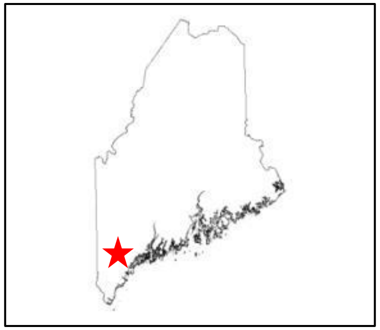
Maine Geologic Facts and Localities

September, 2001

Bottom Sediments of Sebago Lake



43° 51‘ 13.44“ N, 70° 33‘ 43.54“ W

Text by
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Introduction

Modern geophysical equipment allows geologists to investigate previously unmapped environments, including ocean and lake floors. Recent geophysical research studied the types, composition, areal extent, and thickness of sediments on the bottom of Sebago Lake in southwestern Maine. Geologists used side-scan sonar and seismic reflection profiling to map the bottom of the lake. Approximately 58 percent of the lake bottom was imaged with side-scan sonar and over 60 miles of seismic reflection profiles were collected (Figure 1). This web site will discuss the findings of the side-scan sonar profiling. The seismic reflection profiles are described in the web page entitled Why is Sebago Lake so deep?

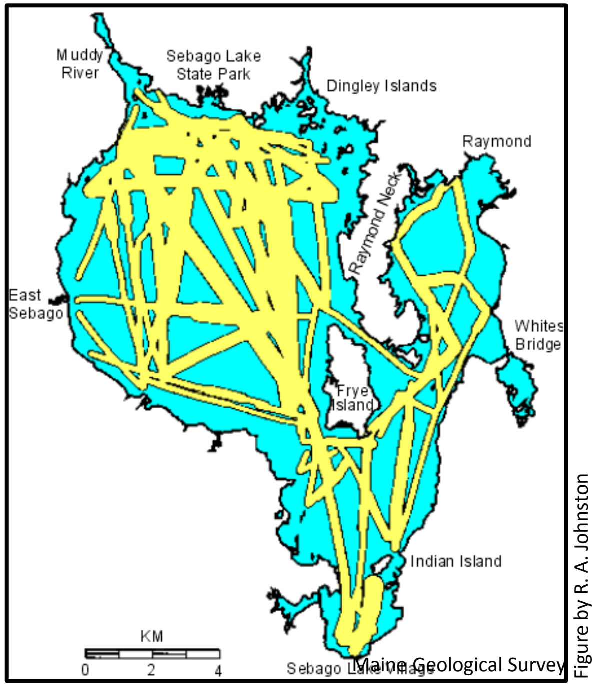

Figure 1. Side-scan sonar coverage map of Sebago Lake, Maine. Yellow areas show regions covered.

Physiographic Setting and Methods

Sebago Lake is located in southwestern Maine, 20 miles northwest of Portland. As Maine's second largest lake, it covers 47.5 square miles and is second in surface area to Moosehead Lake's 117 square miles. Sebago Lake is Maine's deepest lake with a water depth of 316 feet. The lake's deepest point is 49 feet below modern sea level! Sebago Lake drains into the Presumpscot River below Whites Bridge in North Windham. The lake serves as the public water supply for approximately 170,000 people in the greater Portland area. The area has historically been and continues to be a popular summer destination and area towns are experiencing rapid growth.

Side-scan sonar data in Sebago Lake was collected with an EG&G Model 260 slant-range corrected unit operating with a Model 272-T towfish at a frequency of 105 kHz. The device was run with a varying range of between 100 and 300 meters across the lake. A small boat towed the fish generally at a depth of between 6 and 12 feet. Kelley and others (1998) used the same side-scan sonar and seismic reflection profiling techniques on the inner continental shelf of Maine to describe the nature of the seafloor.

Bedrock Geology

The geology of the region is dominated by granitic rocks of the Sebago pluton. The Big Basin of Sebago, the northern two-thirds of the lake, is floored by rocks of the Sebago batholith, a Carboniferous age, two-mica granite (Osberg and others, 1985). The Sebago Lake batholith intruded the metasedimentary rocks of the Merrimack synclinorium approximately 290 million years ago (Creasy, 1996). Gravity models of the batholith estimate a thickness of at least 1 km (Hayward and Gaudette, 1984). The plutonic rock of the northern basin appears to have undergone preferential erosion by granular disintegration, ice scouring, and fluvial erosion. This would account for the great depth of water in the northern basin of Sebago Lake. The rocks of the southern basin, the lower third of the lake, are composed of Devonian granofels with calc-silicate layers and the Silurian sillimanite-garnet-mica schists of the Standish Formation. The Standish Formation was regionally metamorphosed during the Acadian orogeny (Hussey, 1996). The regional pattern of the metasedimentary rocks is northeast trending. The area of metamorphic rock is not affected by any known faults.

Surficial Geology

The most prevalent surficial unit found along the shore of Sebago Lake (Johnston, 1998) is glacial till, also called diamicton. This unit is a heterogeneous mixture of sand, gravel, silt, clay, and rock. It was deposited at the base of the ice during the later phases of the last continental glaciation, 15,000 to 25,000 years before present. Sand and gravel deposits are the second most common surficial unit found in the region. Large volumes of water from the melting glaciers carried and sorted materials, forming stratified drift deposits. Deltas, outwash plains, kames, and eskers all are composed of sand and gravel. Thick deposits of lake-bottom sediments (muds) form a discontinuous cover up to 18 m thick in the Songo and Crooked River valleys and on Frye Island. This unit is composed of alternating layers of clay, silt and sand. Wetland deposits are underlain by this fine-grained silt and clay. The silt and clay deposits formed when the area was covered by water at the end of the last glaciation. Outcrops of both the granitic rocks of the Sebago pluton and the metamorphic rocks of the Standish Formation are common in the area. Generally the tops of most hills and along the shoreline of the lake are good places to look for bedrock outcrop.

Bottom sediment types

The dominant bottom sediment type (Figure 2) found in Sebago Lake is silt and clay (mud) (Figure 3). These fine-grained sediments fill all the deep basins in the lake.

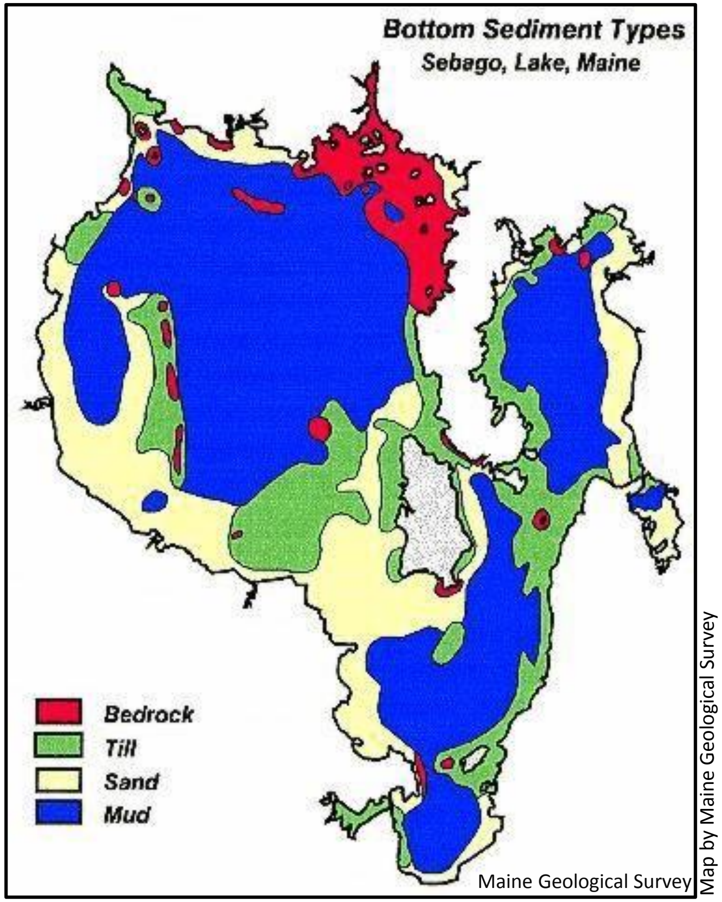

Figure 2. Bottom sediment type map of Sebago Lake, Maine based on interpreted side-scan sonar data.

Bottom sediment types

Side-scan sonar and seismic reflection profiles show evidence of sediment movement from the shallow areas of Sebago Lake to the deep water basins. Density gravity flows have moved the fine-grained materials to the deep basins. In Big Bay over 40 meters (131 feet) of laminated silt, clay, and sand overlay the bedrock surface. These sediments entered the lake basin (carried in by rivers, streams, and runoff) as particles and aggregates and settled onto the floor of the lake. They have episodically moved from shallow areas of the lake to the deeper settling basins.

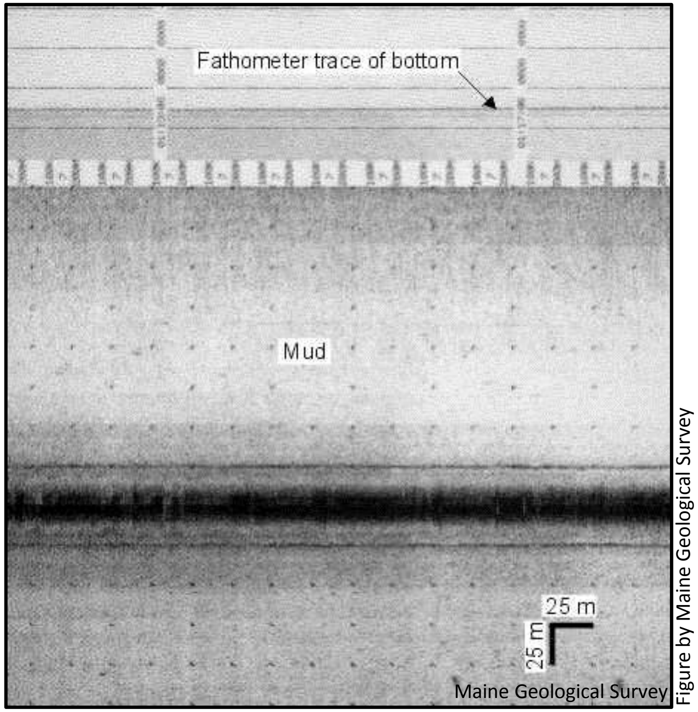

Figure 3. Side-scan sonar image of the surface of a thick mud (silt and clay) unit in Big Basin.

Bottom sediment types

Sand (Figure 4) is generally found along the nearshore areas of Sebago Lake. Extensive deposits are found along the southern and western shore of the lake in water depths of up to 40 feet. Sand is a strongly reflective unit that creates a dark return on the side-scan sonar record. At least two of the extensive sand sheets found along the shore of the lake are over 100 feet thick. The Songo River delta and the Northwest River delta are massive deposits of sand.

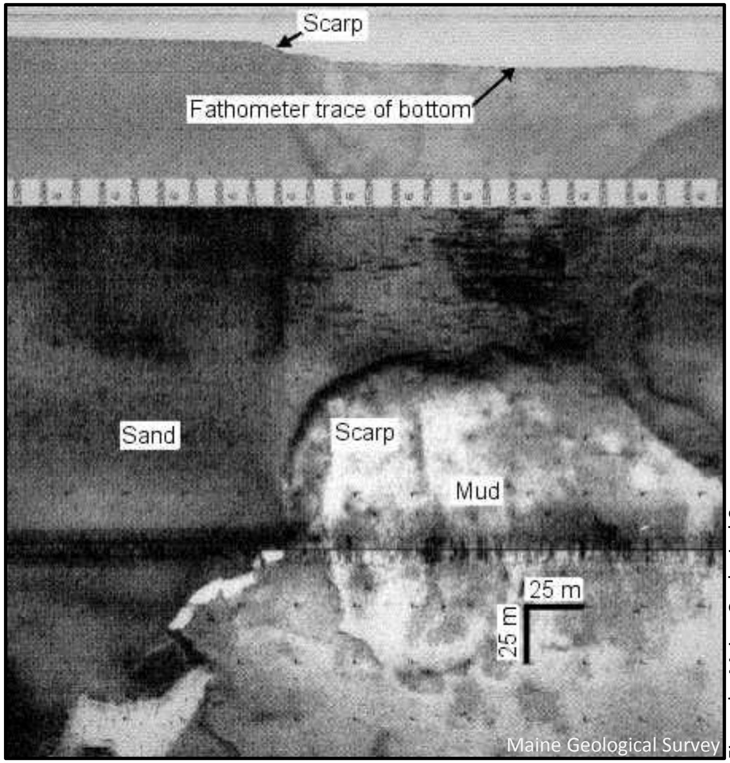

Figure 4. Side-scan sonar image showing sand and mud with a prominent scarp.

Bottom sediment types

Bedrock (Figure 5) occurs mostly in scattered outcrops on the lake bottom. The exception to this is the area around the Dingley Islands where the bedrock surface is covered by a thin layer of mud. Much of the bedrock outcrop has smooth or rounded surfaces, due to the erosive effects of glacial ice and water.

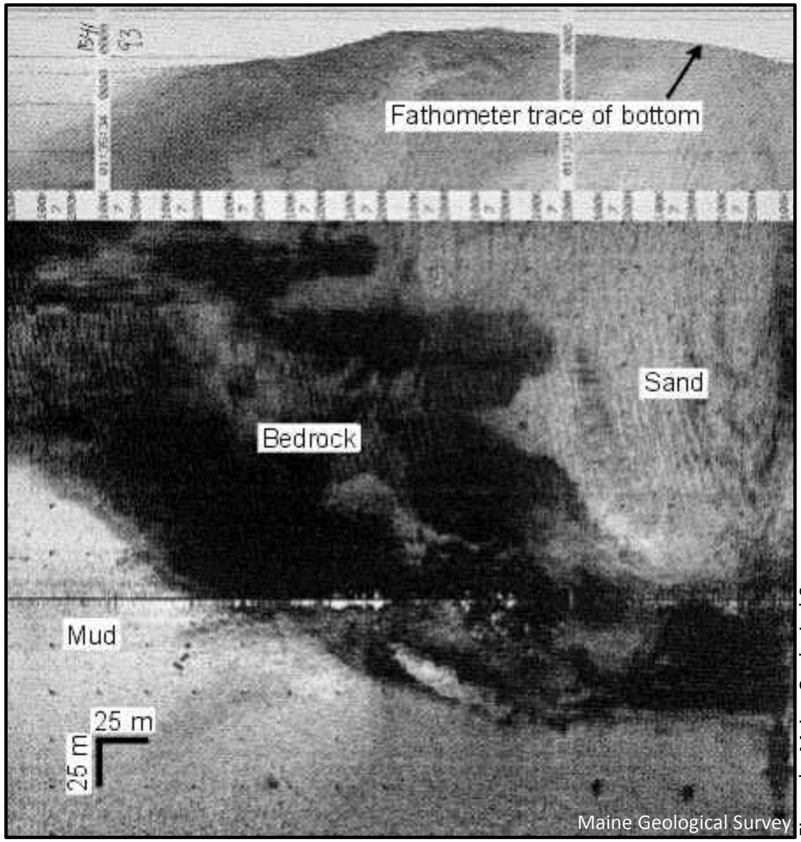

Figure by Maine Geological Survey

Figure 5. Side-scan sonar image showing bedrock outcrop in about 15 feet of water.

Bottom sediment types

The till (Figure 6) that is so common on the upland areas around Sebago Lake is covered by mud and sand in the lake. Commonly, till is only visible in the seismic reflection profiles at the bottom of the profiles, just above the bedrock surface, but till is visible in the side-scan record where a moraine rises up and out of the mud and sand deposits.

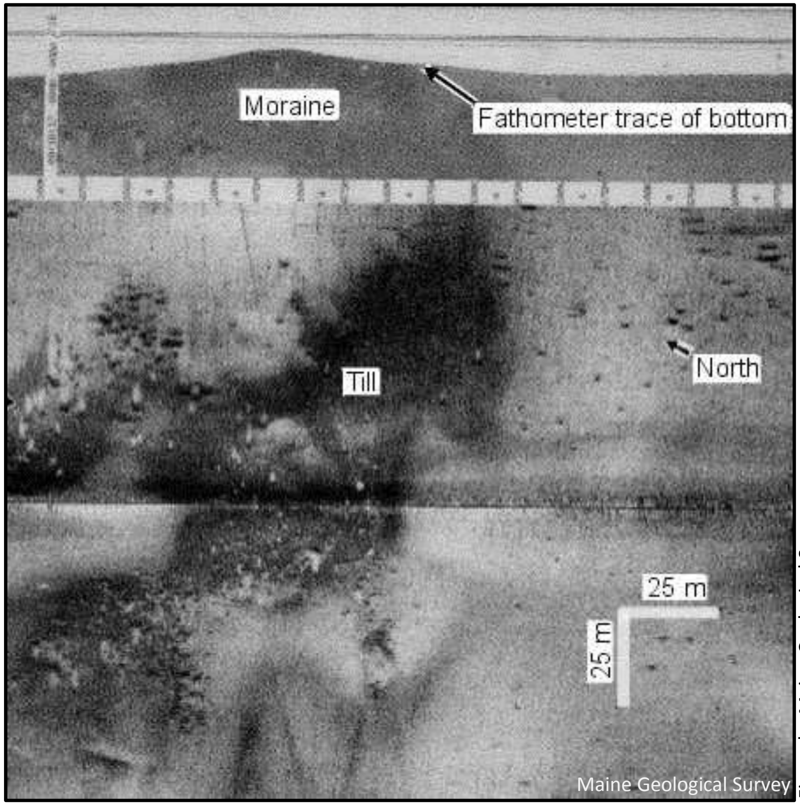

Figure by Maine Geological Survey

Figure 6. Side-scan sonar image of a till-cored moraine near Frye Island.

Bottom sediment types

Gyttja is a thin layer (1 to 3 feet) of organic matter (ooze) that often overlies the sand, silt and clay, bedrock and till units. The side-scan sonar signal generally penetrates the gyttja and projects back the image of the underlying material.

The side-scan sonar survey of Sebago Lake shows extensive deposits of silt and clay filling the deep basins. This mud is the most common sediment found on the floor of the lake with sand the second most common material. Most of the silt and clay has been carried into the lake by inflowing rivers and streams and deposited as the fine-grained material settles out of the quiet lake water. Underwater debris flows move some of this material from the shallow areas of the lake into the deeper basins. Seismic reflection profiles show that debris flows have been occurring in the lake since late-glacial time. What triggers this type of sediment movement is still under investigation. Sand, eroded from ice-contact glacial deposits, rims the shoreline of the lake. This is another dynamic sediment, moving into and along the shoreline of the lake by modern wave and ice action.

References and Additional Information

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