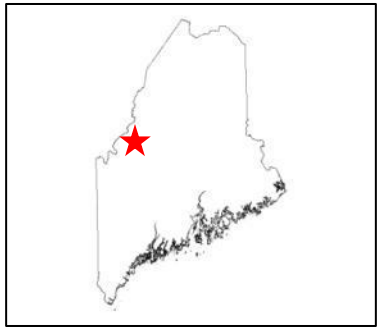
Geologic Site of the Month

October, 2002

Glacial Lake Varves, Dennistown Plantation, Maine



45° 38‘ 56.91“ N, 70° 15‘ 57.07“ W

Text by
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Introduction

During the summer of 2002, the Maine Geological Survey conducted mapping in the Jackman area in northwestern Maine. Exposures of glacial lake sediments known as varves were found along Sandy Stream on the border between Dennistown Plantation and Moose River, northern Somerset County, approximately 3 miles north of the village of Jackman (Figure 1).

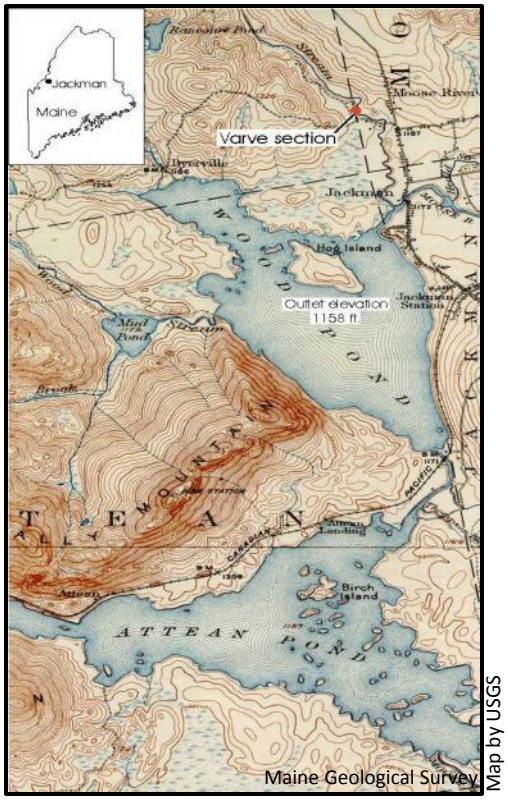

Figure 1. Location of varve section on Sandy Stream, and some features mentioned in text.

Varves

Varves are rhythmic couplets of coarse-grained and fine-grained sediments. A varve couplet represents one year of sediment deposition into a lake. The coarse component usually consists of silt and a minor amount of sand, and is deposited during ice-free conditions when streams bringing sediment to the lake are greatly charged with debris. This part of the varve is commonly referred to as the summer layer. Sometimes there can be multiple coarse layers depending on frequency of sediment influx. The fine sediment consists of silt and clay particles, settled out during the winter when the coarse sediment influx is greatly reduced, and is commonly called the winter layer.

The rhythmic character of these annual deposits provides a record of deposition for the lake and can be used as an approximation of the length of time of the lake's duration by counting the number of varves from the lake basin. In the early part of the 20th-century, a Swedish geomorphologist named Ernst Antevs came to the United States and began studies of varves from former glacial lakes in northeastern North America. He developed a relative chronology of the deglaciation of New England, based primarily on varve deposits in the Connecticut River valley from an ancient lake known as Glacial Lake Hitchcock, as well as from other ancient glacial lakes elswhere in the northeast. Over the last 15 years, Jack Ridge, geologist and professor at Tufts University, has been re-examining the Connecticut River valley varve chronology. He has linked it with modern paleomagnetic studies on the varves and with radiocarbon age-analyses on organic material found in the varves. He expanded his work into southern Maine based on studies of varves from glacial lake deposits in the Naples and Cornish areas in Maine, matching them with the record from Glacial Lake Merrimack in the Merrimack River valley in New Hampshire, and then to the Connecticut River valley.

Varves

A problem magnified by Ridge's work is the interpretation of the time of deglaciation between southwestern Maine and central New England. The problem is in part a result of comparing different radiocarbon-based chronologies: the central New England chronology is based on atmospheric carbon as a source for carbon in terrestrial plants, whereas the Maine chronology is based on radiocarbon ages from marine organisms, who derive their carbon from the ocean. An inherent problem with marine radiocarbon ages is that they generally are older than atmospheric-based radiocarbon ages because of "old" carbon in seawater.

One way the age problem can be addressed is to study varves in Maine. Unfortunately, large sections of varves, like those found in the Connecticut River and Merrimack River valleys are not common in Maine. There are reported exposures, as mentioned above in southwestern Maine, but they are small sections with a short record. Sections in Aroostook County on the Aroostook River have been reported, but these too do not have a long record. Road test-borings by the Maine Department of Transportation and monitor-well borings drilled as part of the Maine Geological Survey aquifer mapping program have reported long varve sections in northern Aroostook County, and in central and northern Somerset County.

The section found this summer (2002) in Dennistown Plantation is previously unreported, and there are several smaller sections found upstream from it on Sandy Stream. The major section is located in Figure 1.

Sandy Stream

The section (Figure 2) is exposed on a cut bank on Sandy Stream, and is approximately 15- 20 feet from river level to the top of the section.

Figure 2. Sandy Stream section, looking upstream (left) and looking downstream (right)

Sandy Stream

Figure 3. Sandy Stream section, base of section at downstream end of exposure.

Till Exposure

The base of the section exposes till , a stony, compact glacial deposit formed and laid down beneath the ice (Figure 4).

Figure 4. Compact, gray, stony till, exposed at base of section. Note crude layering of till at right of shovel head and large stone below shovel. The layering may be indicative of till deposition from a glacier in a lake.

Till Exposure

Stones in the till commonly show scratch marks, or striations, on their surface (Figure 5), that are formed by other stones rubbing against one another during the till transport and depositional process.

Figure 5. Large striated till stone eroded from till at base of section.

Sand and Silt Beds

Above the till, alternating sand beds and silt beds are found, which grade up into a thick silt layer overlain by 4-5 inch thick varve couplets, decreasing in thickness upsection (Figure 6).

Figure 6. Base of section with till as lowest unit, overlain by sand and silt beds just above shovel head, finally overlain by crudely stratified silt (Right). Close up of the transitional contact between sand beds and overlying silt.

Sand and Silt Beds

Figure 7. Fresh exposure of varves midway up section.

Varves at Sandy Stream

Photos by Tom Weddle

Figure 8. Lower part of varve section at upstream end of section (Left). Close-up of varves from Figure 7 (Right). The olive and tan colored layers are the coarse debris; the dark gray layers, some quite thick, are predominantly silt particles. The thin light gray layers are predominantly clay, and mark the end of the winter deposition.

Varves at Sandy Stream

Near the top of the section, the varves are thinner 2-3 inches, and are punctuated by thin sand beds (Figure 9). At the top of the section, coarse pebbly sand overlies the varves. The sand most likely is glacial fluvial outwash deposited over the lake sediments after the lake drained.

Figure 9. Upper part of varve section, with overlying pebbly sand (Left). Close-up of varves (Right). The varves are thinner than those from lower in the section shown in Figure 6, and here the clay-rich layer marking the end of the varve couplet is the darker gray layer.

Varves at Sandy Stream

The Sandy Stream varve section is the partial record of a glacial lake found in the region as the glacier was melting away some 11,000 - 12,000 years ago. A few radiocarbon ages are published from the area, taken from cores in modern lakes with a glacial record below modern lake bottom sediment. The ages provide a minimal time of deglaciation by 11,200 years ago. When the ice pulled away from region, the basins now occupied by Wood Pond and Attean Pond (Figure 1), and the Sandy Stream valley were filled by meltwater coming from the glacier. The varves are found as high as 1220 feet elevation above sea level. Highlands to the south, and the ice margin and highlands to the west and north dammed the lakes in these areas. However, drainage had to be dammed along the modern Moose River valley to the east; the elevation of the river where it exits at Wood Pond today is 1158 feet. It is unclear what dammed the glacial lake east of Wood Pond, possibly a dam of glacial debris and remnant ice blocks in a narrow section of the Moose River valley. Possibly remnant ice masses farther to the east in the Brassua Lake and Mooshead Lake basins may have blocked drainage.

Reconnaisance surficial geological mapping has been conducted for this part of the northwest Maine woods. Few detailed topical studies have been undertaken. Extending the New England varve chronology into northwestern Maine would make a significant contribution to our knowledge of the last stage of Pleistocene deglaciation in our State.

References and Additional Information

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