

GEOLOGY OF THE PALISADES

Tawhidah Rahman, Ronald Nova, Dorothy Rosensweig

Abstract:

The Palisades Cliffs are part of a sill of diabase that extend between Jersey City to the south and the Tappan Zee Bridge near Nyack, NY to the north. The name, meaning "fence of stakes," was established in 1524 by the Italian explorer Giovanni de Verrazano who thought the cliffs resembled the log forts built by local Indians. These cliffs, being North America's best preserved example of a sill of diabase, are protected as a National Natural Landmark.

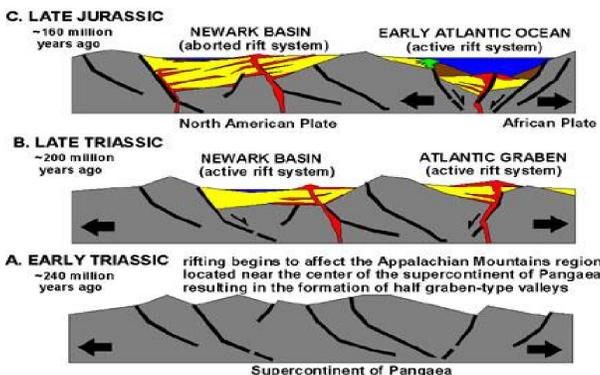
The sill extends roughly 600 ft above the west side of the Hudson river, but, in total, it's around 1000 feet tall. Based on radiometric age dating, this sill formed between 196 to 186 million years ago during the tumult of the early Jurassic Period. The diabase intrusion has squeezed between two older rock formations from the late Triassic: the Stockton Formation and the Lockatong Formation. These older sedimentary layers mostly consist of sandstone and shale, though some arkose is also present.

Directions:

The Palisades Interstate Park is accessible by train from NYC. The A train to 175th Street Fort Washington Ave brings visitors within walking distance of the GWB. Those interested in the scenic route can walk along the GWB's mile long pedestrian walkway. The walk offers impressive views of the Hudson and the Palisades Cliffs. Across the bridge, the park is only short distance off.

Intro:

The cliffs of the Palisades can be viewed from different vantage points on the 7 mile hiking trail within the Park. The shore path runs along the base of the cliffs near the Hudson. From the shore path, a steep trail of uneven stone steps leads up to the cliff top. On the shore path areas where the rocks of the Stockton formation have been altered through contact metamorphism with the intrusion are visible. Talus rock are scattered around the base of the cliffs by the shore path as well. Walking towards the cliff top numerous xenoliths are exposed, or places where the intrusion invaded the older sedimentary rocks. On the cliff top, glacial weathering and erosion have left behind striations and a smooth polish on the diabase. Erratics are scattered throughout the cliffs as well.



Walking across GWB towards Palisades



View of weathered cliffs of diabase



Vertical and horizontal joints in diabase



Rounded joints



Glacial Polish



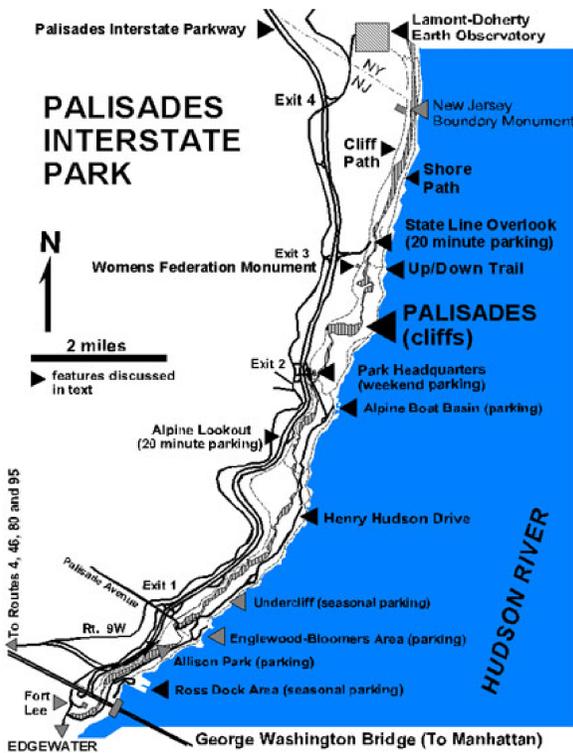
Diabase in contact with Stockton arkose



Vein of calcite in diabase from hydrothermal fluid carrying dissolved minerals into fractures



Melted arkose transitioned into microgranite



Fine grained diabase over hornfels



Lockatong Shale beneath Stockton Arkose



Fine grained diabase indicating fast cooling



Diabase with coarser grains than sample above showing different rates of cooling throughout the sill. Dark pyroxene and lighter plagioclase feldspar grains visible.



Agmatite: Migmatite with Xenolith



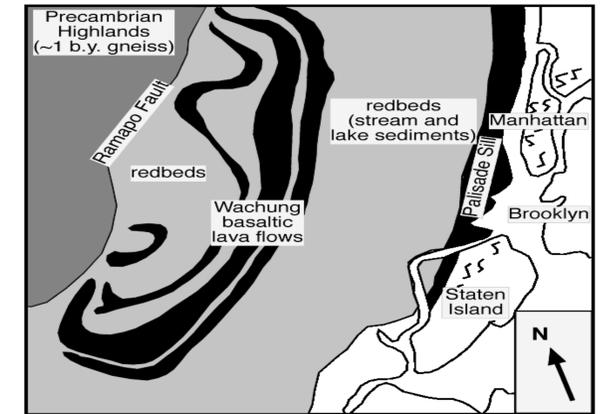
Wedge of Diabase in Hornfels



Microgranite



Layers of sedimentary rock altered through contact metamorphism with igneous intrusion. Lake deposits of sand and mud in basin formed layers of red and gray sandstone, siltstone and shale. Here layers of shale have been metamorphosed into dark and light layers of hornfels.



Map of Newark Structural Basin (central portion)

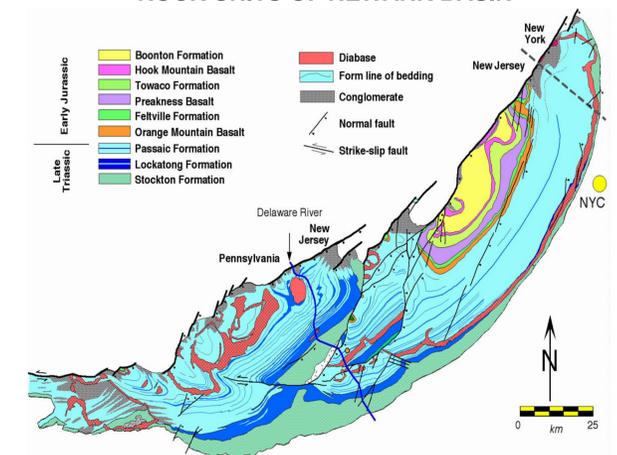
Newark Basin

200 million years ago a major rifting event responsible for the breakup of Pangea and the formation of the Atlantic Ocean, produced such extensional stress that a major fault was formed--the Ramapo fault. This fault spans over 185 miles between Pennsylvania, New Jersey and New York. Where the hanging wall moved down relative to the footwall the Newark Basin was created filling with sediments weathered and eroded from the footwall and surrounding highlands by streams and rivers. As the crust continued to be stretched and thinned several basaltic lava flows erupted at the surface and a large magma intrusion seeped into the cracks between older sedimentary layers creating the Palisades sill. The sill is composed of diabase. Contact metamorphism and hydrothermal alterations have affected much of the surrounding sedimentary layers.

Conclusion:

The sedimentary rock layers that hadn't been metamorphosed by the igneous intrusion have been weathered and eroded overtime. When the Wisconsin ice sheet advanced and retreated over the region between 20 and 18,000 years ago, glacial weathering and erosion further altered the area leaving behind a fairly polished surface of diabase and numerous erratics. The glacial features, the examples of contact metamorphism and hydrothermal alterations around a 400 ft sill of diabase make walking through the Palisades a geologically rich experience.

ROCK UNITS OF NEWARK BASIN



Works Cited
 1. *Geologic Map of the Newark Basin. This Map Shows the Distribution of Triassic- and Jurassic-age Rock Units (formations) within the Newark Basin of New Jersey, Pennsylvania, and New York. NYC Is New York City. The Faults Bounding and within the Basin Are the Black Lines. Click on the Map above to See a Larger Version of This Map. Modified from Schlische (1992) and Olsen Et Al. (1996). * Newark Basin Geology. N.p., n.d. Web. 19 May 2016.
 2. Manecan, Thedosa. Palisades New Jersey: Palisades Diabase Field Trip Guide. New York: Hunter College Dept of Geology, n.d. Print.
 3. Newark Basin. (n.d.). Retrieved May 14, 2016, from http://www.columbia.edu/~vjd1/Newark_Basin.htm