Orchard Beach Ultramafic Erratics – Where Are They From?

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Three distinctly different ultramafic erratics are scattered on glacially sculpted and striated bedrock at South Twin Island in Pelham Bay Park, immediately north of Orchard Beach in The Bronx, NYC. We have examined and sampled the three erratics in an attempt to demonstrate provenance and to establish paleoflow patterns of the Pleistocene glacier or glaciers responsible for transporting them. To this end we have conducted field studies, major, minor, trace, and rare-earth element analyses, electron microprobe analyses, and petrographic analysis on the samples and have compared the results to nearby New England ultramafic intrusives found in the published literature.

The three samples are evenly distributed within 250 m of each other and we have numbered them from north to south as OB1-N, OB2-C, and OB3-S. OB1-N and OB-2C are most similar in that they are pyroxenites (± olivine) with coarse phaneritic to pegmatitic textures. Sample OB3-S is also a pyroxenite but exhibits an obvious poikilitic texture and is more rounded and slightly more feldspathic by comparison with the other two samples.

Our preliminary results indicate that the ultramafic boulders, although similar in major element chemistry and mineralogy are all relatively low in Al_2O_3 ranging from 4.6% to 9.7% and relatively high in alkalis (especially Na_20). By comparing bulk chemistry, REE patterns, and by comparing the mineral compositions (electron microprobe analysis) of olivine, pyroxene, amphibole, and plagioclase we find that OB1-N and possibly OB2-C are quite similar to sample #14 and #16 (cortlandtite) of Bender (1980) from Pluton IV of the Cortlandt Complex and Stony Point Complexes of Ratcliffe (1968a, b) and Ratcliffe and others (1982, 1983). OB3-S is similar in many respects to the sample H232 from the Hodges Complex described by Merguerian (1977, 1985).

Rocks of the Hartland Formation are well exposed on glaciated pavements on South and North Twin Islands in Pelham Bay Park in The Bronx. The glacial features of South Twin Island are remarkable and take the form of glacial polish, roche moutonée structure, and glacial striae oriented N32°W-S32°E. In addition to these features, a thin red-brown till, consisting of rounded boulders set in a reddish-brown matrix of poorly sorted sand, silt, and clay, was extensively exposed as a byproduct of the erosion of a wave-cut scarp during the higher-than-normal spring tides accompanying the perigee-syzygy full moon of Passover (06 April 1993). Sanders and others (1997) exposed red-brown tills and associated outwash by digging down >2m. Their study indicated that at least two and possibly more than two glaciations have affected the region of Orchard Beach and vicinity and they flowed from the general direction of the Newark Basin (NNW to SSE regional flow pattern).

In New York City, glacial sediments deposited by ice flowing from NNW to SSE (**across** the Hudson Valley) are characterized by their distinctive reddish-brown-color, the result of

grinding over hematite-rich sedimentary rocks from the Newark Basin. By contrast, sediments deposited by glaciers that flowed from the NNE to the SSW (**down** the Hudson Valley) are associated with yellow-brown- to brownish-gray tills, the result of glacial scour of non-hematite-bearing rocks underlying the "crystalline corridor" of metamorphic rocks exposed between the Newark- and Hartford basins (Sanders and Merguerian, 1994). Each of the flow directions resulted in a system of crosscutting glacial features and diagnostic indicator stones, easily identifiable in the field.

At the extreme north end of South Twin Island, glacial erosion by two different glaciers has produced a double roche moutonée (Merguerian and Sanders, 1993). Here, the bedrock shows evidence of sculpting by ice that flowed initially from NNE to SSW and subsequently from the NNW to the SSE. Similarly, just east of the jetty at the south end of South Twin Island, a roche moutonée with long axis oriented NNE-SSW has been cut across by glacial grooves and striae trending NNW-SSE. Other studies indicate that as many as five glaciers from two contrasting flow directions (NNE to SSW and NNW to SSE) may have left their mark on NYC bedrock (Sanders and Merguerian, 1998).

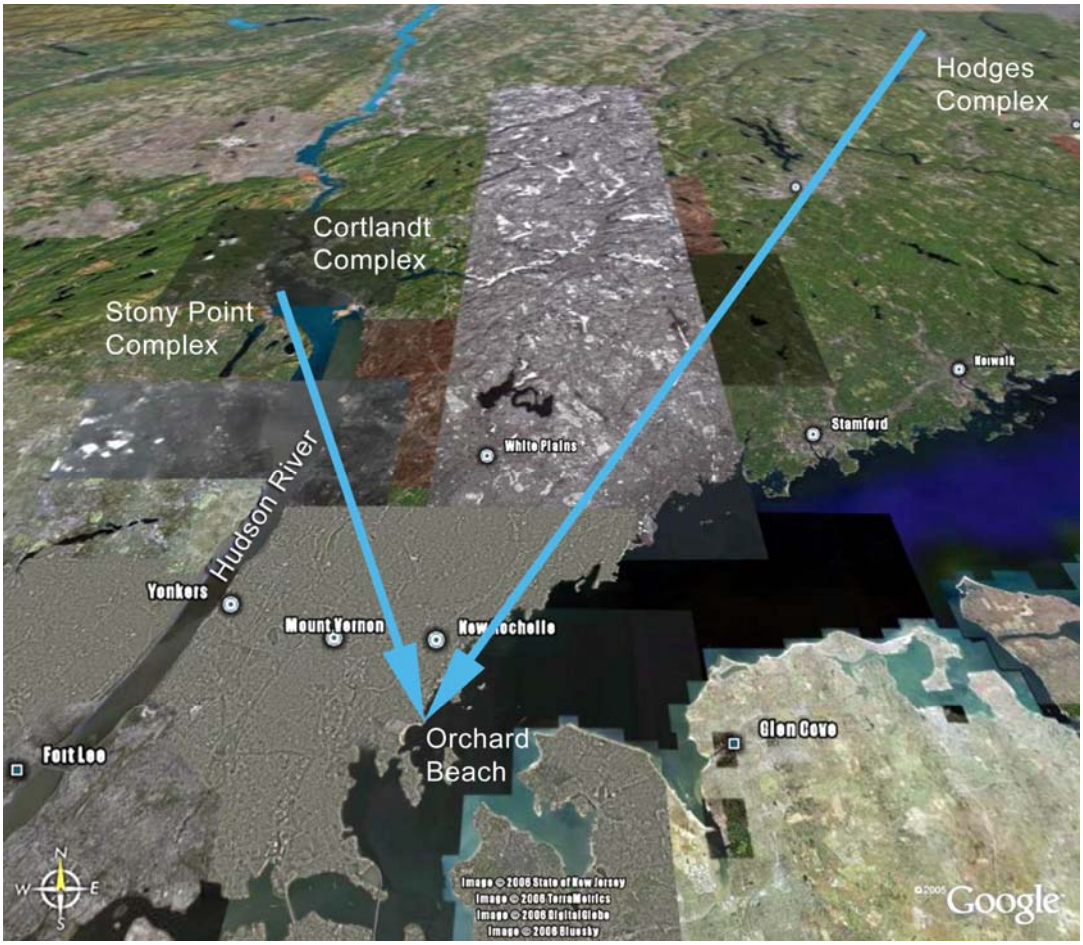

Figure 1. Annotated satellite view of the tri-state area showing locations and inferred flow patterns of ultramafic indicator stones found at South Twin Island near Orchard Beach in The Bronx. The blue arrows show contrasting paleoflow from the NNW and NNE directions supporting a multi-glacier hypothesis for NYC Pleistocene glaciation.

Our field- and laboratory studies strongly suggest that ultramafic erratic boulders OB1-N and possibly OB2-C are indicator stones derived from the Cortlandt Complex and/or the Stony Point Complexes near Peekskill, NY (Figure 1). The straight line azimuth from a point on the Hudson River from the center of Pluton IV of the Cortlandt-Stony Point Complex south to Twin Island is N20°W-S20°E. Atop Bear Mountain, N15°-22°W crescentic gouges are cut by younger N55°W-S55°E glacial grooves (Merguerian and Sanders, unpublished data). These azimuths correspond quite closely to a straight line azimuth of N20°W-S20°E connecting Orchard Beach to the midpoint of Pluton IV and the N32°W readings recorded from glacial striae found emanating beneath red-brown till at South Twin Island in The Bronx. Thus, a NNW to SSE paleoflow direction traversing roughly 40 km is inferred for these two boulders.

Although not conclusive at this point in time, our preliminary studies suggest that boulder OB-3S may have been derived from the Hodges Complex of NW Connecticut (Merguerian, 1977, 1985). If this is correct, OB3-S is a far-traveled boulder (~125 km) and may record a younger episode of glacial flow from the NNE (azimuth N27°E-S27°W). Furthermore, our correlation implies that this NNE-SSW advance must be younger than the relict NNE-trending roche moutonée described above because the roche moutonée structure is cut by NNW-SSE-trending striae at South Twin Island. Thus, evidence for at least three episodes of glaciation in southeastern New York can be inferred from field relationships and our geochemical studies.

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