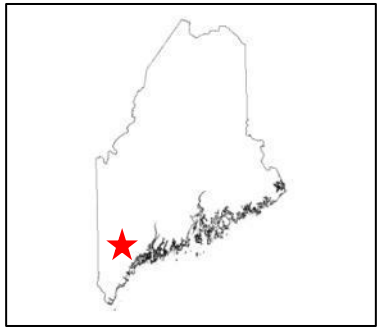
Maine Geologic Facts and Localities

February, 1999

Why is Sebago Lake so deep?



43° 51‘ 13.36“ N, 70° 33‘ 43.98“ 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. This web site will discuss the findings of the seismic reflection profiling.

Physiographic setting

Sebago Lake, although second in surface area to Moosehead Lake, is Maine's deepest lake. With a water depth of 316 feet, its deepest part is 49 feet below sea level! Sebago Lake is located in southwestern Maine 20 miles northwest of Portland and 50 miles southeast of the White Mountains. It lies along the transition between the Central Highlands and the Coastal Lowlands physiographic regions of New England (Figure 1). The abrupt change in landscape can be seen in panoramic views from several vantage points near Sebago Lake.

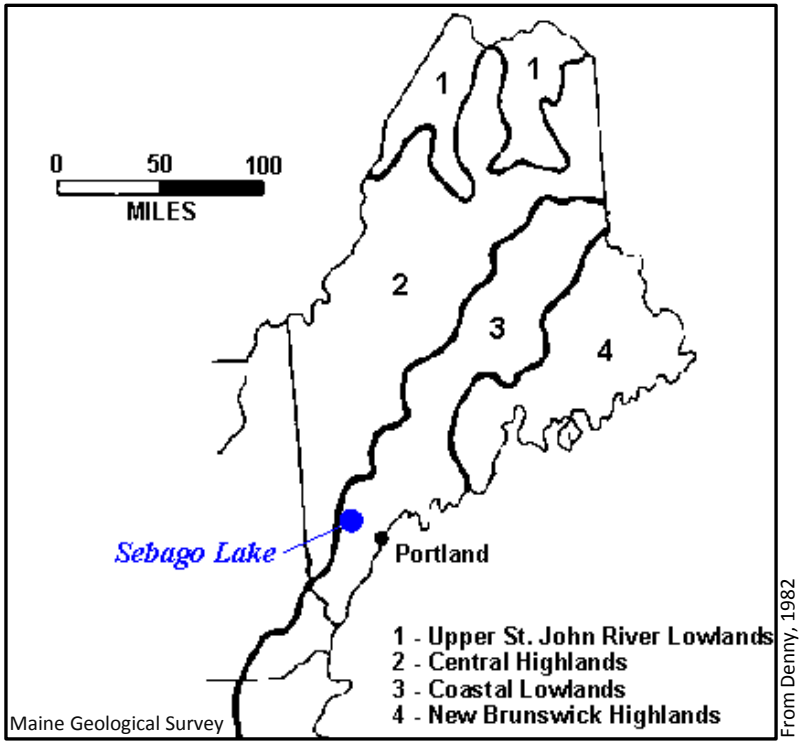

Figure 1. Physiographic regions of Maine. Sebago Lake is at the transition between the Lowlands and Highlands.

Physiographic setting

Douglas Mountain (1416 ft. elevation) in the Saddleback Hills, 3.5 miles west of Sebago Lake, and Quaker Hill (753 ft. elevation), 3 miles north of Sebago Lake, afford excellent views accessible to the public (Figure 2).

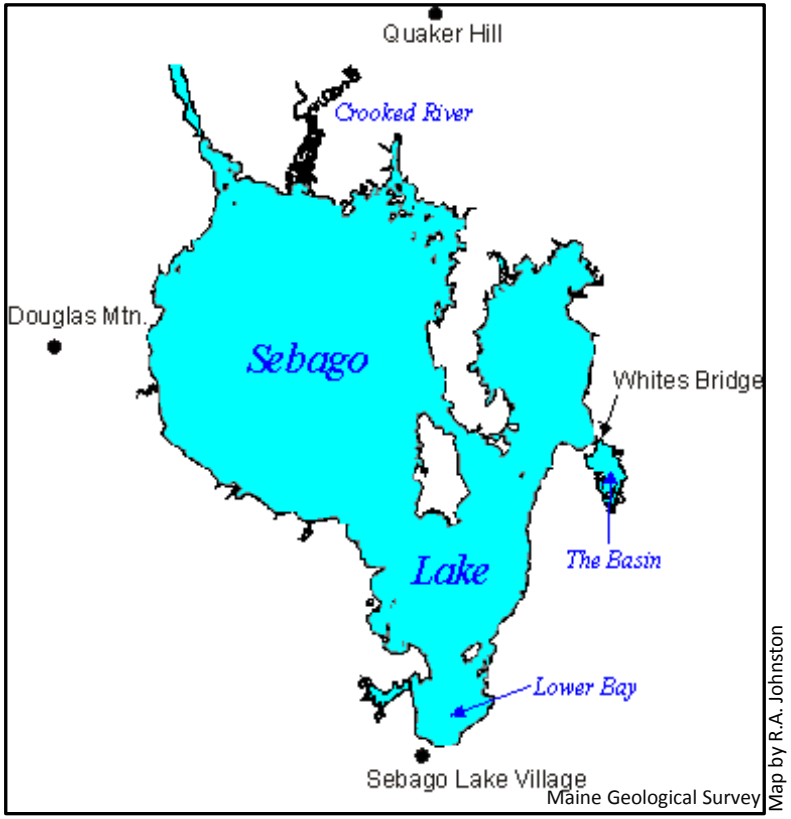

Figure 2. Locations around Sebago Lake. Douglas Mountain and Quaker Hill afford nice regional views. The ancestral Androscoggin flowed south from the Crooked River past Sebago Lake Village. The modern outlet is at Whites Bridge.

Physiographic setting

To the south and east is the Coastal Lowlands physiographic province, a northeast-trending region ranging up to about 400 feet in elevation. The coastal province has a flat-lying, gently undulating surface extending approximately 35 to 60 miles inland in southern Maine. The lowland region ends abruptly against the Central Highlands region to the west and north. In York County, west of Sebago Lake, many of the hills reach 1000 feet. Farther north in Maine, toward the White Mountains of New Hampshire, some peaks exceed 4000 feet.

Origins of the modern Sebago Lake

The modern Sebago Lake originally formed at the edge of the continental ice sheet over 14,000 years ago. During the later stages of glaciation, ice melted from the highland areas and a massive ice block filled the lake basin. As the ice melted, water and ice filled a basin that had been scoured out by a combination of glacial ice and stream erosion. Moving ice and meltwater steams deposited massive amounts of sand and gravel at the southern end of the lake northeast of Sebago Lake Village forming an end moraine and delta complex. This end moraine and delta complex acted as a dam causing a large lake to form behind it. Unable to flow in its old path to the south, a new lake outlet formed over bedrock outcrops at the east side of the lake, near Whites Bridge (Figure 2). Construction of the Eel Weir Dam beginning in 1820, just below Whites Bridge, raised the water level in Sebago Lake approximately 12 feet to its present full pond level of 266 feet.

What was there before today's lake?

Geologists have long speculated that prior to the last ice age the ancestral Androscoggin River flowed from Bethel through the Sebago Lake basin and to the sea. This idea that the Sebago basin served as a conduit for the Androscoggin was first proposed by Charles H. Hitchcock (1861) in his report on the geology of Maine. Hitchcock based his theory on the landforms found in the Crooked River valley (Figure 2). George H. Stone (1899) also studied the extent and thickness of the glacial gravels in the Sebago Lake region. Stone proposed that the preglacial drainage of Sebago Lake flowed from the southern end of the lake near the village of Sebago Lake. The end moraine and delta complex, deposited during the last glacial episode, changed the lake's drainage pattern. Whereas before glaciation the lake drained to the southeast through the North Branch of the Little River into the Presumpscot River valley, after glaciation the lake outlet changed to a place 7 miles to the northeast and the lake drained to the south. This new outlet, through what is now called the Basin, forms the headwaters of the Presumpscot River and empties ultimately into Casco Bay. Stone suggested that the lake, in pre-glacial time, before the formation of the end moraine and delta complex, would have been about 100 feet lower than it is today. Using as evidence the lack of bedrock outcrop in the Sebago Lake Village area, the extensive coarse-grained gravel deposits rimming the lake, and the similar elevation of the lake bottom to the stream channel on opposite sides of the Sebago Village glacial deposits, Stone concluded that a large preglacial river flowed from north to south through the Sebago Lake basin.

What was there before today's lake?

Irving B. Crosby (1922) discussed Hitchcock's and Stone's theories in a paper on the former course of the Androscoggin River. The modern Androscoggin River enters Maine 35 miles (60 km) northwest of Sebago Lake, flows east approximately 35 miles (60 km), and then flows southeast to the sea, completely avoiding Sebago Lake. Crosby mapped the ancestral Androscoggin River coming into Maine at its present location but then flowing south from West Bethel, down the valley of the present Crooked River through Sebago Lake and on through the Little River valley and then into either the Presumpscot or Nonesuch River valleys to the sea. Leavitt and Perkins (1935) concurred that the outlet for Sebago Lake originally drained southeastward from Lower Bay before switching to its present location in the Basin (Figure 2). That the lake formerly drained southeastward to the coast from Sebago Lake Village was further substantiated by Upson and Spencer (1964) in their discussion of the buried valleys along the New England coast. The Stroudwater River, flowing on the south side of Portland, shows evidence of being the ancestral Presumpscot River. Seismic reflection work done in the early 1990's by Bruce Hansen and William Nichols of the U. S. Geological Survey shows convincing evidence from the subsurface geology that the southern end of Sebago Lake served as a large river channel in the past. A V-shaped channel, now buried under 200 feet of sand and gravel has been carved into the bedrock. This may have been eroded by a major river in preglacial times.

Details of the modern lake bottom

The distribution of water depths or bathymetry of Sebago Lake is quite complex (Figure 3). The lake can be divided into four distinct basins. Big Basin is located in the northwest corner of the lake and is approximately 5 ½ miles east-west and 6 miles north-south. The 316 foot (97 m) lake depth is in this basin. Seismic reflection profiling done by the author as part of his Master's thesis (in progress) at the University of Maine shows that the bedrock surface is greater than 360 feet below the lake surface in the central part of the basin.

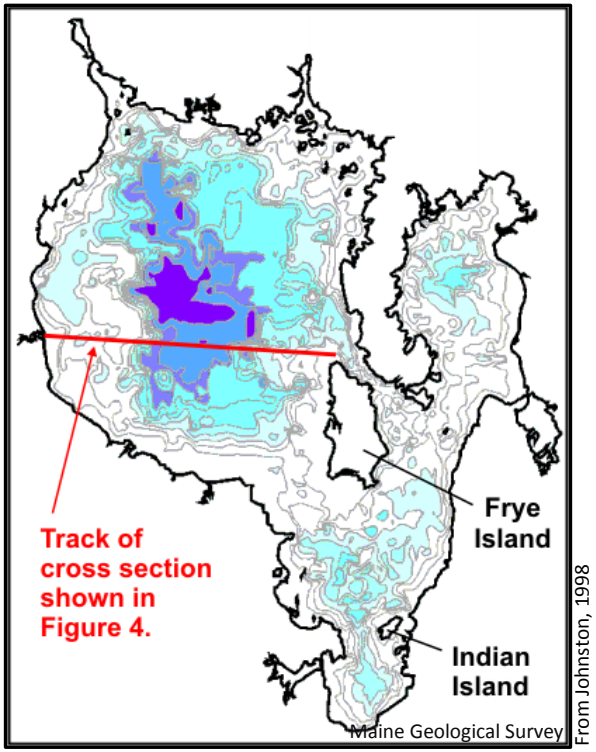

Figure 3. Bathymetry of Sebago Lake based on over 2100 depth points. Colors indicate water depth

Details of the modern lake bottom

Bedrock is covered by a layer of laminated sediments over 160 feet thick (Figure 4). This laminated silt and clay formed from the gradual settling of fine-grained sediments carried into the lake by glacial meltwater. Underwater debris flows have also been identified as a partial source of material for the thick sediment layers in the deep basins of the lake. Jordan Bay is found on the northeast side of the lake and depths range up to 165 feet. The basin bounded by Frye Island on the north and Indian Island on the south has no name. Depths again range up to 165 feet. Lower Bay, the small basin located south of Indian Island, has water depths up to 130 feet. A line of maximum depth drawn on a bedrock surface map shows a connection between the three western basins along a line from northwest to southeast.

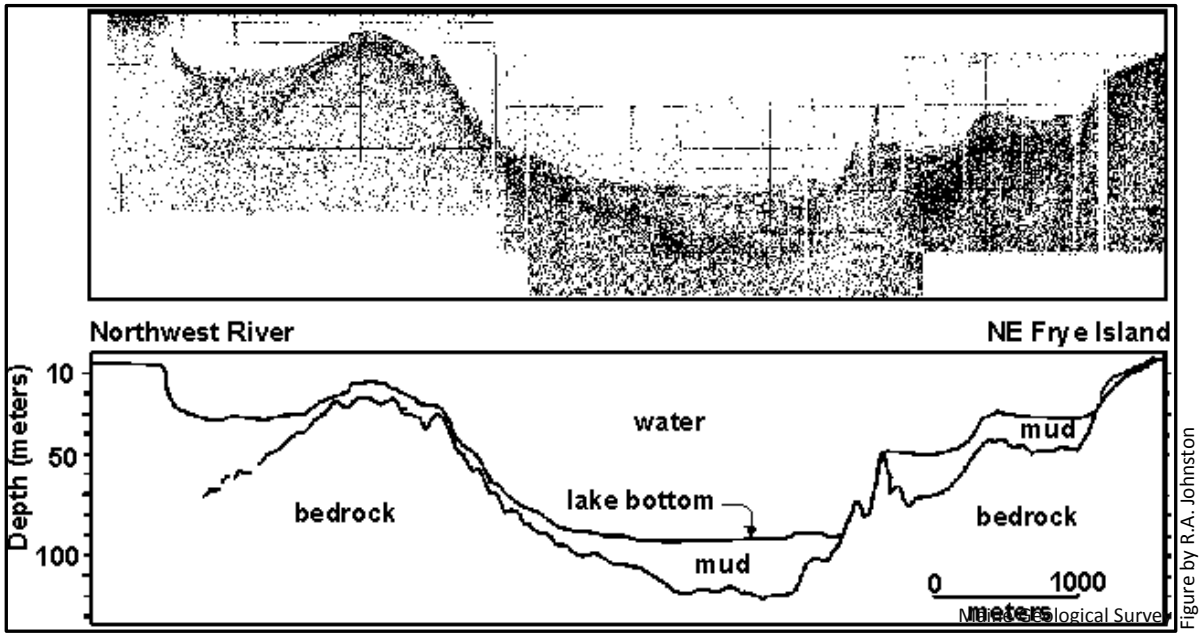

Figure 4. Seismic reflection profile and interpretive cross section of a west to east traverse across Big Basin.

Role of bedrock type

The Bedrock Geologic Map of Maine (Osberg, Hussey, and Boone, 1985) shows the Sebago Lake region to be underlain by both granitic and metamorphic rocks. The metamorphic rocks south of Indian Island are more resistant to erosion than the granitic rocks of the Sebago pluton found north of the island. The metamorphic rocks have been hardened by heat and pressure. Granitic rocks may weather to rottenstone or saprolite and thereby erode more easily (Caldwell, FitzGerald, and Fenster, 1989). Figuring that lakes form in more easily eroded material, Caldwell found that Maine's lakes occupy 11% of the surface area of plutons and less than 3% of areas underlain by metamorphic and sedimentary rocks. Sebago Lake's Big Basin is underlain by granite of the Sebago pluton. Apparently, these granitic rocks are more easily eroded than the rocks underlying Lower Bay.

In summary, the great depth of Sebago Lake is due to a number of factors: 1) Its granitic bedrock is more easily eroded than the neighboring metamorphic bedrock; 2) Preglacial fluvial erosion by the ancestral Androscoggin River carved a deep bedrock valley from the Crooked River to Sebago Lake Village; and 3) Glacial ice abraded and enlarged the basin.

References and Additional Information

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