Grand Manan Geology

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.

Much of the map for the western island is my work, but I am indebted to colleagues such as Sandra Barr, Leslie Fyffe, Malcolm McLeod, Richard Grant, and George Pajari for information about island geology. Some sources are listed below, or see my website at
http://earth2geologists.net/grandmanangeology

Western Rocks

Grand Manan has a "split personality" regarding its physical geology. The western 2/3 of the island contains thick lava flows of Early Mesozoic age, which are little changed from when they cooled in the beginning of the Jurassic Period. They are part of the enormous "flood basalt" that underlies most of the Bay of Fundy, and which erupted 201 million years ago. The same lava flows crop out along the western shores of Nova Scotia, where they are known as the North Mountain Basalt. As on our island, an abundance of interesting minerals have filled the cracks and bubbles left by gases boiling out of the cooling lavas. These include zeolite minerals such as chabazite, mesolite, stilbite, and heulandite, plus attractive quartz-related amethyst, agate, and many others.

The Grand Manan Basalt is divided into three sections, or members, something like a cake with layers of frosting in the middle. At the bottom is the Dark Harbour 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. Above 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. The upper member is called Ashburton Head, where you can see another thick pile of massive lava something like the bottom member. The upper members of the Grand Manan Basalt have apparently been removed by erosion over much of the island.

Beneath the basalt are thick formations of Triassic siltstone and sandstone up to two kilometers deep. They are equivalent to the Blomidon and Wolfville formations across the Bay. Only the top few meters of shaley siltstone are exposed in places along the western beaches, and 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, the nature of which is not so easily understood where they lie several km deep. But on Grand Manan, these formations are exposed at the surface of 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 Jurassic earthquakes, but it has probably been quiet since Mesozoic times, so no worry if you live near it.

The metamorphic formations are organized into groups called Castalia, Ingalls Head, and Grand Manan, along with meta-plutonic masses such as Stanley Brook Granite, Rockweed Pond Gabbro, and Kent Island Granite. 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. In addition, many folds and faults have bent and broken the formations in rather 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, most of the eastern formations are now known to range in age from about 618 to 535 million years, or latest Precambrian into Cambrian. 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 that have quite different rock types with different geological histories, called terranes, and these must have formed at other areas of the planet before being moved here along plate tectonic faults. 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 500 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 12 thousand years ago, Grand Manan was just a high area on a large dry piedmont far from the shoreline. But as the ice melted away, the ocean rose to fill the Bay of Fundy, and we became an island. The glaciers 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 might wish that your island cottage was a bit farther inland! I am planning to still be here, and I hope you are too.

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Sources

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GEOLOGICAL MAP OF GRAND MANAN

compiled by J. Gregory McHone, 2008
adapted from maps by Leslie Fyffe, Richard Grant, and George Pajari