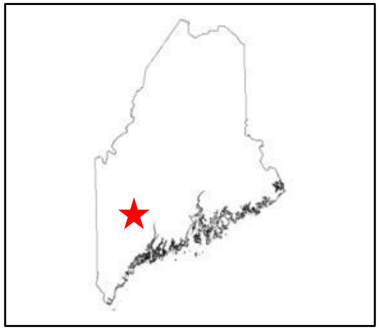
Maine Geologic Facts and Localities

March, 2001

Bald Mountain, Washington Plantation, Maine



44° 38‘ 46.25“ N, 70° 21‘ 0.58“ W

Text by
Robert G. Marvinney

Introduction

Bald Mountain is an outstanding example of an unvegetated mountain summit in western Maine. It is a publicly accessible site that provides excellent exposure of the metamorphic rocks that make up the bedrock of much of this region of Maine and great views of the surrounding mountains. From these exposures, much can be learned about the sedimentary processes that were active as the rocks were deposited and the metamorphic processes that subsequently affected them.

This natural laboratory also affords the opportunity to study the evidence for glaciation in Maine. This evidence includes the broadly rounded surfaces of the bedrock, striations and grooves on the rock surface, and glacial erratics.

Logistics

Permission: This is a popular site for individuals, families, and groups to hike and enjoy spectacular views. Ownership of this property is not known at this time. Inquire locally for more information. However, the site has generally been accepted to be open to the public.

Location: Bald Mountain is located in Washington Township and is shown on the Mount Blue topographic quadrangle map published by the U.S. Geological Survey. The trailhead is accessed from Route 156.

Access: Ample parking for cars or buses is available in the large pullout along the west side of Route 156. There are no toilet facilities at Bald Mountain.

Group size: Large.

Exposure: The top of Bald Mountain exposes broad expanses of bedrock (commonly called ledge).

Sampling: Do not sample the rocks on this or any other private property without landowner permission.

Directions: From the intersection of Route 2 and Route 156 in Wilton, follow Route 156 north through several turns in Wilton. Continue north on Route 156 for approximately 8 miles until you see the large pullout on the left (west) side of the road. This is approximately one mile south of Hills Pond. If you pass the pond on the left, you have gone too far. Buses will need to turn around before parking. This can generally be done just north of the pullout at a dirt road on the left.

Directions

Walking directions: The footpath to the top of Bald Mountain starts at the pullout and immediately crosses Wilson Stream which can be challenging during spring runoff or after rain (Figure 1). The trail proceeds uphill, steeply at times, through mixed hardwood forest. About two-thirds of the way up, the forest abruptly changes to softwoods. Just a short way beyond this begins the scramble over bare bedrock. The total distance is about a mile and, at a reasonable pace, it takes about an hour to get to the top. The total elevation gain is about 1,300 feet.

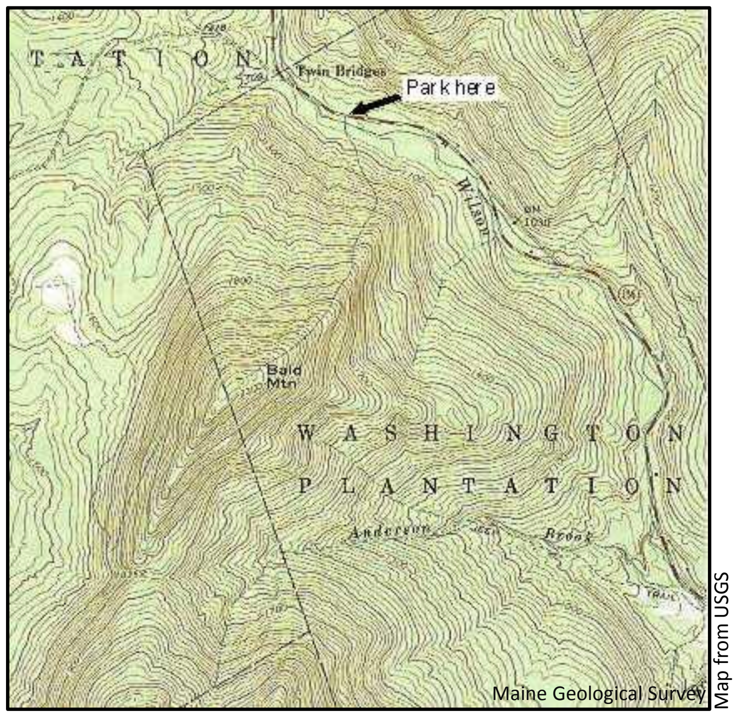


Figure 1. Portion of the Mount Blue 1:24,000-scale topographic map showing the access road to Bald Mountain, Route 156, and the trailhead.

Bedrock Geology

The top of Bald Mountain affords outstanding exposures of the bedrock unit that underlies most of the region. On geologic maps (see Osberg and others, 1985; Pankiwskyj, 1978), this unit is part of the Seboomook Formation, a unit that underlies a large portion of central and northern Maine. The important point here is not the name of the unit but the type of rock and what it tells us about the geologic history of the area. Upon climbing out of the woods, the hiker is greeted by broad pavements of bedrock that have a striking ribbed pattern.

Bedrock Geology

This ribbing is caused by alternating layers or beds of quartzite (a metamorphic rock consisting mostly of quartz) and schist (a metamorphic rock consisting here mostly of mica). Quartzite is more resistant to erosion than schist so layers of quartzite tend to produce the raised ridges in the ribbing while schist forms the valleys (Figure 2). The consistent alternation of the quartzite and schist produces extensive ribbing.

Photo by Robert G. Marvinney

Figure 2. Ribbing in the exposure of bedrock caused by the difference in resistance to erosion of alternating quartzite and schist layers. Note the continuous nature of layering.

Bedrock Geology

Closer examination of the rocks reveals some other interesting clues to their origin. Bedding is generally thin in this unit (1 cm to 10 cm) and is constant over great lengths. The nature of bedding is shown in Figure 3. Several quartzite beds that are about 3-5 cm thick are separated by 5-10 cm of schist. These beds are also graded: the beds have sharp bases and the coarsest material in the bed is at the base. In these examples, the bases of the beds are composed of fine sand. Sand grades gradually upward (towards the top of the picture) to silt and finally to mica at the tops of the beds. The mica originally was clay that was metamorphosed by heat and pressure over the millions of years since the sediments were deposited.

Photo by Robert G. Marvinney

Figure 3. Close up view of bedding. Height of view is 1 meter.

Bedrock Geology

Figure 4 shows another example of graded bedding. The quartzite bed near the top of the photograph has a very sharp base with the underlying schist. It grades upward through finer grain sizes, eventually grading into mica near the top. An interesting point to be made here is that the original sedimentary grading seems to be reversed with the current metamorphic minerals. Now at the top of the bed are coarse mica crystals that grew from clay minerals, originally the finest portion of each bed.

Photo by Robert G. Marvinney

Figure 4. Graded bedding in quartzite.

Bedrock Geology

Another feature that points to the sedimentary origin of the rocks before they were metamorphosed is cross-bedding. Cross-beds are fine layers developed within a single bed. These fine layers are generally not parallel to the base and/or top of the bed and represent rippling of sediment when the bed was formed. Often one set of cross-beds intersects and is truncated by another (Figure 5).

Photo by Robert G. Marvinney

Figure 5. Examples of cross bedding in several beds. The overall bedding is roughly parallel to the moss filled section in the lower mid photograph. Finer layering within the beds is at an angle to this. In several places, the finer layering is truncated by other layers. Field of view is 30 centimeters top to bottom.

Bedrock Geology

Another feature that is fairly common in the bedrock of Bald Mountain is folding. Folds develop in response to forces that compressed the rock after the sedimentary layering was deposited. Figure 6 shows an example of folding.

Photo by Robert G. Marvinney

Figure 6. Typical folds in the layering on Bald Mountain. Field of view is 30 centimeters top to bottom.

Interpretation of Bedrock

The existence of graded bedding, alternating layers of quartzite and schist, and cross-bedding all point to a sedimentary origin for the metamorphic rocks exposed on Bald Mountain. Such features are common in undersea fans where slurries of water and sediment flow down a submarine slope to flatter areas where they slow down and drop sediment. Larger grains generally settle from water faster than smaller grains, resulting in the graded bedding that is so common in these rocks. From this evidence, geologists conclude that the rocks exposed on Bald Mountain were deposited on a submarine slope in an ocean. Each layer of quartzite and schist represents one submarine flow event. It took many events over millions of years to produce the rocks you see exposed on the mountain.

Geologists generally assume that sedimentary layering was deposited in a horizontal position and, with few exceptions, this rule generally holds. On Bald Mountain, layering is tipped up on end. The layering had to be folded from its original horizontal position to its current vertical position. The small folds seen here and there on the mountain are evidence of this episode of folding on a small scale.

Through various means, geologists have determined that the rocks on Bald Mountain are slightly more than 400 million years old. The sedimentary materials were eroded from mountains built when the North American and Eurasian continents collided at that time. The rocks now exposed on Bald Mountain were in the middle crustal level of those ancient mountains and thus subjected to high heat and pressure that metamorphosed clays and other minerals to the micas that are now present in the rocks.

Glacial Geology

The most recent geological episode to have profoundly affected the rocks of Bald Mountain was the last glaciation. At its greatest extent more than 15,000 years ago, this location was covered by at least several thousand feet of glacial ice. About 13,000 years ago this area became ice free, exposing the landscape you see now.

Evidence for this glaciation abounds on the mountain. One of the primary features of glacial erosion is the shape of the mountain itself. It is generally well rounded and streamlined on the north slope and steep with abrupt breaks on the south slope.

Glacial Geology

Pressure from glacial ice advancing from the north smoothed surfaces on that side, but roughly pulled off large blocks from the south side of the mountain. Many of the smaller knobs on the mountain show this same relationship (Figure 7).

Photo by Robert G. Marvinney

Figure 7. Typical knobs in the ledge on Bald Mountain. Rounded surfaces from glacial erosion are generally on the left (north) side and steeper, abrupt surfaces are on the right (south) side due to plucking by the glacier of large blocks.

Glacial Geology

Striations and grooves are everywhere on the mountain. These scratches and troughs formed when rocks bound in the base of the glacial ice were forcefully dragged across the rock surface. Striations are the narrow features and grooves are broader (Figure 8). Striations and grooves cut across the sedimentary layering at high angles.

Photo by Robert G. Marvinney

Figure 8. Glacial grooves and striations in the bedrock surfaces. These features are oriented at high angles to the layering in the rock.

Glacial Geology

Glacial erratics are other evidence of the great glacial episode (Figure 9). Erratics are boulders perched on the bedrock that are of a different rock type than the underlying bedrock. They were carried by the glacier from a source some distance away and deposited on the mountain when the glacier melted.

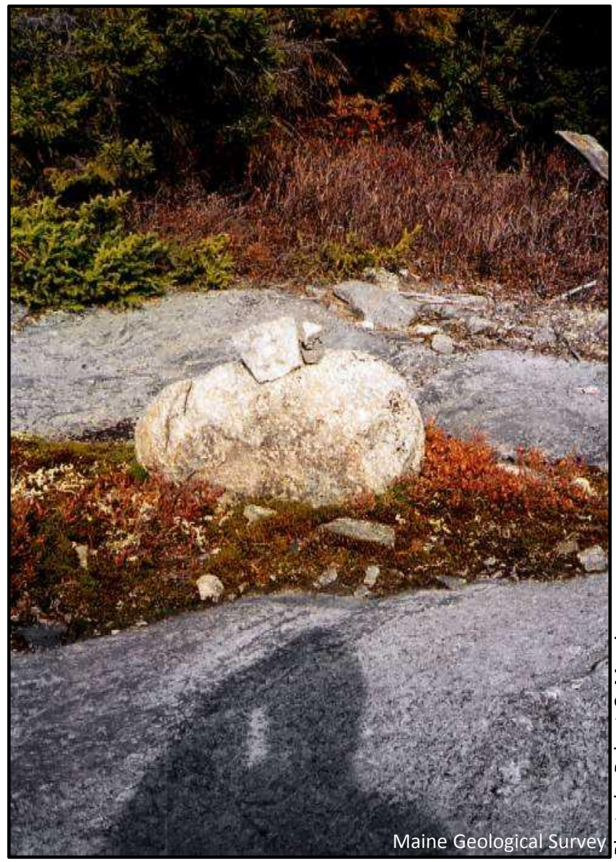


Photo by Robert G. Marvinney

Figure 9. Glacial erratic boulder of granodiorite resting on layered rocks.

Glacial Geology

A common rock type for erratics in this area is granodiorite (a coarse-grained igneous rock containing abundant plagioclase feldspar and quartz). To the north, the entire basin around Webb Lake is underlain with this rock type. Interestingly, in this area the metamorphic rocks are more resistant to erosion than the granodiorite. This is why the glaciers hollowed out a deep basin in the granodiorite at Webb Lake and left a rim of mountains underlain with metamorphic rocks (Figure 10).

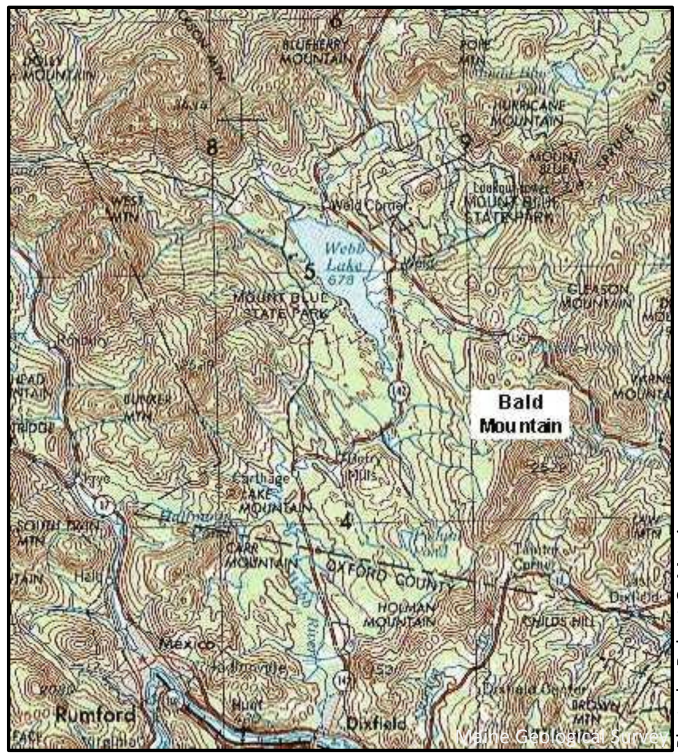


Photo by Robert G. Marvinney

Figure 10. This section of a smaller scale map of the region shows the ring of mountains around Webb Lake. The lake is underlain by easily eroded granodiorite while the ring of mountains is underlain by less erodable metamorphic rocks.

Activities

Climbing the trail to the top of Bald Mountain takes about an hour and along the way there are many interesting things to see. Many boulders of quartzite and schist line the trail as it climbs through hardwood forest. It would be useful to point out the characteristics of these rocks to students before they reach the top of the mountain. About two-thirds of the way to the top, note the abrupt change from hardwoods to softwoods at about the point where ledge is exposed in the trail. This is a useful place to have a discussion about the differences in these types of trees and why there is such an abrupt change.

Once out of the woods and onto bare rock, start looking at the layering or bedding. Is it consistently oriented in one direction? Look for graded beds: these generally have light colored quartzite at the base that gradually changes upward to contain more mica. The tops of beds are generally all mica. Can you find beds in which the grading is in the opposite sense to one another? In other words, are there some beds that show the mica-rich top of the bed on the south side and others that show the mica-rich top on the north side? If so, this would be evidence of tight folding that has turned the flat lying sedimentary layers up on end. Look for cross-bedding in the sedimentary layers. These are fine-scaled layers that are at an angle to the overall orientation of the bed. There are often sets of these that cut across one another and are additional indications of the sedimentary nature of the layers.

Several areas on the mountain show folds in the layers. Find a fold and trace an individual layer around it. Does the thickness of an individual bed change in different parts of the fold? If you find several folds, do they have similar shapes and orientations?

Activities

There is much evidence for glaciation on the top of the mountain. Generally the rounded sides of the many knobs of bedrock on the mountain face in the direction from which the glaciers advanced and the more abrupt side faces away. Look at several of these features and see if you can convince yourself that they all show the same direction of glacial movement.

The most striking features of glacial origin on the mountain are the abundant glacial striations and grooves. Look at several surfaces that show abundant striations. Are all the striations within one exposure parallel? Which way do they point? Do striations in different exposures point in the same direction? Note that as the glacier flowed around obstacles like Bald Mountain, some sections of the glacier may have locally moved in slightly different directions than others.

Find examples of glacial erratics. These are boulders that are of a different rock type than the ledge on Bald Mountain. How many different types can you find? Where do you think they came from?

References and Additional Information

Caldwell, D.W., 1998, The roadside geology of Maine: Mountain Press Publishing Company, Missoula, MT, 317 p.

Osberg, P.H., Hussey, A.M. II, and Boone, G.M., 1985, Bedrock geologic map of Maine: Maine Geological Survey, 1:500,000-scale map.

Pankiwskyj, K.A., 1978, Reconnaissance bedrock geology of the Dixfield 15-minute quadrangle, Maine: Maine Geological Survey, Open-file Map 78-15, scale 1:62,500.