Mount Apatite Park is a 325-acre wooded park located in the western portion of the city. The park offers a wide variety of recreational opportunities not often found in municipal park settings. Rock hounds have known about this area for over 150 years, when the first discoveries of gem-quality tourmaline were found there. Since then, the area has experienced a great deal of mineral exploration, both commercial and amateur. Today amateurs may still search the mine tailings for apatite, tourmaline, and quartz specimens (special rules apply). The park features approximately four miles of trails for non-motorized uses such as hiking, mountain biking, cross-country skiing, and snowshoeing. The Andy Valley Sno Gypsies also maintain a snowmobile trailhead within the park, which links to miles of regional snowmobile trails.The park is open from dawn until dusk year-round. As with all municipal parks, hunting is not allowed within park boundaries. Park brochures, which include a trail map, park rules, and other park information, are available at the Auburn Parks & Recreation Department office, Monday through Friday, 8a.m.-4:30p.m.

Mount Apatite Park, Auburn, Maine

Significance

The Mt. Apatite quarries were important producers of commercial feldspar in the early 1900's. They played a prominent part in Maine's mining history. During the course of this mining activity, rare minerals and colorful crystals of green and pink tourmaline were found in both the Greenlaw and Maine Feldspar Quarries. These quarries also produced many large crystals of transparent smoky quartz. The complexity of the mineral assemblage at Mt. Apatite is matched by only a few other localities in Maine.

These quarries are among a small number of mineral collecting sites in Maine that offer a combination of good public access and the possibility of finding many different minerals. The ledges and boulders surrounding the quarry pits show interesting geological features, including basalt dikes cutting granite pegmatite, and interlayering of pegmatite with metamorphic rock. The coarse pegmatite shows large, easily visible examples of several common rock-forming mineral groups such as quartz, feldspar, and mica. Various features around the quarries illustrate former mining techniques and the linkages between Maine's geologic and human history.

The top of the ledge next to the park trail between the Greenlaw and Maine Feldspar Quarries is an excellent place to show the effects of glacial abrasion. The ledge has been scoured by rock debris dragged along at the base of the moving glacier, forming a flat and polished surface with striations and grooves parallel to the flow direction of the ice. Late-glacial marine sand deposits and dunes composed of windblown sand can be seen at the base of Mt. Apatite.

Logistics


location map

Permission: Mount Apatite Park is owned and administered by the City of Auburn. It is open to the public, and no special permission to visit is required. Further information, including a detailed map of the park and its trail system, is available from the Auburn Parks & Recreation Department (207-333-6601 X2108).

Location: Town of Auburn in the Minot quadrangle. Abandoned quarries within the park are located on the southeast side of Mt. Apatite, north of Route 11/121, between Hatch Road and Garfield Road (see map). Another group of quarries (Pulsifer, etc.) are located on the west side of Mt. Apatite, but these are not open to

the general public and will not be discussed here.

Access: Ample parking for cars or buses is available along park access road. Park next to road, preferably in or near the woods at the base of the hill (road is gated beyond this point). Check at National Guard armory if in doubt about where to park buses, since the large field is armory property. There are no toilet facilities at the quarries.

Group size: Large.


Figure 1

Exposure: The quarry pits have steep rock walls, and some of them are flooded (Figure 1). Caution is necessary in exploring these areas. The big piles of waste rock (dumps) next to the quarries are good places to find mineral specimens, but be careful not to roll rocks downhill if people are below you. The remainder of the park is generally wooded and has a well-developed trail network.

Sampling: Allowed. The park rules state that within the quarry and dump areas, "it is permitted to use hand tools to explore for mineral and gem specimens to a depth of two feet." Recommended equipment: knapsacks or pails, paper for labeling and wrapping mineral samples, sturdy geologist hammers (or equivalent) for breaking rocks, short-handled shovels or other tools for digging, safety glasses, first-aid supplies for cuts, heavy shoes, cameras, food and beverage.

Directions: From junction of Routes 4/100/202 and 11/121 in Auburn, drive west on Rte. 11/121 for 1.9 miles. Turn right onto Garfield Road and go northwest for 0.50 mile. Turn left onto Stevens Mill Road. Go to end of this road, pass National Guard armory, and continue on dirt road across large open field. Park buses next to road on west side of field; cars and vans can park among trees. Walk uphill, staying on the old quarry road, for about 0.4 mile. The Greenlaw Quarry and associated dumps are on the right (north) side of the road; the Maine Feldspar Quarry and dumps are to the left.

Geology and history

The Mt. Apatite quarries were excavated in a type of igneous rock called granite pegmatite (often simply called "pegmatite" in Maine). This is a coarse-grained variety of granite in which the individual mineral grains are very large. They may be several inches - or even more than a foot - in diameter. The most abundant minerals in the pegmatite are creamy white microcline (feldspar), glassy gray to white quartz, and flat sheets of shiny muscovite (mica). Muscovite is very distinctive because the larger pieces can be split easily into thin transparent sheets. This property is called cleavage. It occurs along planes of weakness in the molecular structure of a mineral. Muscovite and other species of mica have one direction of excellent cleavage, while the feldspars have two directions of cleavage (at right angles) which are not always obvious. Quartz lacks cleavage and breaks along jagged irregular fracture surfaces.

These quarries have a long history of mineral production. They were operated commercially as a source of feldspar during the early 1900's (Perham, 1987). This mineral is used for making china and other ceramic products. The feldspar from Mt. Apatite was hauled to a nearby mill built in 1897 at Littlefield Station in Auburn. Here it was ground to a fine powder and readied for industrial use. Besides the pits themselves, a few other remnants of quarrying are still visible. From the stone wall next to the entrance road, you can look down into an old trench cut in the bedrock. This probably was excavated to drain water from the quarries. Groundwater seeps into many of the quarries in Maine, and had to be drained or continually pumped out to keep the workings dry.

Figure 2

During feldspar mining the quarry workers sometimes encountered rare and unusual minerals. (The mountain is named after a phosphate mineral called apatite, which was found as beautiful deep purple crystals at the Pulsifer Quarry on the west side of the hill. See Figure 2). These minerals might be put aside to be sold to museums and gem cutters, but in other cases the superintendents discouraged such activities because they did not want to slow down the mining operation. Crystals of some minerals such as beryl and garnet were encased within the solid rock. Other crystals, including quartz and valuable green and pink tourmalines, were found in cavities in the pegmatite. These "pockets" are natural open spaces where concentrations of gas or liquids containing rare elements remained late in the cooling history of the granitic magma. Fine transparent crystals had the best chance to form in this environment, though they were often shattered by explosive pressure changes as the rock cooled. King (2000) provides a detailed history of mining and mineral discoveries at Mt. Apatite.

Figure 3

Masses of a lilac-colored lithium mica (lepidolite) typically occurred in the vicinity of tourmaline pockets. You may find pieces of this colorful mica on the dumps of the Greenlaw Quarry, which are strewn through the woods on your right as you enter the quarry complex. You will see lots of shallow holes that mineral collectors have dug in the rock piles. The Greenlaw dumps are also the most favorable area in which to find traces of green and blue-green tourmaline (Figure 3), though collectors have already gathered up most of the obvious pieces. Black tourmaline (resembling lumps of coal) is more likely to be found, along with glassy dark-red chunks of garnet and fern-like growths of muscovite mica. Some of the pegmatite is "graphic granite" in which stringers of quartz form curious geometric intergrowths with feldspar.

A variety of surficial deposits (unconsolidated sediments which overlie bedrock over much of Maine) can be seen as you approach the quarries. The flat cleared area around the armory consists of sand, which is visible where the ground surface is unvegetated. In the woods west of the field, there are low mounds which are likewise composed of sand. However, after the road crosses the small swampy area and starts climbing the hill, the surface of the hillside is littered with boulders. The probable origins of these deposits are discussed below.

Interpretation

The granite pegmatite at Mt. Apatite resulted from cooling and crystallization of a body of magma. This mass of molten rock was enriched in water and rare elements, giving rise to the variety of rare minerals found in the quarries. The source of the melts that produced the pegmatite veins in southwestern Maine continues to be debated: were they offshoots from magma intrusions that cooled and formed granite bodies such as the Sebago pluton (igneous model), or did they form when local metamorphic rocks were heated to the point that partial melting occurred (metamorphic model)? These two processes are not mutually exclusive, since magma from a distant source may intrude and melt the surrounding metamorphic rocks, producing locally derived granitic magma.

According to the traditional igneous model, during the cooling of a magma of granitic composition, many rare elements tend to concentrate in the final residual melt because they do not fit well in the structures of the ordinary rock-forming minerals formed earlier in the crystallization process. The presence of water both lowers the crystallization temperature of the melt and facilitates the migration of these elements and their concentration in the final parcels of magma, which may intrude fractures in adjacent rocks and finally solidify to form pegmatites.

Mineralogists who study the origin of New England pegmatites are comparing the chemistry of these rocks with the surrounding host rocks (commonly metamorphic)

and with nearby granite plutons. The pegmatites in the Auburn area are part of a large swarm (Oxford pegmatite field) concentrated around the northeast margin of the Sebago pluton (Wise and Francis, 1992). This suggests a genetic relationship between the granite body and pegmatites.

Creasy (1979) has mapped the bedrock on Mt. Apatite as "heterotextural granite", a map unit which may include both pegmatite and regular granite complexly interlayered with metamorphosed sedimentary rocks. He concluded that the Sebago granite, and presumably the associated pegmatites as well, were derived from melting of the metamorphic rocks. Thus, Creasy's findings support the metamorphic model for the origin of the Mt. Apatite rocks. Simmons et al. (1995, 1996) likewise favor a metamorphic origin for Maine pegmatites, based on textural and geochemical evidence. Assuming the same age as the Sebago granite, the pegmatite on Mt. Apatite would have formed around 293 million years ago, in late Carboniferous time (Tomascak et al., 1996).

The surficial sediments on Mt. Apatite are much younger than the bedrock. They probably formed during and just after the most recent glaciation, between about 25,000 and 13,000 years ago (Marvinney and Thompson, 2000). The bouldery material draping the hillside is rock debris (till) deposited directly from glacial ice. Till is a more-or-less random mixture of clay, silt, sand and rock fragments that the ice sheet eroded, transported, and then redeposited. Large angular boulders scattered across the ground often indicate the presence of till beneath the surface cover of soil and vegetation.

The effects of glacial erosion are nicely displayed on the large horizontal ledge surface next to the trail, where it passes between the quarry pits. During the maximum phase of the last glaciation, the ice flowing across this area was several thousand feet thick. Sand particles and rock fragments at the base of the glacier were dragged over the ledge under great pressure, "sand papering" the rock surface until it was flat and smooth. In this case the ledge is actually polished - notice how it reflects sunlight when viewed at certain angles. Individual rocks dragged across the ledge produced parallel scratches. The narrow ones are called striations, while the deeper and broader furrows are called grooves. These scratch marks are oriented from NNW (340 degrees) to SSE (160 degrees), parallel to the flow of the glacier. By themselves, they do not tell us which way the glacier moved, but they indicate two possibilities: toward the north-northwest or toward the south-southeast. From other types of evidence, such as the transport direction of rocks from known sources, we can safely infer that ice flow in this part of Maine was generally southward, and 160 degrees is presumed to have been the direction of ice flow across Mt. Apatite.

As the last glacial ice sheet withdrew from Auburn, areas below about 350 ft in elevation were submerged by the sea. This happened because the earth's crust was depressed by the weight of the ice. The depression persisted for a short time after glacial retreat, allowing the sea to extend inland and flood low-lying areas as the ice margin receded. Fine sediments washed into the ocean and formed the low flat sand plain seen in the field around the armory. The direction from which the sand came is not obvious. The Taylor Pond basin, just north of here, is slightly lower and there is no apparent source in that direction. The sand is more likely an offshoot of the sand plain that follows the nearby Little Androscoggin River valley to the west and south. The elevation of this plain (250-260 ft) is lower than the upper limit reached by the sea, so the plain probably formed when the ocean was receding.

When the land was uplifted in early postglacial time, the marine sands were blown about by the wind and formed the mound-shaped dunes in the woods. Since the prevailing winds were from the west, some of this sand may have blown in from the Little Androscoggin River valley.

Suggested itinerary, activities, and discussion questions

After parking at the west edge of the field, examine the sand plain in the field near the armory (Site 1 on location map). If this sand was deposited by a flowing stream, what does its fineness suggest about the stream velocity (fast or slow)? Compare the topography of the sand plain with the dunes where you enter the woods (Site 2). How do they differ? (Keep in mind that there has been some human disturbance of the ground in this area.) If the insides of the dunes were exposed, what characteristics you look for to tell if they were formed by wind or water?

Walk west on the woods road leading to the quarries. Just beyond a small wetland (on left), the road starts to climb. Note the boulders on the hillside (part of the glacial till), in contrast to the sand on the valley floor. If time permits, examine a few of these boulders and see if they resemble the rock types exposed in the quarries. Are there any erratic boulders that were glacially transported from other bedrock source areas?

Continue uphill, staying on the main road until reaching the quarries. You will come to a short stone wall on the left side of the road (Site 3). From this point is seen a trench that was cut into bedrock during quarry operations. Perhaps this was done to drain water from the quarry pits? There are very few buildings or other structures remaining at the old mine sites in Maine, so it is challenging to try to reconstruct details of the mining operations from clues that can still be seen. This is the domain of industrial archaeology. Can you find other evidence of mining techniques around the quarries, such as drill holes in the rock or support structures for booms used to hoist the freshly mined feldspar? Some good historical photos of Mt. Apatite mining have been reproduced by King (2000). For those interested in mining history worldwide, a useful Web site is maintained by the Mining History Network.


Figure 4

Just past the stone wall, there is a smooth flat ledge in the clearing on the right side of the road (Site 4). This is a great place to see glacially abraded and polished bedrock, with striations produced by stones dragged across the ledge at the base of the ice sheet. Although there are many such glacially smoothed ledges in Maine, weathering has often destroyed the striations on rock surfaces that have been exposed for a long time. Pegmatite ledges such as this one contain quartz and other hard minerals that tend to preserve striations better than crumbly rock types. Sometimes we can reveal striations that are not immediately evident. Take a hard pencil (H3), pick a very smooth place on the ledge (on polished quartz or the creamy white feldspar), and rub the pencil transverse to the visible striations. This is like taking a charcoal rubbing from a gravestone image. With a little practice and close scrutiny, you will see that the striations show as white lines in the areas smudged by the pencil lead (Figure 4). (Hint: keep a sharpener handy!) Geologists often use this technique on smooth ledges where the striations are not so obvious as they are here.


Figure 5

The group of pits on the north (right) side of the road are the Greenlaw Quarry. The single large pit to the south is the Maine Feldspar Quarry (Site 5). Walk down to the water's edge in the Maine Feldspar Quarry and look across to the high west wall. This face shows metamorphic rock overlying lighter-colored pegmatite (Figure 5).

Figure 6

Continuing up the road between the quarries brings you to a set of stone steps. Just to the right of these steps is a low rock face that at first resembles a stone wall (Site 6; Figure 6). Look closer at this densely fractured bedrock, and you'll see that it's a dark, fine-grained rock called basalt. The basalt forms a vertical vein crosscutting the surrounding pegmatite, with a trend of 055 degrees (NE). Igneous rock veins such as this one are called dikes. Looking closely at the dike, remnants of pegmatite are still attached to the side facing you. Compare the grain size of the basalt with the pegmatite. What does this suggest about cooling rates in the two magma bodies? Which is younger, or did they crystallize at the same time?

Note that the stone steps have been imported from somewhere outside the quarry. They are made of fine-grained gray granite and have drill holes on the edges. These granite slabs look like the foundation stones of many older houses and barns in the area, and may have come from a former home site. Farmers in southern Maine often exploited local granite ledges, or even large boulders, to obtain foundation stone. They took advantage of natural fractures in the rock to facilitate breaking off the slabs. Drill holes in hilltop ledges are evidence of this activity.

Climb the steps to a viewpoint on the north side of the road. This overlooks another old quarry pit which is mostly dry. Look at the boulders placed next to the pit rim. One of them shows a black basalt dike cutting through pegmatite. The margin of the dike shows very fine-grained texture due to chilling in contact with the adjacent rock. Are there any other rock types among the boulders here?

Figure 7

Return back down the road, past the rock wall, and turn left to visit the rock piles next to the Greenlaw Quarry (Site 7; Figure 7). This is a good area to gather a collection of minerals for yourself or your school. Unknown minerals can be brought home and researched with the help of mineral identification guidebooks. Keep in mind that the photographs in many nature guides tend to show ideal or beautifully crystallized minerals, which unfortunately are not typical of what we usually find!

Figure 8

The common minerals at the Greenlaw are described above. They include milky and smoky quartz, feldspar species (microcline and albite), muscovite mica, black tourmaline, and garnet. Two other micas - black biotite and purple lepidolite - can be found, along with fragments or small crystals of green and blue tourmaline. You may be lucky and also find some of the many rarer minerals that have been discovered here. To access another collecting site, continue back down the road and turn right (south) to the huge dump pile from the Maine Feldspar Quarry (Site 8;Figure 8). Many garnets are found here. Thompson et al. (1998) list 39 mineral species that have been reported from the Greenlaw and Maine Feldspar Quarries.

Additional resources

Looking at exhibits in museums, and at shows and stores where minerals are sold, is a good way to get acquainted with them. Students may find that an interest in minerals leads to a career in the earth sciences or a satisfying lifelong hobby. Local mineral clubs conduct meetings and field trips, and club members are usually very helpful to beginners wishing to learn more about the hobby and mineral recognition. For information on the Federation of Maine Mineral and Gem Clubs, contact Scott Davidson (Pres.) at (207) 933-3517.

Acknowledgments

Prof. William B. Simmons (Department of Geology and Geophysics, University of New Orleans) reviewed the text and provided helpful comments on the origin of pegmatites. We are especially grateful to the City of Auburn for keeping this important Maine mineral locality open to the public.

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Present.....

Mount Apatite is actually a group of quarries, Maine Feldspar and Greenlaw Quarries are owned by the city of Auburn. Entrance to Mount Apatite Park is off of the Steven Mills Road Extension.

The Parks Department asks that you park at the ballpark as no motor vechicles are allowed in the park. At the main entrance you will see a gate with a large stop sign, this is the main access road. From the gate, it is a 1/4 mile hike to the main quarry.

The Maine Feldspar Quarry is the larger quarry with dip, and the Greenlaw Quarry is hollow and spread out. The quarry is about 20 feet deep, so young children should not be there unsupervised. There are ledges in the area that are quite steep.

The park is open year round from dawn to dusk. There is no over-night camping, fires, or swimming allowed. Only hand tools are permitted, which can be used to a depth of two feet in exposed mineral areas.

Anything you may discover, you can take home with you.

What has been discovered.....
Past.....

Did you know there is a history of Mount Apatite?

Exploratory mining of this area began as early as 1868. In the early 1900's it was a big mining operation, mined for it's **feldspar.** Other minerals to be discovered there have been apatite, garnet, quartz crystals and beautiful tourmaline gems.

One such story is as follows:

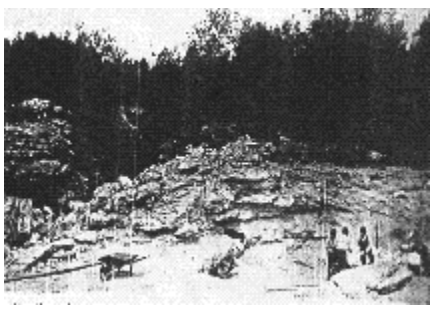
"The tourmaline pocket found by the miners in 1927 is absolutely unforgetable. They had approached an area in the ledge which appeared to contain a large quartz pocket. To avoid having to spend a great deal of valuable time clearing out this pocket area, the miners exploded six cases of dynamite in the outer reaches of the pocket.

To their horror the explosion resulted in a showering of bits and pieces of tourmaline that covered a wide area of the quarry. Judging from the size of the fragments, it seemed likely that this pocket contained some of the largest and finest tourmaline crystals ever found at Mount Apatite.

It soon became obvious that gem watermelon crystals predominated in he pocket contents. The miners also picked up gem tourmaline pieces that were an inch or larger in size."

from: Maine's Treasure Chest

Author, Jane Perham



By the time this photo was taken in June of 1913,

a tremendous amount of feldspar and a small quantity of

gem material had been removed from the Maine Feldspar

Quarry

Coutesy U.S. Geological Survey D.B. Sterrett 503

The Peary Necklace

On exhibit at the Maine State Museum

Noted arctic explorer and Maine resident Robert E. Perry had this necklace made for his wife Josephine for her 50th birthday in 1913. Created by a Portland jeweler, the Peary Necklace contains ten perfectly color-matched tourmalines mined at Mount Apatite and set in gold panned from the Swift River. Regarded by many as the most beautiful piece of jewelry ever crafted from Maine gem stones, the necklace was donated to the museum by the Perry's daughter, Marie Peary Stafford in 1964.

Future.....

In 1991 there was a Mount Apatite study done, commissioned by Mayor Trafton, due to a grant issued by the Land & Conservation Act. An advisory committee was put together on how to best use the park.

Since then, there has been a multi-use trail built which is 3.1 miles long,for hiking and cross-country sking. The Snowmobile Club keeps the trail groomed in the winter.

There is a trail map available at the Parks & Recreation Department, and also a manual on trail etiquette and park guidelines. New signs have been posted in park, and a new trail will be built, defining the boundaries of quarry.

For more information about Mount Apatite Park contact the Auburn Parks and Recreation Department at (207) 784-0101

For more history about Mount Apatite visit the Auburn Historical Society. Mount Apatite is truly one of Auburn Maine's wonderful treasures!

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http://www.taylorpondassociation.org/index.php?section=13
http://www.androscogginlandtrust.org/
http://www.eteamz.com/asll/
http://www.andyvalleysnogypsies.com/
http://www.latrails.org/

http://www.youtube.com/watch?v=BQVSeGDuAU0

Mount Apatite Park

Blue blazes mark the multipurpose trail that loops the park. Hiking, biking, snowshoeing and skiing are allowed on the trails, but no motorized vehicles. Getting there: From Minot Avenue in Auburn, heading west, turn right on Hatch Road, continue approx. 2 miles turn right on Small Rd. and proceed to end. The trail begins by following blue blazes to right or left depending on which way you do loop. For more information, including a printed map, contact the Auburn Recreation and Parks Department at 784-0191. Distance is approximately 5K or 3 miles.