* suggests that the present deep water environment was established only during the postglacial period (Leslie, 1965). The increase in *N. labradorica* and *I. norcrossi* with a subsequent decrease in *C. reniforme, E. excavatum clavata* and *F. fusiformis*, suggests there was an increase in bottom water temperatures and salinities (Bilodeau *et al.*, 1990).

The lithological profile (Figure 15) shows that zone A is made up of poorly sorted clay clasts and pebbles in a silty-clay matrix with sand interlayers. This suggests a high sedimentation rate and ice proximal conditions at this time. Ice proximal conditions were still present at 8625 y BP. A colour change is seen at the A/C and C/D zone boundary. Zone C is characterized by increased mottling, sand pods and a decrease in clay clasts and pebbles from zone A. There is also a change from silty clay sediments in zone C to sandy silt in zone D.

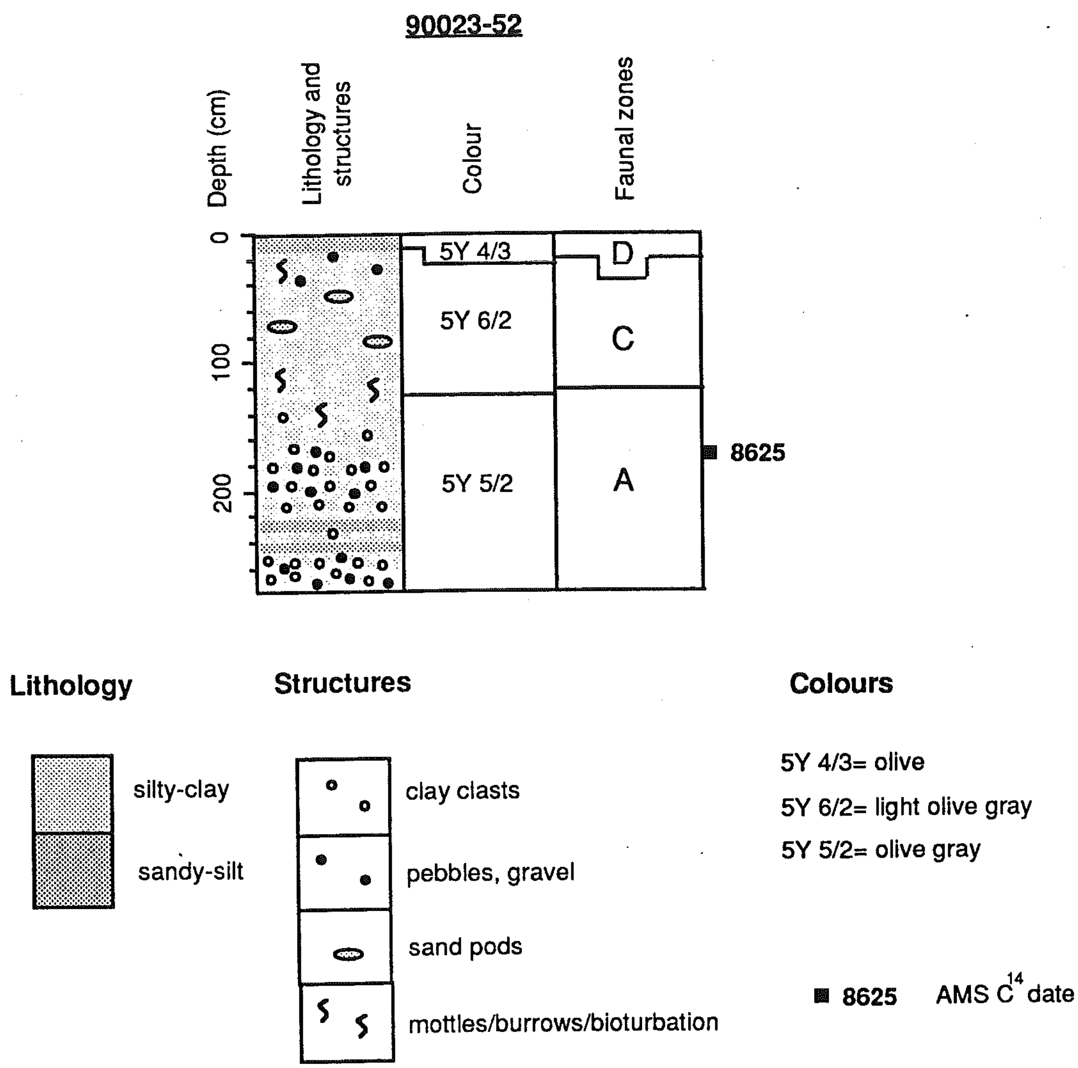


Figure 15: Lithology and Sedimentological structures of core 90023-52

Area 2: Ungava Bay

Area 2 encompasses all of Ungava Bay in southeastern Hudson Strait (Figure 16). Ungava Bay is an outlet for a large drainage basin covering Northern Quebec and Labrador. It is also affected by current activity from incoming Hudson Strait and Labrador sea waters. Deglaciations of southern Ungava Bay did not occur until 7300-7000 y BP (MacLean *et al.*, 1992). Extensive glacial drift and postglacial sediment deposits blanket the area. Three cores were studied from Ungava Bay. Core 90023-62 came from southwest of Akpatok Island and cores 90023-34 and 90023-39 came from the Ungava Trough in eastern Ungava Bay (Table 3).

Zone Definitions

Faunal zone's A and D in cores from Ungava Bay show characteristics typical of the rest of Hudson Strait. There is no distinctly defined zones B or C present in the cores studied for this area. Two separate and distinct transition zones have been found. The zone between the glaciomarine of zone A to the postglacial zone D in cores 90023-34 and 90023-39 is defined as the T_1 transition zone. Zone T_1 shows a mixture of zone A, B and D Foraminifera species. This zone has been influenced by processes such as meltwater sediment influx and paleoceanographic currents. Zone T_1 is characterized by alternating $<$ and $>$ 100 benthonic test/10 cc intervals. The diversity fluctuates from 0 to 1 throughout this zone. There is an increase in the number of planktonics and *F. loeblichi* . *F. loeblichi*

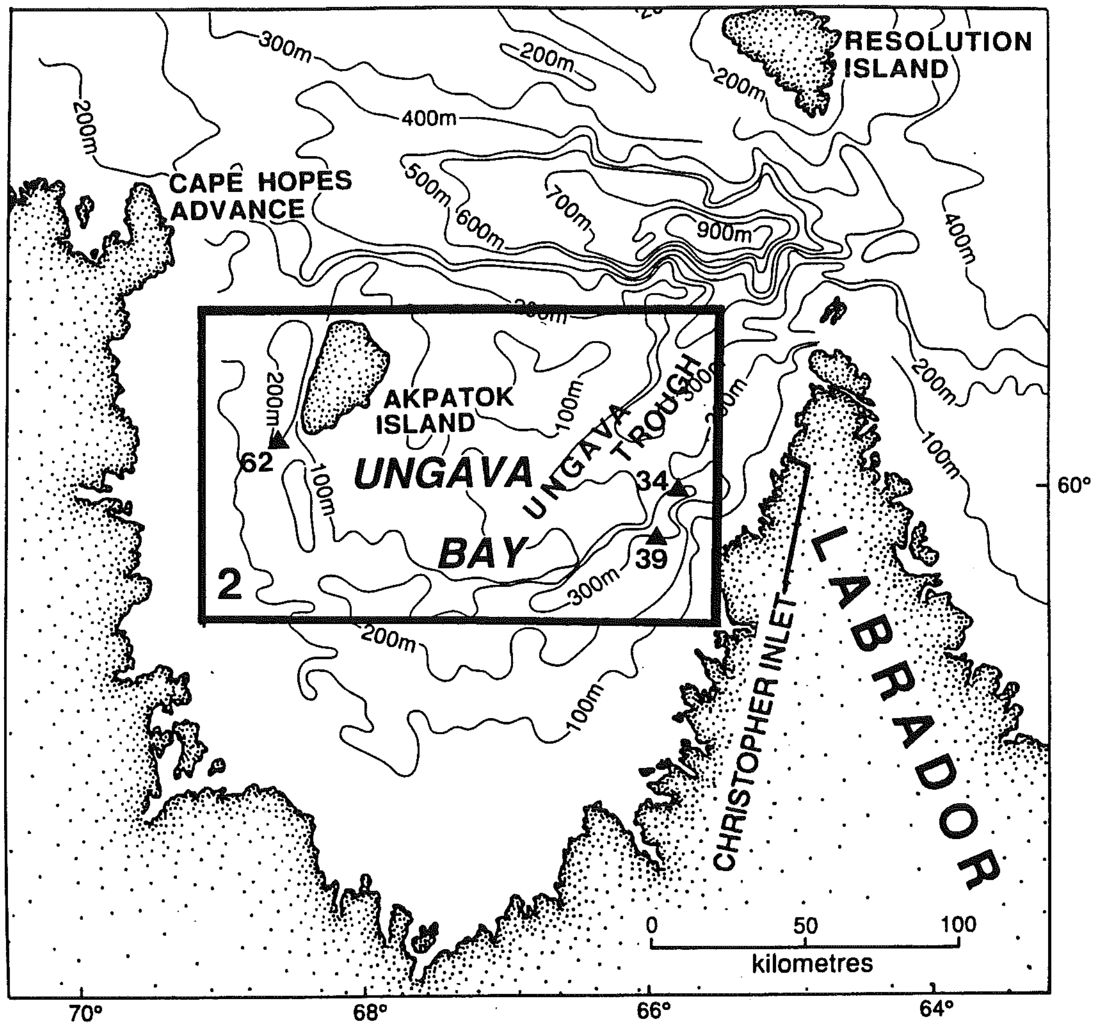


Figure 16: Detailed map of Area 2, Ungava Bay, showing 90023 cruise core sites (▲34).

Table 3: Ungava Bay Core Information

Core	Length (cm)	Latitude (N)	Longitude (W)	Water Depth
90023-39	956	59 57.06	65 55.82	387
90023-34	352	59 59.41	65 44.03	320
90023-62	256	60 15.76	68 32.97	234

is present in greater abundance than *F. fusiformis* in the Ungava Bay cores.

Core 90023-62 has its own unique transition zone (T_2) that suggests a more gradual paleooceanographic transition from a glaciomarine to postglacial environment. The diversity is more constant with less fluctuation as in the other cores. There is an increase in planktonics, *A. gallowayi, B. arctica, B. frigida, C. lobatulus, Elphidium subarcticum, F. fusiformis* and *I. helenae* from zone A.

Vilks (1989) found that *E. subarcticum* was common in arctic, deltaic biotopes. The increased amount of *E. subarcticum* during the transition and postglacial periods may reflect meltwater flowing into Ungava Bay as the Laurentide ice sheet decayed.

The average diversities (Figure 17) for Ungava Bay faunal zones vary from core to core. Core 90023-62 shows the highest diversities for all zones. Core 90023-34 has higher average diversities for zones D and T_1 than 90023-39. All cores show a general trend of low diversities in zone A (0.371-1.122) to a high in zone D (1.644-1.962), with intermediate values for the transition zones (0.748-1.925).

Core 90023-39

Core 90023-39 was taken from the Ungava Trough at a water depth of 387 m. The core was taken in an area with irregular bedrock topography (Figure 18), which the Quaternary sediments overlie. Intermittent unit 3 sediments are overlain by thick deposits of acoustically unstratified or weakly stratified sediments. This suggests a large sediment influx from meltwater streams and/ or increased current activity in the area during the postglacial.

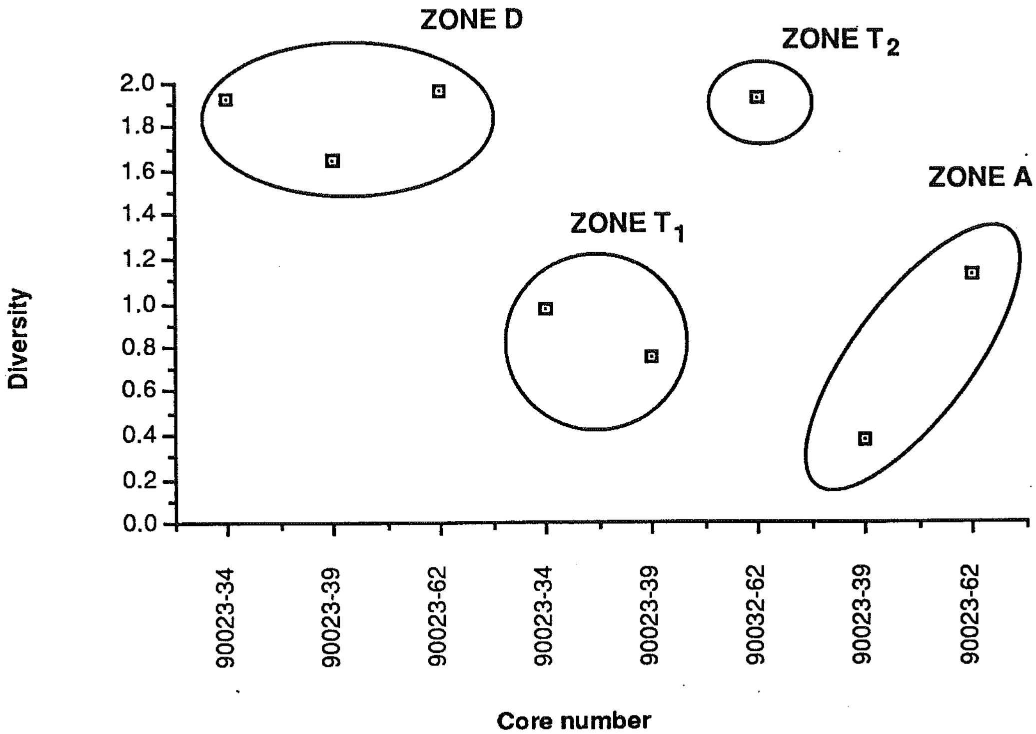


Figure 17: Faunal zone average diversities for Area 2, Ungava Bay

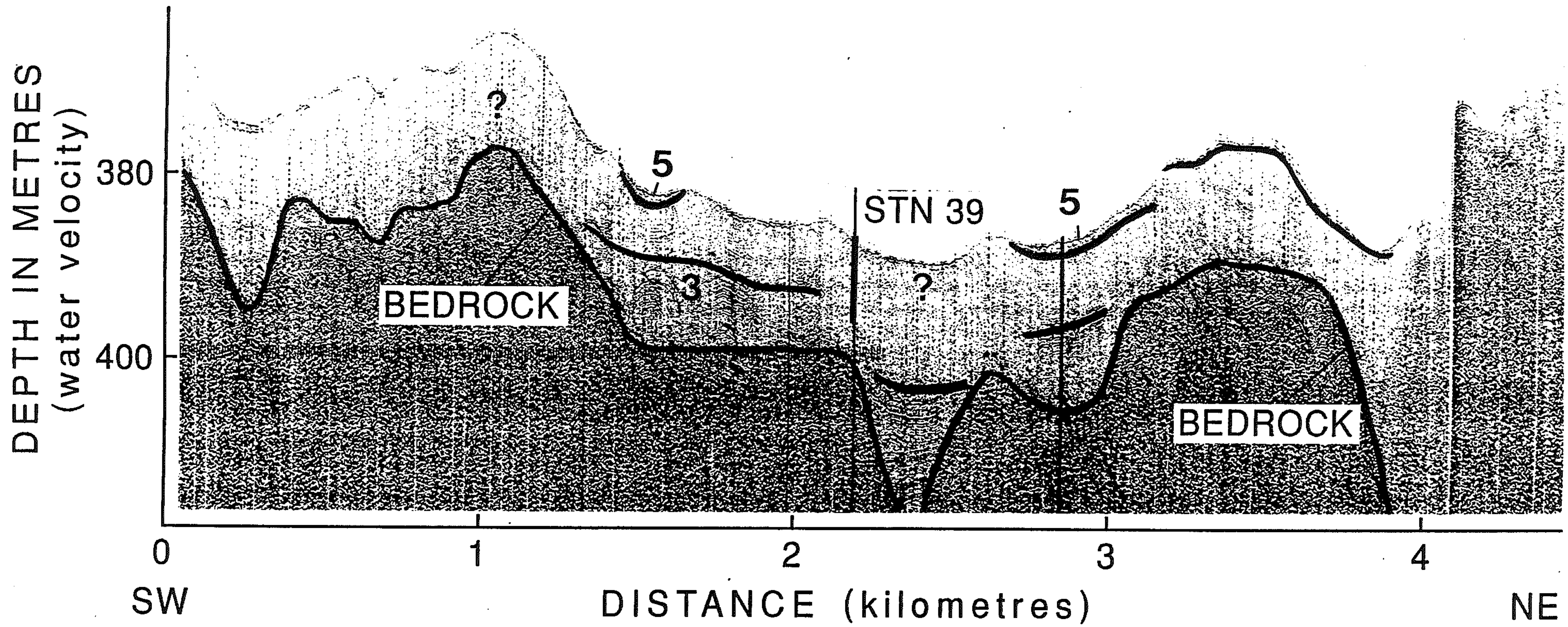


Figure 18: Huntec high resolution seismic profile illustrating glacial drift (1,2), glaciomarine (3), postglacial (5) and unknown (?) sediment units at core 90023-39 locality.

Zone A (Figure 19) is found from 620-920 cm. It is characterized by having < 100 benthonic tests / 10 cc and low diversity that fluctuates from 0 to an average of 0.371. *E. excavatum clavata* and *C. reniforme* are the dominant species, although the intermittent appearance of *F. loeblichi* suggests that influx of higher salinity (32-35 ppm) waters occasionally occurred (personal communique, Vilks, 1993). There are no planktonic tests present in this zone.

Zone T_1 (180-620 cm) is a transition zone from a glaciomarine to postglacial environment in this area. The appearance of planktonics, *N. labradorica, I. helenae, P. osloensis, F. loeblichi* and *I. norcrossi* in consecutive intervals suggests a higher salinity, postglacial influence. The presence of fluctuating intervals of < and > 100 benthonic test/10 cc and the dominance of *C. reniforme* and *E. excavatum clavata* suggest the ice margin was still influencing the area at this time. The diversity is higher (0.371) than in zone A and is fluctuating indicating an unstable, stressful environment for the foraminifera (Buzas and Gibson, 1968).

Zone D is found from 0 to 180 cm. This zone is defined based on the increase in diversity (1.644), benthonic and planktonic tests from zone T_1. There are also substantial increases in *A. gallowayi, B. arctica, B. frigida, C. lobatulus, H. orbiculare, I. helenae, I. norcrossi* and *N. labradorica*. *B. arctica* and *B. frigida* appear later in the core than *I. norcrossi* and *I. helenae*.

Zone A is characterized in the lithology profile (Figure 20) by laminated sediments with abundant clay clasts and a few mottles. Zone T_1 has increased lamination and mottling from the more clay clast rich zone A. Zone D is mottled with no laminations and has a layer of gravel at the top of the core.

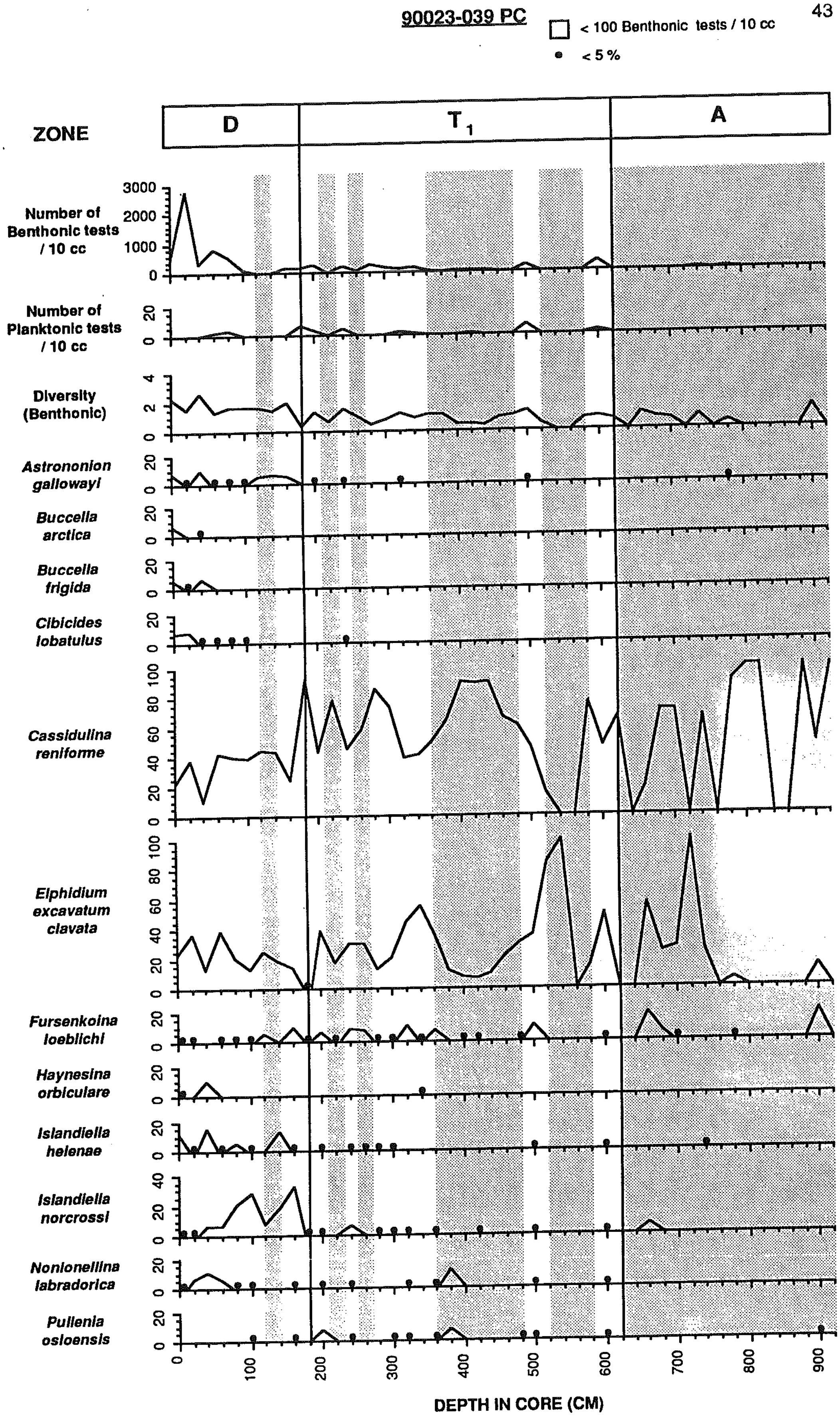


Figure 19: Percent abundances of major benthonic foraminiferal species, numbers of foraminiferal tests, diversity and faunal zones of core 90023-39.

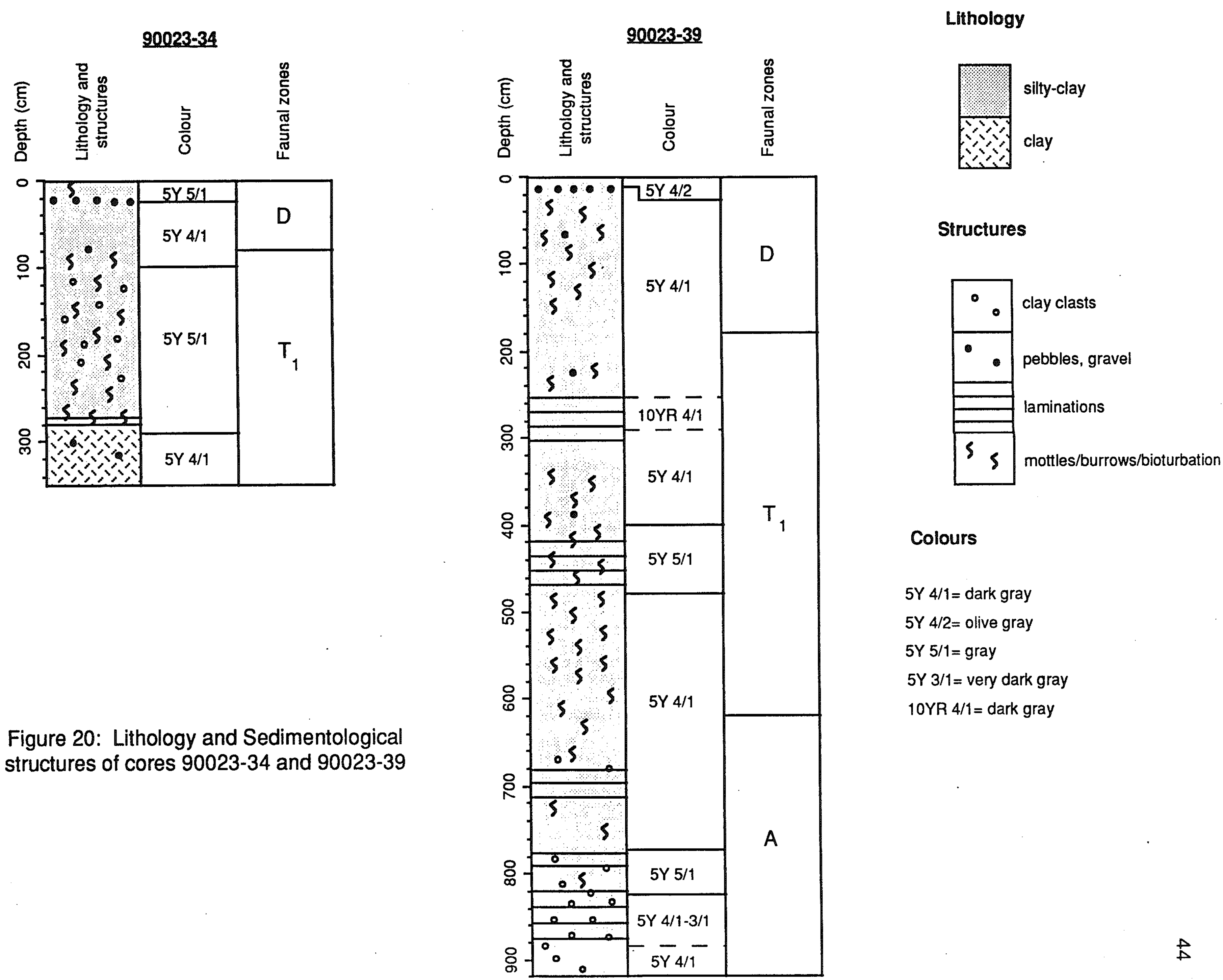


Figure 20: Lithology and Sedimentological structures of cores 90023-34 and 90023-39

Core 90023-34

Core 90023-34 is found north of core 90023-39 at a water depth of 330 m (Figure 16). The seismics (Figure 21) show that the core penetrated units 4 and 5. Unit 4 could represent meltwater and/or current sediment influx.

There is no zone A present in core 90023-34 (Figure 22). A large T_1 zone extends from 30 to 350 cm. It is defined by alternating $<$ and $>$ 100 benthonic test/ 10 cc intervals. There is an intermittent presence of planktonic tests throughout the zone indicates the occasional influx of higher salinity, Labrador sea water. The diversity is also fluctuating about a mean of 0.972. The dominant species are *C. reniforme* and *E. excavatum clavata* with minor amounts of *A. gallowayi, B. arctica, B. frigida, C. lobatulus, N. labradorica, Pyrgo williamsoni, H. orbiculare* , *F. loeblichi* and *E. subarcticum* scattered throughout. This suggests a mixture of glaciomarine and postglacial environmental conditions.

Zone D is found from 0-30 cm. There is an increase in the amount of *N. labradorica, H. orbiculare, B. tenerrima* and *B. arctica.* There is also a significant increase in the diversity (1.925) and the number of benthonic tests from zone T_1 suggesting a stabilization of the marine environment.

The lithology profile (Figure 20) shows that the T_1 zone is made up of clay clasts and mottling in a silty clay to clay matrix. This suggests a quieter current environment than zone D. Zone D is characterized by increased pebble content, less mottling and fewer clay clasts than in zone T_1.

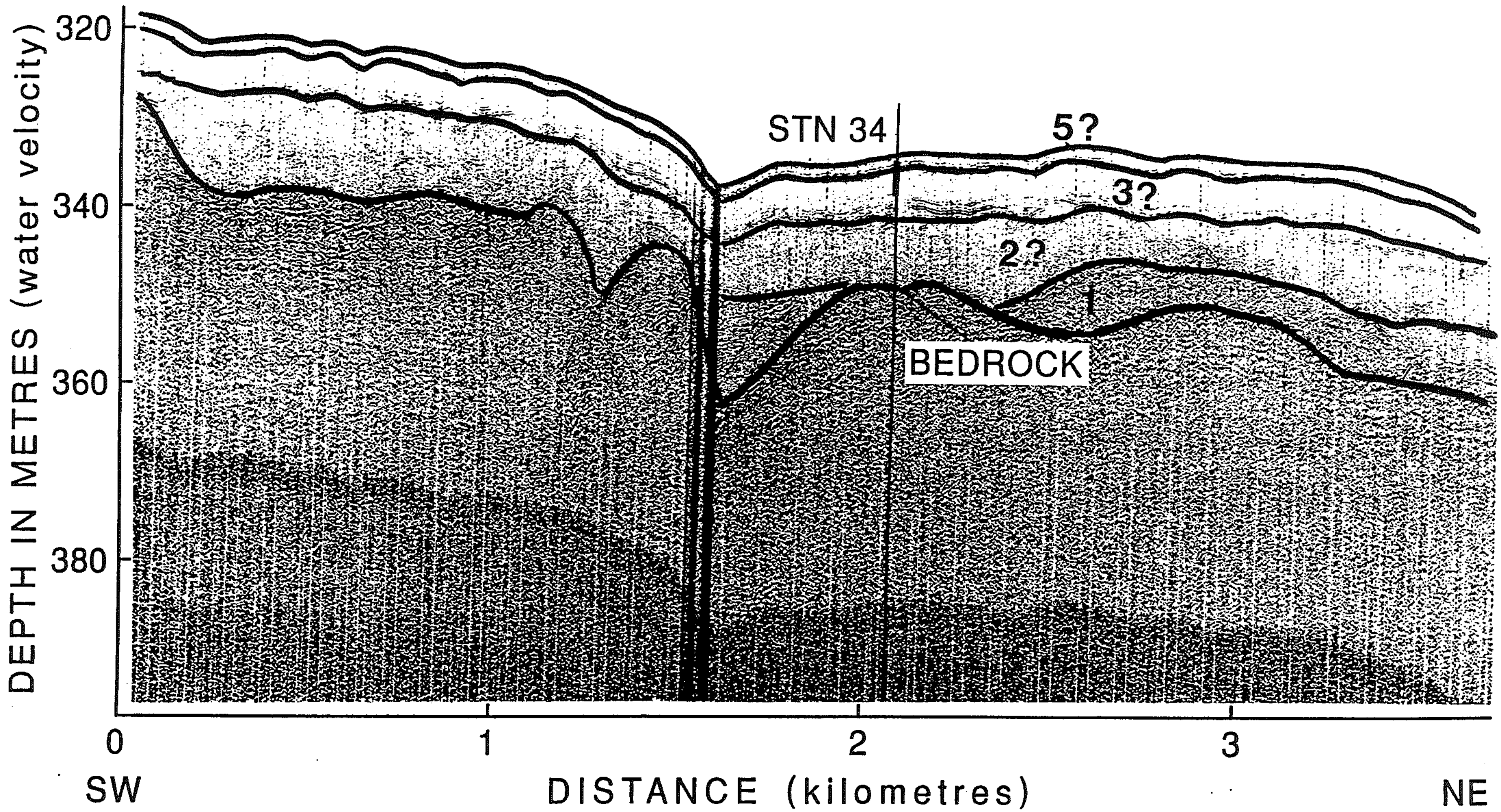


Figure 21: Huntec high resolution seismic profile illustrating glacial drift (1,2), glaciomarine (3), postglacial (5) and unknown (?) sediment units at core 90023-34 locality.

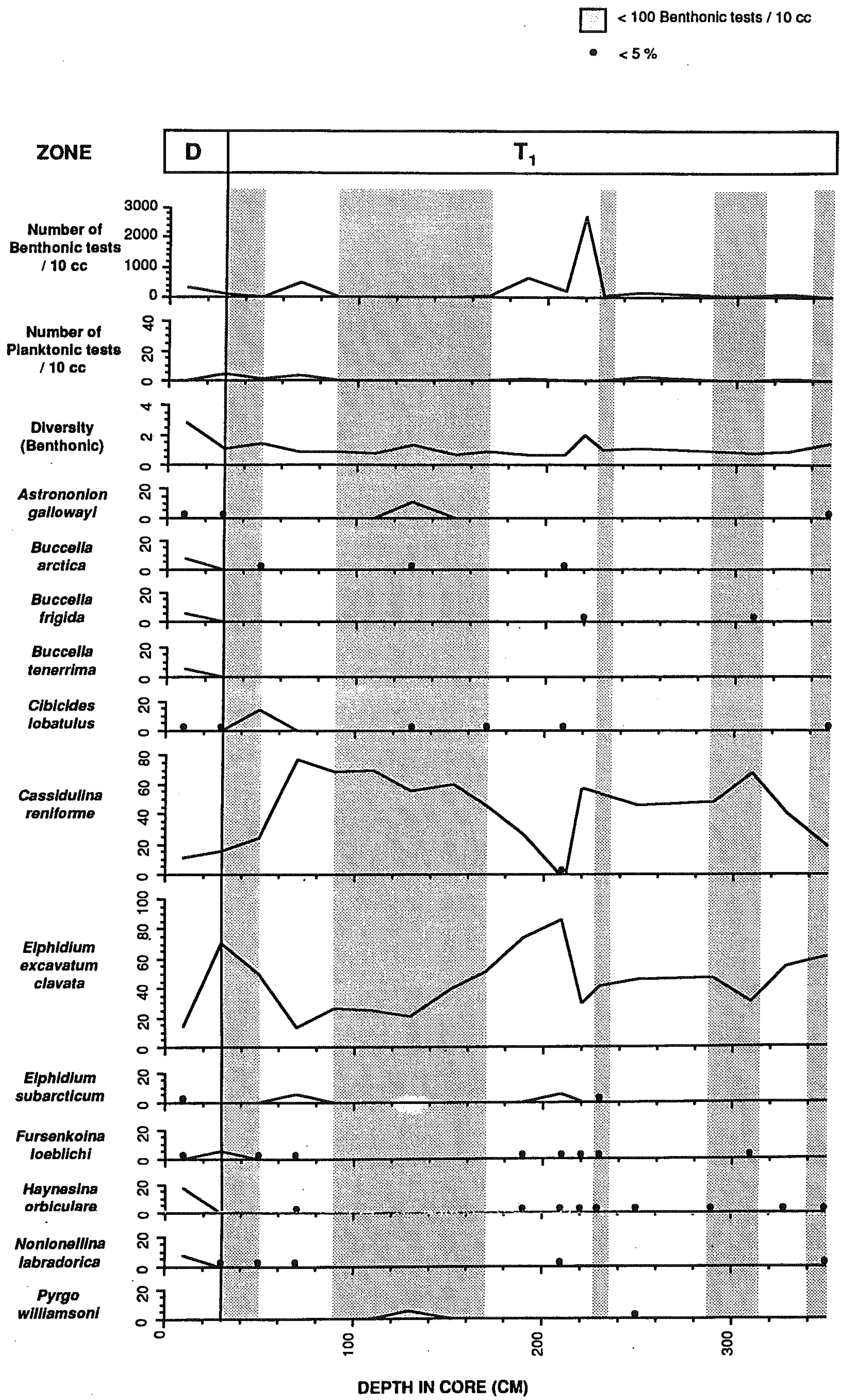


Figure 22: Percent abundances of major benthonic foraminiferal species, numbers of foraminiferal tests, diversity and faunal zones of core 90023-34.

Correlation of 90023-34 and 90023-39

It is very difficult to correlate and interpret cores 90023-34 and 90023-39 because of the fluctuating nature of the Foraminifera abundances. The lithology profiles (Figure 20) show that in both cores zone T_1 is characterized by laminations and mottling with a gray (5Y 5/1) to dark gray (5Y 4/1) colour change. Zone D shows a gravel layer and colour change at the top of each core. These lithologies are roughly correlatable over the distance separating core 90023-34 and 90023-39. Localized current effects and river sediment influx from glaciers melting inland seem to have influenced each core site individually.

Core 90023-62

Core 90023-62 was taken to the southwest of Akpatok Island at a water depth of 234 m (Figure 16). The seismics (Figure 23) show that at the core site, acoustically stratified sediments of unit 3 are transitional to glacial drift within 1 km of the core site. Acoustically unstratified, weakly stratified sediments overlie unit 3 locally. Postglacial sediments infill paleo-ice scours on the surface.

Zone A (Figure 24) is found from 140-240 cm. It is so defined based on the < 100 benthonic tests /10 cc interval, low diversity (1.122) and no planktonic tests are present. *E. excavatum clavata* and *C. reniforme* are the dominant species in this zone. The presence of < 5% *I. helenae, A. gallowayi, C. lobatulus* and *B. frigida* suggest increased offshore bottom current activity was affecting the area at this time.

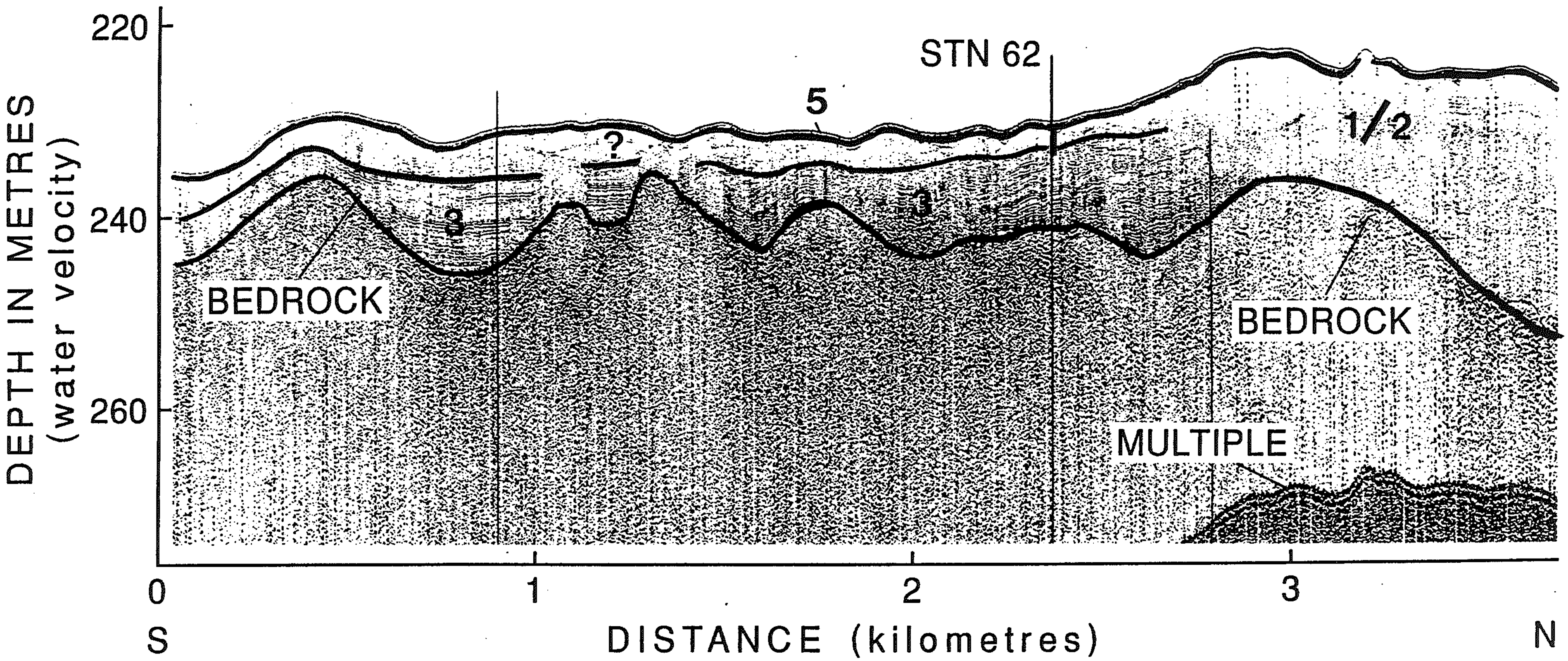
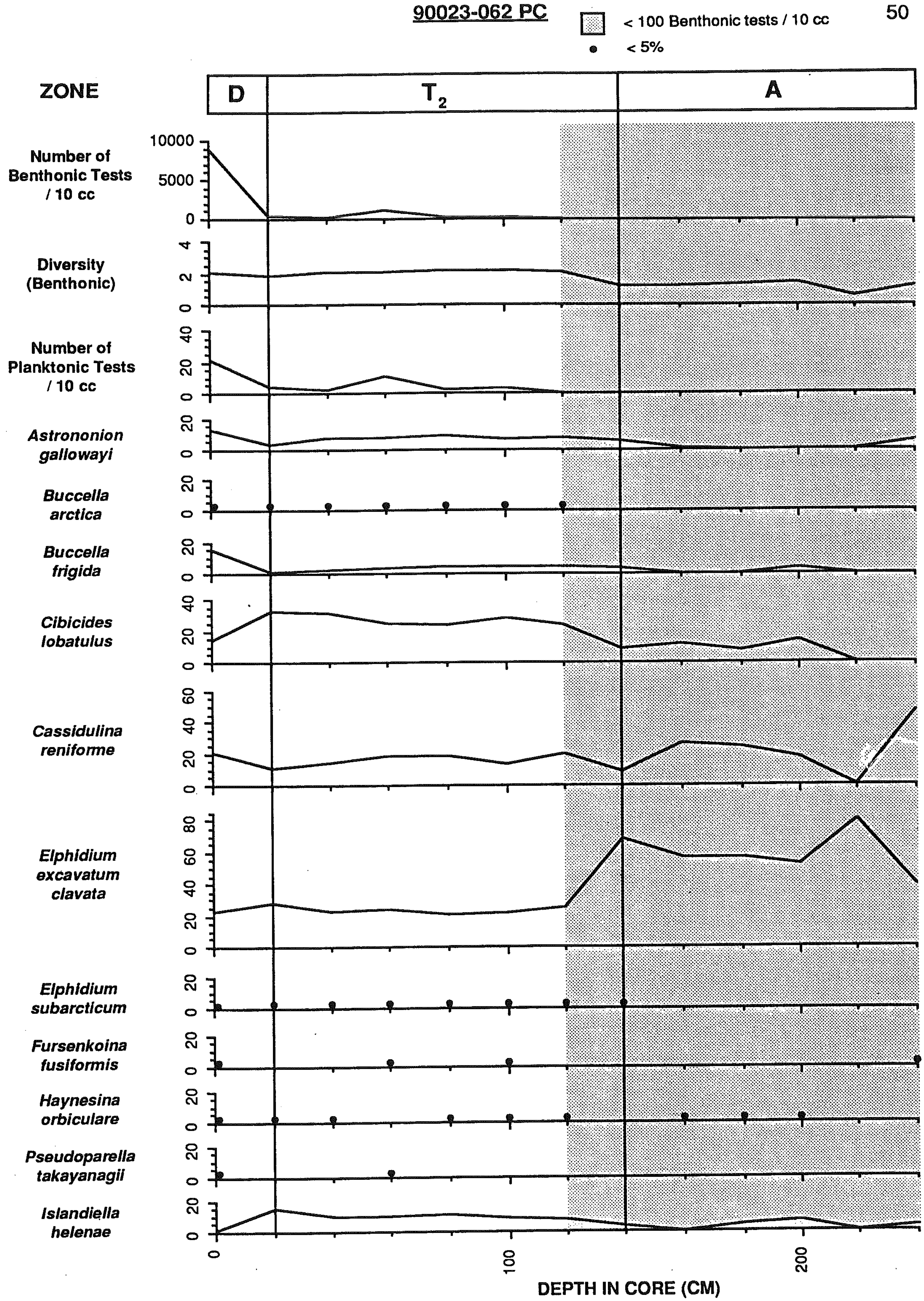


Figure 23: Huntec high resolution seismic profile illustrating glacial drift (1,2), glaciomarine (3), postglacial (5) and unknown (?) sediment units at core 90023-62 locality.



90023-062 PC
< 100 Benthonic tests / 10 cc
< 5%
ZONE
D
T2
A
Number of Benthonic Tests / 10 cc
10000
5000
0
Diversity (Benthonic)
4
2
0
Number of Planktonic Tests / 10 cc
40
20
0
Astrononion gallowayi
Buccella arctica
Buccella frigida
Cibicides lobatulus
Cassidulina reniforme
60
Elphidium excavatum clavata
80
Elphidium subarcticum
Fursenkoina fusiformis
Haynesina orbiculare
Pseudoparella takayanagii
Islandiella helenae
0
100
200
DEPTH IN CORE (CM)

Zone T_2 extends from 20-140 cm and is a transitional zone from a glaciomarine to postglacial environment. It has > 100 benthonic tests / 10 cc and there is an increase in planktonic tests, which indicates an increase in offshore waters into this area. Diversity is high (1.925) indicating stabilization of the environment. The presence of zone A (*C. reniforme, E. excavatum clavata*) and zone D (*A. gallowayi, B. arctica, B. frigida, C. lobatulus, I. helenae, E. subarcticum*) species suggests an early postglacial environment prevailed at this time. *E. subarcticum* suggests a change to a more deltaic biotope. The large amounts of *C. lobatulus* suggests that there is an increase in sand and current activity from the previous zone A (Vilks and Deonarine, 1987).

Zone D is found from 0-20 cm. It is identified by the increase in benthonic and planktonic tests. Diversity has only increased slightly (1.962) from the previous zone. There is also an increase in the number of *A. gallowayi* , *B. frigida* and *C. reniforme*.

This core was taken from an area located close to the glacial ice margin seen by the large masses of glacial drift (unit 1 and 2) in the seismic profile (Figure 23). There is a colour change and increased mottling from zone T_2 to D seen in the lithology profile (Figure 25). Zone T_2 also shows an increase in pebbles and sand pods relative to the more clay clast rich zone A, which suggests more ice transported debris was deposited in T_2 than zone A.

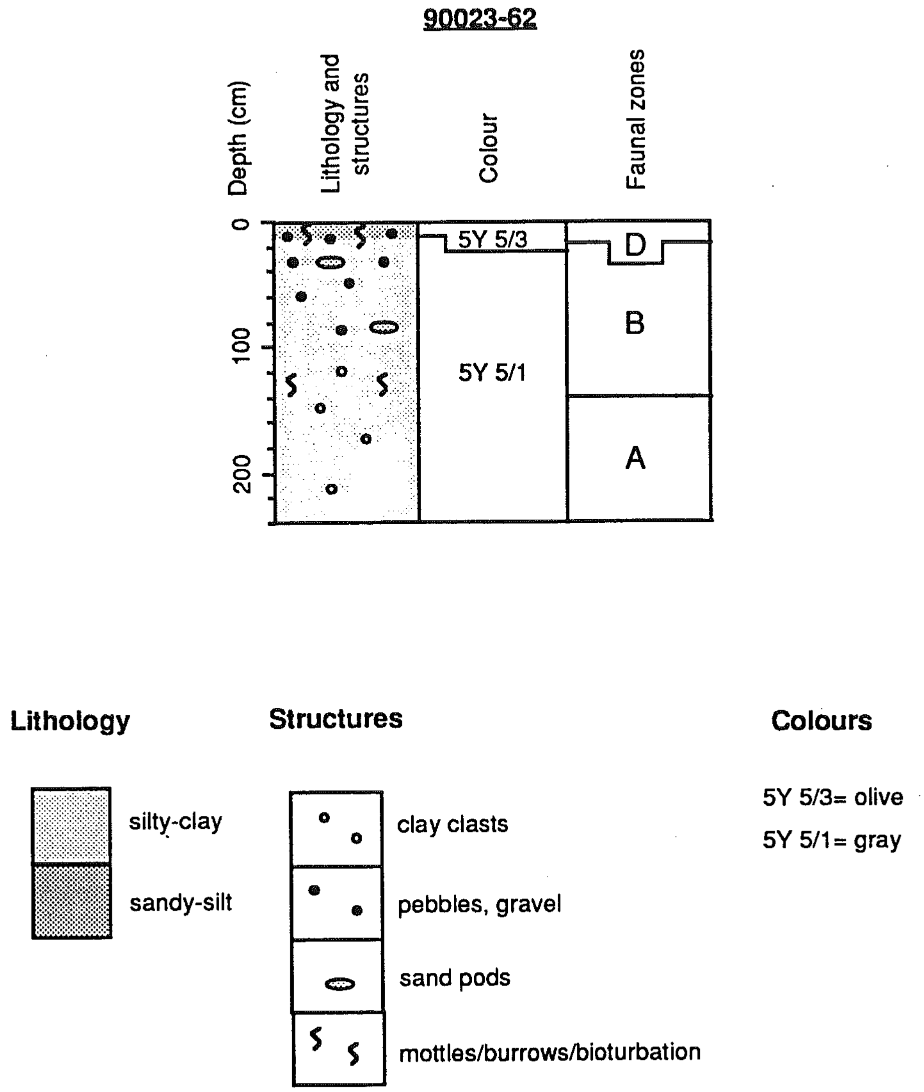


Figure 25: Lithology and Sedimentological structures of core 90023-62

Area 3: Central Hudson Strait

Several cores (Table 4) were taken from the Baie Hericart region (Figure 26) during the 90023 and 92028 cruises. The cores from the 92028 cruise were taken to retrieve the upper portion of sediments missed by the corer during the 90023 cruise and to sample deeper in the section. These include core pairs 90023-107 and 92028-153, and, 90023-64 and 92028-155. Cores in these pairs have been correlated with one another based on magnetic susceptibility profiles (Manley *et al* ., 1993). Core 90023-66 was taken from the northern section of the Baie Hericart area and core 90023-71 was retrieved offshore from Wakeham Bay. Two different surface current regimes affect this area in the present day. One current flows outward toward the Atlantic ocean from the arctic and Hudson Bay. Another minor current approaches the area from Big Island (Figure 2).

Zone Definitions

Faunal zones A, B and D are fairly well defined and show similar characteristics to other zone's A, B and D in Hudson Strait. There are minor variations specific to each area which will be discussed in each core description. There is no zone C or T in this area.

The diversities (Figure 27) for Central Hudson Strait show that zone A has the lowest diversity (0.706) and zone D the highest (2.081-1.370). Zone B diversities are fairly consistent with an intermediate range of 0.980-1.096. As would be expected the diversity for core 90023-107 zone A and B combined (0.795) is found between the zone A and B ranges for the rest of the cores.

Table 4: Central Hudson Strait Core Information

Core	Length (cm)	Latitude (N)	Longitude (W)	Water Depth (m)
90023-107	750	61 20.67	70 37.77	182
92028-153	758	61 20.64	70 37.73	184
90023-64	987	61 07.50	70 34.60	196
92028-155	1076	61 09.50	70 34.20	196
90023-66	749	61 27.82	70 51.00	193
90023-71	616	61 46.72	71 56.65	110

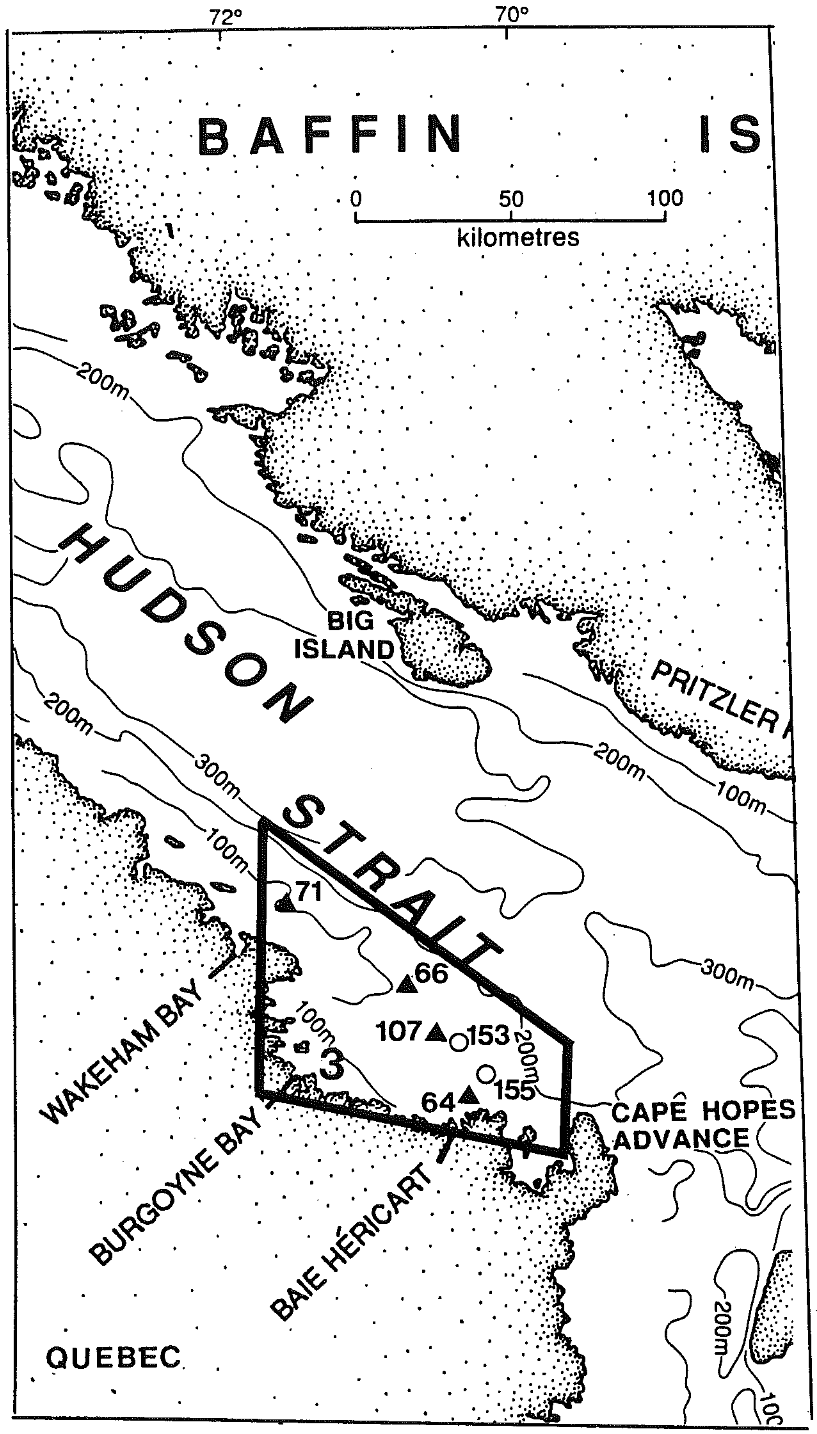


Figure 26: Detailed map of Area 3, Baie Hericart and Wakeham Bay, Central Hudson Strait, showing core sites from the 90023 (▲ 66) and 92028 (○ 155) cruise.

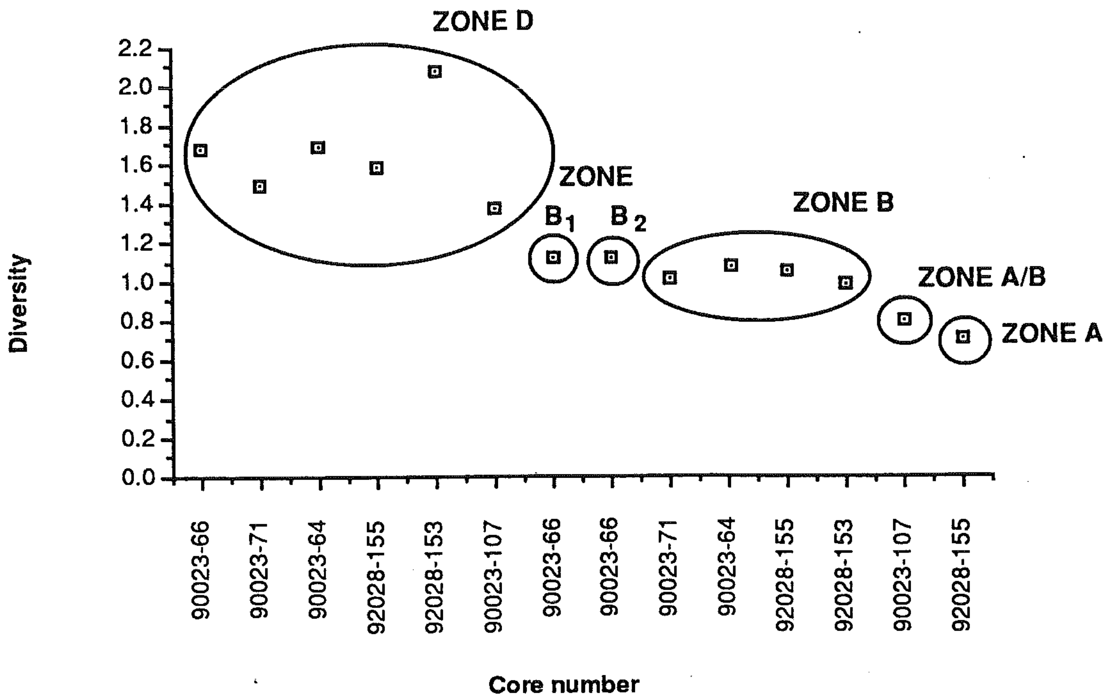


Figure 27: Faunal zone average diversities for Area 3, Central Hudson Strait

Core 90023-107

Core 90023-107 was collected in 182 m of water (Figure 26). Figure 28 shows the core penetrated seismic unit 3 and 5 sediments. It is located close to unit 1 and 2 glacial drift sediments. This core was identified and described by MacLean *et al.* (1992). There is a gradual change (Figure 29) from faunal zone A to B over the span of 20 - 680 cm. *F. fusiformis* is scattered throughout the interval and therefore, it is difficult to pinpoint an exact A/B boundary. Based on magnetic susceptibility correlations with core 92028-153, it would suggest that the A/B boundary in core 90023-107 occurs around 550 cm or lower. Diversity for zone A and B is low (0.795) compared to zone D.

Zone D was so classified by the increases in *N. labradorica, I. helenae, F. fusiformis* and *B. arctica*. There is also an increase in diversity (1.370) and in the number of benthonic tests.

Core 92028-153

Core 92028-153 and 90023-107 were collected about 100 m apart (Figure 28). Core 92028-153 retrieved a longer section of seismic unit 5 than core 90023-107. Core 92028-153 was collected from a water depth of 184 m. There is no zone A (Figure 30) present in this core but zone B is found from 120-740 cm. It is identified by the presence of *C. reniforme, E. excavatum clavata* and *F. fusiformis*. There is increased oceanic influence in this area seen by periodic fluxes of planktonic tests entering the core area. There are minor amounts

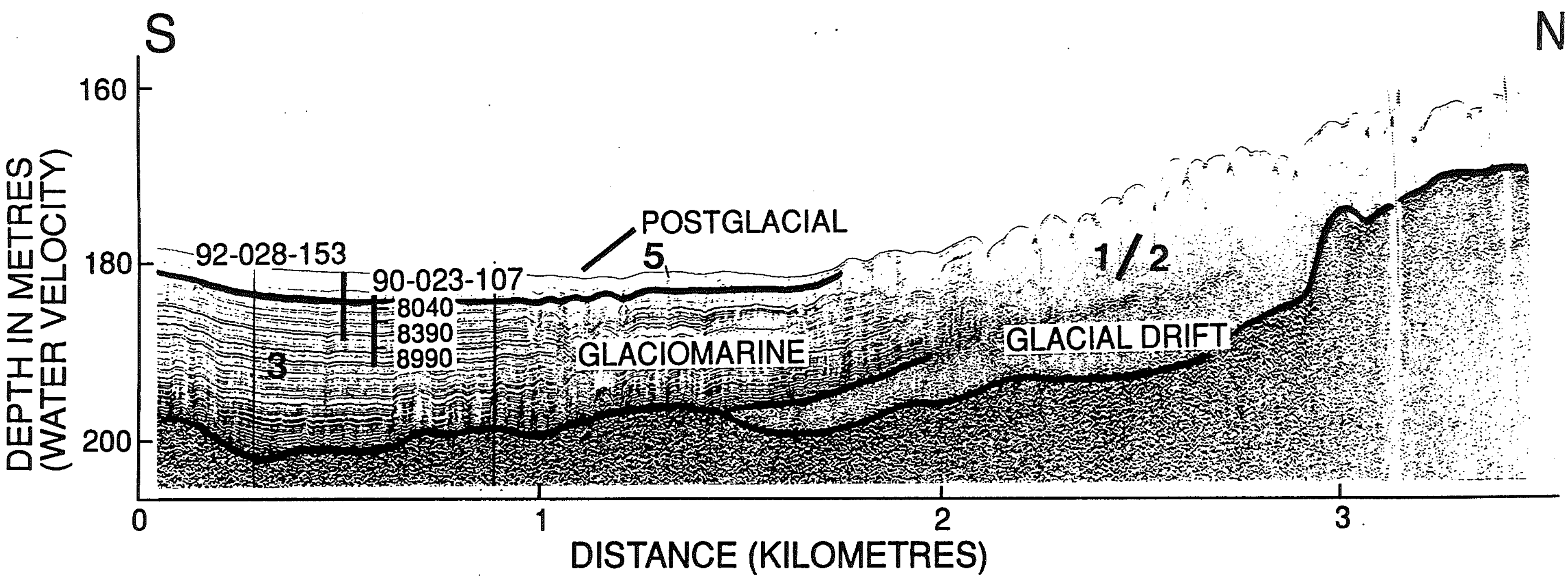


Figure 28: Huntec high resolution seismic profile illustrating glacial drift (1,2), glaciomarine (3) and postglacial (5) sediment units at cores 90023-107 and 92028-153 localities.

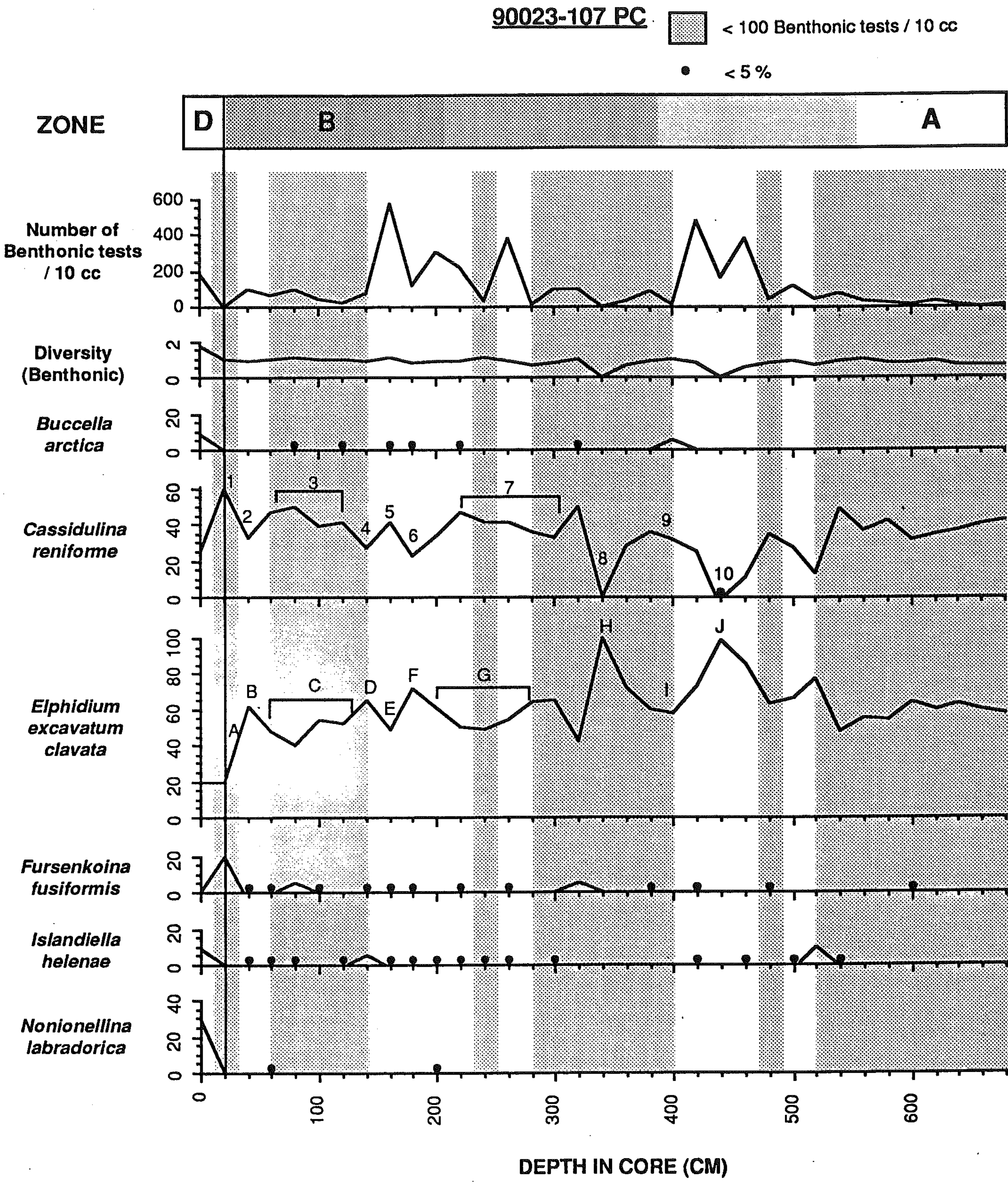


Figure 29: Percent abundances of major benthonic foraminiferal species, numbers of foraminiferal tests, diversity and faunal zones of core 90023-107.

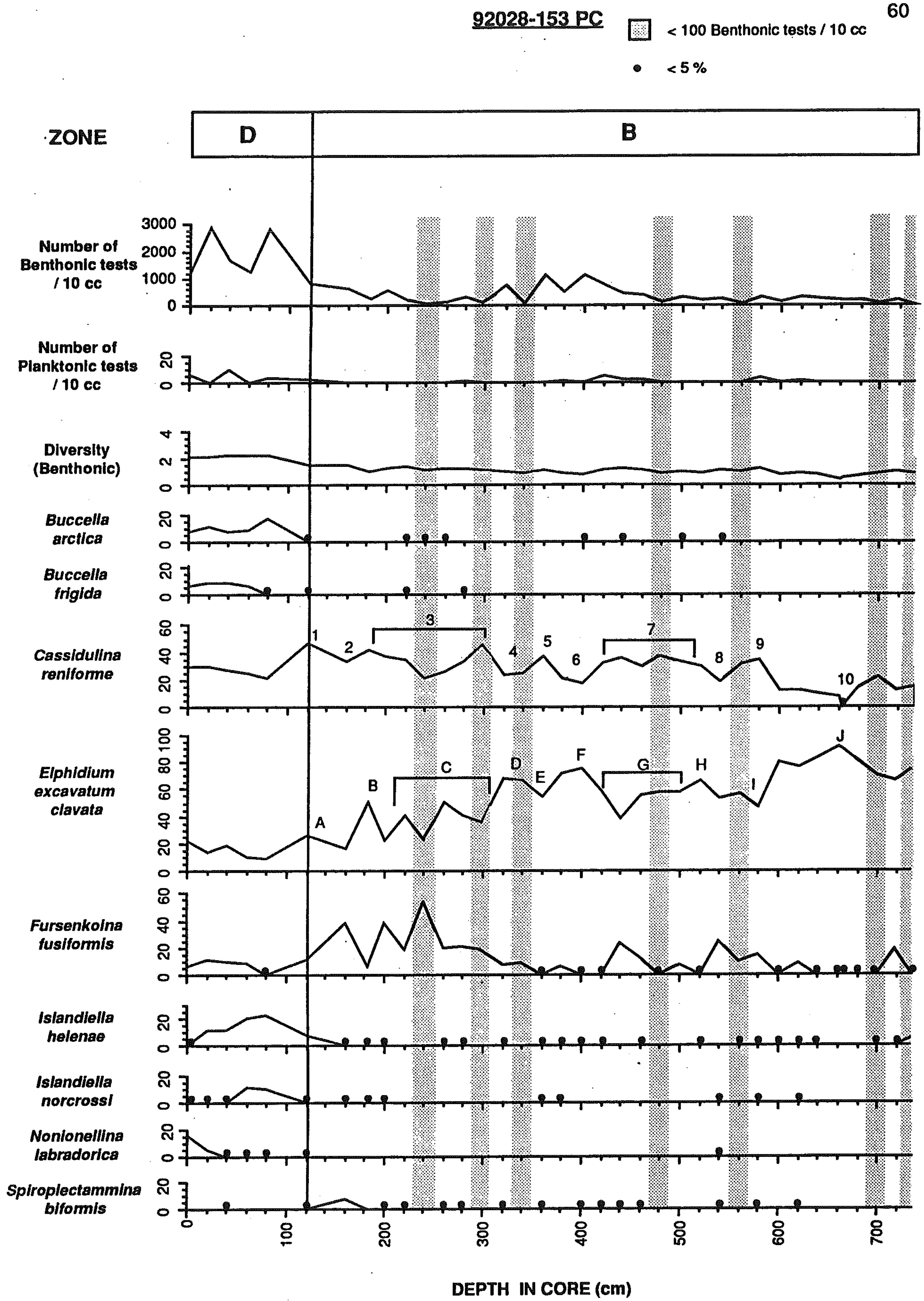


Figure 30: Percent abundances of major benthonic foraminiferal species, numbers of foraminiferal tests, diversity and faunal zones of core 92028-153.

of *I. helenae, I. norcrossi* and *Spiroplectammina biformis.*

A larger portion of zone D was retrieved (0-120 cm) in core 92028-153 relative to 90023-107. Zone D in 92028-153 is classified as such because there is a major increase in diversity (2.081) and in the number of planktonic and benthonic tests relative to zone B. There is also an increase in the amount of *N. labradorica, I. norcrossi, I. helenae, B. frigida* and *B. arctica* tests. *B. arctica* and *B. frigida* appear higher in the core than both *I. norcrossi* and *I. helenae*. *F. fusiformis, E. excavatum clavata* and *C. reniforme* have decreased in number from the previous zone B.

Correlation of 90023-107 and 92028-153

These two cores are correlated quite well on the basis of magnetic susceptibility (Figure 31), but they are more difficult to correlate based on Foraminifera data. This is unexpected since the cores are found only 100 m apart and it was thought that there would be more similarities between the two. They can roughly be correlated based on peaks and troughs in *C. reniforme* (see numbers 1 to 10, Figures 29 and 30) and *E. excavatum clavata* (see letters A to J, Figures 29 and 30) throughout zone B. The D/B boundary is also correlatable as both cores show an increase in diversity, benthonic tests and *N. labradorica, I. helenae* and *B. arctica*. Core 92028-153 has more benthonic tests and higher diversity than core 90023-107. There are also fewer < 100 benthonic test/10 cc intervals in 92028-153 than in 90023-107.

The lithology profile (Figure 32) shows no similarities between core 90023-107 and

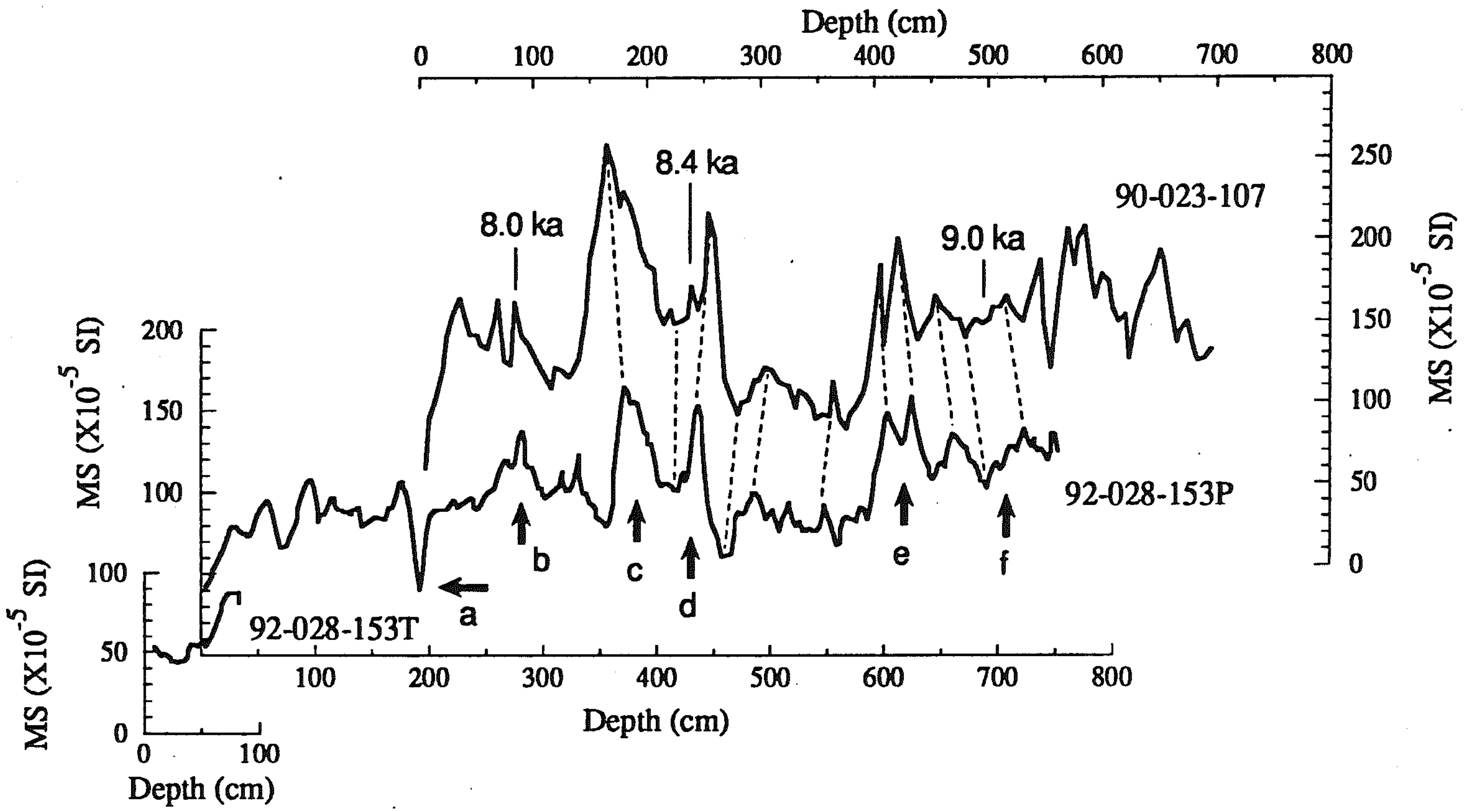


Figure 31: Magnetic susceptibility profiles of cores 90023-107, 92028-153 and 92028-153 trigger weight (T) (Manley *et al.*, 1993).

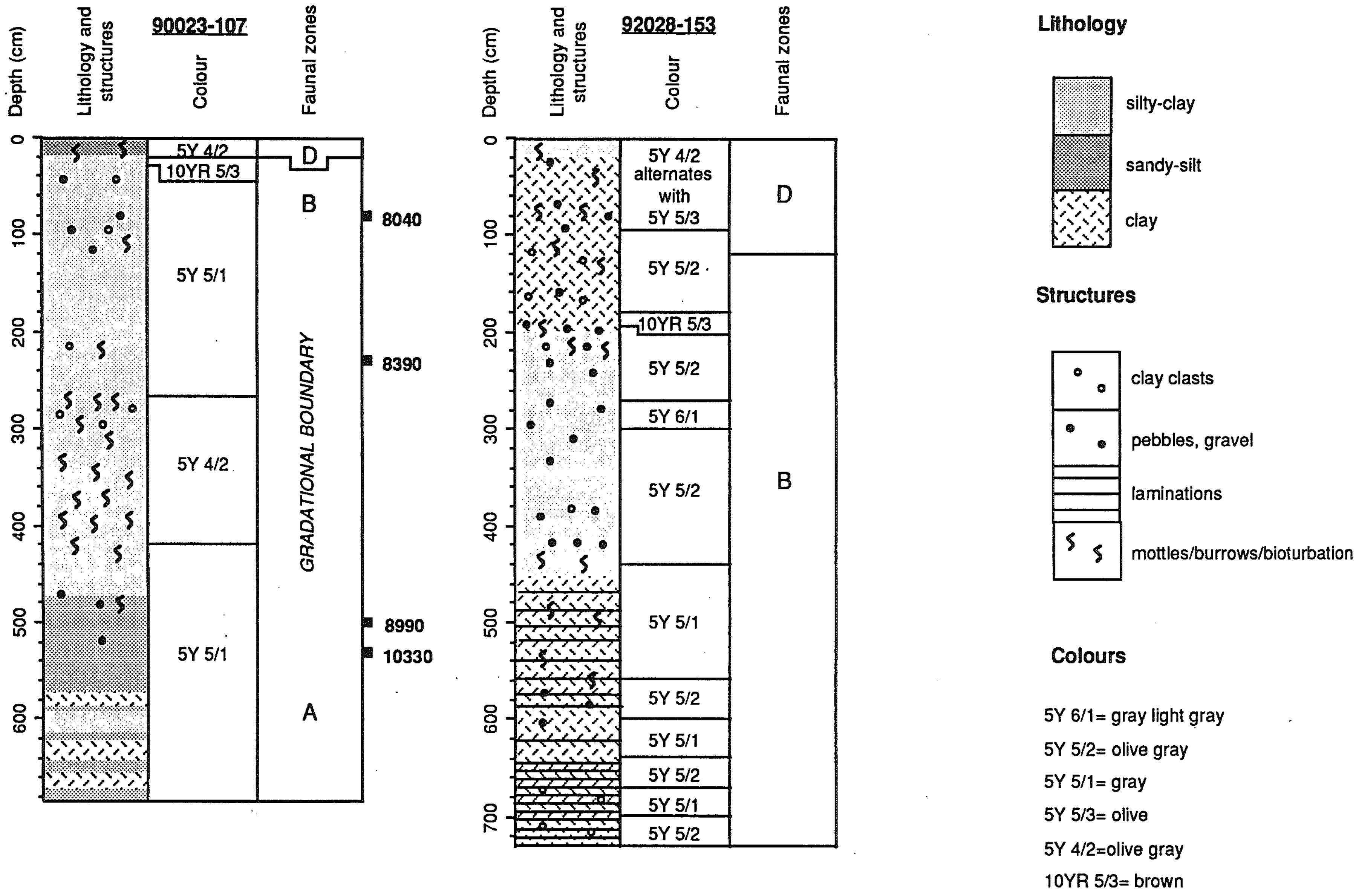


Figure 32: Lithology and Sedimentological structures o' cores 90023-107 and 92028-153

■ 10330 AMS ^{14}C date

92028-153 based on lithology and structure. The zone D/B boundary does not seem to coincide with a change in colour.

A possible explanation for this difference in Foraminifera and lithology over such a short distance is the location of 90023-107 relative to 92028-153. Core 90023-107 is found closer to the seismic unit 1 and 2 glacial drift (Figure 28) and was therefore, slightly closer to the ice margin than 92028-153. Localized ice front sedimentological effects may have only affected 90023-107. Similarly, influx of oceanic water may have only influenced foraminifera distribution in core 92028-153 and may not have reached core site 90023-107.

AMS age dates indicate ice distal conditions were still prevalent 8040 y BP in this region. An age date of 10330 y BP near the bottom of core 90023-107 is a little "old" relative to the sedimentation rates from other dated intervals. The sample sent for dating contained mixed foraminifera species. The possibly "old" date suggests some older tests were washed into this area and do not represent the in situ population.

Core 90023-64

Core 90023-64 was collected in 196 m of water (Figure 26) and penetrated a thick package of seismic units 5 and 3 sediments (Figure 33). Zone A was not represented in the sediments sampled (Figure 34). Zone B occurs from 460 - 920 cm. It is defined by the presence of *C. reniforme, E. excavatum clavata, F. fusiformis. P. takayanagii, I. norcrossi, I. helenae, C. lobatulus* and *A. gallowayi*. Intermittent peaks of planktonic tests indicate an increased presence of higher salinity waters influx. There are also alternating $<$ and $>$ 100

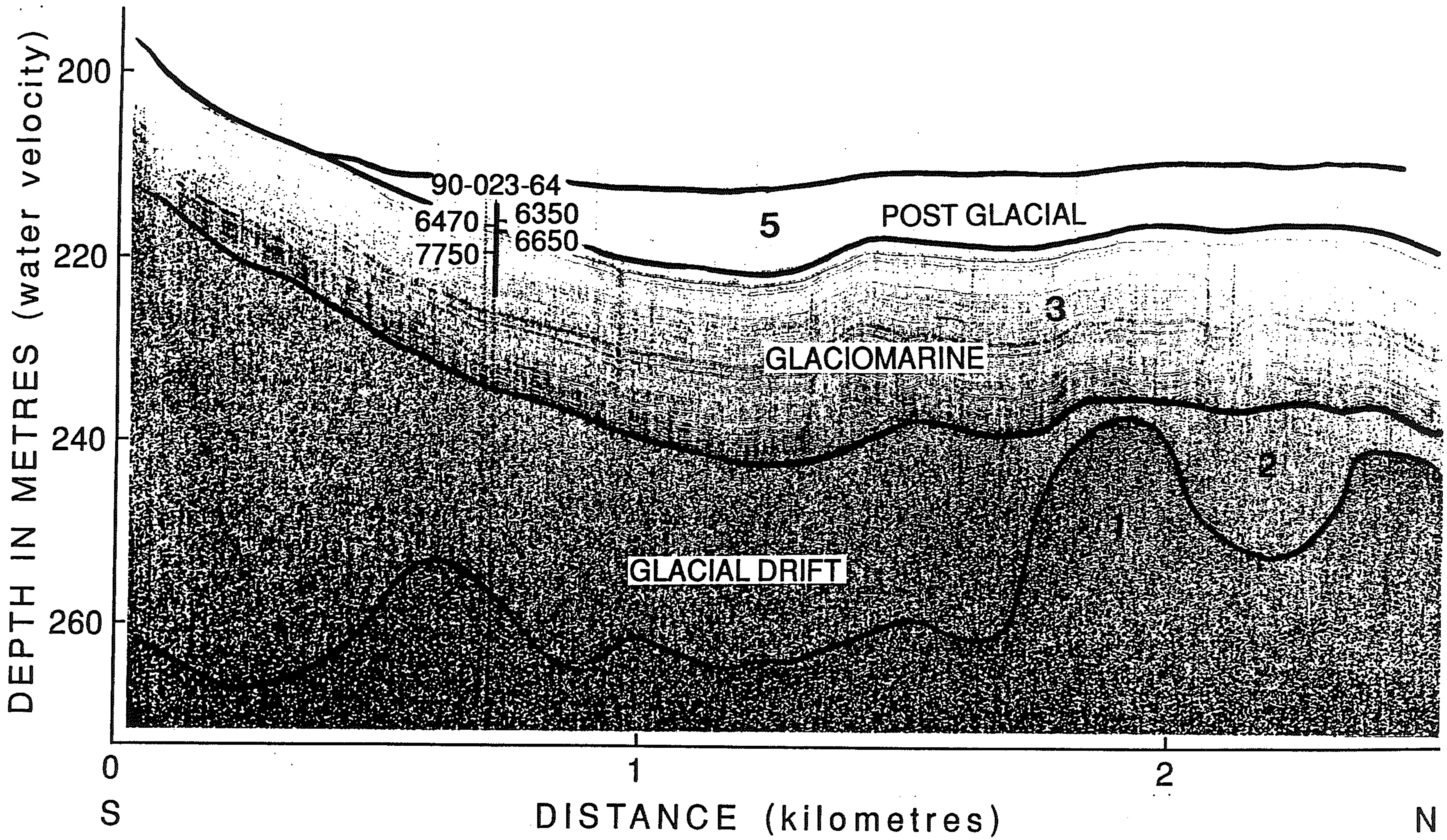


Figure 33: Huntec high resolution seismic profile illustrating glacial drift (1,2), glaciomarine (3) and postglacial (5) sediment units at core 90023-64 locality.

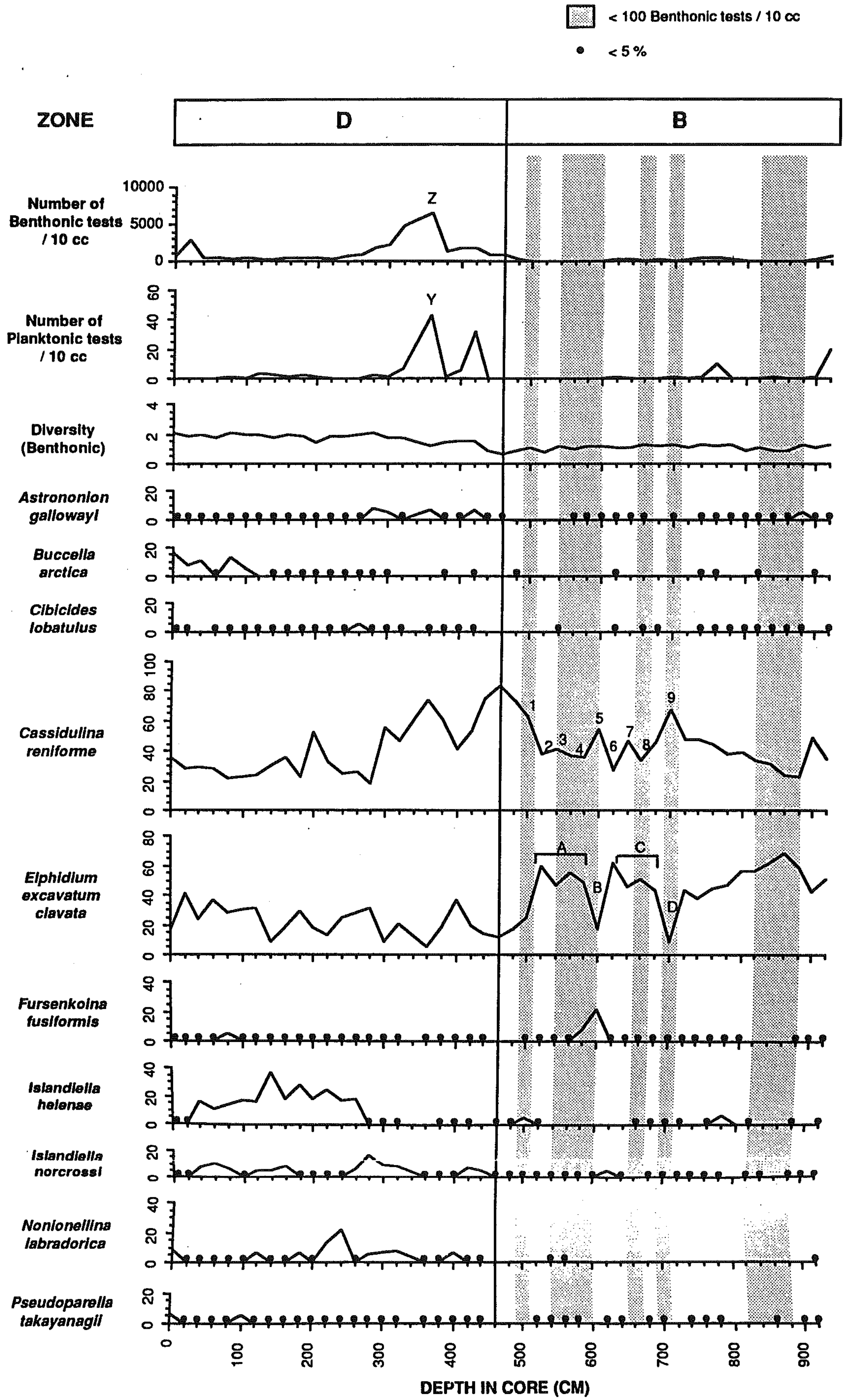


Figure 34: Percent abundances of major benthonic foraminiferal species, numbers of foraminiferal tests, diversity and faunal zones of core 90023-64.

benthonic tests/10 cc intervals, suggesting changes in sedimentation rate. The diversity (1.096) is typical for zone B fauna in this area.

Zone D occurs from 0 - 460 cm. It is defined based on significant increases in *N. labradorica, I. norcrossi, I. helenae, B. arctica* and *A. gallowayi*. *I. norcrossi* and *I. helenae* appear earlier in the core than *B. arctica*. There are also significant increases in diversity (1.689) and in benthonic and planktonic tests compared to zone B.

Core 92028-155

Core 92028-155 was collected approximately 3.4 km north of 90023-64, in a similar geological setting (not seen in Figure 32). Zone A (Figure 35) extends from 1000 -1050 cm in the core. It is defined by high numbers of *C. reniforme* and *E. excavatum clavata*, low diversity (0.706) and low numbers of benthonic tests.

Zone B extends from about 300 - 950 cm. It is defined by the first appearance of planktonic tests and of *F. fusiformis*, *H. orbiculare, I. helenae* and *I. norcrossi*. There is also an increase in diversity (1.050) relative to zone A. Alternating < and > 100 benthonic tests/ 10 cc intervals are also present.

Zone D is found from 0 - 300 cm and is identified based on significant increases in *N. labradorica, I. norcrossi, I. helenae, B. frigida* and *B. arctica* abundances. *I. norcrossi* appears in greater abundance earlier than *I. helenae* and they both appear before *B. arctica* and *B. frigida* in the core. There is also an increase in planktonic and benthonic tests and in diversity (1.582).

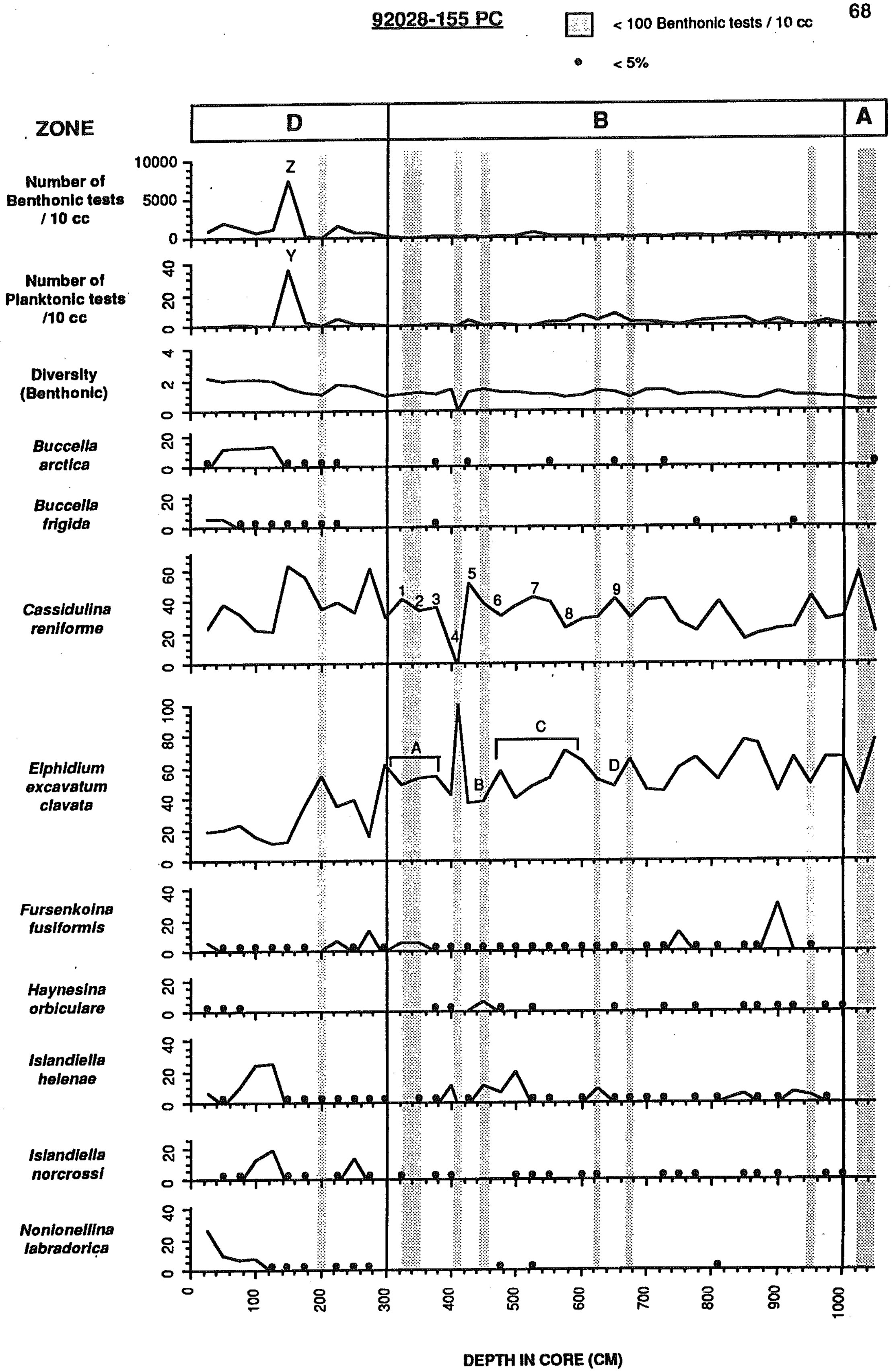


Figure 35: Percent abundances of major benthonic foraminiferal species, numbers of foraminiferal tests, diversity and faunal zones of core 92028-155.

Correlation of cores 90023-64 and 92028-155

These two cores correlate quite well based on magnetic susceptibility peaks and troughs (Figure 36). The Foraminifera profiles do not seem to correlate as well. The faunal zone D/B boundary on both cores correlates well with a sharp spike on the magnetic susceptibility profiles. The two cores can also correlate with one another based on planktonic and benthonic tests peaks in zone D (see Z and Y on Figures 33 and 34). Peaks and troughs in *C. reniforme* (see numbers 1 to 9, Figures 33 and 34) and *E. excavatum clavata* (see letters A to D, Figures 33 and 34) can also be correlated. The difficulty in correlating the two cores may be attributed to a change in sedimentary structure and lithology (Figure 37). Core 92028-155 is made up of mostly clay and experienced less current activity than 90023-64 which has significant mottled mud and pebble deposits. The transition from ice proximal to ice distal conditions occurred sometime before 10720 y BP. The transition from ice distal zone B to postglacial zone D conditions occurred between 7730 and 6650 y BP.

Correlation of cores 90023-107, 90023-64, 92028-153 and 92028-155

The faunal zones of cores 90023-107, 92028-153, 90023-64 and 92028-155 can all be roughly correlated even though they are 21 km apart. Correlation on the magnetic susceptibility profiles is based on peaks and troughs in the data (see letters a to f, Figure 38) which all fall within the ice distal zone B in each core. This would suggest that zone B

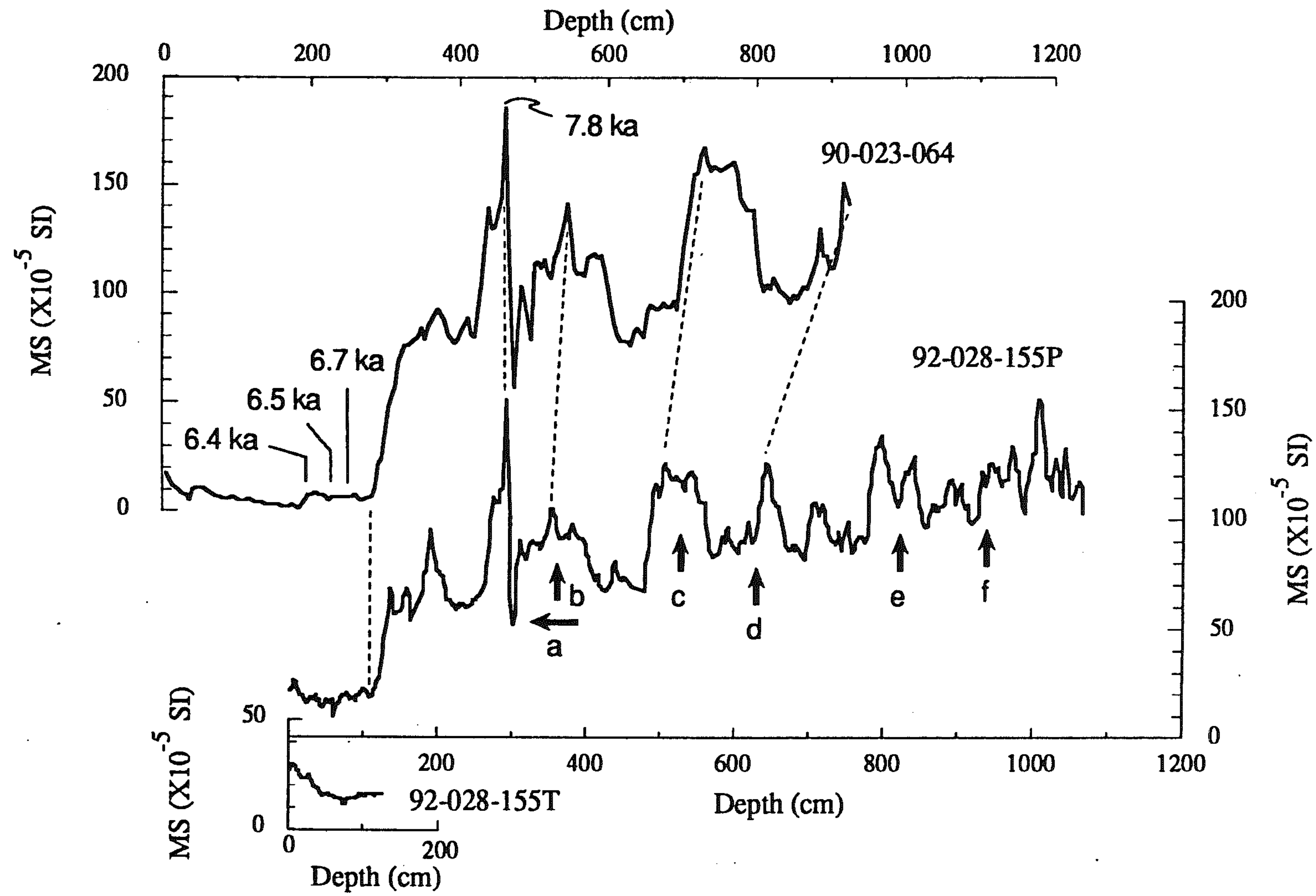


Figure 36: Magnetic susceptibility profiles of cores 90023-64, 92028-155 and 92028-155 trigger weight (T) (Manley *et al.*, 1993).

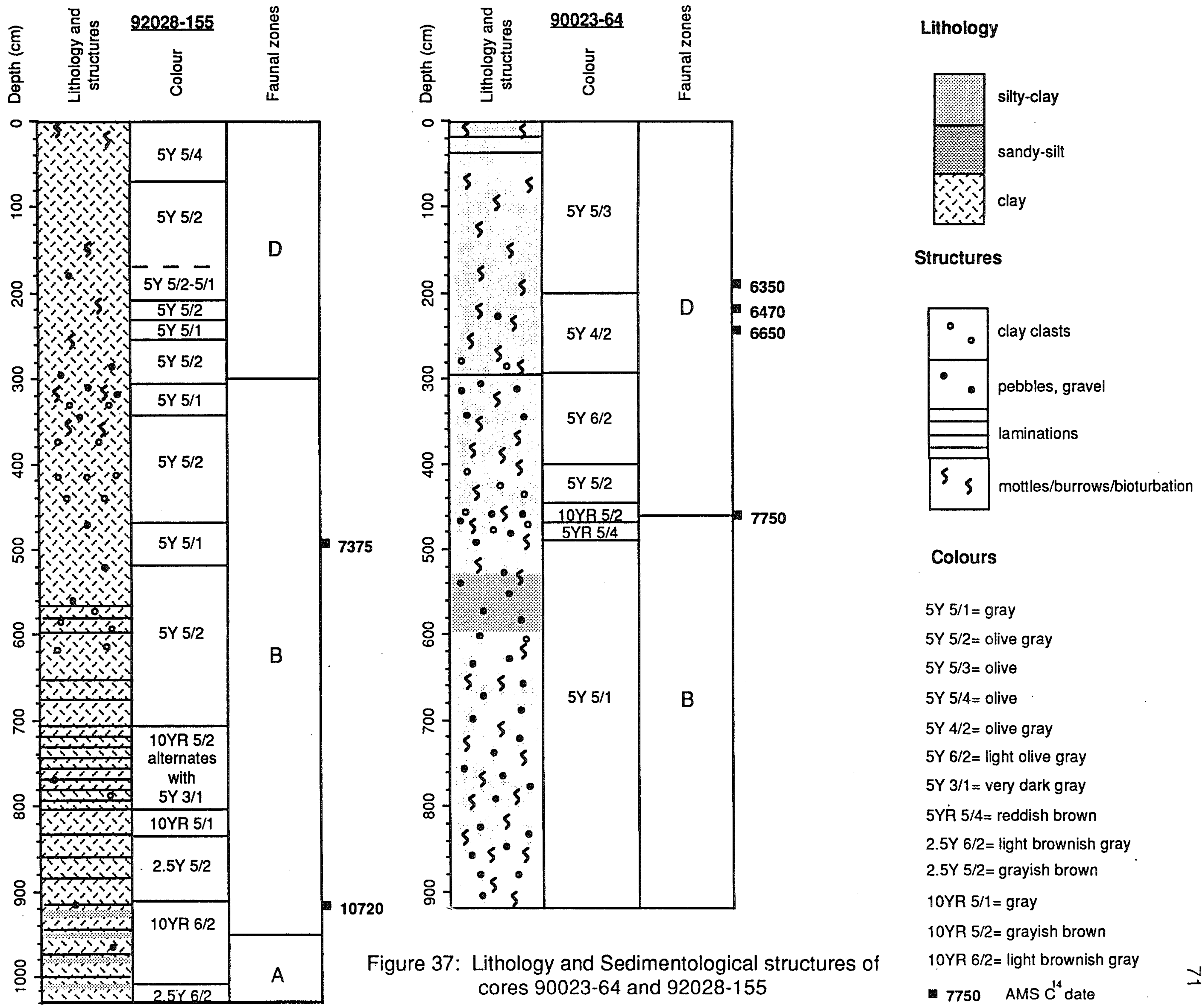


Figure 37: Lithology and Sedimentological structures of cores 90023-64 and 92028-155

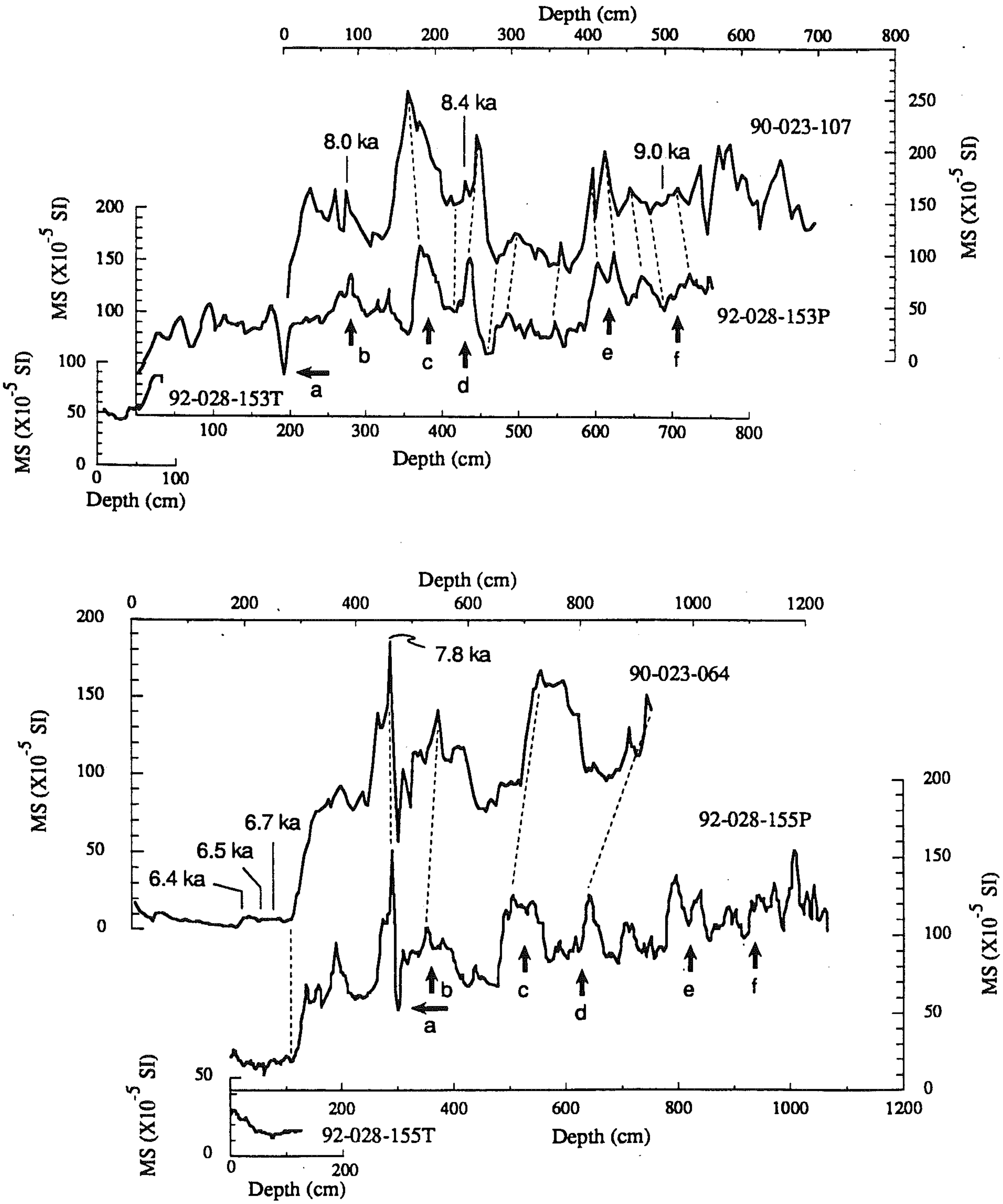


Figure 38: Magnetic susceptibility profiles of cores 90023-64, 92028-155, 92028-155 trigger weight (T), 90023-107, 92028-153 and 92028-153 T (Manley *et al.*, 1993).

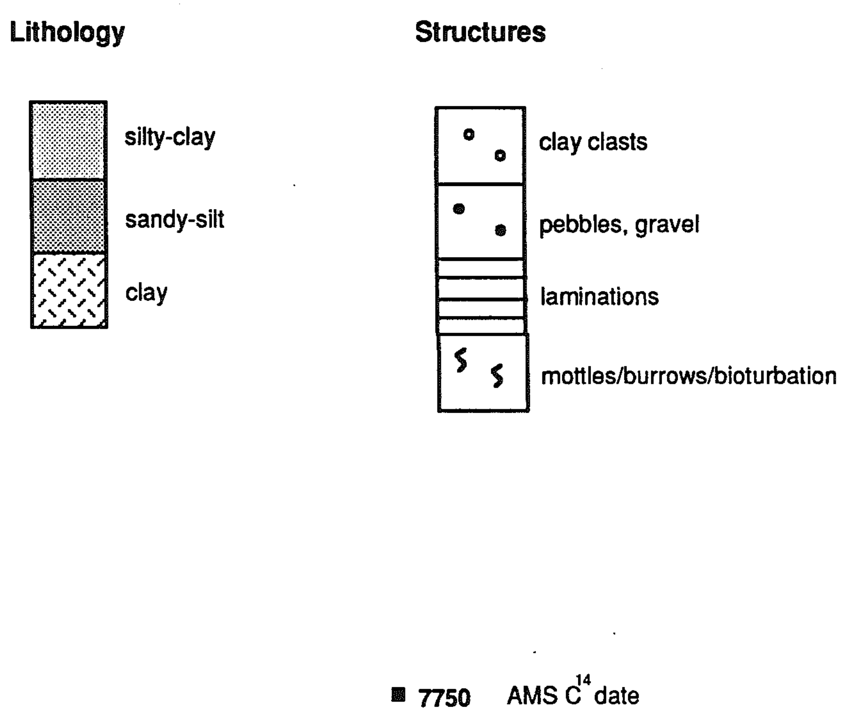
conditions were similar in the entire region, which is not surprising since the cores were taken from locales close to one another. The lithologic profiles (Figure 39) show that the lithology and structures of zone B, D and A differ somewhat from core to core. Foraminifera respond to changes in temperature and salinity of the water and sediment grain size and volume. Magnetic susceptibility reflects changes in sediment density, texture and mineralogy (Manley *et al.*, 1993). Since temperature and salinity conditions vary very little laterally at comparable depths the poor correlation of cores indicates postdepositional changes in the sedimentary environment rather than paleooceanographic effects (Vilks, personal communication; Vilks, 1980).

Core 90023-66

Core 90023-66 was collected in the northern portion of the Baie Hericart region at a water depth of 193 m (Figure 26). It is found northwest of core 90023-107 and the two are separated by a unit of glacial drift (MacLean, personal communication). Core 90023-66 was located close to the ice margin that deposited the glacial drift of seismic units 1 and 2 (Figure 40) west of the core site. The core penetrated seismic unit 5.

Readvances of ice near the core 90023-66 locality are reflected in the sediment section cored (MacLean *et al.*, 1989). Zone A (Figure 41) was not recognized in this core. An ice distal zone B_1 occurs from 500 to 740 cm. There are high (>100 benthonic tests/10 cc) numbers of benthonic and planktonic tests suggesting a higher salinity water influence than the zone above it, which reflects the closer proximity of the readvancing ice margin. There

Figure 37: Lithology and Sedimentological structures of cores 90023-107, 92028-153, 90023-64 and 92028-155 (Legend)



Colours

5Y 5/1= gray
5Y 5/2= olive gray
5Y 5/3= olive
5Y 5/4= olive
5Y 4/2= olive gray
5Y 6/1= gray-light gray
5Y 6/2= light olive gray
5Y 3/1= very dark gray
5YR 5/4= reddish brown
2.5Y 6/2= light brownish gray
2.5Y 5/2= grayish brown
10YR 5/1= gray
10YR 5/2= grayish brown
10YR 5/3= brown
10YR 6/2= light brownish gray

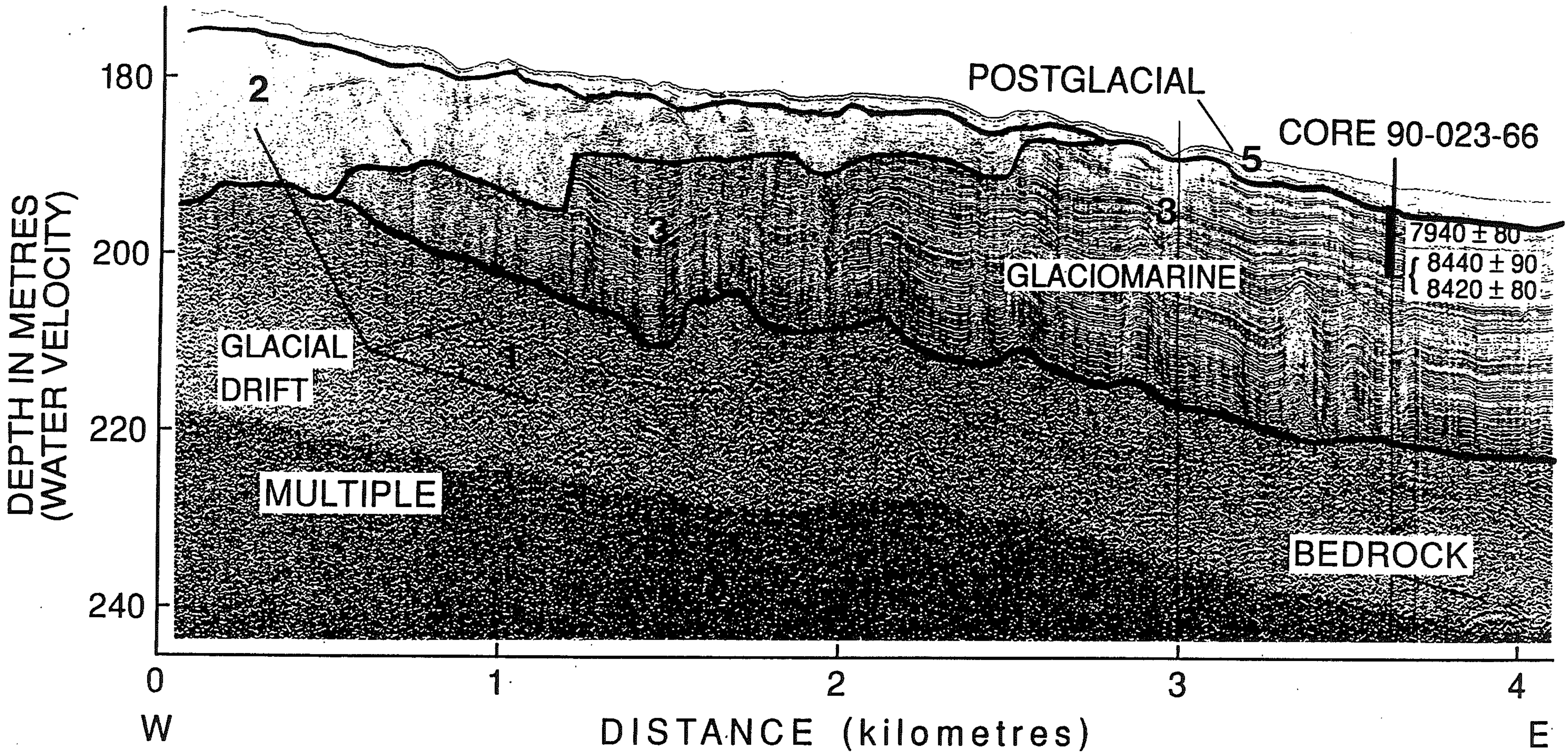


Figure 40: Huntec high resolution seismic profile illustrating glacial drift (1,2), glaciomarine (3) and postglacial (4,5) sediment units at core 90023-66 locality.

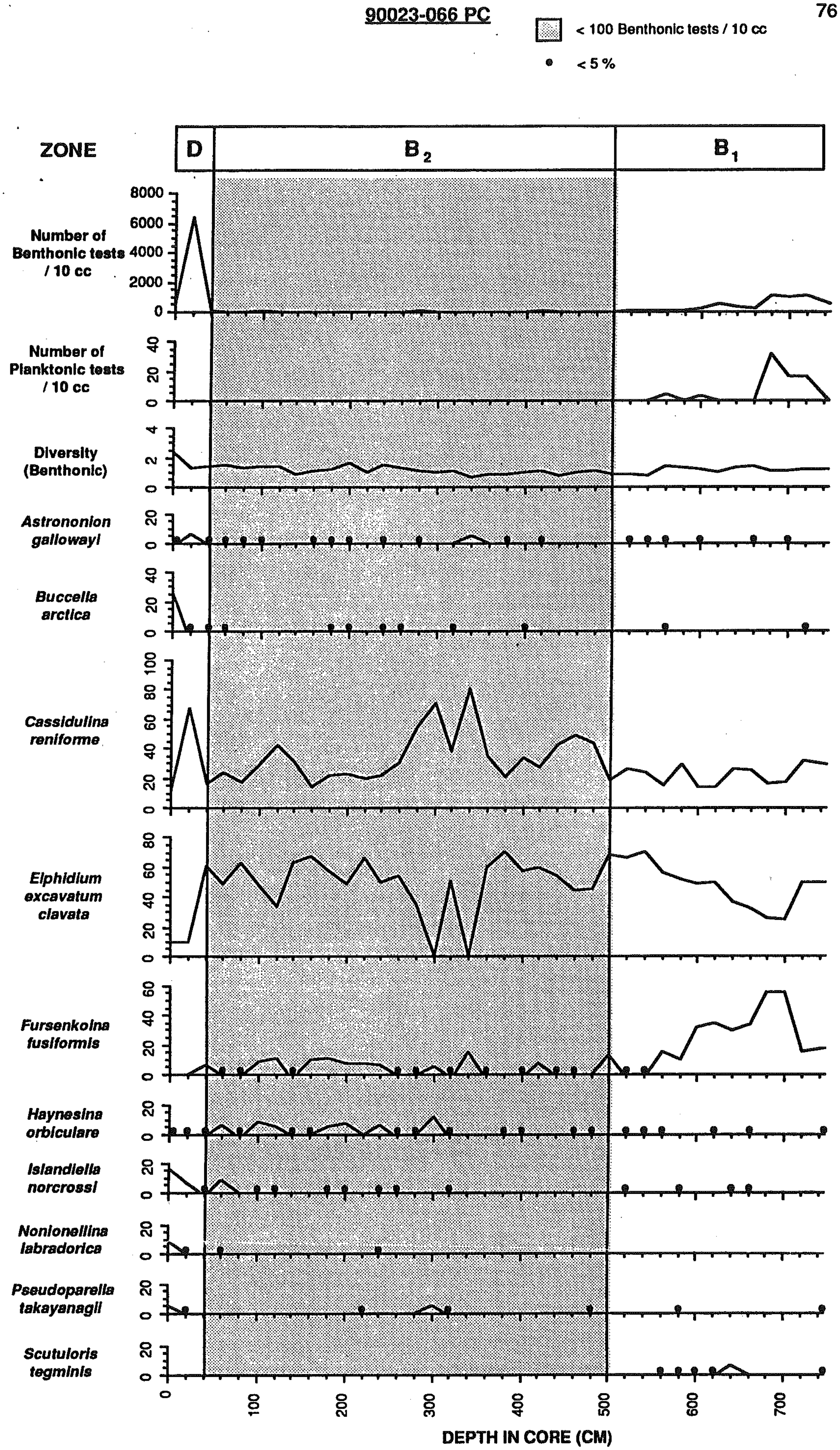


Figure 41: Percent abundances of major benthonic foraminiferal species, numbers of foraminiferal tests, diversity and faunal zones of core 90023-66.

are also high numbers of *F. fusiformis*, *C. reniforme*, *E. excavatum clavata* and *Scutoloris tegminis*.

Zone B_2 occurs from 40 - 500 cm. It is defined as ice distal based on the presence of *F. fusiformis* (although less than zone B_1), *C. reniforme* and *E. excavatum clavata*. As the ice margin readvanced toward the core site there was an increased influx of meltwater into the area seen by the increase in *H. orbiculare* and the absence of planktonic tests. Another significant difference is that B_2 is made up of < 100 benthonic tests/ 10 cc while B_2 has > 100 benthonic tests/10 cc. Diversities are very similar although B_1 is slightly lower (1.122) than B_2 (1.125).

Zone D is found from 0-40 cm. It is characterized by a significant increase in benthonic tests, diversity (1.676) and an increase in *A. gallowayi*, *B. arctica*, *I. norcrossi*, *N. labradorica* and *P. takayanagii* compared to zone B_2. *I. norcrossi* appears earlier than *B. arctica*.

Zone D is seen on the lithologic profile (Figure 42) to be marked by a colour change, from the underlying B units. The B units can not really be divided based upon lithology. Age dates suggest ice readvancement occurred between 8420 and 7940 y BP. Postglacial conditions were prevalent at 6550 y BP.

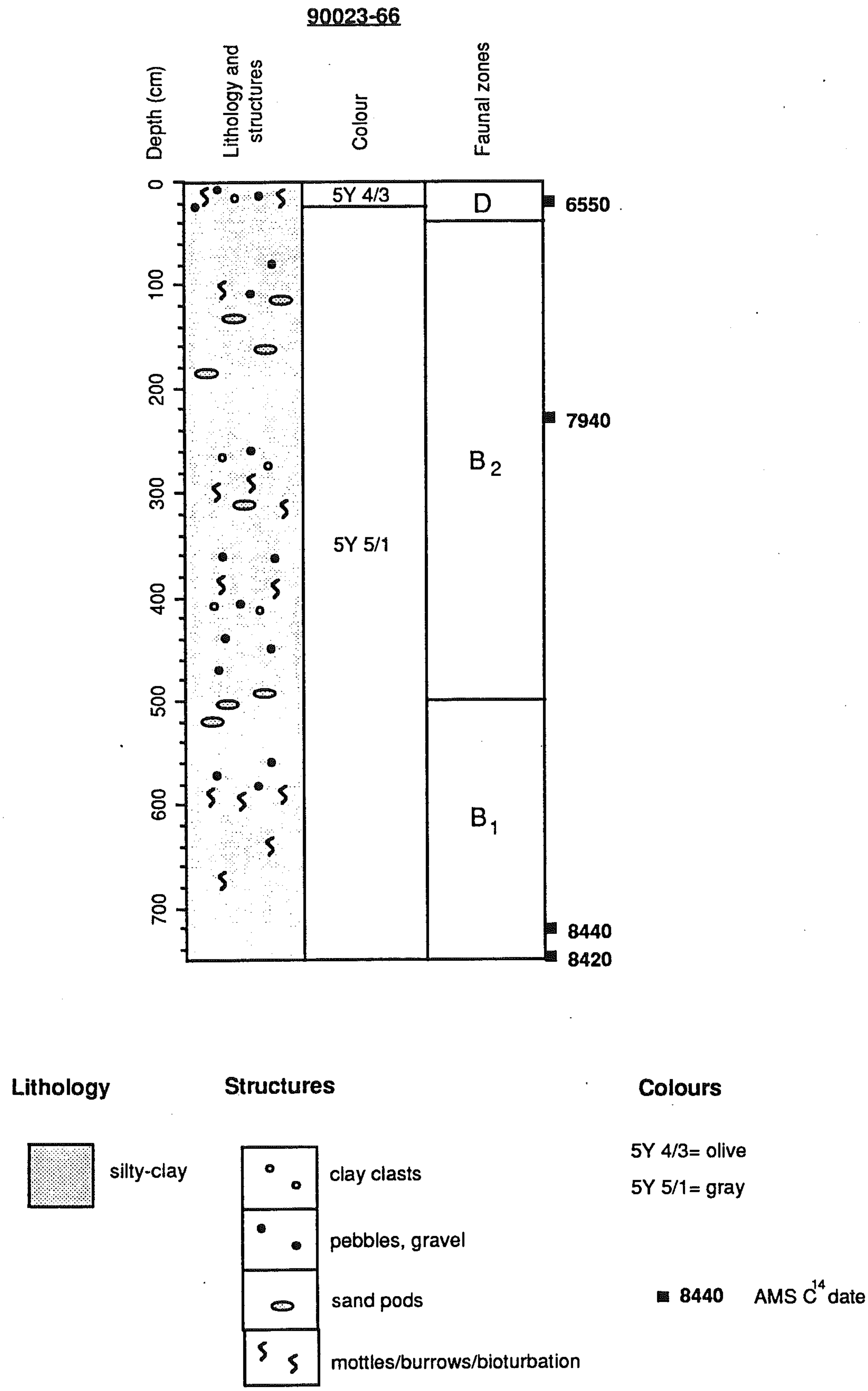


Figure 42: Lithology and Sedimentological structures of core 90023-66

Core 90023-71

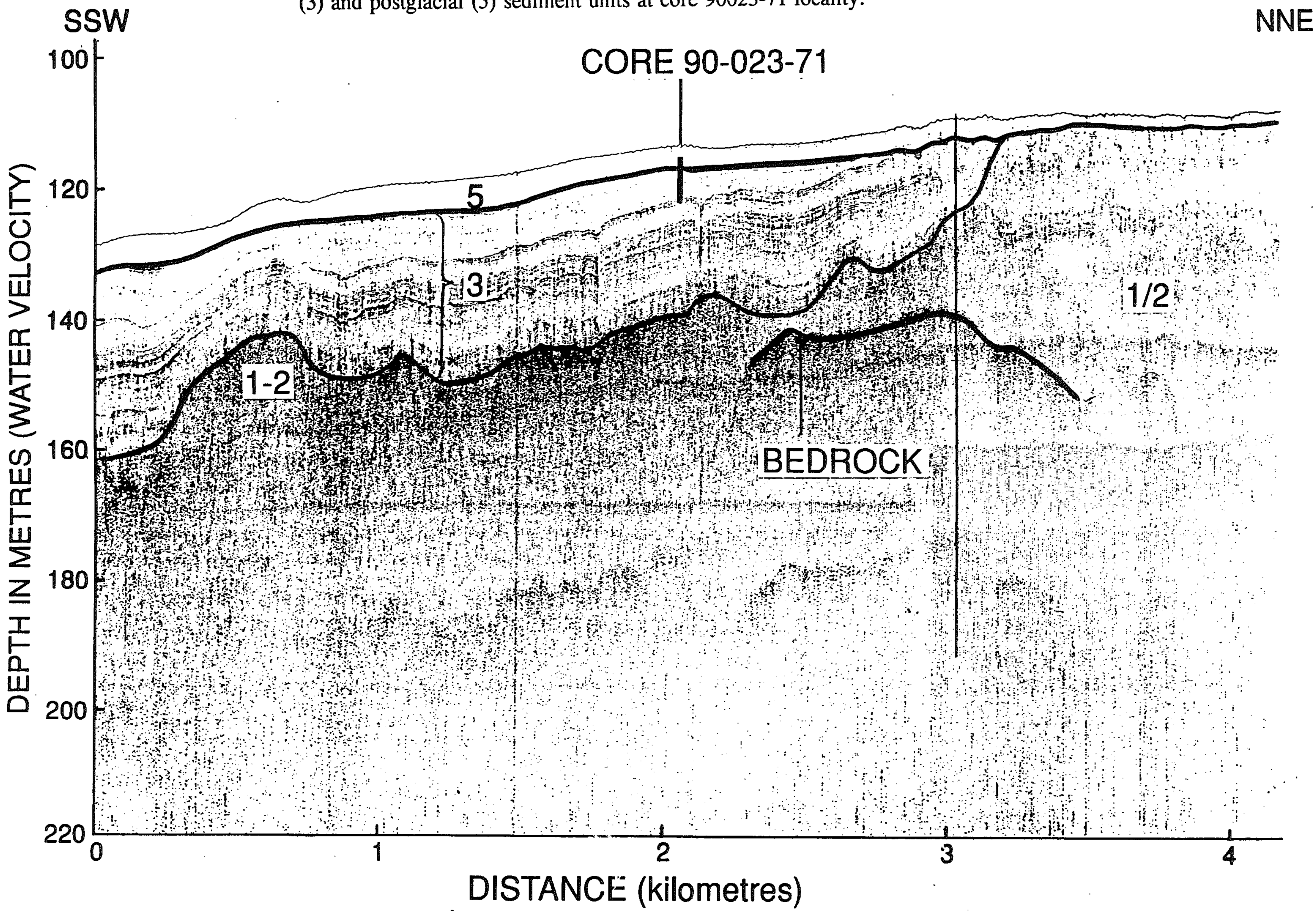
Core 90023-71 is located offshore from Wakeham Bay (Figure 26). It was taken from a water depth of 110 m. The seismic profile (Figure 43) indicates that it is was close to the glacial ice margin with glacial drift deposits of unit 1-2 nearby. The core itself penetrated seismic units 3 and 5.

There is no zone A in this core (Figure 44). The zone A/B boundary is probably close to the bottom of this core (seen by the decrease in *F. fusiformis* at 500 cm), but was not retrieved by the corer. Zone B occurs from 40-580 cm. It is defined by the presence of *F. fusiformis* and the increased amounts of *H. orbiculare, I. helenae, H. nana* and *B. frigida*. There are high (> 100 benthonic tests / 10 cc) benthonic and planktonic test numbers. Diversity is also fairly constant (1.009). The presence of *H. orbiculare* suggests that there were slight fluctuations in the ice margin shooting out streams of lower salinity meltwater. At the same time there were fluxes of higher salinity water entering the area, indicated by the occasional presence of planktonics.

Zone D is found from 0-40 cm in core 90023-71. It is indicated by a sharp increase in benthonic tests from 20 to 0 cm as well as an increase in the diversity (1.491) relative to zone B. There are also increases in the abundances of *H. nana*, *I. helenae* and *B. frigida*. *I. helenae* appears before *B. frigida*.

The lithology profile (Figure 45) shows that the faunal zone B/D boundary is marked by a change in colour. The matrix changed from a sandy-silt in zone B to a silty-clay in zone D. Ice distal conditions were still prevalent 8160 y BP. The anomalously old age date of 10645 y BP suggests older foraminifera tests were mixed with *in situ* fauna.

Figure 43: Huntec high resolution seismic profile illustrating glacial drift (1,2), glaciomarine (3) and postglacial (5) sediment units at core 90023-71 locality.



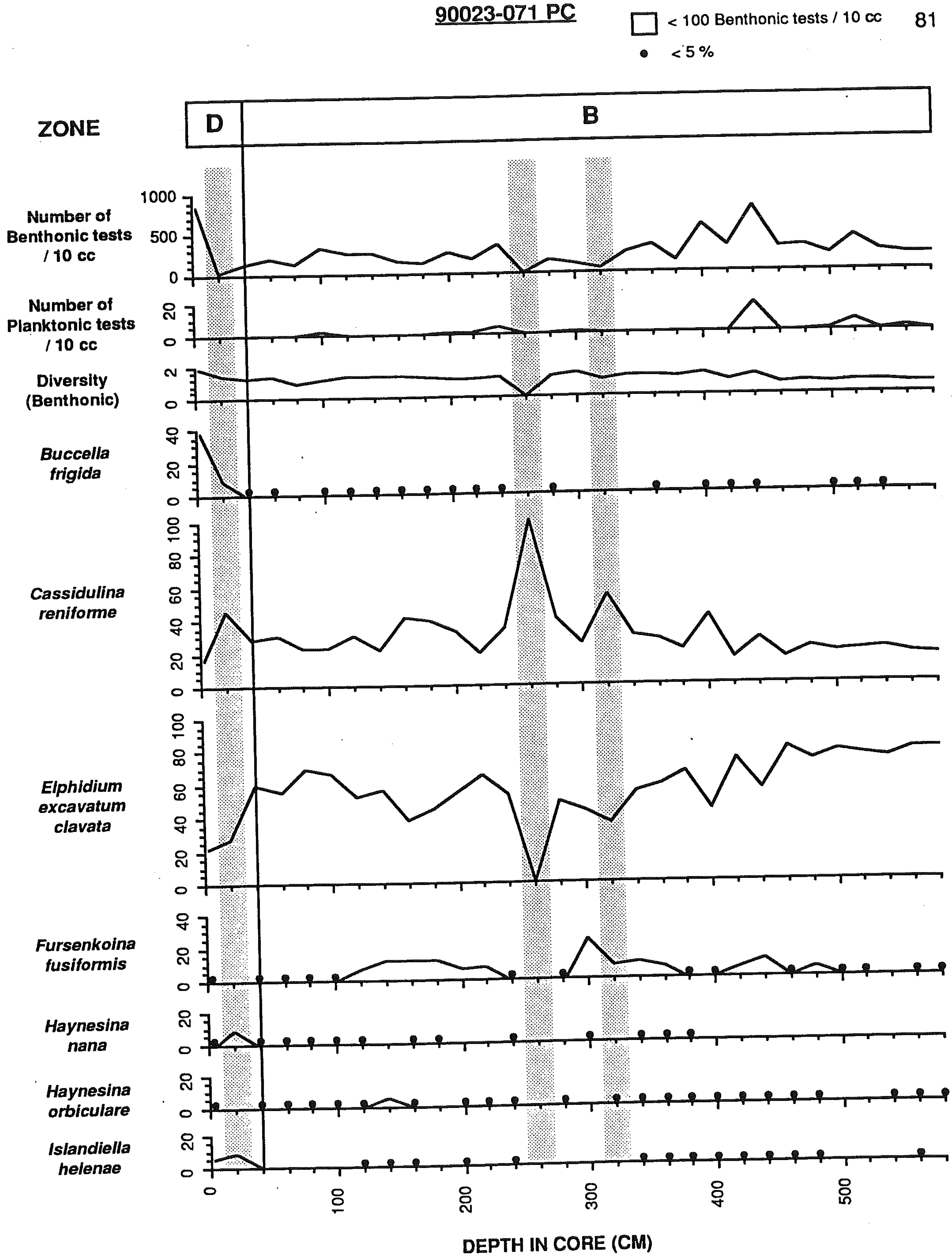


Figure 44: Percent abundances of major benthonic foraminiferal species, numbers of foraminiferal tests, diversity and faunal zones of core 90023-71.

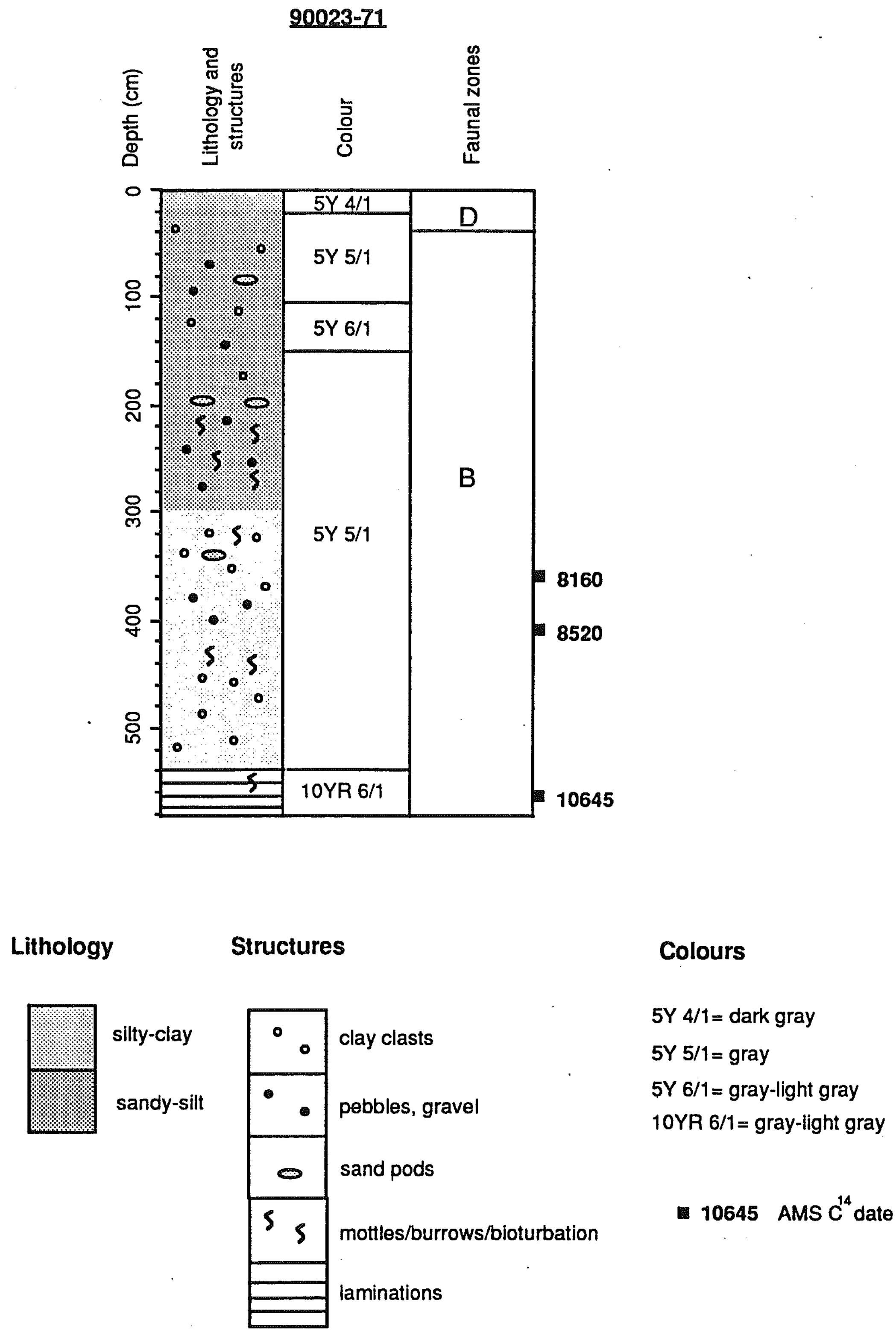


Figure 45: Lithology and Sedimentological structures of core 90023-71

Area 4: Western Basin

The Western Basin of Hudson Strait is located north of Charles Island (Figure 46). The main source of water is outflow from Hudson Bay and Foxe Basin. There were four cores studied from the Western Basin (Table 5). Cores 90023-99, 90023-101, 90023-104 are found close together and are correlatable with one another. Core 90023-97 is found on the northern flank of the basin and is more difficult to correlate with the other three.

Zone Definitions

Area 4 has four faunal zones. Faunal zones A, B and D are typical to Hudson Strait. Zone A and B contain sporadic intervals of < 5% *Islandiella helenae*. *I. helenae* is a postglacial indicator species in Hudson Strait (Vilks *et al.*, 1989) but, an ice distal environmental indicator around Baffin Island (Osterman and Andrews, 1987). The presence of this species in zone A and B suggests that it could be used as an ice proximal/distal indicator for area 4.

A transition zone (T_3) is found between the ice distal zone B and postglacial zone D in core 90023-101 and 90023-104. It is characterized by an increase in benthonic and planktonic tests relative to zone B. The diversity is also higher (1.125 to 1.264) than zone B (0.726-0.927) and it fluctuates from low to high intervals, which indicates environmental instability affecting the Foraminifera population (Buzas and Gibson, 1968). There is an increased high salinity water influence in these cores seen by the addition of *P. osloensis* ,

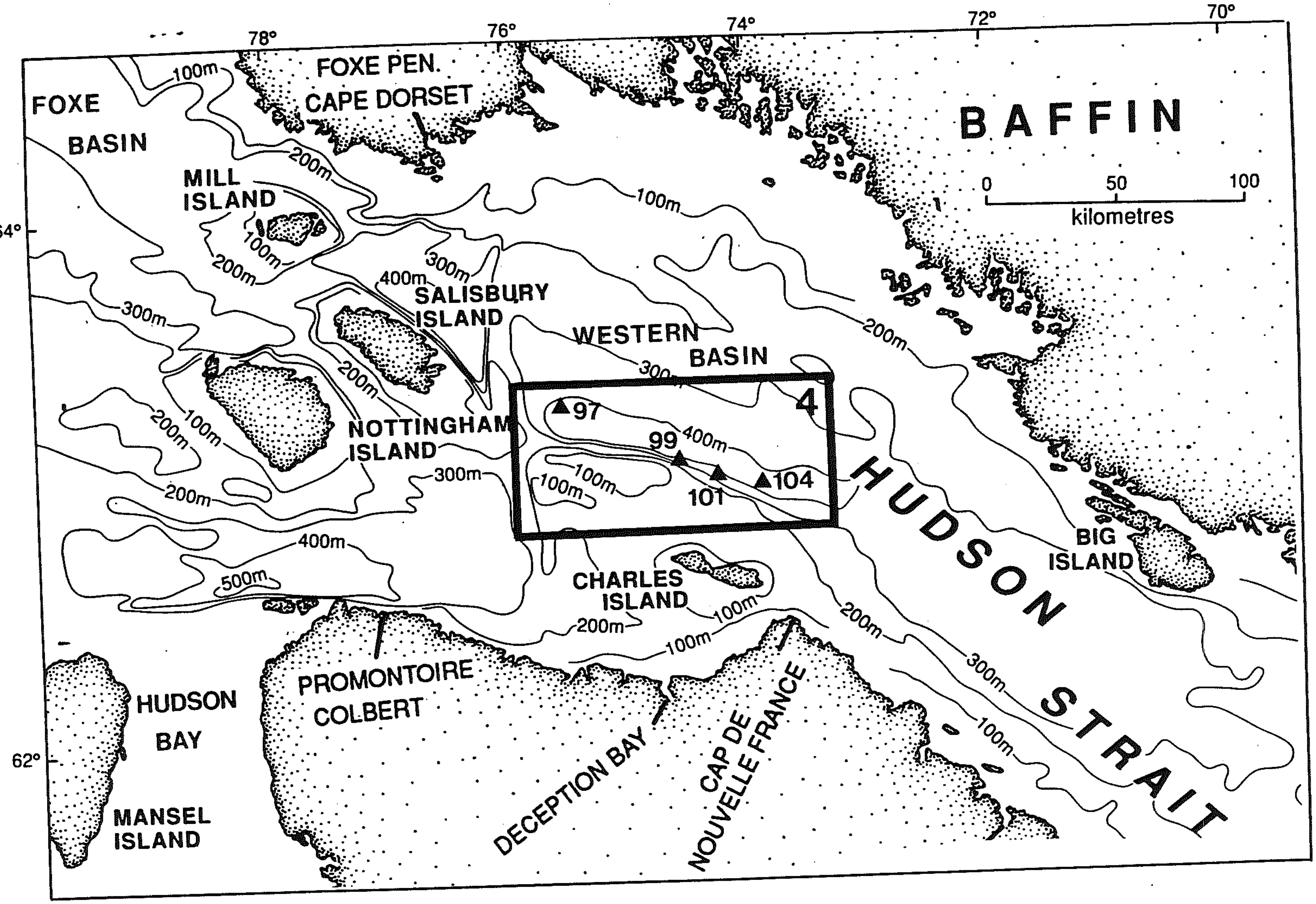


Figure 46: Detailed map of Area 4, Western Basin, showing 90023 cruise (▲ 97) core sites

Table 5: Western Basin Core Information

Core	Length (cm)	Latitude (N)	Longitude (W)	Water Depth (m)
90023-101	776	63 02.99	74 18.24	389
90023-104	582	62 59.58	74 00.04	410
90023-99	479	63 03.98	74 33.96	386
90023-97	662	63 14.96	75 32.68	427

M. zaandamae, C. laevigata and/or *Pseudoparrella takayanagii* (Vilks, personal communication).

The diversities (Figure 47) in this area follow a general trend of increasing diversity as the paleoenvironment changes from the ice proximal glaciomarine (zone A) to postglacial (zone D). Core 90023-97 is a mixture of zone A and B and also has the lowest diversity (0.522) for the cores studied in this area.

Core 90023-101

Core 90023-101 was obtained from a water depth of 389 m. The seismic profile (Figure 48) is not very clearly defined due to degradation of the data based on poor sea conditions, but there appears to be acoustically stratified unit 3 sediments all throughout the section.

Zone A (Figure 49) in core 90023-101 is found from 560 - 720 cm. It is indicated by the dominance of *C. reniforme* and *E. excavatum clavata*. Diversity (0.667) is low and there are generally < 100 benthonic tests / 10 cc.

Zone B is identified 240 to 560 cm deep in the core. It is classified by the presence of *C. reniforme* and *E. excavatum clavata* and the > 5 % abundances of *Fursenkoina fusiformis*. *I. helenae* also appears throughout this zone. Diversity is higher (0.726) than zone A and there are generally > 100 benthonic tests/10 cc.

Zone T_3 is found in core 90023-101 at a depth of 140 to 240 cm. There is a slight increase in the number of benthonic tests. The diversity (1.264) fluctuates and has also

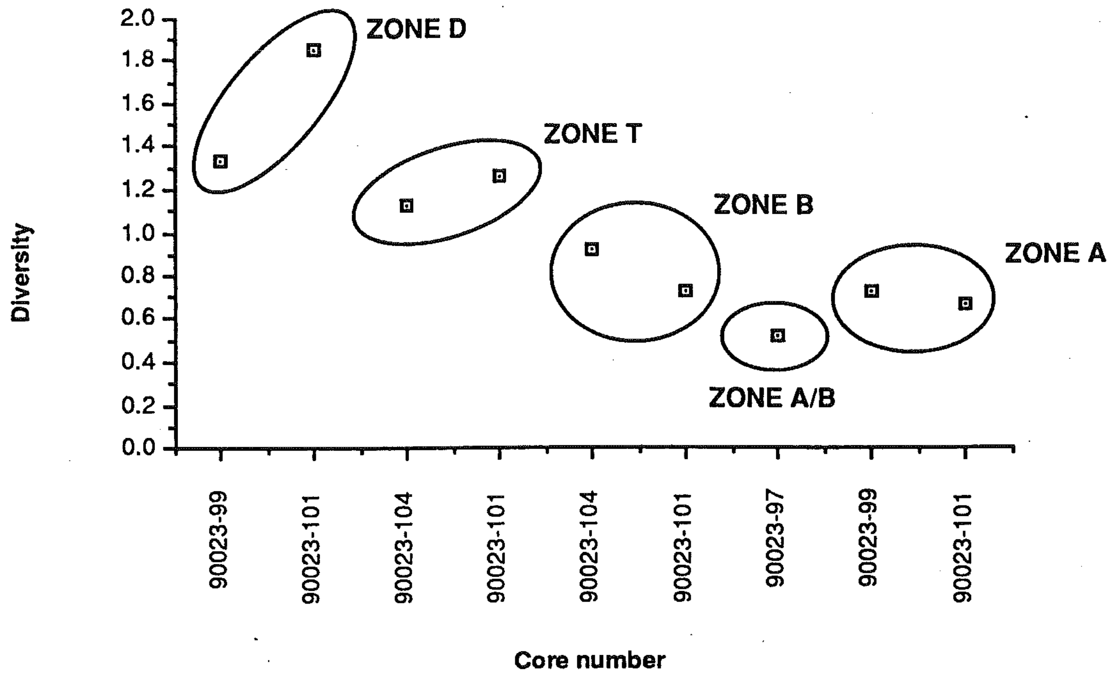


Figure 47: Faunal zone average diversities for Area 4, the Western Basin

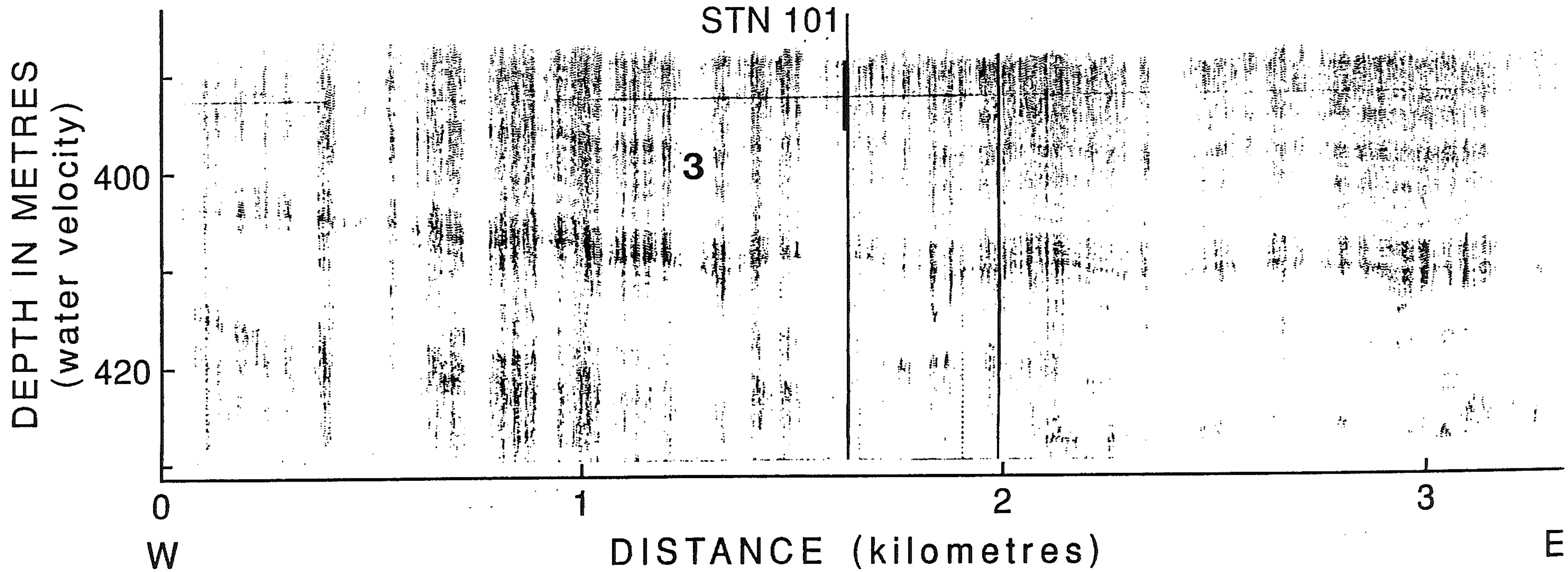


Figure 48: Huntec high resolution seismic profile illustrating a glaciomarine (3) sediment unit at core 90023-101 locality.

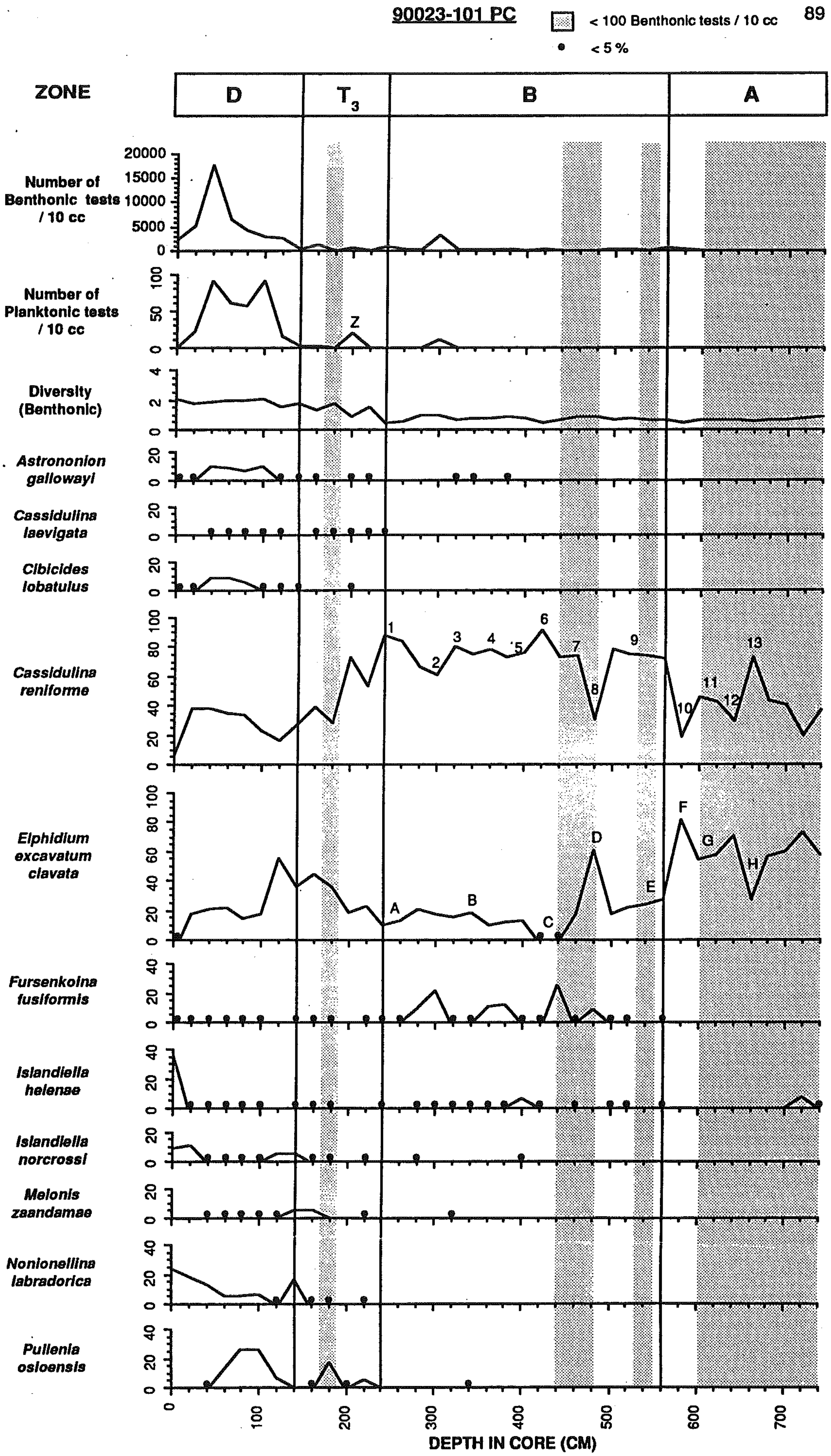


Figure 49: Percent abundances of major benthonic foraminiferal species, numbers of foraminiferal tests, diversity and faunal zones of core 90023-101.

increased relative to zone B. Occasional pulses of higher salinity offshore water are indicated by the intermittent presence of planktonic tests, *C. laevigata* (< 5%), *N. labradorica, M. zaandamae* and *P. osloensis* . The appearance of *C. lobatulus* suggests increased current activity of the bottom waters.

Zone D is found from 0-140 cm in the core. It is classified based on the increase in benthonic and planktonic tests and a high relatively constant diversity (1.866). There are also increases in *A. gallowayi* , *I. helenae*, *I. norcrossi* and *N. labradorica* test numbers. The decrease in *F. fusiformis* and increase in *C. lobatulus* suggests a change from muddy to sandier sediments.

Core 90023-104

Core 90023-104 was taken southeast of core 90023-101 (Figure 46). It was collected from a water depth of 410 m. The section at the core locality consists mainly of seismic unit 3, which is underlain by glacial drift and overlain by a thin section of unit 5 (Figure 50).

Core 90023-104 did not penetrate into faunal zone A (Figure 51) in core 90023-104. Zone B is found from 100 - 520 cm. It is identified by the presence of *F. fusiformis*, *C. reniforme*, *E. excavatum clavata* and a relatively low constant diversity (0.927). There are also rhythmic fluctuations of < 100 benthonic tests/10 cc intervals every 40 to 60 cm. These could be due to episodic events that cause an increase in sedimentation rates diluting Foraminifera total counts. The presence of intermittent *Pateoris hauerinoides* suggests that it was carried into the area with ice rafted sediments from the shallower areas nearby or from Foxe Basin (Culver and Buzas, 1980; Campbell and Collin, 1958).

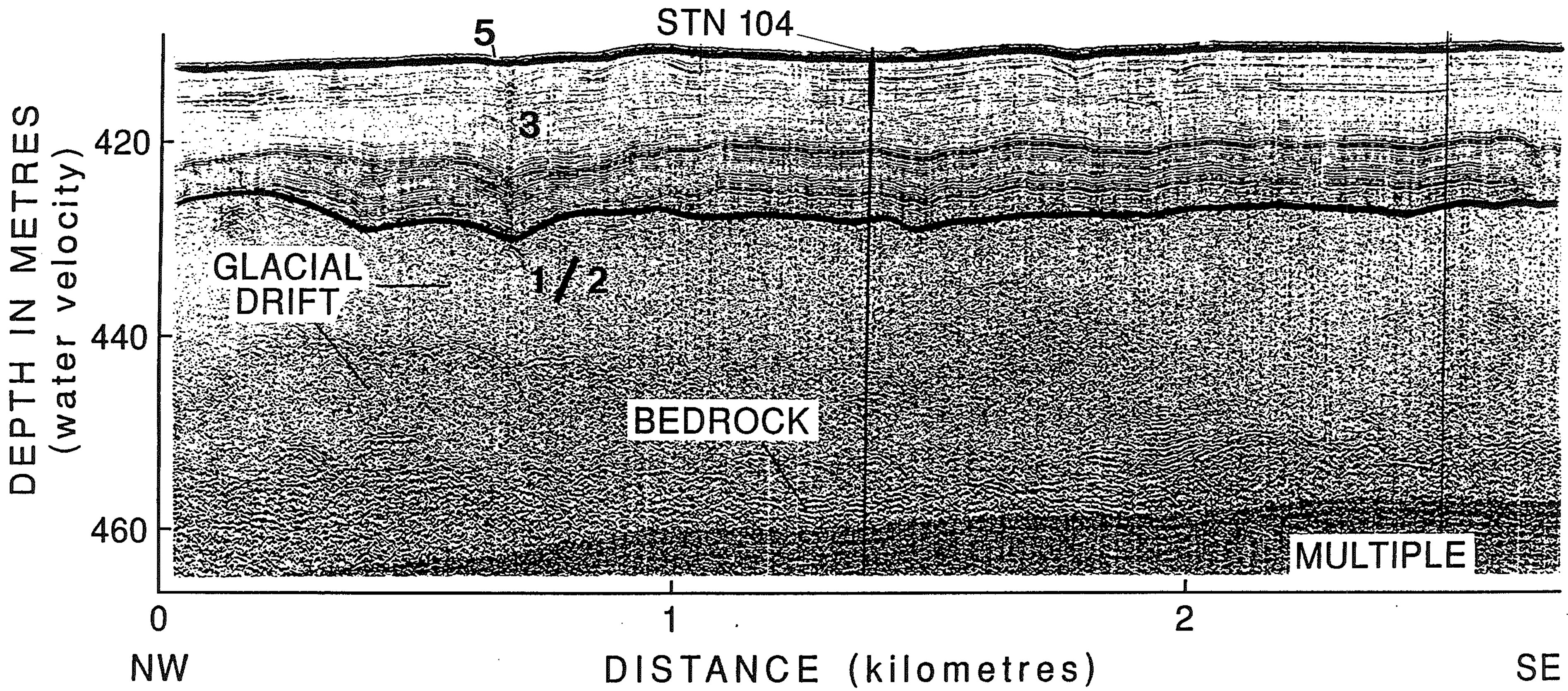


Figure 50: Huntec high resolution seismic profile illustrating glacial drift (1,2), glaciomarine (3) and postglacial (5) sediment units at core 90023-104 locality.

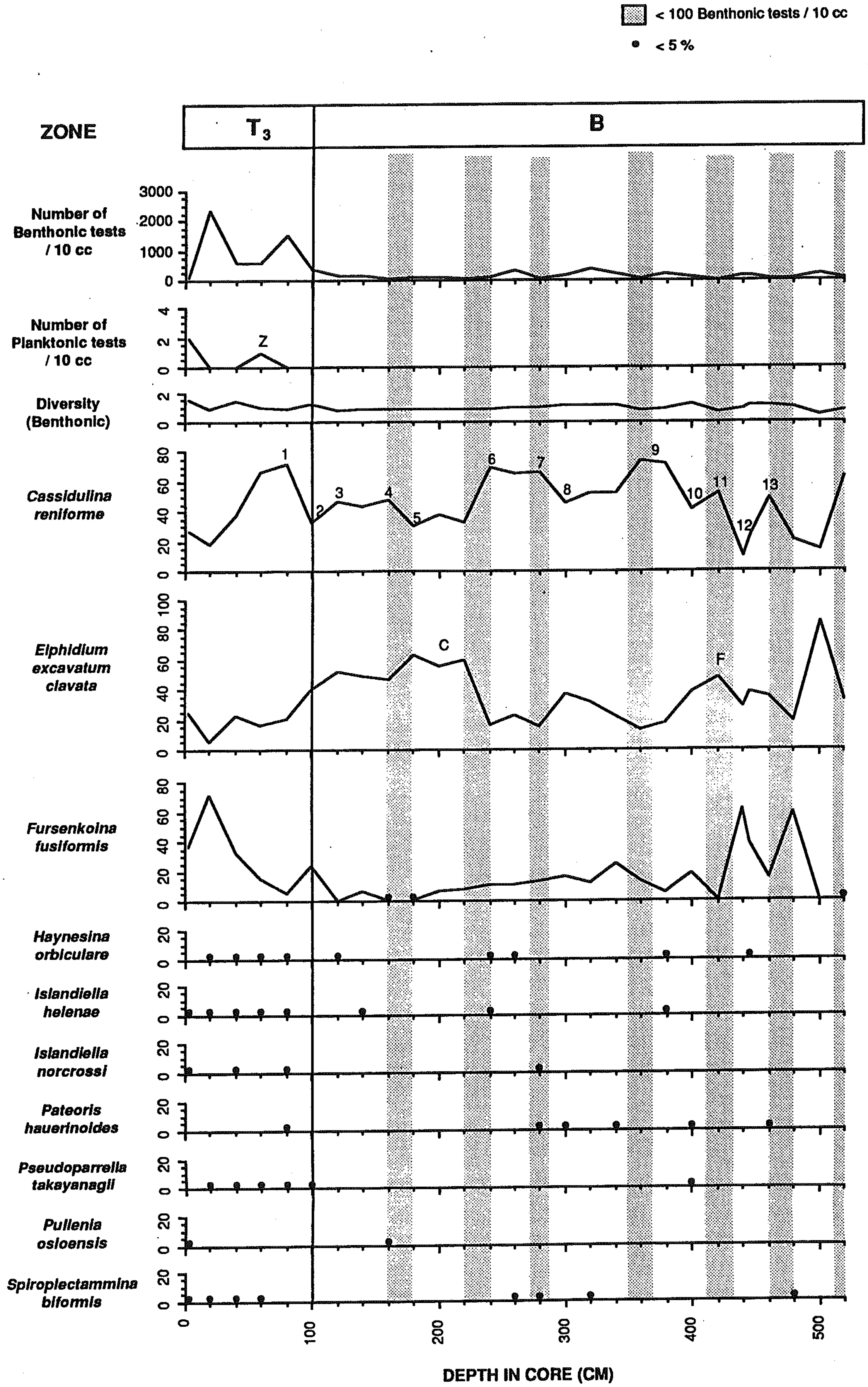


Figure 51: Percent abundances of major benthonic foraminiferal species, numbers of foraminiferal tests, diversity and faunal zones of core 90023-104.

Zone T_3 in core 90023-104 is found from 0-100 cm. It is identified by the fluctuating diversity (1.125) and the increase in benthonic and planktonic tests numbers relative to zone B. There is also an increase in the presence of *S. biformis, P. takayanagii, H. orbiculare, I. norcrossi, I. helenae* and *F. fusiformis*. This suggests alternating higher and lower salinity water influxes.

Core 90023-099

Core 90023-99 was taken west of core 90023-101 at a water depth of 386 m (Figure 46). The seismic resolution (Figure 52) is not very clear but there is a suggestion of acoustically laminated unit 3 sediments overlying unit 1 and 2 glacial drift. The core seems to have been taken from the flank of a basin fill type of structure. This core was previously described by Maclean *et al.* (1992). Based on a review of the data the zonal boundaries have been reclassified. Zone A (Figure 53) is found from 340-460 cm in the core (previously considered to extend from 280-460 cm). The boundary was moved to correspond to the first time *F. fusiformis* is not found in a consecutive interval. It also corresponds to the start of a < 100 benthonic tests / 10 cc zone and the species diversity (0.725) is also low. The dominant species in this zone are *E. excavatum clavata* and *C. reniforme*. The peak in *H. orbiculare* at 380 cm suggests less saline waters were briefly present in the area at that time.

Zone B is found from 60 to 340 cm and is defined based on the consecutive appearances of *F. fusiformis* in the samples. There is also an increase in *I. helenae, I. norcrossi* and *H. orbiculare*.

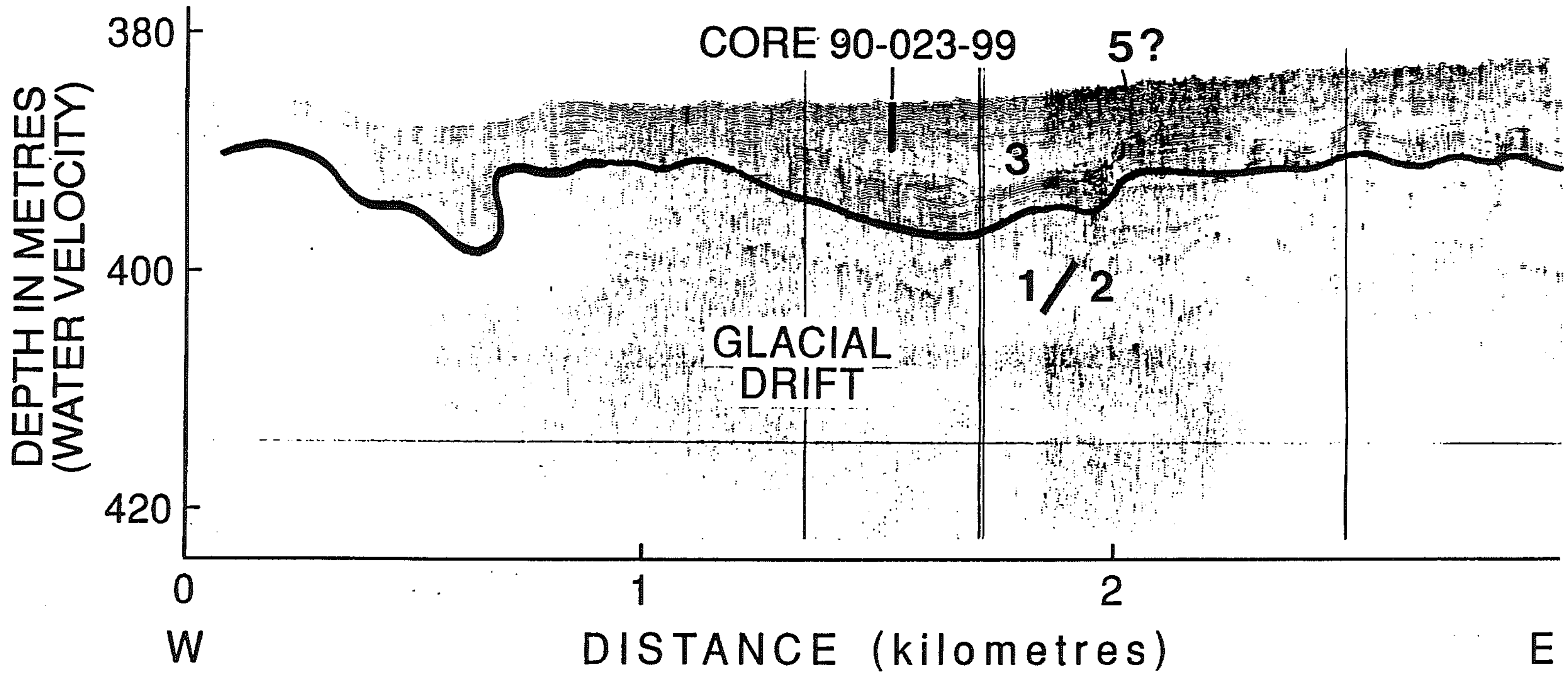


Figure 52: Huntec high resolution seismic profile illustrating glacial drift (1,2), glaciomarine (3) and postglacial (5) sediment units at core 90023-99 locality.

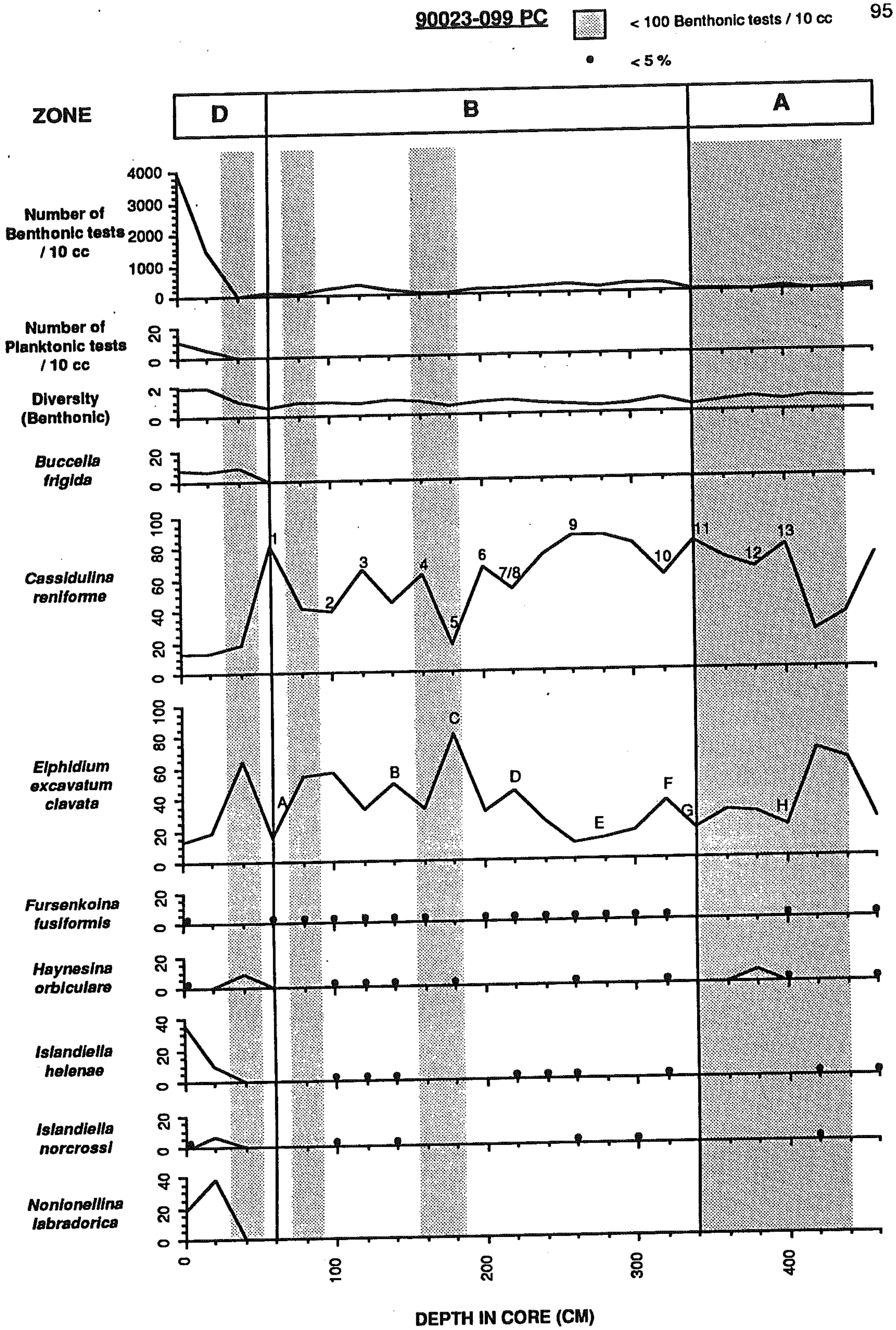


Figure 53: Percent abundances of major benthonic foraminiferal species, numbers of foraminiferal tests, diversity and faunal zones of core 90023-99.

No transition zone (T_3) was found in core 90023-99. Zone D extends from 0 to 60 cm. It is defined based on the increase in benthonic and planktonic tests relative to zone B. *Buccella frigida* begins to appear and there are increases in the number of *H. orbiculare, I. helenae, I. norcrossi* and *N. labradorica* tests. The absence of a transition zone in core 90023-99 suggests that the ice margin retreated quickly from this area allowing for a rapid change from ice distal to postglacial environment. Low sedimentation rates or the erosion of sediments due to current activity could also contribute to the absence of zone T_3.

Correlation of 90023-104, 90023-101, 90023-099

Cores 90023-104, 90023-101 and 90023-99 can all be correlated with one another. Correlations are based mainly on peaks and troughs in the relative abundances of *C. reniforme* (see numbers 1 to 13, Figures 49, 51 and 53) and *E. excavatum clavata* (see letters A to H, Figures 49, 51 and 53). The correlation begins at the T_3/B boundary on cores 90023-101 and 90023-104 and at the D/B boundary at core 90023-99. The peaks and troughs are best correlated in zone B and A as it is assumed there was a more stable environment over a larger area in the ice distal than in the following transitional zone. Core 90023-101 and 90023-104 can be correlated with one another based on a planktonic peak (see letter Z, Figures 49 and 51) in the T_3 faunal zone. Based on the absence of zone D indicator fauna in core 90023-104 we can assume that some surface sediments were not obtained during the coring process.

Sediment lithologies (Figure 54) for core 90023-101, 90023-104 and 90023-99 can be

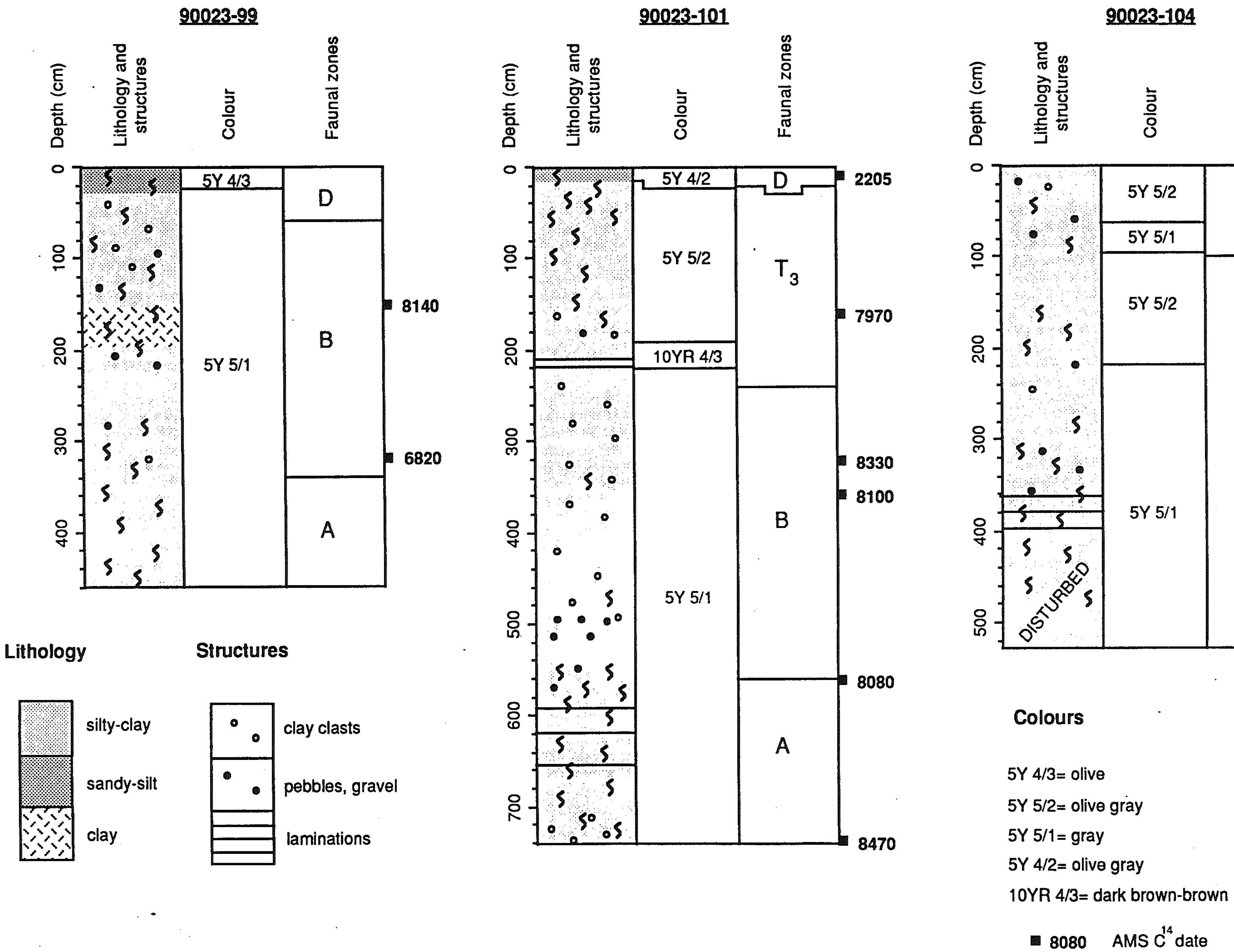


Figure 54: Lithology and Sedimentological structures of cores 90023-99, 90023-101 and 90023-104

correlated as well. Most of zone A and B is made up of gray (5Y 5/1) silty-clay with occasional clay clasts and dropstone pebbles. Zone T_3 /B boundaries in cores 90023-101 and 90023-104 are marked by a colour change. Zone D /B and D/T_3 boundaries are also associated with a colour and lithology change in cores 90023-99 and 90023-101 respectively.

Carbon-14 dates from cores 90023-99 and 90023-101 show some discrepancies that can be attributed to large error bars on the dates obtained and/or laboratory processing errors. However, it is likely that the area was under the influence of various processes (ie. ice retreat/advance, turbidite and gravity flows) mixing younger and older Foraminifera tests. This would make it inaccurate to correlate the cores based on Foraminifera data alone. The chronological data, however, do suggest that area 4 experienced an ice proximal glaciomarine environment at least 8470 y BP. Ice distal conditions seem to have prevailed until 8330-8080 y BP. The transition from ice distal to postglacial conditions was well underway by 7970 y BP. Postglacial conditions were established by 2205 y BP.

Core 90023-097

Core 90023-97 was taken on the northwestern flank of the Western Basin at a water depth of 427 m (Figure 46). The water in this area, in recent times, comes mainly from Foxe Basin with a partial influence from Hudson Bay outflow. Resolution of the seismic data is poor for this area (Figure 55), but there is the suggestion that it is composed of acoustically laminated unit 3 sediments.

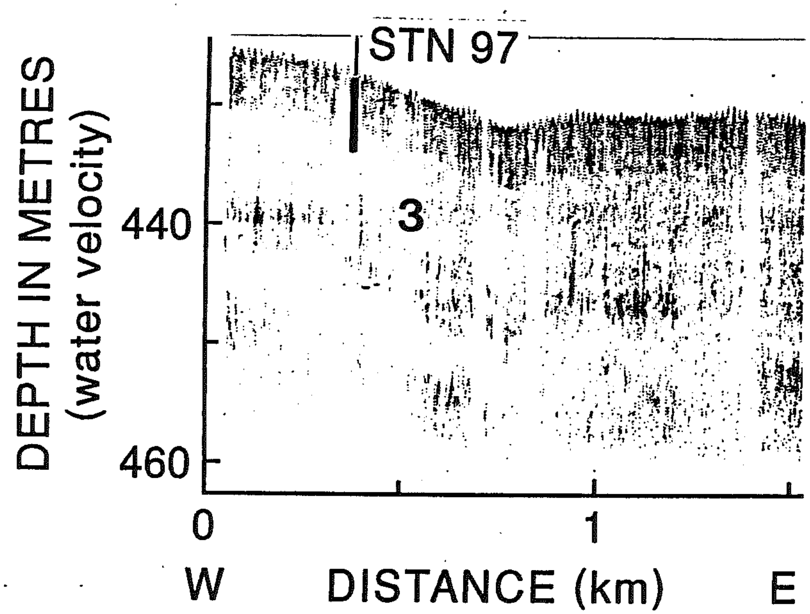


Figure 55: Huntec high resolution seismic profile illustrating a glaciomarine (3), sediment unit at core 90023-97 locality.

There is no definite faunal zonation (Figure 56) in this area. There are alternating episodes of < and > 100 benthonic tests/10 cc zones. It should be noted that the > 100 test zones only extend up to a maximum of 600 tests, so that there is not a lot of variance from the < 100 test zones.

Core 90023-97 has been identified as a combination of zone A and B indicating a fluctuating ice distal/ice proximal environment. The presence of *C. reniforme, E. excavatum clavata* and intermittent *F. fusiformis* all contribute to this conclusion. The diversity (0.522) is low and fluctuates suggesting an unstable environment for the Foraminifera. The alternating < and > 100 benthonic test/ 10 cc zones can be attributed to changes in the sedimentation rate since the relative abundances of species are constant throughout the core.

There are no distinct correlation markers between the lithology (Figure 57) and the Foraminifera distribution in core 90023-97.

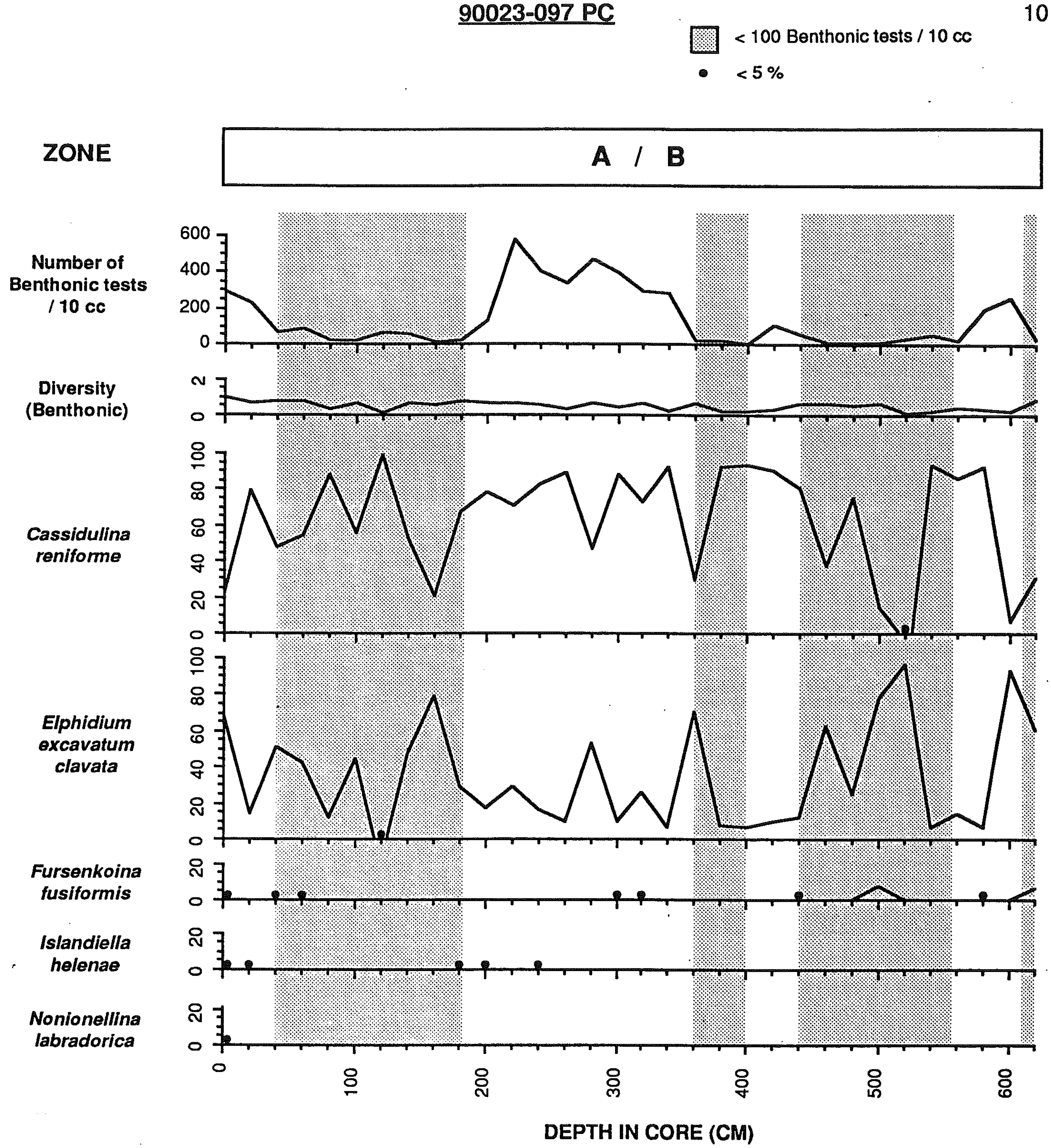


Figure 56: Percent abundances of major benthonic foraminiferal species, numbers of foraminiferal tests, diversity and faunal zones of core 90023-97.

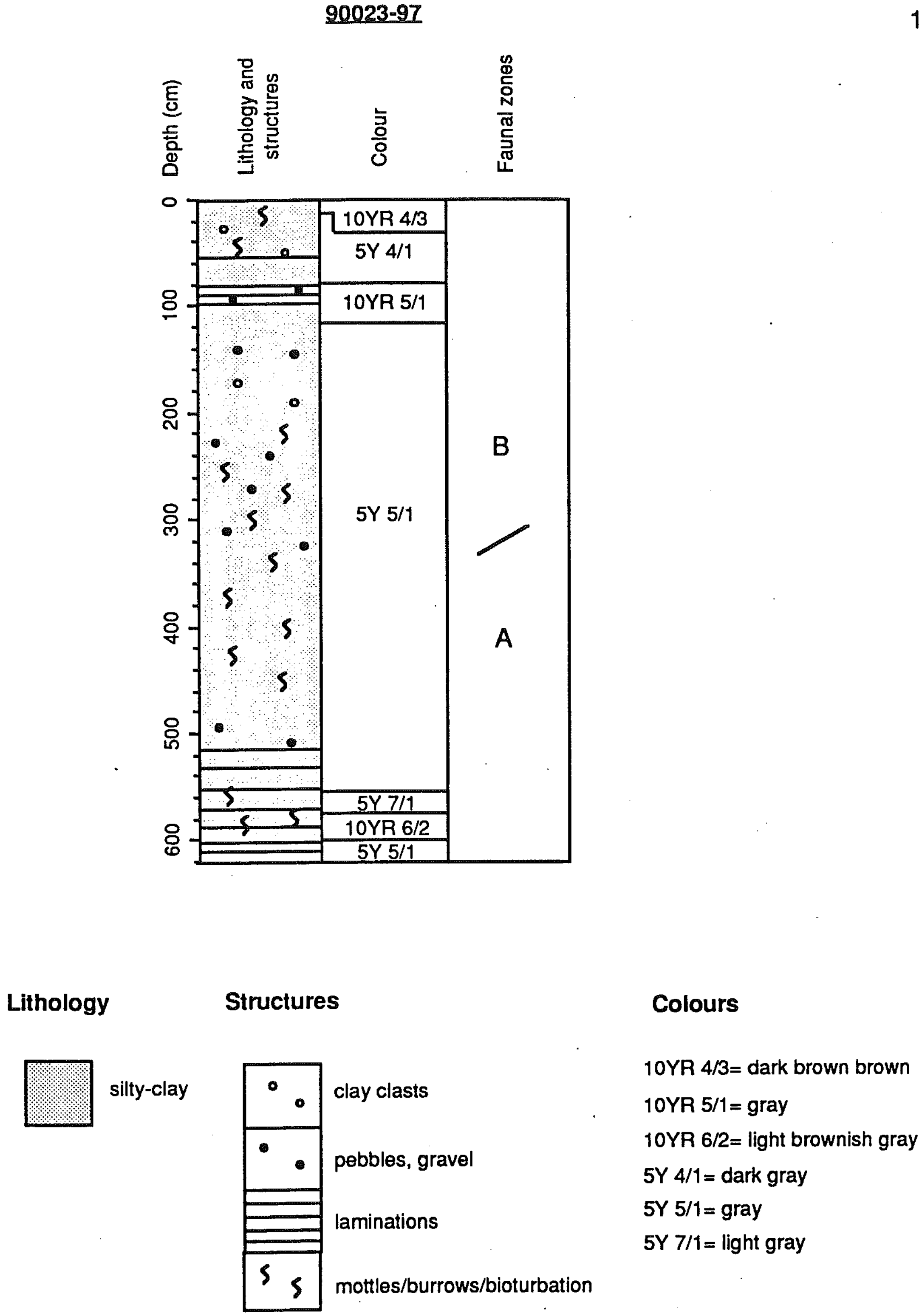


Figure 57: Lithology and Sedimentological structures of core 90023-97

Area 5: Southwestern Basin

The Southwestern Basin (Figure 58) lies south of Salisbury Island. Water depths exceed 400 m in some places. The main source of water in the present day comes from Hudson Bay. Three cores (90023-85, 90023-87, 90023-94) were studied from this area and they are all correlatable with one another (Table 6).

Zone Definitions

Faunal zone's A, B and D show characteristics typical to other such zones in Hudson Strait. There is no faunal zone C or T found in the cores studied in this area. The presence of *H. orbiculare* and *I. norcrossi* in zone A indicate a lower salinity, colder water influence.

The diversities (Figure 59) in this area show an increase from a low (0.601-0.667) in zone A to a high (1.398-1.586) in zone D. Zone B (1.09) is found between these two zones. Each zone shows a tightly confined diversity range with no overlap between zones.

Core 90023-085

Core 90023-85 was taken from a water depth of 380 m. The seismic (Figure 60) profile shows thick postglacial unit 4 and 5 layers underlain by unit 1, 2 and 3 sediments.

This core has been previously described (MacLean *et al.*, 1992), but based upon reexamination of the Foraminifera profiles the faunal zonal boundaries have been changed

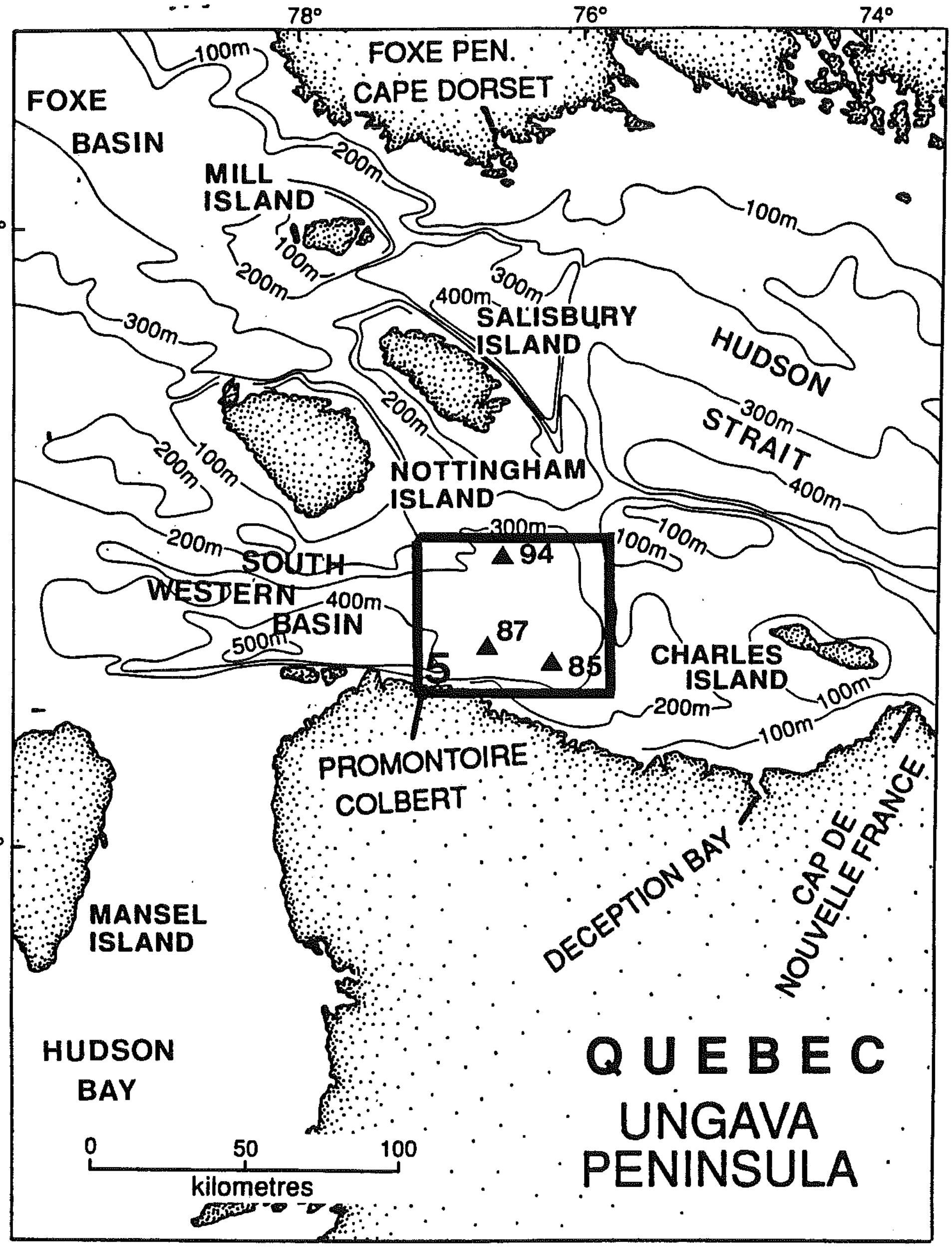


Figure 58: Detailed map of Area 5, The Southwestern Basin, showing cruise 90023 (▲85) core sites.

Table 6: Southwestern Basin Core Information

Core	Length (cm)	Latitude (N)	Longitude (W)	Water Depth (m)
90023-87	370	62 38.90	76 39.77	390
90023-85	548	62 36.95	76 22.53	380
90023-94	499	63 00.97	76 38.61	320

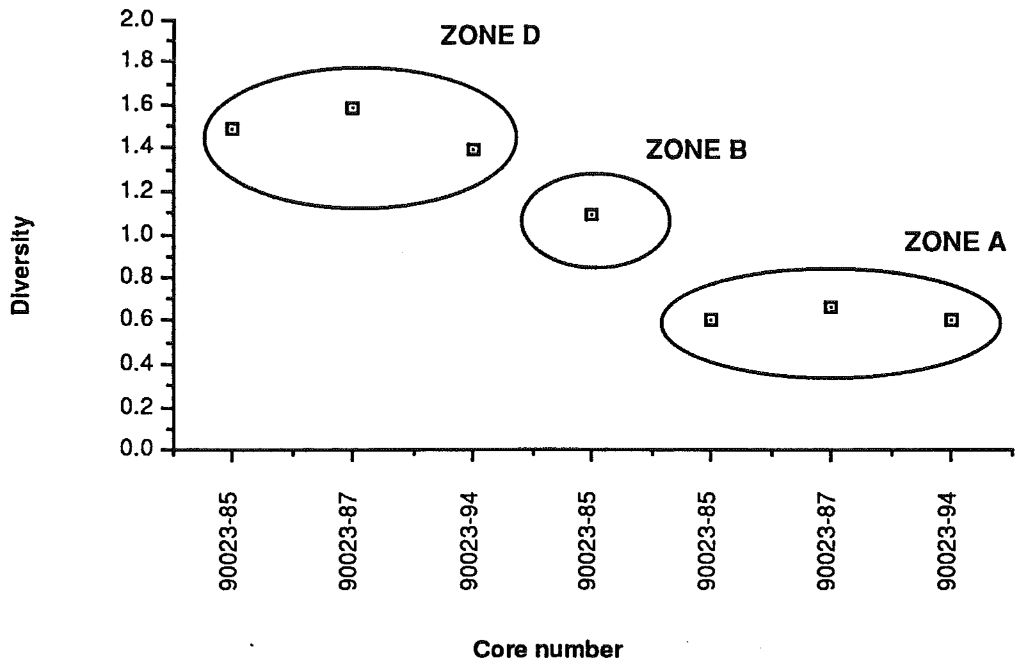


Figure 59: Faunal zone average diversities for Area 5, the Southwestern Basin

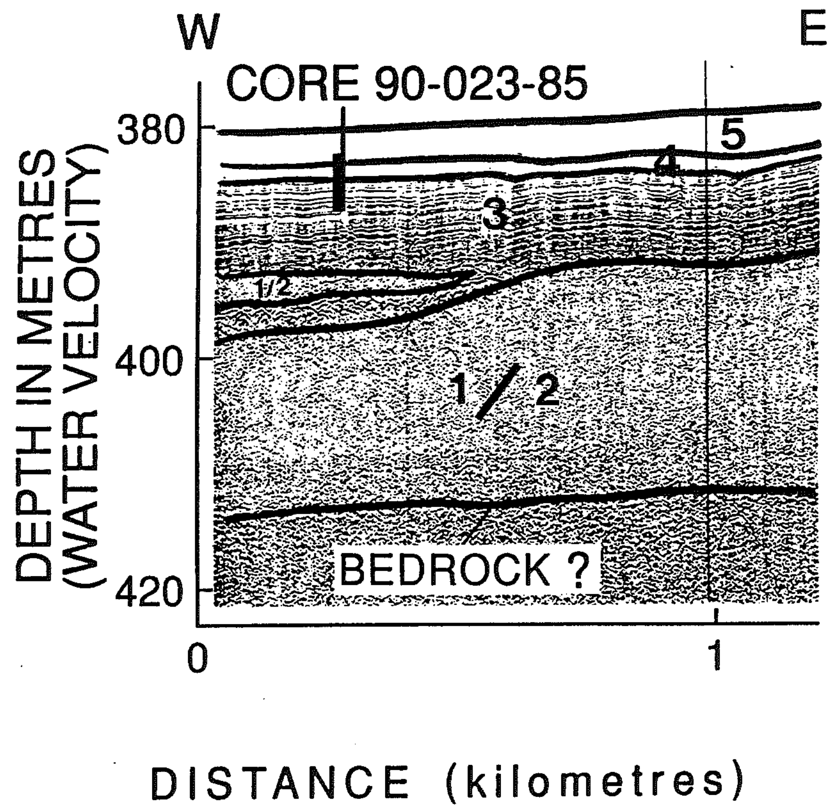


Figure 60: Huntec high resolution seismic profile illustrating glacial drift (1,2), glaciomarine (3) and postglacial (4,5) sediment units at core 90023-85 locality.

(Figure 61). The faunal zone A/B boundary has been moved from 240 cm to 180 cm to coincide with the first > 5 % appearance of *F. loeblichi* and *F. fusiformis* (zone B indicator species). This boundary change will also add a 60 cm < 100 benthonic test/ 10 cc zone to zone A.

The zone D/B boundary at 120 cm will stay the same since it is identified as the first major appearances of *P. takayanagii, N. labradorica, I. norcrossi* and *H. nana*. There is also an increase in benthonic and planktonic tests indicating a postglacial environment. Diversities increase with each zone, starting from a low 0.610 in zone A, increasing to 1.09 in zone B and peaking at 1.49 for zone D.

Core 90023-087

Core 90023-87 was taken west of core 90023-85 at a water depth of 390 m (Figure 58). The seismic section (Figure 62) shows that the core penetrates a very thin postglacial unit 5 layer underlain by a thicker unit 3.

The core is dominated by a thick zone A (Figure 63) spanning from 20 to 360 cm. This is classified as a zone A because it is largely made up of < 100 benthonic test / 10 cc and has a low diversity (0.667). The dominant species include *C. reniforme* and *E. excavatum clavata*. The presence of other species such as *H. orbiculare* and *I. norcrossi* suggest occasional influxes of low salinity glacier meltwater.

Zone D is found from 0-20 cm. It is so identified because of the increase in agglutinated species such as *Trochammina nana, Spiroplectammina biformis* and *Adercotryma*

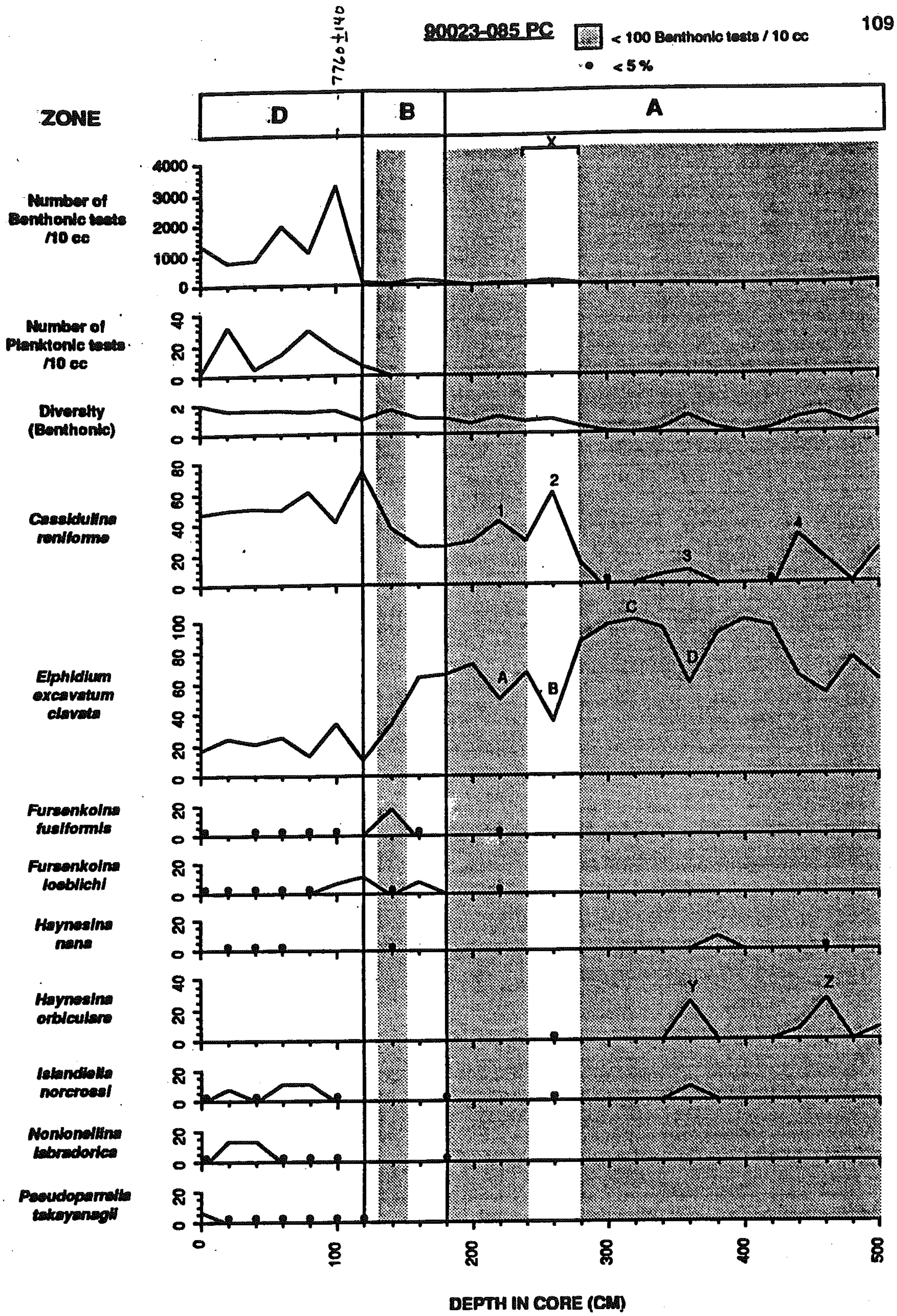


Figure 61: Percent abundances of major benthonic foraminiferal species, numbers of foraminiferal tests, diversity and faunal zones of core 90023-85.

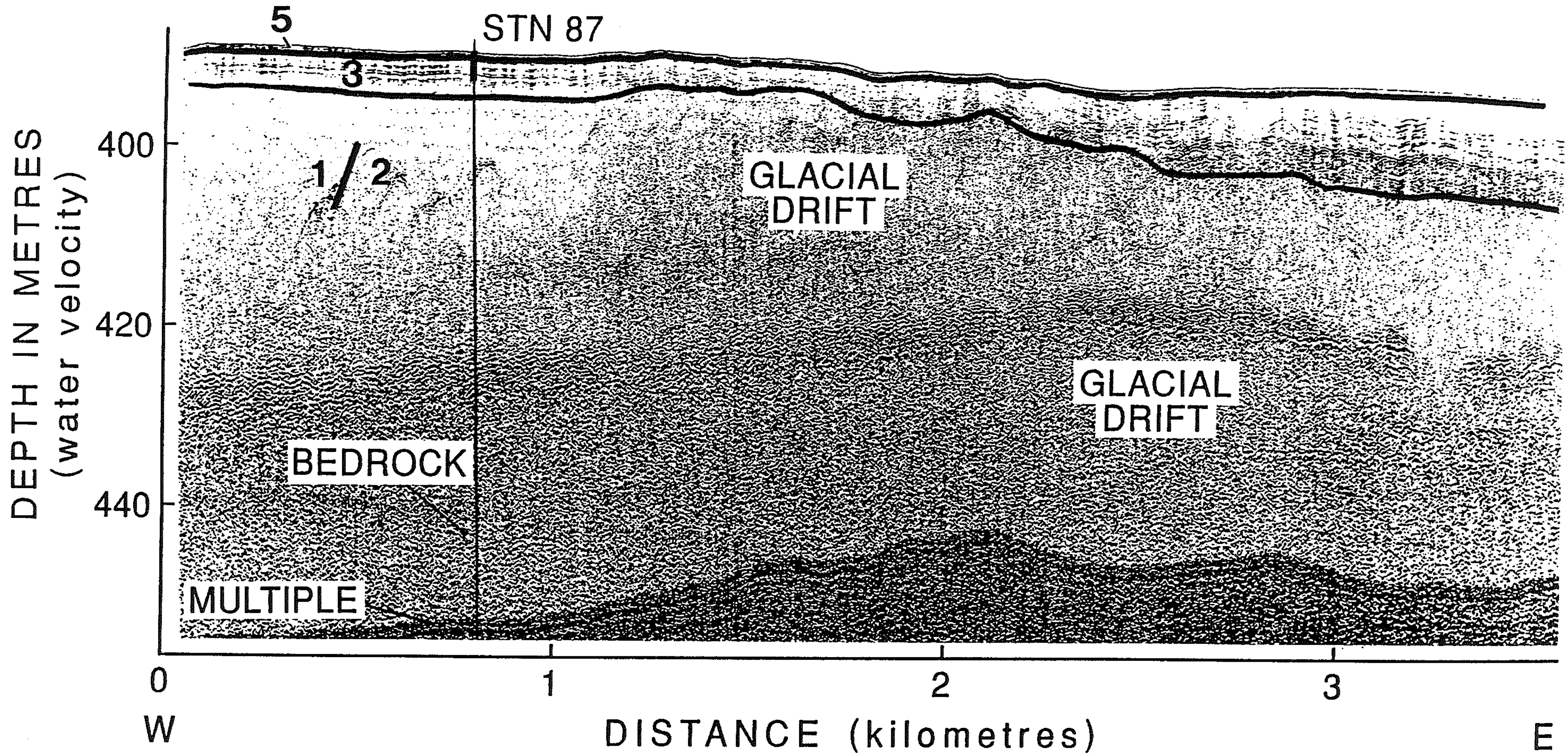
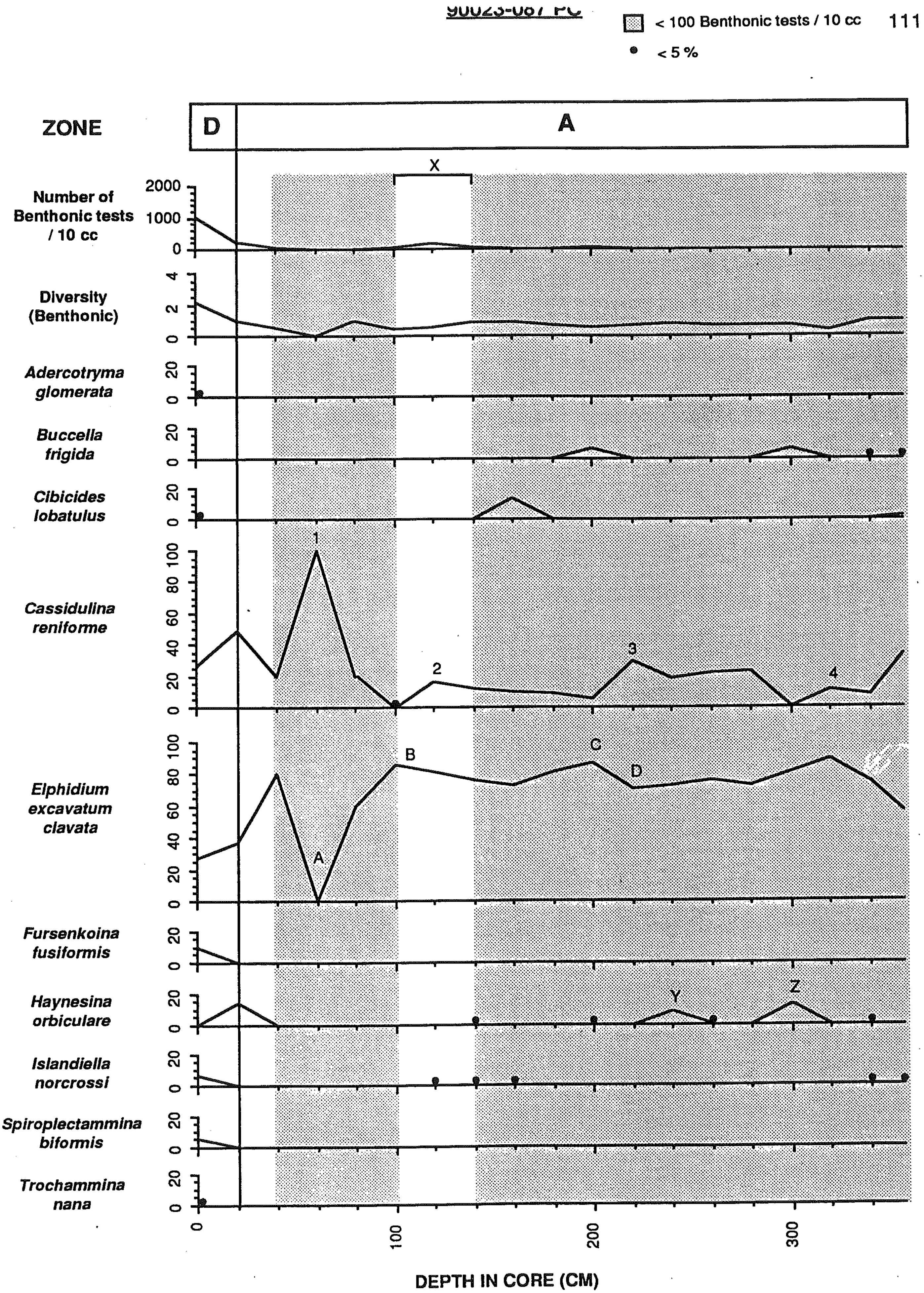


Figure 62: Huntec high resolution seismic profile illustrating glacial drift (1,2), glaciomarine (3) and postglacial (5) sediment units at core 90023-87 locality.


90023-087 PC
< 100 Benthonic tests / 10 cc
< 5 %
ZONE
D
A
X
Number of Benthonic tests / 10 cc
Diversity (Benthonic)
Adercotryma glomerata
Buccella frigida
Cibicides lobatulus
Cassidulina reniforme
Elphidium excavatum clavata
Fursenkoina fusiformis
Haynesina orbiculare
Islandiella norcrossi
Spiroplectammina biformis
Trochammina nana
DEPTH IN CORE (CM)

glomerata as well as the peak in the postglacial species of *I. norcrossi*. There is also an increase in diversity (1.586) and the number of benthonic tests from the previous zone A. The presence of agglutinated Foraminifera suggests that the zone is located near the surface, since agglutinates rarely survive deeper down in the core (Schaffer and Cole, 1988). A grab sample taken from the same area shows dominance of *M. zaandamae, I. helenae* and *N. labradorica*. These species do not appear in core 90023-87. The possibility exists that "pockets" of ice rafted pebbly mud (ie. grab sample lithology) alternate with structureless silty-clay (ie. core 90023-87) on the surface of this area.

Core 90023-94

Core 90023-094 is found southeast of Salisbury Island at a water depth of 320 m (Figure 58). The seismic profile (Figure 64) is unclear, but appears to be made of acoustically laminated unit 3 sediments. Similarly to core 90023-87, 90023-94 is almost entirely composed of zone A fauna, which is dominated by *C. reniforme* and *E. excavatum clavata* (Figure 65). The diversity is low (0.601) and most of the zone has < 100 benthonic tests/10 cc.

Zone D is found from 0-20 cm in the core. It is identified by the increase in diversity (1.398), benthonic tests and in the number of *N. labradorica, I. helenae, B. tenerrima* tests. A grab sample was taken near the core site and was found to contain all of the zone D fauna species with an increase in agglutinated species. Since agglutinates are usually restricted to the surface layer this suggests that the very top portion of 90023-94 was blown away during the coring process as they do not appear in zone D.

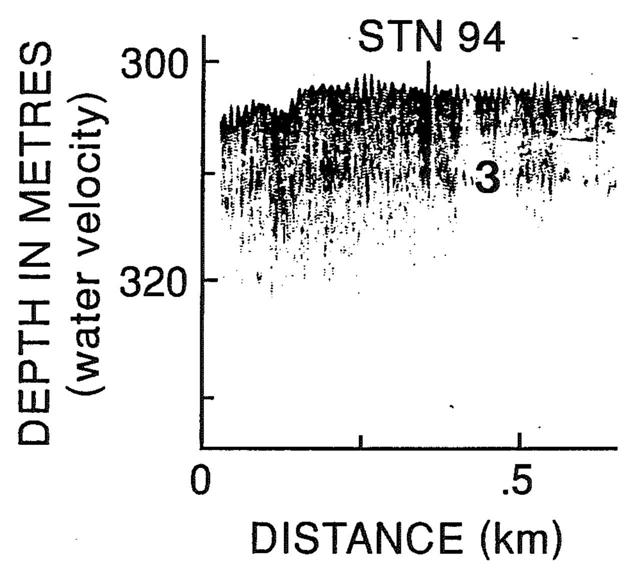


Figure 64: Huntec high resolution seismic profile illustrating a glaciomarine (3) sediment unit at core 90023-94 locality.

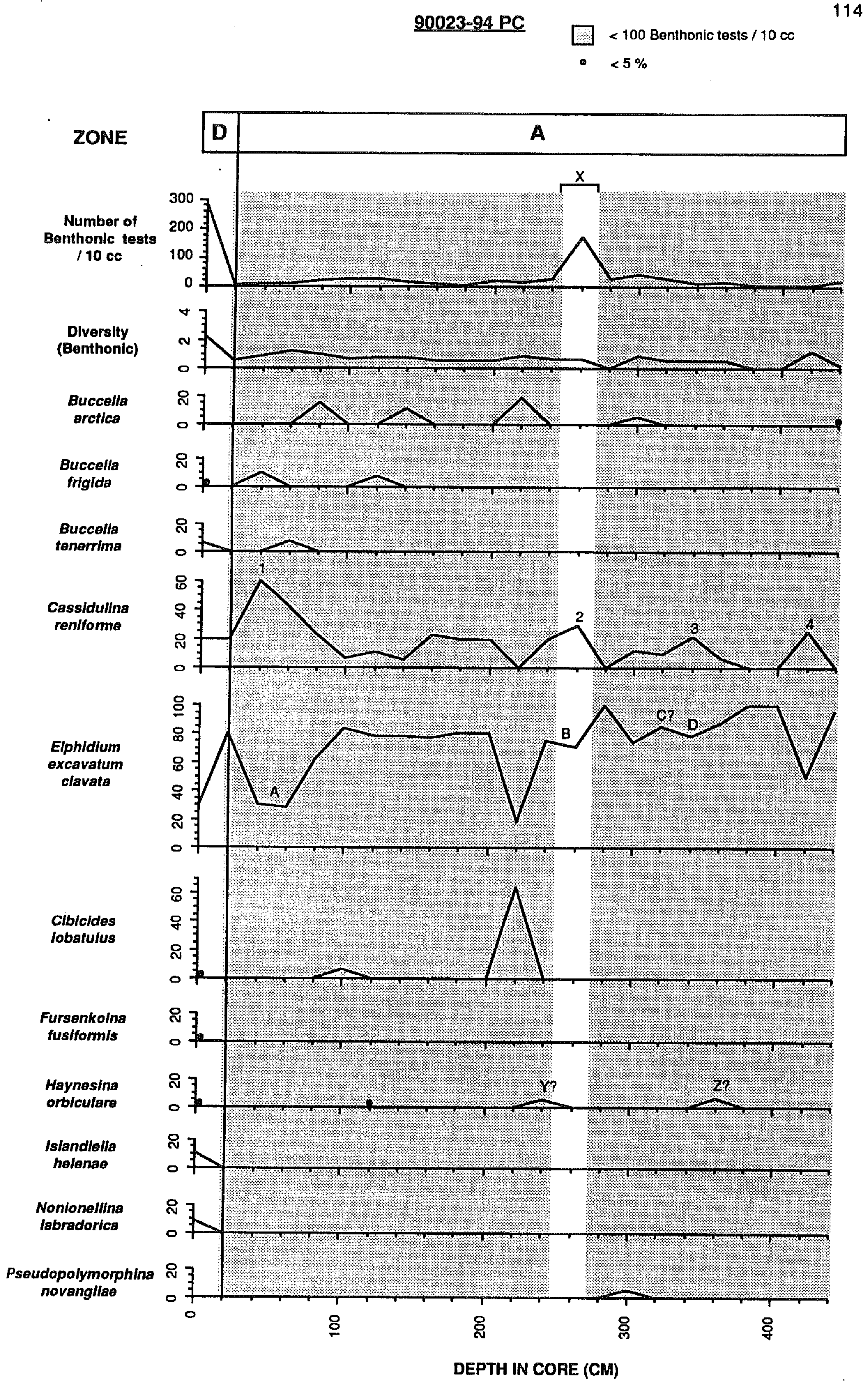


Figure 65: Percent abundances of major benthonic foraminiferal species, numbers of foraminiferal tests, diversity and faunal zones of core 90023-94.

Correlation of cores 90023-85,-87 and -94

The correlation of core 90023-85 and 90023-87 and 90023-94 is based on zone A similarities. All three cores have two peaks of *H . orbiculare* (see letters X and Y, Figures 61, 63 and 65) and they all have two barren zones with a thin > 100 benthonic test/ 10 cc zone (see letter X, Figures 61, 63 and 65) separating them. These cores are also correlatable using peaks and troughs in the percent abundances of *C. reniforme* (see numbers 1 to 4 , Figures 61, 63 and 65) and *E. excavatum clavata* (see letters A to D, Figures 61, 63 and 65). The zone D/A boundary is quite clear on both cores 90023-87 and 90023-94. Since this boundary is so close to the top of the core, it suggests rapid ice retreat not allowing ice distal (zone B) sediment accumulation. Bottom water current activity may have been strong enough to not allow significant deposition of postglacial sediments except in the 90023-85 area.

The lithologic profiles (Figure 66) show that there is a definite colour change in all three cores from the underlying zone B or A to zone D. Zone A in all the cores is made up of alternating colours. The top zone D layer is made up of structureless silty-clay. Cores 90023-85 and 90023-87 are similar as they both contain a silty-clay matrix and many pebbles and clay clasts that stop at the B/D and A/D boundaries respectively. Core 90023-85 also has a clay zone and clay clast zone at the bottom of the core. Core 90023-94 differs the most from the other two cores. Zone A is made up mostly of sandy-silt with abundant clay clasts and pebble dropstones. Zone B seems to have thinned out and to be absent from cores 90023-87 and 90023-94.

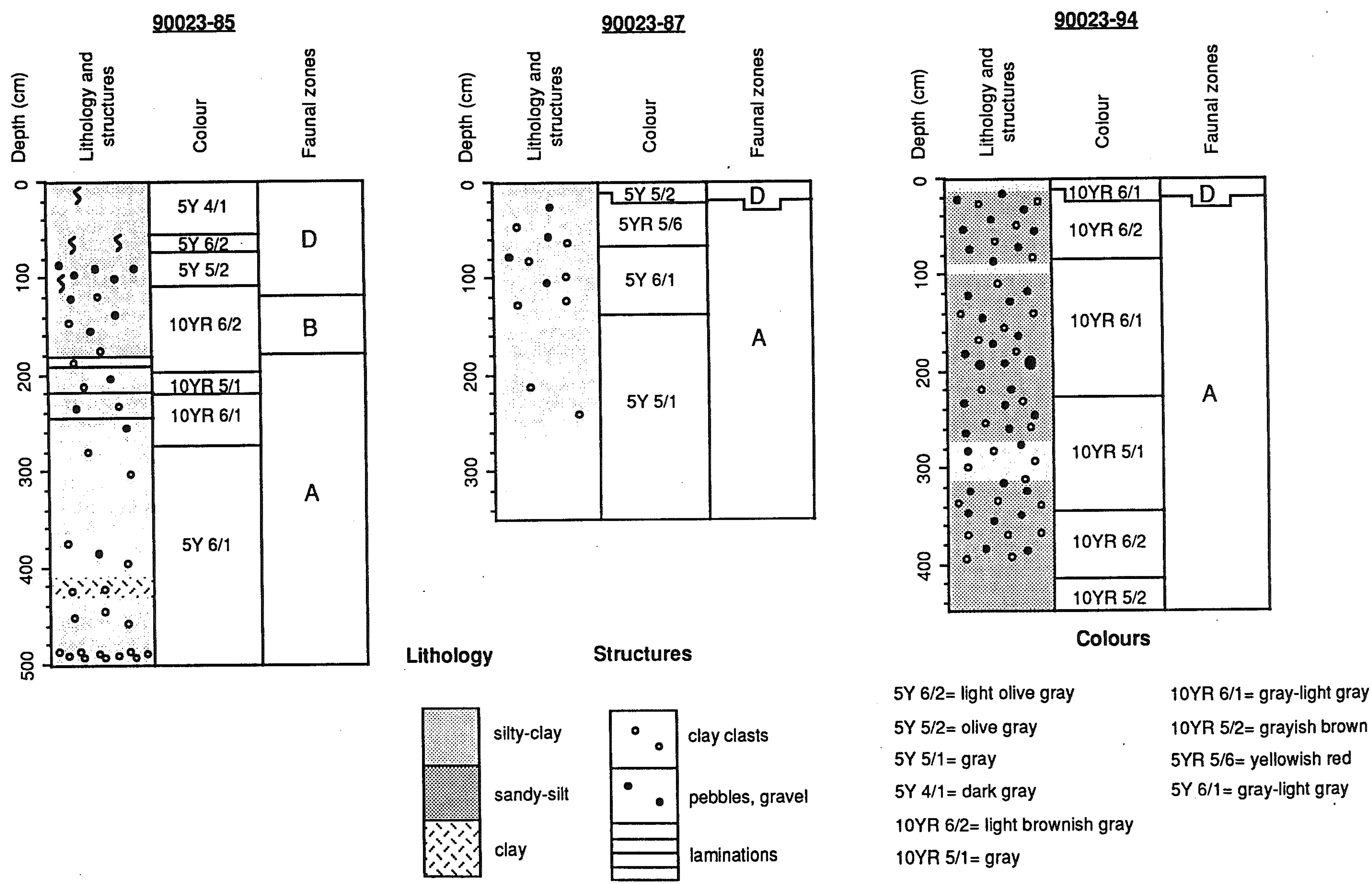


Figure 66: Lithology and Sedimentological structures of cores 90023-85, 90023-87 and 90023-94

Conclusions

Five areas of study in Hudson Strait were described and Foraminiferal biostratigraphy studied in detail. Each area of study has its own unique perspective to offer regarding the late Quaternary (Wisconsinan) Laurentide ice sheet retreats and advances throughout Hudson Strait. Several new Foraminiferal faunal zones were described and quantified and an in depth study of species diversity was done.

It can generally be concluded that each study area showed the lowest diversities in faunal zone A and the highest in zone D. Zones B, C and/ or T had diversities in the intermediate range between zones A and D. There is a linear trend from a high in zone D, through zones T, C and/ or B to a low in zone A.

Area 1, encompassing the Eastern Basin, had three cores studied from it. Generally, it can be concluded that ice proximal glaciomarine conditions were still prevalent at 8590 y BP. High salinity Labrador sea water began to enter the area in the early postglacial and continued on into the late postglacial. Core 90023-52 was influenced by ice readvances from Ungava Bay and Meta Incognita peninsula. A transitional zone found in this core suggests that the glacial influence retreated quite slowly from this area.

Area 2 in Ungava Bay, shows two new transitional zones. These zones are defined based upon the mixture of zone A, B and D Foraminifera species. Cores 90023-34 and 90023-39 show a transition zone (T_1) from ice proximal glaciomarine zone A to postglacial zone D. Zone T was influenced by large amounts of river sediments from the Laurentide ice sheet melting farther inland and/or higher salinity oceanic current influx.

Core 90023-62 in Ungava Bay also shows a transition zone (T_2) from glaciomarine to postglacial conditions. The diversity does not fluctuate in this zone relative to zone T_1. Zones T_1 and T_2 show a change to a deltaic marine environment with fluvial input which is to be expected since the core site locality is in the vicinity of large river outlets.

The Baie Hericart/ Wakeham Bay area in Central Hudson Strait has cores that are correlatable based on peaks in magnetic susceptibility found in faunal zone B. Correlation is also possible based upon peaks and troughs in the numbers of *C. reniforme* and *E. excavatum clavata*. This area experienced localized sedimentological effects from the ice margin and paleooceanographic currents. Higher salinity water began to enter the area during the glaciomarine ice distal zone B. The higher salinity conditions alternated with lower salinity meltwater influxes. The transition from ice proximal to distal conditions occurred 10720 y BP, and the change from ice distal to postglacial conditions occurred between 7750 and 6650 y BP. Ice distal conditions were prevalent at 8040 y BP. Anomalously high age dates (10330 y BP) may be attributed to a mixing of older Foraminifera tests with the in situ fauna.

Core 90023-66 shows that ice readvancement occurred in the northern Baie Hericart region sometime between 8420 and 7940 y BP. The final ice retreat was quite rapid going from ice distal to postglacial conditions with no transition zone in between the two. The postglacial conditions were well established 6550 y BP.

The Western Basin shows that a transition zone (T_3) occurred between the ice distal and postglacial environments. The present offshore oceanographic setting was established during this transition zone, seen by the presence of *M. zaandamae, P. osloensis* and / or *P.*

takayanagii and *S. biformis*. There was also an increase in higher salinity waters as indicated by the addition of planktonics and/or *C. laevigata*. The presence of *I. helenae* can be used as an ice proximal and distal glaciomarine indicator for this area. Ice proximal conditions were prevalent 8470 y BP. The glacier began to retreat to a more ice distal position 8330-8080 y BP. The transition zone was already established by 7970 y BP and postglacial conditions already existed 2205 y BP.

Area 5 in the Southwestern Basin shows that ice proximal glaciomarine conditions prevailed in this area for a long time. When ice retreat began it was quite rapid as shown by the absence of zone B in two of the three cores. A thin layer of zone D in most cores studied suggests that either current activity was strong in this area not allowing for significant deposition of sediments, or the sediments were eroded away by these same currents. Sedimentation rates may have been quite low during the postglacial as well.

Recommendations

The late Quaternary history for each area in Hudson Strait was based upon Foraminifera data obtained from cores. This is only a very generalized history based on the data obtained from a few cores in each area. Future analysis of zone D fauna may yield further subdivisions based upon the first appearance of *I. helenae* and *I. norcrossi* relative to the first appearance of *B. frigida* and *B. arctica*. It is recommended that in the future:

1. The relative abundances of species found in the < 100 benthonic tests / 10 cc intervals should not be plotted on Foraminifera profiles. These species plots can be misleading because in reality only a few tests were found but they appear as high as a high relative abundance.
2. Foraminifera faunal zone boundaries should be further subsampled at smaller intervals (ie. 5 cm) to pinpoint the exact position of the zonal boundary.
3. Table 7 is a list of recommended cores and intervals to date at a future date as time and money allows. The intervals were chosen based on the zone they were located in and the amount of tests that could possibly be obtained.
4. An in depth analysis of grab and IKU samples could yield interesting results of the distribution of surface Foraminifera and sediments.
5. The ostracodes found throughout the cores should be studied to provide more information regarding the paleoenvironments of Hudson Strait.

Table 7: Proposed Intervals for Dating

Area	Core	Depth in Core (cm)	Faunal Zone
1	92028-157	300	C/D
		470	C
	90023-42	100	C/D
		300	C
		420	A
	90023-52	160	B/C
2	90023-34	170	T_1
		220	T_1
	90023-39	200	T_1
		500	T_1
		600	A
	90023-62	60	T_2
3	92028-153	120	B/D
		440	B
	90023-64	760	B
		920	B
	92028-155	860	B
	90023-66	520	B_2
		780	B_1
	90023-71	520	B
4	90023-101	40	D
	90023-104	80	T_3
		320	B
		500	B
	90023-99	60	T_3
		300	B

Table 7 (Continued): Proposed Intervals for Dating

Area	Core	Depth in Core (cm)	Faunal zone
4	90023-97	600	A/B
5	90023-85	160	B
		260	A
	90023-87	0	D
		120	A
	90023-94	260	A

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