Grand Manan Geology: A Summary

Our island is well known for its high cliffs and rocky coves, with only a few sandy beaches or level benches with deep soils. The variety of rock formations attracts students of geology, mineral collectors, and artisans who use rocks in their arts and crafts, which you can find for sale at local shops as well as the Farmers Market on Saturday mornings. Geologists might prefer rocks in their original locations, where they hope to read the story of how our part of the Earth was formed. Grand Manan has a "split personality" regarding its physical geology, with Mesozoic lava flows covering its western side and much older metamorphosed formations across the low eastern shoreline and smaller islands.

Much of the map for the western island is my work, but we are indebted to regional geologists Sandra Barr, Leslie Fyffe, Malcolm McLeod, Richard Grant, and George Pajari for much new information about the island geology. Some sources are listed in the Geological References link.

Western Rocks

The higher western 2/3 of the island has thick lava flows of Dark Harbour Basalt, which are little changed from when they cooled at the end of the Triassic Period. They formed with the enormous "flood basalt" that underlies most of the Bay of Fundy, and which erupted 201 million years ago. The same lavas crop out along the southwestern shores of Nova Scotia, where they are known as the North Mountain Basalt. There as here, an abundance of interesting minerals have filled the cracks and bubbles left by gases boiling out of the cooling lavas. These include zeolite minerals chabazite, mesolite, stilbite, and heulandite, plus attractive quartz-related amethyst, agate, and many others.

The Dark Harbour Basalt is divided into three sections, or members, something like a cake with many thin layers of frosting in the middle. At the bottom is the Southwest Head member, a single massive flow which forms cliffs up to 100 meters high along much of the western shoreline. As it slowly cooled in a huge lava lake, vertical columns formed from bottom to top. Overlying this colonnade, the Seven Days Work member is comprised of 12 to 14 lava flows each a few meters thick. The flows contain a variety of attractive minerals along the famous cliffs of their given name. Over that, a top-most member is named after Ashburton Head, where you can see another thick pile of massive lava something like the bottom member. The two upper members have been removed by erosion over much of the island.

Beneath the basalt are two thick formations of Triassic siltstone and sandstone that total about 3 kilometers deep, called the Dwellys Cove and Miller Pond Road formations. They are equivalent to the Blomidon and Wolfville formations across the Bay in Nova Scotia. The top few meters of their shale and siltstone are exposed along the western cobble beaches, but we have yet to find any tracks or bones of dinosaurs in them, although it is worth looking!

Eastern Rocks

The Mesozoic formations rest upon a surface of ancient metamorphic rocks, which are poorly known where they lie buried deep beneath the Mesozoic rocks. But on Grand Manan, these "basement" formations are exposed in the low-lying eastern third of the island. This is due to vertical movement along a great fault that runs from Red Point (where it is well exposed) northward to Whale Cove (where it is hidden), and far out beneath the sea in both directions. The ridge just west of our highway from Seal Cove to North Head is held up by Dark Harbour basalt along the western side of the fault. As it moved, the Mesozoic formations were eroded away on the up side to eventually expose our eastern "basement." The Red Point Fault must have caused many Mesozoic earthquakes, but it has probably been quiet since then, so not to worry if you live near it!

The metamorphic formations are organized into the Grand Manan Group of Late Proterozoic age; the Castalia Group about 60 million years younger or Early Cambrian; and meta-plutonic bodies such as Stanley Brook Granite, Rockweed Pond Gabbro, and Kent Island Granite of the same two age groups. Although originally they were igneous and sedimentary rocks like basalt, sandstone, and shale, the eastern formations have been metamorphosed into greenstone, argillite, schist, quartzite, and other types during Early Paleozoic mountain-building events. Many folds and faults have bent and broken the formations in tortured-looking outcrops. One such fault can be seen at the north end of Pettes Cove, where it separates meta-basalt of Swallowtail Head from schist of North Head.

With the help of several recent radiometric dates, the eastern formations are now known to range in age from about 618 to 535 million years, or latest Ediacaran into Cambrian periods. This is of great interest to geologists who are trying to correlate the Grand Manan rocks with formations on the mainland of New Brunswick and elsewhere. Our eastern continent is assembled from sections of crust called terranes, which that have quite different rock types with different geological histories, and must have formed at other areas of the planet before being moved here via continental drift. The metamorphism displayed in our eastern rocks could only occur more than 5 km beneath the surface, while their faults, folds, and cleavages attest to dynamic mountain-forming events called orogenies, several of which occurred during the Paleozoic from 600 to 300 million years ago. Exactly which terranes and orogenies are represented on Grand Manan is still in dispute. It is a challenging science!

Recent Times

Near the end of the Ice Age about 14 thousand years ago, Grand Manan was just a high area on a large dry piedmont far from the shoreline. As the ice melted away, the ocean rose to fill the Bay of Fundy to make our island. The glaciers have removed most of the older soils while depositing a blizzard of stones carried from the mainland in Maine and New Brunswick, as every island gardener knows all too well. This glacial sediment, called till, is exposed in a few places along beaches and cliff tops. Waves continue to erode the shoreline, and the sea is rising again, so by the end of the century you (or your heirs) might wish that your island cottage was a bit higher inland!

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Sources

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