Maine Geologic Facts and Localities
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Marshall Shore Town Park, Liberty, Maine

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Introduction

At the southwest end of Lake St. George, the town of Liberty maintains a small picnic and swimming area. Although there are many camps at this end of the lake, this particular piece of property has bedrock very near the surface so it would be a difficult place for building. A public park is an excellent use for it.

Figure 1. Views of Lake St. George.
Figure 2. The town of Liberty maintains a swimming and picnic area at the southwest end of Lake St. George. Camping is available at Lake St. George State Park on the west side of the lake, beside Rt. 3.
Lake St. George Granite Gneiss
Smooth, bare bedrock ledge is exposed near the swimming area. This is a good place to crawl around and study fascinating features of the rock. It is bleached nearly white on weathered surfaces, though broken pieces show that the fresh rock has a subtle light bluish-gray hue. The most distinctive feature of the rock is a streaked texture that looks something like wood grain. This feature, called foliation (Figure 3) is produced by heat and pressure which cause the minerals of the rock to become rotated and distorted into parallel alignment.

Figure 3. The dark and light streaks running across this photo are due to a fine-scale mineral alignment called foliation.
Foliation in rocks is generated at depth in the earth, over geologic time spans. The process of transforming a solid rock into a foliated rock is called metamorphism. The rock at this site is a metamorphic rock called gneiss.

For the most part, the gneiss has the same mineral composition as granite, namely quartz, feldspar, and black mica (biotite). Furthermore, microscopic study has shown that despite showing ragged and broken edges and other effects of metamorphism, some of the individual feldspar mineral grains retain characteristics typical of feldspar found in ordinary granite. Therefore, this gneiss is interpreted to have been a granite originally, before it was converted to gneiss through the process of metamorphism.

A sample of rock was taken from the blasted area across the road and analyzed in the laboratory. It gave an age of 422 million years old (with an analytical uncertainty of 2 million years), which is at the end of the Silurian Period of geologic time. This is the age of the original granite; the metamorphism must have occurred sometime later.
Lake St. George Granite Gneiss

The ledges at the swimming area are part of an extensive body of this kind of rock, first mapped by Kost Pankiwskyj (1976), and named the Lake St. George Granite Gneiss by Tucker and others (2001). Its northeast end is here in the lake, and it has been traced about 10 miles to the southwest (Figure 4).

**Figure 4.** The Lake St. George Granite Gneiss is a long, narrow rock body extending southwest from the lake. It intrudes the Cape Elizabeth Formation of Ordovician age. Several faults (heavy lines) have been mapped in this region.
Lake St. George Granite Gneiss

White streaks through the gneiss are remnants of dikes or veins in the original granite that were squeezed, stretched, and twisted during metamorphism. The shapes of these lighter colored streaks and stripes give a clue to the amount of distortion this rock has been through. In some places, even the foliation is curved or is cut off against other foliation to produce complicated designs.

Figure 5. The white layer, probably a vein in the granite, has been distorted twice by the metamorphic process. Folds in the lower part of the photo trend left to right, but the younger foliation in the upper part of the photo cuts through the rock diagonally.
Figure 6. A complex pattern of curved and cross-cutting foliation in an area with light-colored veins. (Dark splotches are lichen and dirt on the rock surface.)
Figure 7. Foliation at the top of the photo runs left to right, while foliation in the center of the photo is inclined from upper left to lower right. This is a horizontal rock surface.
Pegmatite Intrusion and Deformation

Near the upper part of the rock exposure, there is a prominent white layer a foot or two thick, running through the gneiss (Figure 8).

Figure 8. Upper part of the swimming area. A prominent white pegmatite layer is at the left side of this photo, near the upper picnic table.
Pegmatite Intrusion and Deformation

The mineral grains in this layer are very large compared to those of the ordinary gneiss. This layer was derived from a coarse-grained variety of granite called pegmatite. The pegmatite intruded the granite before metamorphism, as can be seen from the fact that it is broken and deformed.

Figure 9. A white pegmatite layer, about 1 to 2 feet thick, cuts through the gneiss. Pencil is resting on the left edge of the pegmatite.
Pegmatite Intrusion and Deformation

While the middle of the pegmatite is fairly well preserved, the edge of the pegmatite has been very strongly affected by metamorphism.

Figure 10. Large, white feldspar grains in the pegmatite. Though the middle of the pegmatite is relatively well preserved, broken and rounded grains are apparent. Normally, feldspar grains in pristine pegmatite would have flat sides and rectangular outlines.
Pegmatite Intrusion and Deformation

In places, the margin of the pegmatite has been completely disassembled, and individual large feldspar grains are embedded in the gneiss.

Figure 11. At the edge of the pegmatite, deformation of the rock during metamorphism is particularly intense. A large feldspar grain has broken away from the pegmatite below and been incorporated in the gneiss above.
Pegmatite Intrusion and Deformation

Elsewhere, strings of a few large, harried feldspar grains are all that remain of former thin pegmatite layers. Even isolated single feldspar grains in the gneiss beg the question as to whether they were derived by extreme dismemberment of pegmatite that has been mechanically mixed into the gneiss. By carefully trying to trace these layers through the gneiss, it becomes apparent that this rock has been thoroughly distorted and distended by the metamorphic process.

Figure 12. All that remains of this thin pegmatite layer are two rather beaten feldspar grains and a vague train of small white feldspar bits in the strongly foliated gneiss.
Poegmatite Intrusion and Deformation

Figure 13. A large feldspar grain within what looks like uniform gneiss. Could this be the sole surviving remnant of a pegmatite?
Surface Marks left by the Continental Glacier

Around the corner from the swimming area, in front of the picnic tables, more flat bedrock surfaces extend into the lake. In a few places, especially back from the water where the rock has been protected by soil and vegetation, there are faint scrape marks on the bedrock surface. The marks are approximately parallel to each other and trend toward the south. They were made by stones embedded in the base of the continental ice sheet that moved across Maine during the last Ice Age.

Figure 14. Flat ledges at the water's edge, southeast of the swimming area, where glacier markings can be found.
Surface Marks left by the Continental Glacier

These marks are about 14,000 years old, and indicate that the bedrock surface we see today is a natural surface that is essentially unchanged since that time. Striations and grooves like this can be found on bedrock surfaces across New England. They show the direction the ice was moving, in this case almost due South (177 to 179 degrees). If you visit here, please do not damage the natural marks! After 14,000 years, let's hope they last a hundred more.

Figure 15. The top surface of the gneiss has abundant glacial striations. Notice that modern wave and ice action nearer the water has worn away the glacial marks.
References and Additional Information

