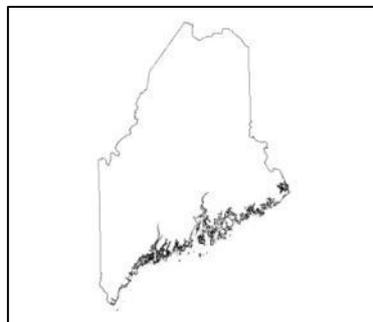


Geologic Site of the Month  
January, 2003

***Pillow Lavas I Have Known***

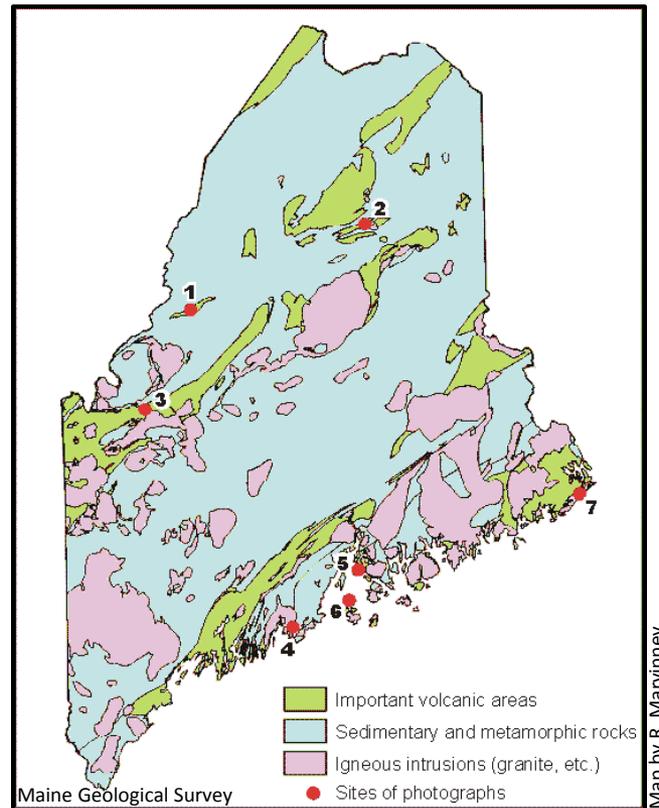


Text by  
Robert Marvinney



## Introduction

Maine's bedrock geology abounds with variety, ranging from sedimentary rocks to high-grade metamorphic rocks, and intrusive igneous rocks of all types. Some of the more fascinating rocks are the volcanic rocks. While Maine currently has no active volcanic zones or even old volcanic peaks, it nonetheless has many areas that are underlain with volcanic rocks (Map 1).



**Map 1.** Map showing the location of volcanic rocks in Maine.



### Formation of Pillow Lava

This month, we will look at a peculiar type of volcanic rock called a pillow lava. When molten lava erupts underwater, it commonly forms mounds of elongate lava "pillows" by repeated oozing and cooling of the hot lava. As the lava oozes, it forms a flexible crust in a blobby pillow shape. More lava expands this flexible crust until it breaks, lava oozes out, and another pillow forms. As new pillows pile onto old, the bottoms of the new, warm pillows mold their shapes to the tops of the older cooled and hardened ones, forming characteristically convex tops and concave bottoms.

While the rock type is most often basalt (a dark volcanic rock rich in iron and magnesium), other types of lavas can form pillows as well. To the geologist, pillow lavas are clear evidence that the lava erupted under the sea (Click to see a [video clip](#) of modern pillows forming). For geologists in Maine, pillow lavas show us where ocean basins existed hundreds of millions of years ago.



Introduction

Maine Geological Survey

Photo by R. Marviny

**Figure 1a.** Pillow lavas in the Canada Falls Member of the Frontenac Formation near Canada Falls and Seboomook Lakes in northwestern Maine. They are slightly more than 400 million years old. In this cross-sectional view the group of pillows have been tipped on edge so that the rounded tops are on the right side and the concave bottoms on the left.



### Pillow Lava

Figure 1b shows pillow lavas in the Canada Falls Member of the Frontenac Formation near Canada Falls and Seboomook Lakes in northwestern Maine. They are slightly more than 400 million years old. The elongated pillows have been flattened. Still, it is possible to see that the rounded tops are on the right side and the concave bottoms on the left.



Photo by R. Marviny

**Figure 1b.** Outcrop of pillow lavas in the Canada Falls Member of the Frontenac Formation.



Pillow Lava

**Figure 1c.** This view shows the internal structure common in some pillows. The outer crust is generally fine-grained and evenly textured. The center here shows former gas bubbles that are now filled with calcite. Geologists call open gas bubbles that are preserved in the rock vesicles. When they are filled with a mineral they are called amygdules.

Pillow Lava

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**Figure 2.** This is an example of pillow lava in the Grand Lake Seboeis group, a collection of related rocks exposed north of Baxter Park in the vicinity of Grand Lake Seboeis. These particularly well formed pillows sit nearly upright. See if you can find the rounded tops and concave bottoms that show this. These pillows are also around 400 million years old.

Pillow Lava

**Figure 3.** Pillow lava of the Jim Pond Formation forms a prominent roadcut along Route 27 about 5 miles north of Eustis where the highway crosses Alder Stream. Shale between the pillows allowed the pillows to break out nearly intact during road excavation. At least 500 million years old.

Pillow Lava



**Figure 4.** Metamorphosed pillow basalt from an unnamed volcanic unit on the coast in Friendship. These rocks are about 450 million years old.

Pillow Lava

**Figure 5.** A landscape of pillow lavas on North Haven Island mapped by the late Olcott Gates (in yellow) as part of the North Haven Greenstone. Most of the rounded shapes in this photograph are individual pillows. These rocks are probably at least 500 million years old.

Pillow Lava

Photo by F. Beck

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**Figure 6.** Pillows beautifully exposed at Condon Point in South Brooksville. Some of the pillows in the foreground show fracturing that radiates from the center of the pillow. Fractures like this typically form in pillows as they cool. Another shows a core that is mostly filled with calcite. These pillows are part of the Castine Formation, ~500 million years old.



Pillow Lava

**Figure 7a.** Pillow lavas of the Quoddy formation as mapped by Olcott Gates at Eastern Head in Trescott. Pillows are shown in cross-section in a sea-worn outcrop. Each pillow shows a quickly cooled thin dark crust. The interiors of some pillows have vesicles.

Pillow Lava



Photo by D. Allen

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**Figure 7b.** Another view of the pillow lavas of the Quoddy formation as mapped by Olcott Gates at Eastern Head in Trescott from Figure 8.

## References and Additional Information

Gates, O., 2001, Bedrock geology of North Haven and Vinalhaven Islands, Maine: Maine Geological Survey, Open-File Map 01-352.

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[NeMO New Millennium Observatory](#)

<http://www.marin.cc.ca.us/~jim/ring/rpillow.html>

