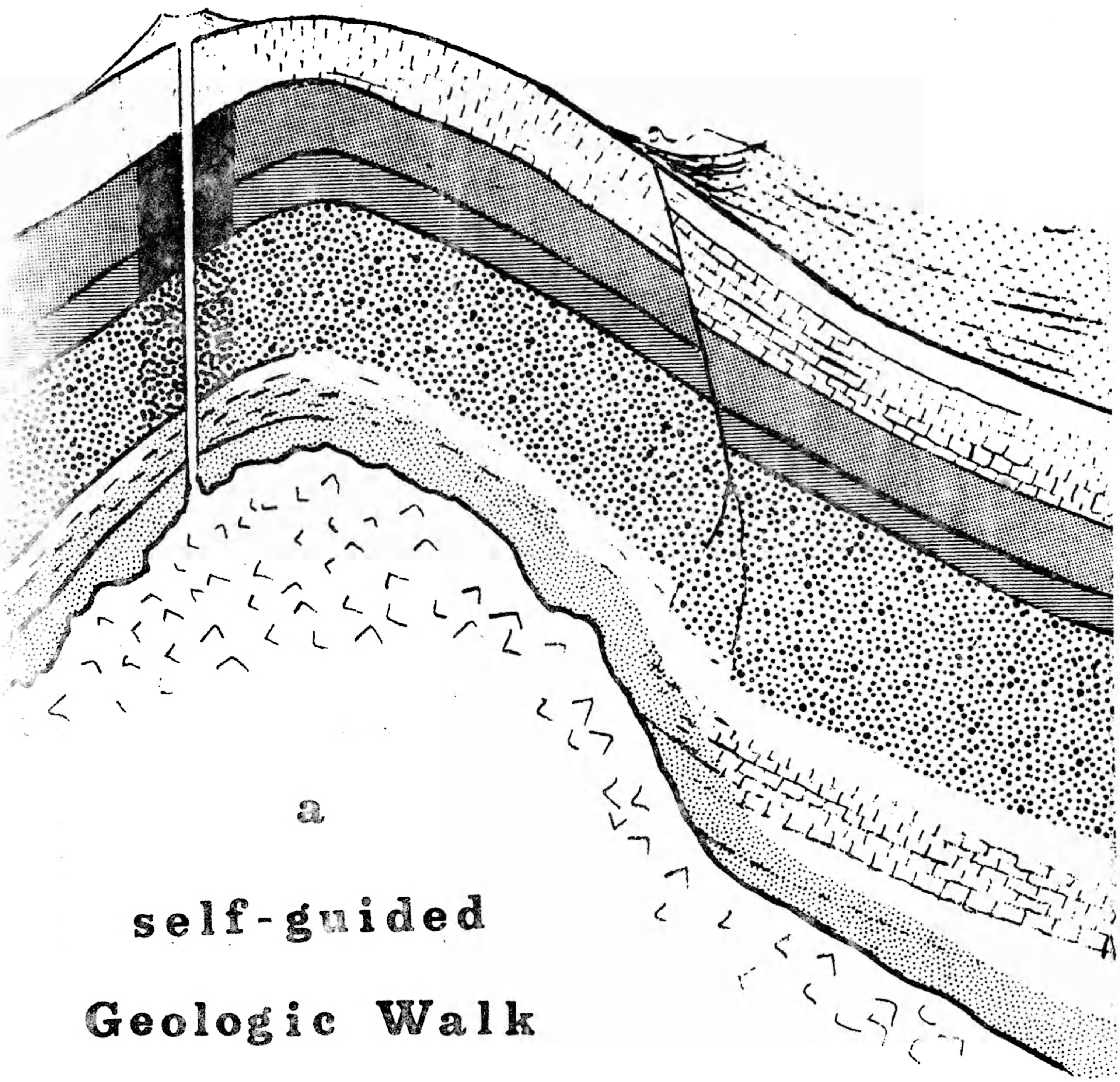
SANDY HOOK



a

self-guided

Geologic Walk

GATEWAY NATIONAL RECREATION AREA

SANDY HOOK UNIT

SELF-GUIDED GEOLOGY WALK

The starting point for this short walk is marked by a sign in the first fisherman's parking lot. Climb to the top of the sea wall and you will find the first of the painted markers which correspond to the numbered portions of this guide. Some of the rocks have marker paint rings which encircle the unweathered portions of the surface area which are best for examination.

Please - Do walk carefully along the seawall

Do not collect specimens on this walk

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A rock may be defined as any solid mineral matter occurring naturally in large quantities. A rock is like a cake; the minerals are its individual ingredients. Just as there are different kinds of cake, often with similar ingredients, so there are different rocks due to varying mineral composition.

Rocks may be classified into three major groups:

1. Igneous - Those rocks formed by the solidification of hot, molten rock material (magma) within the earth. In texture, igneous rocks range from those with large crystals to glassy rocks with no crystals at all. Generally, the longer the period of cooling, the larger the crystals.

2. Sedimentary - Those rocks that are formed by the cementing of sediments derived from other rocks. These rocks form in layers from materials that are deposited by water, wind, and other agents.

3. Metamorphic - Rocks that are formed from other rocks that have been changed from their original form by great heat and pressure. The changes may be barely visible, or may be so great that it is impossible to determine what the original rock once was. All kinds of rocks can be metamorphosed--sedimentary, igneous, and other metamorphic rocks. The changes usually bring about new crystalline structure, a formation of new minerals, the flattening and elongation of mineral structures, and sometimes a coarsening of texture.

This general area is called a compound shoreline, a shoreline consisting of land features of submergence and emergence. A few miles to the north is a submerged river valley that forms the Hudson River channel. Standing proudly above the sea, a mile to the southwest, is a ridge of land called the Highlands of Navesink. This area emerged from the sea about 125 million years ago and resisted erosion by wearing a cap of ironized gravel.

1) Gneiss (pronounced nice) - This metamorphic rock is called Fordham gneiss. It is probably from the Hudson River area. Note the banding (lines) and the separation of dark and light minerals. The larger black crystals are biotite mica. The light-colored minerals are quartz and orthoclase. There is considerable surface weathering.

2) This is Fordham gneiss that has only been weakly developed from granite because of insufficient heat and pressure. Granite is the "rock of the continents." Most of the continental material is granite or sedimentary rocks formed from the breakdown of granite through natural processes.

Look east to the Atlantic Ocean. Due to the curvature of the earth, you cannot see small vessels beyond 12 miles. Notice how the horizon seems to be slightly bent because of this same curvature.

3) Gabbro - This is a dark igneous rock with a texture similar to granite. This is probably from the Palisades Sill of the Hudson River area or the Kingston Trap Rock Quarry near Princeton, New Jersey. This rock is highly weathered. The ferrous (iron) minerals are oxidizing (rusting) and spalling (chipping or peeling).

4) Notice how the waves generally strike the shoreline from the southeast. This produces a deflected run-off of water (undertow) toward the north. This drift of water to the north is called the longshore or littoral current. The sand from the eroding shoreline to the south is carried northward. This drift of sand has produced this six mile curved spit of sand called Sandy Hook. In geology a spit is called a hook when it curves toward the mainland. The "Hook" has grown over 7,000 feet since 1762. Note the rock groin jutting into the sea on your distant left. Its function is to trap sand as it moves northward in the longshore current. This trapping action helps build the beach areas. Notice how the beach is developed to the south or right side of the groin. In the past, two rivers (the Navesink and Shrewsbury) emptied directly into the Atlantic through the barrier beach but these inlets were closed by longshore currents.

Beaches are composed mainly of quartz that has weathered from igneous rock by the action of the atmosphere. When these crystals have been freed from the parent rock, they travel, via streams and rivers, to the shore area. These deposits of sand and silt form a shelf, or ledge, along the continental edge called the continental shelf. When this shelf is exposed by emergence from the sea it is called a coastal plain. Most of New Jersey is part of a coastal plain. Examine a handful of sand. Notice the light-colored quartz. The darker materials are rutile (titanium) and ilmenite (iron-titanium); a magnet drawn through dry sand will attract these minerals.

5) In the past, the ocean has repeatedly broken through the narrow neck of the "Hook." This sea wall was erected in 1921 to prevent these incursions by the sea. Many of the rocks in this wall are from the mountain areas to the north, and the excavation material from the Lincoln and Holland Tunnels. Although this assortment of rock does not give a complete geologic spectrum of rock types, many of the rocks are typical of the northern New Jersey area.

Notice the directional arrows on the walk. Arrow "A" points to the Highlands Ridge. This ridge is 266' above sea level and is the highest point found on the shores of the Atlantic Coastal Plain. This coastal plain stretches from New York to Florida and on to Texas and Mexico. The Highlands ridge is an erosional remnant, or cuesta, on the coastal plain. The protective cap covering the Highlands is ironized conglomerate sandstone. The castle-like Twin Lights is prominent on the edge of the ridge.

Arrow "B" points to Plum Island (the mushroom-shaped peninsula on the other side of the road). This peninsula probably is a remnant of an earlier hook curvature that was formed during the embryonic development of the "Hook." Later you might like to visit Plum Island; an ideal study area for tidal pool environments.

6) Diabase (Igneous) Probably from the Palisades Sill or Kingston Trap Rock Quarry near Princeton, New Jersey. It is highly weathered. The ferrous minerals are oxidizing. (Note the reddish iron oxide).

7) Limestone (Sedimentary) Note the bands of gray and black chert (quartz). The limey portions effervesce (bubble) upon contact with dilute hydrochloric acid (HCL). The gas produced is carbon dioxide (CO_2).

8) Mica Schist (Metamorphic) The shiny, flat crystals are large muscovite mica crystals that have foliated (layer-like parallel bands). This is Manhattan schist from the New York area. Mica is used as an insulator.

9) Can you identify the rock marked "A"? If not, see #7. Can you identify the rock marked "B"? If not, see #6. Notice the channel in this rock. This is a side view of a drill hole that was packed with explosives during the quarrying of this rock.

10) Mica Schist (Metamorphic) The pink veins have rhombohedral cleavage. The test with HCL causes bubbling. This is calcite. Two types of mica are present. The darker, more predominant crystals are biotite mica. The light-colored crystals are muscovite mica. Notice the rock marked "X". The dark quartz present in this limestone is flint.

11) The large dark crystals in this igneous rock are hornblende.

12) Note the particularly well-banded gneiss (metamorphic). Look on the side of the rock on the left. Minerals in igneous rock form and grow as the molten magma cools. These minerals are usually well distributed throughout the rock.

13) Notice the beautiful color bands of minerals in this mica schist.

14) Whenever extremely large minerals form in igneous rock it is called a pegmatite.

15) This diabase (igneous) has rectangular joint patterns. These indicate zones of weakness created during the original cooling of the rock. The weathering processes attack most effectively along these weaker areas.

16) Can you identify this rock? If not, see #12. Why could you call the rock behind it a pegmatite?

17) The rock marked "X," at the beach edge, is of metamorphic origin. What evidence can you see that would indicate stress caused by heat and pressure?

18) This is quartz sandstone (sedimentary). What causes the different layers in this type of rock?

19) Can you identify the dark mineral crystals in this pegmatite? If not, see #11.

20) The holes in these conglomerate sandstones (Stockton Sandstone) are caused by the weathering out of the less hardy pebbles.

21) These purplish-lavender rocks are hard argillitic sandstones from the Stockton Formation.

22) What evidence is present in this sandstone that would indicate that it was deposited in water?

23) This is silica cemented sandstone that has nearly metamorphosed into quartzite.

24) This is conglomerate from the Stockton Formation. (See #20).

25) The wind swirls the quartz sand grains in the potholes of this red sandstone and enlarges the openings. This is one method of weathering rock.

26) The peeling of rock layers is called exfoliation. Why are the cracks being produced in certain areas of this rock? See #15.

27) These are man-made rocks:

> Concrete - This is cement mixed with sand, crushed rock, and water. Portland cement is made by burning limestone and shale in a kiln. The clinkers that form are then ground into powder.
>
> Brick - A building and paving material made from clay by molding into blocks while moist, and hardened by sun or fire.

How would the absence of these two man-made rocks have limited the extent of civilization as we know it today?

28) Notice the strata (bands) in this sandstone. What is the purpose of the rock groin at your distant left? See #4.

29) At low tide you can see the hook-like projection developing off of the north edge of Plum Island (across the road). Would the lack of vegetation indicate that this projection had only recently developed?

30) Plants along the shoreline are valuable anchors in stabilizing the shifting sands. West of the sea wall we can see the following plants in season: Dusty Miller (Artemisia stelleriana) a low, whitisn type plant, Seaside Goldenrod (Solidago sempervirens), Beach Grass (Ammophila breviligulata), Beabh Pea (Lathyrus maritimus), Groundsel (Baccharia halimifolia), and Sea rocket (Cakile edentula).

31) What do you know about the rock on the opposite side of the walk? See #26.

32) Are the majority of rocks in this area igneous, sedimentary, or metamorphic? (These are nearly all schists).

33) As you finish walking along the remainder of the wall, see how many of the numbered rocks on your left you can identify. If in doubt, refer back to the numbered explanations in your guide.