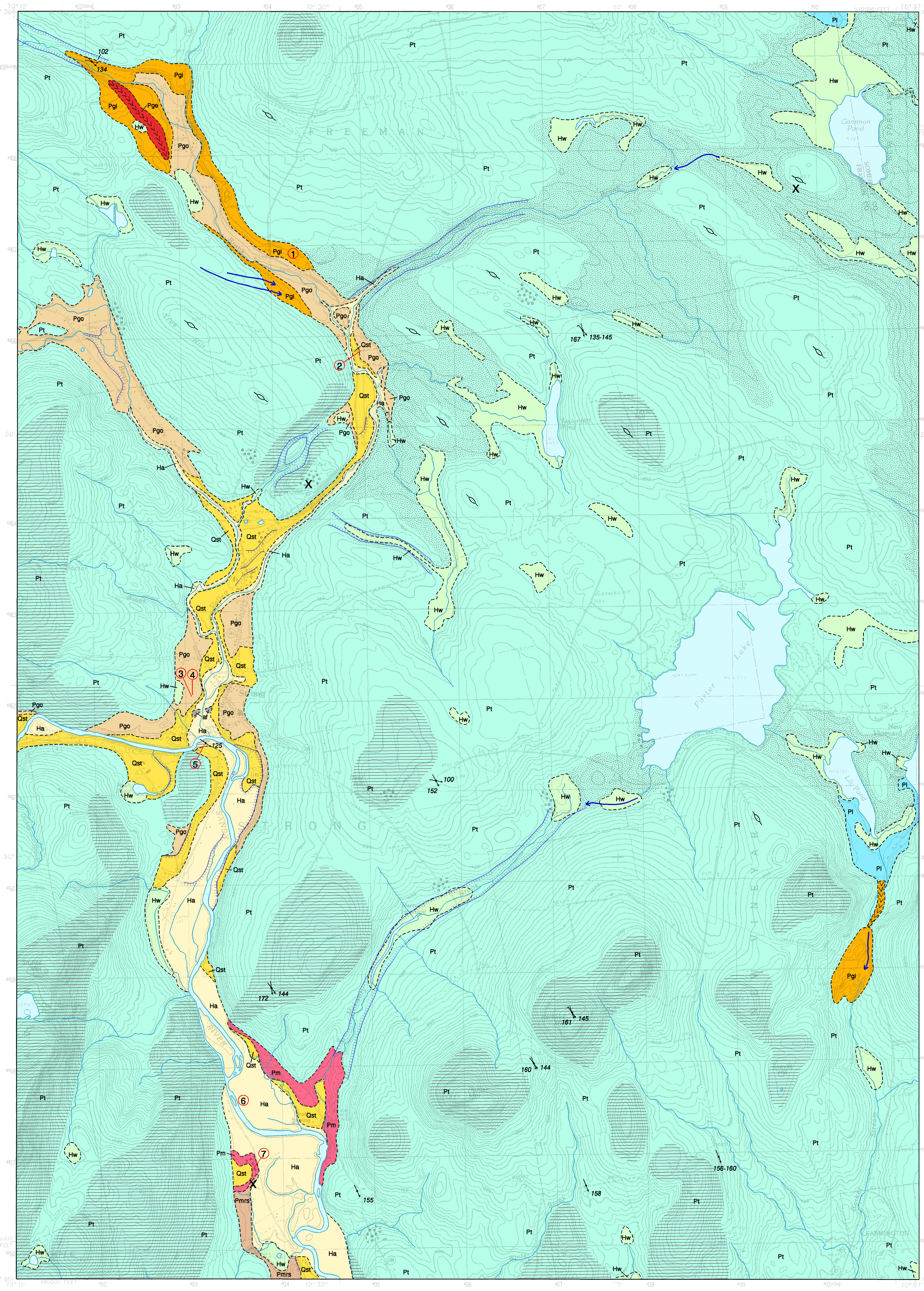
Surficial Geology



SOURCES OF INFORMATION

Surficial geologic mapping of the Strong quadrangle was conducted by Craig D. Neil during the 2002 field season. Additional data and editing by Thomas K. Weddle from field work conducted in 1990 and 2003. Additional editing in 2007 from fieldwork conducted by Carol T. Hildreth in 2006.

Quadrangle Location

SCALE 1 : 24,000

CONTOUR INTERVAL 20 FEET

TRUE NORTH

Topographic base from U.S. Geological Survey Strong 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.

Notes: The first letter of each map unit indicates the general age of the unit:
H = Holocene (postglacial deposit; formed during the last 10,000 years).
Q = Quaternary (deposit of uncertain age, but usually late-glacial and/or postglacial).
P = Pleistocene (deposit formed during glacial to late-glacial time, prior to 10,000 yr B. P. [years before present]).

- af — **Artificial fill** - Variable mixtures of surficial sediments, rock fragments, and artificial materials, transported and dumped to build up roads, waterfronts, etc.
- Ha — **Stream alluvium** - Sand, gravel, silt, and organic sediment. Deposited on flood plains of modern streams. Unit may include some wetland areas. Generally corresponds to the lower terrace levels and current flood plain of the Sandy River valley and its tributaries.
- Hw — **Freshwater wetland deposit** - Peat, muck, silt, and clay. Deposited in poorly drained areas.
- Qst — **Stream terrace deposit** - sand, silt, gravel, and occasional muck on terraces cut into glacial deposits of the Sandy River valley and its tributaries. The highest elevation stream terraces are most likely Pleistocene age and may have had a glacial meltwater source.
- Pl — **Lacustrine deposit** - Sand, gravel, and silt deposited in glacial lake located in extreme northeastern corner and eastern border of quadrangle.
- Pgo — **Undifferentiated glacial outwash** - Sand and gravel deposited by meltwater streams.
- Pge — **Esker deposits** - Sand and gravel deposited by glacial meltwater flowing in tunnels within or beneath the ice.
- Pgi — **Undifferentiated ice-contact deposits** - Sand, gravel, and silt laid down within or against the ice.
- Pm — **Marine deposits, undifferentiated** - May include sand and gravel as well as clay-silt deposited in late-glacial sea, formed in a variety of marine environments and locally modified by post-glacial erosion. May include deltaic, submarine fan, shoreline, and/or nearshore deposits.
- Pmrs — **Marine regressive deposits** - Sand and gravel, minor silt deposited as fluvial or nearshore sediments graded to relative falling sea-level. Commonly occurs as sandy areas and is likely to be underlain by marine clay-silt.
- Pt — **Till** - Light- to dark-gray, nonsorted to poorly sorted mixture of clay, silt, sand, pebbles, cobbles, and boulders; a predominantly sandy diamicton containing some gravel. Generally underlies most other deposits.
- **Bedrock exposures** - Not all individual outcrops are shown on the map. Gray dots indicate individual outcrops; ruled pattern indicates areas of abundant exposures and areas where surficial deposits are generally less than 3 m (10 ft) thick.
- **Contact** - Boundary between map units. Dashed where approximately located.
- >>>>> **Esker crest** - Chevrons point in inferred direction of meltwater flow.
- **Glacially streamlined hill** - Symbol shows trend of long axis, which is parallel to former glacial ice-flow direction.
- 135 135 **Glacial striation locality** - Arrow shows ice-flow direction inferred from striations on bedrock. Dot marks point of observation. Number is azimuth (in degrees) of flow direction. Flagged trend is older.
- **Meltwater channel** - Channel eroded by glacial meltwater stream or outflow from glacial lake. Arrow shows inferred direction of water flow.
- **Large meltwater channel** - Channel eroded by glacial meltwater stream or outflow from glacial lake. Hachured lines show extent of channel.
- **Scarp** - Stream-cut bank caused by river erosion. Hatch marks point to lower surface.
- X **Large boulder** - Site of exceptionally large glacially transported boulder.
- Area of many large boulders.
- Area where very sandy diamicton is found having the appearance of being reworked by flowing water or currents, possibly in a glacial lacustrine environment.
- ④ **Photo locality**

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

1. Neil, C. D., and Locke, D. B., 2003, Surficial materials of the Strong quadrangle, Maine: Maine Geological Survey, Open-File Map 03-63.
2. Neil, C. D., 2003, Significant sand and gravel aquifers of the Strong quadrangle, Maine: Maine Geological Survey, Open-File Map 03-100.
3. Thompson, W. B., 1979, Surficial geology handbook for coastal Maine: Maine Geological Survey, 68 p. (out of print).
4. Thompson, W. B., and Borns, H. W., Jr., 1985, Surficial geologic map of Maine: Maine Geological Survey, scale 1:500,000.

Strong Quadrangle, Maine

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SURFICIAL GEOLOGY OF MAINE

Continental glaciers as large as 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, eroding and transporting boulders and other rock debris for miles. The sediments that cover much of Maine are largely the product of glaciation. The map at left shows the pattern of glacial sediments in the Strong quadrangle.

The most recent "Ice Age" in Maine began about 25,000 years ago, when an ice sheet spread southward over New England. 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 creating grooves and fine scratches (striations). Erosion and sediment deposition by the ice sheet streamlined many hills, with their long dimension parallel to the direction of ice flow.

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. The edge of the glacier reached the present position of the Maine coast by 13,800 years ago. 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 465 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. 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. 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.

The last remnants of glacial ice probably were gone from Maine by 10,000 years ago. 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. Geologic processes are by no means dormant today, however, as rivers continue to modify the land surface.

Figure 1: Glacial lake sediments deposited in an ice-dammed lake in the Valley Brook valley, Freeman. Climbing ripple-drift cross-lamination is represented in fine sand and silt drapes in the section to the right of the keys. This lamination in sedimentary structure forms when fine-grained sediment flows into a lake as a density current. When the density current travels into lower velocity zones, deposition of sediment from suspension occurs. The ripples and drapes in the upper half of the photo are deformed by loading of the deposit by overlying sediment and by dewatering of the deposit by the escape of water from the sediment. At the top of the photo, trough cross-stratified sand is found overlying the deformed layers.

Figure 2: A. Crudely-bedded, poorly-sorted, cobble gravel glacial-fluvial outwash deposit in Valley Brook valley, Freeman-Strong town line. The sediment in this deposit has not been transported far from its source, hence the wide range of sizes of individual gravel and cobble stones.
B. Close-up of bullet-shaped, striated till stone. The till stone is a clast in the outwash deposit in photo A, in which the degree of sorting is poor. The striated stone and poor sorting indicates that the gravel has not been reworked by later fluvial processes.

Figure 3: Coarse-grained cobble-pebble gravel: poorly sorted and showing three crudely differentiated units, Strong village. The first unit above the folding shovel (1) is pebble gravel with weak sub-horizontal and shallow-angle bedding. The second or middle unit (2) is cobble-pebble gravel with imbricated clasts dipping from upper left to lower right. Alternatively, the dipping clasts may represent crude trough cross-bedding in the unit. The third and uppermost unit (3) may be the middle unit lacking the apparent clast imbrication, possibly due to frost action in the upper unit. However, the upper unit appears to have fewer large cobbles than the middle unit, and thus may be a separate deposit. All three units represent deposits by a braided stream in flood conditions, with flow direction from right to left.

Figure 4: Coarse-grained, crudely cross-bedded cobble-pebble gravel overlying fine- to medium-grained sand. The sand body is cut out by the overlying coarse unit in the center of the photo near the shovel head. The coarse gravel in turn overlies a poorly sorted gravel found in the lee of a large boulder at right center of photo. The sand represents the slackwater phase of a flooding braided river, whereas the coarse gravel represents full flood conditions when all material in the stream bed is moving. View is to north; flow direction is toward observer.

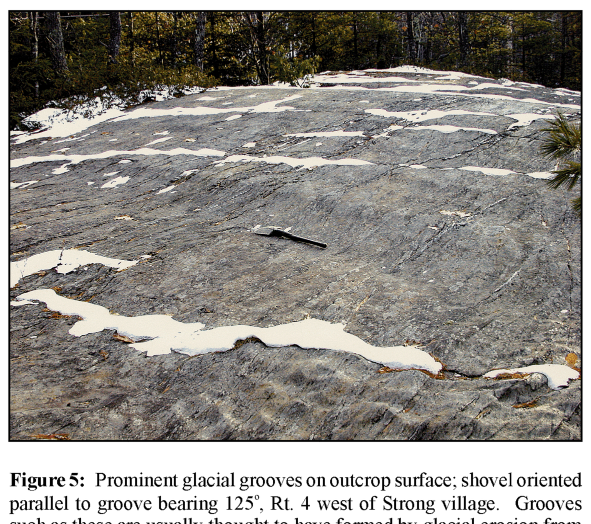

Figure 5: Prominent glacial grooves on outcrop surface; shovel oriented parallel to groove bearing 125°, Rt. 4 west of Strong village. Grooves such as these are usually thought to have formed by glacial erosion from debris in the ice. However, the scalloped features on the bedrock surface at the bottom of the photo are believed to have formed beneath the glacier by sculpting due to sediment-charged meltwater. Although the grooves are near parallel to one another and do not vary along trend; they also may have been formed by meltwater erosion.

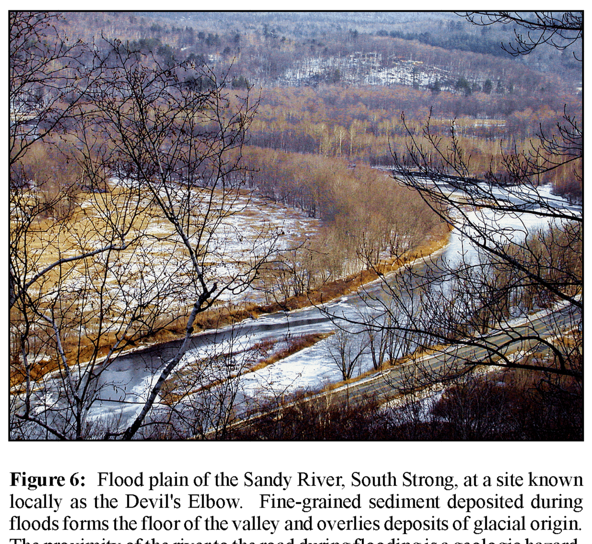

Figure 6: Flood plain of the Sandy River, South Strong, at a site known locally as the Devil's Elbow. Fine-grained sediment deposited during floods forms the floor of the valley and overlies deposits of glacial origin. The proximity of the river to the road during flooding is a geologic hazard, as is bank erosion due to the meandering of the Sandy River over time.

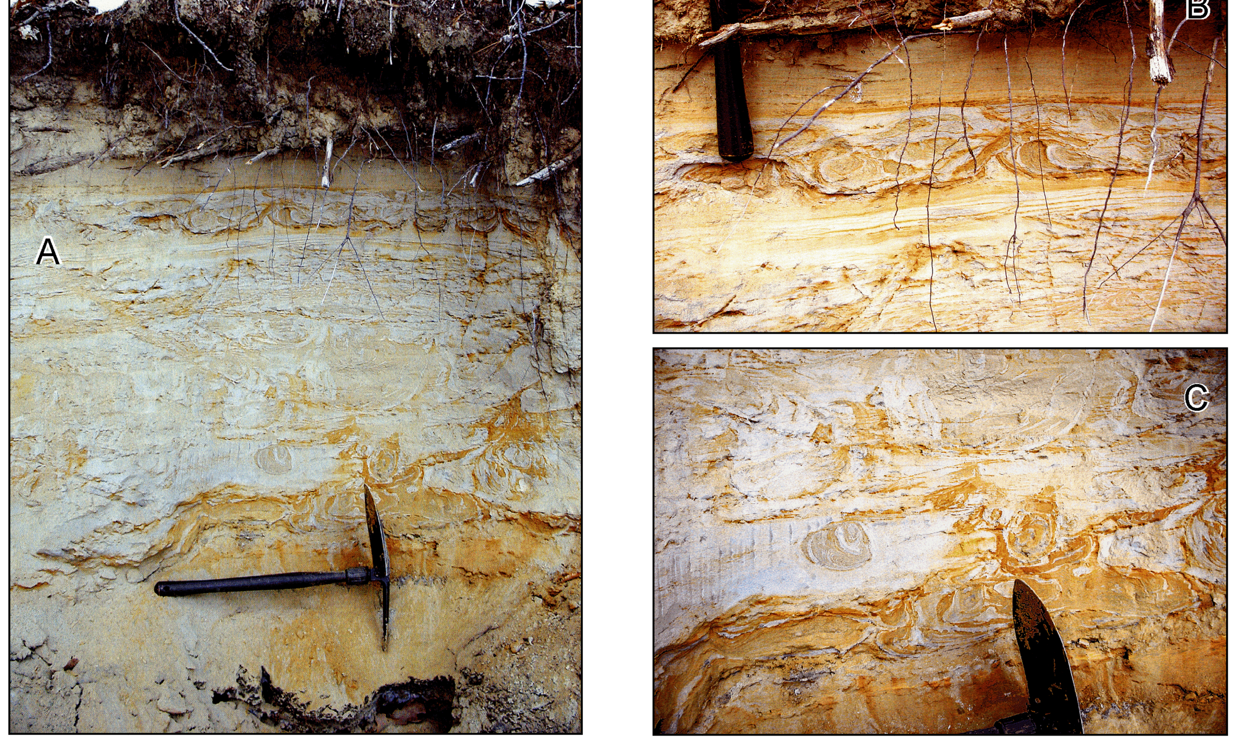

Figure 7 : A. Glacial marine deposits of unknown origin, South Strong. Although not containing marine fossils, these deposits of fine sand and silt are considered glacial marine because they are found at an elevation below the limit of marine flooding of the area during the deglaciation. Also, approximately 0.5 miles to the south on Route 4, an exposure of marine clay-silt overlain by fluvial sand is found in a driveway cut west of the road (see surficial materials map for location). Finally, while not definitive, the sediments lack the climbing ripple-drift cross-lamination commonly found in lake sediments but rare in marine deposits (compare with Figure 1). The photo shows an exposure of deformed layers above the shovel, overlain by undeformed near horizontally bedded sand and silt with a zone of deformed beds within the undeformed section. Above this hillside cut, fluvial stream terrace deposits mantle the marine sediments. B. Close-up of deformed beds overlain and underlain by undeformed horizontally bedded fine sand and silt. C. Close-up of deformed beds at base of section.