Maine Geologic Facts and Localities

March, 2002

Sea-Level Change on Mt. Desert Island, Maine

44° 19' 45.46" N, 68° 10' 54.36" W

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Introduction

The level of the ocean changes in response to many factors and on a variety of time scales. In Maine, evidence for significant, long-term changes in the level of the sea have been recognized since at least 1836 when Charles Jackson noted seashells high above the ocean in what is now called glacial-marine mud (the Presumpscot Formation). These were attributed to Noah's Flood by all observers until the Glacial Theory was advanced by Louis Agassiz in the middle of the 19th century. This theory explained many surficial geological features in high-latitude locations as a consequence of a great Ice Age. It was recognized by many scientists that the water for the great glaciers must have come from evaporation of seawater and caused a lowering of sea level. It was further observed that the weight of the ice near coastal areas was probably sufficient to depress the land and permit an invasion by the sea as the glaciers melted.

Introduction

The first place where abundant higher-than-present sea-level indicators were observed in Maine was on Mt. Desert Island (Figure 1).

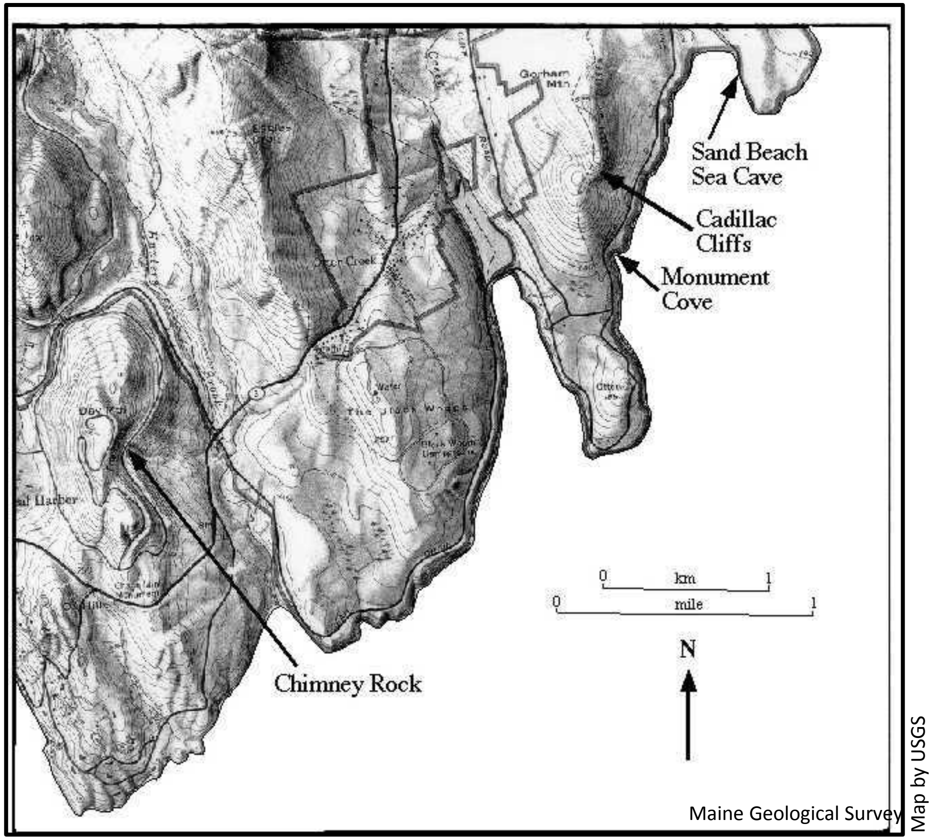

Figure 1. Location map of the southern side of Mt. Desert Island, Maine. Places mentioned in the text are indicated with arrows.

Monument Cove

The motto of geology is "The present is the key to the past." Before delving into ancient sea level locations, it is worth noting some coastal features which characterize the contemporary shoreline. At Monument Cove, directly below the Park Loop Road from the Gorham Mountain parking lot, there is a magnificent boulder beach (Figure 2).

Photo by Maine Geological Survey

Figure 2. A view of Monument Cove looking to the east. Note the angular boulders in the recent landslide in the foreground. Rounded boulders make up the central part of the beach. A 10 m high sea cliff forms the back of the beach. The sea stack (Figure 3) is in the distance.

Sea Stacks

The boulders are worked out of the cliffs by waves and tumbled into near-spherical shapes during storms. At the distant (eastern) end of the cove a sea stack exists (Figure 3).

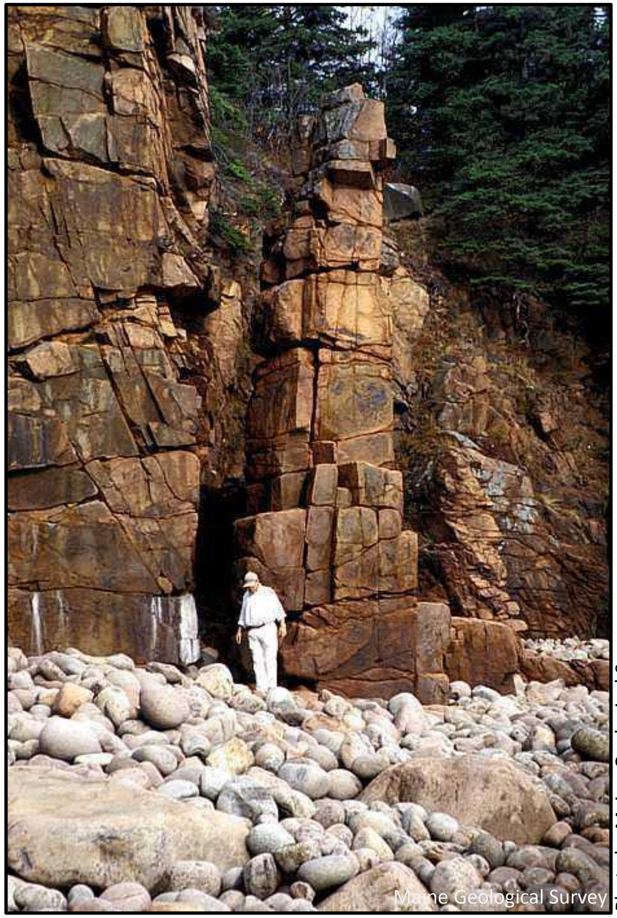

Photo by Maine Geological Survey

Figure 3. The sea stack at Monument Cove. Note the rounded boulders on the beach and the fractures in the bedrock.

Sea Stacks

This column of granite was formerly attached to the mainland, but wave erosion, by focusing on the vertical fractures in the rocks, has separated it (Figure 4). Time 1: a small sea cave is eroded into rock along a vertical fracture. Time 2: Continued erosion of the sea cave develops a sea arch. The old sea stacks continue to erode from battering by wave-tossed boulders; Time 3: A new sea stack forms when the arch collapses, and a new sea cave begins to develop. The old sea stacks are worn down to a wave-cut platform. The time frame for this scenario varies with rock type and wave energy, but could require up to 500 years in Maine granite. At the back of the cove stands a vertical sea cliff that has retreated landward as blocks of granite were quarried away by waves (Figure 2).

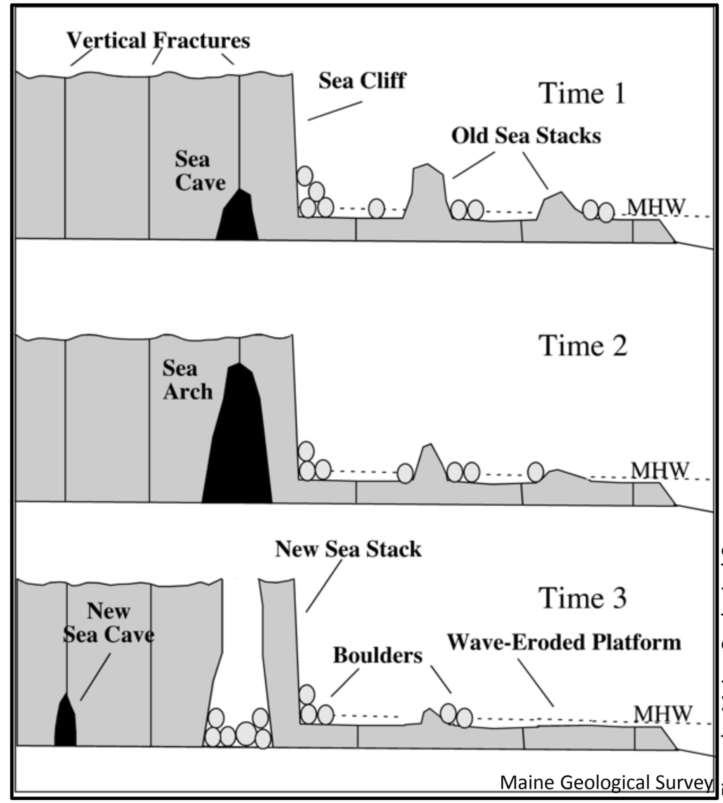

Figure by Maine Geological Survey

Figure 4. Formation of coastal erosion features.

Sea Stacks

Another erosional feature, not seen in Monument Cove, but common in Acadia National Park, is a sea cave (Figure 1, 5). Sea caves, like sea stacks, form where fractures are eroded by waves near the high-tide line (Figure 4). The shape of the fractures and their spacing determines whether sea caves, sea arches, or sea stacks will form. None of these features are long-lived, and the waves that create them soon lead to their destruction. Most of the rocks on the Maine coast have too many fractures to allow these features to form or exist for very long, but the granite of Mt. Desert Island appears ideal for their formation.

Photo by Maine Geological Survey

Figure 5. Sea cave (in shadow of cliff center) on the east side of Newport Cove. Sand Beach is to the left.

Chimney Rock

All of this was known to late 19th-early 20th century geologists, and "Chimney Rock" was recognized as solid evidence for a higher-than-present sea-level position in the late 19th century (Shaler, 1889) (Figure 6).

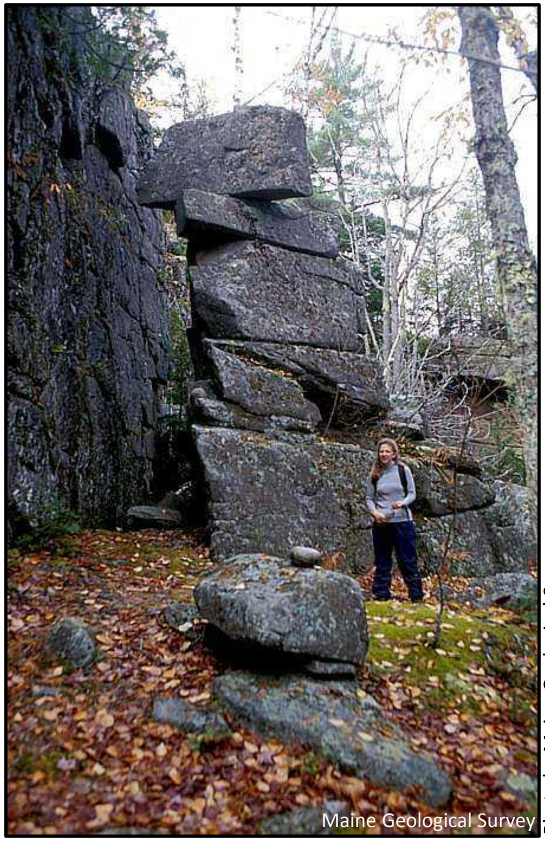

Photo by Maine Geological Survey

Figure 6. Chimney Rock raised sea stack. The sea cliff is to the left, and the vandalized stone is on the top of the stack once again.

Chimney Rock

The raised sea stack is about 60 m above present sea level and remarkably similar in appearance to the Monument Cove sea stack (Figure 3). Chimney Rock is such striking testimony to a raised sea level that wealthy Mt. Desert Island summer resident, John Rockefeller, was interested in it, and Chimney Rock was described in local newspapers. Most impressive was the uppermost stone, which must have been last turned by a great storm perhaps 13,000 years ago. Unfortunately vandals read of Chimney Rock and managed to topple the uppermost stone. As testimony to his fondness for science, Mr. Rockefeller had a crane brought up the nearby Carriage Path and replaced the fallen stone.

Chimney Rock

Behind Chimney Rock and stretching for more than a kilometer is a pronounced sea cliff upon which the Carriage Path is built. Below Chimney Rock, the uneven ground is composed of innumerable rounded granite cobbles (Figure 7). These are strikingly reminiscent of the boulder beach at Monument Cove.

Photo by Maine Geological Survey

Figure 7. Rounded boulders at base of Chimney Rock.

Cadillac Cliffs

On Cadillac Cliffs, directly up Gorham Mountain from Monument Cove (Figure 1), similar features exist. Here one may also find a large sea cave cut into the raised granite sea cliff (Figure 8). In the back of the cave is lodged a rounded granite boulder, that was presumably hurled into the cave by a storm 13,000 years ago. The sea cliff surrounding the cave is 10 m high and seaward of the cliff are rounded boulders as at Monument Cove. All of these raised coastal features exist between 60-70 m above present sea level, the highest elevation the sea reached in this area based on other observations in the region.

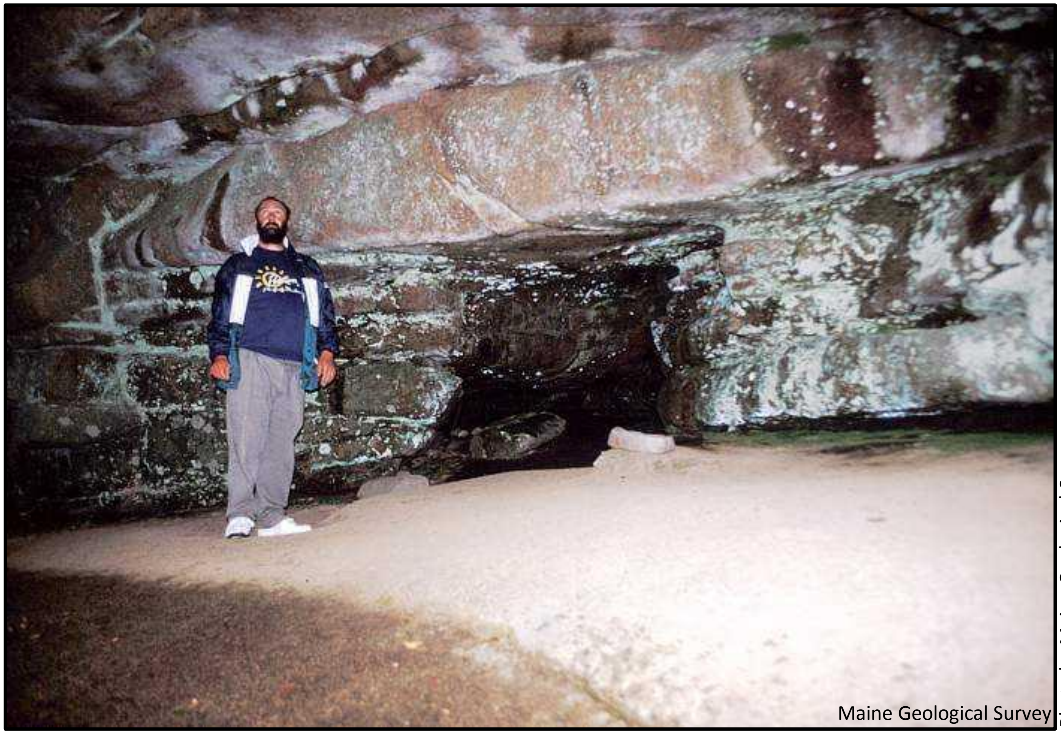

Photo by Maine Geological Survey

Figure 8. Six-foot tall man inside Cadillac Cliffs raised sea cave.