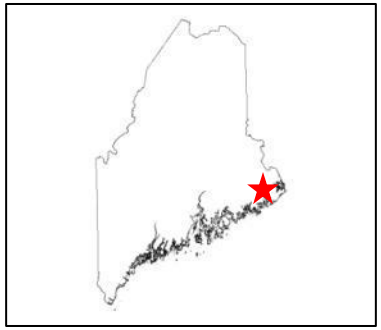
Maine Geologic Facts and Localities

August, 2000

The Geology of Cobscook Bay State Park



44° 50‘ 24.67“ N, 67° 9‘ 3.01“ W

Text by
Robert A. Johnston

Introduction

Cobscook Bay State Park is located in Edmunds Township in eastern Maine, six miles south of Dennysville. The Park is bordered by Whiting Bay, a smaller bay located within Cobscook Bay (Figure 1).

Figure 1. Portion of the Whiting 7.5' U. S. Geological survey topographic map showing the location of Cobscook Bay State Park (outlined in red).

Cobscook Tides

Twice-daily (semidiurnal) tides in the region average 24 feet (Figure 2), with occasional tides running as high as 28 feet. Cobscook Bay's name comes from the Native American word meaning "boiling tides."

Figure 2. The boat launch ramp at the north end of the park at low tide. Note the seaweed marking the high tide line in the foreground.

Cobscook Tides

These strong tides influence the sediments deposited in the Bay and increase shoreline erosion (Figure 3). The geology of the area is shaped by the tidal forces, the underlying bedrock geology, and the glacial action from the most recent ice age.

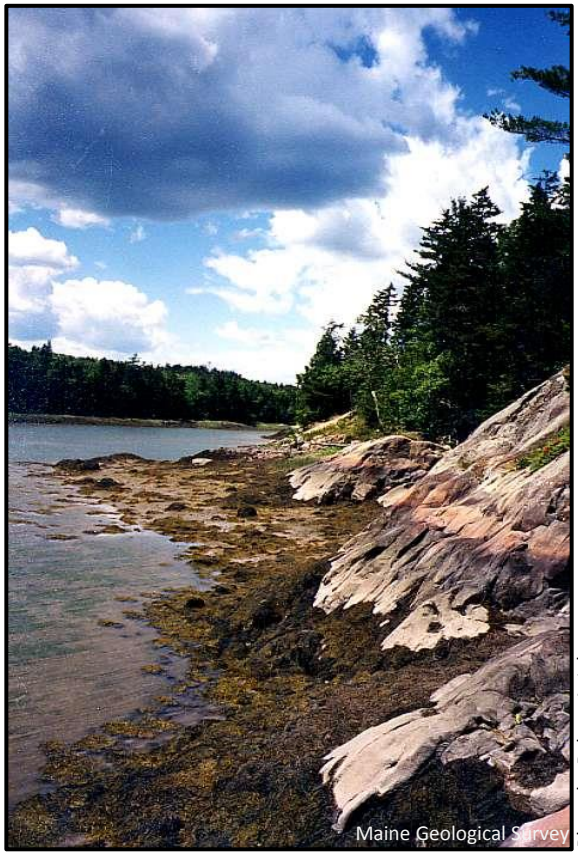


Photo by Robert A. Johnston

Figure 3. Broad Cove in Cobscook Bay State Park shows an extensive tidal flat framed by Edmunds Formation bedrock.

Bedrock Geology

Nathaniel S. Shaler, in 1886, was one of the first geologists to describe the bedrock geology of Cobscook Bay. His report (Shaler, 1886), identified the igneous rocks of the area and cataloged the local fossils. Bastin and Williams, in 1914, published the Eastport Folio, a detailed treatise on the bedrock and surficial geology, and paleontology. The geology of Cobscook State Park is dominated by the bedrock of the Edmunds Formation (Bastin and Williams, 1914), a volcanic tuff-breccia. Outcrops of the Edmunds Formation are found throughout the Park and rim the shoreline of Whiting Bay. The Edmunds Formation tuff-breccia is a resistant rock type of Silurian age (approximately 419 to 424 million years ago) that was deposited on the flank of a partially submerged, explosive volcano (Gates, 1975).

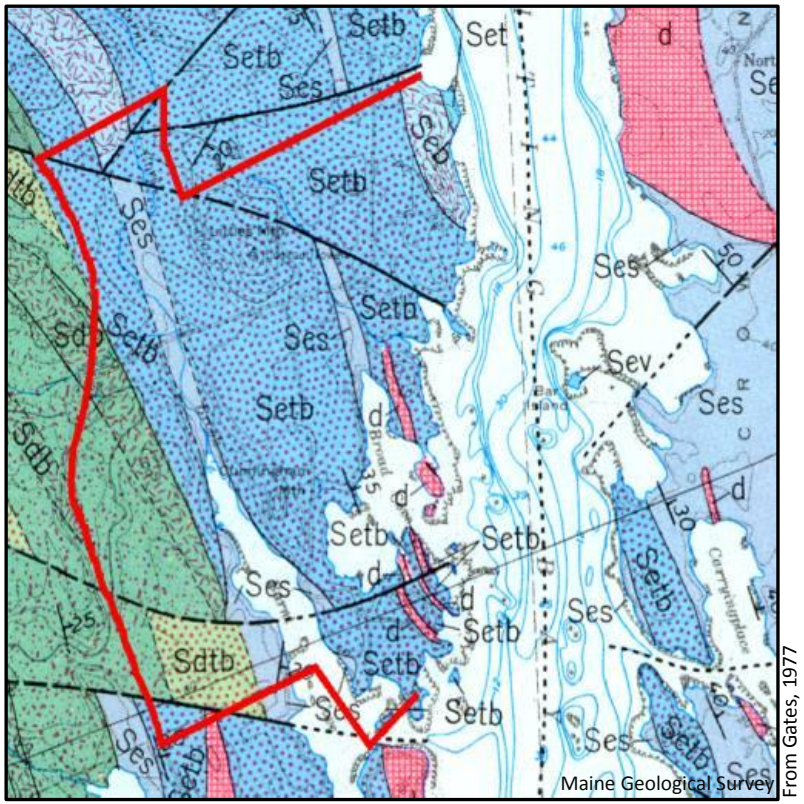


Figure 4. Cobscook Bay State Park section of the Bedrock Geologic Map of Eastport, Maine (7.5' scale of Gates, 1977). Edmunds Formation: Setb - tuff breccia; Seb - basalt; Ses - mudstone. Dennys Formation: Sdb - basalt; Sdtb - tuff breccia. d - diabase and gabbro dikes.

Bedrock Geology

The tuff-breccia is one of seven different units distinguished within the Edmunds Formation. Underlying the State Park is the submarine pyroclastic flow or avalanche deposit that forms the white, pink, and maroon, coarse tuff-breccia. Outcrops of this unit can be seen in the field in the day-use area or along the shore. Angular blocks and smaller fragments make up the matrix of the massive Edmunds Formation unit (Figure 5). The smaller fragments and blocks found in the massive breccia are composed of vitrophyre (an igneous rock with a glassy groundmass) and felsite (a light-colored igneous rock composed chiefly of quartz and feldspar). Pumice lapilli and shard inclusions, indicating a pyroclastic origin, are also found in the tuff-breccia.

Photo by Robert A. Johnston

Figure 5. Edmunds Formation tuff-breccia showing inclusions of vitrophyre and felsite.

Bedrock Geology

Another unit of the Edmunds Formation is fossiliferous, another is composed of hydrothermally altered basalt flows, while another is well bedded. As the Edmunds Formation was deposited into the ocean it moved across a muddy marine sediment. The volcanic flows cut down into the underlying muds, deforming and incorporating the mud and its benthic fauna into its lower layers. The fossils found in the lower sections of the Edmunds Formation are the same as those found in the underlying Dennys Formation (the Dennys Formation is another pyroclastic deposit formed by a separate volcano). Brachiopods are the dominant fossils found in the siltstone and shale unit of the Edmunds Formation.

Bedrock Geology

The Edmunds Formation is intruded by diabase or gabbro dikes and sills. These are also of Silurian and Devonian age. One of these dikes is visible along the shore of Whiting Bay in the day-use area (Figure 6). It is thought that intrusive activity took place during the time of volcanic activity when the Edmunds Formation rocks were deposited. These dikes are visible on a close-up of the map published by Gates (1975) (Figure 4).

Two mapped faults also cross the Park. These faults separate map units and are likely related to regional fault patterns. No offset has been seen on any area faults to indicate any fault movement since the Jurassic Period (Gates, 1982).

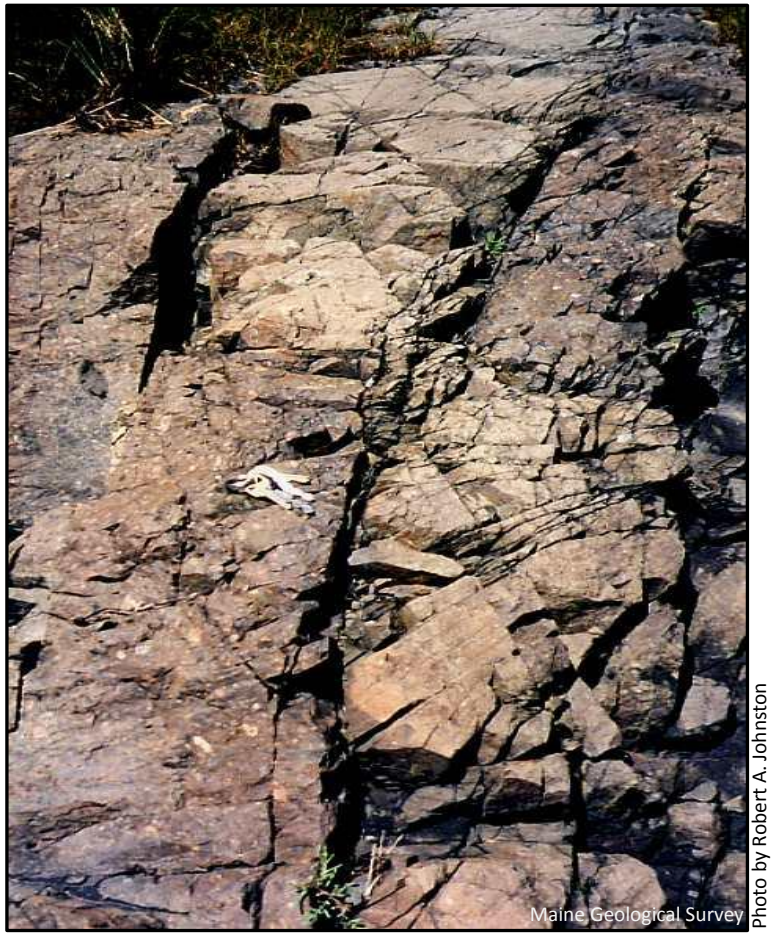


Figure 6. Dike intruded into Edmunds Formation tuff-breccia along the shore of Whiting Bay.

Surficial Geology

The surficial geology of the Park is dominated by deposits of till and Presumpscot Formation mud (Borns, 1975). Both units were emplaced during the late stages of the Wisconsinan ice sheet, approximately 12,000 to 18,000 years before present. Till (Qt), a heterogeneous mixture of rock, sand, silt and clay, was deposited either in direct contact with the ice or as a flow deposit off of the ice sheet. Till usually covers the higher terrain in the area (Figure 7).

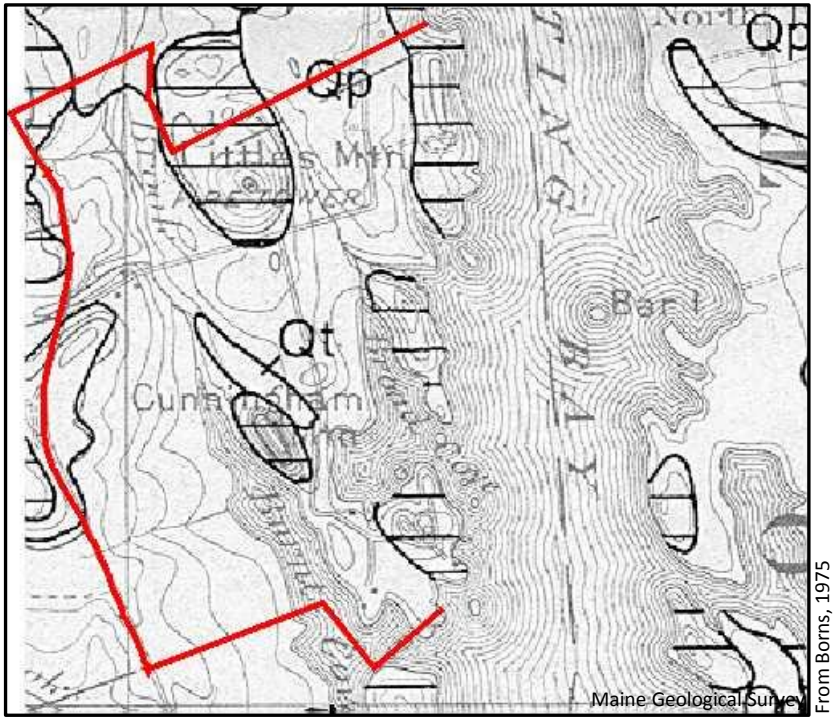


Figure 7. Cobscook Bay State Park section of the Eastport 15' surficial geology map (Borns, 1975). Horizontal ruled lines are areas of thin glacial sediments. Qt is till. Qp is Presumpscot Formation (glacial-marine clay).

Surficial Geology

Presumpscot Formation mud is a glacial-marine, fine-grained deposit composed of clayey silt, with occasional sand lenses. This unit usually fills the lowland regions and can sometimes be locally fossiliferous. The Presumpscot Formation mud unit is composed of sediments that washed out of the Late Wisconsinan ice and accumulated on the floor of the ocean at a time of much higher sea level.

Both the till and Presumpscot Formation mud deposits in the area of the State Park are generally a thin covering over the bedrock, usually less than ten (10) feet thick. Glacial striations, grooves on bedrock surfaces caused by the movement of ice over the bedrock, are visible on some of the outcrops along the shore of the Park. An average of the striations from the Bastin and Williams folio indicate an ice movement direction of 143 degrees (southeast) in the vicinity of the State Park.

Whiting Bay, being far from the open ocean, is a shallow, restricted embayment. Seismic reflection profiling by Kelley and others (1989) indicates a mud thickness up to 28 m (92 feet) in Whiting Bay. A thick Presumpscot Formation mud unit would be expected due to the restricted circulation in the bay.

Marine Geology

The extremely high tides in Cobscook Bay influence the types of materials found on the floor of the bay and along the shoreline. Located in the "Cliffed Shoreline" compartment of Kelley and others (1988), Cobscook Bay is home to miles of bedrock outcrop and numerous, small salt marshes. Fine-grained, algal, mud flats are exposed at low tide in both Burnt Cove and Broad Cove in the State Park (Timson, 1976). Low salt marsh deposits have abundant *Spartina alterniflora* (salt-cord grass) which exists between mean tide level and mean high water. *Spartina patens* (salt-meadow grass), high salt marsh, exists above the *Spartina alterniflora* and at the same level as mean high water (Figure 8).

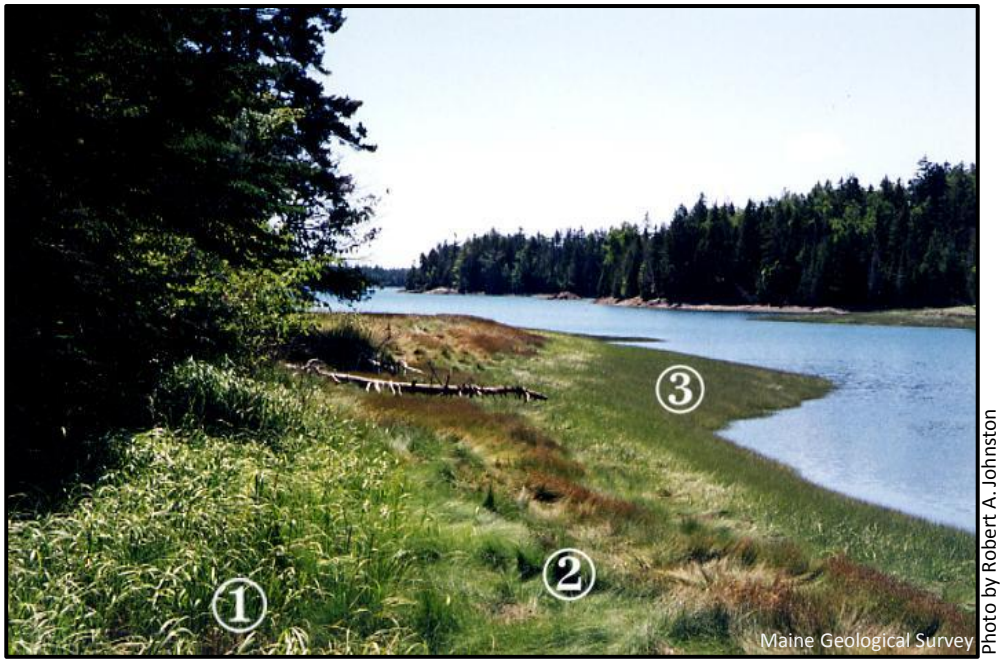


Figure 8. Salt marsh in Burnt Cove showing: (1) freshwater marsh, (2) high salt marsh (Spartina patens), and (3) low salt marsh (Spartina alterniflora).

Conclusions

Cobscook Bay State Park's geology is strongly influenced by three main factors: the resistant rocks of the Edmunds Formation, the erosive effects of the last continental glaciation, and modern tidal processes.

The forces that shaped the landscape produced as Shaler put it in 1886: "a more interesting assemblage of phenomena than can be found on any other part of the eastern seaboard of the United States."

References and Additional Information

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