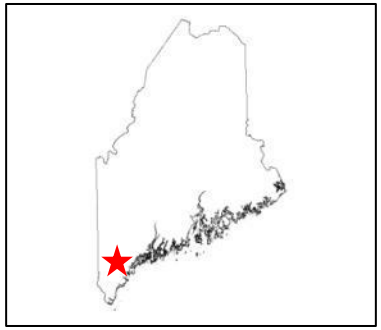
Geologic Site of the Month

September, 1999

The Jailhouse Delta, Alfred, Maine



43 27‘ 32.11“ N, 70 43‘ 8.04“ W

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Ground-penetrating Radar

The study of the earth's interior can be frustrating. It is similar to living in an apartment and hearing wonderful piano music coming from the apartment next door. Without meeting your neighbor, you could only guess whether the music is a recording or whether your neighbor is a trained pianist. The geologist who has no visible exposure of the underground geology has to make an interpretation based only on the surface expression. Fortunately, geologists who study the near-surface of the earth, and in particular the glacial deposits in Maine, have geophysical tools to give them information to help interpret these deposits when excavated exposures or drill records are not available.

One of these tools is a ground-penetrating radar system, a device which emits electromagnetic waves that penetrate into the ground and records the reflected energy. Ground-penetrating radar (GPR) has been used by private industry in environmental studies to find buried drums at hazardous waste sites, and to determine subsurface geologic conditions or location of rebar in concrete at highway and bridge construction sites. Also, it has been used at archeological sites to locate buried artifacts, by law enforcement agencies to find buried evidence or bodies, and even by golf course designers searching for underground cables or pipes. In geological studies, a portable GPR unit is moved over the ground surface in areas of study, and certain characteristics of the sediments can be interpreted by the nature of the image produced.

Surficial Geology

Theses by graduate students under the direction of Dr. Duncan FitzGerald (Boston University), and with assistance from the Maine Geological Survey, have included GPR studies to better understand the geologic history of the broad sand plains in southwestern Maine in the Brunswick and Sanford areas (Crider, 1998; Tary, 1999). Additional studies have begun on the sand-plain barrens in the Cherryfield and Deblois areas of southeastern Maine.

Research on the surficial geology of the Sanford area by Craig Neil of the Maine Geological Survey has utilized the Boston University GPR system. Craig's mapping identified several deposits whose surface features suggest they are deltas, and with the GPR unit, Craig was able to see into the earth's subsurface.

Jailhouse Delta

A dramatic image of the sedimentary structures in the Jailhouse delta in Alfred, Maine, is depicted in the figures below. The location of the track of the GPR unit along the surface of the delta is represented on a topographic map (Figure 1), which also shows the outline of the delta and 10-foot topographic contour lines.

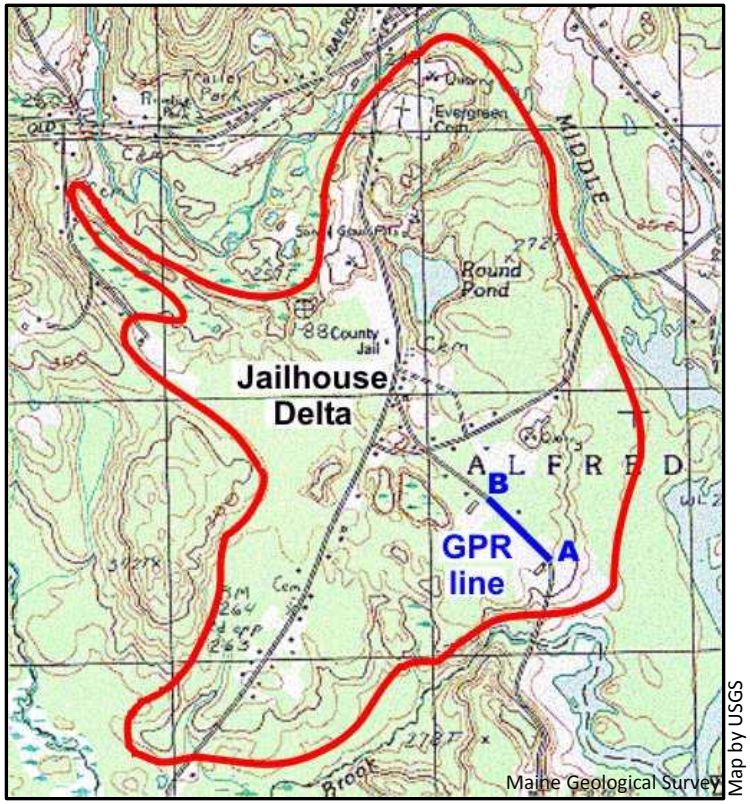

Figure 1. Map view of the Jailhouse Road delta (outlined in red) and location of the GPR line (blue line), Alfred, Maine (from Alfred 7.5-minute topographic map, contour interval = 10 feet).

Jailhouse Delta

The broad, flat area is typical of the top of a delta. The lines tilted down to the left on the GPR printout (Figure 2) are interpreted as the foreset beds of the delta. Foreset beds are features characteristic of deltas. They form as sediment is brought to a lake or the ocean by streams and is deposited at the delta and cascades down the delta's front slope.

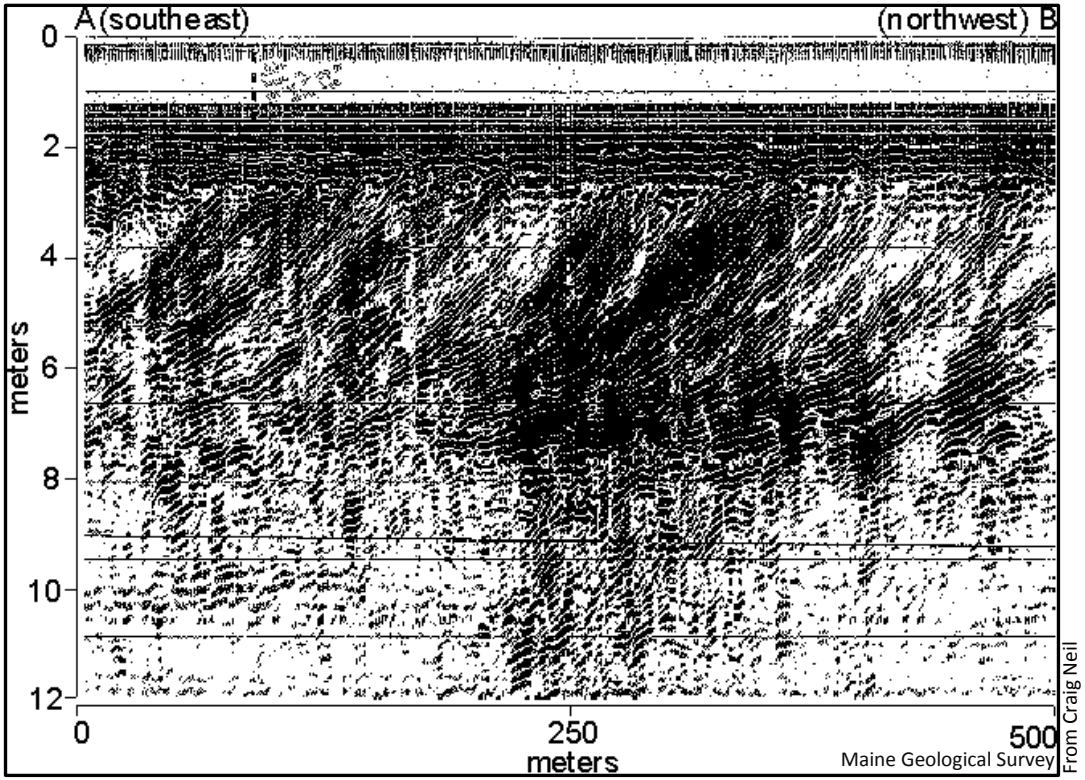

Figure 2. GPR printout from Jailhouse Road delta, Alfred, Maine. Image of lines dipping to the left (southeast) are interpreted as delta foreset beds.

Jailhouse Delta

A photo of a vertical cut in a delta in Whitefield, Maine (Figure 3), shows the stream deposits (topset beds) overlying the dipping foreset beds. The same type of sedimentary structure in the Jailhouse delta is represented in the GPR image, confirming the interpretation from surficial mapping.

Figure 3. Photograph of excavated exposure in a gravel pit in a delta in Whitefield, Maine. The person in the lower right hand corner of the photo is standing adjacent to the foreset beds of the delta.

Bedrock Geology

The foreset beds form as sediment is brought to a lake or the ocean by streams and is deposited at the delta and cascades down the delta's front slope. As the delta builds outward, stream sediments called topset beds are deposited on top of the front slope foresets. In the photo from the top of the face downward, about one-quarter of the exposure is comprised of horizontal layers of gravelly sand. These horizontal layers are the topset bed deposits brought by streams to the ocean and deposited over the foreset beds. The boundary (white line) between the horizontal beds and the dipping beds is called the topset / foreset contact. It represents the approximate position of the surface of the body of water into which the streams entered, resulting in the creation of the delta.

The delta is a thick, well-sorted sand and gravel deposit. It is of economic value as an aggregate resource and as a potential water supply (aquifer). The foreset beds in the delta give the direction of the paleocurrents which deposited the delta. Along with the geologic mapping, this information infers a source for the delta, in this case a glacial ice-margin to the northwest. Finally, the topset beds approximate the old sea-level elevation when the delta formed, useful for a reconstruction of regional sea-level elevation during deglaciation.

For more information on GPR, type the words "ground penetrating radar and geology" in any search engine search site and hit the return button. Originals of the Boston University theses are housed at the Department of Earth Sciences, Boston University. Copies available for viewing are in the library of the Maine Geological Survey.

References and Additional Information

Crider, H. B., 1998, Late Pleistocene development of the Brunswick, Maine, sand plain and adjacent paleochannel (M.S. thesis): Boston University, Boston, Massachusetts, 219 p.

Tary, A. K., 1999, The Sanford sand plain, York County, Maine: the stratigraphic nature and morphogenesis of a glacial marine-limit sand-plain: Boston University, Boston, Massachusetts, 183 p.