DETERMINING THE AGE AND PROVENANCE OF GLACIAL ERRATICS ON THE NORTH SHORE OF LONG ISLAND BASED ON XRF GEOCHRONOLOGY OF THE MINERAL MONAZITE

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While the glaciations that deposited the many glacial erratics on the north shore of Long Island are usually fairly comprehensible, the distance the glacial moraines travelled remains a mystery (Sanders and Merguerian, 1988). By analyzing samples of glacial erratics, especially granitic rocks and felsic schists and gneisses, the age of the rocks can be determined (McEachern, 2012). This offers a more definitive method of comparing rock samples to their potential locations of origin than simply comparing hard samples by sight. While many rocks are visibly similar at a macroscopic level, monazite crystals typically found in the rocks described above provide a more distinctive method of comparing rocks: by their ages. Monazite is a rare earth element phosphate mineral generally consisting of high levels of uranium (U) and thorium (Th) (Williams, 2007). When radioactive isotopes of U and Th decay, stable isotopes of lead are produced as a function of magnitude of radioactive parent isotope and time elapsed (Faure, 1977). Once monazite is identified through the observance of pleochroic haloes visible on a petrographic microscope, synchrotron X-ray fluorescence can be used to determine the relative concentrations of uranium, thorium, and the stable daughter element lead (Pb) (Lanzirotti & Hanson, 1995). These relative concentrations allow the age of the monazite crystal and thus the surrounding region of the rock to be calculated through the CHIME dating method (Asami, Suzuki, & Grew, 2005). Advanced equipment at Argonne National Laboratory allows the ages of different regions within each monazite crystal to be determined, allowing for more accurate and specific ages to be deduced in future experimentation. These rock ages were compared to those of regions to the north of Long Island in an effort to determine the origin and therefore the distance the glaciers carried the erratics, shedding light on important information regarding Long Island Pleistocene History (Lanzirotti & Hanson, 1995, Sevigny and Hanson, 1993). It was hypothesized that the glacial erratics found on the north shore of Long Island would range in age between the Taconic Orogeny of approximately 550 million years ago to the Alleghanian Orogeny of approximately 260 million years ago because the types of rocks sampled were typically formed during such mountain-forming geologic events (Hatcher, 2010). Samples collected from Wildwood State Park and Caumsett State Park yielded ages of 295 +/- 3 million years old, potentially correlating with samples analyzed by Sevigny and Hanson in northern Connecticut which had ages of 291 +/- 4 million years old (1993).

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