

# THE MORPHOLOGY & STRATIGRAPHY OF THE JERICHO MORaine, NASSAU COUNTY, N.Y.

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## Overview

In the 100+ years since the publication of “The geology of Long Island, New York” by Myron L. Fuller (1914), many geologists have followed with their interpretation of his results using new information and techniques. This has led to a much better understanding of the island’s geological history. Today, the big picture of events is generally understood and accepted, however, the devil is in the details - and glacial geology is full of details. One big problem is the lack of continuity of strata over relatively short distances, especially in depositional environments near glacial margins where conditions can change from season to season and year to year. The erosion of coastal cliffs during a storm, road widening projects, or bulldozing for new developments all provide opportunities for study that often pass without notice by glacial geologists.

## Introduction

This report was stimulated by field work in 2004-06 on the Jericho Moraine in Jericho, New York. Excavations for a housing development revealed a unique sequence of glacial drift deposits unlike any seen on Long Island by the author in over 45 years. In addition, the morphology of the Jericho Moraine is discussed in relationship to the adjoining Harbor Hill and Ronkonkoma moraines. And, other glacial drift sequences in northern Nassau County are described and related to the stratigraphy at the Jericho site.

## Morphology

The Jericho Moraine (Sirkin, 1982), (previously described as the western-most segment of the Ronkonkoma Moraine) is an end moraine segment that extends 12 miles (19 km) from the Manetto Hills westward to Lake Success where it is covered by the younger deposits of the Harbor Hill Moraine. East of this intersection, the Harbor Hill and Jericho moraines run parallel to each other in a WSW to ENE direction. They are separated from each other by one to two miles of “pitted outwash plain” (Swarzenski, 1963) so named for the numerous kettle ponds that dot the surface. South of the Jericho Moraine, outwash plain deposits consisting of coalescing alluvial fans, cover the land surface to the south shore of Long Island where they are submerged under back-barrier lagoons. The orientation and juxtaposition of the two moraines and the southern outwash plain shows that the Jericho Moraine marks a terminal position of a glacial advance east of Lake Success, while the Harbor Hill Moraine marks the terminal advance across Queens and Brooklyn.

Utilizing Digital Elevation Models (DEM), the eastern end of the Jericho Moraine disappears as a recognizable topographic feature at the northern end of the Manetto Hills east of Woodbury, NY. In addition, outwash fan deposits, originating from the Harbor Hill end moraine to the north, separate the Jericho segment in the Manetto Hills from the western end of the Ronkonkoma Moraine that DEM show as a clearly defined topographic ridge beginning east of the Dix Hills near the Sagtikos Parkway. This leaves a ten mile gap between the Jericho and Ronkonkoma moraines in an interlobate zone where the glacial deposits are draped over Cretaceous sediments that form the core of these north/south trending hills (Manetto, Dix, & Half Hollow).

Where the Ronkonkoma Moraine emerges east of the Dix Hills it exhibits a more easterly orientation from the WSW-ENE strike direction of the Jericho Moraine. This change of direction makes it most likely that the Jericho Moraine was deposited at the terminus of a glacial lobe centered in the Hudson Valley while the Ronkonkoma Moraine marks the southern-most advance of the much broader Connecticut lobe that extended across Suffolk County as far east as the Montauk Peninsula.

The Jericho Moraine is best observed in a large field just west of the intersection of Routes 106 & 107 and north of Route 25 in the village of Jericho. The undulating land surface features numerous kame-like hills interspersed with kettle ponds that form a typical “knob and kettle” topography. Fortunately, about 70 acres of this landscape, have been protected by New York State, Nassau County, and the Town of Oyster Bay as the “Underhill Preserve” for a nature sanctuary and groundwater recharge area.

Topographically, the hummocky hills appear to be typical kames consisting of stratified drift that was deposited by meltwater streams adjacent to a glacial margin. In 2004 - 06, a portion of the moraine was developed for residential housing. This produced several excavations where the stratigraphy of the glacial deposits was exposed to a depth of from one to three meters. It was surprising to find that rather than consisting of stratified water-laid sediments the hills are comprised mostly of till. In fact, there are two distinctively different tills, the upper one lying directly above the other.

### Stratigraphy

The upper (surface) till varies from 1 – 2 meters in thickness, it is medium brown to gray-brown in color, with abundant pebbles and cobbles (mostly quartz) and a few small boulders, also quartz. Beneath this till, and in direct contact with it, is a second till with a very different appearance. This lower till is predominately comprised of medium to fine sand that is light orange-brown in color, with irregular light tan- colored streaks and thin lenses of silt and clay. There are a few pebbles and rare cobbles. In some exposures there is evidence of small scale

deformation probably caused by ice movement above the till. Up to one meter was exposed in bulldozer cuts but the bottom of the layer was not revealed so the total thickness is undetermined.

In addition to the two tills, there was an outcrop of stratified sand, pebbles and cobbles that appeared to lie below a surface till resembling the lower till described above. The limited exposure made it hard to relate this to the two till sequence seen at other locations but it might be evidence of a thin till draped over a kame. Finally, there was one boulder of significant size (2.5 meters) that presumably was excavated from the upper till. Boulders this large are common in the ground moraine and beaches of the north shore “necks” but they are extremely rare this far south of the Harbor Hill Moraine.

### Discussion

Two till sequences are found at a number of locations on Long Island from Port Washington to the west and Montauk Point and the North Fork to the east. At most locations, the lower till is grayish in color, very dense, and it lacks large boulders. When it erodes it forms characteristic badlands topography with sharp “hoo-doo” ridges and pinnacles. The implication is that this lower (older) till was compacted when it was overridden by one or more subsequent glacial advances. The upper till is browner in color, less compacted and loaded with boulders of all sizes. There is general agreement that this till and associated stratified drift was deposited during the Late Wisconsinan, Woodfordian Substage and that it represents the final ice advance on Long Island reaching its maximum about 22,000 ybp (Sirkin, 1982). The age of the lower till is uncertain with some geologists favoring an Early Wisconsinan date and others an Illinoian age.

On Manhasset Neck, a two drift sequence of outwash-till, outwash-till has been described by many observers (Fuller, 1914; Mills & Wells, 1975, Sirkin & Mills, 1975; and others). In these outcrops the upper (surface) till is separated from the lower till by 15 meters or more of stratified sand and gravel. Both tills are widely distributed in northern Nassau County. The upper till covers most of the land surface north of the Harbor Hill Moraine. The lower till is observed in former sand mines along the west shore of Hempstead Harbor and in wells that penetrate the upper drift deposits as far south as the Ronkonkoma [*here called Jericho*] Moraine in Albertson (Swarzenski, 1963).

During the widening of the Northern State Parkway in 1967, the lower till was briefly exposed south of the Harbor Hill Moraine in Roslyn Heights revealing a 10-12 foot thick, light gray, compacted till with no large boulders. This strata occurs between 100 – 120 feet above MSL in both the sand mines north of the Harbor Hill Moraine and in the parkway excavation south of it. This provides direct evidence that the till occurs as a continuous unit under the massive pile of sediments that make up the Harbor Hill end moraine. Perch water bodies, attributed to the

presence of the lower till, commonly are recorded in well logs as far south as the Jericho Moraine.

This dense, gray till was not observed at the Jericho site where the surface elevations are 200 feet above MSL. Evidence that a compact sub-surface till may be present at greater depth is the inclusion of the Jericho site in the region north of the end moraine where perched water is common (Isbister,1966).

The lower till in Jericho is unlike other tills described on Long Island. It is loosely consolidated, multi-colored, contains scattered stones and exhibits structures typical of small-scale deformation. It is proposed that this is a till of limited extent that formed in an ice-marginal environment where thin ice was wasting and both stratified and unstratified drift was deposited simultaneously. Since the lower till is not compacted it may have been deposited as an ablation deposit from stagnant ice similar to the "soft till" described in New Hampshire by Drake (1971). Meltwater ponds adjacent to the ice may have supplied some of the fine sediments found in this layer but it does not have the appearance of a glacial lake deposit (ie: not enough clay, no varves, wrong color). The orange color of the lower Jericho till is uncharacteristic of most glacial drift found on Long Island and the oxidation is too extensive to represent a "B" horizon in a soil profile.

### Conclusions

To explain the origin of this unique till, one must look beneath the land surface to find the source of sediments that make up the layer. Subsurface contours on the Magothy Formation (uppermost Cretaceous) show that the top surface of the Magothy is 200-220 feet above mean sea level (MSL) in the site area (de Laguna & Perlmutter, 1949). This places it very close to the land surface that tops at 200-231 feet above MSL. It is logical to assume that unconsolidated Cretaceous sediments were scraped up and re-worked to form a till layer of limited extent near the ice-margin. Fine to medium sand, with silt and clay lenses, and the oxidized, multi-colored appearance are all consistent with known Magothy outcrops and well records on Long Island.

The last glacial event in Jericho was the deposition of the upper ablation till on top of the lower till. Unlike other two till sequences found on the island, there was little compaction of the lower till and apparently no significant gap in time between the deposition of the two layers. This can be explained if the glacier that deposited the upper till was thin near its margin and did not cover this area for any significant length of time.

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