MINNESOTA’S IRON MINING INDUSTRY

IRON MINING ASSOCIATION OF MINNESOTA
Milestones Affecting the Iron Mining Industry in the Great Lakes Region

1845 ............ Iron ore discovered in Michigan by Marie Gesick, an Ojibway chief. Saal St. Marie canal opens Lake Superior to ships from lower lakes.
1855 ............ Bessemer process revolutionizes steelmaking, making expensive steel available to waiting markets.
1864 ............ First shipment of iron ore from Minnesota’s Vermilion Range.
1869 ............ Natural Resources Research Institute (NRRI) University of Minnesota was established in response to economic downturn in the late 1970s and early 1980s. NRRI has worked with the industry to reduce costs by improving the efficiency of operations as well as to improve the quality of pellets for better performance in the blast furnace.
1870 ............ Butte Taconite. Nashwauk, Minnesota produces 40.5 million tons over the course of 18 years.
1876 ............ Reserve Mining Company’s owners file bankruptcy, plant closes.
1877 ............ Flux pellets, containing limestone, introduced – increase blast furnace productivity.
1898 ............ Cyprus Minerals reopens closed Reserve mine and plant.
1904 ............ First installation to improve iron ore by washing built at Coleraine, Minnesota. HD Range builds a taconite operation Keewatin Taconite.
1905 ............ Mesabi Nugget commercially produces world’s first high-grade iron pellets.
1941 ............ Minnesota adopts taconite tax law to encourage development for low-grade deposits. Depletion of natural ore deposits in Lake Superior district pressures industry to seek feasible techniques for using lean taconite ores and stimulating research for new sources.
1941 – 45 .... Lake Superior district ships more than 411 million tons, nearly double the 1949 tons mined.
1949 ............ Butler Taconite, Nashwauk, closes permanently after producing 100 millionth ton of iron ore.
1952 ............ EVTAC Mining Co. reopens as United Taconite, owned by Cliffs and United States Steel Corporation.
1953 ............ U.S. Steel assumes ownership of National Steel Pellet Co., renaming the taconite operation Keewatin Taconite.
1955 ............ U.S. DOI grant to NRRI to continue iron nodules development with its innovative leach hematite concept to evaluate the iron ore smelting concept at almost ten times the iron content.
1964 ............ MITTAL Steel USA, a subsidiary of Mittal Steel, a steel company based in London, assumes ownership of the Minaque Mine near Virginia, Minnesota. A Minnesota and European steelmaker Arcelor later merged and became ArcelorMittal.
1967 – 97 ... Advanced oxy-coal and oxy-fuel combustion technologies tested at Gokakore Materials Research Laboratory for use in iron smelting process.
1970 ............ Cleveland Cliffs acquires ownership interest in United Taconite and 2003. EVTAC Mining Co. reopens as United Taconite, owned by Cliffs and United States Steel Corporation.
1972 ............ Cyprus/Northshore is sold to Cleveland Cliffs, Inc.
1973 ............ EVTAC Mining Co. reopens as United Taconite, owned by Cliffs and United States Steel Corporation.
1974 ............ NRRI has worked with the industry to reduce costs by improving the efficiency of operations as well as to improve the quality of pellets for better performance in the blast furnace.
1987 ............ ArcelorMittal Majorca Mine celebrates 40 years of production, 30 years of flux pellets, and the 100 millionth ton of iron ore produced at their plant.
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1990 ............ EVTAC Mining Co. reopens as United Taconite, owned by Cliffs and United States Steel Corporation.
1992 ............ EVTAC Mining Co. reopens as United Taconite, owned by Cliffs and United States Steel Corporation.
1995 ............ Cyprus/Northshore is sold to Cleveland Cliffs, Inc.
2003 ............ Cleveland Cliffs acquires ownership interest in United Taconite and 2003. EVTAC Mining Co. reopens as United Taconite, owned by Cliffs and United States Steel Corporation.
2009 ............ EVTAC Mining Co. reopens as United Taconite, owned by Cliffs and United States Steel Corporation.
2012 ............ Northshore Mining produces the first commercial-scale Direct-Reduced Iron pellets.
2015 ............ Northshore Mining produces the first commercial-scale Direct-Reduced Iron pellets.
2017 ............ ArcelorMittal Majorca Mine celebrates 40 years of production, 30 years of flux pellets, and the 100 millionth ton of iron ore produced at their plant.
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The story of iron began…

Over one and one-half billion years ago a vast, shallow sea covered much of the area we know today as northeastern Minnesota. The great Mesabi Range began in this sea, which contained concentrations of iron and silica. The iron and silica settled to the bottom of the sea and formed thick layers of iron-bearing sediments. As time went on, the sea disappeared, leaving these sediments buried under thousands of feet of sand, clay, and mud. As a result of this deep burial, the iron-bearing sediments were subjected to heat and pressure which transformed them into a hard, flinty rock we call taconite. Taconite consists primarily of a chert, a form of silica, and of magnetite, a black, magnetic iron mineral.

The Mesabi Range, the largest of three iron ranges in Minnesota, consists of a thick layer of taconite extending from Babbitt on the east, 110 miles southwest to Grand Rapids. The taconite deposit is one to three miles wide and up to 500 feet thick.

During the long period since its formation, Mesabi taconite has been subjected to a variety of geologic processes that have altered its character. Certain areas of taconite were affected by solutions that dissolved out portions of the silica, and the black magnetite was converted to red hematite, or “semi-taconite” ore. Natural ore mines, scattered throughout taconite of the Mesabi Range like raisins in a cake, played an important part in Minnesota’s history. In some areas, particularly on the western end of the Mesabi Range, magnetite in the taconite has been changed to red hematite, leaving the silica essentially unchanged, forming non-magnetic taconite and what we call “semi-taconite.” However, the great bulk of the Mesabi Range iron formation remains as hard, magnetic taconite – enough to last hundreds of years using conventional mining methods.

Iron ore is one of the most abundant metals found on earth. Close to five percent of the earth’s crust is iron. However, iron, unlike copper or silver, is found in combination with other elements such as oxygen, silicon or sulphur. These iron minerals are found mixed with clay, sand, rock or gravel. Iron ore is a very common mineral, common enough to be found in your backyard. But only when the iron is concentrated in large enough quantities and sufficient quality can it be mined for commercial use. Use of iron ore dates back more than 5,000 years, and as needs for iron have grown, iron ore deposits have been found all over the world.

Perhaps the first use of iron ore was for the bright red and yellow colors that characterized many iron ores. Even today, iron ores are used in a minor way for paints and dyes. But the major use of iron, since the Syrians used it for weapons in 3700 B.C., has been as a metal – for tools and implements, for weapons and structures, and in modern times, for all the steel goods made from iron.

Iron has always played an important role in the development of the United States. Iron mines in New England provided iron for the cannons of the Continental Army in the Revolutionary War. Later, during the Civil War, iron from Minnesota played an important role in the war effort. The first iron ore mine in the Superior region – including the largest of them all, the Mesabi Range of Minnesota, was established in response to economic downturn in the late 1970s and early 1980s. NRRI has worked with the industry to reduce costs by improving the efficiency of operations as well as to improve the quality of pellets for better performance in the blast furnace.

Iron ore – used as a metal – can be found in almost all modern tools.

Minnesota’s first iron mine opened at Tower-Soudan in 1884. This picture was taken in 1889 before the mine was converted from open pit to underground. Today it is a state park. Minnesota Historical Society Collection.
Iron Ore to Build a Growing Nation

Since the turn of the 20th Century, the nation’s iron and steel needs have been largely met with iron ore shipped from more than 400 producing iron ore mines located on Minnesota’s three iron ranges. During the century’s first decade, 208 million tons of iron ore were shipped down the Great Lakes, and in the next 10 years, reflecting the demands of World War I, total shipments exceeded 360 million tons. The tempo continued through the 1920s, when shipments for the 10-year period approached 365 million tons, and it was clear that as the national economy expanded, iron mines of Minnesota would be busy. And busy they were. Earth and rock overburden had to be removed to expose the iron ore. Carefully engineered plans had to be followed to develop mines in an orderly, efficient way.

Equipment – steam shovels, drills, wagons, trucks and machinery – had to be moved into the mines. Railroads had to be built so that ore could be moved out of the mines. Mining is a complicated process involving care in planning, organization and operations. As the major source of iron ore for a fast-developing nation, Minnesota’s iron ranges reflected the growth of that nation. But growth is sometimes reversed, and as the Great Depression settled upon the nation, activity slackened in Minnesota’s mines. Only 250 million tons of iron ore were shipped during the 1930s.

Some Mining Terms

Agglomeration: The term describing the preparation and heat treatment to prepare iron ore pellets and other iron ore products for shipment and use in a blast furnace.

Beneficiation: A series of processing steps which improve the physical and chemical properties of the ore, usually used in describing treatment of natural ore.

Concentrate: The finely ground iron-bearing particles that remain after separation from impurities, a term usually applied to taconite.

Furnaces are no longer designed to handle natural ore. Hematite is a common natural ore. Taconite, one of the many rocks of low iron content, now generally applied to similar geological formations. Taconite replaced natural high-concentrate ore for use in steel blast furnaces.

Processing plants had operated in Minnesota for many years, built to remove silica and other impurities from ore, and to produce ore uniform in size. By 1958 more than 80 different processing plants were at work in Minnesota. Yet these efforts did not improve Minnesota’s iron ore enough to compete with high-quality iron ore produced in other countries. Minnesota, once the nation’s and world’s dominant supplier of natural ore, had, by 1960, become just one of the numerous sources.

But the influence of rival ore-producing areas was only one side of the story. In the 1965 – 60 period, the natural iron ore curve on the graph was beginning to change, as Minnesota began to meet the challenge with another iron ore resource – taconite.
A New Iron Ore Resource

For years, the basic iron-bearing rock of the Mesabi Range, taconite, resisted man's attempts to make it useful. As early as 1871, Peter Mitchell, a Michigan prospector, opened a test pit in the hard taconite near Babbitt. But the rock was too hard and dense, and its iron content too low. Besides, there was plenty of good natural ore to be mined.

In 1913, a young engineer at the University of Minnesota, E. W. Davis, began working with the tough, magnetic taconite of the eastern Mesabi. One of his theories was that powerful magnets might unlock iron-bearing particles from taconite rock.

After years of experimenting, a small plant was built near Babbitt in 1922. But the plant was ahead of its time. Costs were too high and the market for the product was depressed. The plant closed in 1924. But Davis continued his work, and several mining and steel companies joined in taconite research in anticipation of the day Minnesota's natural ore resources could no longer supply the nation's needs.

Taconite research was further stimulated in 1941 with passage of the taconite tax law by the Minnesota Legislature. Such public support, plus years of study and testing in small-scale "pilot" plants, led to the first two large taconite projects totaling over $1.2 billion, and development came slowly.

The pledge of fair tax treatment helped win further taconite investment. New projects totaling over $400 million were announced following the statewide referendum. Within 10 years, taconite plant capacity grew 165%, from 15 million to 40 million tons per year.

While mining a site, reclamation projects are underway to ensure the land can be used again in the future. The process commonly includes reshaping the land and restoring topsoil as well as planting native grasses, trees, and ground covers. Reclamation is closely regulated by both state and federal law and requires financial assurances by the mines as part of the permit to mine.

Steps to Produce Taconite

1. Drilling
2. Blasting
3. Crushing
4. Grinding
5. Magnetic Separation
6. Pellet Forming
7. Heat Hardening
8. Loading
9. Shipping
10. Hauling
11. Mine Reclamation
12. Steel Making

The Transition to Taconite

The early 1960s brought economic hardship to iron range communities; natural ore production was declining, and the pace of taconite growth was disappointing. Nothing could be done to reverse the trend in natural ore. The only solution was to spur expansion of the taconite industry.

Minnesota's total production of iron ore and pellets reached a low point in the 1965s, then began climbing toward former levels, until the 80s. Taconite's growth has not come easily because capital requirements are extremely large, competition is keen, and a changing steel industry has brought periods of uncertainty to the iron ore market. The 40 million tons annual taconite production capacity attained by 1974 cost investors $1.2 billion, and development came slowly.

While Minnesota was launching a taconite industry, other states and nations began to develop their resources of taconite or similar material. In fact, Minnesota, where the taconite process was pioneered, fell behind in its competition for taconite investment. Minnesota met the challenge in 1964 when a constitutional amendment passed, assuring taconite companies that they would not be singled out for state tax increases.
Competing with the World

For more than 50 years, Minnesota supplied almost two-thirds of the iron ore which helped to build the nation. The iron ore resources of other states and nations were developed and Minnesota’s percentage of the iron ore market began to decline. Mines in Venezuela, Peru, Chile, Brazil and Liberia started producing iron ore in the 1950s and began to displace Minnesota ore in its traditional markets.

Canadian ore also became a factor and large processing facilities similar to our taconite plants were built. Some of these installations in eastern Canada compete with Minnesota products.

Operations in Michigan, too, increased their capacity to turn out pellets.

Foreign ore production became more competitive because of changes in ocean transportation. Ships more than five times as big as the largest on the Great Lakes sharply reduce the shipping cost per ton, even for very long distances.

All these influences on our mining industry underscore the need to keep Minnesota ores competitive in cost as well as in quality.

Dedicated. Responsible. Innovative.

Iron mining has built upon experience, technology and hard work. To make it the industry it is today, these fundamentals are continuously passed to future generations to assure iron mining will be here today and tomorrow.

Safeguarding the Environment

Iron ore research, iron ore processing, iron ore production and all of the work involved, have one purpose: to provide the basic raw material for the iron and steel industry – iron ore. Without steel production, there would be little need for iron ore. Steel, of course, is of vital importance to our economic health and to our standard of living. But steel, too, must compete with other materials and products – with other metals, with wood, concrete, glass, plastics and with steel produced in foreign nations. It is this concern by companies and employees that has resulted in a unified effort to make our steel competitive with other materials and foreign steel.

Just as steel producers must provide high-quality steel at the lowest possible cost, the iron ore industry must produce products that can compete on a cost and quality basis while competing in a global market. Spurred by competition and market demands, the iron ore industry is finding new ways to develop, produce and market iron ore. This means iron ore will continue to play a basic and vital role in our nation and the world. Minnesota iron ore continues to be one of the state’s most important products. Research, a skilled workforce, public support and constant efforts to control quality and production costs are the most important factors in keeping this Minnesota industry competitive in the world market.

Iron Ore in Your Future

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Modern wind turbines contain over 300 tons of steel.
Iron and Steel Producers:

ArcelorMittal Minorca
Owner: ArcelorMittal
Managing Agent: ArcelorMittal
www.arcelormittal.com

Hibbing Taconite
Owners: ArcelorMittal, Cleveland Cliffs, Inc., U.S. Steel
Managing Agent: Cleveland Cliffs, Inc.
www.clevelandcliffs.com

Mesabi Nugget
Owner: Steel Dynamics Delaware
www.steeldynamics.com

Mining Resources, LLC
Owner: Steel Dynamics, Magnetation
Managing Agent: Steel Dynamics
www.steeldynamics.com

Northshore Mining
Owner: Cleveland Cliffs, Inc.
Managing Agent: Cleveland Cliffs, Inc.
www.clevelandcliffs.com

United Taconite
Owner: Cleveland Cliffs, Inc.
Managing Agent: Cleveland Cliffs, Inc.
www.clevelandcliffs.com

U.S. Steel – Keewatin Taconite
Owner: U.S. Steel
Managing Agent: U.S. Steel
www.ussteel.com

U.S. Steel – Minntac
Owner: U.S. Steel
Managing Agent: U.S. Steel
www.ussteel.com

Other Sources of Information:

The Making of Iron Ore into Steel
American Iron and Steel Institute
1140 Connecticut Ave. NW, Suite 705
Washington, D.C. 20036
(202) 452-7100

Mining Iron Ore, Other Metals and Fuels
National Mining Association
101 Constitution Ave. NW, Suite 500 East
Washington, D.C. 20001
(202) 463-2600