U-Pb Age of 448 Ma for Shelter Rock, a Large Glacial Erratic in Western Long Island, New York, Confirms its Source from a Late Ordovician Meta-Granodiorite Pluton Beneath Western Long Island Sound

J Bret Bennington[1], Steven Jaret[2],. Andrew Byrne[1], Brandon Bookbinder[1], and Sandra Guevara Sanchez[3]
[1]Department of Geology, Environment, and Sustainability, Hofstra University
[2]Department of Physical Sciences, Kingsborough Community College
[3]Freeport High School, Freeport, NY

Summary

Shelter Rock is a large, historically significant glacial erratic (one of the largest on Long Island) located on the property of the former Whitney Estate in Manhasset, NY. Shelter Rock is the highlight of field trips conducted as part of the Greentree Foundation Teachers Ecology Workshop and is of great interest to Long Island teachers and their students. A previous report described the location, historical background, lithology, and probable origin of Shelter Rock (Ciano et al., 2013). Here we amend the original lithologic description of Shelter Rock to a meta-granodiorite and report a U-Pb zircon crystallization age of 447.9±2.3 Ma for the bedrock pluton that Shelter Rock was derived from. This age ties Shelter Rock to a suite of granitic-dioritic orthogneiss plutons of Late Ordovician age located in southeastern New York and eastern Connecticut that were emplaced during subduction associated with the Paleozoic closure of the Iapetus (aka Proto-Atlantic) Ocean.

Methods

A large hand sample of Shelter Rock was obtained from a block that was dislodged from the main boulder by weathering along a joint fracture. Part of this block was used to produce polished hand samples and petrographic thin sections and the remainder was crushed to obtain zircon grains for dating analysis. Zircons were concentrated via magnetic and density separation and hand-picked from the 63-250 micron size fraction. Grains were annealed and then mounted in epoxy for CL and LA-ICP-MS analysis at Boise State University. Spot size for isotope measurements was 20 microns.

Results and Interpretation

Hands sample and thin section analysis of the petrology of Shelter Rock shows a moderately foliated orthogneiss composed primarily of plagioclase and biotite, with lesser amounts of hornblende, quartz, and accessory garnet (Figures 1 and 2). Zircon analysis shows a uniform texture to the zircons (Figure 3), consistent with an igneous source. Ages from 39 zircons (Figure 4) are consistent and yield a concordant age of 447.9±2.3. Based on the petrography and age, the most likely source of Shelter Rock is the Harrison gneiss. The Harrison gneiss in eastern NY and near Stamford, CT has been correlated with the Brookfield (and other) orthogneisses, whose age is 453 +/- 3 (Sevigny and Hanson, 1995). This age is within error of our new age on Shelter Rock. Geographically, Harrison gneiss outcrops 15-20 km due north of Shelter Rock making it a possible source for the glacial erratic (Figure 5). The direction of Late Wisconsin glacial flow (Figure 5) across southeastern NY obtained from bedrock striations and the

inferred short travel distance for glacial erratics of large size and angularity (Pacholik et al., 2001) suggest that there is a body of Harrison gneiss in the bedrock beneath western Long Island Sound.

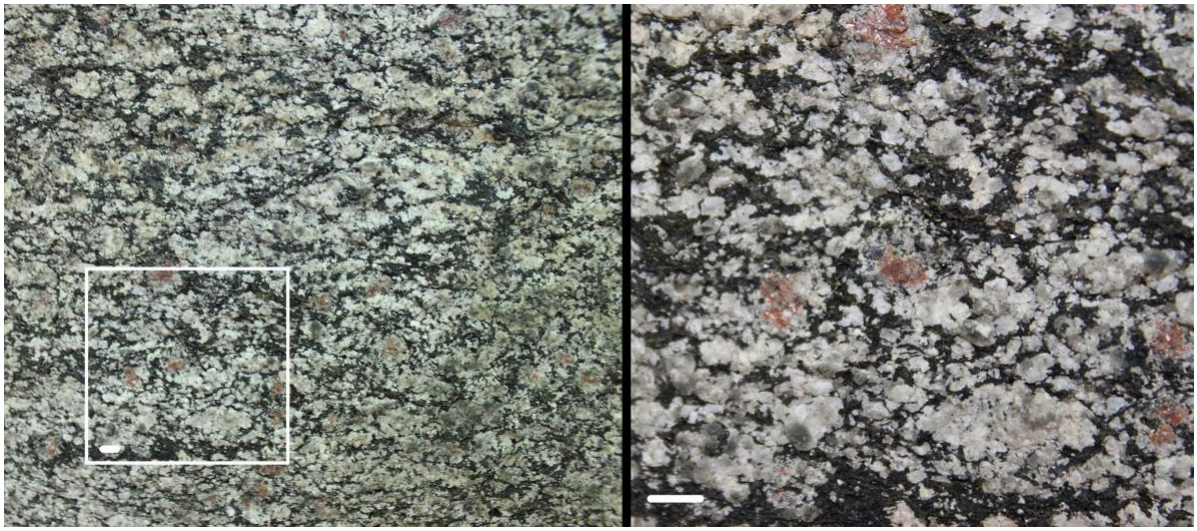

Figure 1. Outcrop photo of Shelter Rock with detail. Scale bar = 5mm

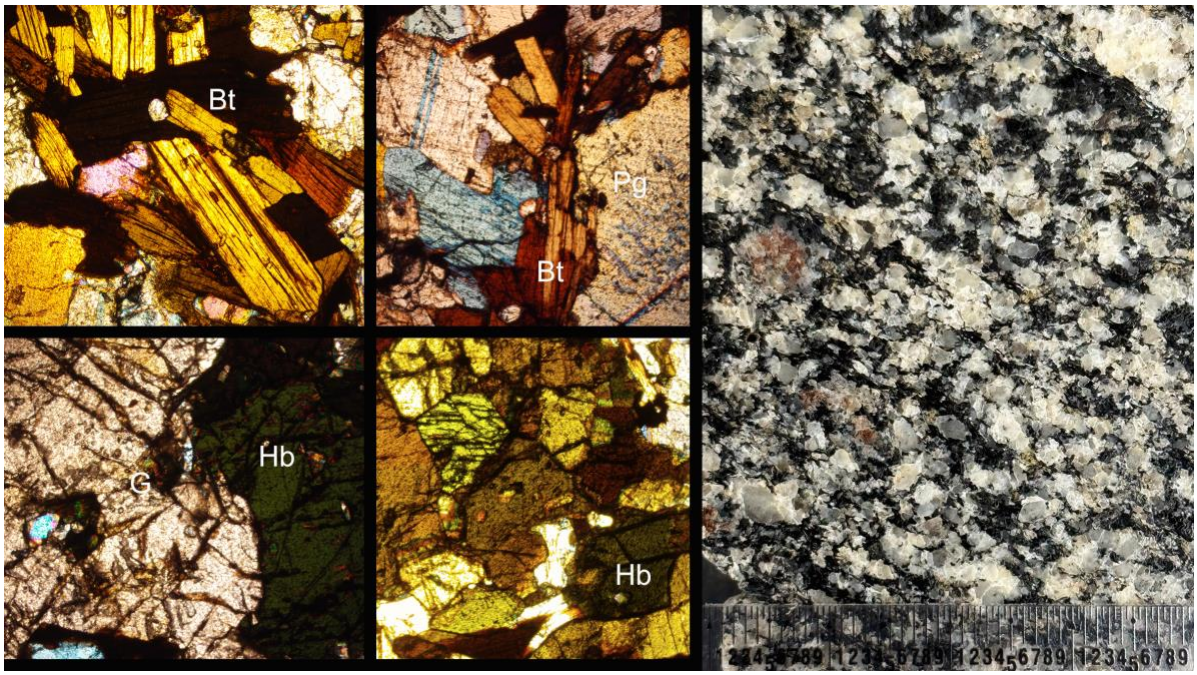

Figure 2. Thin section and polished hand sample images showing mineral composition (G-garnet, Hb-hornblende, Bt-biotite, Pg-plagioclase). Ruler scale is mm, thin section images X40, cross polarized illumination.

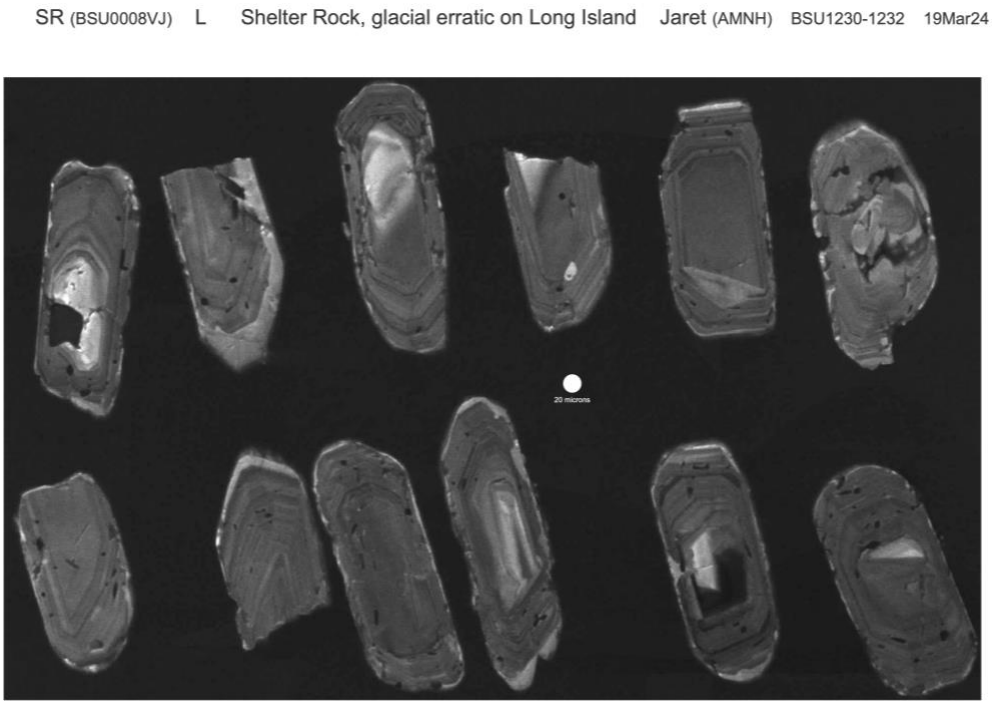

Figure 3. Cathodoluminescence image of Shelter Rock zircon grains.

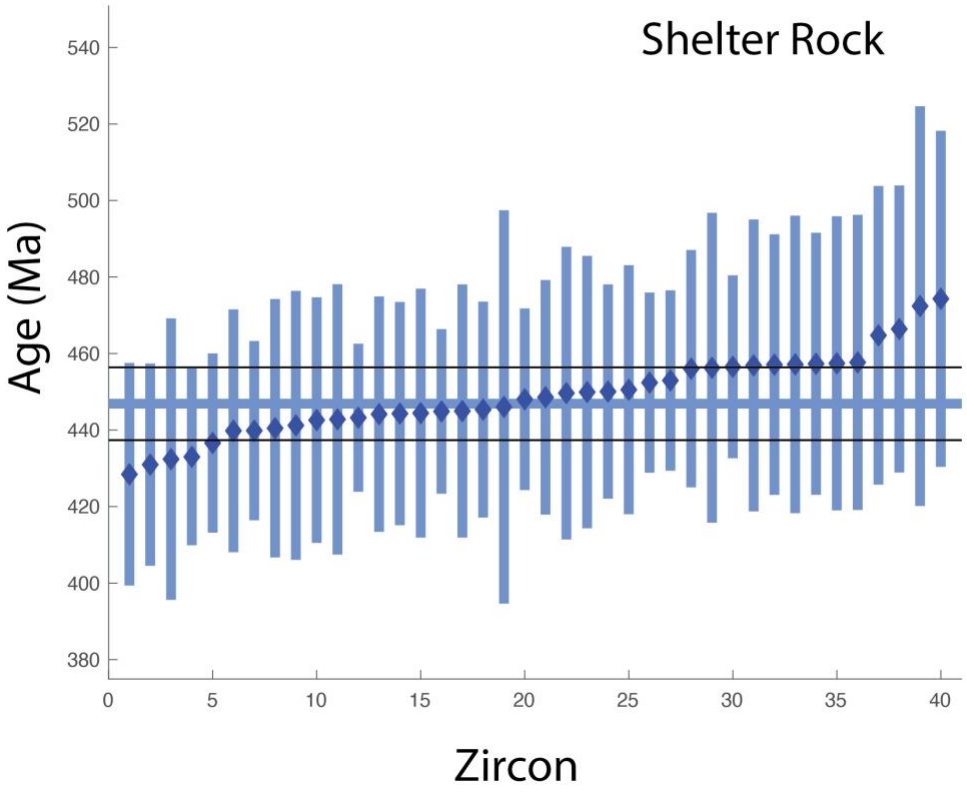

Figure 4. Individual zircon ages ranked by age. Thick horizontal bar indicates mean age with 2-sigma errors shown in black horizontal lines.

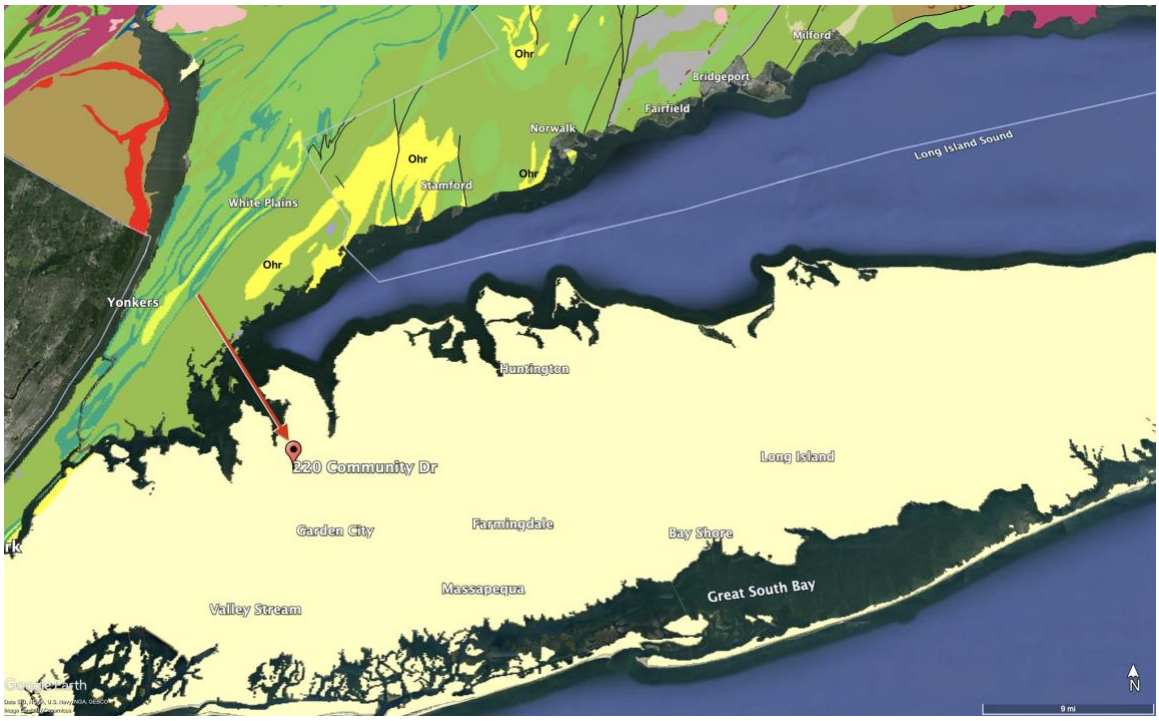

Figure 5. Overlay of the state geologic maps of NY and CT in Google Earth showing the location of Shelter Rock, direction of glacial flow, and the Harrison Gneiss (Ohr) in yellow.

Acknowledgments

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