Brunswick Quadrangle, Maine

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SURFICIAL GEOLOGY OF THE BRUNSWICK QUADRANGLE

The surficial geology in the Brunswick quadrangle records the advance and retreat of the last great glacier in the region, the Laurentide ice sheet, and subsequent Holocene events and deposits. Of the deposits associated with this record, the Brunswick sand plain is the most prominent in the quadrangle. Radiocarbon age analyses of marine fossils from deposits have provided an estimate of the time when the sand plain was formed, and also a basis for hypothesizing that it formed during a worldwide rapid rise in sea level.

By the end of the last great ice age, as the glaciers were melting and the retreating ice margin had reached the present-day coast of Maine, the ocean had flooded the Gulf of Maine and was in contact with the ice front. This flooding was in response to downwarping of the earth's crust due to the weight of the massive ice sheet. As the ice melted, the depressed crust did not respond immediately to the release of weight from the ice, and as a result the sea was able to flood inland, up river valleys and in lowlands. In the Brunswick quadrangle, the highest elevation that the sea reached is about 275 feet above sea level. During the retreat of the ice and the relative rise of sea level, discharging meltwater from the ice carried sediment to the sea where it was deposited. Later, when the earth's crust began to respond to the released weight of the ice, emergence of the land from the sea resulted in a relative fall of sea level, and nearshore deposits associated with the lowering sea were laid down in the shallow water.

The elevation of the sand plain is well below the highest elevation of older marine deposits, by as much as 175 feet. Clearly it is a younger feature than the high elevation marine sediments. Exposures in the surface of the plain show trough cross-bedded sand, representative of a braided stream fluvial system. Test-boring logs and geophysical data indicate the shallow geologic sequence records the transition by late-glacial isostatic emergence from marine to near-shore conditions and the deposition of the Brunswick sand plain. Surficial sand of the plain overlies a sandy silt zone that includes discrete, correlated sand units, which gently dip eastward. Beneath the sandy deposits, thick glaciomarine mud overlies sand and till lying on top of bedrock.

Age analyses on marine fossils from the section shown in Location 1 found at an elevation just above the highest surface of the sand plain yielded 12.8 ka ages. Samples from a seismically identified sequence (Location 5), probably very much like the sequence shown at Location 1, provide the youngest ages from marine fossils (12.2 ka). The seismically identified units are likely the distal equivalent of the sand plain.

Marine fossil radiocarbon ages must be corrected for "old" carbon derived from sea water. For the Pleistocene Gulf of Maine the correction is estimated at –600 years (Dorion and others, 2001). Thus, using 12.2 and 11.6 as corrected bracketing ages for the time of formation of the Brunswick sand plain, the time overlaps the period of rapid worldwide sea level rise during MWP-1A, which occurred between 12.6 and 11.7 kyr BP (Bard et al., 1990; Adkins et al., 1998). The data support the interpretation that the sand plain is a coastal braid-plain delta formed as emergence continued, but during a period of relative sea-level stability as a result of MWP-1A.

References Cited

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Location 1. Light gray massive-appearing glaciomarine mud at base of section, overlain by layered mud that changes color from dark gray and brown up section, and capped by tan silty sandy and sand at top of section (this site is now covered).

Location 1. Rock outcrop overlain by stony till, draped by Presumpscot Formation at location 1, Brunswick-Topsham Route 196 Bypass.

Location 1. West end of section. Note abrupt contact between gray and brown layered mud at mid-section of road cut. Unconformity between dipping beds and overlying horizontal beds at top of section marks transition between coarsening upward marine regressive sequence and tan shoreline sand. A thin veneer of wind-blown sand (darker tan material at very top of section).

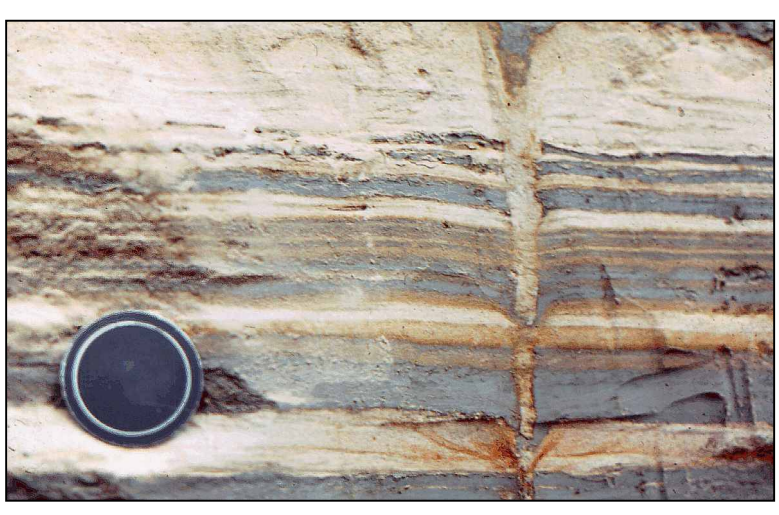
Location 1. Presumpscot Formation; shovel is at contact between layered mud and underlying massive-appearing mud. Note convoluted layers along horizons above shovel head. Slumping of the layers after they were deposited on the ocean floor disrupted the beds. Later, deposition continued with no slumping, evident by the undisturbed layers up section.

Location 1. Barnacle basal plates attached to rock outcrop. Radiocarbon age analyses from these and other marine fossils are approximately 12,800 years before present.

Location 1. Assemblage of fossils from section: left to right, dropstone with barnacles attached; juvenile whelk; juvenile snail (*Natica clausa*); two scallops (*Pecten irradians*); three clamshells in front of small scallop (left to right) *Macoma baltica*, and two valves from *Serripes groenlandicus.*

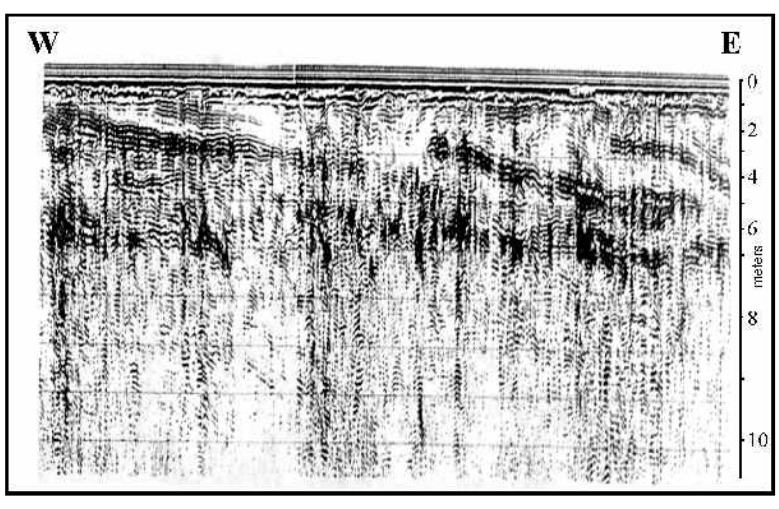
Location 2. Laminated sand and mud containing a lense of coarse-grained debris, which melted out from an iceberg onto the sea floor or slumped off the ice, and was later overlain by undeformed sediment. Webber Pit; photo by M. J. Retelle.

Location 2. Lobe of bedded sand in a glaciomarine fan at bottom of section, truncated and draped by rhythmically bedded sand and mud of younger overlying fan lobe; photo by M. J. Retelle.

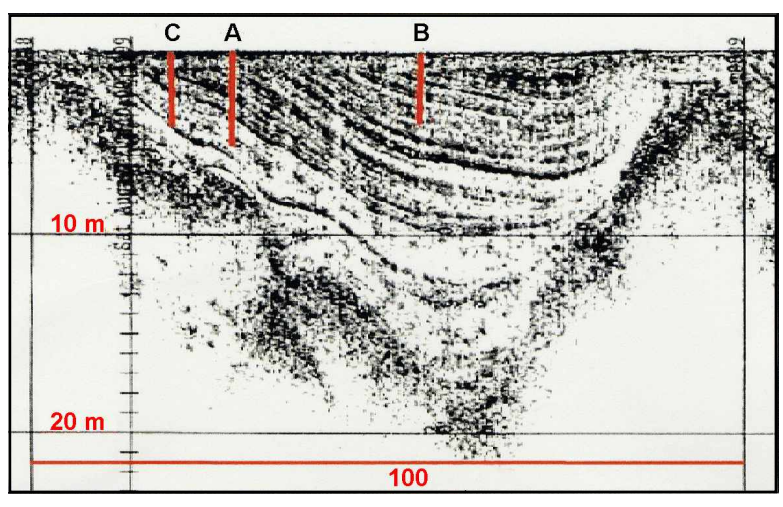


Location 2. Nearshore deposits with vertical burrow by mollusk (?) cutting through laminated sand and mud (photo M. J. Retelle).

Location 3. Fluvial trough cross-bedded gravelly sand interpreted to be delta topset beds at surface exposure of Brunswick sand plain. Bedding is characteristic of shallow-water braided streams, which here flowed on the surface of the plain then into ocean to form a coastal braid-plain delta. View is to west; flow direction is to the east toward observer.



Location 4. Ground-penetrating radar image from Brunswick sand plain, showing eastward-directed shallow-dipping forms interpreted to be low-angle delta foreset beds of the Brunswick sand plain (Crider, 1998).



Location 5. Seismic section from New Meadows River. Layering in seismic image represents layering in glaciomarine deposits similar to that seen at Location 1. Location and length of cores taken from sediment are represented by the capital letters A, B, and C. The upper part of the seismic sequence is likely the distal equivalent of the sand plain. Radiocarbon-dated fossil shells from core C and core B are respectively 13,300 and 12,300 years before present (Oakley, 2001).