Geologic Site of the Month

February, 2016

Heart of Poland Conservation Area
Poland, Maine

44° 3' 54.92" N, 70° 24' 9.93" W

Text by
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Introduction

The town of Poland, Maine is home to a number of public nature trails where the local geology and natural history are on display, including the most recently constructed trail network through the Heart of Poland Conservation Area. This town-owned property, officially opened in November 2015, is open to the public all year. From the trails, a person on foot can visit several bedrock outcrops, including one that forms an overhanging cave (Figure 1), a historic granite stone quarry, a large vernal pool, and the remains of a sandy ocean shoreline in the form of glacial outwash that fills two small stream valleys.

Photo by Ryan P. Gordon

Figure 1. This outcrop of overhanging bedrock forms a shallow crepuscular "twilight" cave along a trail in the Heart of Poland Conservation Area.

Location and Directions – Area Map

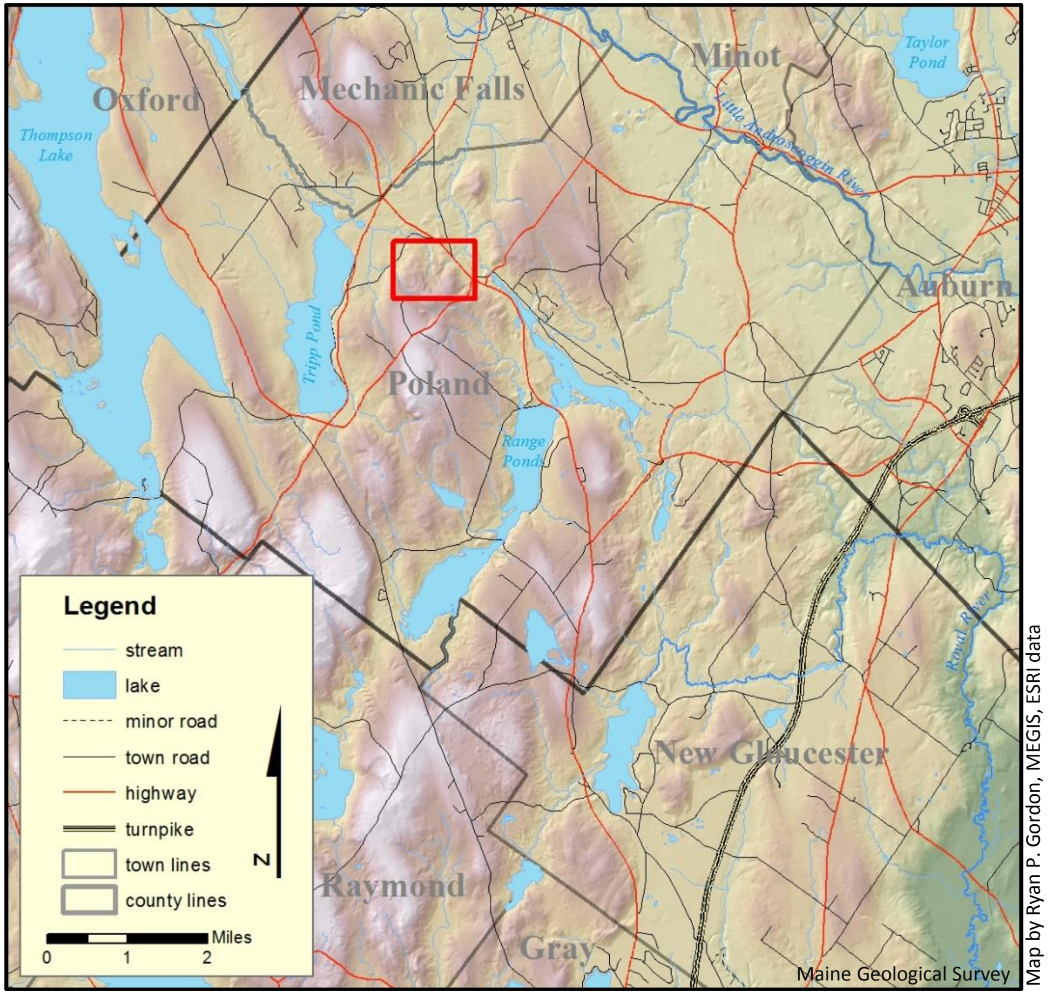


Figure 2. Location of the Heart of Poland Conservation area in Poland, Maine. The red rectangle indicates the approximate area shown in the trail map of Figure 3.

Location and Directions – Trail Map

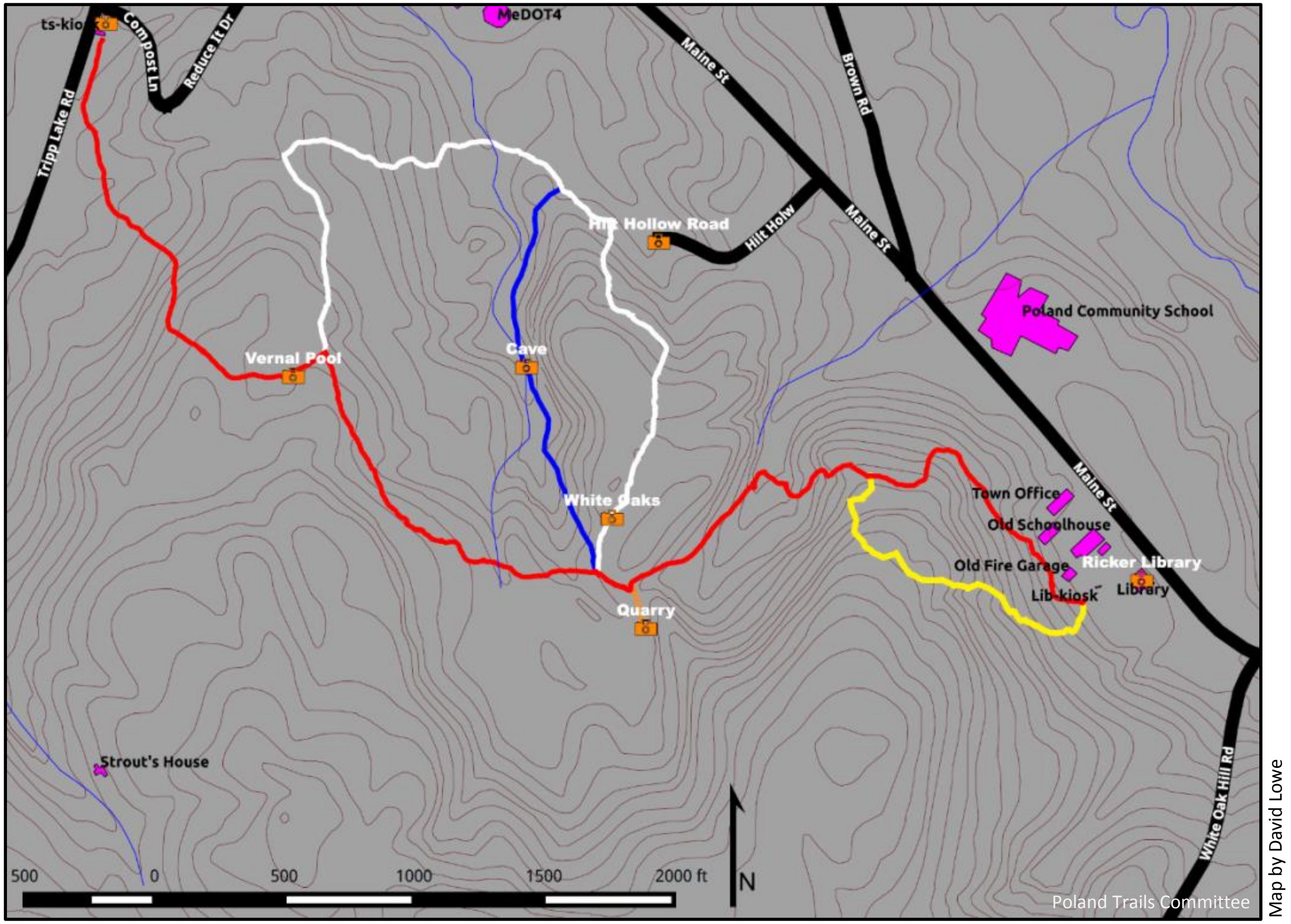


Figure 3. Trail map of the Heart of Poland Conservation Area. Trails are shown in thick blue, white, red, and yellow lines. Parking is located at the Ricker Library, Hilt Hollow Road, and the kiosk on Tripp Lake Road. Map by David Lowe for the Poland Trails Committee.

Location and Directions – Access

The Heart of Poland Conservation Area is located near the center of the town of Poland, Maine (Figures 2 and 3). The trail network can be accessed behind the Ricker Memorial Library, located at 1211 Maine Street (Route 26) in Poland. Parking is behind the library, and the trail begins at a kiosk near the northwest corner of the library parking lot (Figure 4).

Photo courtesy of Poland Trails Committee

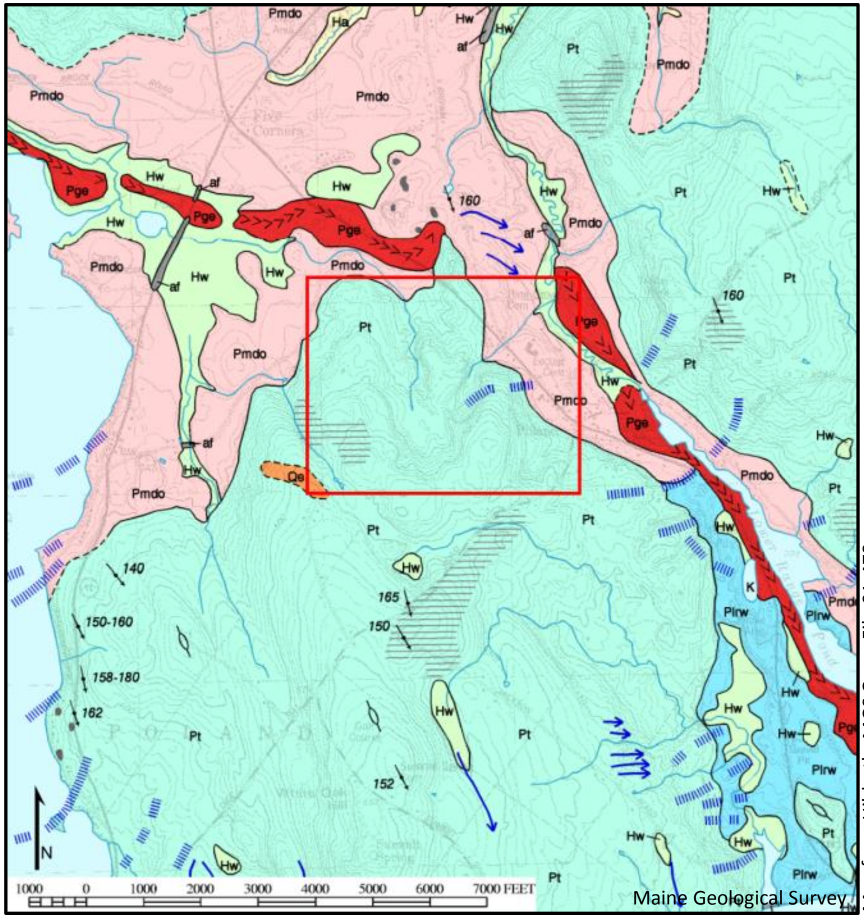
Figure 4. The kiosk at the trailhead behind the Riker Library, on official opening day. Poland town forester Fred Huntress (left) and Parks and Recreation Director Scott Segal are pictured.

Location and Directions – Access

The trail can also be accessed from the end of Hilt Hollow Road, which can be reached by walking, cycling or driving from the library 0.4 miles northwest on Maine Street to Hilt Hollow Road on the left, and then traveling down Hilt Hollow Road 0.2 miles west to where it dead ends in a small sand pit. The trailhead is to the left of the sand pit, at a small pile of stones (Figure 5). Trail maps are available from Poland Trails Committee.

Figure 5. The trailhead and sand pit at the end of Hilt Hollow Road.

Glacial Outwash Sands on an Ancient Coastline



Map from Hildreth, MGS Open-File 01-478

Beginning in the sand pit at the end of Hilt Hollow Road (Figure 5), visitors can easily see and feel the fine, well-sorted sand that was left behind by the last glacier to cover this part of Maine. Approximately 13,000 years ago, this location was at the boundary between the ocean and a retreating continental glacier. In fact, this spot is very near to the highest stand of sea level during the last deglaciation of Maine; the land uphill to the south and west, farther into the Conservation Area, has a stony deposit of glacial till that was never inundated by ocean, while the land here at the sand pit and downhill to the north towards Maine Street was at one time beneath the waves (Figure 6). The sediments here were carried by flowing melt water at the edge of the ice sheet and deposited as sand bars and deltas in the shallow ocean. There is even evidence of sand dunes in the area nearby (Hildreth, 2001a). The sand pit was probably dug out by a past land developer, who removed the vegetation and exposed the glacial outwash sediment below.

Figure 6. Detail from the Surficial Geologic map of the Mechanic Falls quadrangle (Hildreth, 2001b). The inland limit of the late glacial marine submergence is approximately along the contact between the upland till unit (green, Pt) to the south, and the sandy delta deposits of marine (pink, Pmdo) or lake (blue, Plrw) origin that fill the valleys. The elongated, red unit (Pge) is an esker that is older, and partially buried by, the glacial outwash sands. The red rectangle indicates the area shown in the trail map of Figure 3.

Glacial Outwash Sands – Soil Profile

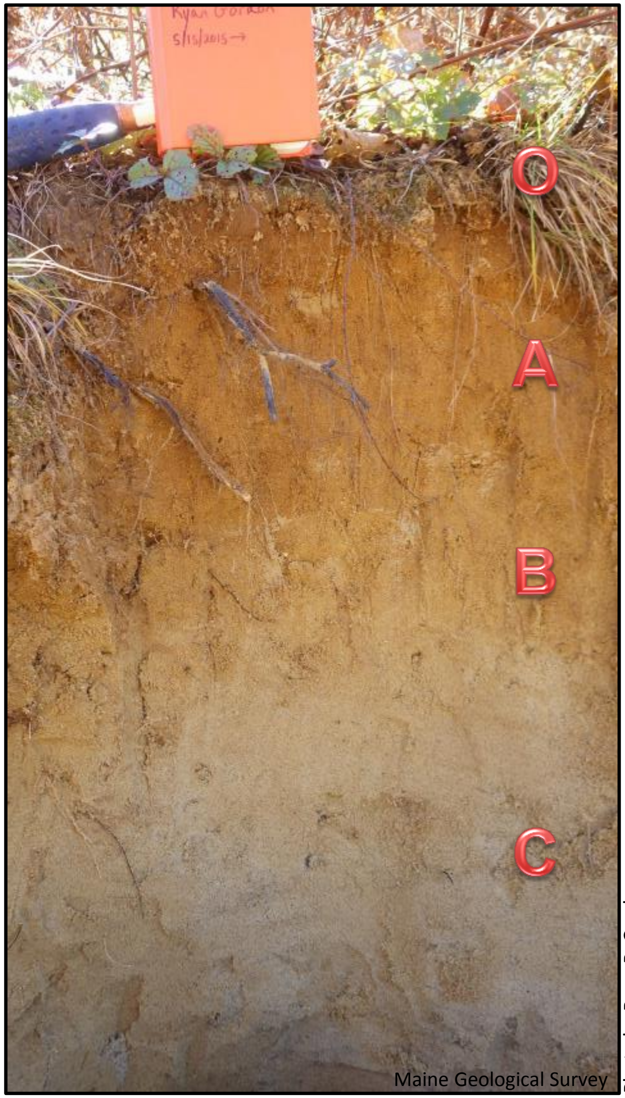


Photo by Ryan P. Gordon

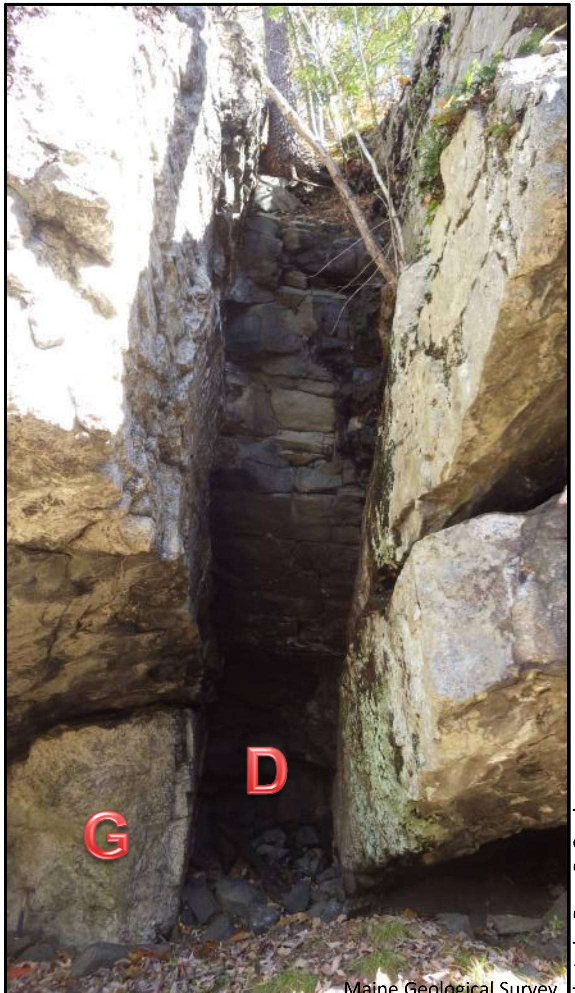
Figure 7. Soil profile in the sand pit. The material is consistent fine sand with some silt, but the variation in color indicates the progression of weathering in the different soil horizons. The organic layer is very thin and is mostly buried in the grass at the top. The A layer is orange in color because of oxidized iron minerals that coat the sand grains. The B layer is higher in silt than the A layer, and changes from darker to lighter yellow as the degree of oxidation decreases from top to bottom. The C layer is the unoxidized, gray sand seen at the bottom of the photo.

The Sebago Batholith, Exposed

Walking up the trail shown in the center of Figure 5 and taking the first left, a hiker will find herself walking south along a small stream and forested wetland to the right. The soil exposed along the trail changes from the uniform sand seen at the last stop to a thin till (Figure 8). The till is a poorly sorted mix of sand, silt, gravel, and granitic boulders that was deposited on top of bedrock directly beneath the glacial ice sheet. Its relatively sandy composition, in comparison to other tills in Maine, is because it was derived by breakdown of the coarse parent rocks of the Sebago Batholith (Hildreth, 2001a).

Figure 8. Stony, sandy till makes up the soil beneath the forest floor along the trail north of the cave (see trail map in Figure 3).

The Sebago Batholith, Exposed



Within a few hundred yards, a cliff outcrop appears in the deciduous trees, above and to the left of the trail (Figure 1). The lower portions of the outcrop have been eroded away to form an overhanging, shallow cave, sometimes called a crepuscular cave (from the Latin *crepusculum*, meaning “twilight”). The majority of the outcrop is composed of granite, a light-gray, coarse-grained, intrusive igneous rock. The other notable feature of the outcrop, even at a distance, is the vertical stripe of dark rock that cuts through the middle (Figure 9). This stripe is a dike of fine-grained, dark-gray diabase, another intrusive igneous rock of a different composition and age from the surrounding granite.

The granite is part of the Sebago Batholith, which forms the bedrock under most of the town of Poland and the surrounding region, with a total area of about 800 square miles (Hussey, 1981, 1985). The Sebago Batholith is the largest pluton in New England, and it formed when a body of melted continental crust (high-silica magma) intruded older metamorphic rocks deep underground, then slowly cooled and solidified about 296 million years ago (Robinson et al., 1998). The darker diabase dike also began as a molten magma, but is much younger than the rock that surrounds it; it probably intruded into a brittle fracture in the granite long after the latter had cooled. The diabase is fine grained because it solidified quickly when it came in contact with the cold granite, not giving the mineral grains much time to grow large when the melt crystallized.

Figure 9. A vertical dike of fine-grained, dark-gray diabase (D) has intruded the older granite (G). The dike has weathered and broken away faster than the rock around it, likely due to rain water flowing along the dike, creating a gap in the outcrop. A pair of barn swallows (*Hirundo rustica*) chose the sheltered left side of the gap to make a nest.

The Sebago Batholith, Exposed

Coming closer, into the overhanging cave, a visitor might notice that there is a third rock type exposed at this outcrop. The ceiling and part of the floor of the cave is composed of a dark-gray, layered metamorphic rock (Figure 10). It appears that this type of rock is easier to weather and break apart than the granite above and below it, which is why the open part of the cave formed here. The metamorphic rock is the oldest rock at this outcrop, and represents the host rock that predated and was intruded by the magma that formed the granite. This rock is commonly found mixed with granite on the eastern side of the Sebego Batholith, starting around Poland and becoming more prevalent to the east (Creasy, 1979; Hussey, 1981). The metamorphic rock is also found outside the batholith, as a solid rock with little or no granite. In the cave, the contact between the metamorphic rock and the granite both above and below is wavy and banded (Figures 11 and 12), very unlike the straight, clean contacts along the edge of the diabase dike. The wavy contact indicates that these two rock types mixed while the host rock was quite hot and ductile, perhaps about the consistency of peanut butter. There are even some places along the contact where the two rock types have been deformed together in small, tight folds (Figure 13). This type of rock, where igneous and partially melted metamorphic rocks are mixed together, is called migmatite.

The Sebago Batholith, Exposed

Photo by Ryan P. Gordon

Figure 10. The cave opens up in a layer of easily weathered, dark-gray, banded metamorphic rock, which is in contact with the more resistant granite above and below it.

The Sebago Batholith, Exposed

Photo by Ryan P. Gordon

Figure 11. A thin layer of metamorphic rock is still attached to the ceiling of the cave.

The Sebago Batholith, Exposed

Figure 12. The lower contact between the metamorphic and igneous rocks is wavy, with the metamorphic rock bending around some of the larger mineral grains in the granite.

The Sebago Batholith, Exposed

Photo by Ryan P. Gordon

Figure 12. A tight fold of migmatite, composed of granite and metamorphic rock mixed together. The green color is algae growing on the surface of the wet rocks.

The Bridgham Quarry

Walking farther south on the same trail, past the cave outcrop and several smaller granite outcrops to the left, a visitor will eventually come to an old granite quarry buried in the trees (Figure 14). There are not many records of the quarry or its uses, but it is likely that the rock removed from this location was used to construct roads, culverts, or building foundations in the local area. An entry in the Cumberland County Registry of Deeds from 1848 references "all the rock and granite" on this lot (Book 211 Page 281), conveying it to George Bridgham Jr. In 1925, the heirs of N. Q. Pope conveyed what was then called "The Bridgham Quarry" to the Town of Poland (Book 292, Page 231), and it was likely not in use by that date. Maine has a long history of granite quarrying (Johnston, 2003), and many similar quarries are scattered throughout the state (Austin and Hussey, 1958).

Photo by Ryan P. Gordon

Figure 14. Historic granite quarry in a hemlock grove.

The Bridgham Quarry

The granite in this quarry is different in texture than the granite at the cave outcrop. Here there are two types, a finer-grained granite similar to what was seen before, mixed with veins of a coarse-grained granite called pegmatite (Figure 15). The large mineral grains in the pegmatite are mainly quartz, feldspar, biotite and muscovite mica (Figure 16), the same main minerals that make up the finer-grained granite. The sheets of mica are large enough to be peeled off the rock and their color (or lack thereof) appreciated in the dim forest light (Figures 17 and 18).

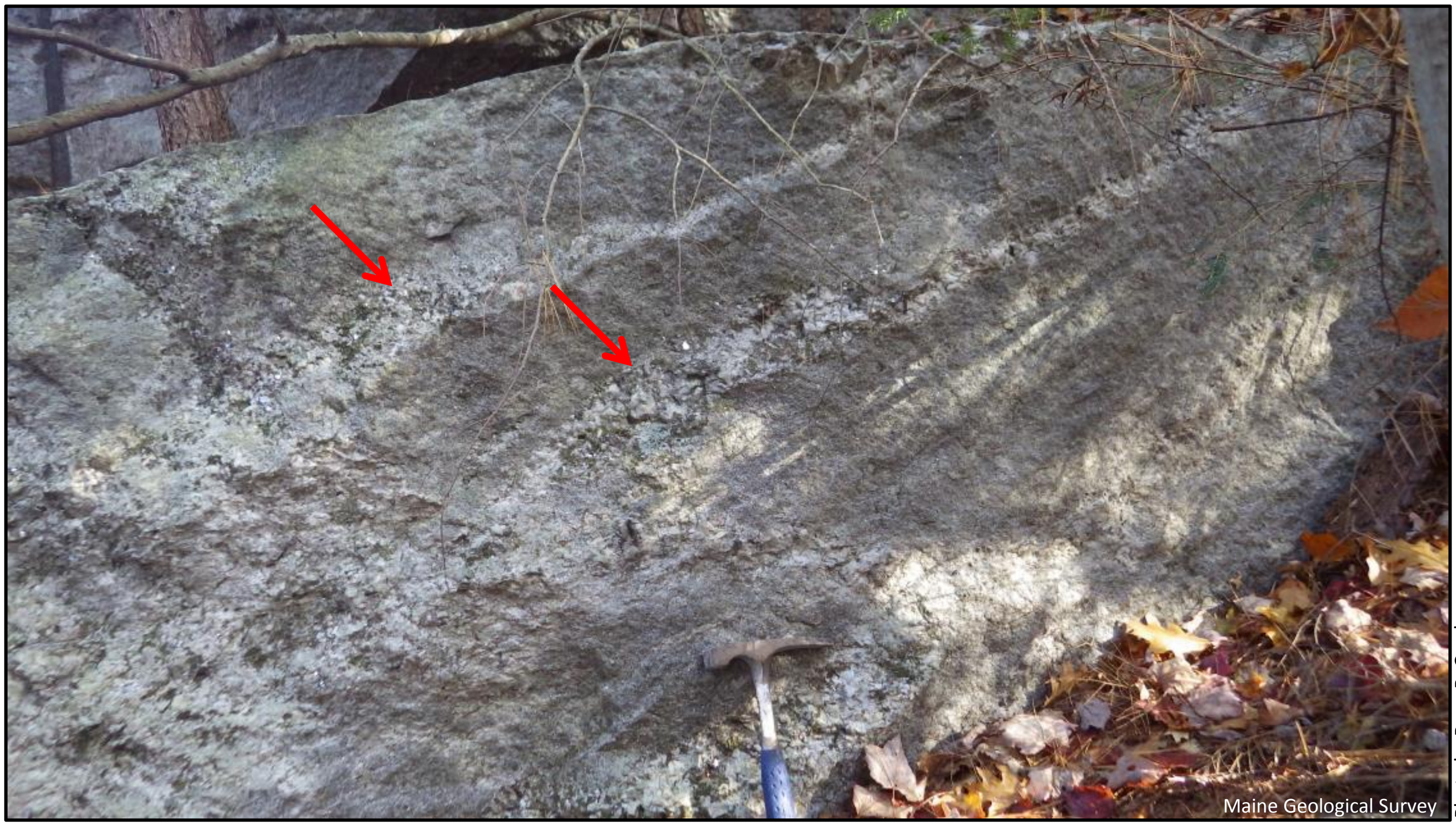


Figure 15. Veins of coarse-grained pegmatite (arrows) cross finer-grained rock at the granite quarry.

The Bridgham Quarry

Photo by Ryan P. Gordon

Figure 16. The granitic pegmatite is made up of large mineral grains of gray, translucent quartz, milky white, opaque feldspar, sheets of brown biotite mica and clear muscovite mica.

The Bridgham Quarry

Photo by Ryan P. Gordon

Figure 17. A sheet of brown biotite mica.

The Bridgham Quarry

Photo by Ryan P. Gordon

Figure 18. The pegmatitic outcrop seen through a sheet of clear muscovite mica.

The Bridgham Quarry

Near the right end of the quarry is another vertical diabase dike that used to intrude through the granite. At this location, however, the quarrymen removed all the granite on either side of the dike, leaving it standing in the woods like a rampart (Figure 19). It must have been easier to break and remove the granite at this location where it was in contact with the diabase intrusion.

Photo by Ryan P. Gordon

Figure 19. A wall of diabase forms the boundary of an old quarry pit. Discarded broken rock is scattered on the quarry floor.

Vernal Pool

Backtracking just one hundred yards or so to the north leads back to the main east-west trail through the conservation area (red line in Figure 3). Walking right leads to the trailhead at the Ricker Library, while the left-hand trail heads towards an interesting hydrologic feature of the Heart of Poland, a large vernal pool (Figure 20). Vernal pools are shallow depressions that fill with water for only part of the year, typically in the springtime but also sometimes in the fall, like this one, photographed in late October. Because they are seasonal and are not connected to other water bodies, vernal pools do not host purely aquatic species, such as predators like fish. As a result, they are important breeding grounds for insects and amphibians, such as frogs and salamanders.

Photo by Ryan P. Gordon

Figure 20. The vernal pool in late October, containing plenty of leaves, grasses, and fallen trees to provide cover for and to anchor amphibian eggs next spring.

A Disappearing Stream (and wells dug to tap it)

Photo by Ryan P. Gordon

Walking back east, past the trail spur leading to the quarry and towards the Ricker Library, the trail passes along a shallow stream valley before it crosses the stream on a boardwalk and climbs a steep hill. The valley is filled with sandy sediment very similar to what was seen at the sand pit, described above, and is from the same glacial source. The sand is so clean and permeable to water, that the stream sometimes travels through the ground instead of on the surface (Figure 21). The sand grains here (Figure 22) are of a very consistent size and are “sub-rounded” (meaning just a little more angular than “rounded”), both of which characteristics suggest that they were transported some distance from their source and deposited by flowing water. Homogeneous, rounded grains such as these also give sediments a high hydraulic conductivity, which means that a large volume of groundwater can flow through the material easily. When a useable amount of groundwater can be extracted from a material like this, it is called an aquifer.

Figure 21. A disappearing stream! The sand here is so permeable that the stream has a difficult time staying on top of the ground surface, and repeatedly dives into the ground, only to reemerge tens of yards downhill.

A Disappearing Stream (and wells dug to tap it)

Photo by Ryan P. Gordon

Figure 22. Sub-rounded, homogeneous, fine sand grains from near the disappearing stream.

A Disappearing Stream (and wells dug to tap it)

From the evidence left behind, we see that the people who lived in Poland during the last century knew that this was a good place to find water. Farther down the valley, just below where the trail crosses, there are at least three old wells dug into the sand to tap the plentiful groundwater that is moving down this sandy valley (Figure 23). For centuries, dug wells were a common way to access shallow groundwater in Maine, and many are still in use today (Locke, 2011). Fred Huntress, the Poland town forester, explained that in the past, water from these wells was piped to a creamery that used to exist on Maine Street where the public school is located today. Please be very careful around these wells, and do not let children near them unsupervised!

Figure 23. An abandoned dug well that taps into this sandy aquifer. The water table (represented by the elevation of the static water surface in the well) is very close to the surface of the ground, and similar to the elevation of the water in the stream nearby.

References and Additional Information

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