

Geologic Site of the Month
December, 2007

Grindle Point, Islesboro, Maine



44° 16' 52.79" N, 68° 56' 34.31" W

Text by
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Introduction

One of the many jewels along the Maine coast is the island of Islesboro, in northern Penobscot Bay. There are about 600 year-round residents in the town of Islesboro, which includes the big island and several smaller neighboring islands. Primarily a residential town, summer visitors will find enjoyable activities for day trips such as bicycling and kayaking.



Figure 1. Lighthouse at Grindle Point, Islesboro.

Grindle Point

The public ferry from Lincolnville lands on the western side of the island at Grindle Point. The topic of this web site is the geology of the coastal ledges (Figure 2) next to the ferry parking lot, just north of the [Grindle Point Lighthouse](#) and Sailor's Memorial Museum. The readily accessible ledges show many representative features of the geology of Islesboro.



Figure 2. Air photo of Grindle Point, Islesboro. The ledges described in this web site are along the shore next to the ferry parking lot.



Islesboro Geology

Islesboro is distinctive among the larger islands of Penobscot Bay in being long and narrow, over 11 miles north-south, and only 2½ miles across at its widest. This shape reflects its bedrock, which is dominated by sandstone, slate, and limestone - layered rocks that are aligned predominantly north-northeast. Nearby islands such as Mount Desert Island, Swans Island, Deer Isle, and Vinalhaven, which are more nearly circular in outline, are underlain primarily by masses of granite.

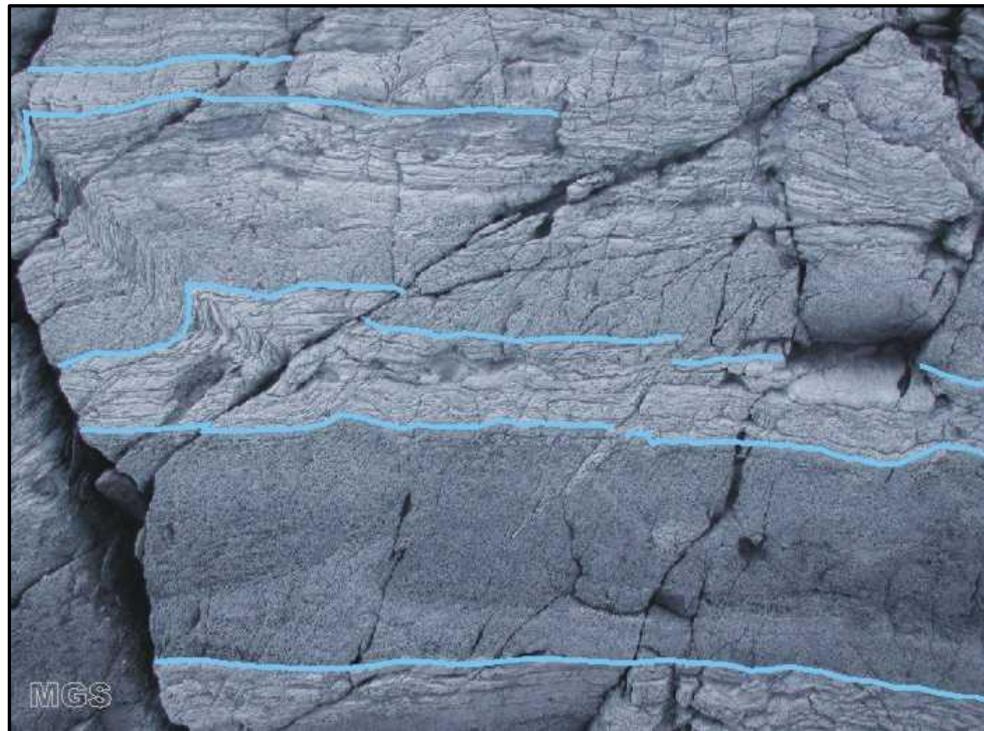


Figure 3. The light and dark colored layers represent individual sediment deposits called beds (highlighted with blue lines). A few of these beds were sand and most were silt. Even though the beds were folded, crumpled, and faulted to various degrees in their later history, their essential sedimentary character is preserved here.

Islesboro Geology

The Islesboro Formation (Smith, Bastin, and Brown, 1907 - see references) comprises the bedrock of most of the island, and is preserved in very few places outside the island. It formed originally as a sequence of sedimentary rocks that later was changed by heat and pressure into the metamorphic rocks we see today. The rocks at Grindle Point contain thin layers that formed as the sediments were being deposited.

The metamorphic events caused the rocks to be deformed, so that the layers are now folded into curved shapes, and disrupted by faults. It is the basic rock structure that controls the northeast trend of the island. The age of the original sediments is probably Cambrian(?) or late Precambrian(?), over 500 million years old. The age of metamorphism and faulting is not well known, but is probably of Silurian age (Stewart and Tucker, 1998; Stewart and others, 2001). Thin, dark green dikes of igneous rock cut the Islesboro Formation at many places.



Folds

Photo by Henry Berry

Figure 4. Small folds in the sedimentary layers were produced when the rock was deformed during metamorphism. Layers which originally were flat and straight are now tilted and curved. The shapes of these particular folds indicate that the rock was shortened in a northwest-southeast direction (left to right in the photo) as a result of pressure.

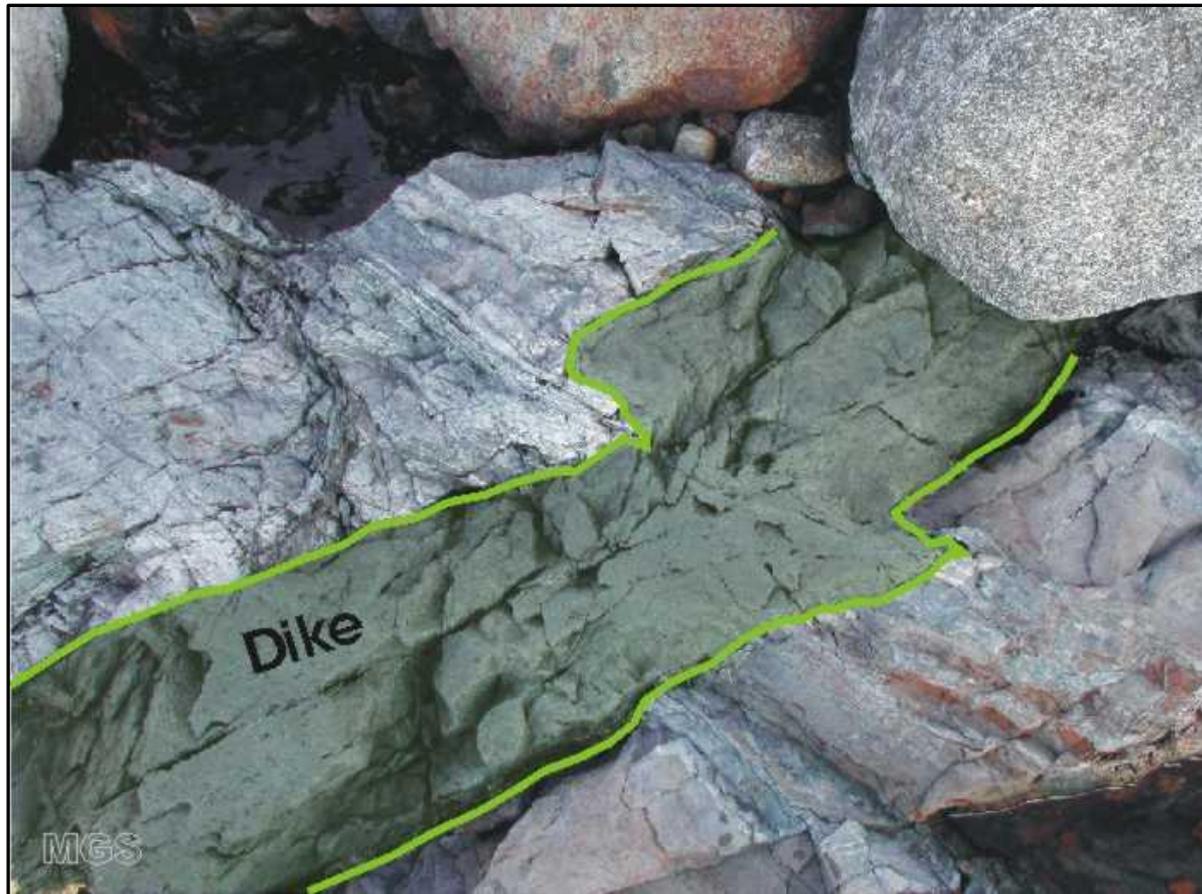
Dikes

Figure 5. Dark colored dike of igneous rock cuts across the light colored metamorphic rocks (highlighted with green). The dike formed when magma at depth intruded along a fracture. The walls of the dike were spread apart as the magma came into it. There is a jog in the dike because the fracture was not straight.

Faults

Photo by Henry Berry



Figure 6. Layered rocks of the Islesboro Formation cut by many small faults (highlighted with pink on the right). Each fault is a surface along which the rock broke and was displaced. Faults are most easily seen in rocks such as this with layers that can be followed across the outcrop.

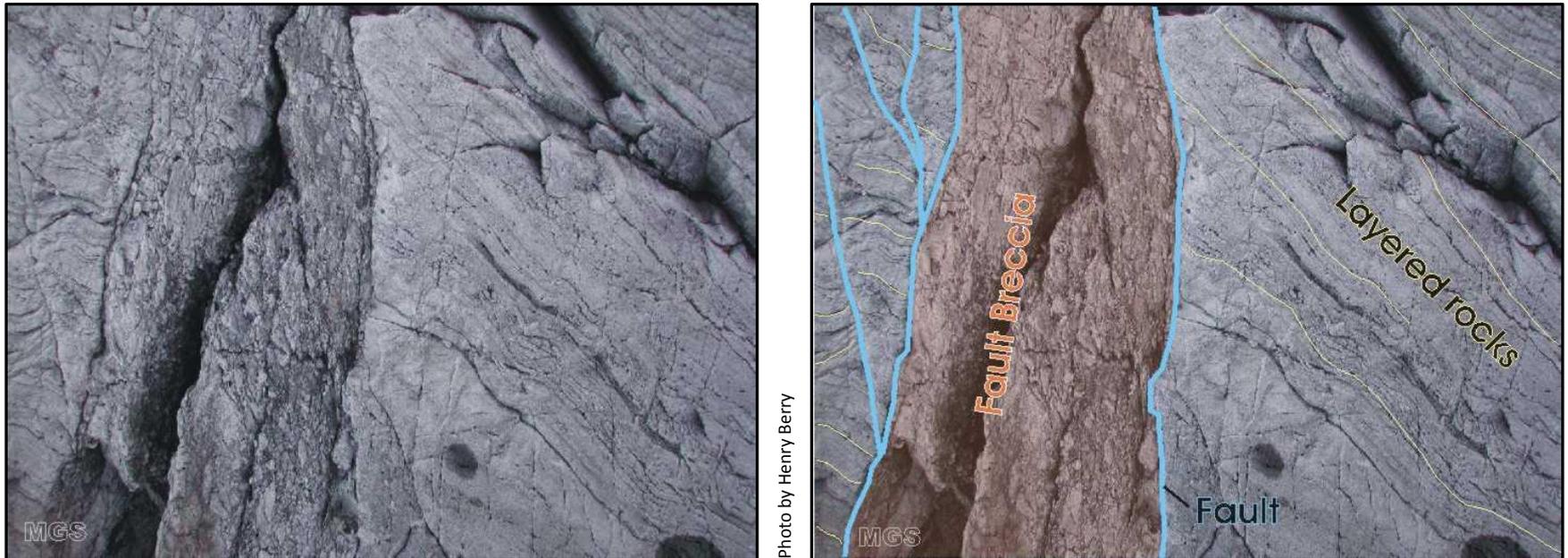
Faults

Figure 7. Fault breccia. Layered rocks in the right side of the photograph are cut abruptly by a brittle fault. The rock to the left of this fault is broken into small fragments (highlighted in yellow on the right). Such a fragmental rock produced by faulting is called breccia (breh'-chya).

Glacial Striations

Figure 8. This natural surface above high water was worn down and striated during the last Ice Age. As the continental glacier moved across the surface, embedded stones at its base scraped and gouged the bedrock surface, leaving these parallel marks. These marks are about 14,000 years old.

Photo Tour

Now that you have learned what to look for, take a photo tour of the geology at Grindle Point.



Photo by Henry Berry

Maine Geological Survey

Slide 1. Route 1, Lincolnville, decorated for the holidays.



Photo Tour



Photo by Henry Berry

Slide 2. Ferry terminal at Lincolnville Beach. Islesboro on the horizon.



Photo Tour



Maine Geological Survey
Photo by Henry Berry

Slide 3. Ferry terminal at Lincolnville Beach. Islesboro on the horizon.



Photo Tour



Photo from Maine Office of GIS

Slide 4. Air photo of the ferry approaching Grindle Point, Islesboro. Warren and Spruce Islands to the south.



Photo Tour



Photo by Henry Berry

Slide 5. Grindle Point from the ferry.



Photo Tour



Maine Geological Survey Photo by Henry Berry

Slide 6. Looking north at Grindle Point Lighthouse and Sailor's Memorial Museum. Mount Waldo on the horizon.



Photo Tour



Photo by Henry Berry

Slide 7. Northern part of Gilkey Harbor, looking from the ferry landing.



Photo Tour



Slide 8. Ledges along the shore next to the former lighthouse keeper's boathouse, and ferry terminal.



Photo Tour



Photo by Henry Berry

Maine Geological Survey

Slide 9. Craggy rocks of the Islesboro Formation. Weathering and erosion have followed the rock structure.



Photo Tour



Photo by Henry Berry

Maine Geological Survey

Slide 10. Light and dark layers (beds) of sandstone and siltstone in the Islesboro Formation.



Photo Tour



Photo by Henry Berry

Maine Geological Survey

Slide 11. Thinner beds, tilted down to the right.



Photo Tour



Photo by Henry Berry

Maine Geological Survey

Slide 12. The layers have been folded during subsequent geologic activity. This is one of a set of nearly horizontal folds.



Photo Tour



Photo by Henry Berry

Maine Geological Survey

Slide 13. The beds are also deformed by upright crinkle folds. These upright folds are common across the outcrop, and deform the older horizontal folds.



Photo Tour



Photo by Henry Berry

Maine Geological Survey

Slide 14. More upright folds, seen in cross-section on a vertical rock surface.



Photo Tour



Photo by Henry Berry

Slide 15. Delicate folds in thin beds. Fascinating!



Photo Tour



Photo by Henry Berry

Maine Geological Survey

Slide 16. In some places the rock was sheared along relatively thin, vertical bands



Photo Tour



Photo by Henry Berry

Maine Geological Survey

Slide 17. Dikes of igneous rock (basalt) were injected into the Islesboro Formation along fractures. These dikes are now greenstone, having been since metamorphosed.



Photo Tour



Photo by Henry Berry

Maine Geological Survey

Slide 18. Edge of a dike (bottom) which cuts across folded layers of the Islesboro Formation.



Photo Tour



Photo by Henry Berry

Maine Geological Survey

Slide 19. Man standing on a large dike, over 10 feet across.



Photo Tour



Photo by Henry Berry

Maine Geological Survey

Slide 20. Subtle color variations in the dike (top) probably represent magma flow parallel to its contact during emplacement.



Photo Tour



Photo by Henry Berry

Maine Geological Survey

Slide 21. Brittle deformation (faulting) occurred later and at lower temperatures than the folding. Layers are broken and offset.



Photo Tour



Photo by Henry Berry

Maine Geological Survey

Slide 22. A vertical zone of fragmented rock (breccia) cuts the layered rock to the right. Breccia is produced by faulting.



Photo Tour



Photo by Henry Berry

Slide 23. This smooth rock surface was shaped and striated (scratched) by the continental glacier during the last Ice Age.



Photo Tour



Photo by Henry Berry

Slide 24. Grooves and striations on the rock surface were caused by moving glacier ice.



Photo Tour



Photo by Henry Berry

Maine Geological Survey

Slide 25. Glaciers cause grooves in the upper rock surface (right to left), easily distinguished from criss-cross fractures which penetrate into the rock.



Photo Tour



Photo by Henry Berry

Slide 26. Ferry headed west toward the mainland. Rocks of Grindle Point in foreground; Camden Hills on the horizon.



References and Additional Information

Smith, George Otis, Bastin, Edson S., and Brown, C. W., 1907, Description of the Penobscot Bay quadrangle, Maine: U. S. Geological Survey, Geologic Atlas, Folio 149, 14 p. (map scale 1:125,000).

Stewart, David B., 1974, Precambrian rocks of Seven Hundred Acre Island and development of cleavage in the Islesboro Formation: in Osberg, Philip H. (editor), Guidebook for field trips in east-central and north-central Maine: New England Intercollegiate Geological Conference, 66th Annual Meeting, Orono, Maine, p. 86-98.

Stewart, David, B., and Tucker, Robert D., 1998, Geology of northern Penobscot Bay, Maine: U.S. Geological Survey, Miscellaneous Investigations Map I-2551, scale 1:62,500, two sheets.

Stewart, David B., Tucker, Robert D., Ayuso, Robert A., and Lux, Daniel R., 2001, Minimum age of the Neoproterozoic Seven Hundred Acre Island Formation and the tectonic setting of the Islesboro Formation, Islesboro block, Maine: Atlantic Geology, v. 37, p. 41-59.

[Islesboro Formation listing in the U.S. Geological Survey database](#)

[Islesboro Ferry](#)

[Maine Air Photo Viewer, Maine Office of Geographic Information Services.](#)

