To Smithsonian Associates November 2021 nature walk participants from Melanie Choukas-Bradley, Author of *Finding Solace at Theodore Roosevelt Island*

Theodore Roosevelt Island Geology Thumbnail

By Geologist Tony Fleming, Geologist and Author of the Geologic Map of the Washington West Quadrangle (with Avery Drake, Jr. and Lucy McCartan); Geologic Atlas of the City of Alexandria, Virginia and Vicinity; and Technical Guide to the Natural Communities and Physical Environment of Rock Creek Park (with NatureServe and the National Park Service)

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Geologically, TRI consists of two parts. The central, slightly higher 'spine' of the island is held up by metamorphic rock of the Sykesville Formation (and soil derived from it), while the low lying outer margins are underlain by a mix of modern river deposits (called 'alluvium') and artificial fill. Prior to European settlement, the island was about half the size it is today, consisting only of the part underlain by rock and a few small muddy shorelines; the remainder of the island was created by the placement of artificial fill along the margins of the spine. The distinction between original and 'synthetic' parts of the island is readily evident by looking at the way the island is depicted on the modern geologic map of the Washington West Quadrangle. When and why the artificial fill was emplaced is not well documented, but it appears to have occurred early on in the European history, probably during the era of the Mason estate, and possibly to expand the acreage of cultivated land. Alternately, it could have happened during the Civil War. Either way, the likely source of the fill is material dredged from nearby parts of the river.

The Sykesville Formation is a gray, medium grained metamorphic rock containing conspicuous inclusions of mica schist, sandstone, quartz 'pebbles', and metamorphosed volcanic rocks. It is the most widespread Piedmont rock unit in the Baltimore Washington corridor and is estimated to be several miles thick. Despite decades of study and hypotheses, no one has conclusively demonstrated how it originated. Superficially, the rock looks deceptively like granite – early geologists named it 'Sykesville Granite' - but seen in detail, it has a composition and characteristics more like an originally sedimentary rock. It contains abundant volcanic debris at places. The most likely place of origin is in a submarine trench along a subduction zone, where the rock could have formed by repeated, earthquake-generated submarine landslides, with inputs of volcanic debris and quartz-rich sediment derived from nearby rivers. It is at least 480 million years old – the age of the oldest igneous rocks that intrude it in the DC area, and is so thoroughly recrystallized that most of its original texture and features are obscure. Presumably it is early Ordovician in age, the period from which other area rocks date.

The Sykesville Formation at TRI, with its characteristic suite of inclusions.

Prior to our most recent Ice Age, when the Potomac assumed its present channel, the bedrock at TRI was very likely connected directly to similar bedrock found at Braddocks Rock, another outlier of Piedmont rock that pokes up through the innermost Coastal Plain directly behind the Kennedy Center and is exposed along E Street Expressway near the entrance ramps to the TR bridge. It would not be unreasonable to assume that bedrock formed a continuous shelf, or low ridge between the two at about 5-10 feet above sea level – the same elevation of the summits of Braddocks Rock and TRI. At that time, the river channel was elsewhere – and much higher, as river deposits from that period form gravel terraces 100-150 feet above sea level.

During the most recent Ice Age, ice sheets expanded to cover northern temperate regions several times. The growth of the ice sheets came at the expense of ocean volume, and with each glacial advance, sea level fell by hundreds of feet and the shoreline migrated hundreds of miles seaward of its location today. The lowering of sea level effectively 'rejuvenated' (or steepened the gradients) of rivers up and down the east coast and caused the Potomac to cut what is now a 'drowned' (submerged) submarine canyon extending from about Georgetown, through the Chesapeake Bay, and well out onto the continental shelf. Most of the canyon has filled back in with alluvium during interglacial and post-glacial periods, so it is not readily visible (or detectable by traditional bathymetric surveys); nevertheless, boreholes and seismic data suggest the canyon may have been as much as 200 feet deep adjacent to Alexandria and nearby parts of Fairfax Co, in other words well below modern sea level. The head of the canyon lies beneath what we think of as the 'main' channel between TRI and Kennedy Center, and is one reason Georgetown was such a good deepwater port. It is also why the bedrock knobs at TRI and Braddocks Rock are now distinct, separate features.

The main geologic influences on the low-lying, swampy fringes of the island are floods and tides, which move sediment around and cause both erosion and deposition. Tides tend to deposit thin layers of silt and clay over long periods of time, producing the mud flats and similar features. Large floods, on the other hand, tend to erode this soft mud and may deposit thin layers of sand and silt as the flood wanes. This dynamic, along with the constantly saturated soil that results from being at sea level, is responsible for the varied wetland communities that occupy the low lying parts of the island, which are dominated by plants that tolerate 'wet feet'.

In contrast, the main dynamic acting on the higher, bedrock part of the island is weathering and soil formation. The only exposure of hard 'bedrock' is on the upstream end of the island, where floods continually strip away soil, alluvium and tidal mud. Elsewhere, however, the bedrock is mantled by a fairly thick soil profile produced by deep weathering of the rock, or by patches of alluvium. Most of this bedrock area is well drained and supports mesic or dry-mesic vegetation communities.