Adirondack Research Consortium

Field Trip

Whiteface Mountain, NY

Atmospheric Science, Geology, Alpine Ecosystems

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The Atmospheric Sciences Research Center

The Atmospheric Sciences Research Center has operated the Whiteface Mountain field station since 1961. This station is a rural mountain top site located in the Adirondack Mountains of northern New York State at an elevation of ~1500m (~ 90m above tree-line). The mountain is a tourist attraction and open to the public from approximately April through October.

The main facility is located at 600m msl on a shoulder of Whiteface Mountain properly known as Marble Mountain and includes extensive laboratory and instrument space, offices, and a lecture hall. At the summit (1500 m) ASRC maintains a three-story observatory. The summit building which sits atop Whiteface Mountain is reached via a 426 ft long access tunnel dug approximately into the center of the mountain and met by an elevator which is 276 ft in height. The tunnel entrance is from the summit parking lot, an area accessible by a paved controlled access highway.

Although Whiteface Mountain is not high by western U.S. standards, the summit is located above the timberline and experiences most of the unusual and interesting weather phenomena which occur at much higher elevations.

The observatory at Whiteface Mountain is home to a large array of instruments. Many of these measure chemical species both in the gas phase and dissolved in cloud, fog and rain water. The continuous surface ozone measurements provide one of the longest continuous records of ozone. Many researchers use this data to examine changes in that critical species as it relates to Air Quality studies. Other gas phase measurements include carbon monoxide and various nitrogen oxides. Further, hydrogen peroxide and formaldehyde as well as hydrocarbons are monitored. Whiteface Mountain is also a measurement site in the PMTACS-NY program in order to collect data about PM mass and composition.

http://asrc.albany.edu/observatories/whiteface/whiteface.html

Many thanks to Paul Casson for leading this portion of the trip.

Geology

The bedrock geology of Whiteface Mountain is dominated by anorthosite and related coarse metamorphosed igneous rocks. Anorthosite is the igneous rock that holds up the topography of the major High Peaks summits of the Adirondacks. The anorthosite exposed at Whiteface Summit is the so-called "Whiteface Facies" which is a coarse-grained rock made up of white to gray of plagioclase feldspar and dark minerals such as hornblende, pyroxene and garnet. Crystals of plagioclase (a moderately calcium-rich variety called andesine) dominate the rock. Some parts of the rock are richer in dark minerals and are properly called gabbroic anorthosite. Rocks of this family formed from melts derived from the earth's mantle.

The anorthosite of the High Peaks region, and here at Whiteface, intruded into older crustal rocks about 1155 million years ago. These older rocks include metamorphosed igneous and sedimentary rocks that were already deformed by previous tectonic events. Rocks in the vicinity of Lake Placid Village are part of this older, pre-anorthosite suite.

The Whiteface variety of anorthosite shows the effects of even later metamorphic events, which caused the growth of garnet, and produced the layering which is evident at some places here at Whiteface. This layering produces rocks called gneisses, and is the result of physical compression and deformation of the rock. These intrusive and metamorphic events took place during the so-called Grenville Orogeny, a major super-continent forming event that lasted from 1300 to 1000 million years ago. At this time, eastern North America was surrounded by other continental masses, forming the supercontinent Rhodinia. Rhodinia split apart beginning about 750 million years ago, and some of the major faults that produce long NNE-oriented valleys are likely related to this rifting event, and even younger faulting episodes. Some modern faulting occurs at depths in the Adirondacks, producing earthquakes.

The calcium-rich plagioclase of the anorthosite provides modest buffering of acid precipitation, but the massive nature of the rock makes chemical weathering, and therefore buffering, proceed rather slowly. The resistant nature of the rock also promotes landslides on steep slopes because of shallow soils and limited root penetration by trees.

Large (3-6 cm) crystals of plagioclase in anorthosite gneiss. These large crystals may be relics from a coarse anorthosite that was deformed and metamorphosed. The finer, white plagioclase in the gneiss was derived from these large, coarse crystals. Dark minerals are hornblende.

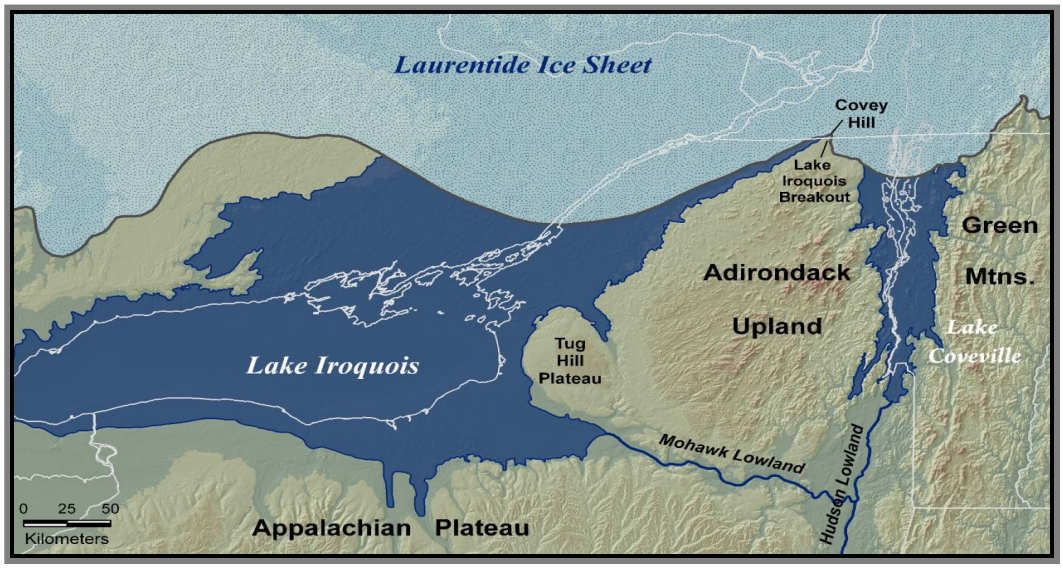
Random anorthosite facts:

- The lunar highlands are made of anorthosite.
- Anorthosite from the Adirondacks was used widely as an ornamental building stone in the New York State capital mall in Albany.
- Anorthosite separates from gabbroic magma near the base of the crust by crystal floatation since plagioclase is less dense that the more mafic constituents of gabbro. The buoyant mush of crystals and melt then rises up into shallower crustal levels.

The modern topography of Whiteface Mountain and the High Peaks region is a product of the interplay between erosion forces of wind, water and ice, and the resistance of the bedrock beneath. Prior to the Pleistocene glaciations that began about 1.8 million years ago, the region had undergone broad uplift and erosion by streams carved out valleys along fault zones where the rock was weakened by fracturing and weathering. The glacial advances of the Pleistocene completely covered the High Peaks by ice. We know this because boulders of rock derived from the north are found as erratics on the bedrock summit of the High Peaks.

The last glacial advance and retreat is termed the Wisconsin, and that event again caused significant erosion of weaker rocks, and deepened and widened valleys. As the ice began to melt from the maximum advance (about 25,000 years ago), the High Peaks were slowly exposed. By about 14,000 years ago, much of the higher terrain of the Adirondacks was ice-free, but ice remained in the northern part of the range, and in the St. Lawrence Valley. This ice blocked the drainages to the northeast, and for a period of time the Great Lake drainage was through the Mohawk-Hudson. Eventually this ice dam was breached, and flow out the St. Lawrence was established. During this melting and retreat of the ice sheet, significant deposits of gravel, sand and mud were laid down as sheets of till, outwash, moraine and glacial lake sediments. The lake sediments in some cases were deposited in areas now prone to landslides, such as the Keene Valley area.

Here on Whiteface, most of the glacial features we see are erosional, including the bowl-shaped depressions beneath the summit that have very steep upper slopes. This features likely formed as small cirques, or ice-carved depressions, very late in the glacial history when small ice fields remained at the highest elevations in the High Peaks.



Ice margin and drainage pattern about 13,400 years ago.

Diagram from Dave Franzi, SUNY Plattsburg.