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Surficial Geology of the Old Orchard Beach Quadrangle, Cumberland and York Counties, Maine

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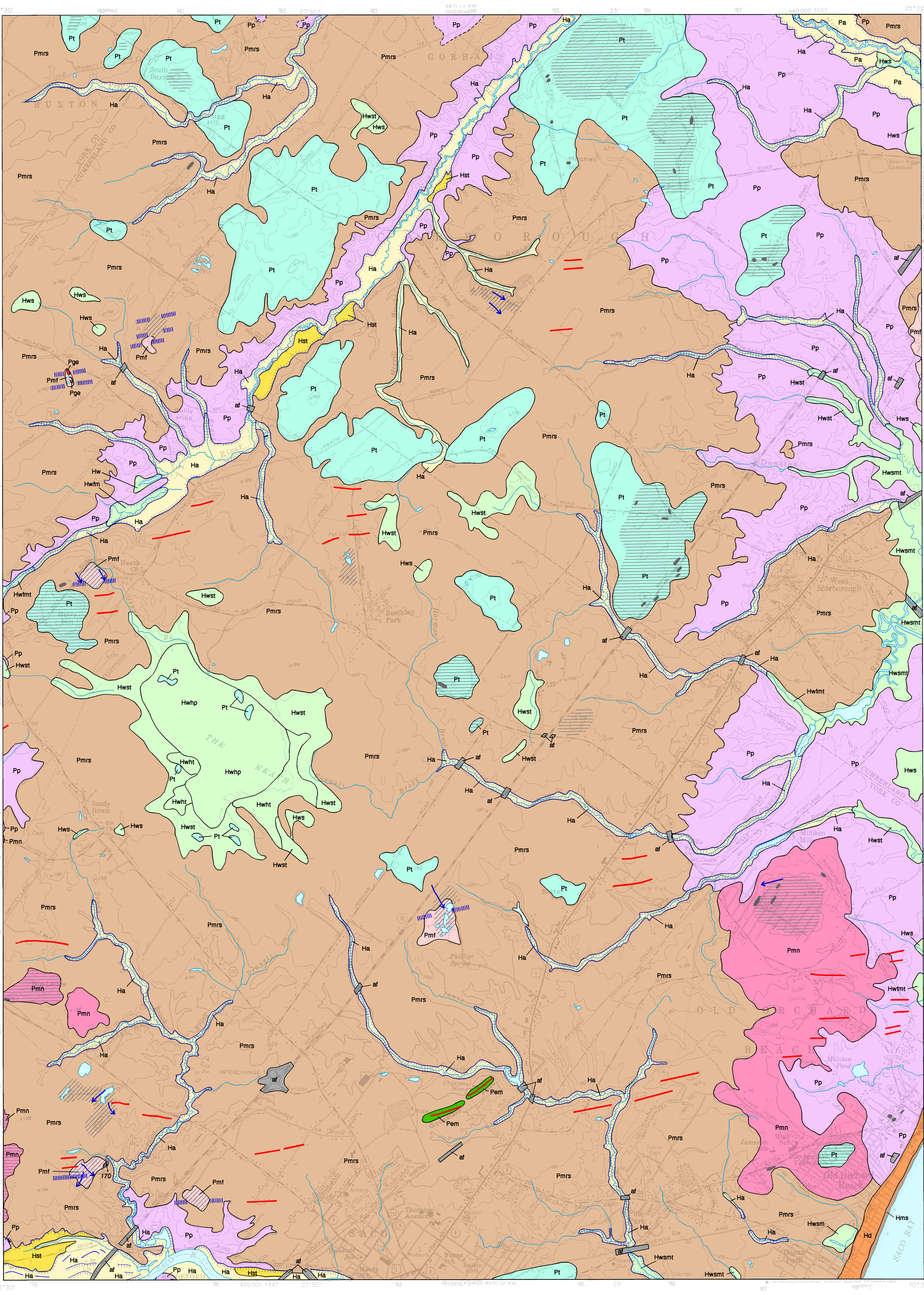
Surficial Geology



Old Orchard Beach Quadrangle, Maine

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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 1.5 million and 10,000 years ago. The slow-moving ice superficially changed the landscape as it scraped over mountains and valleys (**Figure 1**), eroding and transporting boulders and other rock debris for miles (**Figure 2**). 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 the Old Orchard Beach quadrangle.

The most recent "Ice Age" in Maine began about 25,000 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 (**Figure 3**). 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 years ago, soon after it reached its southernmost position on Long Island (Sirkin, 1986). The edge of the glacier withdrew from the continental shelf east of Long Island and reached the present position of the Maine coast by 13,800 years ago (Dorion, 1993). 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 (**Figure 4**) 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. Age dates on these fossils tell us that ocean waters covered parts of Maine until about 11,000 years ago, when the land surface rebounded as the weight of the ice sheet was removed.

Meltwater streams deposited sand and gravel in tunnels within the ice. These deposits remained as ridges (eskers) when the surrounding ice disappeared (**Figure 5**). 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 (**Figure 6**).

The last remnants of glacial ice probably were gone from Maine by 10,000 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 (**Figure 7**). 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 (**Figure 8**), and worldwide sea level is gradually rising against Maine's coast.

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Figure 1: "The Bubbles" and Jordan Pond in Acadia National Park. These hills and valleys were sculpted by glacial erosion. The pond was dammed behind a moraine ridge during retreat of the ice sheet.

Figure 2: Daggett's Rock in Phillips. This is the largest known glacially transported boulder in Maine. It is about 100 feet long and estimated to weigh 8,000 tons.

Figure 3: Granite ledge in Westbrook, showing polished and grooved surface resulting from glacial abrasion. The grooves and shape of the ledge indicate ice flow toward the southeast.

Figure 4: Glaciomarine delta in Franklin, formed by sand and gravel washing into the ocean from the glacier margin. The flat delta top marks approximate former sea level. Kettle hole in foreground was left by melting of ice.

Figure 5: Esker cutting across Kezar Five Ponds, Waterford. The ridge consists of sand and gravel deposited by meltwater flowing in a tunnel beneath glacial ice.

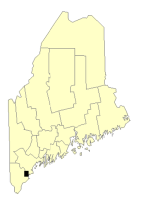
Figure 6: Aerial view of moraine ridges in blueberry field, Sedgwick (note dirt road in upper right for scale). Each bouldery ridge marks a position of the retreating glacier margin. The ice receded from right to left.

Figure 7: Sand dune in Wayne. This and other "deserts" in Maine formed as windstorms in late-glacial time blew sand out of valleys, often depositing it as dune fields on hillsides downwind. Some dunes were reactivated in historical time when grazing animals stripped the vegetation cover.

Figure 8 : Songo River delta and Songo Beach, Sebago Lake State Park, Naples. These deposits are typical of geological features formed in Maine since the Ice Age.

SOURCES OF INFORMATION

Surficial geologic mapping by Michael J. Retelle completed during the 1987-1989 field seasons; funding for this work provided by the U. S. Geological Survey COGEOMAP program. Wetlands data provided in part by Cornelia C. Cameron, U.S. Geological Survey, 1988. Geologic unit designations and contacts revised and matched to adjacent quadrangles in 1999 by MGS geologists.



Quadrangle Location

SCALE 1 : 24,000

1 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET

TRUE NORTH

Topographic base from U.S. Geological Survey Old Orchard Beach quadrangle, scale 1:24,000 using standard U.S. Geological Survey topographic map symbols.

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.

- Ha — **Stream alluvium** - Gravel, sand, and silt deposited on flood plains of modern streams.
- Hst — **Stream terraces** - Flat alluvial benches situated above modern flood plains of rivers and streams. Materials forming depositional terrace may include gravel, sand, silt, and clay; step-like morphology is created by downcutting of stream through alluvial plain.
- Hws — **Wetland, swamp*** - Peat and fine-grained inorganic sediment. Poorly drained area with standing water common.
- Hwfm — **Wetland, freshwater marsh*** - Peat and fine-grained inorganic sediment. Poorly drained grassland with standing water common.
- Hwsm — **Wetland, saltmarsh*** - Peat and fine-grained inorganic sediment in coastal areas commonly subject to tidal flooding.
- Hwh — **Heath*** - Peat and fine-grained inorganic sediment. Distinguished from other wetlands by the absence of trees and the presence of shrubs.
- Hw — **Wetland, undifferentiated** - May include peat, muck, clay, silt, and sand deposited in poorly drained areas.
- Hms — **Marine shoreline deposit (beach)** - Sand and gravel deposited by marine processes along the ocean shore.
- Hd — **Dune deposits** - Sand dunes adjacent to modern beaches.
- Pa — **Alluvium** - Coarse to fine alluvial sand in high terraces and overlying Presumpscot Formation clays, north and south of the Nonesuch River.
- Pmn — **Marine nearshore deposits** - Sand and gravel deposits formed as beaches and shallow marine sand bodies during marine submergence and regression.
- Pmrs — **Marine regressive sand deposits** - Sand deposited in marine waters during regression of the sea from the coastal zone. Sand is commonly interbedded with fine-grained sediments of the Presumpscot Formation.
- Pp — **Presumpscot Formation** - Fine-grained silt and clay with minor marine fossils and dropstones deposited in deeper, quiet water during the marine submergence of the coastal zone.
- Pmf — **Marine fan** - Layered gravel and sand deposited in wedge or mound form at the glacier margin during marine submergence.
- Pge — **Esker** - Gravel and sand deposited in ice tunnel by subglacial meltwater stream (northwestern part of the quadrangle).
- Pem — **End moraine** - Till, sand, gravel, and clay deposited in ridge form by glacier ice.
- Pt — **Till** - Poorly sorted mixture of gravel, sand, silt, and clay deposited directly by the action of glacier ice.
- **Bedrock** - Where bedrock is covered by thin veneer of surface materials, horizontal ruling is shown. Gray dots show areas of "ledge" exposed at the surface.
- af — **Artificial fill** - Mixture of till, gravel, sand, silt, and clay transported and dumped to form elevated sections of roadways, etc.
- **Contact** - Boundary between adjacent map units, dashed where approximated.
- 135 — **Glacial striation or groove** - Arrow shows inferred direction of former ice movement. Number is azimuth (in degrees) of ice flow direction; dot shows location of observation.
- **Inferred direction of meltwater flow** - Curved arrow shows direction of former glacial meltwater flow measured from current indicators (cross-bedding) in sediments.
- **End moraine** - Ridge of till, sand, and gravel deposited by glacier ice.
- **Stream terrace scarp** - Indicates edge of terrace step. Teeth indicate front of terrace riser.
- **Ice margin position** - Line shows an approximate position of the glacier margin during ice retreat.
- **Flood plain scroll** - Curved lines indicating former position of meanders on flood plain as observed from aerial photography.
- **Modified ground** - Pattern shows areas affected by change in topography resulting from development or excavation subsequent to publication of topographic base map.

*NOTE: Wetland symbols followed by "t" indicate areas where peat deposits probably do not constitute a significant commercial resource, either because they are thin (< 1.5 m), or they have an ash content greater than 25 percent. Symbols followed by "p" indicate peat deposits that are thicker (generally > 1.5 m), with ash content less than 25 percent, and thus may be suitable for commercial applications.

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. Refer to the list of related publications below.

OTHER SOURCES OF INFORMATION

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