Maine Geologic Facts and Localities
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The Sunkhaze Peatland Complex

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44° 57’ 24.51“ N, 68° 36’ 14.93“ W
Introduction

Peatlands develop from a unique set of conditions. Interaction between the bedrock and surficial geology, climate, geomorphology, hydrology, and hydrogeology under the appropriate conditions provides the required environment for the growth and accumulation of peat. Maine, due to its past and present climate and geologic history, has provided an excellent environment for the development of peat deposits.
Peatlands

According to the American Geological Institute’s Glossary of Geology, peat is defined as an unconsolidated deposit of semi-carbonized plant remains in a water-saturated environment. Formed in low-lying wetland areas, peatlands are characterized by acidic conditions. Vegetation becomes partly decomposed under waterlogged, oxygen-depleted conditions and new vegetation grows upon the old. Peat deposits form in lacustrine (lake or pond) basins, along streams and rivers, and even over rolling upland terrain under the proper conditions.

Maine has a vast number of peat deposits. Estimates range from as many as 600 to 800 individual peatlands (Cameron, 1984), encompassing a total area of 500,000 to 750,000 acres. Many of these peatlands were studied during the Maine Peat Resource Evaluation program in the early 1980's. This program investigated Maine's large peat deposits which contain commercial quality peat suitable for use as a domestic fuel and was a cooperative study between the U.S. Department of Energy (DOE), U.S. Geological Survey (USGS), the Maine Department of Energy Resources, and the Maine Geological Survey (MGS). Over 233 peat deposits were investigated and visited as a part of this program.
Geologic Setting for Maine Peat Deposits

Maine is part of the Northern Appalachian physiographic province. Its underlying bedrock primarily consists of metamorphosed sedimentary and volcanic rocks which range in age from approximately 350 to 600 million years and are intruded by numerous bodies of granitic rock (Osberg and others, 1985). Bedrock of the Appalachians has been subjected to several episodes of folding and faulting as well as millions of years of weathering, which have resulted in rounded mountains and well-established drainage patterns.

Much of Maine's bedrock is covered by sediments deposited during the episodes of glaciation that occurred in the last hundred thousand years. Large continental glaciers spread southward from Canada until much of northern North America was covered by a sheet of ice hundreds to thousands of feet thick. These ice sheets eroded the bedrock and deposited a blanket of clay, silt, sand, gravel, and boulders. As the last ice sheet retreated, much of southern Maine was submerged as the ocean inundated land that had been depressed by the weight of the great thickness of ice. Between 13,200 and 11,000 years ago (Stuiver and Borns, 1975; Smith, 1985), fossiliferous marine sand, silt, and clay were deposited on top of the bedrock and glacial sediments (Thompson and Borns, 1985). The ocean gradually receded as the land surface slowly rebounded. (Click here for more on the [bedrock geology](https://www.maine.gov/parks/hiking/guides/bedrock_geology.html) and [surficial geology](https://www.maine.gov/parks/hiking/guides/surficial_geology.html) of Maine.)

Erosion by glaciers and deposition of glacial and marine sediments significantly altered pre-glacial morphology and drainage, creating environments favorable for the formation of peat. Streams and rivers were slowed or dammed. Ponds and lakes formed in bedrock basins or in poorly drained depressions, particularly those underlain by silt and clay deposits. Where drainage was impaired, the accumulation of non-decayed organic material was enhanced.
Formation of Peat Deposits in Maine

Development of domed peat deposits that are typically found in Maine normally follows through five phases or stages. During the initial phase (Figure 1), the remnants of aquatic plants such as algae and pond weeds accumulate over inorganic clay in the bottom of a pond.

**Figure 1.** A stream flowing into a pond or lake deposits sediment and organic material on top of the glacial clay.
Formation of Peat Deposits in Maine

When a sufficient thickness of organic material as well as relatively shallow water depths are attained, rooted plants such as bulrushes and pond lilies begin to grow. With continued accumulation of aquatic plant remains, water flow begins to become diverted (Figure 2) which allows the growth of grasses, sedges, reeds, and mosses.

Figure 2. The accumulated aquatic plant remains divert surface water flow.
Formation of Peat Deposits in Maine

The remains of these marsh plants, primarily reed-sedge peat, gradually fill in the basin (Figure 3).

**Figure 3.** The remains of marsh plants gradually fill in the basin.
Formation of Peat Deposits in Maine

In the fourth stage (Figure 4), the peat-forming vegetation spreads out beyond the margins of the original basin forming a continuous flat surface. During this phase, surface water flowing toward the bog and ground water flowing from adjacent aquifers lack the energy necessary to reach the centers of the peat-filled depressions. Because the mineral content of the water is greatest at the edges of the marsh, plants along the margins increase in variety and abundance. A less diverse plant assemblage including sphagnum moss becomes established away from the deposit edges and gradually, the proportion of sphagnum increases toward the interior of the marsh.

Figure 4. The marsh plants spread out beyond the edges of the original basin.
Formation of Peat Deposits in Maine

When sphagnum moss becomes the dominant species, moss peat begins to accumulate in a convex mass or dome (Figure 5).

**Figure 5.** Heath-covered sphagnum dome forms with perched water table.
Formation of Peat Deposits in Maine

In the fifth stage, surface water and ground water can contribute to the water supply only along the narrow trench-like land form, known as the moat, between the dome of peat and the mineral soil. The moat collects runoff from both the mineral soil and the slopes of the domed sphagnum peat. Eutrophic marsh and swamp grasses, shrubs, and trees grow where they are fed by nutrient-rich surface and ground water and soil, while the mosses and heath vegetation on the dome are oligotrophic, receiving nutrients solely from precipitation. Within the dome, a water table is maintained by capillarity (surface tension).

Peat deposits in Maine may be covered by marsh, swamp, or heath vegetation according to the phase of peatland development. Floods and fires during any phase may have destroyed all or a part of the peat deposit while variations in climate or nutrient input may change the rate of growth and decomposition. Therefore, deposits in varying stages of development are common. Such variability in development stage is seen in the Sunkhaze peatland complex.
The Sunkhaze Peatlands

The Sunkhaze peatland complex occurs within a large drainage basin bound by till-covered hills, sand and gravel deposits, and eolian (wind-blown) sand deposits in the town of Milford, Maine. These peatlands encompass an area of approximately 3,301 acres (Cameron and others, 1984) (Figure 6).

Figure 6. Location map of the Sunkhaze Peatland Complex along with location of geologic cross sections (see Figure 7).
The Sunkhaze Peatlands

During 1983-84, a private company considered development of the Sunkhaze peatland complex along with nearby Chemo Bog as mines for the processing of peat as fuel. In the environmental investigation process, numerous multilevel ground water monitoring wells and piezometers were drilled, stream discharge was measured, and precipitation and evaporation rates were monitored in order to characterize hydrologic / hydrogeologic conditions and to evaluate potential impact to the environment from the mining of peat. Changes in the focus of the search for alternative energy caused work on these peatlands to cease near the end of 1984. In 1988, the Sunkhaze peatlands along with adjacent areas were purchased by the U.S. Fish and Wildlife Service to form the Sunkhaze Meadows National Wildlife Refuge which encompasses more than 10,000 acres.
The Sunkhaze Peatlands

Information from drilling records allows the construction of geologic cross-sections. For this discussion, three cross-sections were prepared along F-F', G-G', and H-H' (Figure 7). Along F-F', there is a well-defined moat at the north end of the section which is underlain by silt and clay. Just to the south of this area, the land surface rises to form a dome-shaped structure composed predominately of sphagnum peat in upper layers. Underlying these features are peat formed from marsh and aquatic plants, silt and clay, glacial till, and bedrock. The surface elevation varies from 110.21 feet near Sunkhaze Stream and 115.19 feet at the moat (near the north end of the section) to 120.76 feet near the top of the dome. Since there is a perched water table within three feet of the surface, shallow ground water generally would slowly flow radially outward from the dome toward the moat as well as toward Sunkhaze Stream. Along a different vertical plane, section G-G', the land surface elevation drops from 120.76 feet near the dome top to 107.89 feet near Sunkhaze Stream. Since there are no wells near the northwest end of this section, very little detail is provided to characterize the shape of the land surface here. It is presumed that this moat area would actually resemble that on section F-F'. Drilling revealed the same basic sequence of geologic strata except that near the stream, a layer of silty sand was encountered between the bottom of the peat and the top of the silt and clay.

Toward the south end of the peatland complex, an east-west section along H-H' was prepared. Here, the same sequence of peat, silt and clay, till, and bedrock was found. The land surface elevations vary from 106.56 feet at a site near Baker Brook to 110.17 feet and 113.61 feet near the dome tops or central areas. An interesting feature of this section is the fact that the peatland on the east side of Baker Brook is generally higher in elevation than its counterpart to the west. This difference might indicate conditions on the east side have been more favorable for peat accumulation.
Figure 7. Geologic cross-sections (see Figure 6 for locations). Top is F-F’, Middle is G-G’, and Bottom is H-H’.
References and Additional Information


Smith, G. W., 1985, Chronology of the late Wisconsinan deglaciation of coastal Maine, in Borns, H. W., Jr., Lasalle, P., and Thompson, W. B. (editors), Late Pleistocene history of northern New England and adjacent Quebec: Geological Society of America, Special Paper 197, p. 29-44.


Thompson, W. B. and Borns, H. W., Jr. (editors), 1985, Surficial geologic map of Maine: Maine Geological Survey, scale 1:500,000.