Geologic Site of the Month

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Maine's Eskers

Photo by Woodrow B. Thompson

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Introduction

Maine is well-known among glacial geologists for its many long gravel ridges called "eskers". These ridges formed in ice-walled tunnels at the base of the most recent continental glacier (Laurentide Ice Sheet) that covered Maine approximately 25,000 to 12,000 years ago.

Figure 1. Esker ridge near mouth of Bear River in Newry, Maine. This esker segment is flanked by younger gravel (foreground) laid down by subaerial streams. From Thompson (2008a).

Today's glaciers show how eskers form

Much of the water and sediment released from melting glaciers is carried in tunnels at the bottom of the ice. The subglacial meltwater is under pressure, may flow uphill in places, and gushes out at the ice margin. The tunnels may accumulate large volumes of gravel deposited by these subglacial streams. After the glacier melts, the gravel remains as a ridge.

Figure 2a. A 1990 view of water pouring from ice tunnel in Aktineq Glacier, Nunavut, Canada.

Figure 2b. A bouldery esker gravel that was exposed 3 years later by glacial retreat. Note people in background.

Photos by William Shilts, Prairie Research Institute

Glacial melting exposes eskers

Figure 3. Aerial view of esker ridges emerging from melting glacier in Svalbard, Norway. Photo by Harmon D. Maher Jr., University of Nebraska at Omaha.

Eskers Today

Long after the glacier is gone, Maine esker ridges mark the paths of former ice tunnels and record an important part of the glacial meltwater drainage history. Early settlers took advantage of these ridges as easy routes across lakes, swamps, and bogs. Roads and trails still follow parts of many eskers.

Photo by Woodrow B. Thompson

Figure 4. Esker protruding from Five Kezar Ponds in Waterford, Maine.

Esker systems

Eskers form long systems that originate in central Maine and extend nearly to the coast. They have branching patterns due to the glacial tunnels having converged toward the southern edge of the ice sheet. Individual esker ridges usually are discontinuous but occur in chains many miles long.

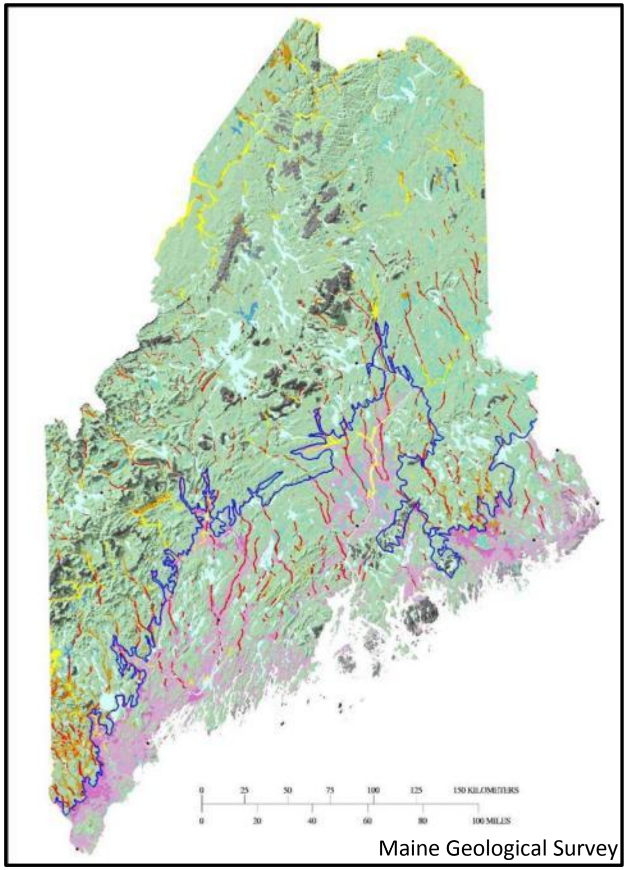

Figure 5. Simplified surficial geologic map of Maine. Major esker systems are shown in red. Blue line is inland limit reached by the sea as the Laurentide Ice Sheet receded. From Thompson and Borns (1985).

Early esker studies

George Stone worked in Maine for the U. S. Geological Survey and published a monumental book on the "glacial gravels of Maine" (Stone, 1899). He described many eskers, which in the 1800s were called "osars" (a Swedish term).

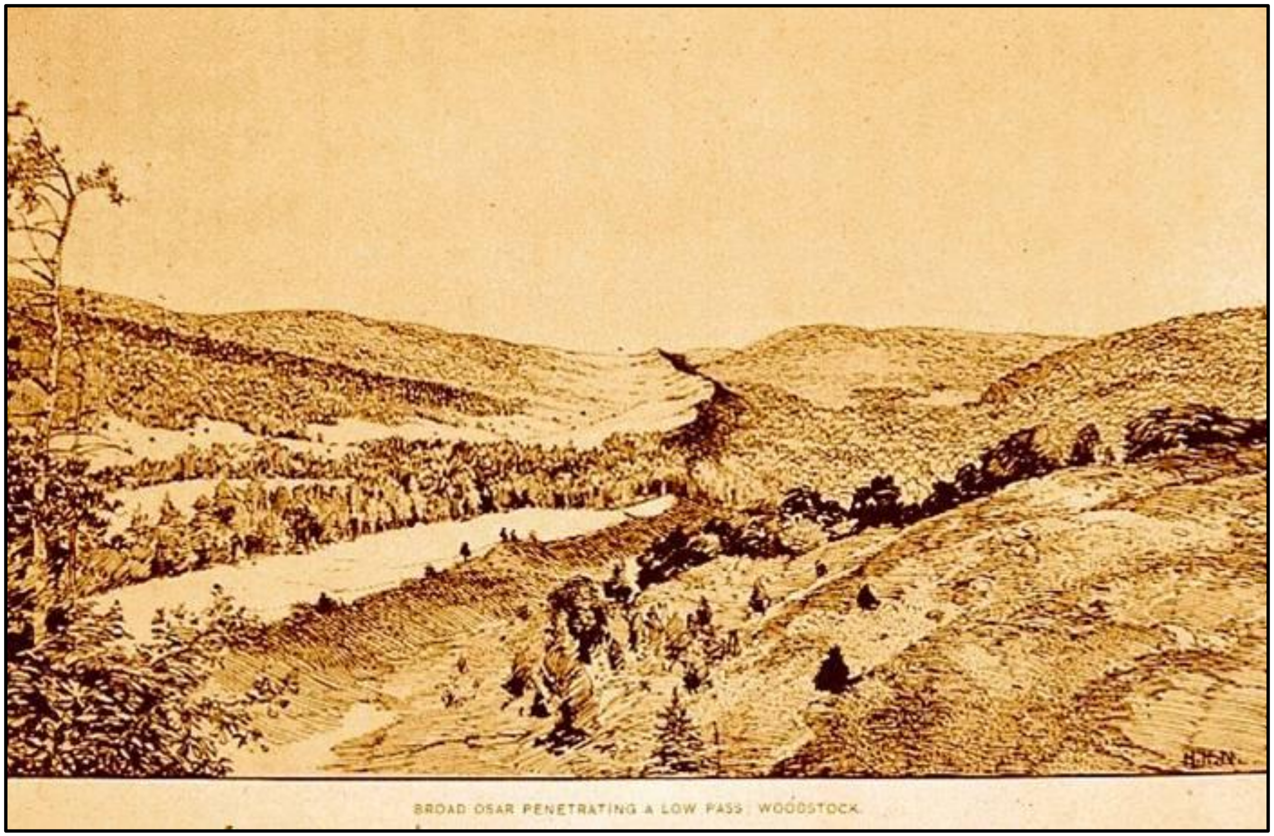

Figure 6. Figure from Stone (1899) showing view looking south along esker ridge (center) to where it passes through a gap between hills in North Woodstock, Maine.

Lidar reveals previously unknown eskers

Newly available lidar imagery reveals eskers that cannot be seen on topographic maps or air photos. This imagery also shows that some of them are very complex networks of many small ridges!

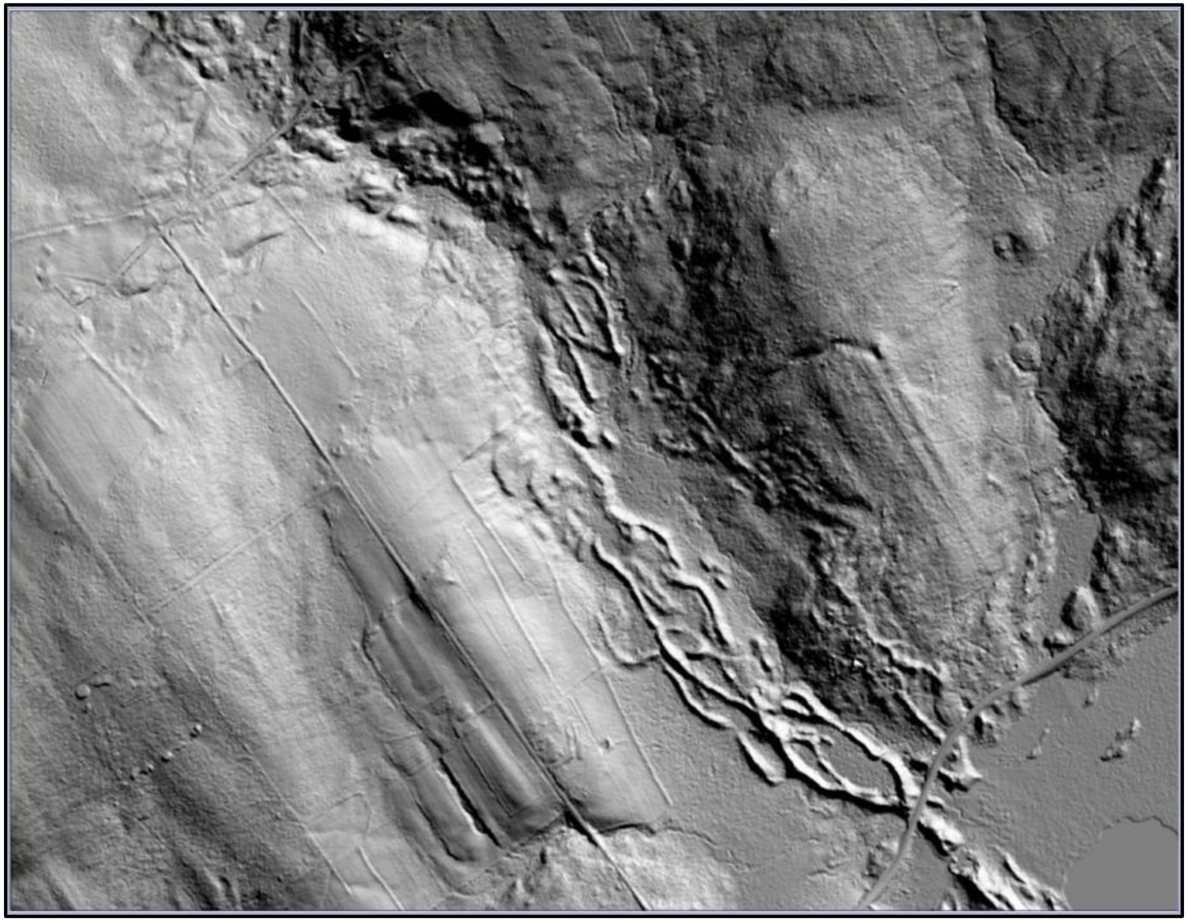

Figure 7. Lidar image of esker network in Monroe, Maine. Note roads for scale.

Ground truth

The esker network seen in Figure 7 has ridges up to 30-40 feet high, but none of them show on local topographic maps! They were also overlooked during earlier reconnaissance geologic mapping of this densely forested area. A cross section of one ridge is apparent in a road cut (Figure 8a), and exploration of the woods confirmed the identity of eskers visible in the Lidar image (Figure 8b).

Photos by Woodrow B. Thompson

Figure 8a. Esker cross section exposed next to Route 139 in Monroe.

Figure 8b. Trail following one of the sharp-crested esker ridges back in the woods.

The insides of eskers

Gravel pits provide excellent exposures showing the composition and stratigraphy of eskers. The simplest eskers mainly consist of sediments deposited within the ice tunnels, and may be relatively small in cross section. The tunnel fillings usually include a large percentage of coarse, poorly sorted gravel with clasts ranging from pebbles to boulders.

Photo by Woodrow B. Thompson

Figure 9. Pit showing cross section of esker ridge in Kennebago River valley, Stetsontown Twp, Maine.

Natural rock tumblers

The high-energy streams in subglacial tunnels could carry boulders as large as several feet across. As rocks tumbled along in these streams, their sharp edges and corners were worn down and they became progressively more rounded with increasing travel distance.

Photo by Woodrow B. Thompson

Figure 10. Very well-rounded granitic stones in esker exposure south of Wellman Pond, near Augusta-Windsor town line. From Thompson (2007).

Internal deformation

Stratified sediments in eskers often show folds and faults. Most of these structures resulted from slumping when the supporting walls of ice tunnels melted away.

Photo by Woodrow B. Thompson

Figure 11. Sand and gravel layers offset by near-vertical faults (center) in esker at Larrabee Pit, Knox, Maine.

Composite eskers

An esker ridge, as seen on a map, may include not only the sediments deposited in a subglacial tunnel, but also younger sand and gravel laid down in calmer ocean or lake waters near the mouth of the tunnel as the ice margin receded. These sediments sometimes completely buried parts of the esker.

Photo by Woodrow B. Thompson

Figure 12. Deep pit on east side of the Kennebec River valley, Augusta, showing very bouldery esker gravel overlain by a great thickness of submarine fan sediments built at the glacier margin during ice retreat. From Thompson (2007)

Abrupt change of environment

Marine clay accumulated on the ocean floor during the late-glacial submergence of southern Maine, adding to the blanket of sediments that lapped against or covered eskers in this area. Some pits show the clay directly overlying eskers, without the usual sandy-gravelly fan deposits seen in Figure 12.

Photo by Woodrow B. Thompson

Figure 13. Cross section of esker on east side of Kennebec River valley in Pittston, showing abrupt transition from the brownish esker gravel to the gray overlying marine clay (Presumpscot Formation). From Thompson (2009).

Eskers are an important aggregate resource

Eskers have provided much of the sand and gravel (aggregate, both natural and crushed) needed for highway projects and other construction activities in southern Maine. Pit excavations are usually limited to the dry upper portions of the eskers in order to protect the deeper water-bearing zones.

Photo by Woodrow B. Thompson

Figure 14. Active gravel pit in esker, Canton, Maine. From Thompson (2008b).

Eskers are an important source of groundwater

The coarse gravels found in most eskers can store and transmit large quantities of groundwater. The thicker water-saturated parts of many such deposits are shown on the Maine Geological Survey's Significant Sand and Gravel Aquifer maps.

Photo by Woodrow B. Thompson

Figure 15. Poland Spring Company pumping station for extracting water from esker in Dallas Plantation, Maine. View looking southward along the partly-excavated and landscaped esker ridge. Thompson, et al. (2006).

References and Additional Information

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