Maine Geologic Facts and Localities
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Geology of the Frye Mountain Loop, Montville and Morrill, Maine

44° 28’ 21.66” N, 69° 15’ 31.04” W

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Introduction

The Frye Mountain Loop is located in the Gene Letourneau/Frye Mountain Wildlife Management Area (WMA) and includes sections of the Georges Highland Path and Hills-to-Sea Trail. The Frye Mountain area provides an interesting look at both geologic and human history. This area was once mostly farmland, but was purchased by the federal government in 1937 and eventually turned over to the state.

Figure 1. Map of the Frye Mountain area. Red line = WMA boundary; black dashed line = trails; P = parking.
Bedrock Geology

The bedrock (sometimes referred to as ledge) underlying the Frye Mountain WMA was mapped by geologist Stephen Pollock in 2008 – 2011, but continued mapping north and east of this area has resulted in new interpretations of the rocks (West, 2018; Pollock, 2018). Bedrock mapping remains exciting in this area due to the Norumbega Shear Zone - an ancient fault system active approximately 380 to 280 million years ago (West, 1999). It crosses this region from northeast to southwest and provides scientists with a lot of information, including how rocks break during earthquakes (Rowe and others, 2018). Evidence for the Shear Zone lies in mylonite which are rocks that have been stretched and squashed under pressure and high temperatures. The rocks sheared in this branch of the Norumbega belong to the Ordovician Cape Elizabeth Formation (Oce); the zone of mylonite is called the Ray Corner Mylonite Suite. The crest of Frye Mountain and the southeast face are composed of the Scarboro Formation (Os). The Sunny Side fault is shown as a zone of mylonite (ssm) that lies to the east of the trail.

Figure 2. Bedrock geology map. Red line = WMA boundary; heavy black dashed line = trails.
Surficial Geology

Surficial geology (earth materials that overlie bedrock) for most of the Frye Mountain area was mapped in 2013. The Frye Mountain Loop traverses glacial till (Pt) and thin glacial till (areas with horizontal line overlay). Glacial till is a mixture of sediments (from clay and silt to boulders) deposited by glaciers during the last Ice Age. Thick blue lines indicate glacial meltwater paths. Areas that were sculpted and streamlined by glaciers are marked with black lines and indicate that ice flow was generally northwest to southeast. Examples of these materials and other features related to glacial geology will be described at various stops along the loop.

Figure 3. Surficial geology of the Frye Mountain area (from Weddle, 2014). Red line = WMA boundary; black dashed line = trails.
Hiking Tour of Frye Mountain

The Frye Mountain Loop is a moderate but long (about 9 miles) hike. Parking is available off Maine Routes 220 and 137. The hike may be shorted to about 5 miles by leaving a car at each end. If the WMA gates are open, it is also possible to drive in and intersect the trail at various points (consult map links below). A pit toilet is available at the Route 220 parking area. **This is a very popular hunting area so blaze orange attire is a must in fall.** Trails are marked with blue blazes and Hills-to-Sea and/or Georges Highland Path signs. There are several stream crossings – the largest may be avoided with detours marked on the trail. Additional maps and information can be found at [Waldo County Trails](#) and [Georges River Land Trust](#).

**Figure 4.** Lidar hillshade and aerial imagery map of the Frye Mountain Loop with suggested stop locations (numbers). Green line = WMA boundary; black dashed lines = trails; P= parking.
Stop 1: Rock Walls

The Frye Mountain Loop passes over and by many old rock walls, which hint at the geologic and human history. When the area was cleared for farming the cobbles and small boulders that comprise the walls were picked from the fields and stacked around the edges to make working the land easier. The shape and type of rocks in the wall hint that they come from glacial till. Rocks transported in glacial ice tend to be worn into somewhat angular or “faceted” shapes from being dragged over bedrock or other rocks. Take a look – are these rocks erratics? Sometimes old rock walls even show up on lidar topographic imagery.

Figure 5. Lidar hillshade image (left) shows traces of rock walls outlining what was once farm fields. On the right, a picture of one of the many rock walls encountered along the trail.
Stop 2: Bartlett Stream Abandoned Channel

After crossing Bartlett Stream, the trail follows the stream closely and provides views of fluvial features such as the abandoned channel in Figure 6. The area outlined in blue was once the main channel of Bartlett Stream. The stream cut a new path (in background of photo behind trees) and left this channel, probably during a large flood. This channel is now part of the stream’s floodplain and may have standing or flowing water during floods, but most of the time it is dry.

Figure 6. A geologist stands in an abandoned channel of Bartlett Stream (outlined in blue).
Stop 3: Enigmatic boulder?

This large boulder near the trail consists of some very hard quartzite with a crumbly rock on top that may be a fault breccia. The Cape Elizabeth and Scarboro Formations are in fault contact with one another, and the various branches of faults in the later Norumbega Shear Zone have further broken up the formations. This boulder may have tumbled off the mountainside or been transported here by glacial movement.

Figure 7. Photos of an odd boulder near the trail. Is it a clue to the local geology, or was it transported from afar?
Stop 4: Striations and Polished Quartz near Frye Mountain Summit

Frye Mountain’s summit does not boast panoramic views since the fire tower was removed, but a short side trail that leads down the NW side of the ridge has examples of glacial striations and polished quartz. Rocks, gravel, and sand that were frozen to the base of the glacier were dragged across the bedrock here, leaving scratches and grooves called striations and polishing areas of hard quartz. Striation orientation provides evidence of glacial flow direction, which was to the southeast in this area. Run your hands over patches of polished quartz – sometimes tiny striations can be detected.

Figure 8. Striations (left) and polished quartz (right).
Stop 5: Glacial Meltwater Channels

Here the trail crosses two abrupt valleys. The valley bottoms are dry, but there are boulders and cobbles as if there was once flowing water. Lidar topographic imagery confirms that these areas were probably glacial meltwater channels. These channels are easy to spot with lidar because they are often short hillside valleys that seem out of place. A modern stream with a waterfall passes *between* these two channels (see next page).

**Figure 9.** Lidar hillshade image of where the trail crosses two small meltwater channels (left). Dashed black line = trail. Blue lines = channels. Looking down into a meltwater channel on the trail (right).
Stop 5 (Continued): Waterfall

The waterfall near this stop tumbles over rocks of the Scarboro Formation. These rocks are silvery schist, a metamorphic rock containing flat minerals like muscovite and biotite, which are aligned like stacked plates and allow the rock to part easily. You might also see dark spherical garnets if you look closely.

Figure 10. The falls at Stop 5 (left). The shiny silver schist of the Scarboro Formation with garnets (right).
Stop 6

The trail parallels a large cliff of Scarboro Formation schist here. As you inspect the surface, you will see folded white quartz veins and many ruffles on the rock face – this schist was folded deep in the earth under pressure and high temperatures, which soften the rock a bit and allows it to bend without breaking. Over millions of years, all the rock that was once on top of this has been eroded away by wind, water, and glaciers to bring this up to the surface.

Figure 11. Left, the cliffs at trailside. Right, a red line highlights the structure in the rock.
Stop 6: Viewpoint

At the top of the cliffs, there is a view to the southeast with glimpses of the coastal mountains in the distance.

Figure 12. A lovely view of late-fall splendor is a reward for your long hike!


