The Provenance and Ages of Glacial Sediments from Long Island, NY

Davies, R. M.[1,2], Jaret, S.[2,3], Nicolas, J. [1], Crowley, J.[4], Kinney, S.[5]

1. Department of Biological Sciences and Geology, Queensborough Community College of the City University of New York, Bayside, NY 11364

2. Department of Earth and Planetary Sciences, American Museum of Natural History, New York, NY 10024

3. Department of Physical Sciences, Kingsborough Community College of the City University of New York, Brooklyn, NY 11235

4. Department of Geoscience, Boise State University, Boise, ID 83725

5. Department of Earth and Planetary Sciences, Rutgers University, New Brunswick, NJ 07102

rdavies@qcc.cuny.edu

During the last glacial maximum, about 24,000-21,000 years before present, the Laurentide ice sheet advanced southward across New York State and terminated where Long Island is today. The glacier left behind ridges of elevated topography trending in an east to west direction across the length of the island and known as the Harbor Hill and Ronkonkoma glacial moraines (Bennington, 2016; Balco and Shaefer, 2006; Balco et al., 2009).

There is debate about the direction the glaciers moved and the provenance of the glacial deposits that make up the Long Island dating back to Fuller (1914). Most workers suggest both the Ronkonkoma and Harbor Hill moraines formed during the last glacial maximum from glaciers moving from a NW-SE to a N-S direction (Sanders & Merguerian, 1994; 1998; Sirkin, 1996; Pacholik and Hansen, 2001; Bennington and Young, 2005; Kundic et al. 2007). In eastern Long Island, evidence of a NE-SW direction for glacier motion also exists (Pachilok, 2014; 2018; Sirkin and Mills, 1975; Kundic et al., 2007; 2012).

Considering the basement rocks of New York and New England are well mapped and age dated, showing a general younging from west to east across Laurentia and Gondwana derived terranes, it should be possible to identify the dominant source of the rocks that make up the moraines of Long Island and to better constrain the direction glaciers moved. The goal of this work is to determine the provenance of the rocks that make up the moraines of Long Island to provide insights into the pathway and travel history of the Laurentide ice sheet.

We measured sand-sized grains from three glacial deposits and one sedimentary unit along an 80-mile west to east transect for (1) ages from U-Pb dating of detrital zircons and (2) provenance using heavy mineral concentrates. 939 detrital zircons from four localities were age dated with LA ICPMS. Overall and for each location age dates have a large range (183 to 2699 Ma) which is to be expected considering the zircons are detrital and represent many populations of source rocks. However, dominant age peaks at each location inform us of the most representative populations.

From western Long Island, glacial sediments at Huntington and Cretaceous sediments from Caumsett State Park have dominant Mesoproterozoic age peaks at 1017 and 1043 Ma respectively. These ages correspond to the Grenville orogenies and likely represent recycled zircons in Laurentian margin metasedimentary rocks from the Manhattan prong (Jaret et al., 2023). Huntington and Caumsett also have a small peak at ~440 Ma, consistent with peak metamorphism during the Taconic orogeny.

The Caumsett Cretaceous sediments also show peaks at 183 and 363 Ma. These ages are discussed below.

Eastern locations at Greenport, on the North Fork, and Hither Hills near Montauk have peaks at ~275, which may correspond to plutonism and pegmatite emplacement throughout New England. Glacial sands from Hither Hills also contain a large peak between 365 and 409, similar to that at Caumsett, which likely represents igneous and metamorphic events related to the Acadian and Neoacadian orogenies. The paucity of Alleghanian age zircons is surprising considering these rocks are well represented in southern New England.

Jurassic ages (~190 Ma) for zircons from Caumsett State Park, Greenport, and Hither Hills are puzzling considering they do not correspond to the ages of igneous or metamorphic events of nearby terranes. We suggest they are derived from igneous rocks of the White Mountain batholith in northern New Hampshire (Kinney et al., 2022) which is north-northeast of Long Island.

Heavy minerals at Huntington are dominated by kyanite, magnetite, tourmaline, rutile, garnet pyroxene, and amphibole with minor staurolite to suggest the sediments are largely derived from metamorphic rocks. At Caumsett State Park heavy minerals are dominated by kyanite with minor sulfides, rutile, and staurolite. At Greenport, heavy minerals mostly contain magnetite, tourmaline, and garnet with minor kyanite, staurolite, rutile, pyroxene, and epidote. Hither Hills contains a wide range on heavy minerals with a dominance of kyanite followed by amphibole, pyroxene, magnetite, tourmaline and small amounts of rutile, garnet, staurolite, and epidote. Staurolite is not common in metamorphic rocks of the Manhattan prong to the northwest (Jaret pers. comm.).

Our data rules out glacial motion from was from a northwest direction and indicates it was from the north to northeast.

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