MATTITUCK CLIFFS AND RANCO QUARRY: MODELS FOR ORIGIN OF ROANOKE POINT AND RONKONKOMA MORAINES?

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ABSTRACT

Study of outcrops of Pleistocene sediments at Ranco Quarry (Ronkonkoma Moraine, Manorville) and Mattituck sea cliffs (Roanoke Pt. Moraine) using photomosaics and measured sections have clarified stratigraphy and sedimentary facies of the moraines, and have shown two very different depositional settings for their stratified drift. The Ronkonkoma Moraine at Ranco Quarry comprises a pre-tectonic subaerial outwash fan, overlain by pre-Wisconsinan fossiliferous beach/barrier sands that have been glacio-tectonically transported upward and southward onto the elevated north edge of the outwash fan. This is unconformably overlain by syn-tectonic and post-tectonic channelized water-laid pro-glacial gravels, in turn overlain unconformably by a blanket diamict representing partial or complete overriding of the moraine by the glacier.

Mattituck cliffs comprises a lower diamict (probably till) capped by a paleosol and overlain by a coarsening-up section of laminated and small cross stratified sands grading up to medium cross bedded gravelly sands. This is interpreted as subaqueous outwash prograding into a shallow lake dammed between the glacier front to the north and the Roanoke Pt. push moraine to the south. The section is capped by a blanket diamict, which may represent overriding of the lake sediments and push moraine by the glacier.

These studies can serve as models for comparing and contrasting with other morainal outcrops and subsurface sections on Long Island.

INTRODUCTION

Glacial and peri-glacial sediments are of obvious geologic and economic importance on Long Island; in spite of this there are relatively few published sedimentological/facies studies of these strata. One reason for this is the paucity of outcrops and the resultant reliance on bore hole information and surface geomorphology. Student projects at Stony Brook and some notable other studies show however that accurate and detailed stratigraphic cross sections coupled with measured-sections can greatly improve out understanding of the geology. Specifically, recording the stratigraphy and facies in sea cliffs, gravel quarries, and construction excavations using photomosaics and measured-sections can give valuable information about depositional models and glaciotectonics, and allows comparisons with published studies. This recording is important because these outcrops are transitory, and in the case of quarries change rapidly with excavation of the quarry, and eventually disappear.

Measured-sections are particularly valuable as "ground truths" for applying sedimentological models, which often are framed in terms of vertical variations in textures and sedimentary structures. In regard to measured-sections, using accepted nomenclature for siliciclastic lithofacies (e.g. Miall 1992) and for diamicts (e.g. Eyles, et al. 1983) allows accurate and consistent descriptions that incorporate both textures and sedimentary structures. These terms are preferred to many popular or interpretive terms because they give more accurate picture of lithology, and allow comparison with descriptions in the literature. Terminology used for various types of diamicts allows them to be differentiated from one another and allows comparison with those in the literature. This is important because "glacial" diamicts may have a variety of origins only some of which are true tills.

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Student projects at Ranco Quarry (Manorville) (Fig. 1, Table 1) used this approach and form the basis for this synthesis. The Ranco Quarry outcrop is a north-south cross section about 100 m long of a portion of the Ronkonkoma Moraine, which in this area has a lobate south margin and irregular north margin (Fig. 2,3). The north margin is at a lower elevation than the south margin, and the plain to the north is irregular with isolated hills and depression, probably

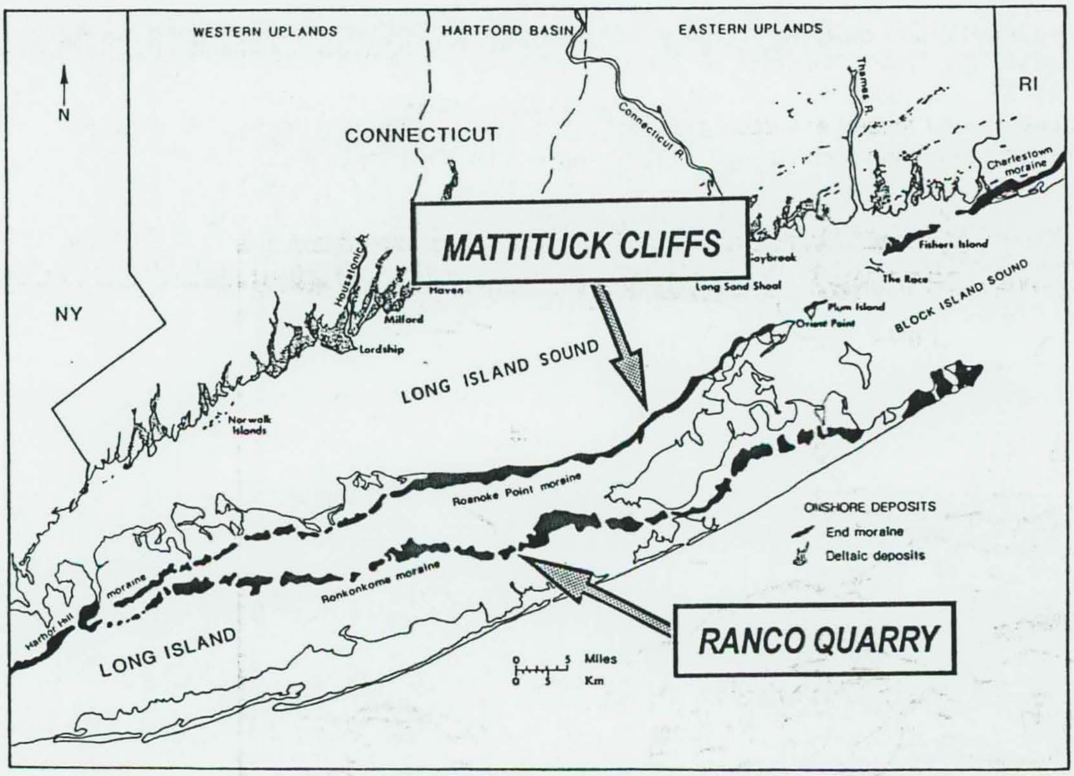

Figure 1. Location map of Ranco Quarry and Mattituck cliffs exposures described in text. (From Lewis and Stone, 1991)

TABLE 1. LITHOFACIES NOMENCLATURE ADAPTED FROM MIALL (1992) & EYLES ET AL. (1983)

CODE	LITHOFACIES	SEDIMENTARY STRUCTURES
Gm	Massive gravels	No or crude horizontal bedding; imbrication
Gh	Stratified gravels	Distinct horizontal bedding
Gt	Stratified gravels	Trough cross stratification, medium scale
Gp	Stratified gravels	Planar (tabular) cross stratification, medium scale
Sm	Massive sand, medium to coarse, may be pebbly	No or crude bedding
St	Cross stratified sand, med. to coarse	Trough cross stratification, medium scale
Sp	Cross stratified sand, med. to coarse may be pebbly	Planar cross stratification, medium scale
Sr	Cross stratified sand, fine	Trough cross stratification, small scale, including flaser and climbing ripples
Sh	Stratified sand, fine to coarse	Horizontal to low angle laminations
Fm	Silt, mud	Massive
Fl	Silt, mud	Laminated

Modifiers = dessication cracks **(c)**, rootlets **(r)**, paleosols **(p)**, grading **(g)**, etc.

CODE	LITHOFACIES	SEDIMENTARY STRUCTURES
Dmm	Diamict	Massive, no bedding
Dms	Diamict	Crude horizontal or inclined stratification

Modifiers = Jointing or shears **(s)**, grading **(g)** representing ice-retreat depositional and erosional topography (Fig. 2). The outwash plain south of the moraine is cut by channels that probably represent post-outwash erosion (rather than braid channels on the outwash fan), as suggested by their depth (10's ft.) and by their relatively long simple plan view geometries.

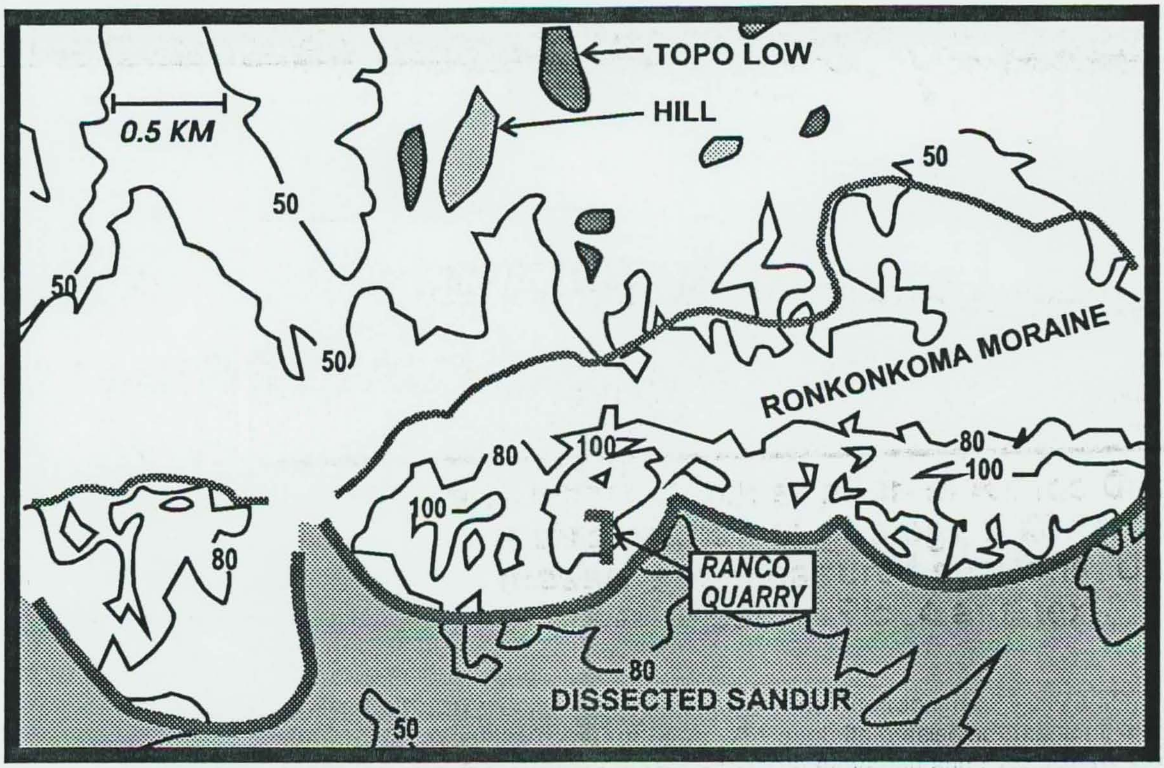

Figure 2. Simplified topographic map of area around Ranco Quarry. Elevations in feet.

A composite measured-section about 20 m thick (Fig. 3, 4) comprises in ascending order: Unit 1 composed of predominantly parallel stratified gravels and coarse sand (Gh, Sh, minor Gp) interpreted as braided streams of a glacial outwash fan; Unit 2 composed of small-scale cross stratified sand (Sr?); Unit 3, a stratified diamict (Dms) interpreted as glacier-derived debris flows. This, in turn is overlain by Unit 4 a thick section of parallel laminated well sorted fine sands (Sh) the upper part of which is coarser and contains medium scale cross stratified sands (St) and thin gravel layers. The parallel laminated sands of Unit 4 are interpreted as beach/barrier sands, an interpretation consistent with layers of shell fragments (Mercenaria). Amino acid racemization age of a shell from Unit 4 suggests a pre-Wisconsinan age (O isotope stage 5, 80-130,000 ybp). Units 3 and 4 are thrust faulted and tensionally faulted.

Unconformably overlying Unit 4 is Unit 6, composed of discontinuous lenses of stratified sandy gravels (Gh, Gm, some imbricated, Sh) that truncate Unit 4 bedding. Although most bedding within Unit 6 is horizontal and onlaps the channelized base of lenses, some is sub-parallel with the lens base (Fig. 3). Based on these lithologies and stratigraphic relationships Unit 6 is interpreted as late syn-tectonic and post-tectonic water-laid pro-glacial gravels partly filling small channels and other topography on top of the glaciotectonic terrane. Unit 7 is a blanket unstratified, unjointed and unsheared diamict (Dmm) that unconformably overlies Units 3, 4, and 6 (Fig. 3). It caps the cliff and contains the modern soil zone. It is unclear if this is a true basal till or a debris flow(s) derived from the snout of the glacier.

The tectonic features mapped in the quarry wall, along with the topography of the moraine indicate that this is a lobe of push moraine in which pre-Wisconsinan marine sands (Unit

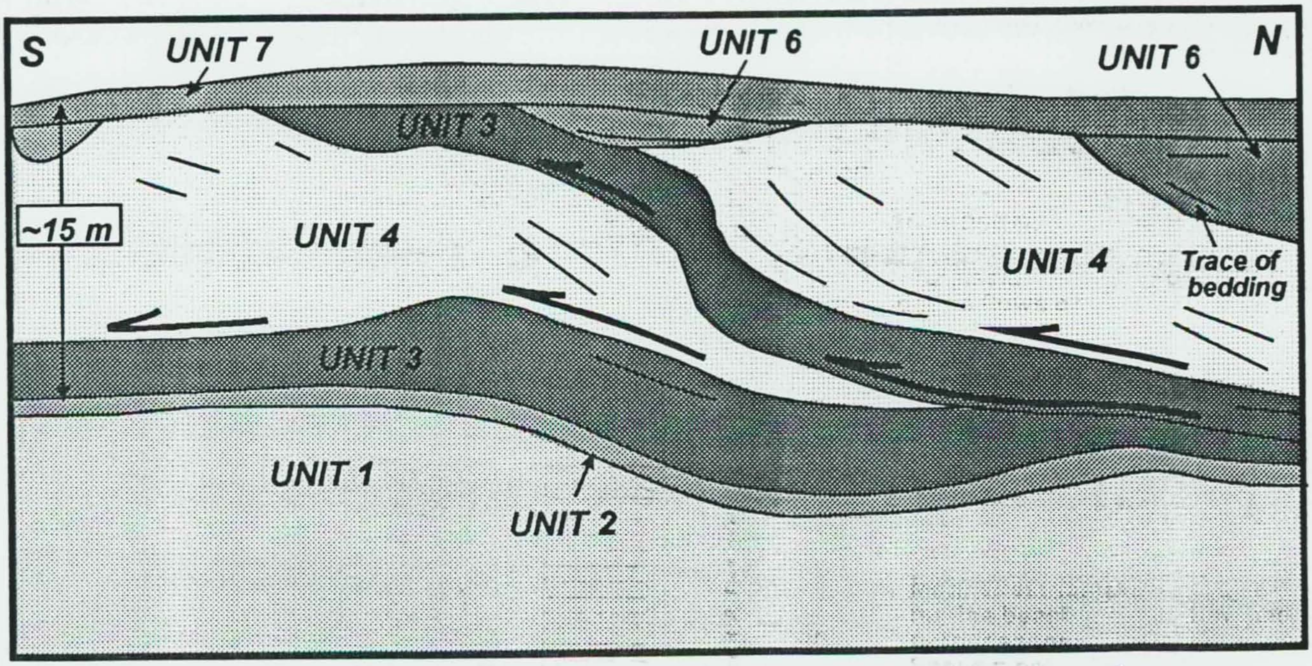

Figure 3. North-south section in Ranco Quarry showing interpretation of geology taken from photo-mosaic and measured sections. Unit numbers are same as those in Fig. 4 and text.

4) were thrusted centrifugally southward onto the topographically elevated north edge of an outwash fan (Units 1 2, 3) (Fig. 5). Although its precise source is unknown, Unit 4 was probably glacio-tectonically transported 30 - 50 m in elevation and possibly kms southward. Tectonic topography was subsequently modified by erosion and filling by debris-poor effluent from the glacier snout (Unit 6, 7?). The snout of the glacier then overrode much or all of the moraine (unit 7?). The scale, overall morphology, and post-tectonic erosional features of the moraine in the Ranco Quarry lobe are similar to those documented in modern push moraines (10's m high, 100's m across), which may serve as analogues for portions of the Ronkondoma Moraine (Croot, 1987, 1988).

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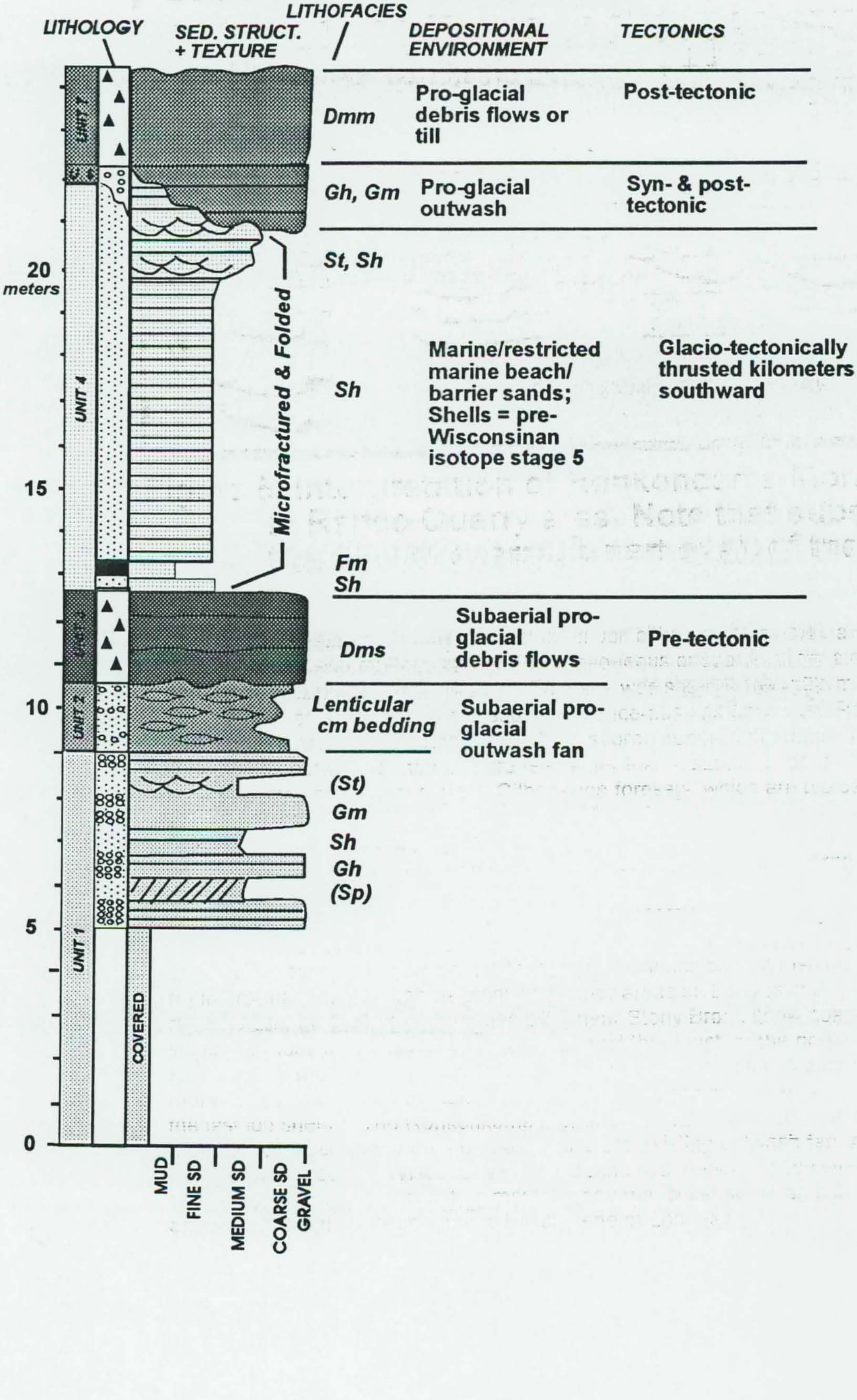
Measured-sections and mapping stratigraphy along the east-west trending Mattituck cliffs show a very different stratigraphic/facies picture (Fig. 6). Although studied in less detail, the outcrops comprise about 15 meters of section, in ascending order a lower Unit 2 of fine sand, silt and clay containing common small scale trough cross-stratification and fine parallel laminations (Sr, Fl)). This is overlain by Unit 3 composed mainly of medium scale trough cross-stratified sands and gravelly sands (St, Gt) the upper part of which contains deformed and massive sands Cross bedding in Units 2 and 3 consistently dip eastward in 2-dimensional exposures. Units 2 and 3 contain a few lenses of poorly sorted massive gravels (Gms) interpreted as debris flows. Together Units 2 and 3 comprise a coarsening-up sequence. Unit 2 is interpreted as shallow lacustrine sediments and Unit 3 as either subaqueous outwash or shallow subaerial ice contact delta. Three types of deformation occur in these sediments, all of which become more common westward along the cliffs; subaqueous slumps, ice collapse tensional faults, and ice shove compressional folds. The section is capped by a blanket diamict (Dmm) (Unit 4). Unit 1 also consists of diamict (Dmm) with paleosol features (gleyed root zones) along its upper surface. It occurs only in the eastern part of the studied outcrop. Unit 2 laps onto and pinches out eastward against the irregular upper surface of Unit 1. Eastward of this pinchout, Unit 4 rests directly on Unit 1.

FIGURE 4. RANCO QUARRY COMPOSITE STRAT SECTION



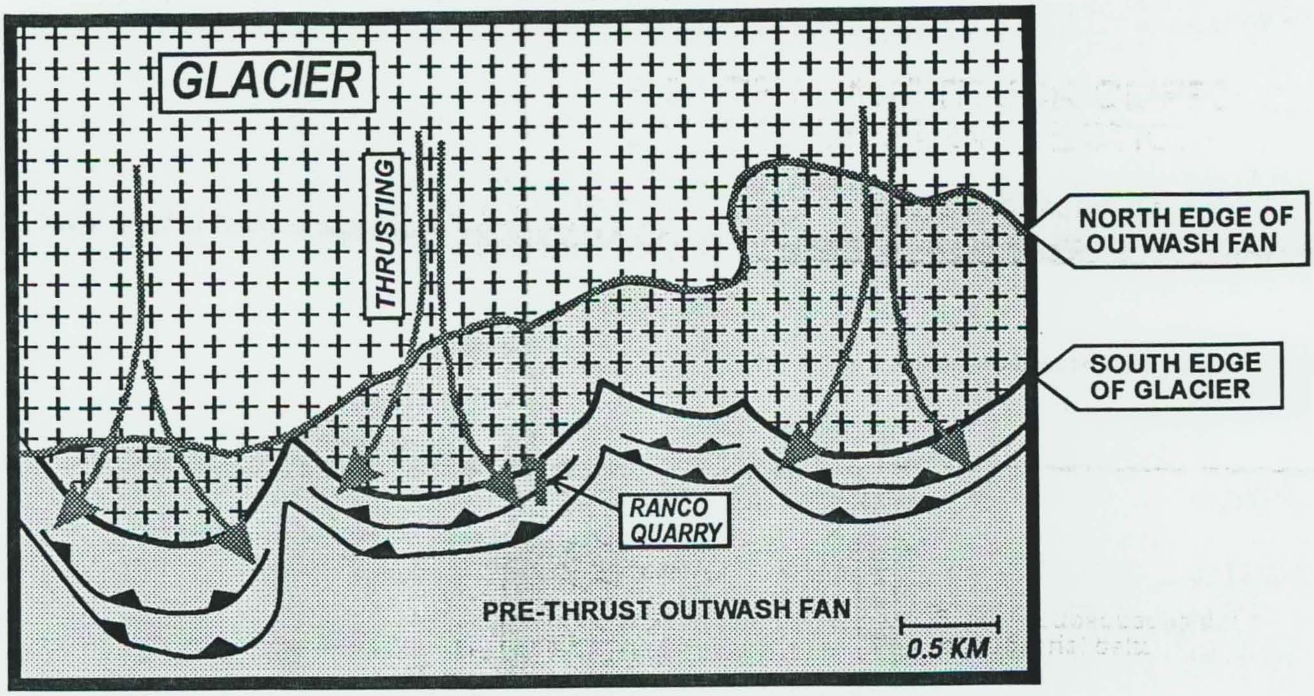


Figure 5. Interpretation of Ronkondoma Moraine in Ranco Quarry area. Note that subsequently the glacier overrode part or all of the moraine.

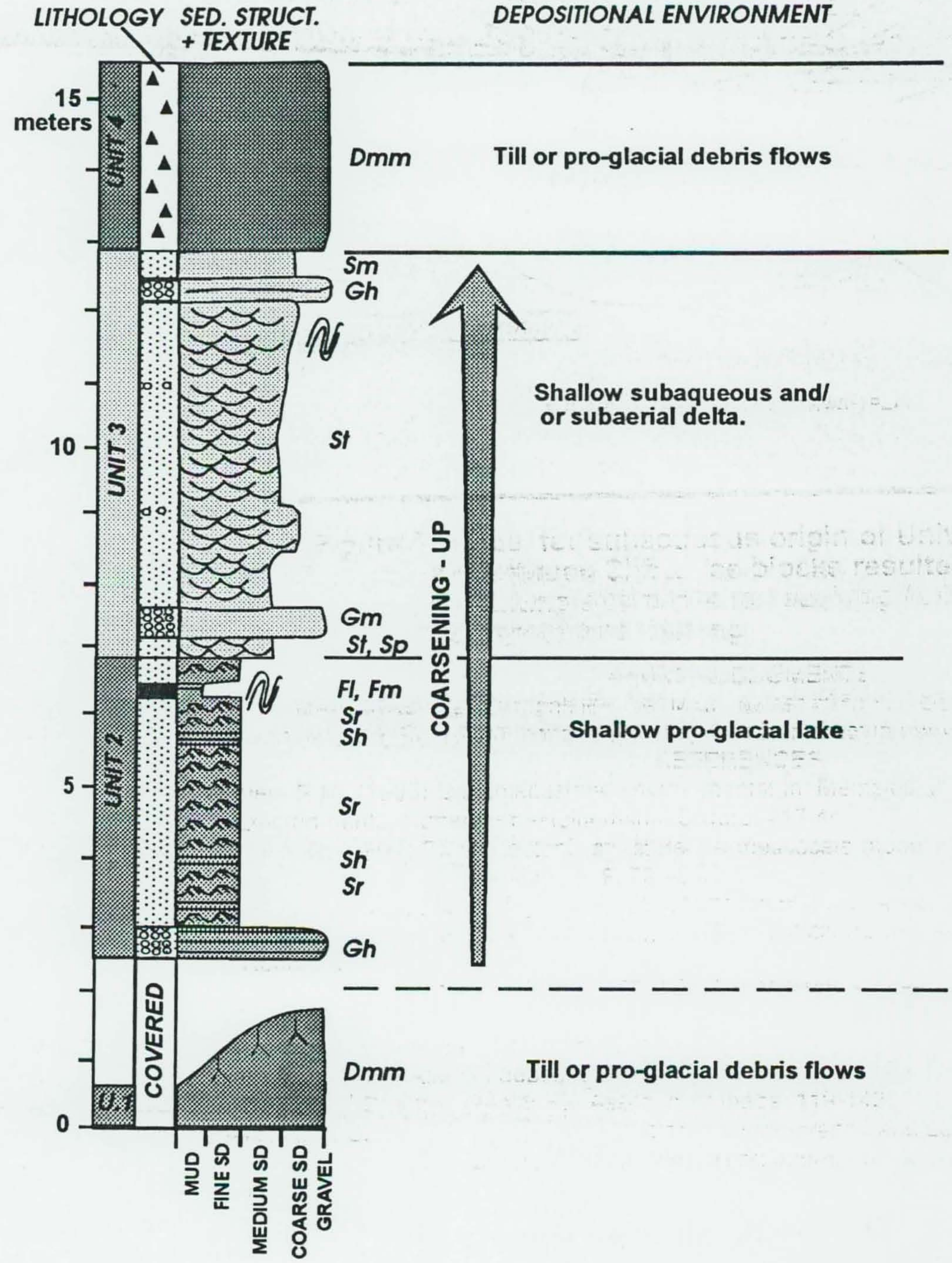
The stratigraphy and facies at Mattituck cliffs are interpreted as in-place relatively untectonized ice-contact lacustrine and subaqueous or subaerial deltaic sediments deposited in a glacier-front-parallel lake(s) (Fig. 7). The lake was shallow (few 10's m) and was dammed to the north by the ice sheet and to the south by the ice-push portion of the Roanoke Point Moraine, and was of largely post-tectonic age. The favored depositional model is that Unit 3 represents subaqueous outwash sands and gravels rather than a subaerial delta. The main evidence for this is the absence of large steep Gilbert type foresets, which are typical of coarse-grained subaerial glacio-lacustrine deltas (Ashley, 1995).

Unit 4 the capping diamict may represent either a debris flow(s) from the snout of the glacier, or a till. In either case it represents a post-lake advance of the glacier.

SUMMARY

These studies have helped document and clarify the roles of glacio-tectonic and periglacial sedimentary processes in forming moraines on Long Island, and may serve as models for interpretations and comparisons with other areas on Long Island. For example reconnaissance observations of sea cliffs near Stony Brook show coarsening-up sequences similar to those in Mattituck Cliffs, and suggest that much of the north flank of the Harbor Hills/ Roanoke Pt. moraine may consist of a string of ice-contact lakes damned north of the main push moraine, but older than the lake(s) occupying the Long Island Sound during the main retreat of the last ice sheet.. The Ronkonkoma Moraine, in contrast consists of a relatively "naked" push moraine localized along the north edge of a pre-existing outwash fan, and containing cores of south transported pre-Wisconsinan Pleistocene sediments. These studies have also proposed a simple and objective descriptive methodology that could serve as a common "language" amongst geologist working on the Pleistocene of Long Island.

FIGURE 6. MATTITUCK CLIFFS COMPOSITE STRAT SECTION



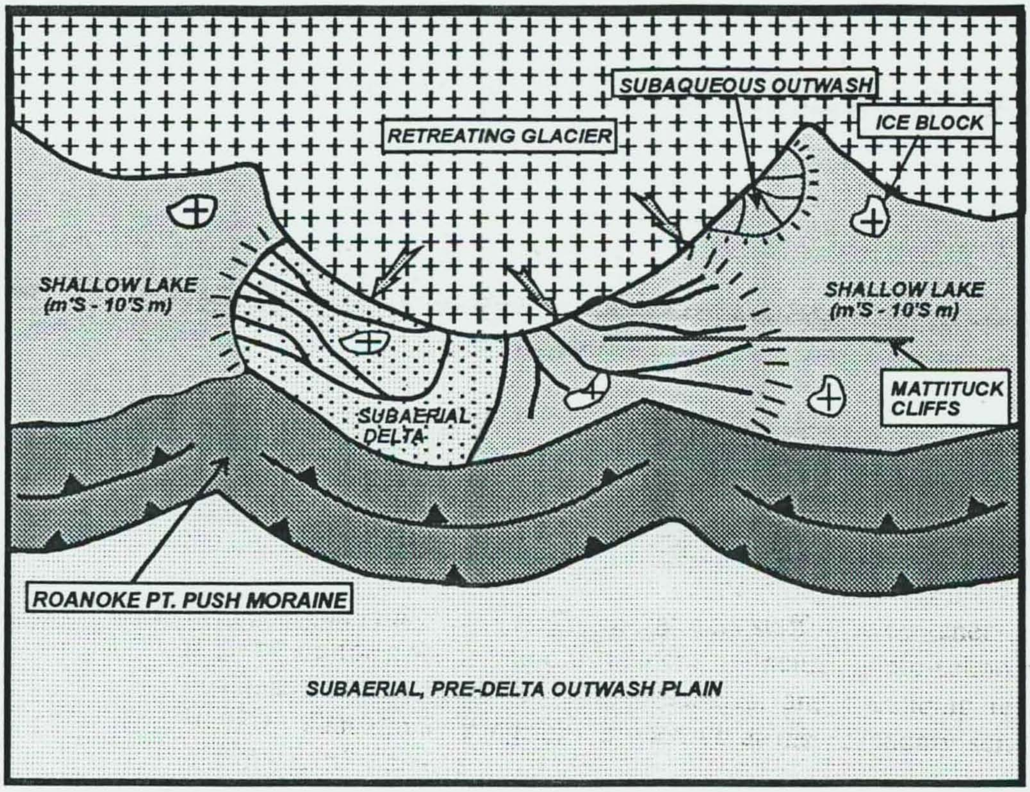


Figure 7. Model for subaqueous origin of Units 2 and 3 at Mattituck Cliffs. Ice blocks resulted in faulting and minor ice pushing (arrows) resulted in compressional folding.

ACKNOWLEDGMENTS

We wish to heartily thank Mr. Mat Metz, owner of Ranco Quarry for his cooperation in allowing us to do field work in the quarry, and for his interest in our work.

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