

# DEGLACIATION OF CENTRAL LONG ISLAND

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## ABSTRACT

The moraines of Long Island were deposited during the late Wisconsinan Stage of the Pleistocene Epoch by the lobate margin of the Laurentide Glacier. This glacier advanced into the Long Island region twenty-two thousand years ago (22ka) and deposited the terminal moraine and the outwash plain to the south. Between 22ka and 20ka, the ice receded northward across Long Island, establishing at least two recessional positions. During each stand of the ice, recessional moraines were deposited, proglacial lakes developed between the ice and the moraines, and meltwater carved drainage channels southward across the outwash plain and laterally along the ice front. In central Long Island, these features, which can be identified by tracing the recession of the Connecticut Lobe of the glacier northward from the Ronkonkoma Moraine, the terminal moraine of this lobe, include the Connetquot-Nissequogue meltwater channel that drained north to south through outwash plains and proglacial lake basins, the Stony Brook Recessional Moraine, and finally the last recessional moraine, the Roanoke Point Recessional Moraine, along what is now the northeastern coast of Long Island, and draining of the proglacial lakes in the Long Island Sound basin. The glacial history of the region is the subject of Dr. Sirkin's books "Eastern Long Island Geology" and "Western Long Island Geology."

## INTRODUCTION

In the context of geologic time-- over four and one half billion years-- the formation of Long Island is barely a footnote. It took only about two thousand years, between twenty-two thousand and twenty thousand years ago for glacial advance and deposition of the terminal moraine and deglaciation and deposition of the recessional moraines. From twelve thousand years ago to the present, sea level rise and coastal erosion have shaped the moraines and created the characteristic, fish-shaped Island geography. Consequently, the variety of glacial and postglacial features, ranging from ice-contact deposits to relict landforms is readily available for study. This geology is well represented and readily accessible in coastal bluffs and on the surface, and is easily seen from roadways, beaches and trails.

### Field Trip Geology

The geology of western Long Island, as seen in its coastal bluffs, gravel pits, and excavations is characterized by glacial deposits and deformation and erosion of the two drift sheets. Exposures of these features allow us to examine the results of glacial and postglacial processes, in sections along the direction of ice advance, north to south, ice retreat, south to north, and across the grain of advancing glacial lobes, from west to east. The major stratigraphic units are the upper (younger) and lower (older) drift sheets, both of which contain tills, outwash and lake beds. They are distinguished first by their relative position, normally the younger, upper drift is superimposed over the older, lower drift. Color and texture are the next considerations: the older drift is fine-grained and in shades of gray; the younger drift is often coarser and more in yellow-brown hues. The colors depend on grain size and mineral content. The upper drift is rich in granitic rock debris owing to its northerly source areas in granitic terrane, and it has abundant till stones and erratics. In this context, "granitic" is used as an arbitrary category that includes rocks with similar color and mineral content, such as granite, granite gneiss, pegmatite and quartzite. The darker color of the lower drift may also be related to clay content.

The oldest sedimentary deposits in the region are beds of sand, clay and gravel of Cretaceous age, which may appear as masses of sediment thrust into the moraines by the last glacier. The Cretaceous clasts were moved by the glacier from the edge of the uptilted strata now submerged beneath Long Island Sound north of Long Island. Next, the lower drift unit is comprised of till, often a variety known as basal or lodgement till, deposited and compacted beneath the glacier. The lower drift may be in place where it was deposited, or as deformed masses of sediment, detached from the main body of drift and ice shoved. Blocks of this sediment have been ripped-up, thrust and engulfed in the outwash of the younger drift. Lake sediments in the lower drift include banded clays that appear as tightly-folded, thin-bedded sequences.

In the upper drift, outwash beds may slope away from the ice or may be folded, steeply inclined, and intercalated with thrust Cretaceous beds and lower drift. The most common, upper drift till is meltout till, which as the name implies has melted out of the ice. It may be partly washed by meltwater, but is still more or less unstratified. Meltout till may overlie outwash and may vary in thickness from several feet to thin layers of till stones. Till interbedded with outwash may be flow till, a variety that flowed in thin layers from the ice along with sand and gravel, or beds of lake clays homogenized by thrusting.

The outwash consists of lenses of sand and gravel coalesced into outwash plains, kames or crevasse fillings, deposited adjacent to or within the glacier by meltwater streams. Fan-shaped deposits of outwash along the ice margins are the heads of broad outwash plains like the main, late Wisconsinan outwash plain of southern Long Island. Some sand and clay layers are deposited from the ice into proglacial lakes to form kame deltas or in lakes away from the ice margin to form deltas. Due to glacial deformation, exposures of glacial deposits may vary in thickness and structure and may change in complexity as coastal erosion and slumping alter dimensions and form, even though the relative position of the beds remains the same.

Postglacial, wind-blown silt, called loess, is found in thick layers covering the glacial deposits. The loess can be a few feet thick and may contain old soil profiles, or paleols, buried under recent sand dunes. Beach deposits, excluding flotsam, are the result of the interaction of coastal processes and the erosion of bluffs. On beaches that lie below bluffs, berms of coarse gravel, erratics, slump blocks with masses of sediment and vegetation, and slides of sediment from high up the cliffs are common. This eroding part of the coast is in the process of nourishing the beaches. The condition of beaches can also vary with the season or sequence of storms; sand won from the headlands may be pushed ashore by gentle summer waves; massive erosion of beach sand, dunes, and coastal structures usually follow a storm.

This overland trip reveals many surface features resulting from glacial deposition and erosion. The sediments at the surface are likely to be those of the upper drift. The terrain of glacial deposition, erosion, and recessional features, such as meltwater channels, proglacial lakes and ice-contact deposits, is as distinctive as the hummocky topography of the moraines. The moraines form an upland with a crest or ridge line and slopes-- the one facing the glacier is the proximal slope, the one facing away is the distal slope. In addition to these features, the landforms have also been modified by postglacial fluvial erosion and deposition and the formation and movement of sand dunes. These all combine to make the overland geology a fascinating complement to that encountered along the coasts.

## **FIELD TRIP I: DEGLACIATION OF CENTRAL LONG ISLAND**

This trip covers the geology of a south to north transect through the sequence of late Wisconsinan glacial deposits--the Terminal Moraine, Recessional Moraines, Outwash Plains, Proglacial Lakes and a Prominent Meltwater Channel-- in central Long Island. The Connetquot River, which drains southcentral Long Island from north to south, and the Nissequogue River, which flows through northcentral Long Island from south to north, have nearly coalescing drainage basins in central Long Island (Figure 1). The route of this field trip crosses, from south to north, the USGS 7.5' Quadrangle Maps: Bay Shore East, Central Islip and Saint James. These two underfit rivers together cinch the waist of Long Island and reveal an intriguing stream valley system that originated as a late-glacial meltwater channel draining a series of proglacial lakes north of the terminal moraine, flowing through a gap in the moraine and across the outwash plain and continental shelf.

The trip straddles the arbitrary geographic boundary between eastern and western Long Island. Geologically, it is situated east of the late Wisconsinan Interlobate Zone between the Hudson and Connecticut glacial lobes in the vicinity of Huntington. The Interlobate Zone resulted in the complex of interlobate morainal deposits, meltwater channel gravels and proglacial lake, deltaic beds that make up the north-south range of hills: Manetto Hills, Half Hollow Hills and Dix Hills. The route of the field trip lines up roughly with the axis of the last interlobate angle between the receding glacial lobes and trends northward toward the interlobate angle formed at the inferred junction of the Sands Point Moraine of the Hudson Lobe and the Roanoke Point Moraine of the Connecticut Lobe projected beneath Smithtown Bay (Figure 2). The deposits were eroded by meltwater flowing

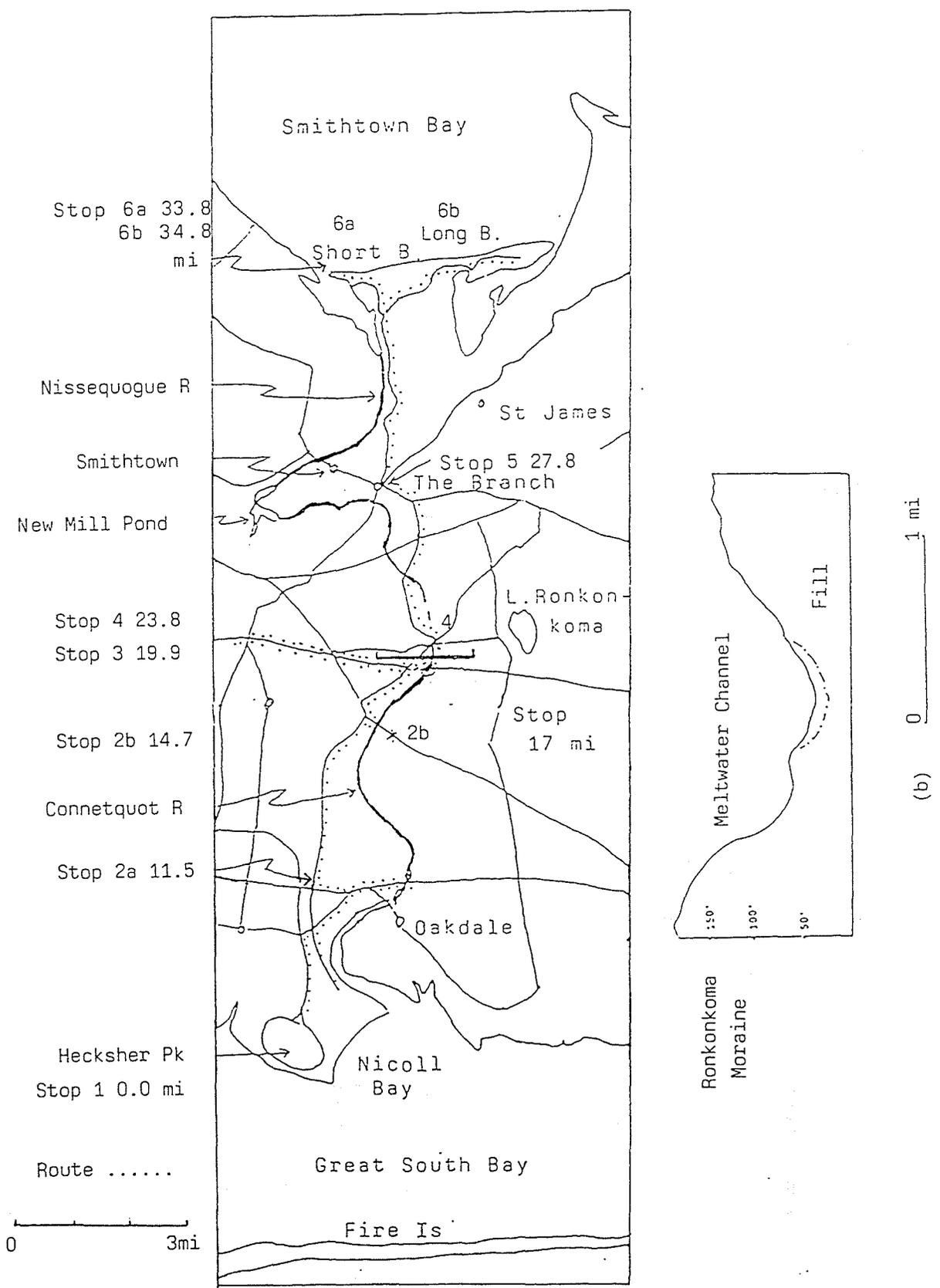
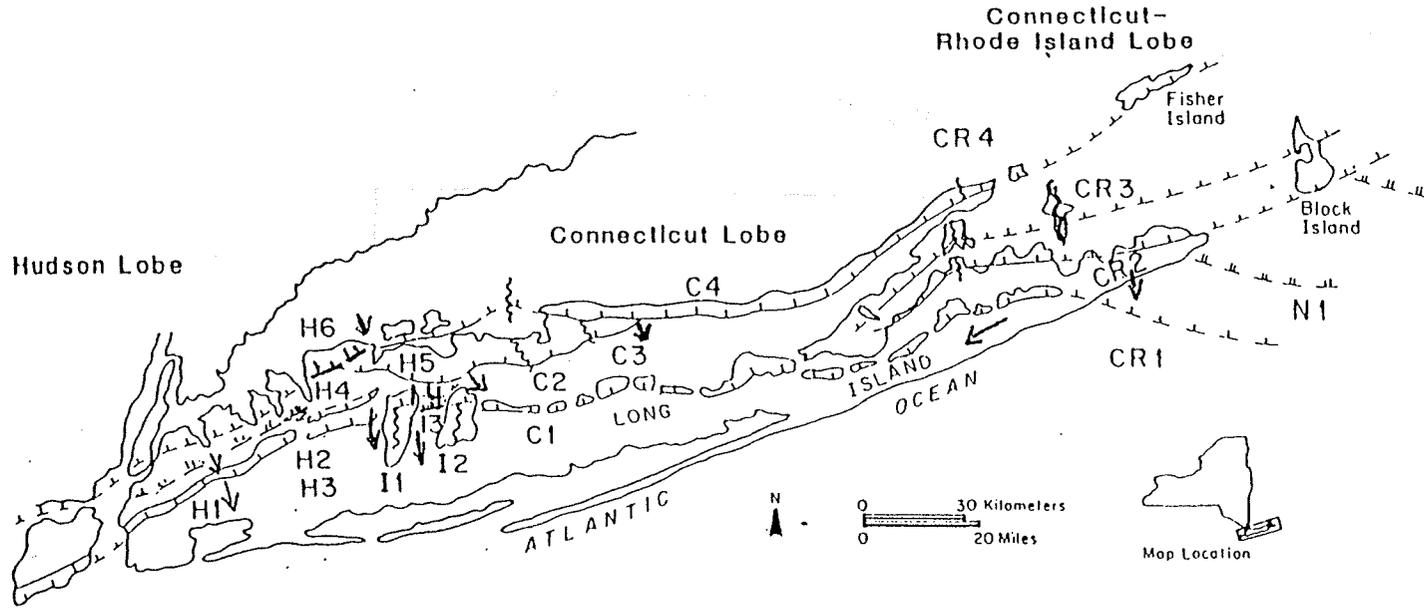


Figure 1. a) Route of Field Trip 1; b) Valley Profile (\_\_\_\_\_).

Figure 2. Long Island Moraine Map.



Map of Long Island glacial end and recessional moraines and the relative positions of glacial lobes, keyed as follows:

- H1 Harbor Hill Moraine
- H2 Jericho Moraine
- H3 Old Westbury Lobe
- H4 Oyster Bay Moraine
- H5 Northport Moraine
- H6 Sands Point Moraine

Interlobate Moraine

- I1 Manetto Hills Lobe
- I2 Dix Hills Lobe
- I3 South Huntington Lobe
- I4 High Hill Interlobate Moraine

Connecticut Lobe Ice Margins

- C1 Ronkonkoma Moraine - Shinnecock Moraine
- C2 Stony Brook Moraine
- C3 Mount Sinai Moraine
- C4 Roanoke Point Moraine

Connecticut Lobe and Eastern Connecticut - Western Rhode Island Ice Margins

- CR1 Amagansett Moraine
- CR2 Sebonack Neck - Noyack - Prospect Hill Moraine Envelope
- CR3 Robins Island - Shelter Island - Gardiners Island - Moraine Envelope
- CR4 Roanoke Point - Orient Point - Fishers Island Moraines

Narrugansett Lobe

- N1 Montauk Point (Altonian?)

southward from the proglacial lakes, the last is now Long Island Sound, and later submerged by the rising postglacial sea.

While the Connetquot and Nissequogue rivers seem to originate miles apart, as depicted on the topographic maps, their valleys begin on either side of a divide located near a broad gap in the Ronkonkoma Moraine, the terminal moraine, both at elevations of about sixty feet. They are separated by a tract of pitted outwash and meltwater channel deposits formed on residual ice. The two valleys have meandering stream patterns and are incised north and south of the gap into outwash and lacustrine deposits. If interpreted as a single meltwater channel that traversed the Island from north to south, the combined river valley reveals a broad meander pattern eroded into the glacial deposits that form its outside banks. The origin of this drainage is interpreted from the geomorphology and sedimentary deposits of this area.

Stop 1. 0.0 miles. The trip starts at the entrance to Heckscher State Park (Bay Shore East Quadrangle). Follow the roadway loop through the park for four and one-quarter miles.

0.0-5.6 miles. The late Wisconsinan outwash plain underlies the park, salt marshes and the bay to the south. A filled-in, crescent beach forms the south shore of the park. The Connetquot River estuary drains into Nicoll Bay over one mile to the northeast, but prior to Holocene submergence the river probably meandered to the southwest against the Heckscher shore. A few miles to the south, Fire Island forms the barrier beach that encloses Great South Bay.

5.6-5.7 miles. Turn right on Rt 27 and then right again on Great River Road. Great River Road follows the west bank on the outside curve of the southernmost meander of the river, beginning south of Sunrise Highway. The west bank is the steep side (outside) of the meander loop, and it rises about fifteen feet above the river. The topography of the river valley is somewhat obscured by development. Turn around near the golf course and proceed northward to Montauk Highway, Rt 27A.

7.9 miles. Turn right (east) on Rt 27A, essentially following the meander curve but well above the cut bank.

**Note:** the field trip follows the meanders of the meltwater channel valley in the direction of glacial recession and against the direction of late-glacial meltwater discharge. North of the terminal moraine, the meltwater channel meandered and lengthened as the ice front receded and tributary channels drained proglacial lakes.

9.4 miles. Junction with Sunrise Highway, Rt 27. Turn right (east) on Rt 27 and cross the Connetquot River valley near Lower Pond. The river has been dammed here to form Lower Pond and East Pond. The river bottom is partially hidden by development and highway ramps to the south. To the north, stands of trees and shrubs mask the ponds and the channel. At the next stop light turn left (west) on Rt 27. Proceed westward toward Connetquot Avenue.

Stop 2a. 11.5 miles. Turn right (north) on Connetquot Avenue. Stop where convenient to become oriented to the terrain. Note that while the river meanders are easily followed on the topographic map, extensive housing development hides the valley. The road follows the western margin of the Connetquot valley, passing the Bayard Cutting Arboretum and the Connetquot State Preserve (Central Islip Quadrangle). The Connetquot River, while gently meandering on its flood plain, has been dammed for mill ponds and a fish hatchery. A well defined, west-trending valley meander forms the river's reach and a low eroded bank in the outwash between the Long Island Railroad tracks and the village of North Great River. But it is against the easterly bend of the valley, located in the State Preserve to the south, that meltwater carved a twenty foot escarpment. The breadth of the valley meanders compared with the width of the Connetquot channel shows the river to be decidedly underfit in this segment. Evidently, a much more robust, meltwater-laden river established the meander pattern and shaped this much broader valley (Figure 1b). The fifty-foot contour line and the adjacent contour lines outline the valley morphology from meander to meander northward from the State Preserve to the Ronkonkoma Moraine.

14.5 miles. Connetquot Avenue turns right.

Alternate Stop 2b. Junction with Veterans Memorial Highway, Rt 454. Bear right on Rt 454 about 0.2 miles to sign: "Headwaters of Connetquot River." The valley can be entered from a gate east of the sign with permission from the State Park Preserve, as indicated. Turn back (northwest) on Rt 454.

15.2 miles. Turn right (northeast) on Nichols Road which crosses the outwash plain between the Ronkonkoma Moraine to the north and the rapidly narrowing river valley to the east (Figure 3a).

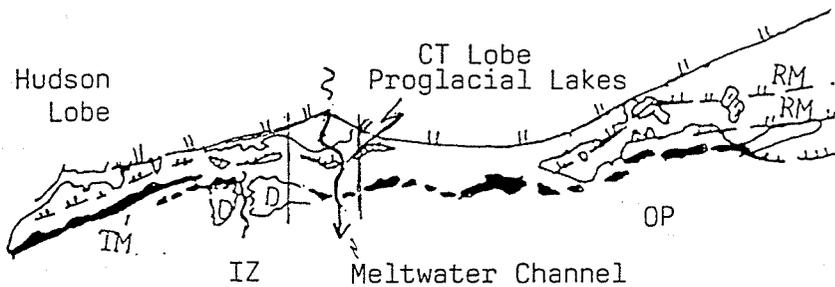
16.5 miles. The Long Island Expressway, Interchange 58. Enter the LIE, westbound ramp.

19.5 miles. Exit the LIE at Interchange 56. Turn left (south) on Rt. 111 for 0.2 miles.

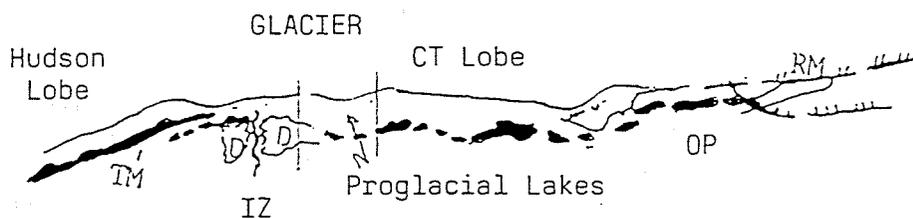
Stop 3. 19.9 miles. Turn right (west) on Central Avenue; proceed for 0.2 miles to sand pit in the Ronkonkoma Moraine. Walk to the west to the remnant exposure in the extensively mined and once two hundred foot high segment of the Ronkonkoma Moraine. Here about twenty feet of outwash is capped by a thin (two to four foot) layer of brown sandy and gravelly till. Erratics are scarce. The thin soil horizon (A?) at the top is formed on loess (Figure 4).

20.3 miles. Return to the LIE, eastbound.

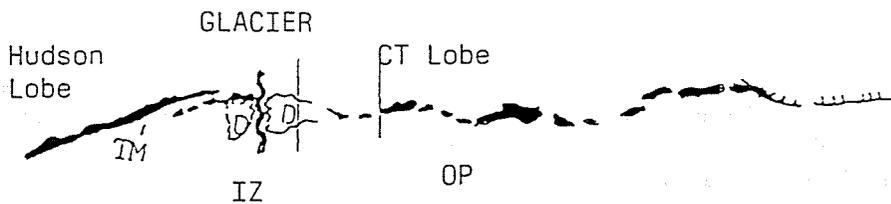
23.3 miles. Exit the LIE at Interchange 58. Turn left (north) on Nichols Road.



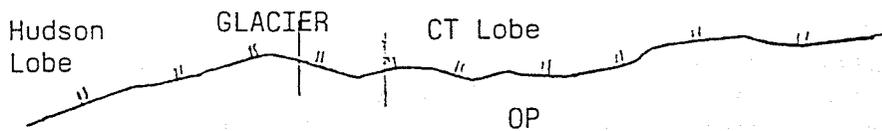
d) Sands Point, Roanoke Point Ice Margin, ca 20 ka



c) Oyster Bay, Northport, Stony Brook, Mt Sinai Ice Margin

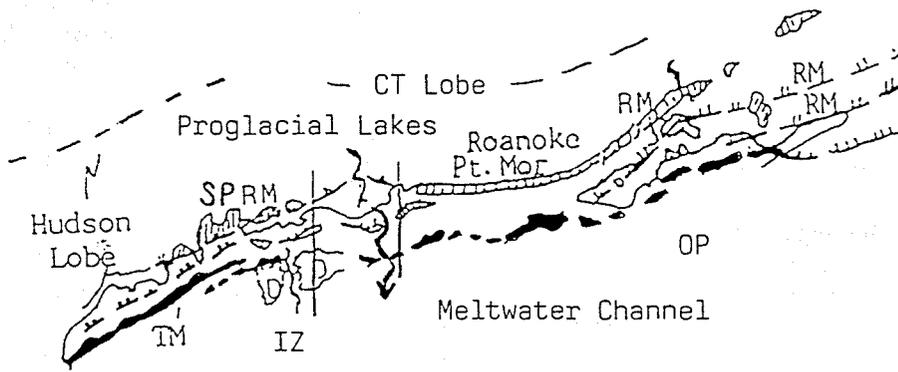


b) Late Wisconsinan Terminal Moraine

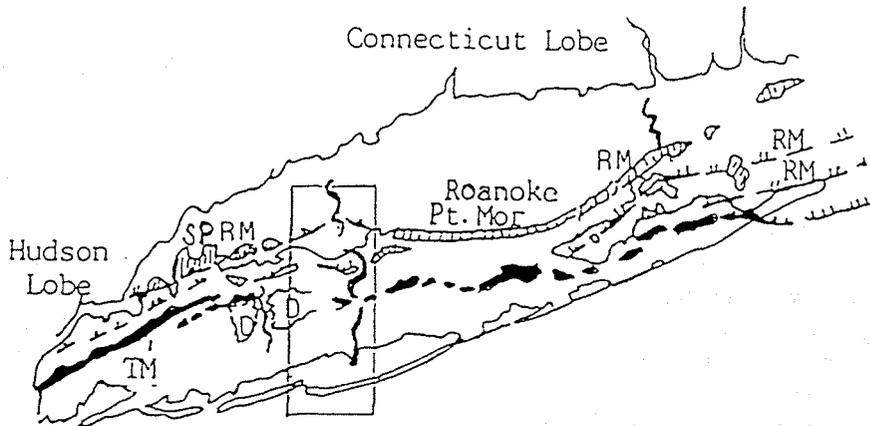


a) Late Wisconsinan Ice Margin, ca 22 ka

Figure 3 a-f. Moraines, Ice Margins, and Proglacial Lakes in Central Long Island.



e) Sands Point, Roanoke Point Recessional Moraines, ca 20 ka

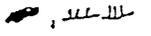
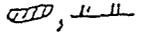


f) Long Island Moraine Map

Legend:

IZ- { - Interlobate zone; D: Delta

0 50 mi

TM: Terminal Moraine   
 RM: Recessional Moraine 

 FIELD TRIP AREA

OP: Outwash Plain

Figure 3 a-f. Continued.

Stop 4. 23.8 miles. Roughly where Nichols Road, Terry Road and Vanderbilt Motor Parkway converge in a triangular intersection, about 0.4 miles north of the Long Island Expressway, Rt 495, the headwaters of the Connetquot River drainage are now buried under the roadways. The watershed begins in a significant gap in the Ronkonkoma Moraine. Stop, if traffic allows, as near the gap as possible, even though roads and residential development obscure the view. The late-glacial meltwater channel was incised through the moraine as meltwater carved an easterly meander sixty feet above present sea level (Figure 1b). In a short excursion to the east, Vanderbilt Motor Parkway ascends the Ronkonkoma Moraine (Figure 3a and b). To the west, the Parkway crosses the gap and climbs the meander-scarred moraine--although not easily seen due to the highly suburbanized character of the terrain.

23.9 miles. Turn left (northwest) on Terry Road. The road goes up a hill that follows the meander scar. The evidence of meander erosion shows that meltwater flowed at this higher elevation during the interval of valley widening. Upstream, the valley turns sharply from the northwest against the steep proximal slope of the moraine, incised by a seventy foot-high meander scar.

The northern half of this meltwater-formed meander has become, in the context of the modern drainage, the headwaters of the north-flowing Nissequogue River drainage, a region of wetlands and ponds within the fifty-foot contour line. The river valley casts two broad meanders over the relatively flat basin enclosed by the Ronkonkoma Moraine to the south and the recessional moraines of the last glaciation to the north--the Stony Brook Moraine to the northeast and the Northport Moraine to the northwest). These moraines may be recessional moraines of the Connecticut and Hudson lobes of the glacier, respectively, or segments of the moraine of a sublobe of the ice front that formed between the main lobes at this stage of glacial recession (Figure 3c and d). This lowland, characterized by meanders incised into a plain of low relief, wetlands and pitted outwash, is underlain by lake clays deposited on the floor of a proglacial lake formed between the terminal moraine and the ice front during deglaciation. Continue northward on Terry Road from the intersection.

24.9 miles. Intersection with Town Line Road. Terry Road enters hummocky, stream-dissected and kamic topography north of the Ronkonkoma Moraine.

25.9 miles. Intersection with and merge left into Smithtown Blvd.

26.4 miles. Intersection with Rt 347, Nesconset-Port Jefferson Highway.

26.8 miles. Note the exposure of a dissected kame or outwash fan on the east side of Terry Road.

27.0 miles. Another possible dissected kame or outwash fan can be seen on the north side of the junction of Terry Road and Rt 25, Middle Country Road. Eroding sand and gravel forms the slopes.

27.2 miles. Intersection with Middle Country Road, Rt 25. Turn left (west) on Rt 25.

Stop 5. 27.8 miles. Junction of Rt 25 with Rt 111, Rt 25A and Nissequogue Road in the village of The Branch, just east of Smithtown. Stop where convenient to consult the topographic map (Central Islip Quadrangle), get your bearings, and consider these features. Terry Road and this segment of Rt 25 follow the edge of a proglacial lake basin that formed between the Ronkonkoma Moraine and the receding ice front during the late Wisconsinan. The roads curve against the meander-cut valley wall. The underfit channel of the Northeast Branch of the Nissequogue River first wanders northward through (former) wetlands before making a broad northward curve.

The channel is divided into several small ponds formed from dammed-up stream segments. It then heads westward, south of Smithtown, to New Mill Pond, also the result of a dam, and then turns northward across the flat channel bottom and flood plain deposits where the valley narrows significantly. While clearly seen on the topographic map, the channel is obscured on the east side by housing, office buildings and a shopping center. The poor drainage on the proglacial lake-bottom clay beds, cf. the Smithtown Clay, of late Wisconsinan age, serves as a reminder of the geologic history of this lowland. Emerging from the lake basin southwest of Smithtown, the valley turns northeastward. The narrow river channel is incised into the outwash with high banks on either side. The river can be seen south of and parallel to Rt 25, west of the Rt 25-Rt 25A fork, west of Smithtown, where it flows northeastward through a young hardwood forest established on the flood plain. It then crosses Rt 25 just east of the Rt 25-Rt 25A fork, about one mile west of the Rt 111 intersection.

The narrow valley persists through a broad eastward meander north of Smithtown where the meltwater channel cut through the recessional moraine. The modern Nissequogue River actually meanders in a confined belt on its own marsh-covered flood plain, but through steep valley walls of the meltwater channel up to one hundred feet high. The river becomes tidal near Mill Creek, and tidal flats cover channel deposits northward to the river mouth. Where the Nissequogue River enters Smithtown Bay, it is restricted by sand bars from both the east and west sides. On the east side, a northwest-hooking spit, Short Beach, indicates the dominant direction of littoral drift. The spit has forced the river outlet to bend further westward; the west sand spit has, in turn, confined the westward discharge.

A proglacial lake basin extends to the northeast and underlies much of the Saint James region. This basin drained, in part, to the southwest via narrow channels into the Nissequogue meltwater channel in the Village of the Branch and Smithtown, and eroded the interfluvies into narrow ridges. One such ridge was described by Fuller

(1914) as an esker which bordered a driftless area [i.e. the proglacial lake bed of the current model] and was somehow seen as evidence of the greater age of that terrain.

27.9 miles. Immediately after crossing the intersection take the left fork, Nissequogue River Road, and proceed northward (Saint James Quadrangle). Pass the old cemetery on the right.

Within a short distance, the road rises onto the distal slope of the recessional moraine, the Stony Brook Moraine. The river lies near the interlobate angle, but Nissequogue River Road and adjoining roadways cut through successive, washboard ridges and swales of the Stony Brook Moraine for over three miles between here and the north shore. This segment of the Stony Brook Moraine is typically hummocky and has a number of kettles. The east-west washboard texture is probably the result of stillstands of the ice front during recession and postglacial channel deepening.

30.1-30.4 miles. A good view of the river to the west (left) and the eroding roadcut in the moraine on the east (right) side. Merge with River Road.

30.8 miles. Views of Nissequogue tidal estuary to west.

32.4 miles. River Road intersects Moriches Road.

Route to Stop 6a. Northwest to Short Beach. Bear left into Horse Race Lane, and then Boney Lane at 32.9 miles.

33.6 miles. The road descends the kame moraine to the level of the salt marsh, and then enters Smithtown Short Beach.

Stop 6a. 33.8 miles. Park and walk to the beach. Consider the variety of coastal landforms. To the southwest, a bluff has been cut into the moraine by coastal processes. To the northeast, you can see the topography of the Roanoke Point Recessional Moraine forming distant bluffs on the Old Field headland. The successive ridges of this eroded westernmost extension of the moraine are apparent from this perspective. Try to imagine the confluence of the Roanoke Point and Sands Point moraines to the north in what is now Smithtown Bay in late-glacial time before the deposits were erased by meltwater streams and later by coastal currents. To the east, large erratics in the Bay are a reminder of the continuing erosion of the moraine and recent increments of sea level rise. Today, bay currents are dominantly east to west along this beach.

From the parking lot follow the dune ridge westward to the river edge and the boat ramp.

34.0 miles. Here you can observe the estuary and the meanders of the meltwater channel valley south of the Short Beach spit. The Nissequogue River estuary, the drowned and silting mouth of the north-flowing river, is confined by two sand bars. Short Beach trends east to west and then northwest on the east side and forces the river to the northwest; the opposing Sunken Meadow Beach on the west side channels Sunken Meadow Creek eastward parallel to the bar and into the estuary.

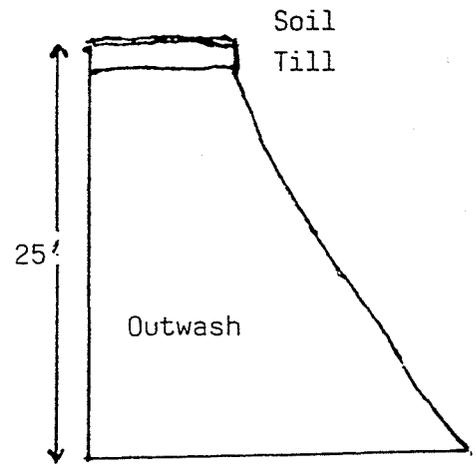
Route to Stop 6b. Northeast to Long Beach.

32.4 miles. Right on Moriches Road.

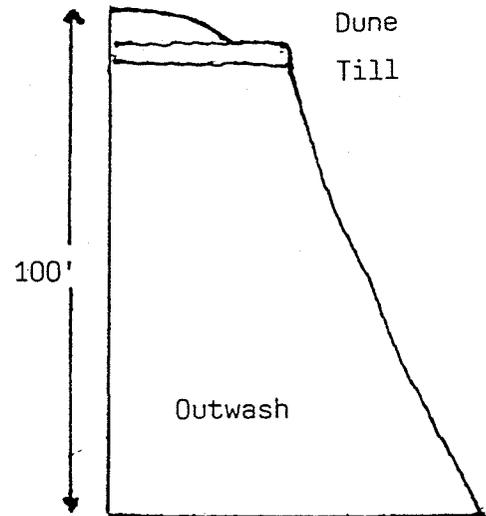
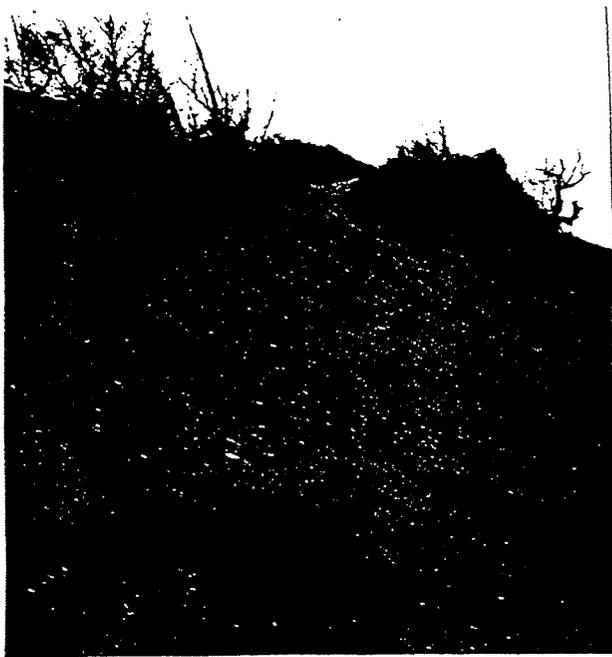
32.9 miles. Left on Long Beach Road. Long Beach Road cuts northeasterly across the last prominent ridge of the Stony Brook Moraine.

Stop 6b. 34.8 miles. The eroded edge of the moraine, at the base of Long Beach, reveals a 100' high bluff with an exposure of thin (2-4 ft), sandy meltout till over outwash, capped by 5-10 ft high sand dunes (Figure 4).

Stop 6b. 34.8-36.3 miles. Long Beach. Stony Brook Harbor, the mouth of a north-trending stream valley cut into the Stony Brook Moraine, is diverted eastward through Porpoise Channel by the one and one half mile long, Long Beach sand bar. This estuary is also silting in. On the east side of Smithtown Bay, Long Beach forms a narrow inlet along with West Meadow Beach, a spit that trends southward along the Setauket coast from the distal margin of the Roanoke Point Moraine at Old Field to the northeast. The Roanoke Point Moraine forms the headland in a series of washboard ridges. As mentioned, the geographic extension of the trends of the Roanoke Point Moraine from the east and the Sands Point Moraine from the west meets in an interlobate angle near the northcentral margin of Smithtown Bay (Figure 3d-f).



a) Ronkonkoma Moraine, Islip.



b) Stony Brook Moraine, Long Beach

Figure 4. Stratigraphy and Cross Sections of the Terminal and Recessional Moraines.

Additional Readings:

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Fuller, M. L., 1914, The Geology of Long Island, New York. U.S. Geological Survey Professional Paper 82. 231p.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions.

2. It is essential to ensure that all data is entered correctly and consistently to avoid any discrepancies.

3. Regular audits should be conducted to verify the accuracy of the records and identify any potential errors.

4. The use of standardized procedures and protocols is crucial for maintaining the integrity of the data.

5. It is also important to ensure that all records are properly stored and backed up to prevent data loss.

6. The document concludes by emphasizing the need for ongoing training and education for all staff involved in the process.

7. Finally, it is noted that maintaining accurate records is a key component of effective financial management.