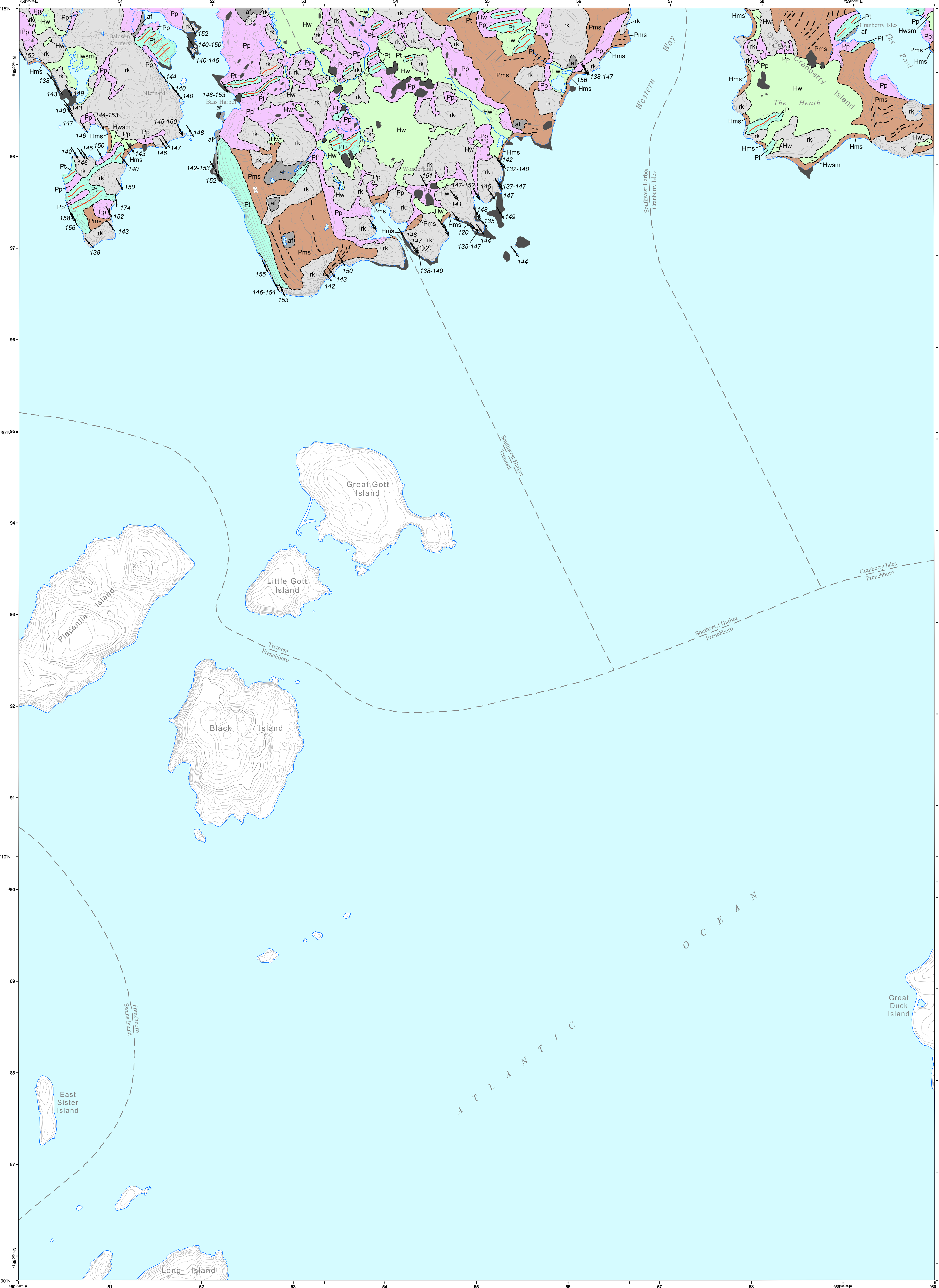
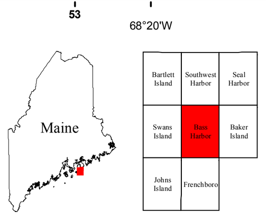
Surficial Geology



SOURCES OF MAP INFORMATION

Surficial geologic mapping of the Bass Harbor quadrangle was conducted by Duane D. Braun during the 2012 and 2014 field seasons.



SCALE 1:24,000

CONTOUR INTERVAL 10 FEET

Approximate Mean Declination, 2015 16.5° W (not to scale)

Base map features from Maine Office of GIS - 1:24,000 USGS contour lines, E911 roads, 1:24,000 National Hydrography Dataset, USGS GNIS placenames and 1:24,000 political boundaries. Map projection Universal Transverse Mercator, North American Datum, 1927.

The use of industry, firm, or local government names on this map is for location purposes only and does not impute responsibility for any present or potential effects on the natural resources.

Note: The first letter of each map unit indicates the general age of the unit:
H = Holocene (postglacial deposit; formed during the last 11,700 years).
Q = Quaternary (deposit of uncertain age; usually late-glacial and/or postglacial).
P = Pleistocene (deposit formed during glacial to late-glacial time, prior to 11,700 yr B.P. [years before present]).

af — **Artificial fill** - This unit occurs along roadways, at building sites, and abandoned gravel pits.

Hms — **Marine shoreline deposit** - Beach ridges composed of cobble to boulder-size material 2-5 m (6-15 ft) thick. Such deposits form the natural "seawall" along the coast from Seawall Pond to west of the Seawall Picnic area.

Hw — **Freshwater wetland** - Muck, peat, silt, and sand, typically 0.3-2 m (1-6 ft) thick. Poorly drained areas, often with standing water. Extensive wetlands occupy the lowlands between Seawall Campground and the harbor of Bass Harbor.

Hwsm — **Salt marsh** - Grass, reed, and sedge wetland, inundated at high tide, that is underlain by fine grained sediment having a variable thickness of 0.3 – 2 m (1-6 ft). Salt marsh is present to the west and southwest of the village of Bernard.

Pms — **Marine shoreline deposit** - Stratified pebble to boulder gravel and sand that has layering dipping downslope. This deposit was mapped where abandoned gravel and sand pits show the material to be 2-5 m (6-15 ft) thick or where there are distinct strandline features. Deposited during the postglacial marine submergence of the coast. The most extensive areas of such deposits are around the Seawall Campground and north of the Bass Harbor lighthouse.

Pp — **Presumpscot Formation** - Fine-grained glaciomarine mud (silt and clay with sandy lenses) commonly containing gravel dropstones and, more rarely, marine shell fossils. Typically 1-3 m (3-10 ft) thick. The mud was deposited in deeper, quieter water during the postglacial marine submergence of the coast.

Pt — **Till** - Poorly sorted mixture of gravel, sand, silt and clay (diamict) deposited directly by the glacial ice; typically 1-5 m (3-15 ft) thick. Land surface is often more bouldery than the underlying till due to removal of smaller size surface material by running water or waves.

rk — **Bedrock** - Areas shown as solid gray are where 25% or more of the land surface is knobs of bare or vegetation-covered bedrock ledge. Thin (.3-1 m [1-3 ft]) glacial, glaciomarine, and/or colluvial materials overlie the bedrock between knobs. Where gray spots lie within other colored areas of glacial deposits, the gray spots are bedrock ledges projecting through the glacial deposits.

Disturbed earth - Original topography of the area has been disturbed by gravel pit excavation.

Contact - Indicates approximate boundary between adjacent map units. Expectable line location error is 3-6 m (10-20 ft) to locally as much as 10-15 m (30- 50 ft) where the materials are obscured by dense surface vegetation and lack diagnostic landforms.

Small moraine ridge - Ridge of till and/or sand and gravel deposited and/or deformed by glacial ice. Such ridges probably represent annual "push moraines".

Marine beach ridge or strandline - Subtle ridge or bench feature with an abrupt steepening of slope in the downslope direction in an area of Pleistocene marine shoreline deposits. A strandline marks a temporary pause in sea-level lowering or an especially stormy period as the sea receded.

125 / 165 — **Glacial striation locality** - Arrow shows ice-flow direction(s) inferred from striations on bedrock. Dot marks point of observation. Number is azimuth (in degrees) of flow direction. Where relative ages are known, flagged arrow shows older flow direction.

Other glacial erosion marks on bedrock - Includes crescentic marks and stoss-and-lee topography. Arrow shows direction of ice-flow. Dot indicates point of observation.

② **Photo locality**

The Northern Portion of the Bass Harbor Quadrangle, Maine

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Funding for the preparation of this map was provided by the Maine Geological Survey.

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Open-File No. 15-32
2015
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SURFICIAL GEOLOGY OF MAINE

Continental glaciers like the ice sheet now covering Antarctica probably extended across Maine several times during the Pleistocene Epoch, between about 2.5 million and 11,700 years ago. The slow-moving ice superficially changed the landscape as it scraped over mountains and valleys, eroding and transporting boulders and other rock debris for miles. The sediments that cover much of Maine are largely the product of glaciation. Glacial ice deposited some of these materials, while others washed into the sea or accumulated in meltwater streams and lakes as the ice receded. Earlier stream patterns were disrupted, creating hundreds of ponds and lakes across the state. The map at left shows the pattern of glacial sediments in this quadrangle.

The most recent "Ice Age" in Maine began about 30,000 years ago, when an ice sheet spread southward over New England (Stone and Borns, 1986). During its peak, the ice was several thousand feet thick and covered the highest mountains in the state. The weight of this huge glacier actually caused the land surface to sink hundreds of feet. Rock debris frozen into the base of the glacier abraded the bedrock surface over which the ice flowed. The grooves and fine scratches (striations) resulting from this scraping process are often seen on freshly exposed bedrock, and they are important indicators of the direction of ice movement. Erosion and sediment deposition by the ice sheet combined to give a streamlined shape to many hills, with their long dimension parallel to the direction of ice flow. Some of these hills (drumlins) are composed of dense glacial sediment (till) plastered under great pressure beneath the ice.

A warming climate forced the ice sheet to start receding as early as 21,000 calendar years ago, soon after it reached its southernmost position on Long Island (Ridge, 2004). The edge of the glacier withdrew from the continental shelf east of Long Island and reached the present position of the Maine coast by about 16,000 years ago (Borns and others, 2004). Even though the weight of the ice was removed from the land surface, the Earth's crust did not immediately spring back to its normal level. As a result, the sea flooded much of southern Maine as the glacier retreated to the northwest. Ocean waters extended far up the Kennebec and Penobscot valleys, reaching present elevations of up to 420 feet in the central part of the state.

Great quantities of sediment washed out of the melting ice and into the sea, which was in contact with the receding glacier margin. Sand and gravel accumulated as deltas and submarine fans where streams discharged along the ice front, while the finer silt and clay dispersed across the ocean floor. The shells of clams, mussels, and other invertebrates are found in the glacial-marine clay that blankets lowland areas of southern Maine. Ages of these fossils tell us that ocean waters covered parts of Maine until about 13,000 years ago. The land rebounded as the weight of the ice sheet was removed, forcing the sea to retreat.

Meltwater streams deposited sand and gravel in tunnels within the ice. These deposits remained as ridges (eskers) when the surrounding ice disappeared. Maine's esker systems can be traced for up to 100 miles, and are among the longest in the country.

Other sand and gravel deposits formed as mounds (kames) and terraces adjacent to melting ice, or as outwash in valleys in front of the glacier. Many of these water-laid deposits are well layered, in contrast to the chaotic mixture of boulders and sediment of all sizes (till) that was released from dirty ice without subsequent reworking. Ridges consisting of till or washed sediments (moraines) were constructed along the ice margin in places where the glacier was still actively flowing and conveying rock debris to its terminus. Moraine ridges are abundant in the zone of former marine submergence, where they are useful indicators of the pattern of ice retreat.

The last remnants of glacial ice probably were gone from Maine by 12,000 years ago. Large sand dunes accumulated in late-glacial time as winds picked up outwash sand and blew it onto the east sides of river valleys, such as the Androscoggin and Saco valleys. The modern stream network became established soon after deglaciation, and organic deposits began to form in peat bogs, marshes, and swamps. Tundra vegetation bordering the ice sheet was replaced by changing forest communities as the climate warmed (Davis and Jacobson, 1985). Geologic processes are by no means dormant today, however, since rivers and wave action modify the land, and worldwide sea level is gradually rising against Maine's coast.

References

Borns, H. W., Jr., Doner, L. A., Dorion, C. C., Jacobson, G. L., Jr., Kaplan, M. R., Kreutz, K. J., Lowell, T. V., Thompson, W. B., and Weddle, T. K., 2004, The deglaciation of Maine, U.S.A., *in* Ehlers, J., and Gibbard, P. L., eds., Quaternary Glaciations – Extent and Chronology, Part II: North America: Amsterdam, Elsevier, p. 89-109.

Davis, R. B., and Jacobson, G. L., Jr., 1985, Late-glacial and early Holocene landscapes in northern New England and adjacent areas of Canada: Quaternary Research, v. 23, p. 341-368.

Ridge, J. C., 2004, The Quaternary glaciation of western New England with correlations to surrounding areas, *in* Ehlers, J., and Gibbard, P. L., eds., Quaternary Glaciations – Extent and Chronology, Part II: North America: Amsterdam, Elsevier, p. 169-199.

Stone, B. D., and Borns, H. W., Jr., 1986, Pleistocene glacial and interglacial stratigraphy of New England, Long Island, and adjacent Georges Bank and Gulf of Maine, in Sibrava, V., Bowen, D. Q., and Richmond, G. M. (editors), Quaternary glaciations in the northern hemisphere: Quaternary Science Reviews, v. 5, p. 39-52.

Figure 1: Polish and striations resulting from glacial scour on Seawall granite along Ship Harbor trail. The polished surface is being eroded by wave attack.

Figure 2: Glacial crescentic fracture "trains". This series of crescent-shaped fractures are aligned one after the other spaced 1-2 cm apart (1 cm is length of each green bar on scale card). Formed by rock embedded in the base of the glacier being both pressed into and dragged along the bedrock surface. The alternating stick-slip motion of the rocks produced the individual crescent-shaped fractures. Ice flow is toward the open end of the crescents.

USES OF SURFICIAL GEOLOGY MAPS

A surficial geology map shows all the loose materials such as till (commonly called hardpan), sand and gravel, or clay, which overlie solid ledge (bedrock). Bedrock outcrops and areas of abundant bedrock outcrops are shown on the map, but varieties of the bedrock are not distinguished (refer to bedrock geology map). Most of the surficial materials are deposits formed by glacial and deglacial processes during the last stage of continental glaciation, which began about 25,000 years ago. The remainder of the surficial deposits are the products of postglacial geologic processes, such as river floodplains, or are attributed to human activity, such as fill or other land-modifying features.

The map shows the areal distribution of the different types of glacial features, deposits, and landforms as described in the map explanation. Features such as striations and moraines can be used to reconstruct the movement and position of the glacier and its margin, especially as the ice sheet melted. Other ancient features include shorelines and deposits of glacial lakes or the glacial sea, now long gone from the state. This glacial geologic history of the quadrangle is useful to the larger understanding of past earth climate, and how our region of the world underwent recent geologically significant climatic and environmental changes. We may then be able to use this knowledge in anticipation of future similar changes for long-term planning efforts, such as coastal development or waste disposal.

Surficial geology maps are often best used in conjunction with related maps such as surficial materials maps or significant sand and gravel aquifer maps for anyone wanting to know what lies beneath the land surface. For example, these maps may aid in the search for water supplies, or economically important deposits such as sand and gravel for aggregate or clay for bricks or pottery. Environmental issues such as the location of a suitable landfill site or the possible spread of contaminants are directly related to surficial geology. Construction projects such as locating new roads, excavating foundations, or siting new homes may be better planned with a good knowledge of the surficial geology of the site.

SOURCES OF RELATED INFORMATION

Braun, Duane D., 2015, Surficial materials of the northern portion of the Bass Harbor quadrangle, Maine: Maine Geological Survey, Open-File Map 15-21, map, scale 1:24,000.

Thompson, Woodrow B., 2015, Surficial geology handbook for southern Maine: Maine Geological Survey, Bulletin 44, 97 p.

Thompson, W. B., and Borns, H. W., Jr., 1985, Surficial geologic map of Maine: Maine Geological Survey, scale 1:500,000.

REFERENCES

Lowell, T.V, 1980, Late Wisconsin ice extent in Maine: evidence from Mount Desert Island and the Saint John River area: unpublished M.S. thesis, University of Maine, Orono, 180 p.

Norton, S. A. and others, 2010, Early post-glacial and Holocene history of the Sargent Mountain pond watershed, as seen from the bottom of Sargent Mountain pond, Acadia National Park, Maine: in Gerbi, C., Yates, M., Kelley, A., and Lux, D., eds., Guidebook for field trips in coastal and interior Maine: 102nd NEIGC meeting, p. 45-60.