

FIELD TRIP GUIDE for the FRIENDS OF THE PLEISTOCENE

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Leaders:

H. Borns, University of Maine

C. Dorion, University of Maine

J. Kelley, University of Maine & Maine Geological Survey

K. Kreutz, University of New Hampshire

D. Smith, University of Maine

W. Thompson, Maine Geological Survey

R. Will, Archaeological Research Consultants, Inc.

Sponsored by: Harold W. Borns, Jr., Institute for Quaternary Studies and
Department of Geological Sciences, University of Maine, Orono, ME

University of Maine

The Deglaciation of Southeastern Washington County, Maine

By

Michael R. Kaplan

B.A. State University of New York at Buffalo

A THESIS

Submitted in Partial Fulfillment of the
Requirements for the Degree of
Master of Science
(in Geological Sciences)

The Graduate School
University of Maine

August, 1994

Advisory Committee:

Harold W. Borns, Jr., Professor of Geological Sciences and
Quaternary Studies, Thesis Advisor

James L. Fastook, Associate Professor of Computer Science and
Quaternary Studies

Woodrow B. Thompson, Maine Geological Survey

**PALEOCEANOGRAPHIC CONDITIONS OF THE LATE WISCONSIN
MARINE TRANSGRESSION AND REGRESSION IN
EASTERN COASTAL MAINE:
STABLE ISOTOPIC EVIDENCE**

By

Karl J. Kreutz

B.A. State University of New York at Buffalo, 1992

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**Daniel F. Belknap, Professor, Department of Geological Sciences, Marine
Studies, Oceanography, and Institute for Quaternary Studies**

**Kirk A. Maasch, Assistant Professor, Institute for Quaternary Studies and
Department of Geological Sciences**

**Martin G. Yates, Research Assistant Professor, Department of Geological
Sciences**

**AN UPDATED HIGH RESOLUTION CHRONOLOGY OF DEGLACIATION
AND ACCOMPANYING MARINE TRANSGRESSION IN MAINE**

By

Christopher C. Dorion

B.A. Franklin & Marshall College, 1983

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Woodrow B. Thompson, Maine Geological Survey, Adjunct Professor of
Geological Sciences

INTRODUCTION

G. Stone (1899), in his study of glacial gravels, was the first to recognize the extensive "sand plains" of SE Maine as marine deltas. H. Leavitt and E. Perkins, in their study of the glacial geology of all of Maine (1935), reported the presence of the Pond Ridge moraine bank along with several extensive deltaic sand and gravel deposits that they called "wash plains." However, because of their limited field time in SE Maine of a few weeks (Pers. Comm. J.M. Trefethen), they failed to recognize the extensiveness of what is now informally called the emerged coastal moraine complex.

During the field seasons of 1965 and 1966, H.W. Borns (1967) initially defined components and age of the end moraine complex along the coast from Penobscot Bay eastward to the Eastport and the New Brunswick/Maine border (Fig. 1). Work has continued by H.W. Borns, his students and other professionals to further refine the distribution, chronology and processes involved in the deposition of the complex and to assess its significance in understanding late glacial events in the circum North Atlantic region.

As presently understood, the coastal moraine complex actually is present along the entire Maine coast and is composed predominantly of cross-cutting glacial-marine grounding-line moraines, scattered ice-contact marine deltas, submarine kames, and glacial-marine muds (Thompson & Borns, 1985).

In eastern coastal Maine, the width of the complex varies from 10 to 30 miles. To the south, the complex, its extent unknown, has been submerged by the Holocene sea level rise, and to the north the moraine/delta complex is sharply replaced by eskers that extend up to 100 miles northward beginning on the north side of the moraine complex. In general, the moraine segments of the complex range in size from being 30-50' high, 500' wide and several miles long to being 5-10' high, 100' wide and 0.5 miles long. They are composed predominately of stratified sands and gravels with lesser amounts of basal till. The till is located primarily on the proximal side, and the submarine outwash is progressively intercalated with fossiliferous marine mud in the distal direction.

The recessional moraines, formed along the grounding line of the marine-based ice sheet terminating in up to 250' of water, were deposited in a lobate cross-cutting fashion indicating a fluctuating recessional margin. This lobated system of moraines is cross-cut along its full length, from the Cherryfield area eastward to Lubec and into New Brunswick, by the Pineo Ridge moraine system (Fig. 1). This is essentially a non lobated system of grounding-line moraine segments which, in contrast to those to the south, are larger, bulkier, and more closely spaced forming a zone up to one mile wide that cross-cuts the entire system to the south. The Pineo Ridge moraine system was deposited at the termination of a readvance of unknown distance.

The age of the entire end moraine complex in southwestern Maine is constrained between about 14,000 and 13,200 yrs B.P. (uncorrected) and the readvance to the Pineo Ridge end moraine system is terminated about 13,800 and 13,350 yrs B.P. (uncorrected). These events along the southeastern section of the Laurentide ice sheet, the recession across the coastal zone, the readvance marked by the Pineo Ridge moraine system, and the subsequent recession appear to be coincident with marked events in both the North Atlantic and circum north Atlantic region and in the mid-continent of North America. (Note: We will discuss the ^{14}C marine reservoir correction factor in the field).

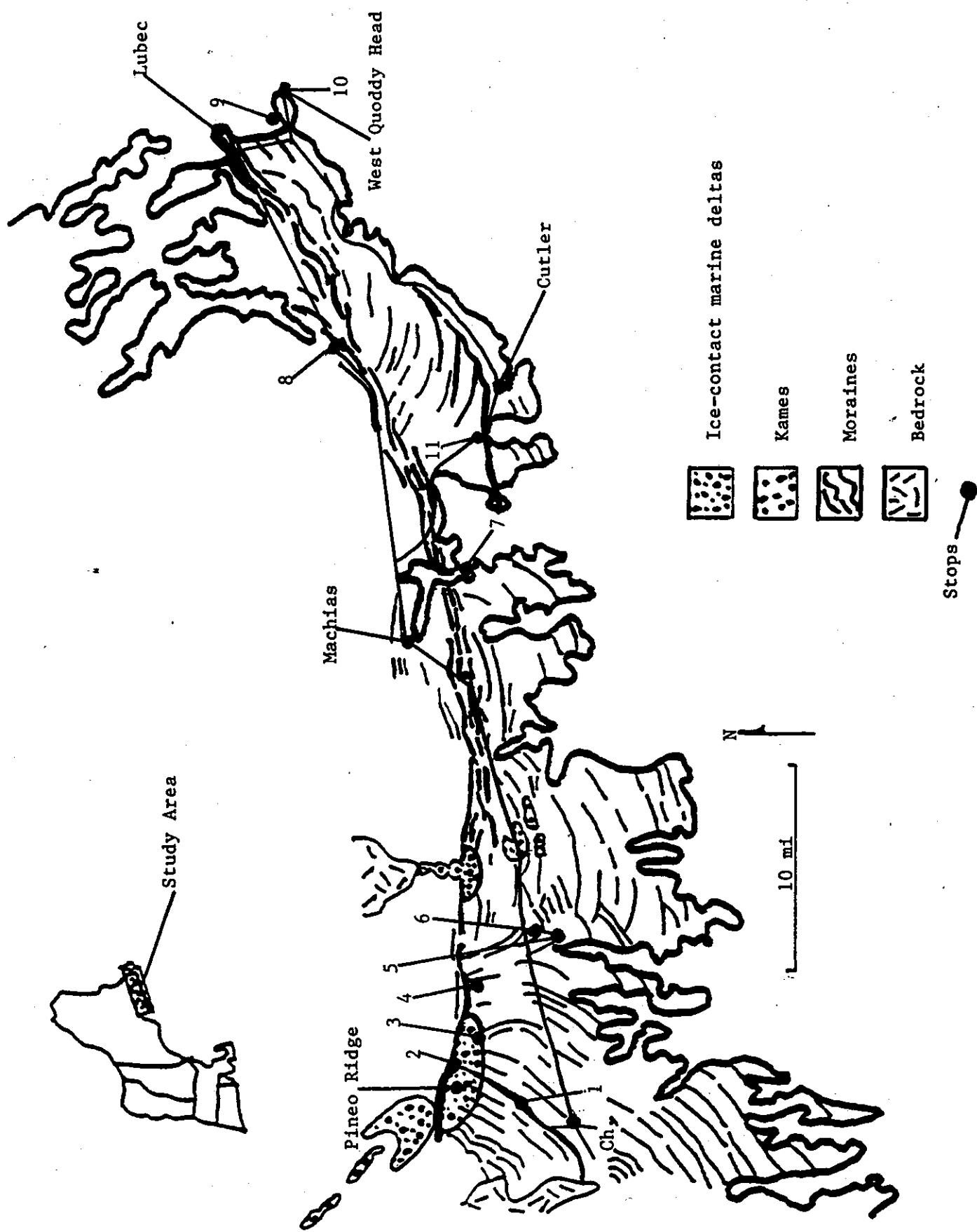


Figure 1 Index Map - Southeastern Maine

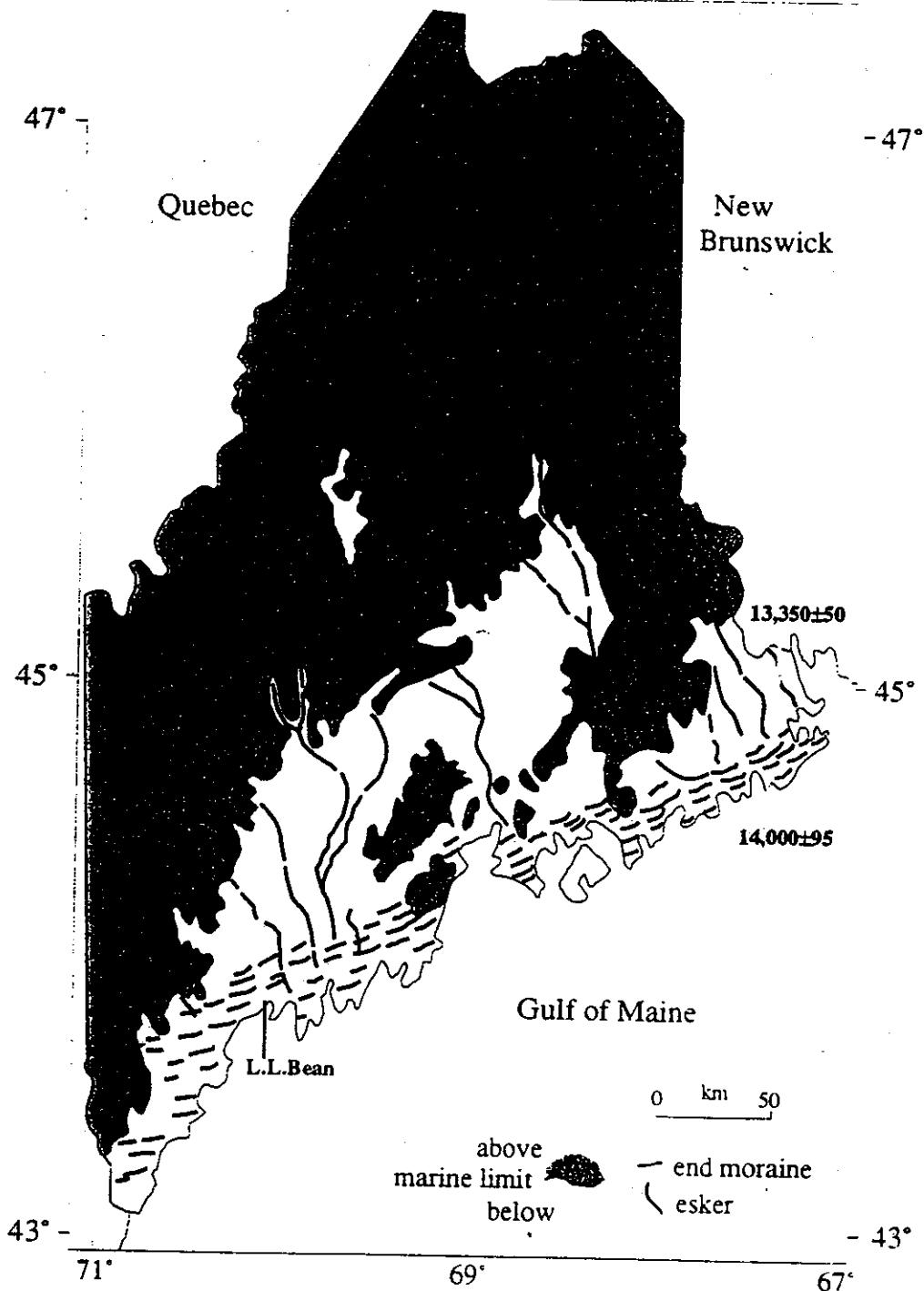
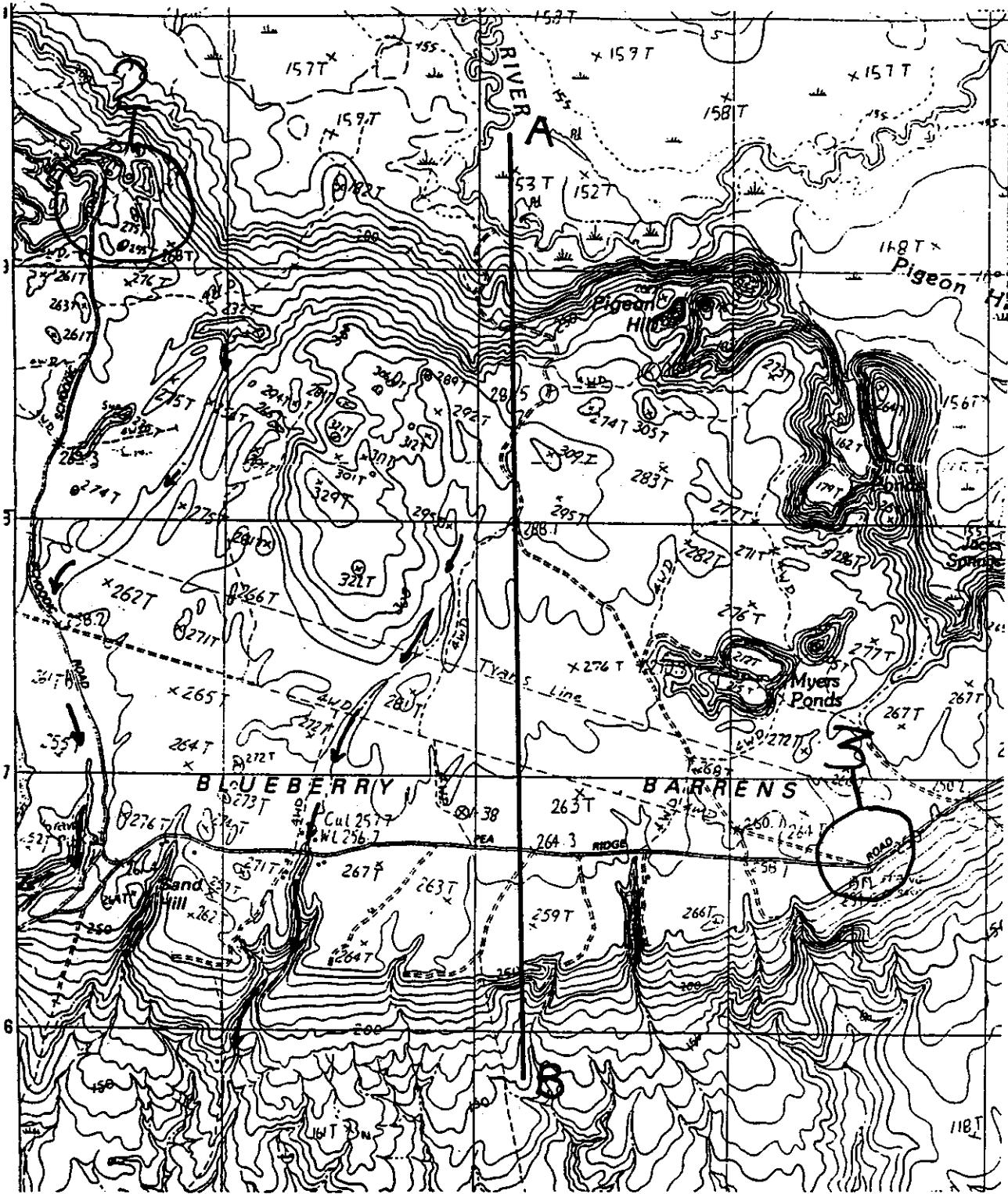


Figure 15. Schematic map of the geographic pattern of the coastal end moraine complex and the younger extensive esker system (H. Borns).



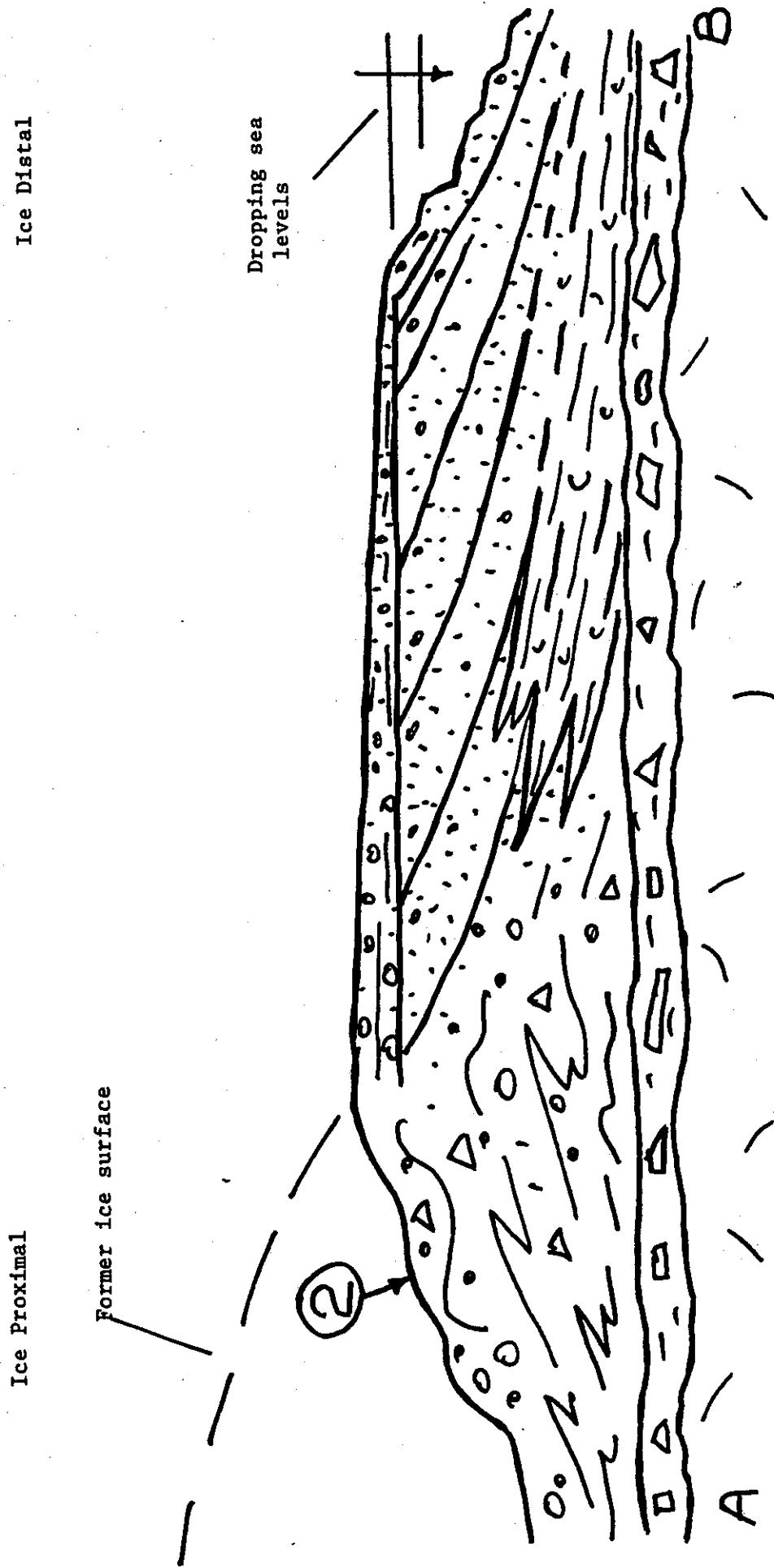


Figure 3. Schematic cross-section through Pineo Ridge delta along transect A-B (Figure 2).

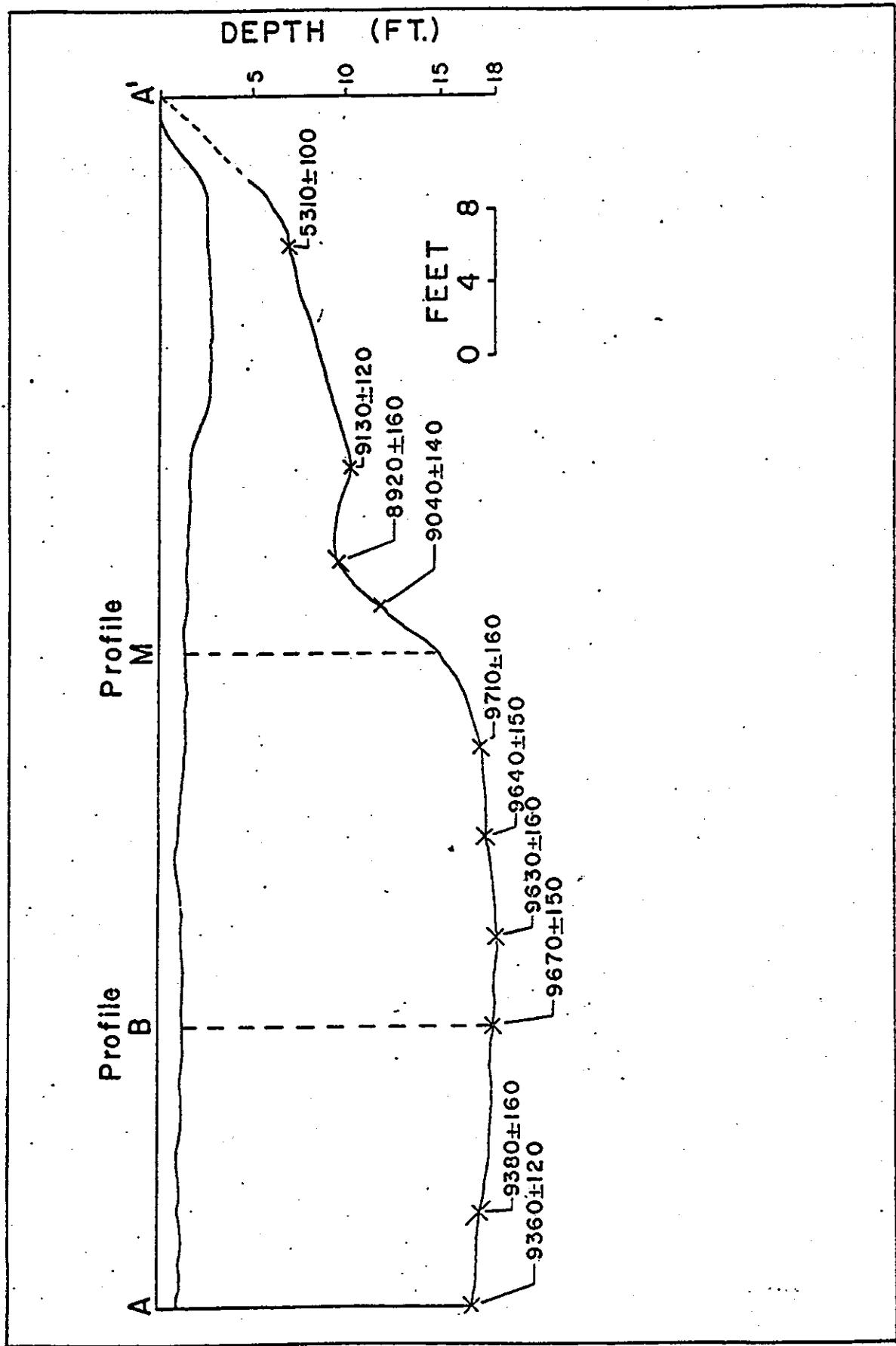


Figure 4. Cross-section of a kettle-hole peat bog on Pineo Ridge, Maine showing depths and radiocarbon ages of basal organics (Mickelson, 1968).

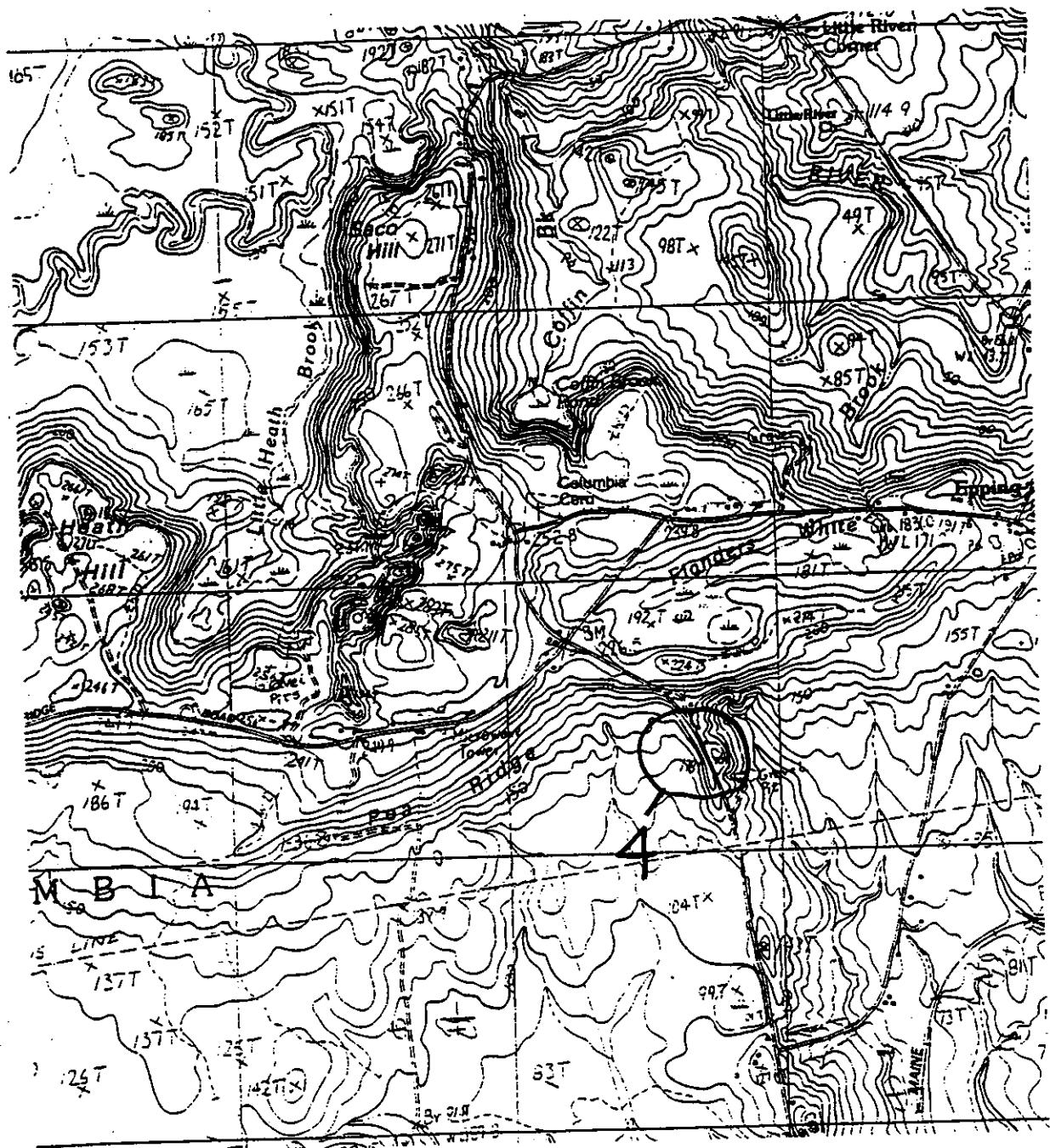


Figure 6. Pineo Ridge moraine cross-cutting an older moraine. EPPING, Maine-USGS Quadrangle 7.5 min. map.

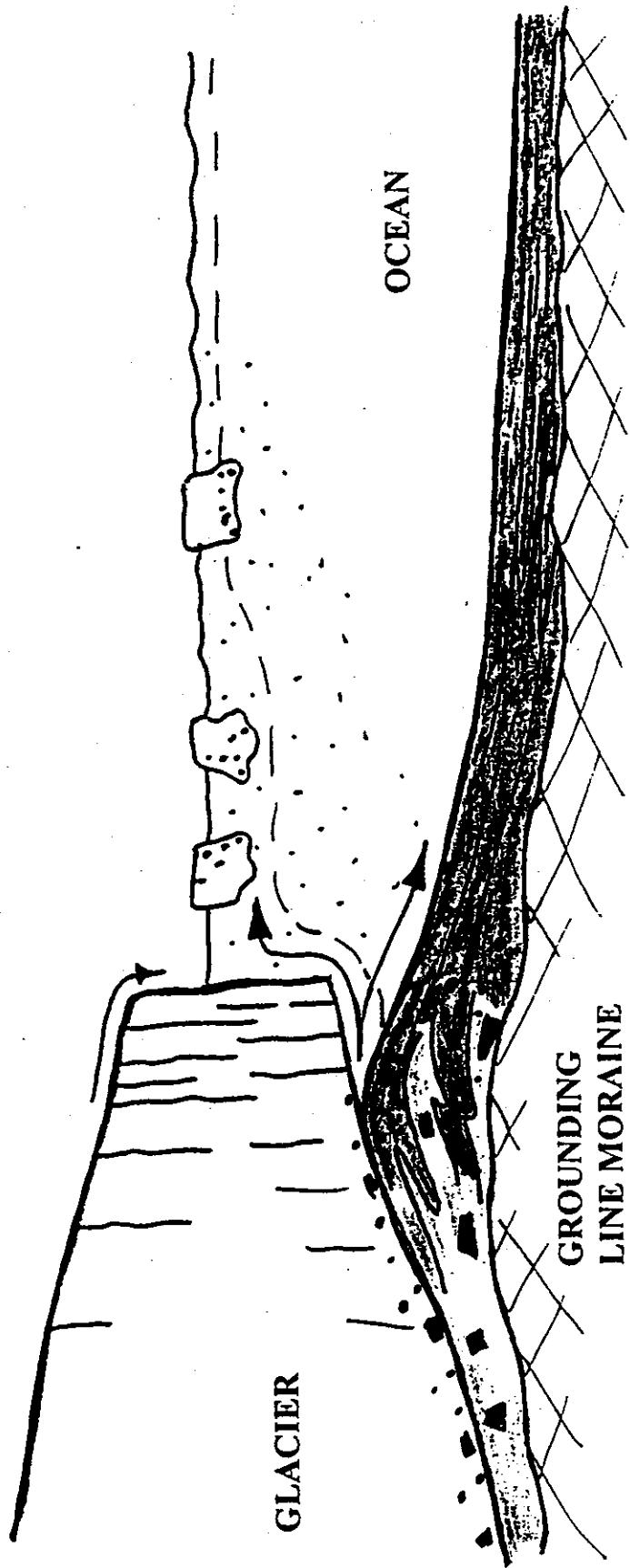
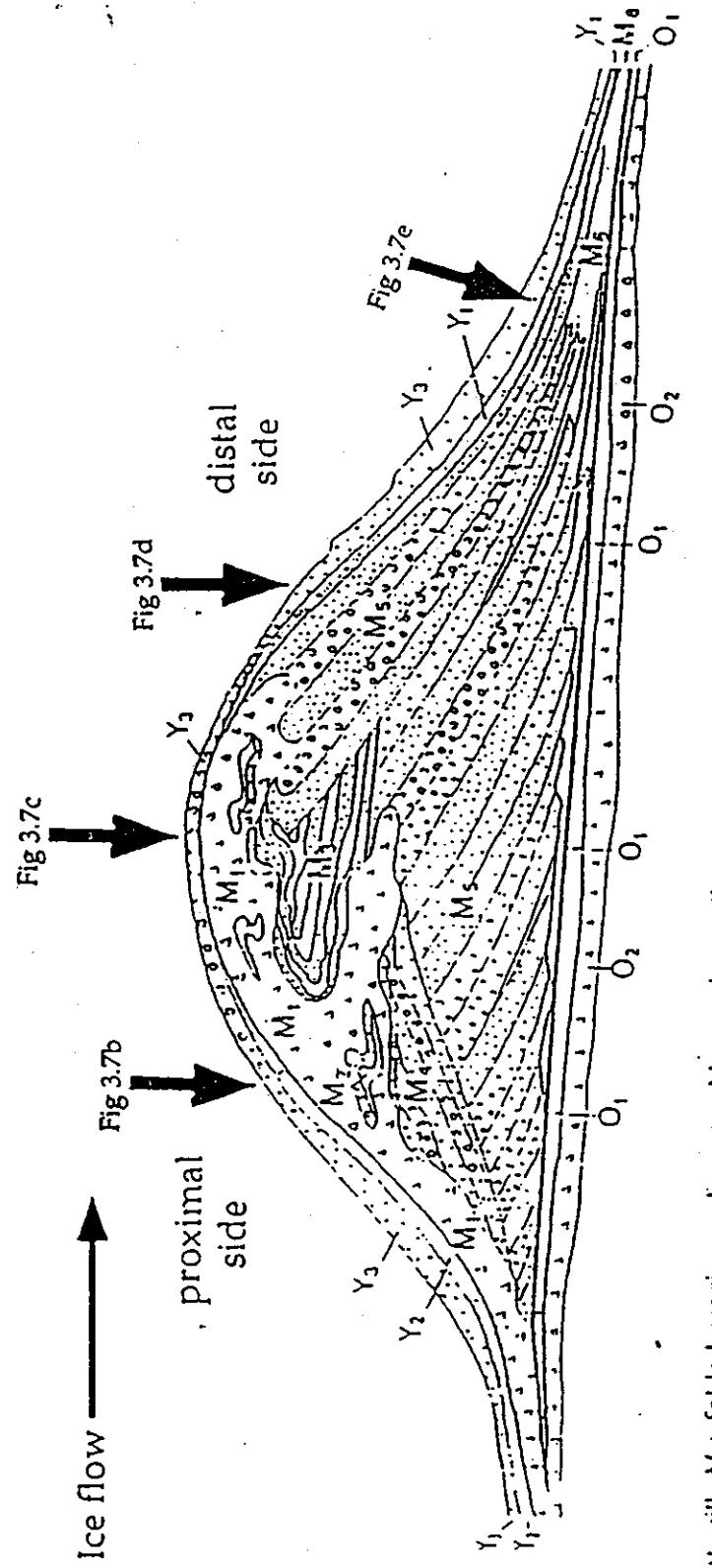


Figure 8.
A schematic cross-section showing the formation of a submarine grounding-line moraine in eastern coastal Maine. The meltwater and sediment are discharging from closely-spaced tunnels at the base of the ice margin. (H. Borns).



M₁: till. M₂: folded marine sediments. M₃: marine sediments. M₄: "foreset" beds. glaciofluvial, glaciomarine and flow till. M₅: glaciofluvial sediments.

Y₁-Y₃: glaciomarine sediments which are younger than the moraine. Y₁: post glacial marine sediments, including beach deposits and reworked till.

O₁: glaciomarine and marine sediments which are older than the moraine. O₂: older basal till or bedrock.

Figure 3.7a (modified from Andersen et al., 1981). Schematic cross-section of a grounding-line moraine deposited in the sea. Arrows indicate the approximate locations of the stratigraphy shown in Fig. 3.7b-e.

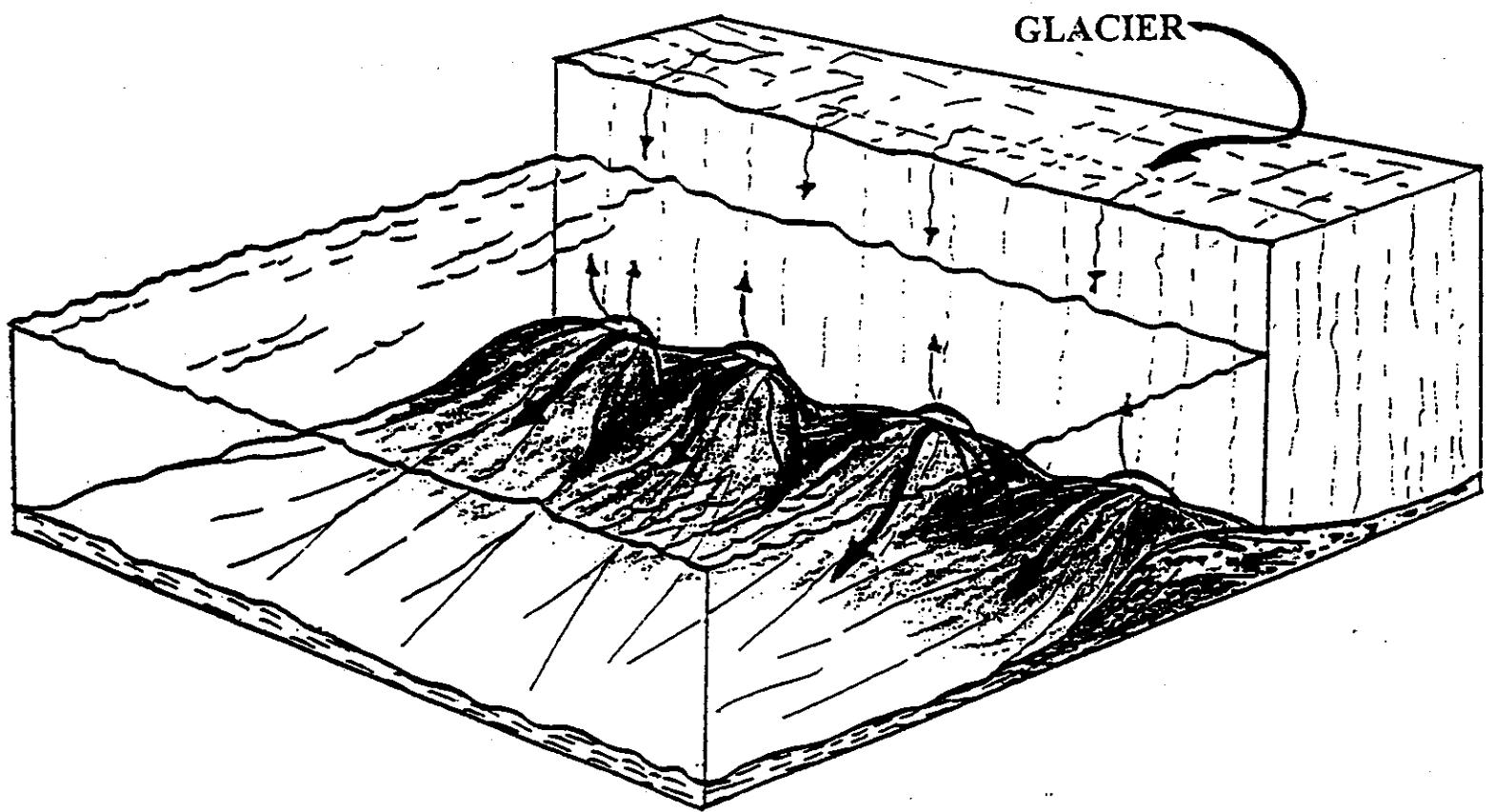


Figure 8A.
A schematic diagram showing the formation of a submarine grounding-line moraine in eastern coastal Maine. Meltwater and sediment are discharging from closely-spaced tunnels at the base of the ice margin. (H. Borns).

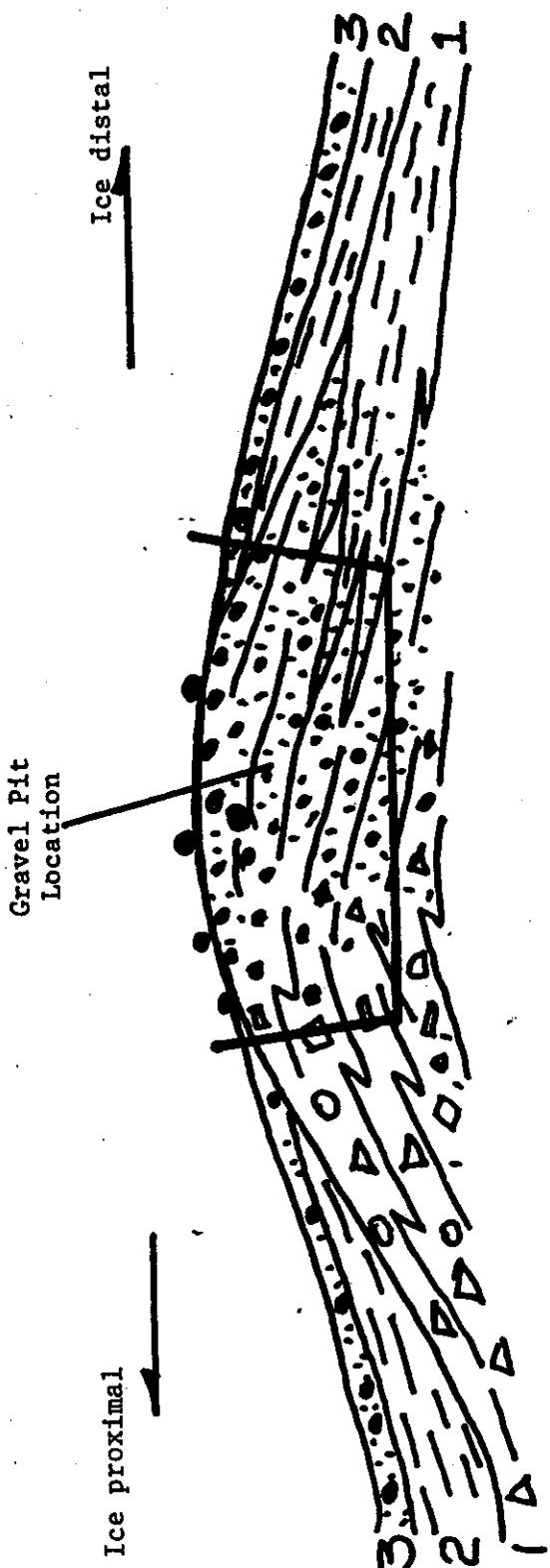


Figure 9. Schematic cross-section of a typical stratified grounding-line in Maine composed of three sediment packages representing: 1) ice deposition, 2) deep water deposition, and 3) offlap redeposition (H. Borns).

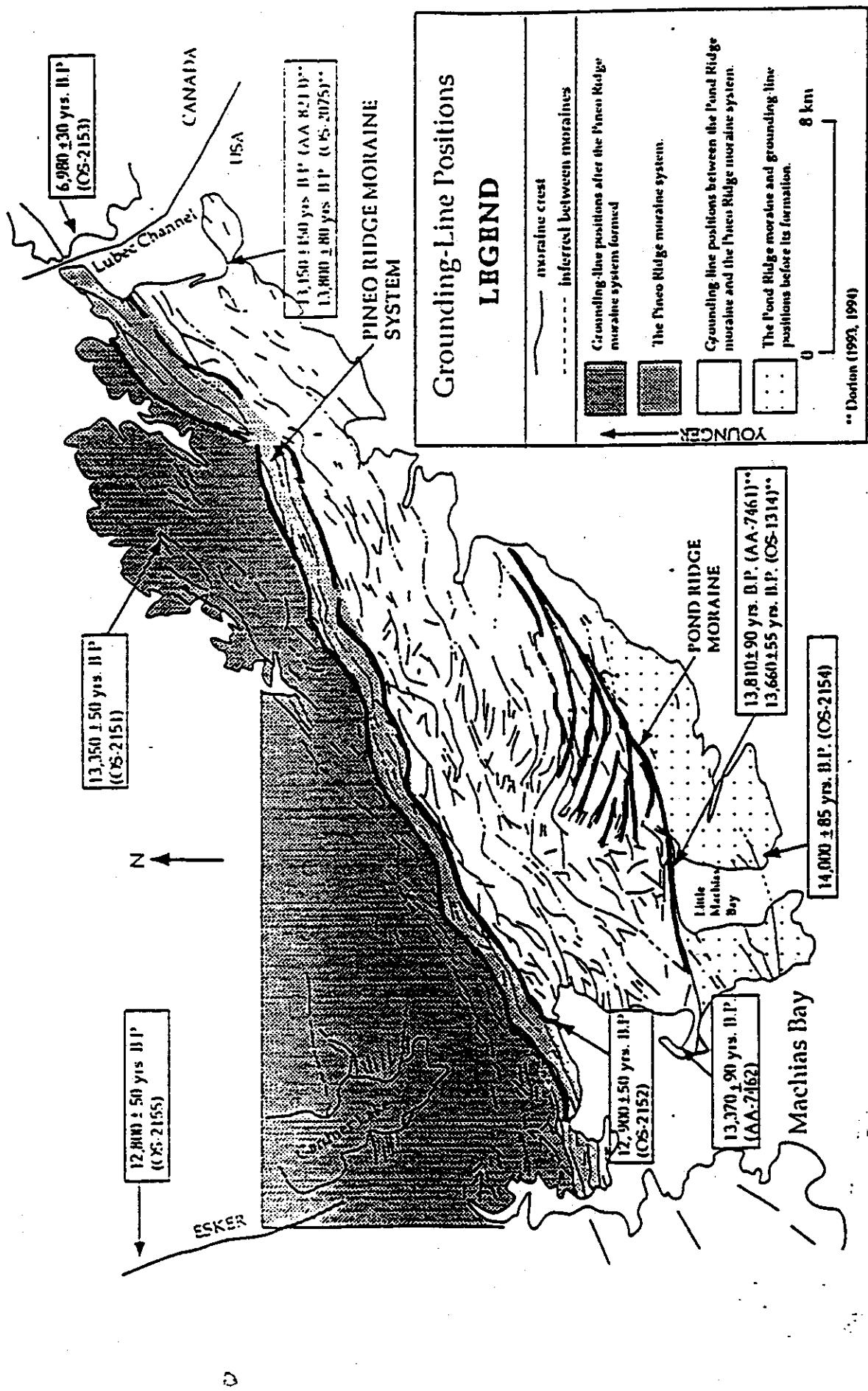


Figure 16. The details of the end moraine complex in southeastern Maine (Kaplan, 1994).

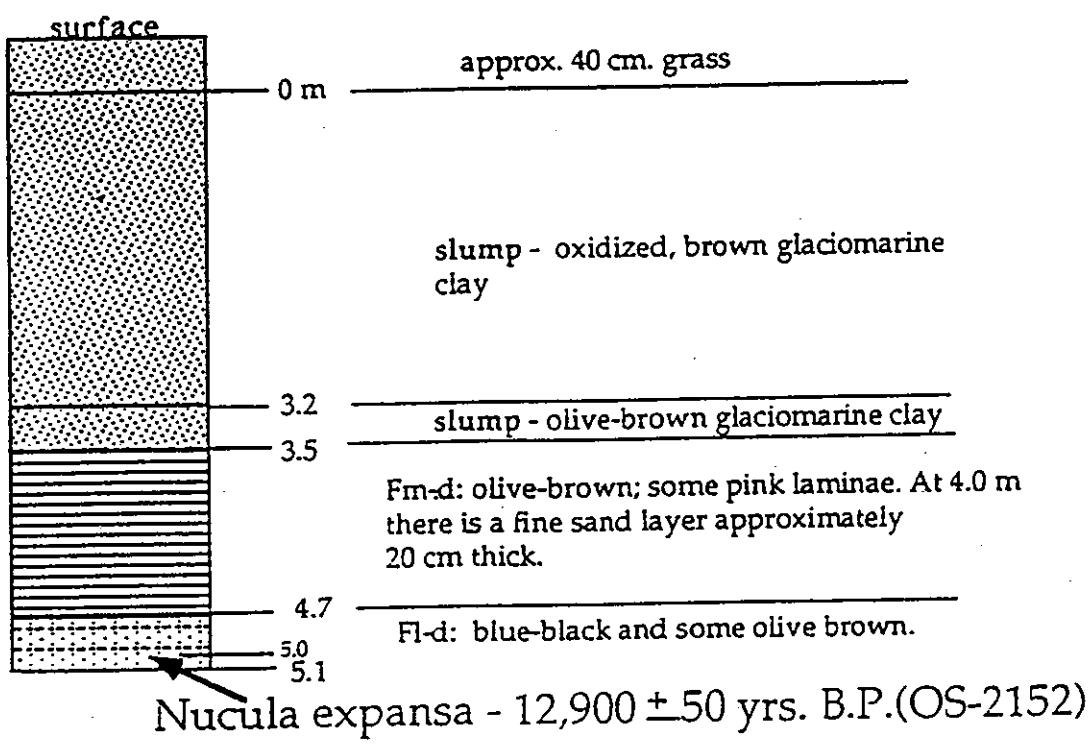
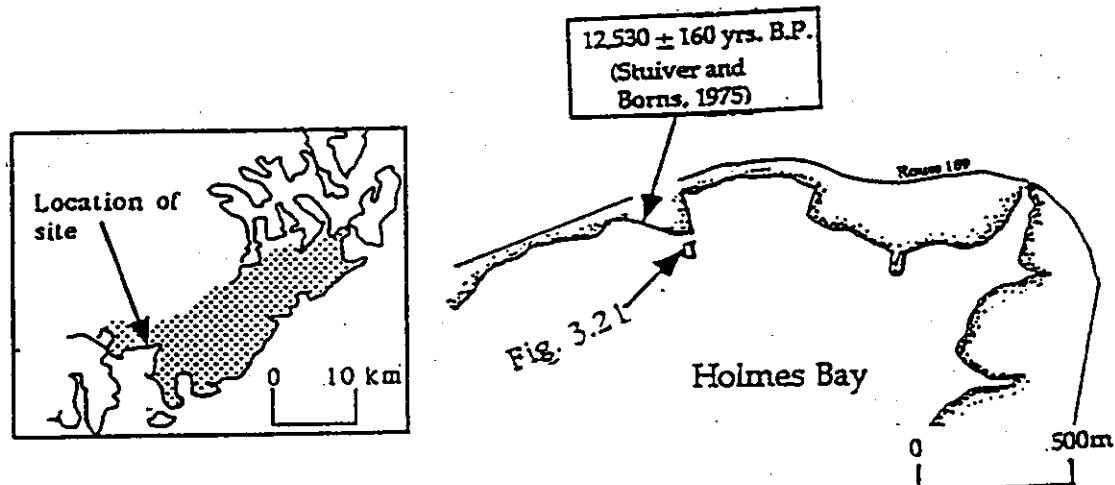


Figure 3.21. Stratigraphy at the Machias Bay Quad site (Look's Seafood Cannery).

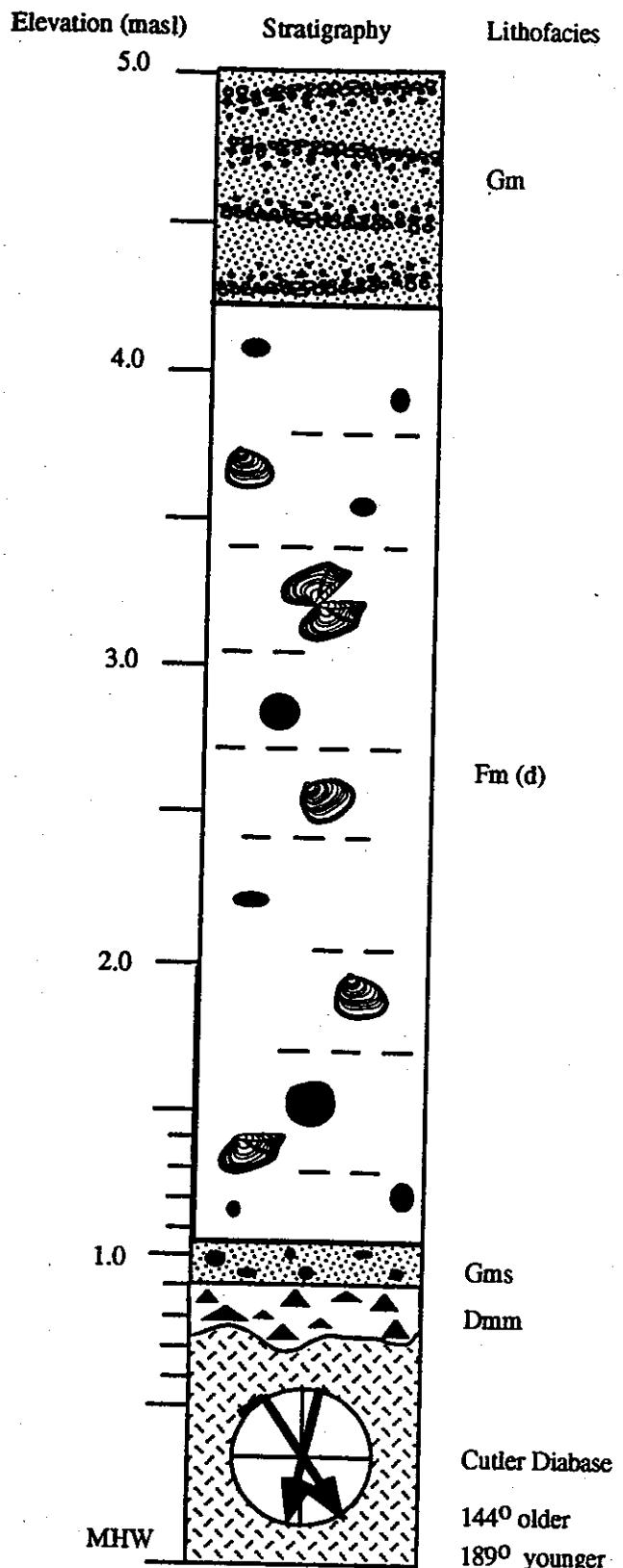


Figure 17. Turner Brook distal moraine site #1. A lodgement till with glacially shaped, faceted, and striated stones rests on multiply striated bedrock. It is unconformably overlain by gravelly sandy subaqueous outwash. The fossiliferous marine mud is massive and is truncated by crudely bedded sandy gravels representing shoreface deposits. (Dorion, in progress).

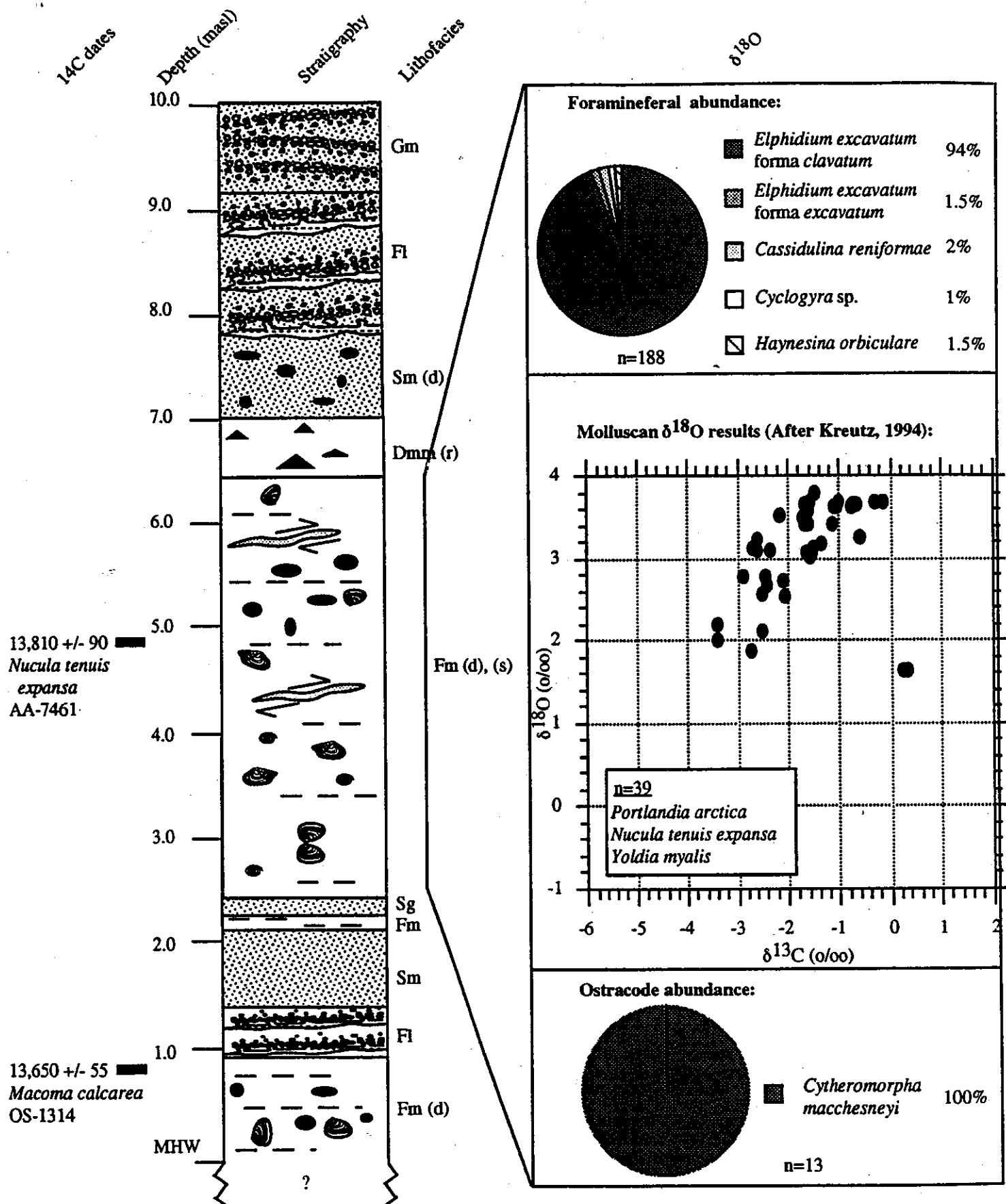


Figure 18. Turner Brook distal moraine site. The fossiliferous marine mud is interbedded with sandy outwash, sediment gravity flow deposits, and diamicton. $\delta^{18}\text{O}$ data after Kreutz (1994). (Dorion, in progress)

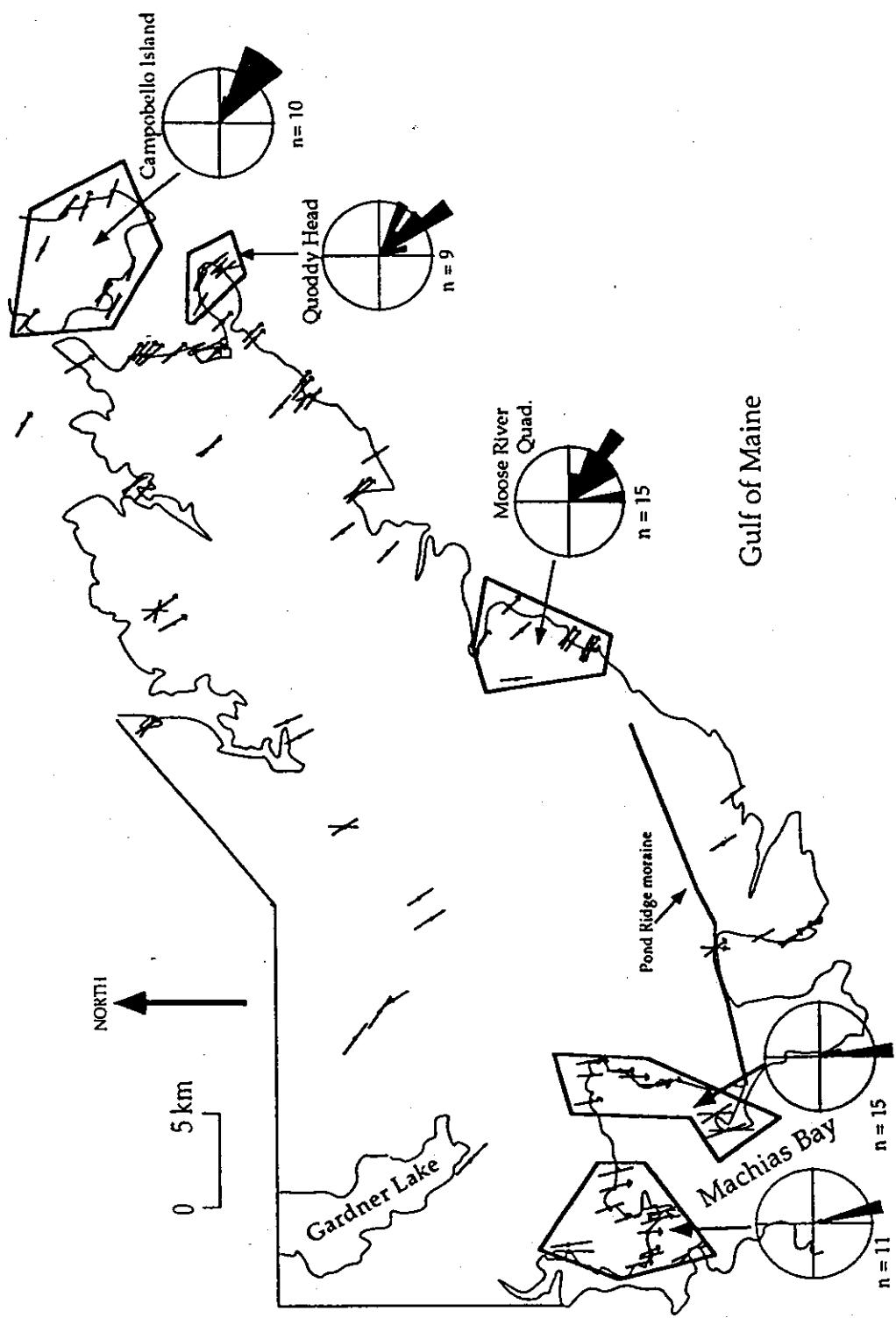


Figure 3.5. Areas where the dominant striae orientation is not consistently towards the southeast. I assume that ice-flow was always towards the Gulf of Maine.

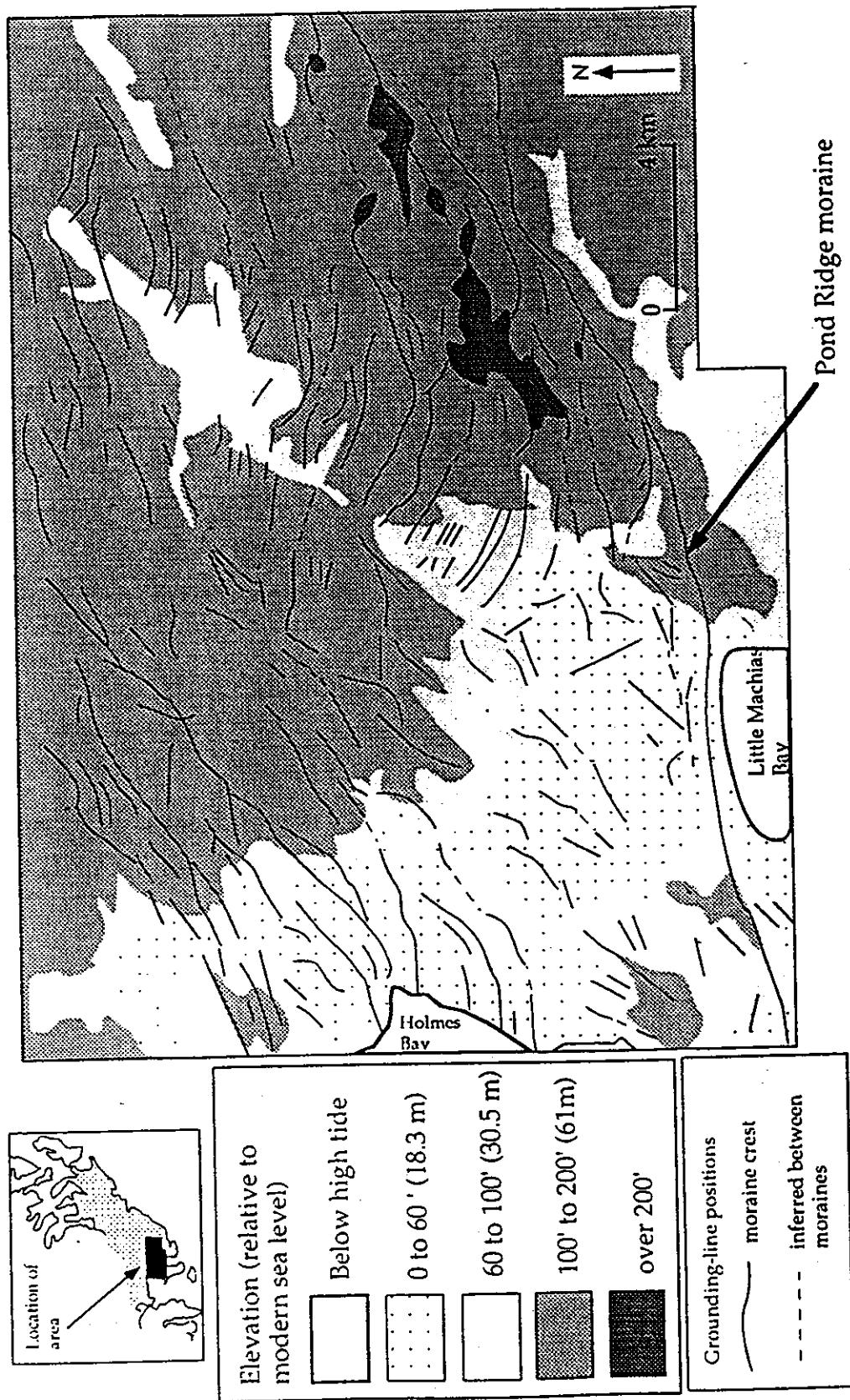


Figure 3.17. The orientation of grounding-line moraines, relative to topography.

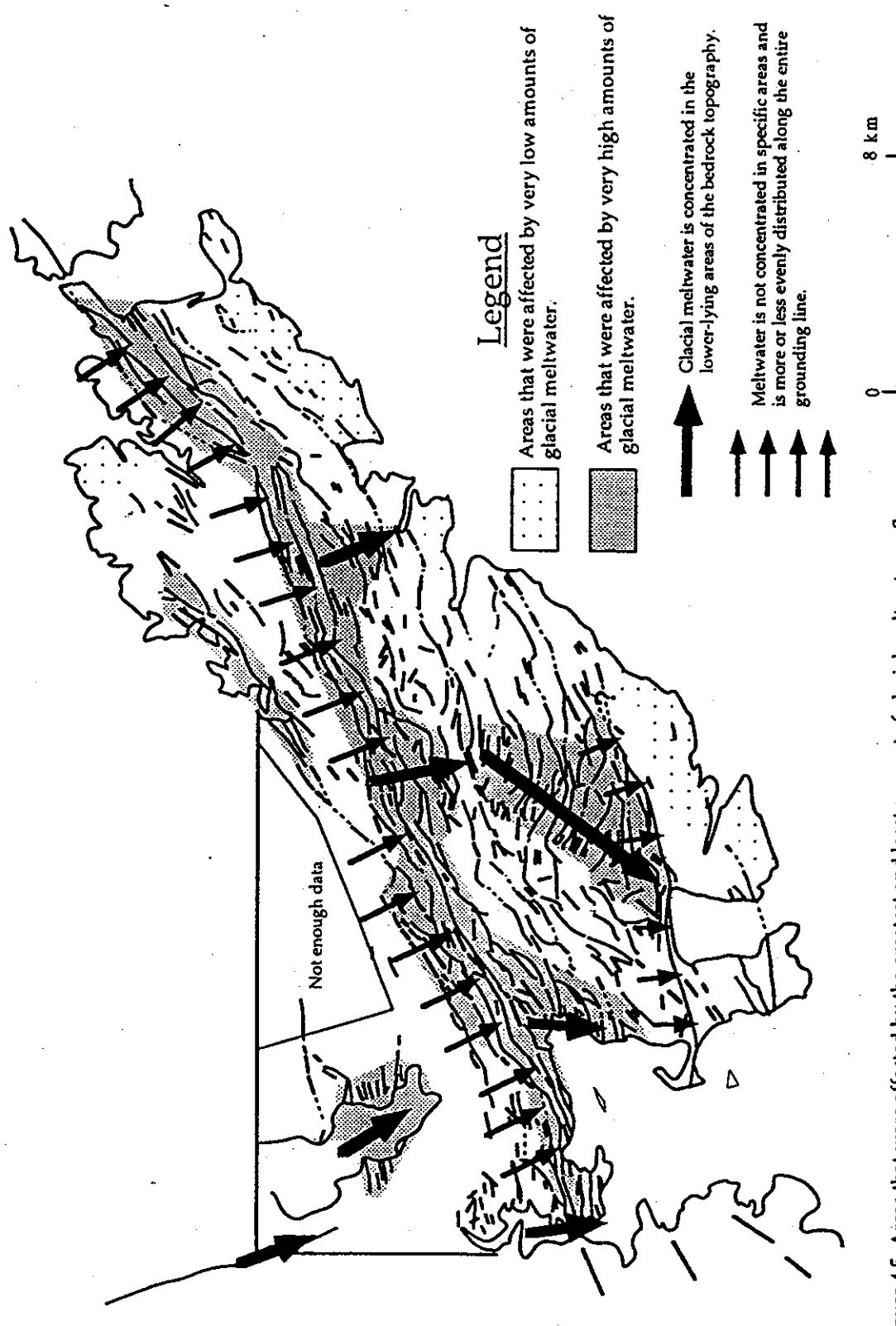


Figure 4.5. Areas that were affected by the greatest and least amount of glacial meltwater outflow.

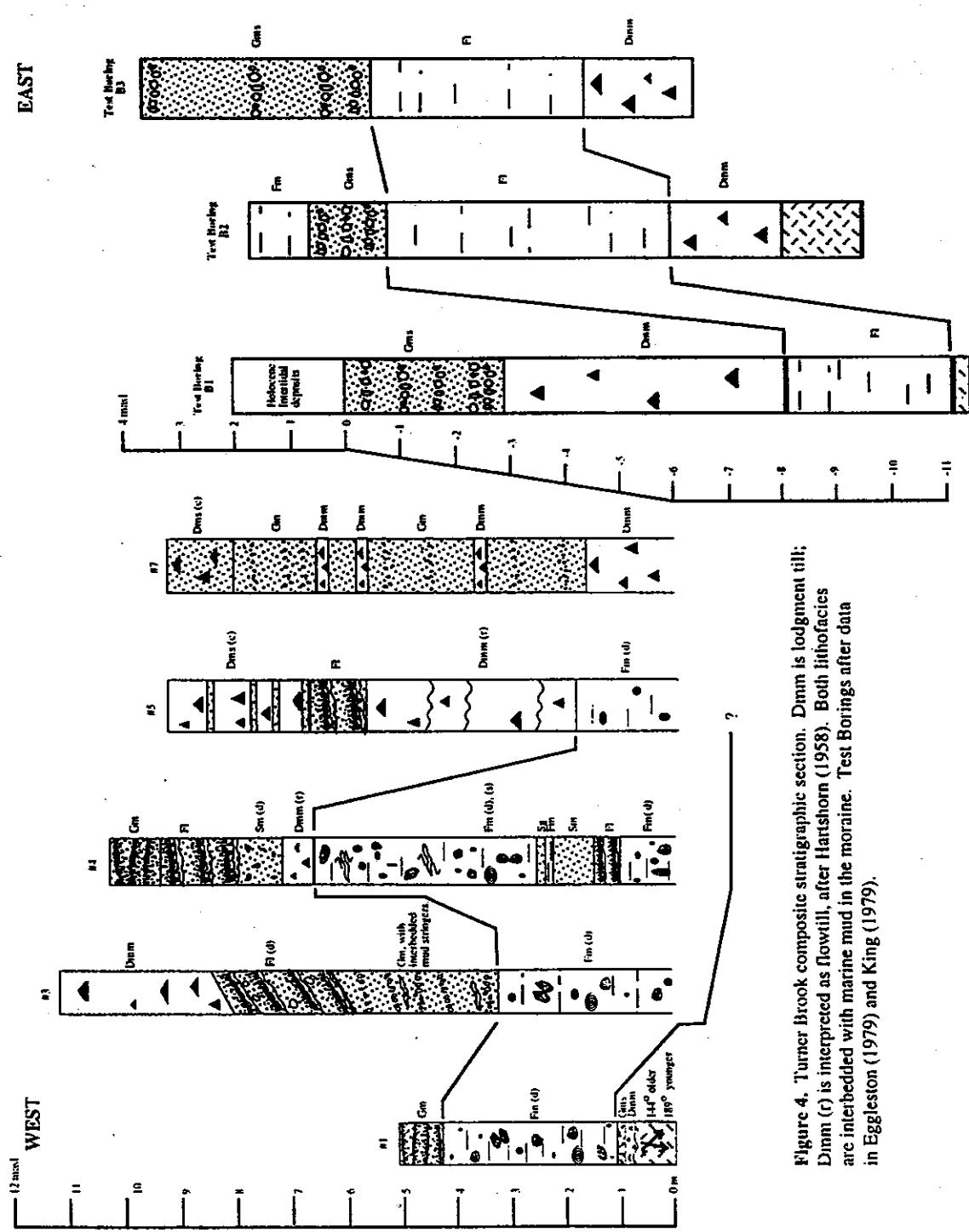


Figure 4. Turner Brook composite stratigraphic section. Dm is lodgment till; Dm (c) is interpreted as flow till, after Hartshorn (1958). Both lithofacies are interbedded with marine mud in the moraine. Test Borings after data in Eggleston (1979) and King (1979).

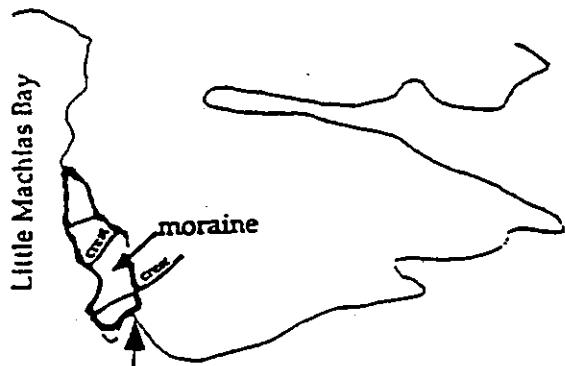


Fig. 3.18

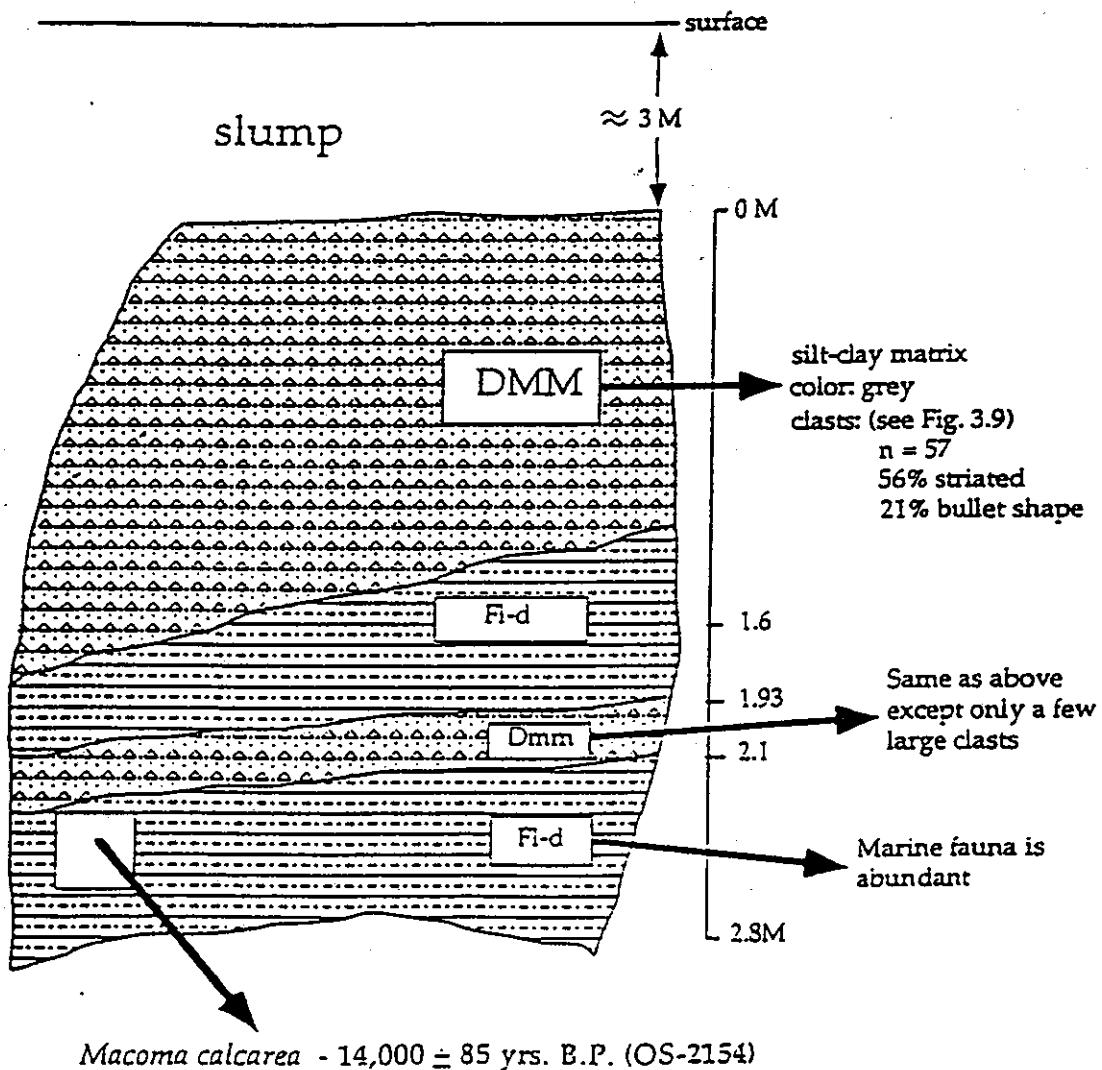


Figure 3.18. Stratigraphy at Dennison Point. The faunal analysis presented in the text is from the same stratigraphic location as the AMS date. See table 3.1 for definitions of lithofacies codes.

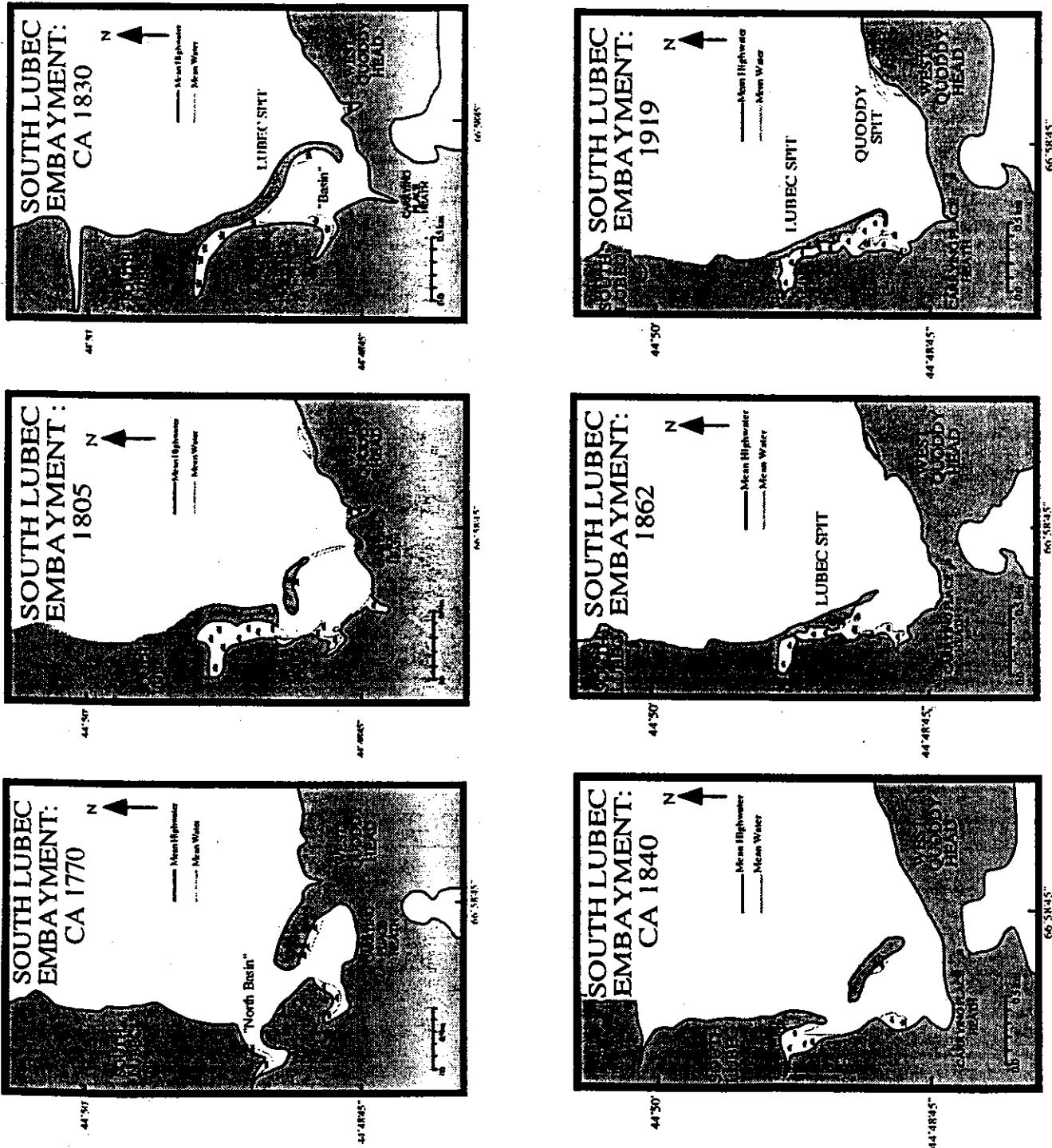


Figure 13. Holocene development of the South Lubec Embayment (J. Kelley).

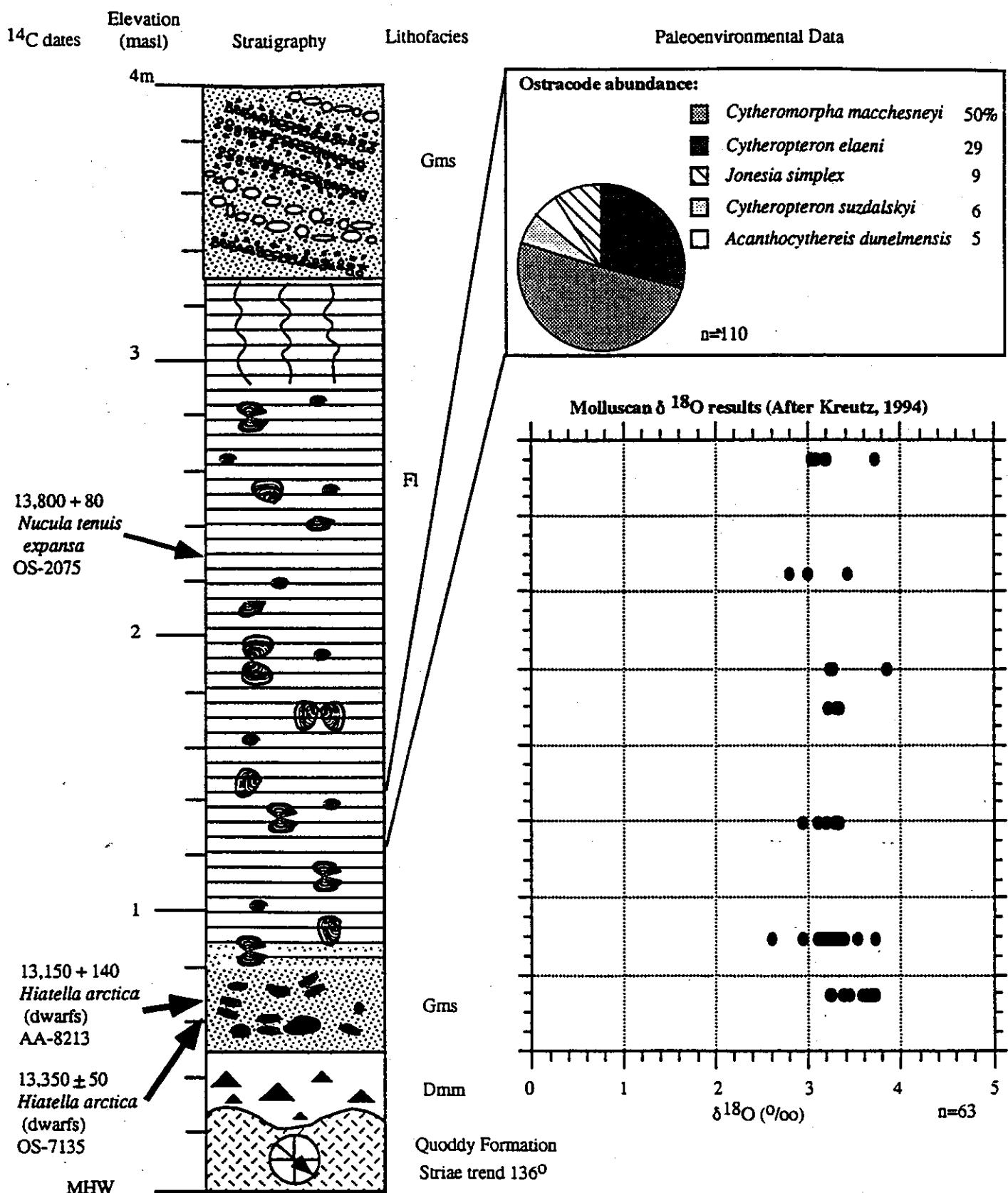


Figure 11. Carrying Place Bluffs exposure in Lubec, Maine. Striated bedrock is mantled by lodgement till. Grounding line deposits directly overlie till as a dropstone rich silty fine sand with a unique assemblage of dwarfed *Hiatella arctica* articulated molluscs. 2.5 m of laminated mud drapes the underlying units and is truncated by shoreface pebbly sands, deposited during regression of the sea. $\delta^{18}\text{O}$ analyses after Kreutz (1994).

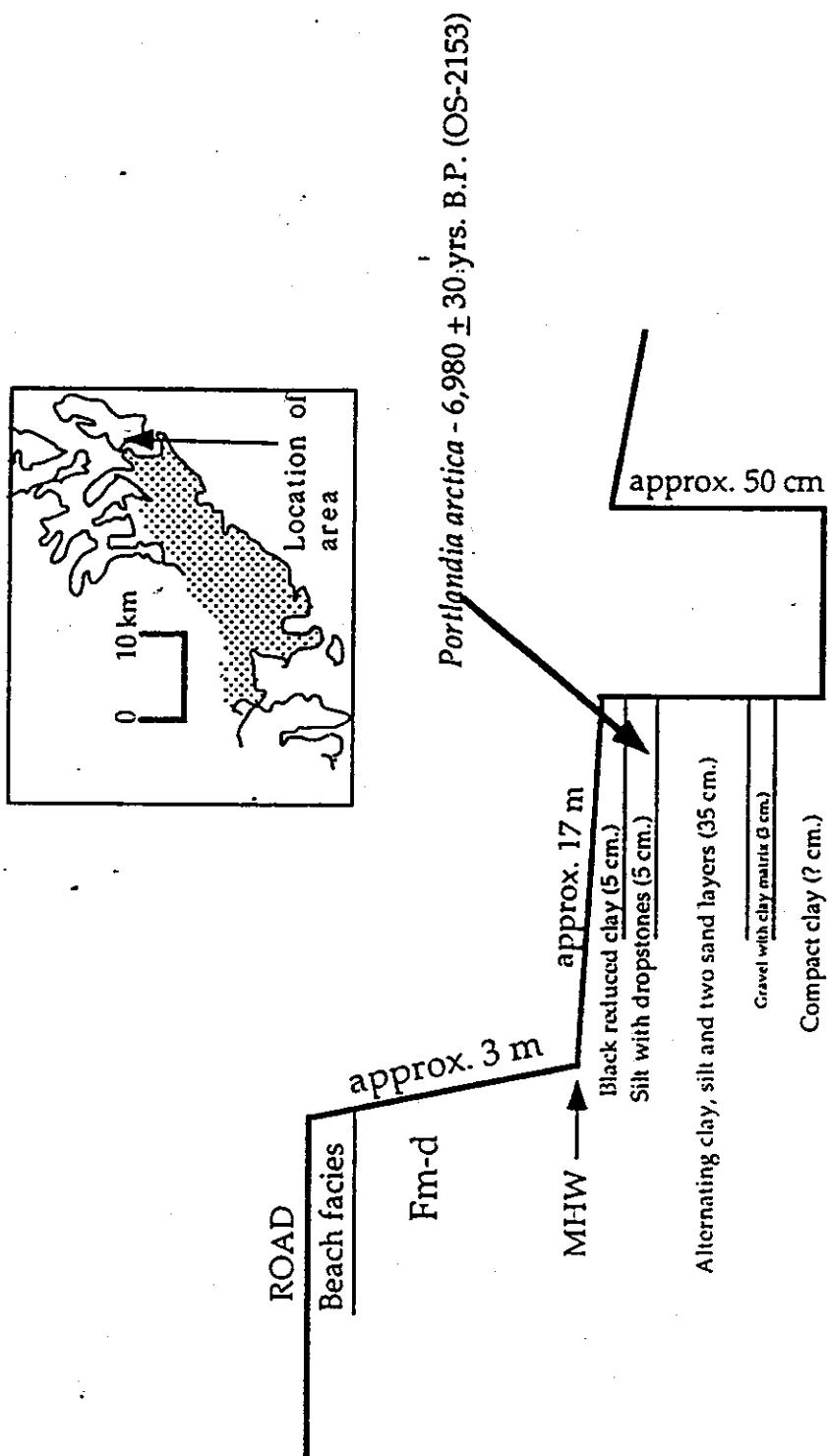


Figure 3.19. This site is on Campobello Island near Fox Farm. The stratigraphic location of the *Portlandia arctica* that was dated by the AMS method. Note the changes in scale.

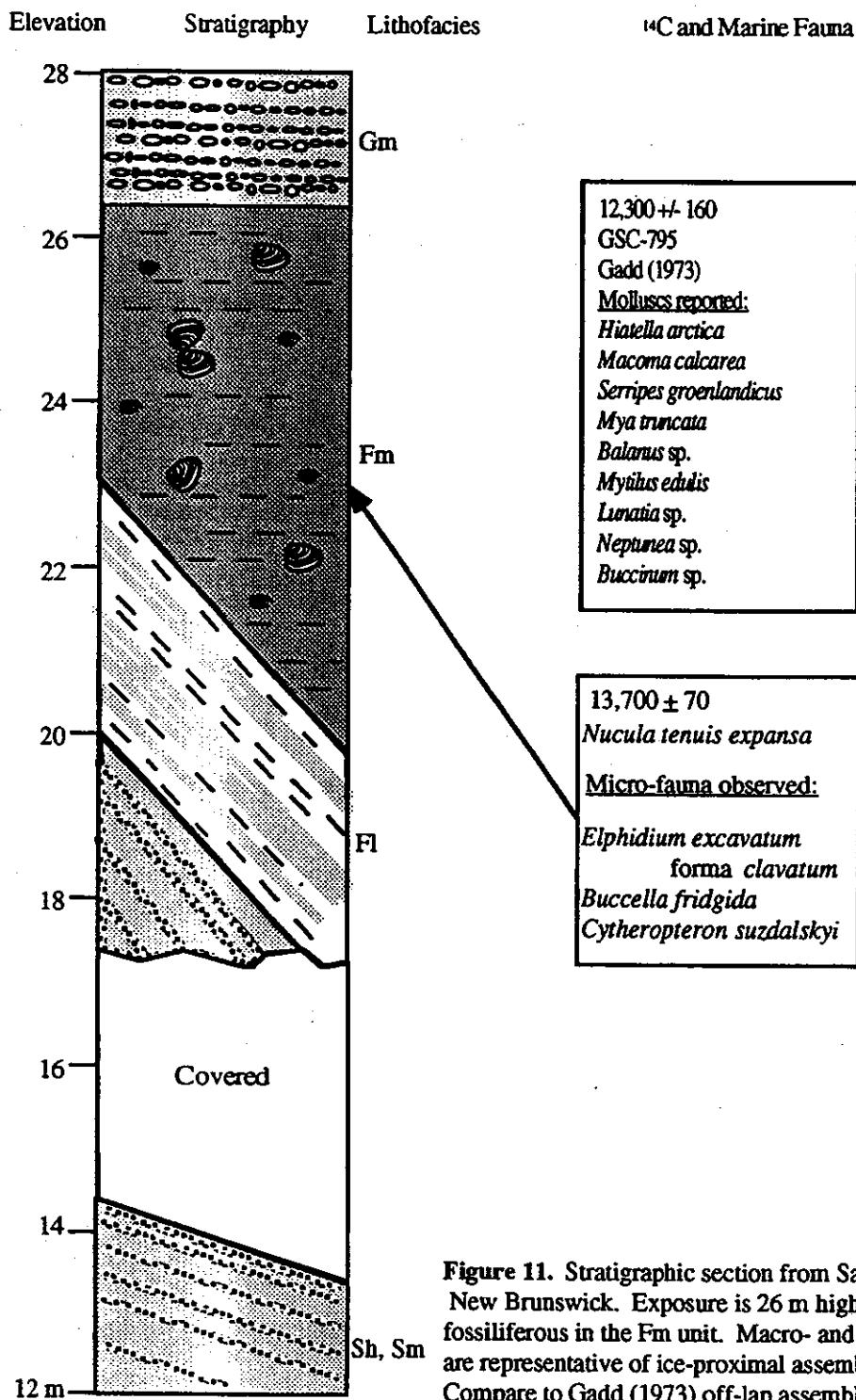


Figure 11. Stratigraphic section from Sand Point, New Brunswick. Exposure is 26 m high and is fossiliferous in the Fm unit. Macro- and micro-fauna are representative of ice-proximal assemblages. Compare to Gadd (1973) off-lap assemblage.

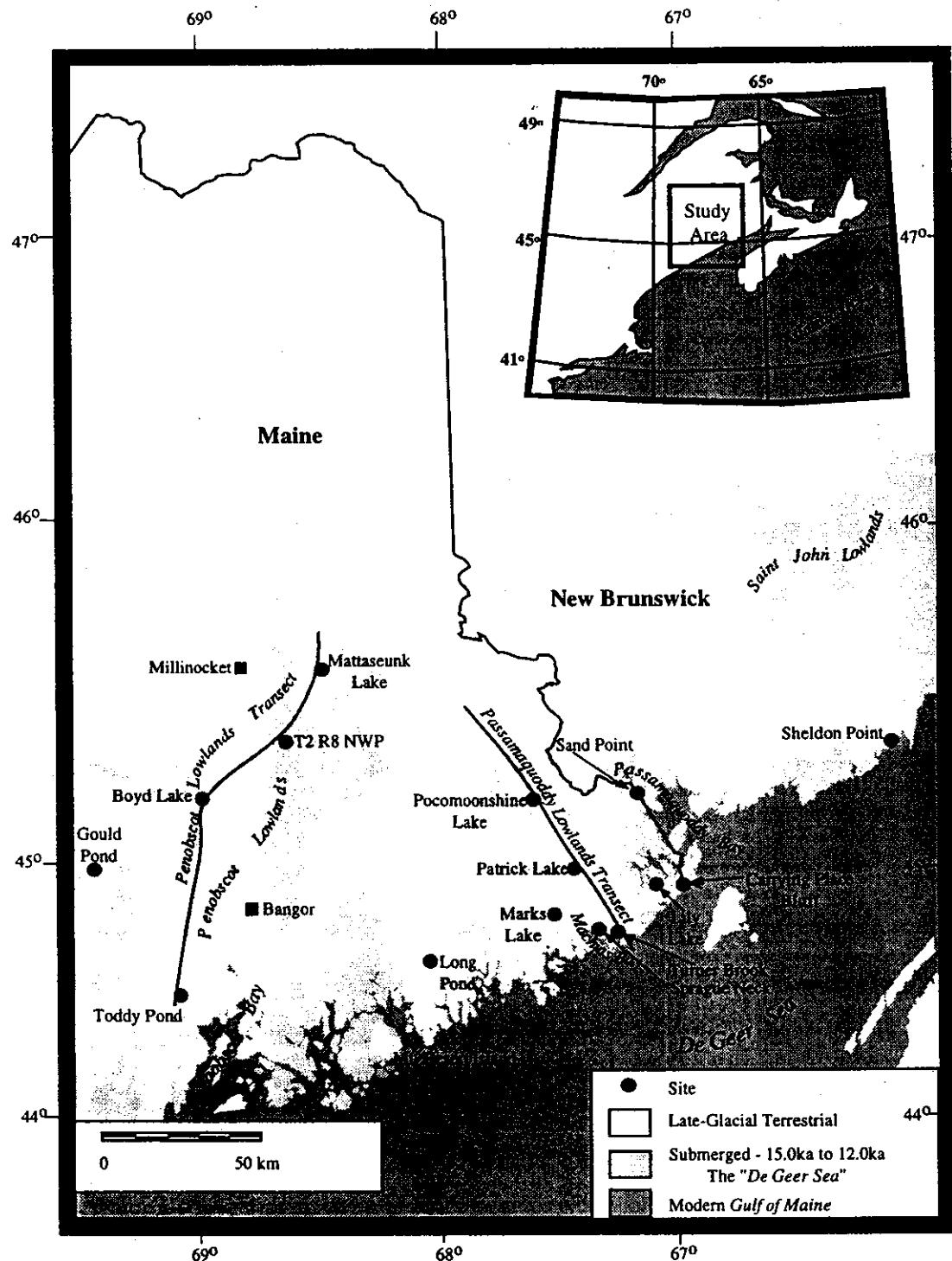
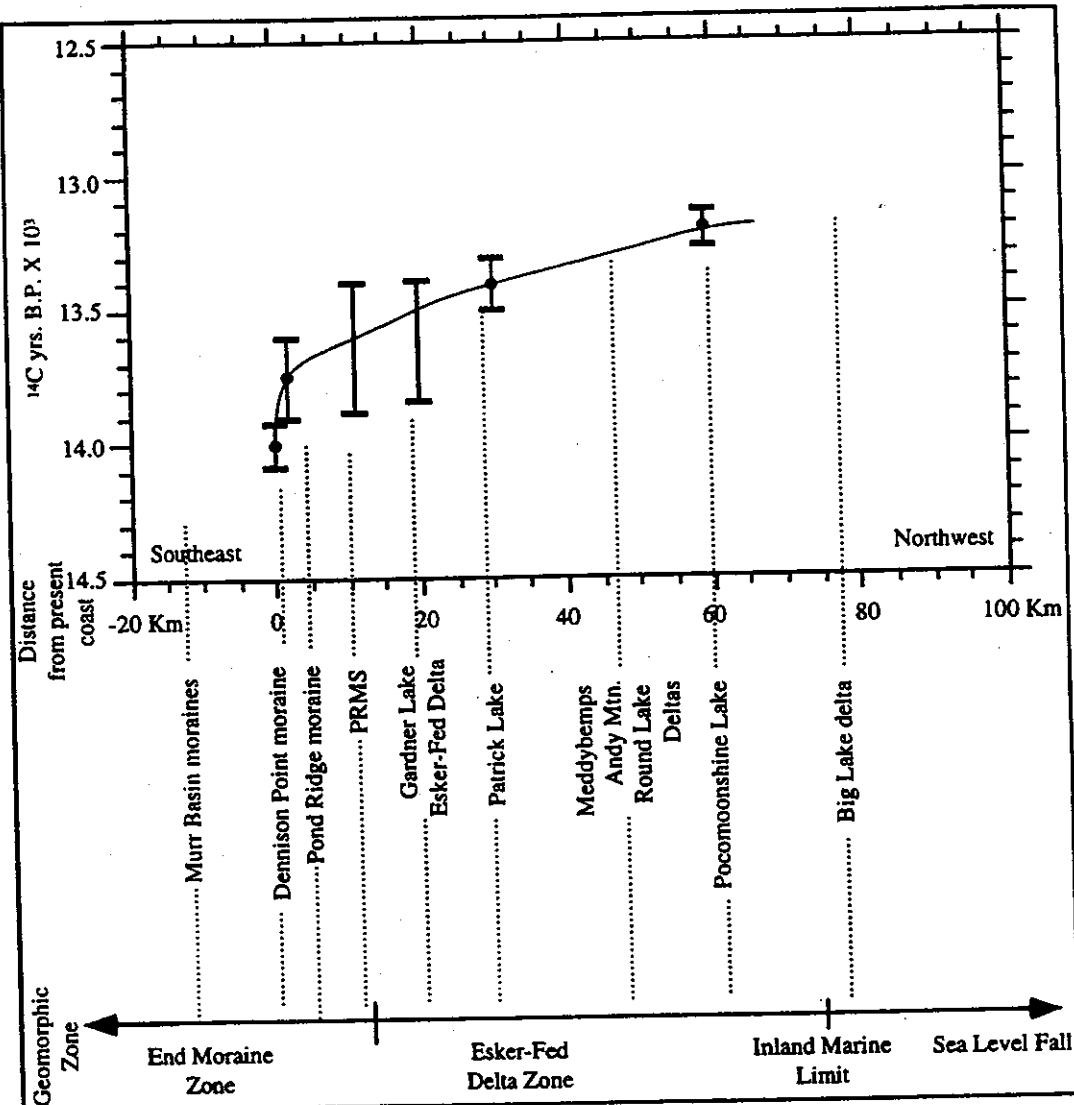
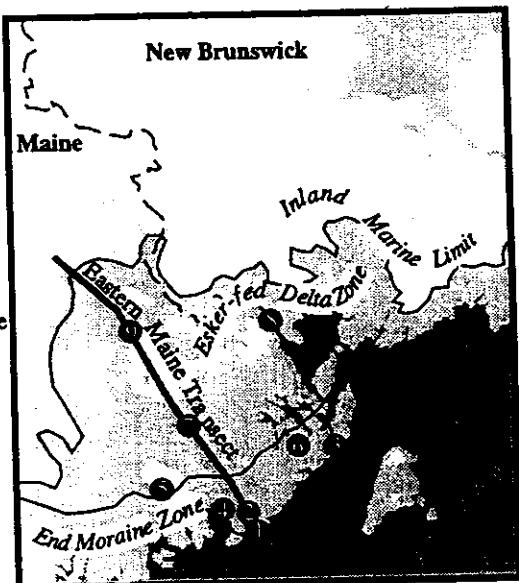


Figure 1. Location map of field sites and transects. The De Geer Sea is shown at its hypothesized maximum extent approximately 13,100 ^{14}C yrs. B.P. by which time the ice sheet margin terminated entirely terrestrially and above the marine limit. ^{14}C ages from each site are compiled in Table 1.



- Dennison Point
- Turner Brook
- Carrying Place Bluff
- Sprague Neck
- Marks Lake
- Lily Lake
- Patrick Lake
- Sand Point, N.B.
- Pocomoonshine Lake

Figure 34. Graph of time versus distance from eastern Maine for the southeast margin of the LIS. Ages of significant geomorphic features are plotted beneath their distance from the coast. Geomorphic zones based on Thompson and Burns (1985). Offshore moraine data from Shipp (1989) and Dennison Point data from Kaplan (1994).



Lily Lake Isotope Data

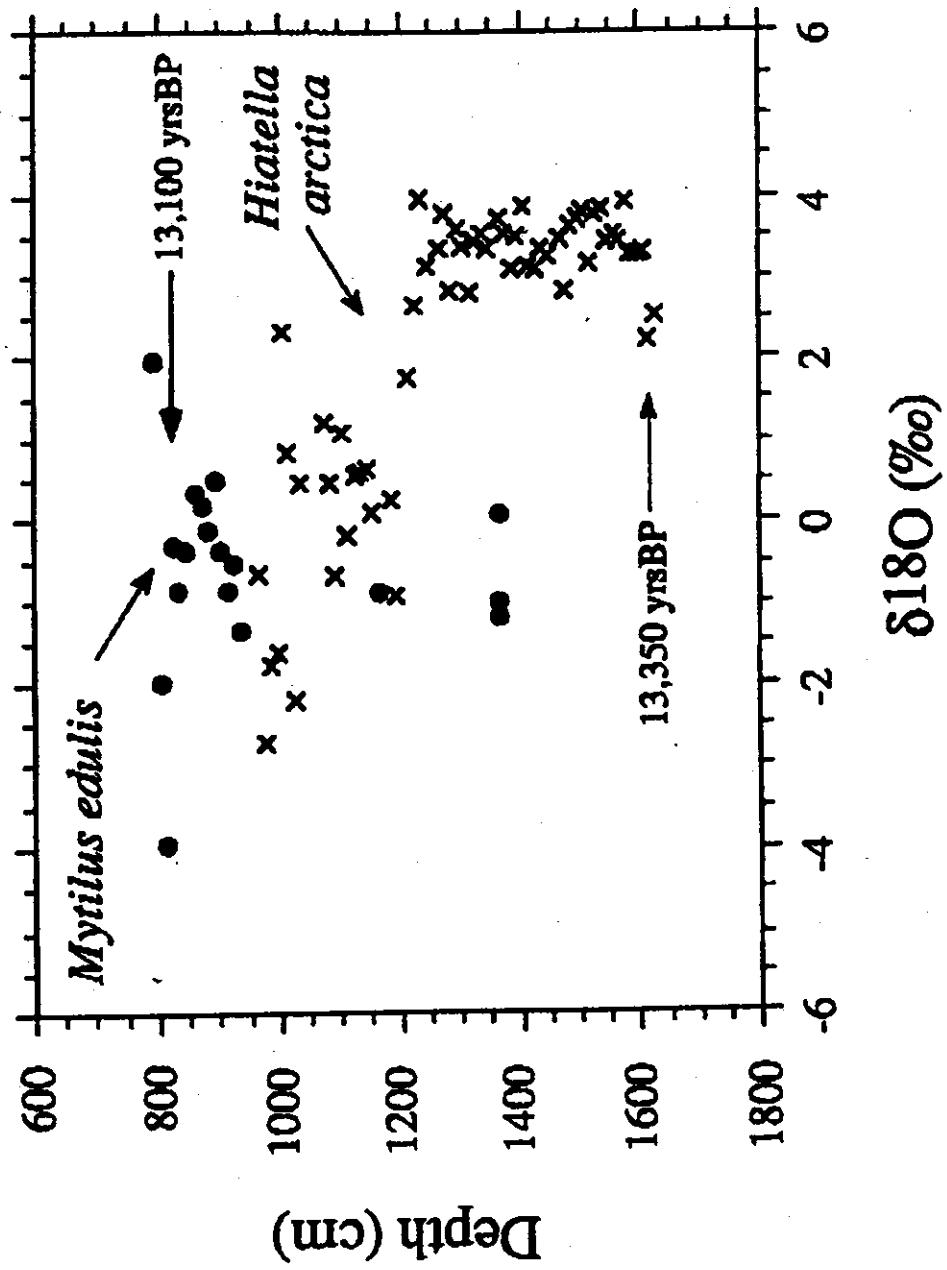


Figure 12. Isotope data on marine fossils, Lily Lake, Maine (Kreutz, 1994).

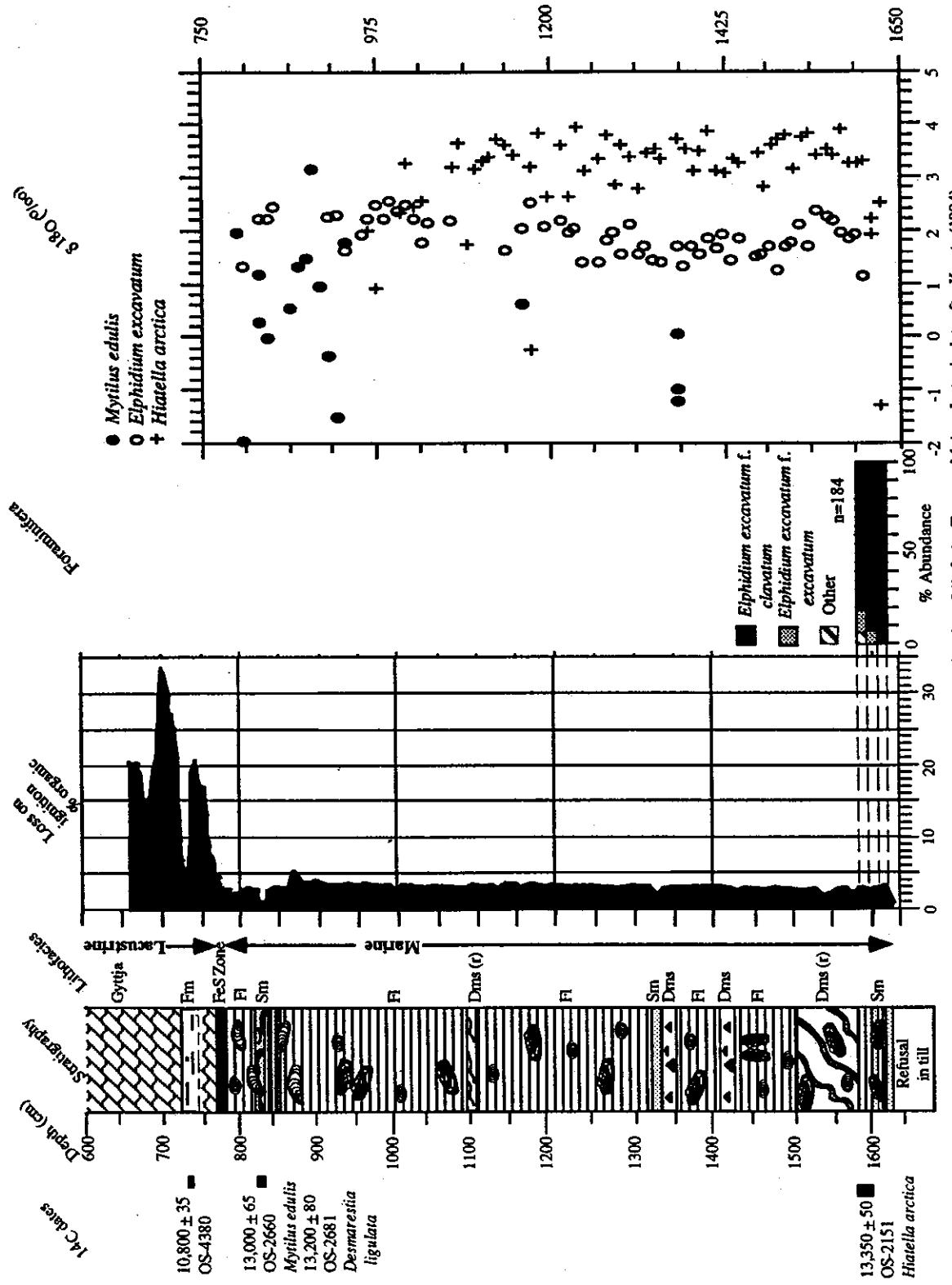


Figure 13. Lily Lake core log, loss on ignition, and $\delta^{18}\text{O}$ analyses of molluscs and foraminifera from Lily Lake, Trescott, Maine. Isotopic data after Kreutz (1994) and Wright (unpublished data).

Location	Age (NOSAMS Accession #)	Species	$\delta^{13}\text{C}$	Significance
Lily Lake core (1602 cm - 1582 cm) 44°49' 45" N, 67° 6' 15" W	13, 350 \pm 50 (OS-2151)	<i>Hiatella arctica</i>	0.41	Specimen lived at or near the grounding line.
Deminson Point 44°38' 30" N, 67° 14' 30"	14, 000 \pm 85 (OS-2154)	<i>Maconia calcarea</i>	-2.03	Specimen lived at or near the grounding line
Campobello Island 44°51' 15" N, 66° 58' 8"	6, 980 \pm 30 (OS-2153)	<i>Portlandia arctica</i>	-8.21	erroneous
Hadley Lake Quad esker pit 44°45' N., 67° 25' 13" W.	12, 800 \pm 50 (OS-2155)	<i>Hiatella arctica</i>	0.56	Stratigraphic position is unclear. This date is a minimum age for deglaciation of the study area.
Machias Bay Quad Look's seafood cannery 44°43' 13" N, 67° 18' 36" W.	12, 900 \pm 50 (OS-2152)	<i>Nucula expansa</i>	-7.66	Specimen lived after the ice-margin retreated from this location.

Table 3.2. AMS ^{14}C dates on mollusc shells collected by the author.

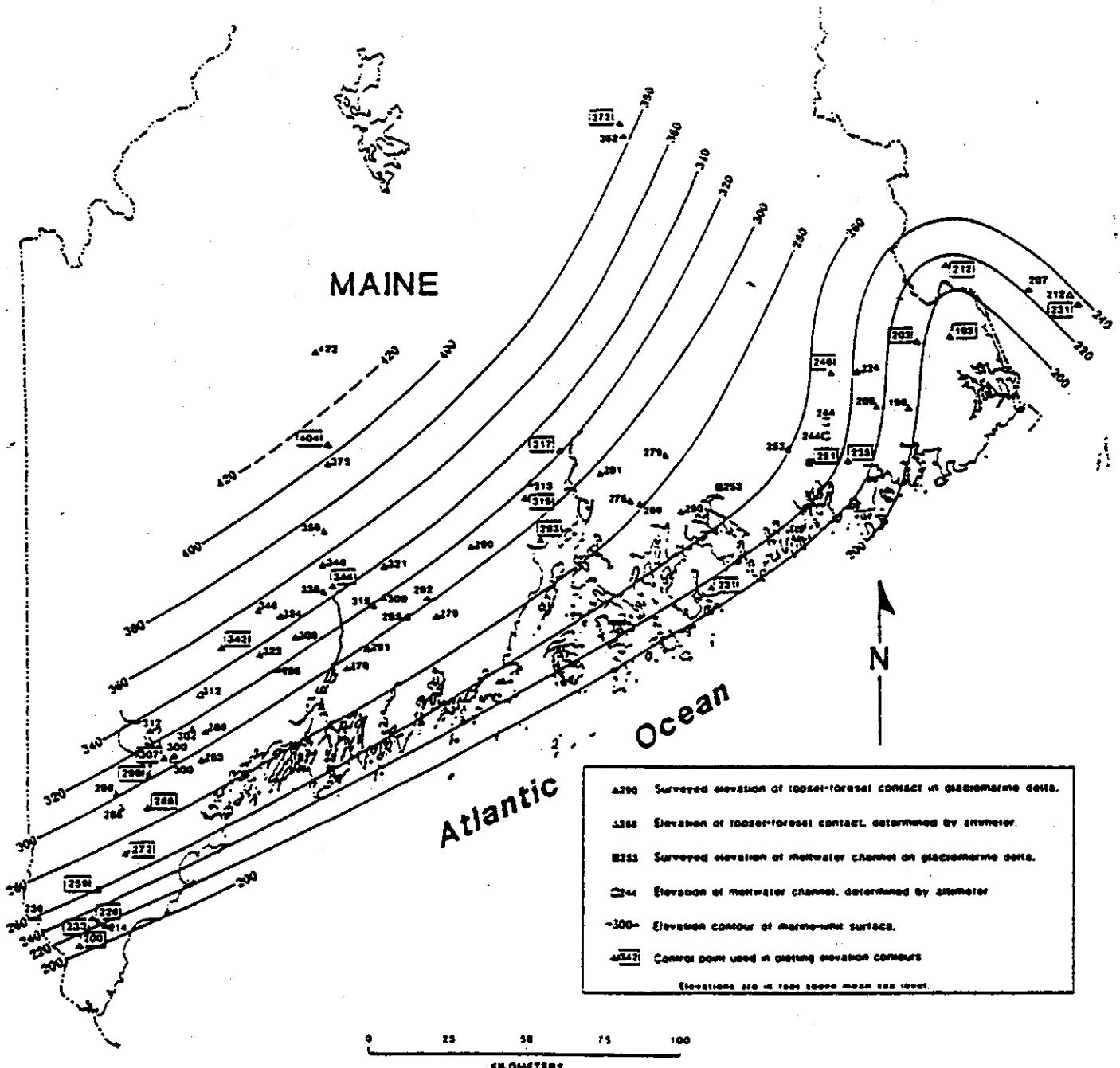


Figure 5. Map showing elevations of surveyed glaciomarine deltas in Maine and New Brunswick (Thompson et al., 1989).

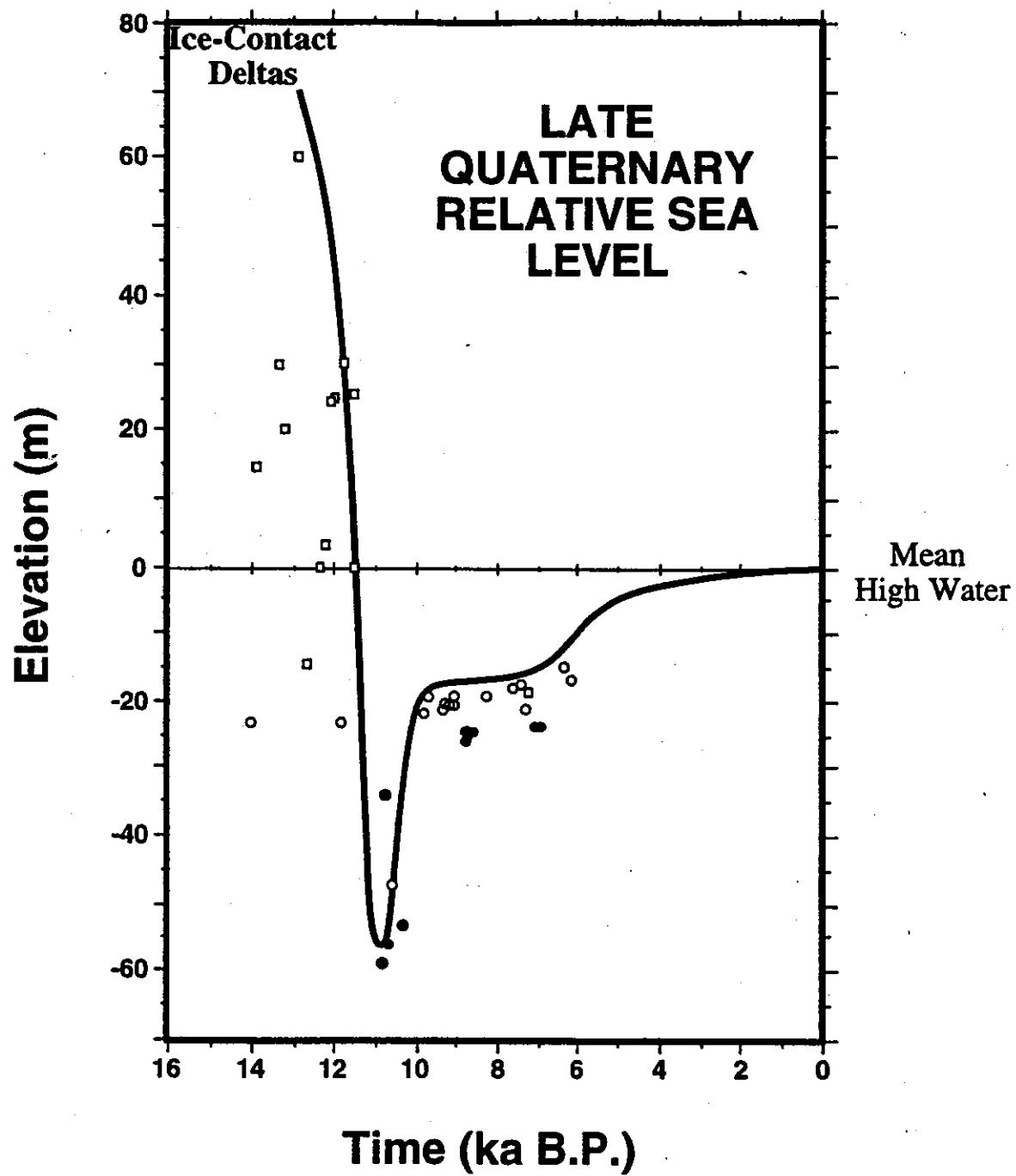
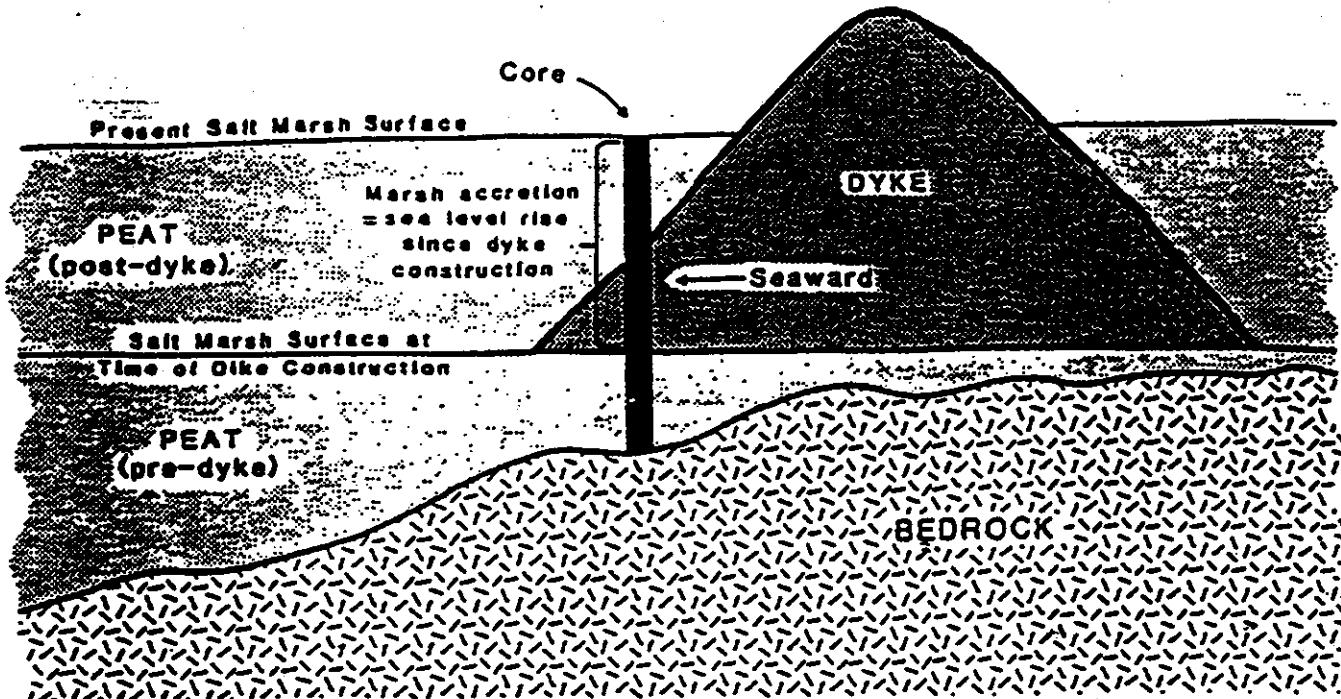
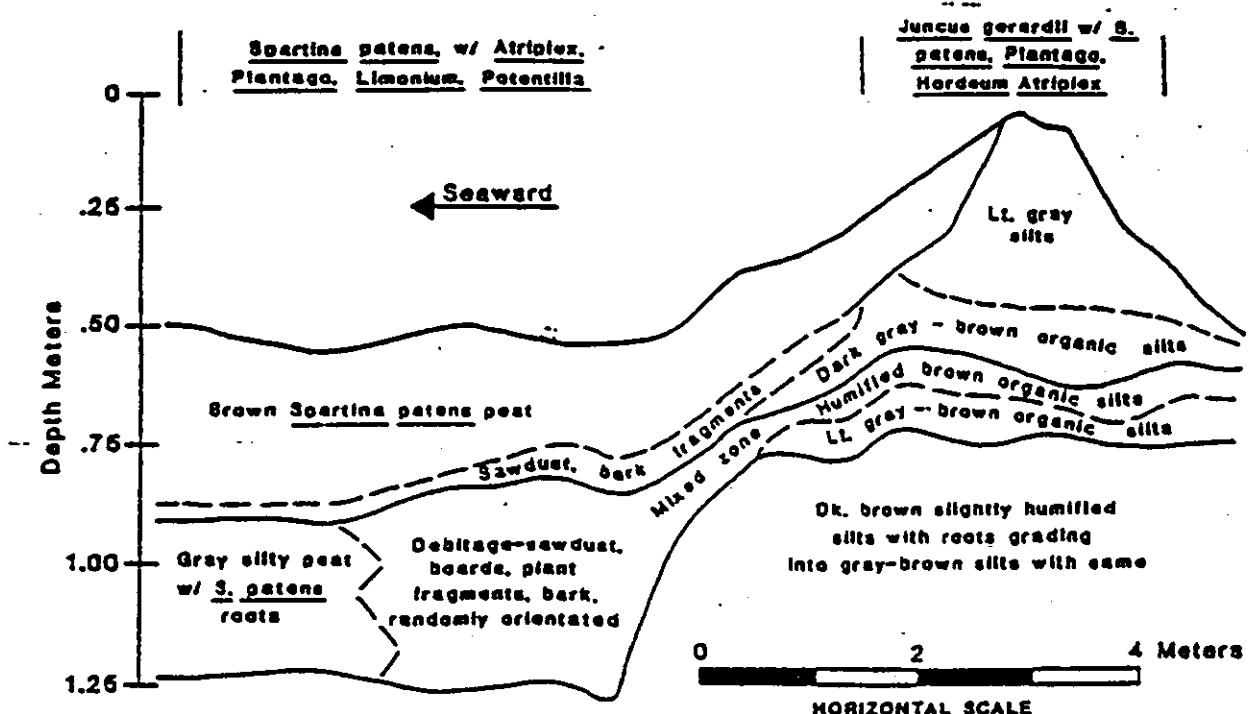


Figure 14. Generalized post glacial sea level change curve for the Maine coast (Barnhardt et al., 1995).



Schematic cross section showing how the amount and rate of sea-level rise can be determined from the accretion of salt marsh on a dyke of known age.



CROCKER POINT DYKE
MACHIASPORT, MAINE

Figure 7. Excavation showing cross-section of the salt marsh dyke (1823) at Crocker Point, Machiasport.

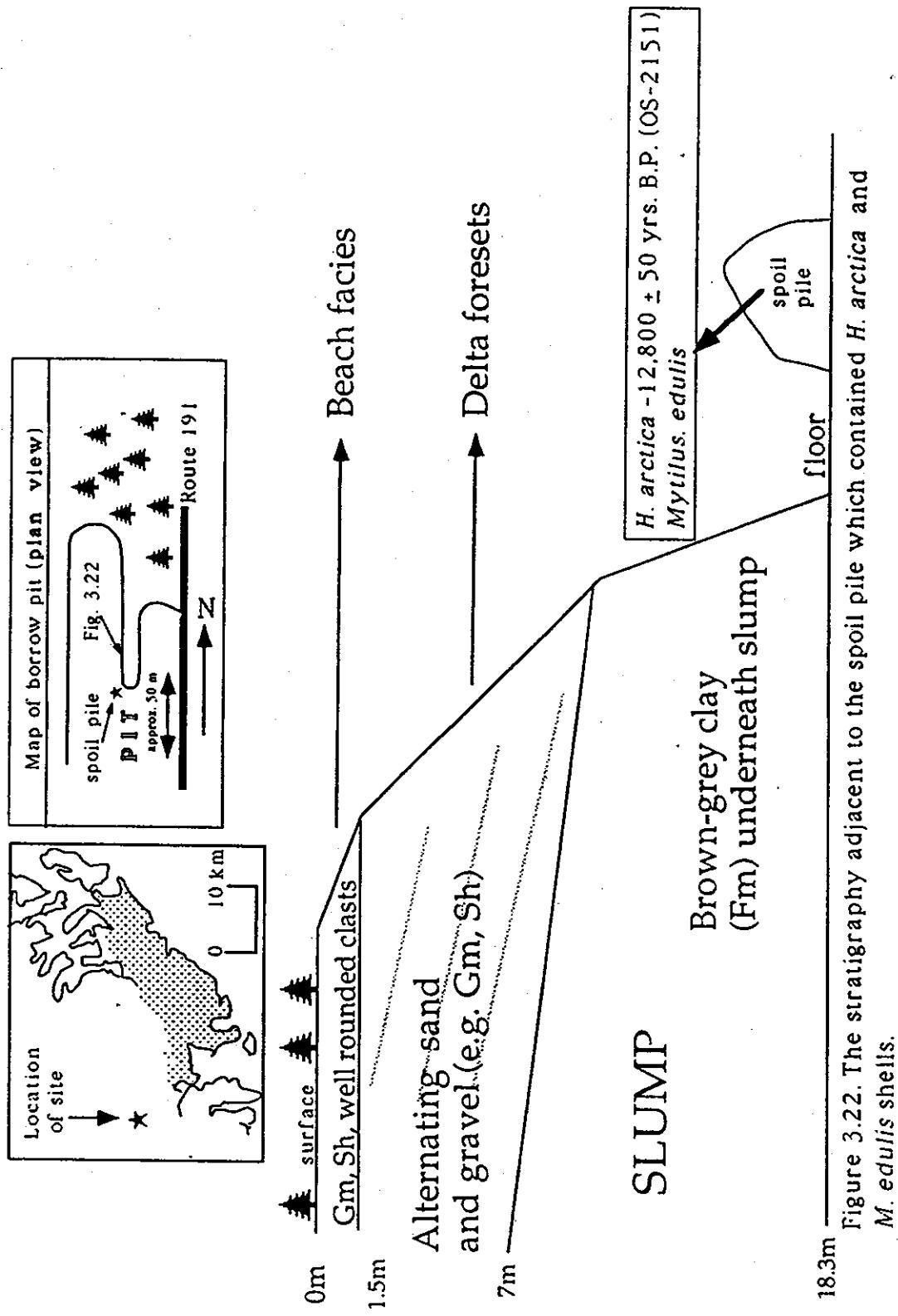


Figure 3.22. The stratigraphy adjacent to the spoil pile which contained *H. arctica* and *M. edulis* shells.