1986

# Late Quaternary stratigraphy of the lower Androscoggin Valley, southern Maine

Michael Retelle
*Bates College*, mretelle@bates.edu

K. Bither



Recommended Citation
Retelle, M.J., and Bither, K. (1986) Late Quaternary stratigraphy of the lower Androscoggin Valley, southern Maine, in Guidebook to Field trips in Southwestern Maine, New England Intercollegiate Geological Conference 78th Annual Meeting, Lewiston, Maine. p. 20-36.

# LATE QUATERNARY STRATIGRAPHY OF THE LOWER ANDROSCOGGIN VALLEY, SOUTHERN MAINE

Michael J. Retelle
Department of Geology and Geography
University of Massachusetts
Amherst, Massachusetts 01003

Katherine B. Konecki *
Geology Department
Bates College
Lewiston, Maine 04240

## INTRODUCTION

The late Quaternary history of the lower Androscoggin River valley is documented by complex stratigraphic relations between sediments of glacial, glaciofluvial, and glaciomarine origin. The entire coastal zone of southern Maine and nearby New Hampshire illustrates an environment that is unique to the New England region in terms of its Pleistocene stratigraphy and style of deglaciation.

The removal of the last, or late Wisconsinan, ice sheet from the coastal zone was accomplished by progressive marginal retreat of an active marine-based ice sheet. This is in contrast to other areas of New England where the retreating ice sheet was grounded on land and retreated by the progressive withdrawal of a stagnant ice margin (Koteff and Pessl, 1981). The active ice, retreating in contact with a shallow inland sea, deposited DeGeer, washboard, and stratified end moraines containing various diamicton facies and stratified drift below the limit of marine submergence (Bingham, 1981; Lepage, 1982; Smith, 1982, 1985; Thompson, 1982; Borns, 1986; Retelle and Konecki, 1986). Abundant outwash sediments were deposited in eskers, glaciomarine deltas, and submarine outwash fans beneath, and in front of the warm-based ice sheet. The coarse outwash facies grades distally (and vertically in cross-section) to fine-grained silty clay of the Presumpscot Formation (Bloom, 1960) that was deposited in the isostatically depressed foreland in front of the ice sheet. The fine-grained fossiliferous sediment blankets much of the surface of the coastal zone.

The purpose of this field trip is to examine stratigraphic evidence from a wide spectrum of glacial, glaciofluvial and glaciomarine environments on a transect from the coast, near Brunswick, to the inland extent of marine submergence near Poland Springs. We hope to visit exposures and sections that exhibit relations between various sedimentary facies and also point out some detailed information that we have obtained on the sedimentology and

* Presently at:
Department of Earth Sciences
University of New Hampshire
Durham, New Hampshire 03824

stratigraphy of these deposits. Discussion in the field will hopefully center on some of the factors such as water depth and subglacial topography (cf. Smith, 1984; Meier, 1985) that control the style and rate of ice retreat and the development of the stratigraphic sequence.

For a more comprehensive understanding of the glacial and glaciomarine stratigraphy of the region, the reader is referred to publications by Bloom (1960, 1963), Stuiver and Borns (1975), Smith (1982, 1984, 1985) and Thompson (1978, 1982). Maps of the surficial geology of the region have been completed at a reconnaissance level on scales of 1:24,000 and 1:62,500 Thompson and Borns (1985) have recently compiled the surficial geologic map of the state. More topic related research on endmoraine geomorphology and stratigraphy has been completed by students at the University of Maine at Orono (e.g. Bingham, 1981; Lepage, 1982; Attig, 1975) and Ohio University (Jong, 1980).

## ACKNOWLEDGEMENTS

The authors express their sincere gratitude to the many people who have contributed to the production of the field trip. First, we would like to thank the gravel pit owners and operators, especially Mr. John Bisson and Mr. Ron Webber for allowing us to visit and study the geology of their property. Professors John Creasy, Roy Farnsworth and Donald Newberg from Bates College pointed out most of the stops we will visit on the trip and lent critical information and assistance throughout the study. Professor Joseph Hartshorn of the University of Massachusetts and Tom Weddle of the Maine Geological Survey visited the field sites and gave valuable critical assistance. Julie Retelle assisted in preparation of the field trip guide. Dr. Robert Stuckenrath of the Smithsonian institute kindly provided for a radiocarbon date for the Topsham site.

## REFERENCES

Bingham, M.P., 1981, The structure ang origin of washboard moraines and related glacial marine sediment in southeastern coastal Maine: unpub. M.S. thesis University of Maine, Orono.

Bloom, Arthur L., 1960, Late Pleistocene changes of sea level in southwestern Maine: Maine Geological Survey, Augusta, Maine.

_____, 1963, Late Pleistocene fluctuations of sea level and postglacial rebound in coastal Maine: Americal Journal of Science, v. 261, p. 862-879.

Borns, H.W. Jr., 1986, Diamicton facies within glaciomarine end moraines, eastern coastal Maine, Abstracts with Programs, Northeast Section, The Geological Society of America.

Chick, Susan A., 1986, The Carrier Gravel Pit in South Durham, Maine, as an example of deglaciation in Coastal Maine, unpubl. B.Sc. thesis, Bates College.

Domack, Eugene W., 1983, Facies of late Pleistocene glacial-marine sediment lithofacies on Whidbey Island, Washington: An isostatic glacial-marine sequence, in Molnia, Bruce F., ed., Glacial-marine Sedimentation: New York, Plenum Press, p. 535-570.

_____, 1984, Rhythmically bedded glaciomarine sediments on Whidbey Island, Washington, Journal of Sedimentary Petrology, vol. 54, no. 2, p. 589-602.

Eyles, Nicholas, Eyles, Carolyn H. and Miall, Andrew D., 1983, Lithofacies types and vertical profile models; an alternative approach to the description and environmental interpretation of glacial diamict and diamictite sequences, Sedimentology, v. 30, p. 393-410.

Jong, Ron S., 1980, Small push moraines in central coastal Maine, unpubl. M.S. thesis, Ohio University, 75 p.

Koteff, Carl and Pessl, Fred Jr., 1981, Systematic ice retreat in New England: U.S. Geological Survey Professional Paper, 1179, 20 p.

Lepage, Carolyn A., 1982, The Composition and origin of the Pond Ridge moraine, Washington County, Maine, unpubl. M.S. thesis, University of Maine, Orono, 74 p.

Meier, Mark F; Rasmussen, L.A.; Krimmel, R.M.; Olsen, R.W.; and Frank, David, 1985, Photogrammetric determination of surface altitude, terminus position and ice velocity of Columbia glacier, Alaska, Geol. Survey Prof. Paper, 1258-F, p. F1-F41.

Retelle, Michael J. and Konecki, Katherine B., 1986, Proximal-Distal glaciomarine facies relations: Sedimentation at a pinning point in the lower Androscoggin Valley, Maine, Abstracts with Programs, Northeast Section, The Geological Society of America.

Rust, B.R., and Romanelli, R., 1975, Late Quaternary subaqueous outwash near Ottawa, Canada, in Jopling, A.V. and McDonald, B.C., eds., Glaciofluvial and Glaciolucustrine Sedimentation: Soc. Eco. Paleon. and Miner. Spec. Publ. 23, p. 177-192.

Smith, Geoffrey, 1982, End moraines and the pattern of last ice retreat from central and south coastal Maine, in Larson, Grahame J., and Stone, Byron D., eds., Late Wisconsinian Glaciation of New England, Iowa, Kendall/Hunt Publishing Co., p. 195-209.

_____, 1984, Glacio-marine sediments and facies associations, Southern York County, ME in Hanson, Lindley, ed., Geology of the Coastal Lowlands Boston, MA to Kennebunk, ME, 76th Annual N.E.I.G.C., p. 352-369.

_____, 1985, Chronology of late Wisconsinan deglaciation of coastal Maine, GSA Special paper 197.

Stuiver, Minze and Borns, Harold W. Jr., 1975, Late Quaternary marine invasion in Maine: Its chronology and associated crustal movement: Geological Society of America Bulletin, vol. 86, Jan 1975, p. 99-104.

Thompson, Woodrow B., 1982, Recession of the Late Wisconsinan ice sheet in coastal Maine, in Larson, Grahame J., and Stone, Byron D., eds., Late Wisconsinan Glaciation of New England, Iowa, Kendall/Hunt Publishing Co., p. 211-228.

_____, Maine Geological Survey, Borns, Harold W. Jr., 1985, Surficial Geologic Map of Maine, State of Maine Department of Conservation.

## ITINERARY
(See Fig. 1 for stop locations.)

Mileage

0.0 Topsham Fair Mall - assembly point. Brunswick 7.5 minute quadrangle
Leave Mall parking lot; turn right onto Route 196 (SE).

0.5 Turn left onto Second Street
Take an immediate left onto Route 201 (North) passing over Route 95 (1.4 miles)

1.8 Turn left onto Meadow Road. Pass over bedrock hill. Slow down at crest of hill.

2.5 Turn left into Bisson Pit.

2.9 End of pit access road.

STOP 1: Bisson Pit
This is an actively worked pit. Please pull off the access road to allow the trucks room to pass. This pit and the exposure at STOP 2

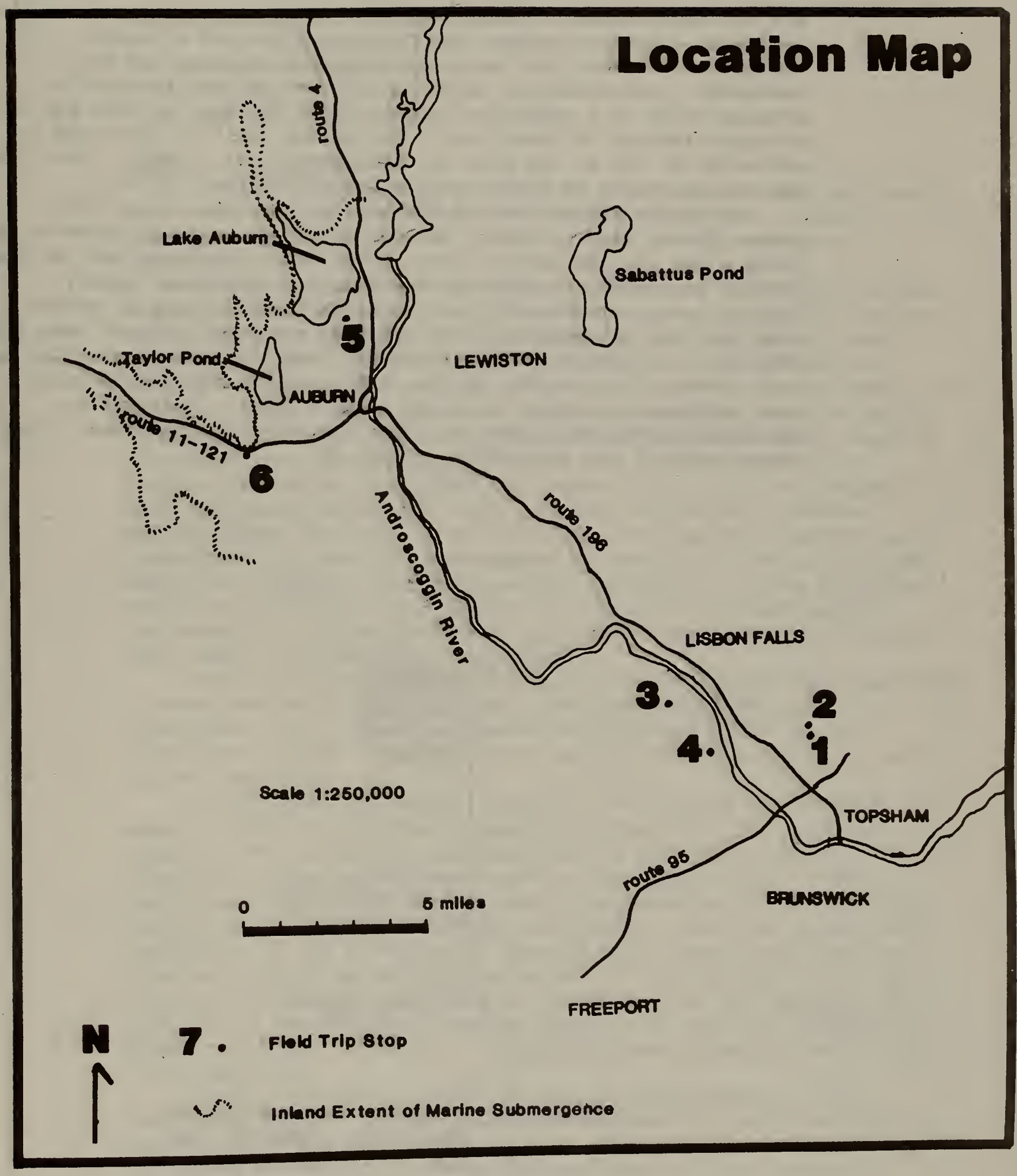

Location Map
route 4
Lake Auburn
Taylor Pond
AUBURN
route 11-121
5
6
LEWISTON
Sabattus Pond
Androscoggin River
route 196
LISBON FALLS
3.
4.
2
1
TOPSHAM
route 95
BRUNSWICK
FREEPORT
Scale 1:250,000
0
5 miles
N
7. Field Trip Stop
Inland Extent of Marine Submergence

Figure 1

are located along a bedrock ridge that trends in a northeast to southwest direction between the Cathance River and a linear topographic lowland that marks a structural lineament to the northwest. Approximately 5m of section are exposed through the proximal edge of a submarine outwash fan. The apex of this fan is at approximately 180 feet (asl); the marine limit for the area is estimated at 280 to 290 feet asl (Thompson et al., 1983). Thus, the fan was deposited in water depth of about 100 feet (30 m).

Sediments at the base of the section are cross-bedded to planer-bedded sandy gravel. Boulders as large as 1m in diameter are found along the ice contact head of the fan. The upper part of the section is medium to coarse sandy outwash. Individual gently dipping sandy outwash beds can be traced distally tens of meters from the head of outwash. Both gravelly and sandy outwash beds are faulted and folded in the ice proximal area. A compact gravelly mud unit (debris flow deposit or flow till) approximately 0.8m thick lies conformably within the sandy outwash unit. Laminated to massive Presumpscot Formation silty clay laps onto the lower lying distal side of the outwash fan. (Fig. 2)

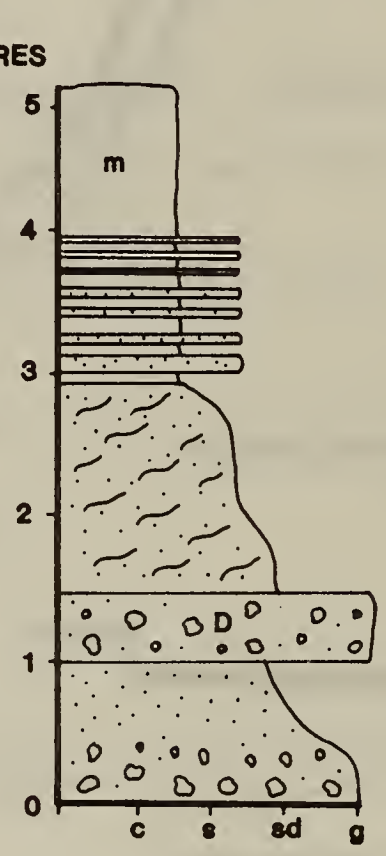



**Figure 2. Composite stratigraphy of Bisson Pit - Stop #1 (see fig. 4b for column key)**

Turn vehicles around and return to Meadow Road.

3.4 Turn left onto Meadow Road.

3.8 Turn left into Webber Pit.

STOP 2: Webber Pit

At this stop, depending upon available exposures at the time of the field trip, we will examine the stratigraphy and sediments interpreted as proximal and distal glacial and glaciomarine environments.

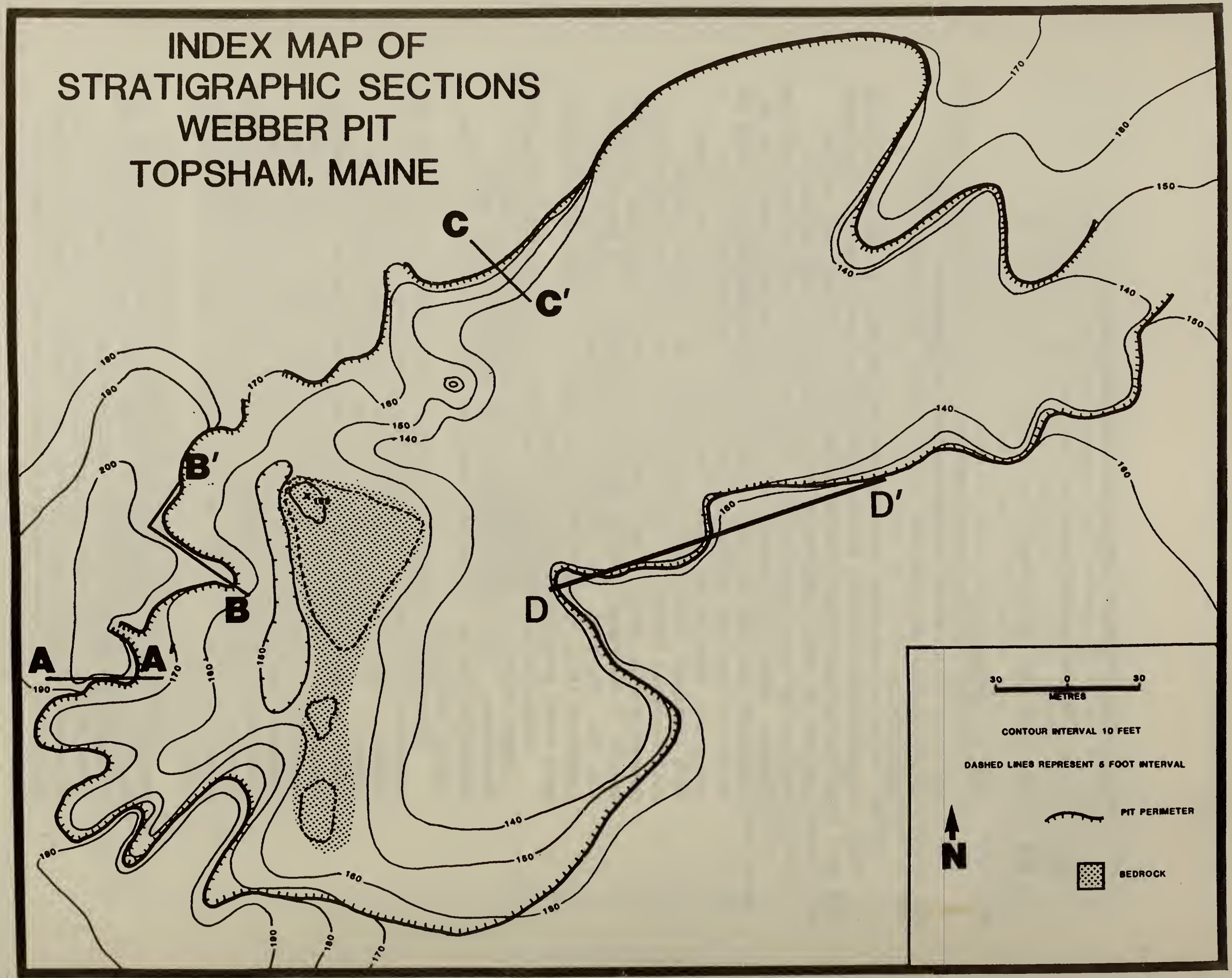
In the northwest and north-central sections of the pit several exposures are cut into a stratified end moraine (Fig. 3). The crest of the moraine ridge is at an elevation of 198 feet asl. approximately 100 feet (30m) below the marine limit. The moraine is composed of interbedded bodies of diamicton and stratified sands and gravelly sands. At least three layers of diamicton, consisting of lodgement till and flow till (resedimented lodgement till) range in thickness from approximately 50cm to 2m. Lodgement tills are texturally similar throughout the deposit (Fig. 4a), are compact with prominent lenticular sandy partings and contain lineated bullet-shaped boulders. The flow till is variable in texture and compactness in several exposures in the moraine depending upon the amount of reworking that the flow has undergone. In the middle of the flow till unit, the diamicton is similar in texture to the lodgement till; in exposures at the edge of the flow, reworking and more sandy interlamination is common.

Submarine outwash sands and gravels, most likely deposited from a tunnel source at the ice front, are interstratified with the diamictons. The outwash sediments are deformed by low angle thrustfaulting and recumbant isoclinal folding, especially at the top of the sands.

The proximal and distal flanks of the moraine are overlain by massive silty clay of the Presumpscot Formation. The silts are locally normal-faulted, presumably due to post-depositional slumping. Along the moraine crest and flanking outwash sands, poorly-sorted gravelly marine sands were deposited as the landform passed through wave base during post-glacial isostatic uplift and regression of the inland sea. Massive silty sands overlying the proximal zone of an outwash fan contain a rich *in situ* intertidal fauna consisting of a pavement of disarticulated *Mya arenaria* shells overlain by paired *Mytilus edulis* valves with attached *Balanus* in growth position. A sample of the *Mytilus* and *Balanus* dated 12,820 120; (SI-7017)

Along the southern margin of the pit approximately 6.5m of section is exposed through subaqueous outwash fan deposits (Fig. 3). Nearly all of the overlying 2 to 2.5m of the massive fossiliferous Presumpscot Formation has been stripped away by pit operations. Three outwash facies are recognized, primarily by the ratio of the thickness of sand to silt layers: (1) Proximal Subaqueous Outwash Fan Facies, (2) Distal Subaqueous Fan Facies and (3) Transitional Facies.

# INDEX MAP OF STRATIGRAPHIC SECTIONS WEBBER PIT TOPSHAM, MAINE



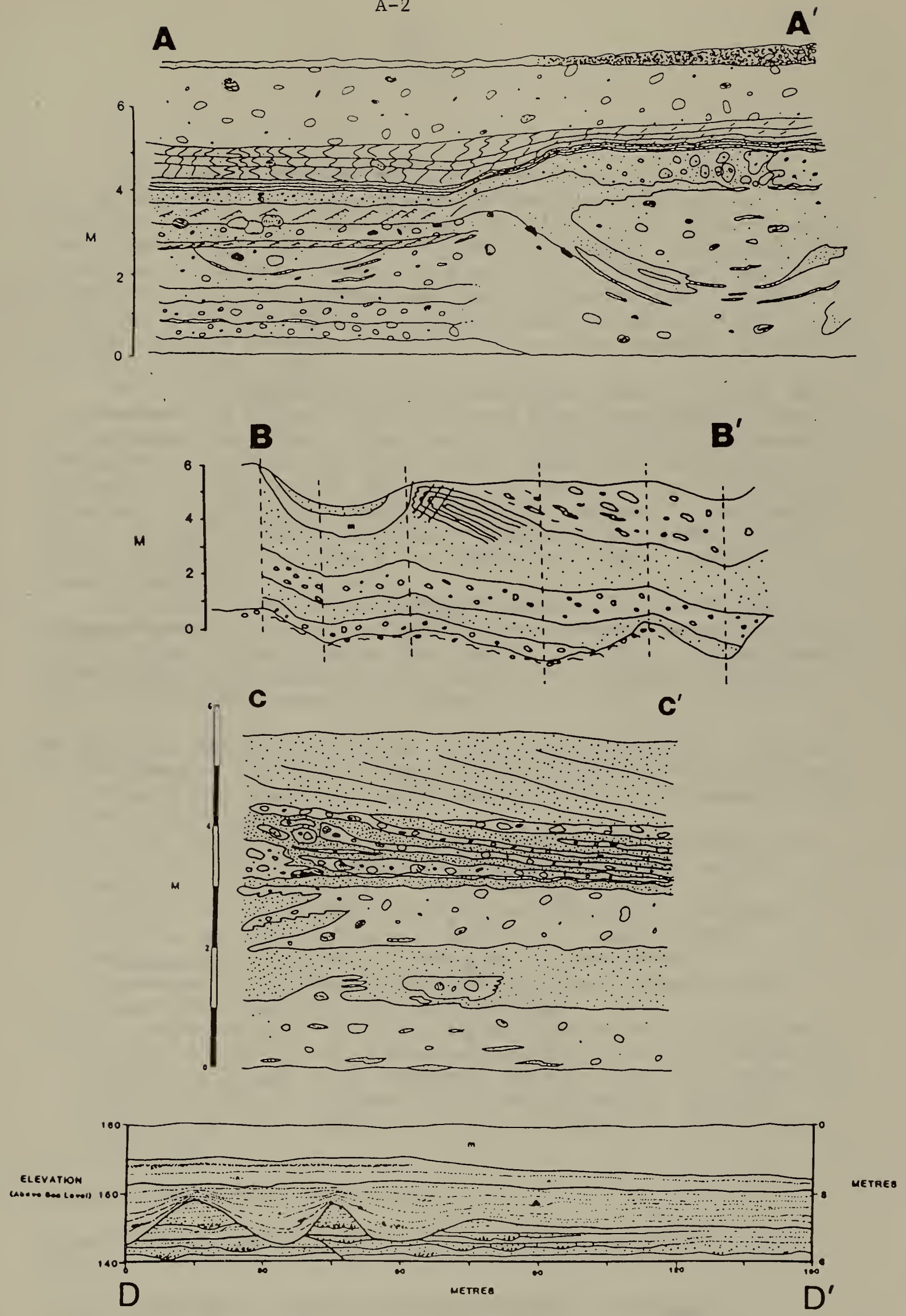



**Figure 3. Index map and stratigraphic sections, Webber Pit, Topsham Maine.**

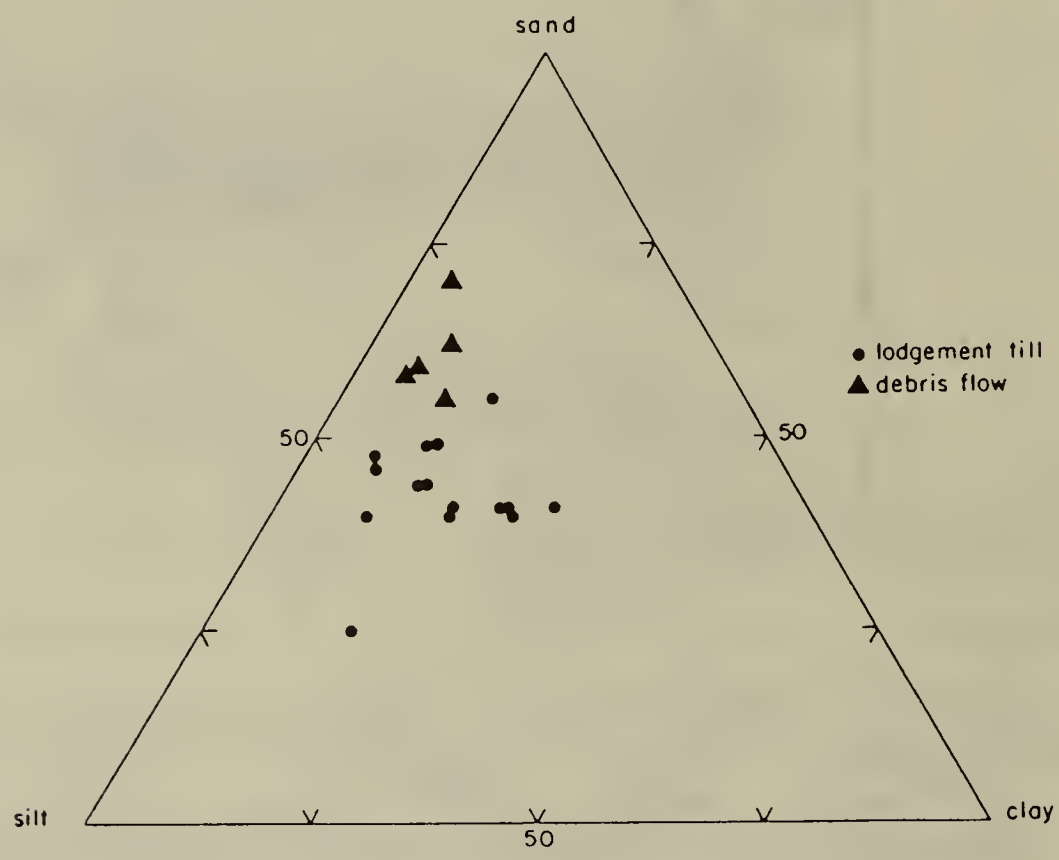




Figure 4a. Triangular plot of textural variations in diamicton facies in Webber Pit moraine (Stop 2). Gravel:sand:mud plot of 200 g samples. Sand:silt:clay plot of matrix.

The lowermost Proximal Subaqueous Fan Facies (Unit I in Fig. 4b) is characterized by sand layers thicker than silt layers. Truncated outwash fan lobes ranging 10m laterally and 3m vertically are evident. This facies is also characterized by: interbedded and graded beds of gravels, sands and muds; channel scour and lag deposits; ripple cross-laminations and climbing ripples. These features, and others which distinquish Facies II and III, are similar to those discussed in detail by Rust and Romanelli (1975) and Domack (1983, 1984).

The Distal Subaqueous Outwash Fan Facies (Unit II in Fig. 4b) is characterized by sand layer thickness being approximately equal to silt layer thickness. These layers are rhythmically laminated and graded silty sands and silty clays. Individual layers are traceable for at least 100 metres and the amount of mud increases laterally. These layers thicken within the channels cut through Unit I and soft sediment deformation structures are common. Ice rafted dropstones and dropped (or slumped in) diamict masses are found frequently.

The Transitional Facies (Unit III in Fig. 4b), which grades into the massive Presumpscot Formation is characterized by the silt layers being thicker than the sand layers. The thinly bedded graded silty clays intertongue with silty sand; soft sediment deformation and ice rafted dropstones are present.

We summarize the glacial geology at this site as follows: (Fig. 5)

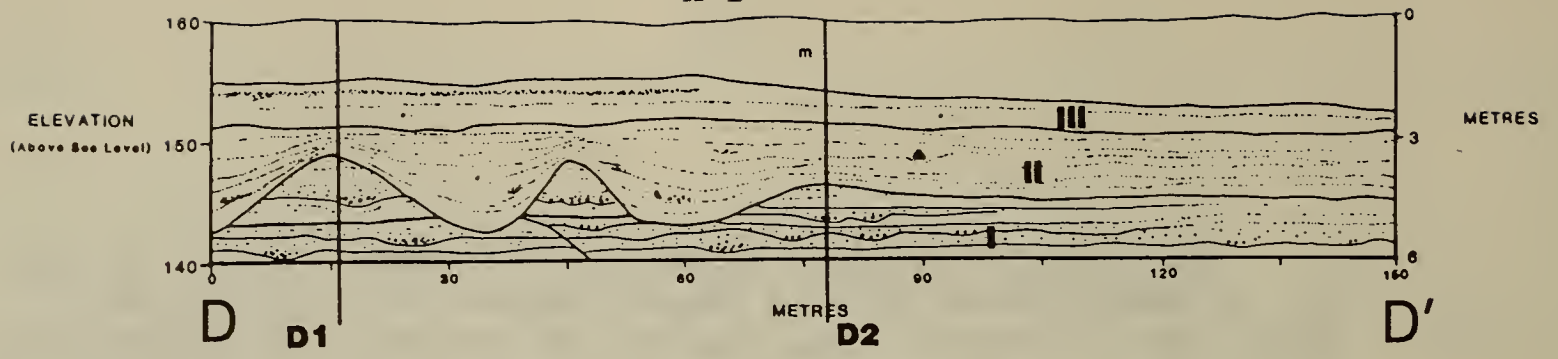
1. Progressive ice marginal retreat from south to north this area is marked by successive submarine deposited in approximately 100 ft. (30m) water depth.
2. The ice margin became grounded or pinned when it retreated to the high point of the bedrock ridge underlying the western section of the Webber Pit. The stratified moraine was constructed by the oscillation of the ice margin. Lodgement till was deposited during stillstands or slight forward advances, perhaps during winter when calving ceased. Interstratified outwash beds were laid down during the melt season and later overridden and deformed.
3. Ice retreated more rapidly to the east where the ice front was not pinned against the bedrock topographic high. Accelerated calving in deeper water influenced the rapid retreat. Submarine outwash sequences, exposed in the southern margin of the pit fine upward and demonstrate the increasing distal nature of the sediments.

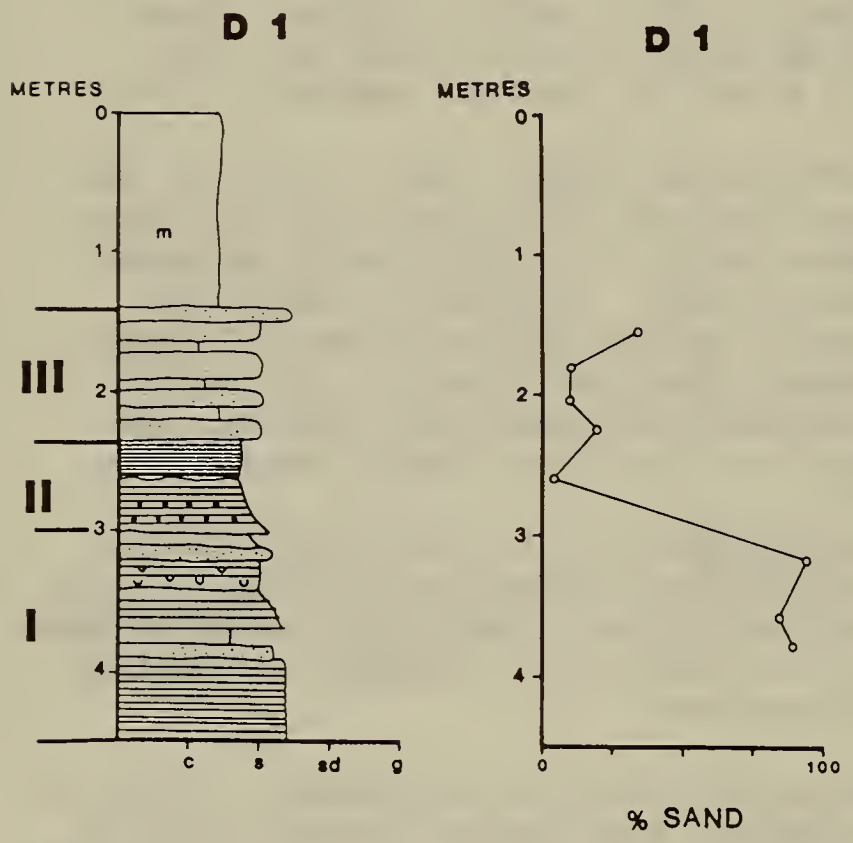
4.0 Return to Meadow Road, turn left.

4.9 After crossing swampy lowland, turn sharp left onto Cross Meadow Road.

5.9 Cross brook, enter Lisbon Falls South 7.5 minute quadrangle.

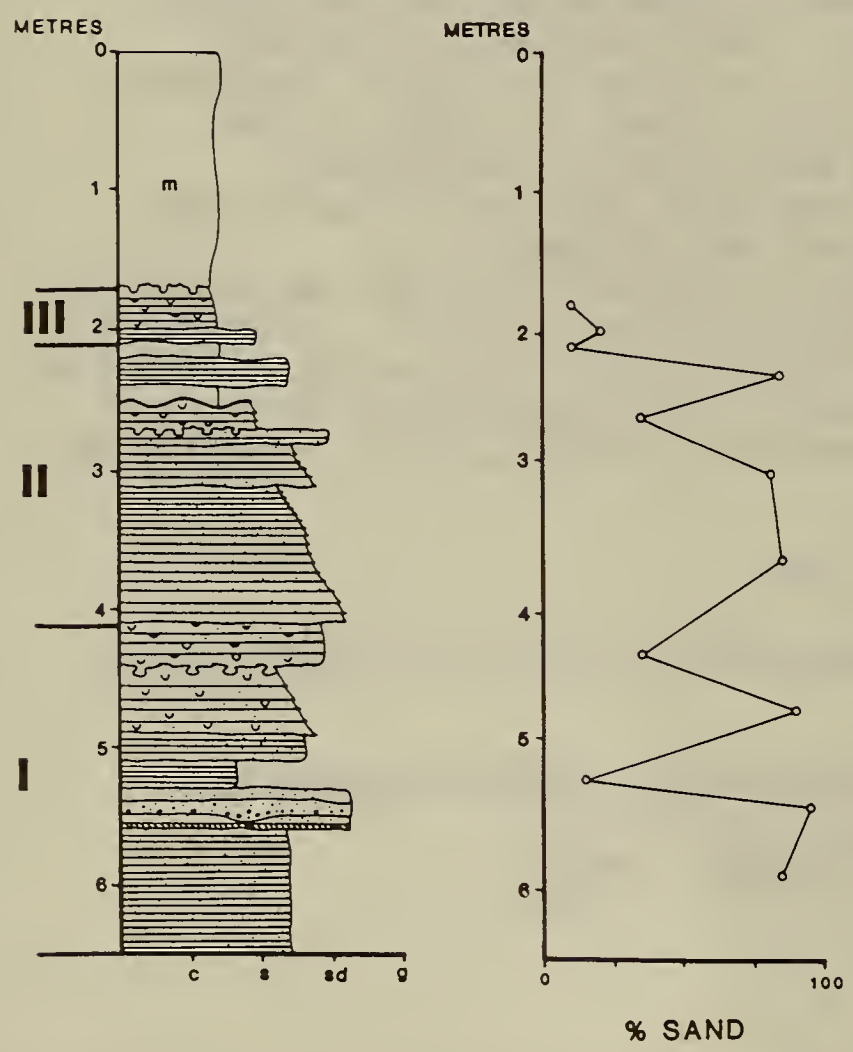
6.9 Intersection, Route 196; turn right (west).













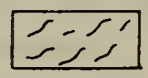
# STRATIGRAPHIC COLUMN KEY

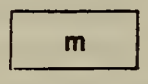
( After Eyles )

## SYMBOLS

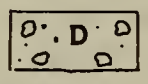

Gravel


Sand

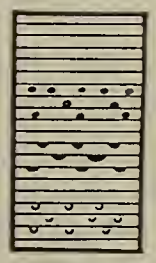

Stratified



Glaciomarine Deposits



Diamict


Laminations

with silt and clay clasts

with dropstones

with loading structures

## CONTACTS


Erosional

Conformable

Loaded

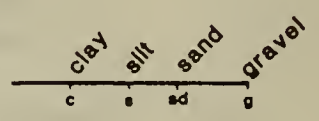



Figure 4b. Stratigraphic section and vertical profiles, Webber Pit (Stop 2).

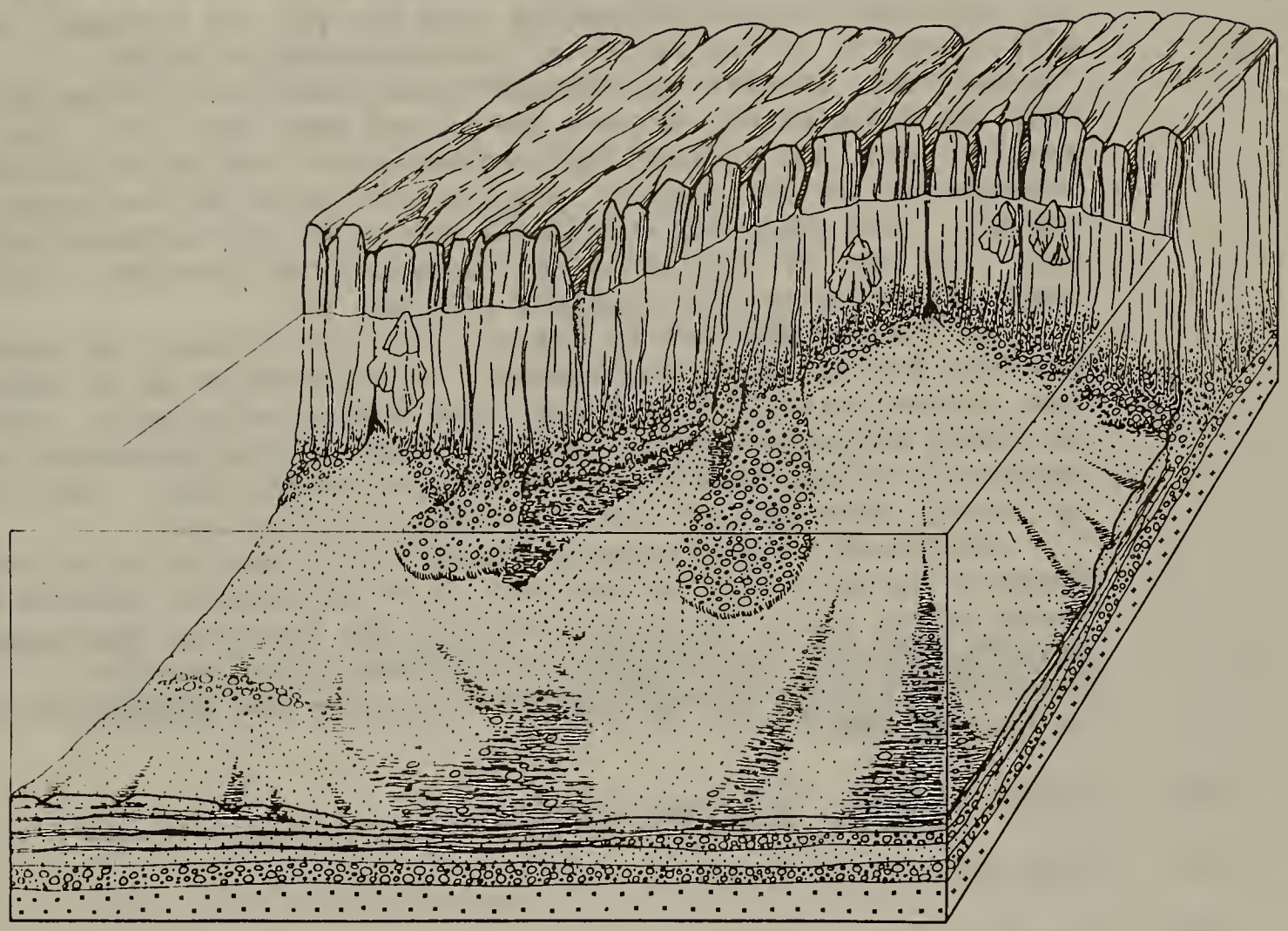


**Figure 5. Diagrammatic model of glacio-marine deposition based on exposures at Webber Pit, Topsham, Maine.**

10.5 Androscoggin County Line, Village at Lisbon Falls.

11.0 Junction Routes 9 and 125. Turn left.

11.3 Cross Androscoggin River, turn left at end of bridge.

11.4 Follow Route 125 passing large open gravel pit then uphill.

12.2 Turn left into Tupper Construction Pit.

STOP 3: Tupper Gravel Pit, Durham

We will park on the pit access road and proceed to an overlook for discussion before descending into the pit for a closer look. At this exposure, in the center of the Androscoggin Valley, fine-grained, massive and fossiliferous Presumpscot Formation overlaps ice-proximal outwash gravel and sand (Fig. 6). The glaciofluvial and glaciomarine sediments are incised by fluvial deposits of the post-glacial Androscoggin River on the north wall of the pit. The upper surface of the pit is at approximately 200 feet asl. The base of the pit is approximately 170 feet asl. The marine limit elevation is approximately 310 feet asl.

As the eastern base of the pit, a linear deposit of cobbley to bouldery gravel (40-50 cm diameter) is interpreted as an esker ridge that grades distally to finer grained submarine outwash. Overlying the esker ridge are several gravelly sand to sand sequences that represent the aggradation of successive outwash fans. The outwash is locally deformed and contains bodies of flow till.

Laminated to massive-bedded marine silt laps onto the outwash sequence in the center of the pit. Rich macrofaunal remains are found in the silt. Pelecypods include Mya truncata, Mya arenaria, Hiatella arctica, and Mytilus edulis among other species. Additionally several large gastropod species and Balanus are found in the sediments.

12.7 Return to Route 125; turn left.

14.1 Turn left on Soper Road.

15.9 Turn left into pit (Cianbro Corp. sign).

16.2 Park in the bottom of the Pit.

STOP 4: Chick Pit

This pit is located approximately 1/2 mile southeast of a large northeast trending moraine and within the pit a bedrock ridge trends northeast (Chick 1986). The upper surface of the pit is at approximately 200 feet asl and the local marine limit is approximately 310 feet asl. Thus the materials were deposited in water depth of approximately 100 to 120 feet (30-40 m). Good exposures within two sections of this pit show a series of overlapping outwash fan deposits topped by 2 to 3m of Presumpscot Formation. Several outwash fan heads are visibly recognized by the location of boulder concentrations, deformation within the outwash deposits, and surface topographic expression of the fans (lobate form).

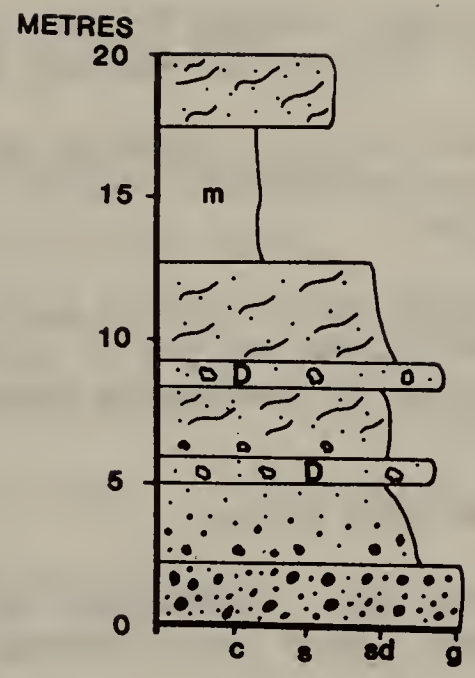



**Figure 6. Composite stratigraphy of Tupper Pit - Stop #3 (see Fig. 4b for column key)**

Turn vehicles around and return to Soper Road.

17.3 Turn right onto Soper Road.

19.1 Intersection with Route 125. Proceed straight ahead on Soper Road.

19.5 Stop sign. Intersection of Meadow Road. Proceed straight ahead.

21.5 Intersection Route 9. Stop sign. Proceed straight ahead on Route 9 (west).

22.8 Enter North Pownall 7.5 minute quadrangle.

22.9 Intersection with Route 136. Take right turn (north).

23.7 View across Androscoggin River to right. Broad river terraces on left.

24.6 Enter Lewiston 7.5 minute quadrangle.

26.4 Rise upon terrace.

26.5 Auburn townline.

30.0 Cross under Maine Turnpike.

31.9 Y-Intersection. Follow Route 136 left on Mill Street.

32.0 Broad Street straight through lights. At 2nd stop light follow Route 136 right. Stay on 136 through 3rd and 4th lights.

32.8 Junction Route 202/100/11. Continue straight across intersection (Court Street) to LaVerdiere's Drug Store. Take left in front of store at stop sign.

33.0 Turn right at light; keep to right and proceed ahead on Route 4. There are several places for you to purchase lunch, either sitting in a fast food place or purchasing groceries to eat at the lunch stop.

33.5 Beginning of Fast Food strip.

34.4 Intersection Route 202. Auburn Mall on left, continue straight ahead. Enter Lake Auburn East quadrangle.

36.1 Lunch stop and reassembly point. After lunch we will turn around and proceed south on Route 4. Take right turn onto Turner Street.

36.3 Lido gas station.

37.4 Intersection with Grace Lawn Road. Take right turn.

37.7 Right turn into Auburn Landfill.

STOP 5: Auburn Landfill - Gravel Pit

There are several exposures at this site that expose the topset, foreset, and bottomset beds of a glaciomarine delta. The north slope of the landform is kettled and exhibits good evidence of collapse. Pegmatite bedrock crops out along this slope and above the topset plain. The highest elevation on the topset plain is 360 feet elevation. The topset-foreset contact, measured at 336 feet asl. (Thompson et al., 1983) is illustrated by a spectacular cobble and boulder horizon in the north central area of the pit. Sandy foreset beds prograde southward over massive sandy silt bottomset beds from which several whole valves of Hiatella arctica were recovered.

This landform, which is graded to relative sea level of 336 feet is in the form of a classic Gibert type delta, is distinct among the fluvial marine features that we have examined already today. Other sandy fluvial beds were depostied on fans that graded to the sea floor at a depth of approximately 100 feet (30m). Perhaps this deposit originated as a submarine fan and later aggraded to sea level due to a constant sediment source with the ice sheet pinned on the bedrock topographic high.

Turn right on Grace Lawn Road leaving the landfill.

38.2 Enter Minot 7.5 minute quadrangle. Mt. Auburn Cemetary on left.

38.5 Turn left on Park Avenue.

38.6 Cross Summer Street at stop sign. Proceed straight ahead on Park Avenue.

39.4 Enter Lewiston 7.5 minute quadrangle.

39.7 Stop sign. Proceed straight ahead.

40.4 Intersection with Court Street. Turn right.

41.4 Intersection with Minot Avenue. Turn right at light.

41.7 Intersection. Stop light. Go straight ahead.

42.8 STOP 6: Minot Road Borrow Pit

Please pull off the road into the pit on the left (southside of Minot Road). Watch for oncoming traffic around the corner as you cross the left lane.

This pit is located on the southern end of a till/bedrock hill (Mt. Apatite) at an elevation of 300 feet asl. While this site is probably below the marine limit (approx. 340 feet, Thompson et al., 1983) parts of the hill to the south of the borrow pit are above the estimated marine limit elevation.

Several small exposures in the pit are cut into a sandy silty diamict that is distinctly different from other till or debris flow deposits that we have already seen today. At this site there is approximately 2.5 to 3.0m of sandy till that overlies striated pegmatite bedrock (N 25 W). The till has a distinctive sub-vertical to vertical fabric seen in fissility, in sandy interlaminations and in till clasts which is exposed in several areas of the pit. The "till" is texturally and structurally similar to the "upper till" of southern New England (cf. Koteff and Pessl, 1985) and the sandy drift at New Sharon (T. Weddle, pers. comm., 1985). The till is also similar to that in several exposures in the uplands about one mile northwest of the pit. The section is capped by 50 to 70cm of eolian silty sand that overlies a ventifacted pavement on the till ridge surface.

The genesis of both the sediment and the landform at this site is not well understood and we invite your discussion.

This is the formal end of the trip. If time allows, we offer you an alternative return route with one quick stop in an esker to view stratigraphy and structures in an ice contact setting. We estimate approximately 1 hour for the extended trip. If you wish to return to the Lewiston-Auburn area, turn right out of the pit and follow Minot Avenue east towards Auburn. To get to downtown Lewiston-Auburn and the Bates College area, follow Minot Avenue (Route 11-121) to the intersection with Central Avenue, bear left at intersection. Follow Central Avenue (Route 4/100) north to downtown Auburn. To return to Bates College, turn right on Court Street (lights) and cross Androscoggin River. Go uphill approx. 1/2 mile, bear right onto Sabattus Street and take the second left onto College Street. Follow until you reach the campus. For those continuing on the trip a handout sheet will be provided with additional instructions.