

## Optional Field Trip Stop – Stony Point Battlefield State Historic Site, Stony Point, NY

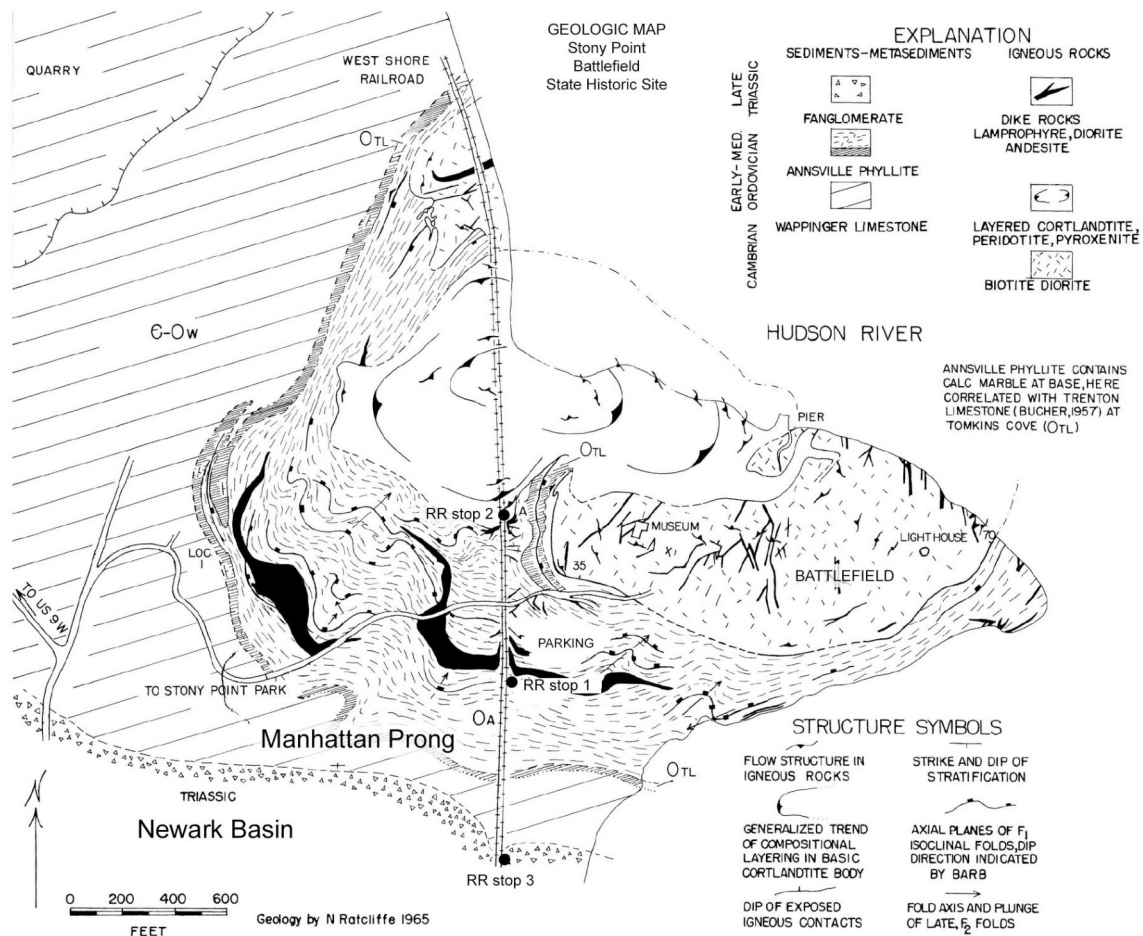
From Bear Mountain, take NY 9W south approximately nine miles and turn left onto Park Road. Follow the signs to the park entrance.

In July of 1779, British and American forces battled for control of Stony Point, a small peninsula of rock with a commanding view of the Hudson River just south of where the river narrows as it exits the Hudson Highlands. Although the Americans prevailed, Washington soon abandoned Stony Point and the British returned, only to be withdrawn in October as the war in the north wound down. Doubtless none of the soldiers or officers involved in the battle appreciated the significance of the white and black mottled bedrock they were scrambling over in the dead of night, but Stony Point owes its strategic significance to a mass of erosion-resistant crystalline igneous rock that geologists call a pluton. The bedrock at Stony Point represents two distinct episodes of magma intruding into the surrounding regional metamorphic rock of the Manhattan Prong. The earlier magma crystallized into a diorite composed of white plagioclase feldspar crystals intermixed with black crystals of biotite mica. Later, a different magma was intruded and cross-cuts the diorite as a mass of dense, dark black igneous rock rich in pyroxene minerals (cortlandite / peridotite / pyroxenite in the diagram below). Both of these igneous plutons are related to a much larger region of plutons across the Hudson River to the east called the Cortlandt Complex. Radiometric dating and mineral analysis of the Cortlandt rocks show that the magmas were intruded deep within the crust of North America during the Late Ordovician Taconic Orogeny.

From the parking area, walk uphill to the battlefield. Note the rounded knobs of diorite exposed along the slopes of the hill. The smooth, rounded appearance of the bedrock is due to its having been sculpted by glaciers flowing down the Hudson Valley. Careful inspection of the bedrock surfaces will reveal glacial grooves oriented N3°W. From the lighthouse at the top of the hill there is a view to the southwest of the ridge formed by the Palisades intrusive sheet. Also visible across the river to the northeast is the Indian Point nuclear power station, built directly atop the Ramapo Fault that borders the southern margin of the Hudson Highlands.

Returning to the parking lot, follow the path leading through the fence to the CONRAIL tracks. The bedrock exposed along the tracks near the path (RR Stop 1) is the Annsville Phyllite, a foliated, complexly folded metamorphic rock containing layers of tiny mica crystals. The Annsville represents deposits of mud on the continental shelf that were caught up in the collision between eastern North America and a volcanic island arc during the Taconic Orogeny. Some layers of the phyllite are covered with large mica flakes that likely formed as a result of additional metamorphism caused by the proximity of the rock to a large mass of cooling magma. Walking north along the side of the tracks (keep on the alert for trains!) to the end of the narrow cut in the bedrock (RR Stop 2) brings us to an exposure of the pyroxenite pluton that underlies the north side of Stony Point. This distinctive rock is extremely dense, being composed of iron-rich pyroxene mineral. Note the large, blocky crystals that reveal themselves by their flashy cleavage plains when turned slowly in the light. Turning around and walking south along the tracks for about two tenths of a mile brings us to an outcrop of grey cobbles cemented within a reddish sandy matrix (RR Stop 3). This is a conglomerate (often called a

“fanglomerate” because of it is interpreted as an alluvial fan deposit) and it indicates that we have crossed from the metamorphic bedrock of the Manhattan Prong into the sedimentary strata of the Newark Basin. Most of the cobbles in this rock are limestones of the type that once covered the bedrock of the Hudson Highlands and were probably eroded off of the elevated region on the far side of the Ramapo Fault to the north during the formation of the Newark rift basin in the Late Triassic. The poorly rounded clasts of limestone could not have traveled very far as they were transported by gravity and flash floods out of the highlands to be deposited in massive alluvial fans along the margin of the basin. Note that the beds of fanglomerate exposed in the outcrop on the west side of the tracks are tilted (dip) to the southwest at an angle of  $35^\circ$ . This dip is the result of continued subsidence of the basin along its western margin after the deposition of the originally horizontal sedimentary layers.



Geologic map of Stony Point showing a variety of igneous, metamorphic, and sedimentary rock units. Modified from Ratcliffe (1968).

## References

Merguerian, Charles; and Sanders, J. E., 1994, Geology of the Hudson Highlands and Bear Mountain: Guidebook for On-The-Rocks 1994 Fieldtrip Series, Trip 30, 21 May 1994, Section of Geological Sciences, New York Academy of Sciences, 112 p.

Ratcliffe, N. M., 1968, Trip H: Stratigraphic and structural relations (sic) along the western border of the Cortlandt intrusives, in Finks, R. M., ed., Guidebook to field excursions: New York State Geological Association, 40th Annual Meeting, Queens College, Flushing, New York, p. 197-220.