

**DEPARTMENT OF CONSERVATION
Maine Geological Survey**

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OPEN-FILE NO. 97-71

Title: *Surficial Geology of the North Sebago 7.5-minute Quadrangle,
Oxford and Cumberland Counties, Maine*

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Date: *1997*

Financial Support: Funding for the preparation of this report was provided in part by the U.S. Geological Survey STATEMAP Program, Cooperative Agreement No. 1434-HQ-96-AG-01492.

Associated Maps: Surficial geology of the North Sebago quadrangle, Open-File 97-56
Surficial materials of the North Sebago quadrangle, Open-File 98-187

Contents: 4 p. report

Surficial Geology of the North Sebago 7.5-Minute Quadrangle, Oxford and Cumberland Counties, Maine

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INTRODUCTION

The present investigation was carried out as part of a cooperative geologic mapping project funded by the Maine Geological Survey and the U.S. Geological Survey. Two maps are associated with this report. The *geologic map* (Lepage, 1997) shows the distribution of the sedimentary units and discusses their age, composition, and origin. It also includes information relating to the geologic history of the quadrangle, such as glacial striation azimuths and radiocarbon dates on fossil organic remains. The geologic map provides the basis for the discussion of glacial and postglacial history presented here. The *materials map* (Lepage, 1998) shows specific site data used to help compile the geologic map. These data include observations from gravel pits, shovel and auger holes, construction sites, and test borings.

Geographic Setting

The North Sebago 7.5-minute quadrangle is located in southwestern Maine about 20 miles northwest of Portland and about 8 miles east of the New Hampshire border. The map is bounded by 43°52'30" and 44°00'00" latitude, and 70°45' and 70°37'30" longitude. The area mapped includes parts of the towns of Sebago, Naples, Hiram, Denmark, and Bridgton. The topography consists primarily of rolling hills, reaching a maximum elevation of 1147 feet at Bald Pate Mountain in the central part of the map area. Portions of two large lakes, Long Lake and Sebago Lake (the lowest point in the quadrangle at 267 feet), occur in the northeastern and southeastern corners respectively. The area is dotted by a number of smaller ponds and lakes, as well as numerous wetlands. The major drainage system is the Northwest River, which extends from Peabody Pond in the center of the map, draining southward toward Sebago Lake.

Bedrock Geology

With the exception of Silurian-age mica schist, migmatite, and quartzite of the Rindgemere Formation and a small slice of the Silurian-Ordovician Vassalboro Formation granofels in the southwestern corner, the map area is underlain by the Sebago batholith. This Carboniferous intrusive body consists of a muscovite-biotite granite (Gilman, unpublished; Osberg and others, 1985).

PREVIOUS WORK

Among the earliest geologic investigations in this part of the state was Stone's reconnaissance of glacial gravel deposits (Stone, 1899). A more detailed reconnaissance was performed by Thompson in the 1970s (Thompson and Smith, 1977). Sand and gravel aquifer mapping conducted by the Maine Geological Survey identified several small aquifers scattered through the quadrangle and one relatively large aquifer along the Northwest River as having yields in the 10 to 50 gallon-per-minute range. There were no mapped aquifers with yields greater than 50 gallons per minute (Williams and Lanctot, 1987).

DESCRIPTION OF MAP UNITS

Till (Pt)

Till is by far the most common of the surficial geologic deposits in the map area. Till is a poorly sorted sediment, or diamicton, deposited by the glacier. It consists of a mixture of particle sizes, which can range from clay to boulders, that are the product of glacial erosion of bedrock or previously deposited surficial materials. The composition of the tills in the North Sebago quadrangle reflect the nature of their source. The tills are

generally sandy or silty-sandy and contain numerous stones. The lack of finer-grained material results from the coarseness of the underlying granitic bedrock. The sandy nature of the till matrix and limited exposures make it difficult to clearly identify or differentiate lodgement and ablation tills. In general, the lodgement tills are relatively compact and somewhat fissile, or exhibit a platy structure (Sites 116 and 143 on the materials map). The ablation tills (Site 102, for example, on the materials map) tend to be less compact and may show crude stratification. The tills observed in the field appear to be the so-called “upper” till deposited during the most recent major glaciation between about 26,000 and 14,000 years ago (Weddle and others, 1989). The “lower” till, which was deposited by an earlier glacier advance, was not identified during this investigation, although it may be present in the area.

Streamlined landforms identified on the geologic map are likely bedrock-cored ridges with a veneer of glacially-smoothed till. The geologic map also shows areas interpreted as having till deposits that are less than 10 feet thick. These areas of “thin drift” occur primarily on the upper slopes of the steeper hills. Delineation of thin drift is based on field observations of landforms and bedrock outcrops, supplemented by interpretation of aerial photographs. In addition, water well information compiled by the Maine Geological Survey, while not extensive in this area, provides some data concerning overburden thickness (Maine Geological Survey, 1997).

End Moraines (Pem)

End moraines are ridges of till, and sometimes other material, formed at the glacier’s terminus.

The moraines typically form in topographically low-lying areas from material transported by the glacier, and thus represent ice-margin positions. As in the Hiram quadrangle immediately to the west (Thompson and Holland, 1999a,b), moraines occur in only a few locations in the North Sebago quadrangle. Where the moraines are wide enough, such as at the south end of Foster Pond, north of Perley Pond, and north of Sebago Cove, the ridge is delineated as map unit Pem. The small moraines north of Middle Pond (west edge of map) are indicated by a map symbol only.

Hummocky Moraine (Phm)

Only one area of hummocky moraine has been delineated in the quadrangle, although several areas have been mapped in the adjacent Hiram quadrangle. The land surface is very lumpy or knobby in appearance and typically marked by many boulders. Holland (1986) suggested that this type of deposit formed as stagnant debris-rich ice melted. The area may also include moraine ridges that formed along the ice margin.

Eskers (Pge)

Eskers, sand and gravel ridges that accumulated in meltwater-stream tunnels within the glacier or in stream channels incised in the ice surface, are rare in the North Sebago map area. Short esker segments have been mapped south of Middle Pond and Southeast Pond, and on the hillside west of Peabody Pond. Stone (1899) provided the earliest description of these eskers.

Sand and Gravel and Ice-Contact Deposits (Pg and Pgi)

Where the formation of sand and gravel deposits is not understood, the deposits are designated by the map symbols Pg or Pgi. The symbol Pgi indicates an ice-contact deposit, or where the sand and gravel accumulated adjacent to glacial ice. Where contact with ice is not clearly demonstrated, as in the deposits along the Northwest River, the unit is marked with the Pg symbol. The contact between the sand and gravel units and the adjacent till was not exposed in the field. The sandy nature of the till in the map area further complicated interpretation. Air photos and soils maps (Hedstrom, 1974; Wilkinson, 1995) were used in support of field observations to interpret boundaries.

Glacial Lake Hancock (Plhd)

Thompson and Holland (1999a,b) mapped a sequence of sand and gravel deposits in the eastern part of the Hiram quadrangle they interpreted as being deposited in or in association with a glacial lake or lakes. The deposits were designated as Glacial Lake Hancock deposits and designated as map unit Plhd. The lake(s) was thought to have been dammed by an esker segment at the southwest corner of Barker Pond. Glacial Lake Hancock deposits extend into the North Sebago quadrangle along the shores of the present-day Hancock Pond, where they consist of flat-topped plains. Limited exposures along the shore or in shovel holes indicate the deposit consists of sand and gravel.

Willett Brook Deposits (Plwb)

These deposits were also mapped and named by Thompson and Holland (1999a,b). The sand and gravel deposits mapped in the Hiram quadrangle extend into the northwest corner of the North Sebago map area as well as into the Bridgton quadrangle to the north. The map unit occurs within the drainage area of Willett Brook, hence its name. It is interpreted as having been deposited in a lake dammed by the retreating glacier. It is possible that the Willett Brook deposits are actually part of the Glacial Lake Hancock deposits. However, there is no clear connection through the Perley Pond area between Plwb deposits at the upper reach of Willett Brook and the Glacial Lake Hancock deposits to southwest.

Lacustrine Deposits (Plsb)

While more common in the Naples quadrangle immediately to the east (Hildreth, 1997a,b), glacial lake-bottom deposits have not been identified as widespread in the North Sebago quadrangle. A small area has been identified at the north end of Sebago Cove. Several small exposures of fine-grained rhythmites have been identified along Sanborn's Point near North Sebago. However, their limited extent precludes their being shown on the geologic map. A series of strandlines in the field along Sandy Beach Road in North Sebago indicate a series of shorelines higher than the current water levels in Sebago Lake. Hildreth has suggested that the majority of the water-laid deposits in the Naples quadrangle are graded to a col at an elevation of 310 to 320 feet asl, or over a notch in the ice block that might have filled the Sebago Lake basin. The elevations of the strandlines at North Sebago range from approximately 300 to 320 feet in elevation, and may be related to lake levels associated with late glacial drainage in the Sebago Lake basin.

Beach Deposits (Hls)

Many shorelines within the map area are rocky or bouldery. A limited number of modern beaches have been designated by Hls on the geologic map. These are typically narrow sand and gravel deposits formed by wave and current action along present-day lake shorelines. While beach deposits have only been mapped along the shores of Long and Sebago Lakes, they may occur elsewhere, particularly where shorelines have formed in glacial sand and gravel deposits.

Wetland Deposits (Hw)

Numerous wetlands where organic-rich material has accumulated in poorly-drained areas occur throughout the map area and are designated Hw. Some of the wetlands, including a couple in the vicinity of Middle Pond, formed in kettles after the ice within the depression melted. The boundaries shown on the geologic map are adapted from the 1992 U. S. Fish and Wildlife Service wetland maps. These wetland boundaries have not been field checked and should not be used for land-use planning, zoning, or other activities requiring accurate wetland mapping. Only the wetland area along Willett Brook was included in a state-wide inventory of peat resources (Cameron and others, 1984). The bog was estimated to have an average thickness of 10 feet over a 200-acre extent.

Alluvium (Ha)

Wetland deposits mapped adjacent to streams and rivers are often associated with alluvial deposits. Elsewhere on the map, the alluvial deposits are designated as Ha and consist of a variety of sediments deposited in a riverine environment.

GLACIAL AND POSTGLACIAL GEOLOGIC HISTORY

Glacial History

The North Sebago map area has likely been subjected to several episodes of glaciation during the Pleistocene Ice Age. However, only evidence of the last major advance of the Laurentide Ice Sheet was observed. The "lower" till deposited by one of the earlier glacier advances was not identified, although it may be present in the area (Weddle and others, 1989). In addition, striations and other indicators of previous glacial events are lacking. During the most recent major glaciation, glacial ice reached its maximum extent on the continental shelf by about 26,000 years before present (B.P.). Transgression of the sea was concurrent with retreat of the ice margin, reaching the present Maine coast around 14,800 years B.P. (Weddle and Retelle, 1995). In this part of the state, the sea reached its maximum inland location, called the "inland marine limit" somewhere in the Sebago Lake basin. The area covered by the North Sebago quadrangle was apparently not inundated by marine waters, and therefore lies beyond or above the inland marine limit.

The mode of deglaciation, and consequent deposition, inland of the marine limit have been described by Holland (1986), Thompson (1989), and others. Moraines are generally smaller and not nearly as common as in the coastal areas subjected to marine transgression. As deglaciation proceeded in the hilly terrains, topography exerted an increasing influence on ice flow direction and depositional locations as large portions of the ice became cut off from the thinning primary ice mass. This resulted in a largely stagnant ice margin in the final stage of deglaciation, with associated deposition of ablation till, glacial lake sediments, and meltwater deposits.

Evidence of ice flow direction during the last major advance is poorly preserved in the map area. The coarse-grained texture of the underlying bedrock is not conducive to retaining striations once exposed to weathering. The striations observed on freshly exposed bedrock surfaces ranged from 150° to 170°, with the 150°-155° end indicative of peak Laurentide flow, while later ice flow was generally more southerly.

Postglacial History

During the past 10,000 years (the Holocene or postglacial period), any remaining glacial lakes, such as Glacial Lake Hancock, drained. Drainage patterns became stabilized, resulting in the current arrangement of ponds, lakes, rivers, and streams. The ongoing development of postglacial deposits includes accumulation of organic material in wetlands and sediments in lake bottoms. Erosion and deposition both occur in modern beaches and in alluvium along streams and rivers. Along with the establishment of vegetation, man-made alterations, such as the construc-

tion of the now-abandoned railroad line through the western portion of the quadrangle, also change the landscape.

ACKNOWLEDGMENTS

The author wishes to thank Woody Thompson for his support and suggestions during the project, and Carol Hildreth for her collaboration in the field. Maine Geological Survey staff, including Dan Locke, Bob Johnston, and Spike Berry, were helpful providing relevant unpublished data and information. The author also thanks Dr. Dorothy Anderson for her unwavering support in the field. This project was funded in part by the U. S. Geological Survey State Geologic Mapping (STATEMAP) Program.

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