Introduction

Mount Kineo State Park is one of Maine’s most dramatic features and well worth the trip. The park has about six miles of easy to moderate trails that loop around the perimeter. The observation/fire tower on top of Mount Kineo offers views of Moosehead Lake and the surrounding landscape. This publication provides an overview of the geology that can be viewed from the park trail network.

A trip to Kineo State Park does require some planning. In the summer months, visitors can take a ferry from Rockwood (web search ahead for schedule). When Moosehead Lake has adequate ice in the winter, Kineo is accessible by snowmobile, snowshoes, or skis. Be sure to bring enough food and water for the day, and clothing for a range of weather conditions – there are no public amenities. Primitive campsites and outhouses are available at Hardscrabble Point. If you intend to camp here, plan on potentially windy conditions.

Figure 1. Mount Kineo State Park area. Red star indicates Rockwood boat launch – ferry and lake access here. Blue star indicates Kineo docks. In winter, a snowmobile trail from Rockwood to Kineo is marked when the ice is safe to cross, but always use caution when crossing on ice and watch out for snowmobiles if you are on foot. Please note that land southeast of Mount Kineo (the golf course and houses) is private property. Approximate park boundaries are marked with red line.
Bedrock Geology

There are two types of bedrock in Mount Kineo State Park (Figure 2). The northwest portion of the park is composed of metasedimentary rocks (sedimentary rocks that have undergone some metamorphism) belonging to the Tomhegan Formation (Dto) that are Devonian in age. These rocks are mostly covered by glacial till. The better known rocks that form the sheer cliffs on the southeast side of Mount Kineo are the Kineo Volcanic Member of the Tomhegan Formation (Dtokm) - more widely known as “Kineo rhyolite.” Rhyolite is a felsic extrusive volcanic rock, meaning that it is rich in silica and formed at or very near the earth’s surface from cooling magma. Some geologists refer to Kineo rhyolite as felsite, which is a more generic term for felsic extrusive rocks, but recent chemical analysis of rocks from Mount Kineo have confirmed that it is rhyolite (Putnam, 2012).

Figure 2. Bedrock geology of the Mount Kineo State Park area (from Simmons, 1987).
Mount Kineo was shaped by glaciers during the last Ice Age (Figure 3). As the ice sheet flowed from northwest to southeast, it eroded the up-ice side of Mount Kineo and plastered glacial till, creating a smooth, gradual slope. The down-ice side of Mount Kineo was shaped into a sheer cliff as the bedrock froze to the base of the glacier, which plucked it off and carried it away. Fractures in the Kineo rhyolite likely made it easier for the glacier to “quarry” the rocks. Hills sculpted by glacial abrasion and plucking are often called “rôches moutonnées” - especially if they are completely composed of bedrock. The name rôche moutonnée was devised in the 1700s when these types of hills were likened to popular wigs that were styled with sheep (mouton in French) fat (Benn and Evans, 2010). The Kineo landscape continued to evolve after the glacier was gone. During the winter months, water freezes and expands in fractures, working blocks of rock loose, which eventually tumble down off the cliff and form a slope of rock debris known as talus. Lidar topographic imagery recently revealed a small landslide of unknown age on the north side of the park.

**Figure 3.** Lidar hillshade over aerial imagery of the Mount Kineo State Park area. Approximate surficial geology from Genes and others (1986).
Mount Kineo State Park is interesting at all times of the year, but is most accessible in summer, fall, and winter. Figure 4 provides a trail map with suggested stops. In summer, one can hike a loop around the entire park on the trail network. In winter, the Bridle Trail is the best Kineo summit approach. The Indian Trail and the North Trail approaches are more challenging and are not recommended for winter hiking. A loop may be completed in the winter if there are safe lake ice conditions. Stop photos show a mix of scenery from fall and winter visits.

Figure 4. Trail map of Mount Kineo State Park with suggested stop locations (bold numbers). Red star = summit fire tower; black star = park kiosk.
Park Kiosk

From the Kineo Docks area, go left (west) and you will see the park entrance kiosk. Please note entry fees and park rules. Proceed on the Carriage Road Trail, which follows the shoreline.

Figure 5. Park entrance kiosk. The Carriage Road Trail continues straight along the shoreline.
Langmuir Lines

If you visit Kineo on a windy day in spring, summer, or fall, you may see an interesting water feature known as Langmuir lines as you walk along the shore between the kiosk and Stop 1. When steady winds blow across a body of water, the water near the surface begins to churn and develops into cells of rotating water that are parallel to the wind direction. This rotation is known as Langmuir circulation and creates lines of foam and/or debris where the rotating cells converge.

Figure 6. Langmuir lines on Moosehead Lake, viewed from the Carriage Road Trail on a windy day in fall. The black line indicates wind direction and the blue cylinders illustrate a small portion of Langmuir circulation that has created the foamy Langmuir lines.
Stop 1: Talus Area

Talus (also known as scree) is an accumulation of rocks and rock debris at the base of a slope. There is a large talus deposit at the base of the Mount Kineo cliff. Many of these rocks may have been initially plucked from the mountain by glacial ice. In the thousands of years since the last Ice Age, freeze-thaw action continued to work rocks loose from the cliff. Much of the talus slope is covered with vegetation but the Carriage Road Trail goes right past an exposed area. Please note that climbing on the talus is not recommended. The rocks are loose and may have very sharp edges (a significant characteristic of this rock type that will be explained later).

Figure 7. View of talus deposit along the Carriage Road Trail. Ski poles for scale.
Stop 2: Kineo Rhyolite

Between the talus area and the Indian Trail intersection, the Carriage Road Trail narrows to a small strip between the lake and Mount Kineo, offering a close-up view of the Kineo rhyolite. Much of the outcrop has weathered to a light greenish-grey to brown color and many fractures are visible. Water flows through these fractures and freezes in the winter, gradually prying pieces loose and revealing grey unweathered areas that show the true characteristics of the rock.

![Figure 8](image-url) Exposition of the Kineo rhyolite along the Carriage Road Trail. An unweathered section is circled in red. Camera case for scale.
Stop 2: Kineo Rhyolite (continued)

Figure 9. Water flowing through fractures in the rock drips down the side of this outcrop, forming little ice falls in the winter. Ice formation also gradually wedges the rock apart over time, causing pieces to break off. Ski poles for scale.
Stop 2: Kineo Rhyolite (continued)

Kineo rhyolite formed when felsic (silica-rich) magma began to cool very near or at the earth’s surface. At first the magma cooled slowly, allowing some larger quartz and feldspar mineral crystals (phenocrysts) to form. (Boucot and Heath, 1969). These are visible in the rock with the naked eye or a hand lens. Then the magma cooled very rapidly during a volcanic eruption so the bulk of the rock (groundmass) is composed of silica-rich microcrystals that give it an almost glassy appearance.

Figure 10. Mostly unweathered piece of Kineo rhyolite. Many of the light areas in this piece are not large mineral crystals – they are tiny fractures/chips in the rock.
Stop 2: Kineo Rhyolite (continued)

High silica content makes the Kineo rhyolite break apart in a unique way known as conchoidal fracturing, meaning that the rock does not break along a natural plane of separation. Conchoidal fracturing makes the rock easier to shape, and Native Americans used Kineo rhyolite to create arrowheads and tools through the knapping process, shaping the rhyolite by striking it with other rocks or hard objects (Willoughby, 1901).

Figure 11. Close-up view of unweathered Kineo rhyolite fragment, showing its tendency to form sharp edges when broken. *It can be tempting to bring some of this special rock home, but please do not remove rocks from the park.*
Stop 3: Mount Kineo Summit

There are three ways to approach Mount Kineo’s summit. If it is summer and you intend to loop around the island, you may want to take the North Trail, making the summit your last stop. If it is summer and you don’t intend to hike the loop, the Indian Trail is suitable for those that are okay with steep drop-offs. If it is winter or if you would simply like a more moderate approach, the Bridle Trail is the best option. There is a small overlook on the way to the summit with south/southeast views where the Bridle and Indian Trails meet, but 360° views from the summit are only available from the top of the old fire tower. Use caution on the fire tower, especially in winter or wet and windy conditions.

Figure 12. The Mount Kineo fire tower.
Stop 3: Mount Kineo Summit (continued)

Figure 13. View to the south from Mount Kineo summit.
Figure 14. View to the southwest from Mount Kineo Summit. Glacial action sculpted Blue Ridge similar to Mount Kineo so the up-ice slope is gradual and the down-ice slope is steeper.
Figure 15. View to the northwest from Mount Kineo summit. This view illustrates the gentle, up-ice slope of Mount Kineo.
Figure 16. View to the east from Mount Kineo Summit. Many of the mountains in this view were also sculpted by glacial erosion with gentle up-ice slopes and steeper down-ice slopes.
Stop 3: Mount Kineo Summit (continued)

Figure 17. View to the southeast from Mount Kineo summit. The cluster of mountain peaks in the distant left includes Prong Pond and Lily Bay Mountains.
Boulders

After you return to the Carriage Trail and make your way towards Hardscrabble Point, keep an eye out in the woods for large boulders that were transported by glacial ice. These boulders are also a good clue that the surrounding area is covered by glacial till, which is a mix of sediments (clay to boulder-sized particles) that were picked up, transported, and deposited by glacial ice.

Figure 18. A glacially transported boulder just off the Carriage Road Trail. Ski poles for scale.
Stop 4: Hardscrabble Point

Windy Hardscrabble Point offers extensive views of the relatively flat landscape to the northwest, and side views of Little Kineo and Shaw Mountains. Again we see that these mountains have been sculpted by glaciers, with gentle up-ice and steep down-ice slopes. This is a nice place to stop for lunch in the summer and fall. From Hardscrabble Point, the North Trail continues the loop around the island but it is much less traveled than the other Kineo trails – you may have to navigate through some overgrown vegetation and tree falls.

Figure 19. View to east from Hardscrabble Point.
Stop 5: Landslide

The North Trail goes right across the down-slope edge (toe) of a relatively small (1 ⅓ acres) rotational landslide. The age and cause of the landslide are unknown, but it may have occurred when lake wave action undercut the base of the shoreline bluff which is about 14-18 feet high in the area. This drop to the lake is noticeable when approaching the landslide on the North Trail. The material that failed (slid) is the glacial till that covers the northwest side of Mount Kineo.

Figure 20. Lidar hillshade image of the landslide area. Compare labeled areas with the diagram in Figure 21.

Figure 21. Cartoon 3-D diagram of a rotational landslide (modified from Highland and Bobrowsky (2008)). In this type of landslide, material moves down and out along a curved plane.
Stop 5: Landslide (continued)

**Figure 22.** View down to lake level from the North Trail just west of the landslide. Wave action may have destabilized the relatively steep slope, leading to the landslide. Ski poles for scale.

**Figure 23.** View down into the landslide crater on the North Trail from the west side of the landslide. Edge of landslide marked with dashed line. Ski poles for scale.
Stop 5: Landslide (continued)

Figure 24. View down into the landslide crater from the top of the scarp, which is the steep drop at the upslope boundary of a landslide. This scarp is about 30 feet high. Edge of landslide marked with dashed line. Ski poles for scale.
Stop 5: Landslide (continued)

Figure 25. View of subtle slide blocks in the landslide crater. Slide blocks are chunks of earth material (glacial till in this example) that stuck together and moved as individual units during the landslide. Tops of the slide block ridges are marked with dashed lines. Ski poles for scale.
Figure 26. If ice conditions are safe in winter, hikers can exit the North Trail just before it turns southwest to ascend Mount Kineo and walk out onto Moosehead Lake for a nice view of the mountain and cliffs. The work of glaciers is evident again with this fine view of Mount Kineo’s gentle up-ice and steep down-ice slopes. Ice fishing traps for scale.

To return to the Rockwood area, follow the snowmobile trail that crosses the golf course (see Figure 4). Stay to the side of the trail and keep eyes and ears open for fast moving snowmobiles.
Figure 27. View of the Mount Kineo cliff face in fall from the unnamed Moosehead Lake cove east of Mount Kineo. A steep slope may have existed before the last Ice Age, but it was enhanced by glacial plucking.
References


