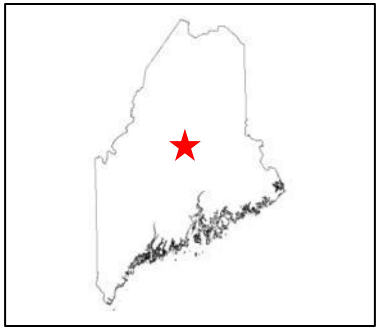
Maine Geologic Facts and Localities

September, 2003

The Iron Age of Maine - 1800's - Katahdin Iron Works



45° 26‘ 42.77“ N, 69° 10‘ 27.25“ W

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Introduction

About 11 miles east of Dover-Foxcroft and 5 miles north of Brownville Junction you come to a sign, pointing up a dirt road, which reads Katahdin Iron Works State Historic Site. Driving up this dirt road you then come to two unusual stone and brick structures. One is a domed structure looking like a beehive or igloo (Figure 1); the other, a tower-like structure (Figure 2). These structures are all that is left of a prosperous iron-producing operation which took place here, and elsewhere in Maine during in the 1800's.

Figure 1. Brick kiln at Katahdin Iron Works.

Katahdin Iron Works

During the 19th century, mining activity in Maine focused primarily on the search for silver. But during this same time interval, a search for iron localities occurred, and a handful were discovered. Notable sites were located in Pembroke, Clinton, Newfield/Shapleigh, and the largest of them all at the Katahdin Iron Works locality. All of these locales set up forges to produce "pig iron," which was then used to produce cast iron. The primary use of the Katahdin Iron Works cast iron was to make rail car wheels and wire. Most of the furnace operations in Maine were on a very small scale, except for the one at Katahdin Iron Works, which was a large and thriving operation from 1840 to 1890.

Photo by J. Poisson

Figure 2. Furnace at Katahdin Iron Works.

History

The precursor to the Katahdin Iron Works, the Pleasant River Iron and Steel Company, named after the river which ran through the area, was founded and incorporated in 1836 by a group of Maine residents (Eastman, 1967). Nationally rising iron prices may have encouraged the group to proceed with this venture. However, a nationwide depression occurred, and the ironmaking endeavor of the Pleasant River Iron and Steel Company did not proceed further than the purchase of some land. A new group of inventors took over and incorporated as the Maine Iron Company in 1841. Samuel Smith of Newmarket, New Hampshire, and his son, Edward Smith of Bangor, were the heads of this new company. In 1843, the Smiths had purchased most of the land in the township and were ready to begin construction of the iron works. A road was built into the site allowing the construction of the forging operation and development of a settlement, named Smithville.

Photo by J. Poisson

Figure 3. Furnace at Katahdin Iron Works.

History

The blast furnace was the most important part of the iron works. A dam was built across the West Branch of the Pleasant River providing the water power to operate a large air pump (bellows) which supplied the blast of air for the furnace. Several large brick ovens (kilns) (Figure 4) were built where hardwood could be turned into charcoal, and several storage sheds were constructed to store the charcoal and limestone used in the operation. The blast furnace had only been in operation for a short period of time when the Smiths sold the business to David Pingree in 1845 for $100,000. (Eastman 1967).

From Katahdin Iron Works

Figure 4. Charcoal kilns at Katahdin Iron Works (from Katahdin Iron Works website).

History

Pingree chartered a new corporation, the Katahdin Iron Works, early in 1846. He named it after Mount Katahdin, which lies thirty-five miles to the north. He hired an operations manager, found an experienced iron founder to run the blast furnace, and hired Dr. Charles T. Jackson, the first state geologist of Maine, to survey and test the ore deposit. Improvements were made at the site with the construction of new charcoal kilns and storage sheds, along with a new wood yard. A new store and several new houses were also constructed. By 1850, the company town of Katahdin Iron Works had a population of 160, including wood choppers, miners, and smelters. Pingree was the principal stockholder and president, and ran the company until his death in 1863 (Eastman, 1967).

Others continued the operation sporadically until 1890. In 1872, Owen W. Davis purchased the Katahdin Charcoal Iron Company at Katahdin Iron Works. He managed this property until 1887 and he built the Katahdin Iron Works Railroad, twenty miles in length. The railroad helped the Katahdin Iron Works reach it's peak production in the 1880's, with 18-20 tons of pig-iron being produced daily. In 1884, during the height of operations, the village had grown to include homes for 200 workers (Eastman, 1967).

History

During the late 1880's, new steel mills were developed which used the blast furnace to supply molten pig iron directly to the steel-making furnaces. This allowed the steel-making operation to take place at one site, alleviating the need for the extra cost of transportation of the raw material to the furnace. A remotely located iron works, such as Katahdin Iron Works, was put at an economic disadvantage due to its remote location and high transportation costs. Furthermore, the small amount of poor quality ore remaining at Ore Mountain could not compete with the vast new and richer iron deposits discovered in the Lake Superior District (Hanson and Sauchuk, 1991). All of this made the Katahdin Iron Works operation outdated and uneconomical, and it ceased operation in 1890.

Exploration of the sulfide portion of the ore body by the General Chemical Division of the Allied Chemical Corporation began in the late 1920's. Allied Chemical held on to the property for many years as a potential sulfur reserve. In the 1970's, Superior Mining Co. conducted an exploration program for economic concentrations of metals within the deposit (Babitzike and others, 1978). This project involved deep drilling. The most recent drilling activity took place during the winter of 1989-1990. No exploration is being conducted at Katahdin Iron Works at this time.

Katahdin Iron Works - Description of Operation

As stated in the introduction, some remnants (kiln and furnace) of the Katahdin Iron Works operation still exist. The stone furnace (Figure 2) was once attached to a group of buildings that comprised the iron-making operation. Figure 5 is a photo taken in the late 1880's, showing the Katahdin Iron Works operation, with each segment numbered for identification and description.

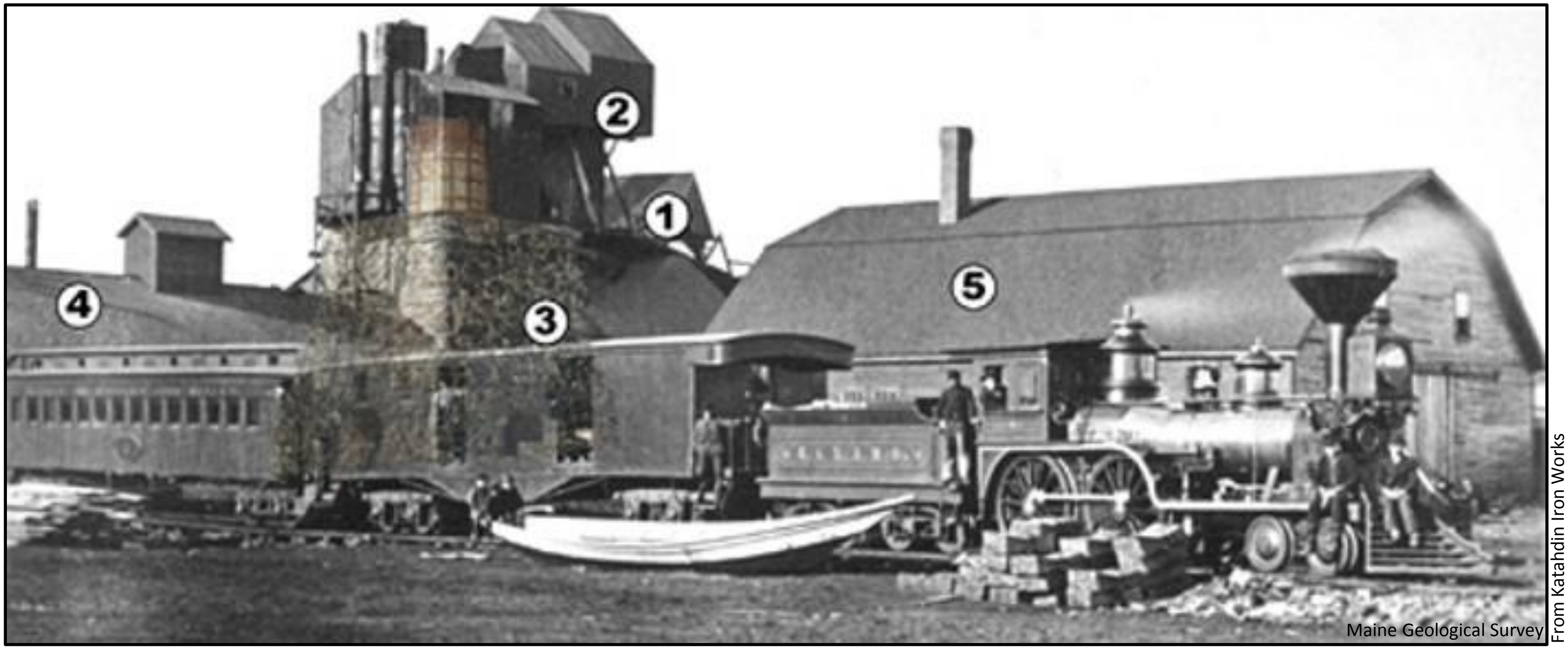

Figure 5. Building complex at Katahdin Iron Works showing ore kiln (1), top houses (2), furnace (3), casting shed (4) and storage barn (5) (from Katahdin Iron Works website).

Katahdin Iron Works - Description of Operation

Once the iron ore was mined from nearby Ore Mountain and transported to the Katahdin Iron Works, it was prepared (crushed) for smelting in the ore kiln (1), before being dumped into the furnace through the top houses (2). Once in the blast furnace, the iron ore was heated and reduced to molten iron. The heat was provided by burning charcoal produced in brick kilns (Figure 1). The surrounding forests supplied thousands of cords of wood annually, which were easily converted to charcoal in large beehive-like kilns (Figure 4). Water from the West Branch of the Pleasant River was used to power the bellows which pumped air into the furnace (Figure 6) and increased the temperature to melt the ore. Limestone was mixed with the ore as a flux, lowering the melting point of the ore, and allowing the molten iron to flow more easily out of the bottom of the furnace and into the casting shed (4) (Figure 5) which was attached to the base of the furnace.

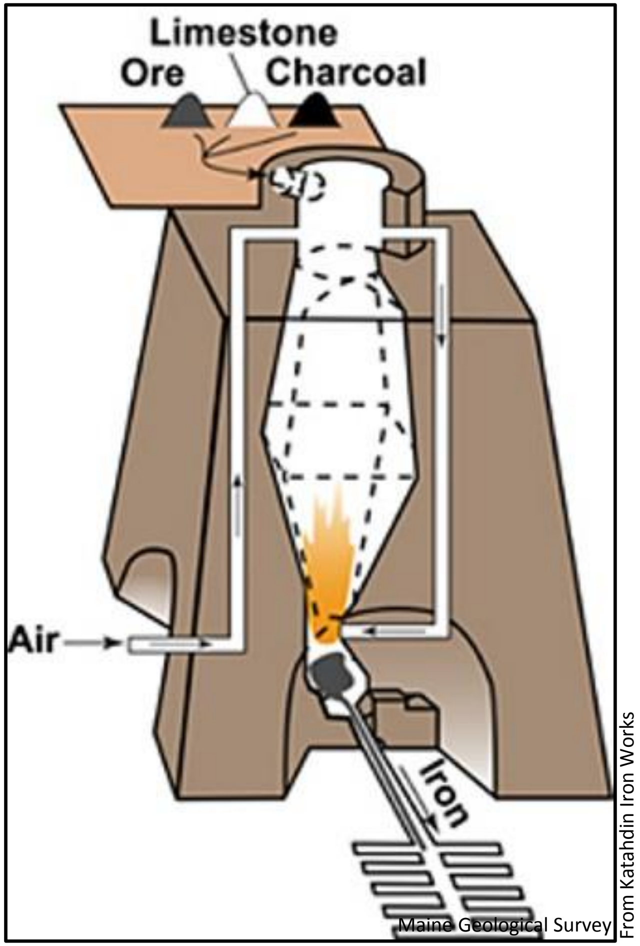

Figure 6. Diagram of workings of blast furnace (from Katahdin Iron Works website).

Katahdin Iron Works - Description of Operation

When the molten iron had pooled at the bottom of the furnace, workers in the casting shed "tapped" the furnace by knocking out a clay plug. The iron then ran out into channels made with shovels in the sand floor by the workers (Figure 7). As it oozed over the sand, the iron made a noise like a pig, thus the name "pig iron." When the "pigs" cooled, they were sent to market either by wagon, or in later years by train to Bangor where they could then be shipped by boat to market. On their return trip to Katahdin, the wagons and trains carried supplies and limestone for the operation. The large storage barn (5) (Figure 5) housed all of the equipment and replacement parts needed to keep the operation running.

From Katahdin Iron Works

Figure 7. Casting house with pig-iron molds (from Katahdin Iron Works website).

Geology and Geologic Setting

The primary source of the iron ore used at the Katahdin Iron Works came from a pyrrhotite (FeS - iron sulfide mineral) deposit located on the northern flank of Ore Mountain, at an elevation of 850 feet. This Katahdin Pyrrhotite Deposit is located entirely within a small gabbroic stock of Devonian age (Figure 8) (Hanson and Sauchuk, 1991).

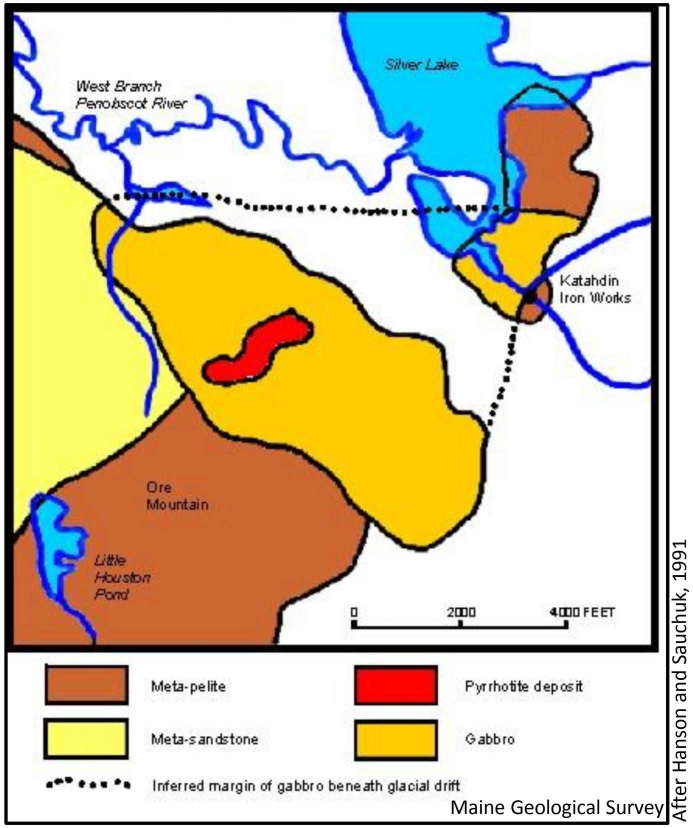

Figure 8. Geologic map of Ore Mountain and vicinity.

Geology and Geologic Setting

The stock is rectangular in shape, with the mineralized zone dimensions being 400 feet wide by 2000 feet long. This gabbro, or norite, intrudes folded slates and quartzites of Silurian and Devonian age. The stock occupies the nose of an east-plunging anticline which brings up the Silurian Rangeley, Perry Mountain, Smalls Falls, and Madrid Formations through the extensive cover of the Devonian Carrabassett Formation (Osberg and others, 1985). The east end of the Devonian Onawa pluton lies only one mile to the west of this deposit.

The stock, which hosts the pyrrhotite body, is a medium-grained dark-gray norite, composed primarily of labradorite (60%), bronzite (25%), augite (12%), and minor olivine. Accessory minerals include biotite, hornblende, magnetite, and ilmenite (Hanson and Sauchuk, 1991; Houston, 1956).

Geology and Geologic Setting: Katahdin Pyrrohotite Deposit

With the known surface dimensions of this deposit, and assuming the deposit extends to a depth equal to its length at the surface (2050 feet), and that the surface dimensions and grade of the ore persist to this depth, the total mass of sulfides would exceed 200 million tons. This would make the Katahdin Iron Works deposit one of the largest massive sulfide deposits in the world (Hanson and Sauchuk, 1991). But the current price of iron ore, rural location, and low quality of the ore, still make this an uneconomic mining operation.

Mining operations at the Katahdin Iron Works in the 19th century used the gossan, which covered the sulfide deposit, as its primary source of iron ore. The Katahdin gossan is composed primarily of limonite and clay minerals, and is formed by the weathering of the underlying sulfide deposit. Limonite is a term used for amorphous hydrated iron oxides. It may include goethite (brown), jarosite (yellow), and minor hematite (red) (Hanson and Sauchuk, 1991). Weathering of the sulfides is partly controlled by a steeply-dipping orthogonal joint set. Where there is more jointing in the rock, more weathering to depth takes place, and more gossan forms. Initial alteration of fresh pyrrhotite begins with the formation of green veinlets of melanterite (ferrous sulfate) and yellowish white surface coatings of copiapite (hydrated iron sulfate) (Houston, 1956).

Geology and Geologic Setting: Katahdin Pyrrhotite Deposit

The pyrrhotite which makes up approximately two-thirds of the deposit, occurs primarily as interstitial masses between silicate minerals (Houston, 1956). The ore body is essentially structureless and is composed almost entirely of pyrrhotite and its associated minerals. The more massive ore contains about 75% sulfides and grades toward the outer border of the deposit where the surrounding norite contains less than 5% sulfides (Houston, 1956). The silicate minerals are the same as those present in the surrounding norite, with olivene and orthopyroxene constituting a higher percentage of those minerals. Economic concentrations of metals have not been found in the sulfide deposit. Analysis of chip samples taken by Miller (1945) were found to have 43-45% Fe, 26-28% S, 0.01-0.1% Cu, 0.2% Ni, and 0.1% Co. Unlike most pyrrhotite, the magnetic susceptibility of the sulfides at the Katahdin deposit is quite low. A magnet or compass needle will not be noticeably deflected by the pyrrhotite. The gabbroic country rock typically exhibits a large magnetic response due to magnetite (Hanson and Sauchuk, 1991).

Evidence against a hydrothermal origin for the deposit includes lack of pervasive replacement textures, mineralogy that is incompatible with hydrothermal replacement, and the localized occurrence of the pyrrhotite in the mafic stock (Houston, 1956). The Katahdin pyrrhotite deposit is generally considered a magmatic segregation deposit in which an immiscible sulfide phase separated from the mafic magma during the latter stages of crystallization (Houston, 1956; Miller, 1945). The dense, ferrous sulfide liquid settled into the partly-crystallized norite to form the observed interstitial texture.

Today the Department of Conservation, Bureau of Parks and Land, maintains this area as a state historical site with a restored kiln and blast furnace. Further information on the geology and history of the area can be obtained at their website, and in the references contained herein.

Definitions

Blast furnace - a furnace for smelting of iron from iron oxide ores; combustion is intensified by a blast of air.

Gabbro - a group of dark-colored, basic intrusive igneous rocks composed of feldspar (pinkish white), pyroxene (dark green mineral), amphibole, mica (a black mineral), and olivine (green mineral).

Gossan - an iron-bearing weathered product overlying a sulfide deposit. It is formed by the oxidation of sulfides and the leaching-out of the sulfur and most metals.

Pig-iron - raw iron in an ingot form. It is the immediate product of smelting iron ore with coke and limestone in a blast furnace. It requires further treatment in a furnace to produce steel or wrought iron.

Pluton - an igneous intrusion.

Pyrrhotite - a common red-brown to bronze mineral whose primary constituent is iron-sulfide FeS.

Stock - an igneous intrusion that is less than 40 square miles (100 square kilometers) in surface exposure.

References and Additional Information

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