A Study of Erratics on the Ronkonkoma Moraine in Eastport, Long Island

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Introduction

The presence of erratics in a landscape is an indicator of past glacial activity in that area. Long Island's erratics have been intensely studied to aid in determining a more precise glacial history for the area. The mineralogy and composition of erratics can point to a terrane source, thus indicating flow direction of the glacier. Roundness and shape of erratics can determine how far the boulder has traveled. Several studies have shown that erratics that are transported at the base of a glacier would travel no more than 20 miles before they are abraded and broken. (Pacholik and Hanson, 2001 and Pacholik, 1999). It is no surprise then that most of Long Island's largest erratics are located on the north shore (on or near the Harbor Hill Moraine) since the presumed ice flow of the last ice age (Wisconsian) was overall from north to south. A study of large erratics on the south shore (on or near the Ronkonkoma Moraine) of Long Island would give researchers more information about Long Island's glacial history but has been hampered by their scarcity. This paper details boulders located in Eastport, New York by the three authors and suggest that further study of these boulders could lend new theories to Long Island's glacial past.

Historical Background

The unresolved controversy surrounding the timeline and sequence of Long Island's topographical glacial advances have stirred debate amongst scientists and historians over the past century. This debate on Long Island's glacial history has had varying viewpoints throughout the years.

In the 1880's, T.C. Chamberlin developed the "one glacier theory" for Long Island. Though he found evidence for multiple glaciations, he believed that one glacier was responsible for all the features on Long Island today. This theory was and still is still considered valid among many geologists.

In 1914, in M.L. Fuller's *The Geology of Long Island*, Fuller found supporting evidence for four (4) glacial advances, including that the Ronkonkoma Moraine preceded the Harbor Hill Moraine in the historical framework of Long Island's depositional sequence. His interpretation theorized that the moraines were formed during different glacial advances.

Despite Fuller's research and supporting evidence from early researchers, the contemporary view held by most geologists does not agree with his theory. One view developed by Sirkin (1968) believes that the last glacier to pass across Long Island, the "Woodfordian" Glacier, caused both of Long Island's terminal moraines leaving behind a glacially sculpted island in a single advance, further supporting T.C. Chamberin's "one glacier did it all theory" (Sanders, Merguerian, 1998).

Current research on Long Island's formative depositional history is a popular debate to this day. Saunders and Merguerian (1998), more recently concluded that, upon review of all evidence collected, a minimum of two separate glacial events created Long Island's terminal moraines. In describing the provenance of the two terminal moraines, Saunders and Merguerian detail them as glacial deposits from two different transport directions. Furthermore, they state that the "Woodfordian" Glacier event, believed by many geologists to have been responsible for the formation of Long Island's currently seen glacial features, did not reach past Queens and therefore could not be responsible for features found east of Queens. The authors believe that a previous series of glacial advances and retreats first formed the Ronkonkoma Moraine, followed later by the younger Harbor Hill Moraine.

Procedure

Study Area

In an effort to clarify this glacial debate, cosmogenic dating has been done to several north shore boulders (Hanson, 2005). No erratics have been found thus far on the south shore that have been suitable for this type of dating. By examining a DEM of Long Island's south shore moraine (Ronkonkoma Moraine) and through historical research, fieldwork, and local resources, the authors have found several erratics in Eastport that they feel are suitable for dating. Local residents of Eastport are very much aware of their glacial heritage in the form of erratics that pepper their landscape. Rock Hill Golf and Country Club bears out its namesake in its location on the higher elevation of the Ronkonkoma Moraine and in the presence of many boulders. In an historical account from 1895 in the *American Geologist,* Colonel Bryson, an amateur geologist of his time, describes a large erratic atop the moraine overlooking the south shore. (See **Figure 1**.) He calls this boulder, Rock Hill Boulder, which he measured as 50 by 20 feet but estimates it must have been more than 125 by 20 feet before it was locally quarried. Myron Fuller (1914) in his work on Long Island geology also mentions the Rock Hill boulder but adds no new information, apparently acquiring his information from Bryson's accounts.

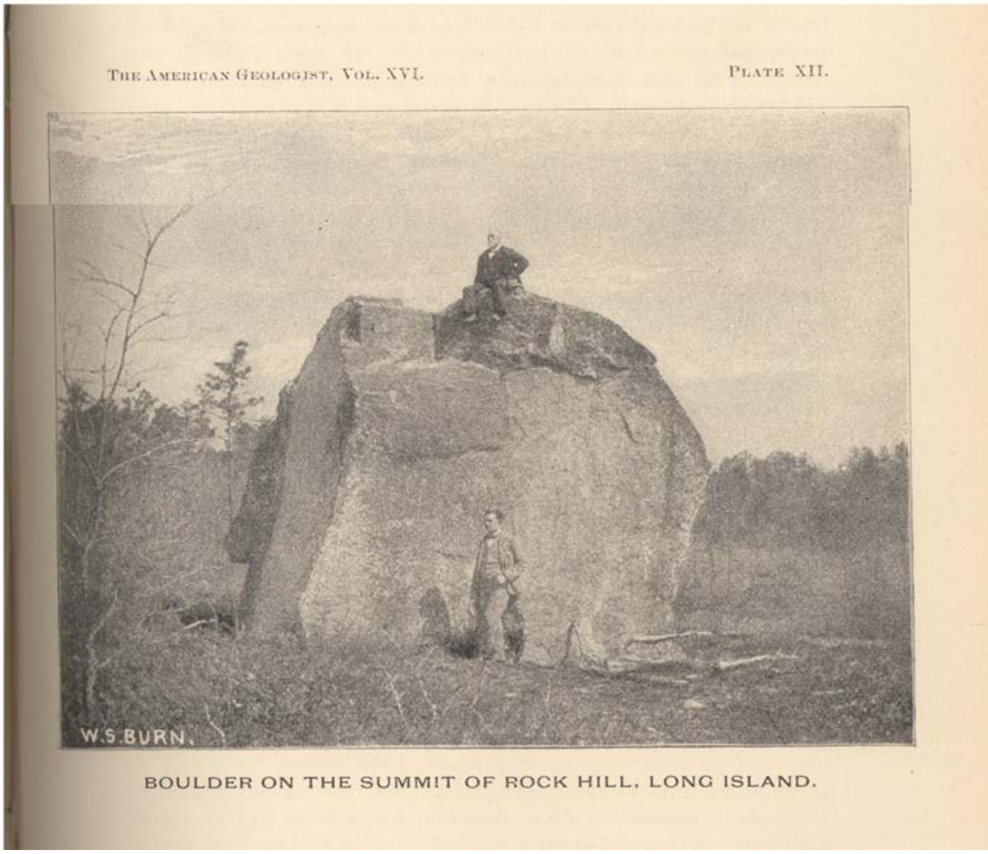


Figure 1. Rock Hill Boulder/ Source: American Geologist, 1895

Figure 2. Authors, 2005

In addition to the historical evidence, DEMs were used to aid in narrowing a search area. DEMs are digital elevation models based on computer generated colored enhanced topographic maps. Combining these features allows for visual understanding of a locality's geographical features and the Ronkonkoma Moraine in Eastport was easily located and chosen for a search area. After many searches, Colonel Bryson's Rock Hill Boulder was located along with many other large erratics in the Our Lady of the Island Shrine. Other erratics were located in the Rock Hill Gold Club. This 2-3 square mile region in Manorville/Eastport yielded a total twelve boulders which the authors deemed suitable for this study.

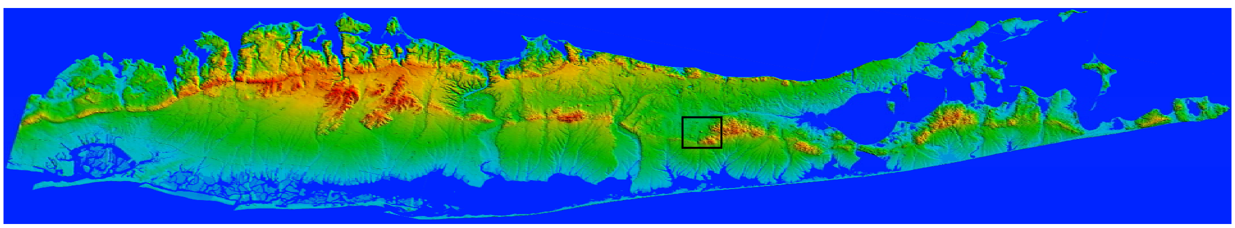
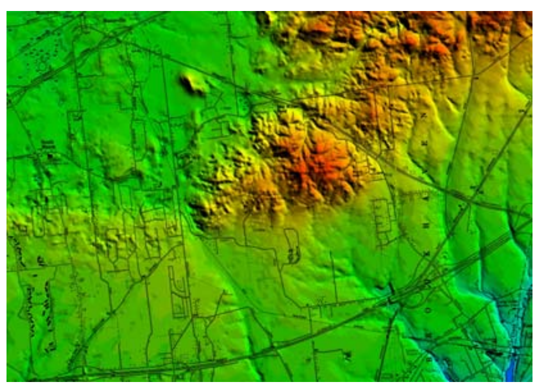


Figure 3.
DEM of Long Island and Eastport. Inset is of Eastport, Long Island, area of study. The DEMs clearly show the southern location of the moraine.

Source: Hanson, G.



Survey Methods

Suitability of Sample Boulders

The boulder sample population was restricted to those greater than one meter in height, due to cosmogenic dating restrictions. Cosmic rays interact with silica and oxygen in the quartz present in the boulders thus producing measurable isotopes. This gives an estimate of the length of time that the surface of the boulder has been exposed. Therefore, cosmogenic dating measures the time a boulder has been in place, not the age of the boulder. Requiring boulders to be greater than one meter ensures that the boulder has not spent a significant amount of time covered by snow. Boulders that had their bases buried in till were considered, allowing for less of the possibility of relocation by landowner or builder. All boulders chosen fell well within the Wentworth classification system measuring greater than 256mm in diameter.

The huge Rock Hill boulder (**Figure 2**) is particularly impressive. The contact horizon where the boulder meets the ground has been paved for practical purposes, as the shrine's outdoor services are held at the base of this boulder overlooking the view toward the southern lowlands and the Great South Bay. Although the surroundings have changed, as can be seen by comparing the photographs, the boulder is clearly the same one that Colonel Bryson wrote about over 100 years ago.

Many boulders were measured that were less than 1 meter, and all may have been resurfaced during excavation, and are not considered to be in-situ. For the purposes of this study, analyzing their size, petrographic composition and relative glacially-traveled distance, in-situ is not of paramount importance.

Measurements and Petrography

In addition to the UTM values, measurements of height, and three axial measurements when possible were recorded. From this data, diameters and classification of shape using Zingg's shape chart were calculated. (See **Figure 4**.) The mineral composition of sample SO-1, (Rock Hill boulder) (**See Figure 5**.) the largest and most prominent sample, contained primary assemblages of quartz, plagioclase feldspar phenocrysts, lesser amounts of micas, biotite/phlogopite varieties, rose quartz, and still lesser amounts of hornblende, muscovite, and epidote. This mineral assemblage is representative of a large majority of the boulders the authors encountered.

Figure 4. Table of Results of the Eastport/Manorville boulder study within Suffolk County, Long Island, NY

Rock				Measured circumferences			Diameter ϑ		Class. of
ID	Easting	Northing	H(dia)	x-axis	y-axis	z-axis	b/a	c/b	shape
SO-1	0688932	4524402	442cm	2777cm [1]	1828cm	n/a	0.658	n/a	blade/disc [2]
SM-1	0688933	4524402	110cm	390cm	347cm	325cm	0.890	0.937	sphere
SO-2	0688870	4524401	110cm	770cm	800cm	690cm	0.963	0.896	sphere
SM-2	0688984	4524740	55cm	420cm	460cm	400cm	0.913	0.952	sphere
SO-3	0688851	4524482	150cm	1006cm	650cm	600cm	0.646	0.923	rod
SO-4A	0688897	4524787	100cm	387cm	160cm	140cm	0.413	0.875	rod
SO-4B	0688897	4524787	80cm	380cm	480cm	330cm	0.792	0.868	sphere
SO-4C	0688897	4524787	50cm	310cm	260cm	n/a	0.839	n/a	sphere/disc[2]
RHo-1	0687766	4524102	110cm	530cm	435cm	435cm	0.821	1.000	sphere
RHm1	4524102	4524333	130cm	465cm	300cm	n/a	0.645	n/a	rod/blade [2]
RHo-2	0687309	4523773	83cm	460cm	435cm	360cm	0.946	0.828	sphere
Emm1	0689271	4524959	100cm	490cm	435cm	420cm	0.888	0.966	sphere

Notes:
Sphericity is determined by the ratio of b/a / c/b, classified into 4 possible boulder shapes.
b/a is the intermediate/long axis proportionality ratio
c/b is the short/intermediate axis proportionality ratio

ϑ Diameter for axis proportionality calculated from $C=2\pi r$ and $2r=d$ constant relationship

[1] circumference calculated from height measurement; massiveness of boulder prohibited a field measurement.

[2] Classification of sphericity of boulder is given as two possibilities, as the z-axis was immeasurable due to a large percentage of the boulder actually beneath ground level.

n/a: field measurements were not able to be taken due to the limited amount of the boulder above ground and/or the sheer size of the boulder. Dependent calculations were also therefore affected.

Rock identification key: SO refers to Shrine location, original position
SM refers to Shrine location, possibly moved
RHO Rock Hill Country Club, original position
RHM Rock Hill Country Club, possibly moved
Emm- Eastport location; possibly moved

Yellow highlighted samples denote samples which authors thought suitable for dating.

Figure 5. Photographs of Highlighted Samples

SO1 East exposure

SO1 Close Up

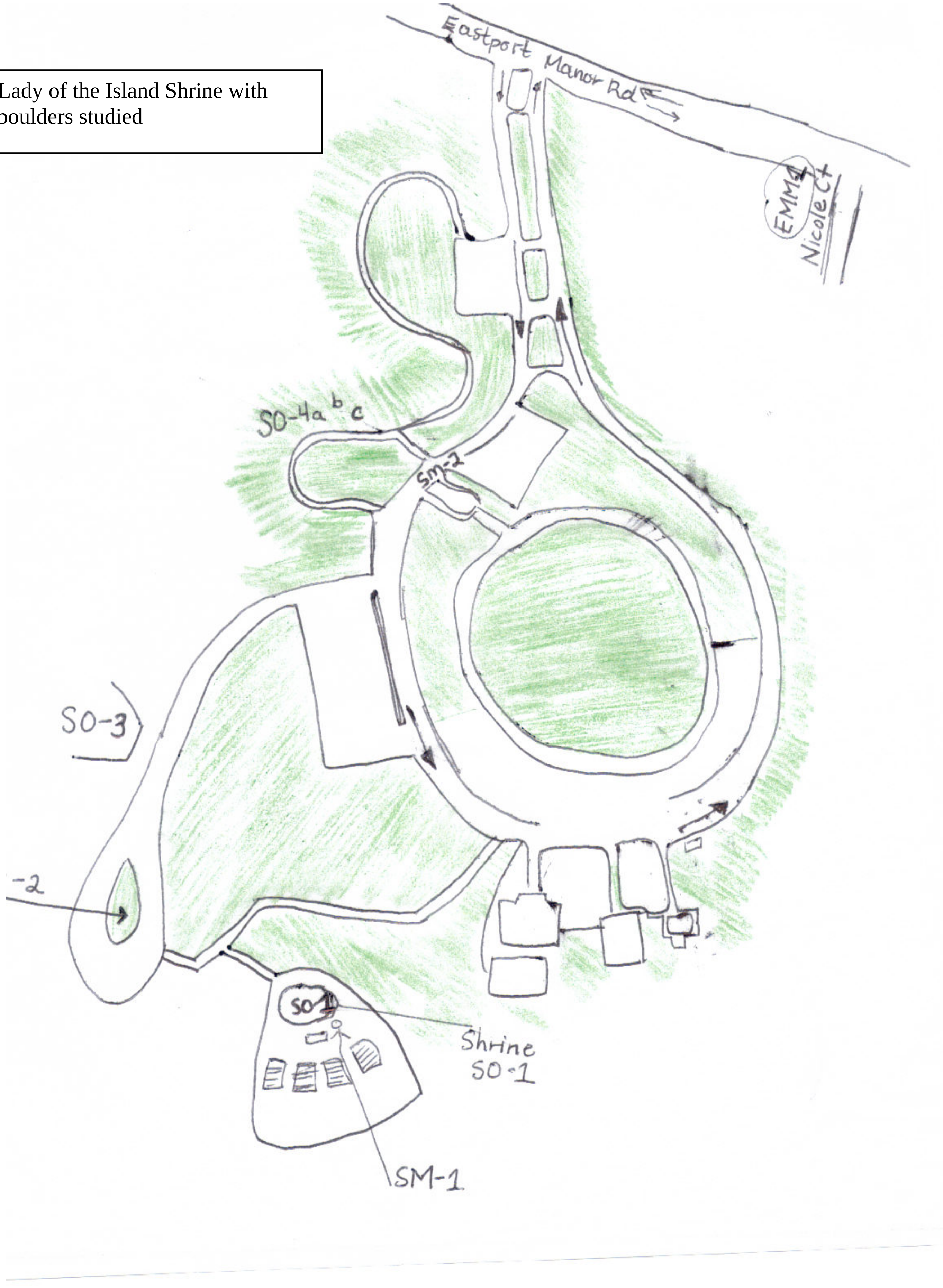
SO2

SO3

SO4

RHO-1

Map of Our Lady of the Island Shrine with locations of boulders studied



Interpretation of Boulder Study Data

Boulders sampled within the Eastport vicinity were classified into one of four shapes, fitting within Zingg's shape classification.

Sphere	sm-1, so-2, sm-2, so-4b, rho-1, rho-2, emm-1
Rod	so-3, so-4a

Three boulders were shape-indeterminable based upon their high percentage of buried surface area; thus, each is offered as fitting into one of two possible categories listed.

Blade/disc	so-1
Sphere/disc	so-4c
Rod/blade	rhm-1

Our population density concludes that between 7 and 8 of the 12 measured boulders (>60%) exhibit a spherical shape according to Zingg's system. The spherical shape is defined as consisting of both b/a and c/b diameter ratio greater than 0.667. The ratio originated by Zingg denotes that the sphere shape is somewhat equilateral, regardless of the true outer form (angular or rounded) and comprises x,y,z axes that are of somewhat equal length, regardless of their hemimorphic crystal orientation.

Conclusion and Future Work

Although many erratics have been dated on the north shore, until now, no suitable specimens have been found on the south shore of Long Island along the Ronkonkoma Moraine. This study of Eastport boulders demonstrates that not only is field work important in making new discoveries but information can be found by searching out historical accounts and by soliciting the knowledge of local residents. It is the authors' conclusion that the Eastport boulders examined can be loosely correlated with the boulders studied in depth by Pacholik (1999) that are found on the Stony Brook campus and north shore region. Indications of similar petrographic assemblages and size/shape characteristics lend to the theory that the sampled boulders within Eastport/Manorville are of the same type and variety, and most likely originated from the same location prior to glacial transport. The fact that greater than 60% of the boulders studied were rounded give credence to this supposition because the distance they traveled would have abraded any sharp angles or edges. Further mineralogical and provenance studies on the Eastport boulders could confirm the relationship to the Stony Brook boulders.

However, new discoveries also bring many questions. How can the southerly presence of such a large erratic as the Rock Hill boulder be explained? It has been theorized that most erratics are broken up after 20 miles of transportation at the bottom of a glacier. Since the erratics at Stony Brook from Pacholik's study are the maximum size to have come from Connecticut, it is difficult to explain how such a large boulder, as the Rock Hill boulder, made it 15 miles further south than Stony Brook. Could it be that a glacier moved farther south of the Ronkonkoma Moraine than anyone to date has suspected? Pacholik (1999) theorizes that erratics could have traveled inside the glacier over the slower moving ice on the bottom due to the morphology of Long Island Sound. A glacier presence farther south has also been proposed in a study of till on Long Island's south shore. (King, C., Mion, L., Pacholik, W., Hanson, G, 2003.) It is the authors' hope that in the near future the Eastport boulders can be cosmogenically dated, thus clarifying and defining a more precise glacial history for Long Island. Despite the various opinions in research on its glacial history, no geologist will argue the fact that Long Island has undergone an extensive and intriguing geologic history. The

Ronkonkoma moraine offers many opportunities for further discoveries and investigations.

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