Explore Minnesota: IRON ORE

Minnesota's iron ore operations have a production capacity of about 40 million tons of high-grade iron ore annually, which is approximately 75 percent of total U.S. iron ore production. To produce 40 million tons of high-grade iron ore pellets, Minnesota moves on the order of 240 million tons of material and 105 million tons of surface and rock stripping.

Geology

For the past 30 years, all of Minnesota's iron mining has occurred on the Mesabi Iron Range, a narrow belt, approximately three miles wide and 120 miles long, of shallow-dipping iron-rich sedimentary rocks known as the Biwabik Iron Formation. Most of the formation is buried by glacial drift, creating an intermittent, narrow outcrop pattern. The rocks are middle Precambrian in age, about 1.8 billion years old, and consist of layered iron carbonates and iron silicates.

Iron ore mining first occurred in Minnesota on the Vermilion Iron Range in 1884 followed by the Mesabi Iron Range (1892), Cuyuna Range (1911) and the Fillmore County District (1941). The first mines on the Mesabi exploited the so-called "natural ore", which is a weathering or alteration of the Biwabik Iron Formation along fractures or other areas of permeability, oxidizing the magnetite to hematite and removing silica or carbonate, thus enriching the ore to 50-60% iron. From 1890 to about 1980, 2.5 billion tons of this ore were mined, and these "natural ores" have all but been exhausted.

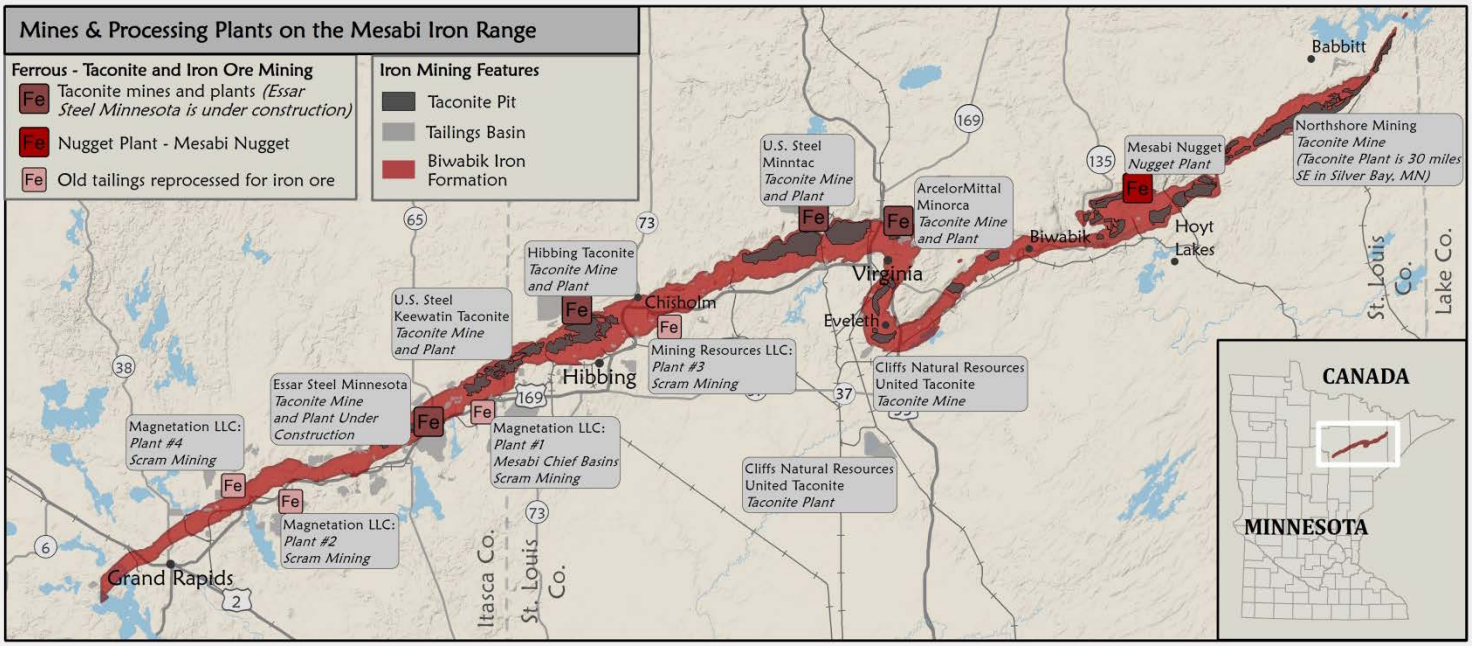
Mining of the low-grade iron formation, or chert-magnetite ores, began during the mid-1950s. At about 25 to 30% recoverable iron, these low-grade ores are beneficiated and upgraded to high-grade iron ore concentrates with an iron content of approximately 65%. To date, approximately 1.6 billion tons of high-grade iron ore pellets have been produced from Minnesota's Mesabi Iron Range iron ore.

State of the Range

The on-going downturn in the U.S. domestic steel industry, fueled by a plunge in steel prices and global over-supply, has caused a major decline in demand for Minnesota's iron ore pellets. As of March 2016, most of the Mesabi Iron Range mines and processing plants shown below were idle. The production rates and operational descriptions within this pamphlet reflect pre-downturn conditions.

Modern Taconite Production

Iron ore is both mined and upgraded on Minnesota's Mesabi Iron Range. After being extracted from the ground, low-grade iron ore is hauled from open-pit mines to nearby taconite processing facilities, where it is crushed into a fine powder. Pure iron oxide (magnetite) is wet separated from impurities (tailings) by rotating drum magnets. Bentonite clay is added to the powdered iron concentrate, and this mixture is agglomerated into marble-sized balls that are baked at high temperature to form hardened pellets. These pellets are then shipped by rail and Great Lakes freighters to steel mills, where they are fed directly into blast furnaces.



Active Iron Mining Operations

The three companies that operate Minnesota's iron ore mines and taconite processing facilities update and report their iron ore reserves annually.

Cliffs Natural Resources

Cliffs Natural Resources is the largest producer of iron ore pellets in North America, and it sells the majority of its pellets to integrated steel companies in the United States and Canada.

The Company operates three iron ore mines in Minnesota: Hibbing Taconite Company, Northshore Mining Company and United Taconite, LLC. Cliffs Natural Resources Minnesota mines have the combined annual capacity to produce 18.2 million tons of iron ore pellets annually. Based on its percentage ownership of the mines it operates in Minnesota, Cliffs' share of the rated pellet production capacity is currently 12.5 million tons annually.

The Company sells its share of iron ore production to integrated steel producers, generally pursuant to long-term supply agreements with various price adjustment provisions.

ArcelorMittal

ArcelorMittal is the largest steel producer in the world, formed from the consolidation of Mittal Steel's existing U.S. business (Ispat Inland), with the assets of International Steel Group.

Following the purchase of Arcelor, ArcelorMittal owns and operates the Minorca Mine in Minnesota and has 62 percent ownership of Hibbing Taconite Company operated by Cliffs Natural Resources. ArcelorMittal is currently producing iron ore from its Laurentian and new Biwabik mine pits.

U.S. Steel

United States Steel Corporation is the second largest steel producer in the United States and makes all of its steel by processing iron ore pellets and other raw materials in blast furnaces. U.S. Steel has been permitted to expand from six million to nine million tons annually at its Keewatin Taconite facility. U.S. Steel's Minntac facility has been permitted at the state level to extend its East Pit mine. It also owns 14.69% of Hibbing Taconite Company's 8.0 million ton capacity mining operation on the Mesabi Range.

Secondary Iron Ore Recovery and Production

Two Minnesota companies are producing iron ore concentrate from the tailings of previous natural iron ore mining operations.

Magnetation LLC

Magnetation LLC is a joint venture between Magnetation, Inc. (50.1%) and AK Steel Corp. (49.9%). Magnetation LLC produces iron ore concentrate from previous natural ore mining operations (iron ore tailings basins). Magnetation LLC opened a new iron ore concentrate plant near Grand Rapids in 2014, achieving first concentrate production less than ten months after the first concrete pour. Magnetation LLC also owns and operates two plants located in Keewatin (0.4 million mt capacity) and Bovey, MN (1.2 million mt capacity).

Mining Resources LLC

Mining Resources LLC is a joint venture between Steel Dynamics, Inc. (80%) and Magnetation Inc. (20%). Mining Resources LLC produces iron ore concentrates from iron ore tailings basins and operates a 1.0 mt production plant near Chisholm, MN. Mining Resources LLC iron concentrates are shipped to Mesabi Nugget, a Steel Dynamics and Kobe Steel pig iron nugget operation near Hoyt Lakes, MN.

Value Added Iron

Mesabi Nugget, LLC has constructed the world's first commercial iron nugget plant that is now using a new environmentally friendly process for producing high purity pig iron. The ITMK3 process has produced its first iron nuggets containing 97% metallic iron directly from iron ore, which can then be shipped as a prime raw material to electric arc and basic oxygen steel makers and foundries.

The partners of Mesabi Nugget, LLC are SDI of Butler, Indiana and Kobe Steel, Japan. The site for the world's first commercial iron nugget plant is Hoyt Lakes, Minnesota. The Mesabi Nugget plant has a total nameplate production capacity of approximately 500,000 metric tons of nuggets per year, and employs about 100 permanent workers.

Essar Steel Minnesota, LLC, (ESML) part of the Essar Steel Holdings Limited group of companies, is developing a new taconite/iron ore mine at the former Butler Taconite mine near Nashwauk, MN. It is designed to produce up to 7.0 million tonnes each year and employ up to 500 people. ESML secured the final financing required to complete construction of the $US1.8 billion project in September, 2014.

Other Iron Ore Potential

Although much of Minnesota's iron ore is dedicated to support the existing commercial operations, there are additional resource areas that offer additional iron ore potential. The major areas include the reserves of the former LTV operation and the identified resources known as the Sherman, Buhl, Kinney and McKinley deposits. These deposits together contain 1.5 billion tonnes of potential high-grade iron ore pellets.

There are also over one billion tons of natural iron ore tailing basins and stockpiles that contain recoverable iron ore. Magnetation, a Minnesota company, is currently recovering high grade iron ore fines from a number of natural iron ore tailings basin located on the Mesabi Range.

Taxation

The 2015 Minnesota Mining Tax Guide summarizes Minnesota's mining related taxes paid by the iron mining industry each year. This book simplifies complicated tax statutes using language that is easy to understand through non-technical narratives, tables, graphs, and flowcharts.

http://www.revenue.state.mn.us/businesses/mineral/Documents/2015_mining_guide.pdf

Infrastructure

The Mesabi Iron Range is home to several communities that have a long history of supporting the iron mining industry. Minnesota's Iron Mining Association is a trade group promoting the state's mining industry and is represented by over 200 of the state's mining supplier companies.

Minnesota's highways reach all corners of the state. Even in the sparsely settled north, little land is more than a few miles from all-weather highways suitable for large trucks. More than 4,500 miles of railroad track connect all Minnesota cities larger than 25,000, with main line track that links the state to major cities and ports throughout North America.

Northern Minnesota is home to the state's four Great Lakes cargo ports. The Port of Duluth-Superior is the #1 tonnage port on the Great Lakes, and is operated by the Duluth Seaway Port Authority. This multi-modal hub for domestic and international cargo ships taconite pellets, coal, grain, and other commodities. Three other Lake Superior ports (Two Harbors, Taconite Harbor, and Silver Bay) handle taconite. These ports are accessible to ocean-going vessels via the St. Lawrence Seaway.

Reliable electricity is available at competitive rates across the state through a network of power suppliers. Natural gas pipelines of substantial capacity span southern Minnesota and much of northern Minnesota.

Land and Mineral Ownership

Minnesota's Mesabi Iron Range iron ore potential has been known for more than 120 years, and the land and mineral ownership is well defined and available for iron ore mining and development. Mineral acquisition is generally done by entering mineral leases with fee holders.

The state is the largest owner of mineral rights. It has in place a system of leasing the state's ferrous minerals for mining. Other private mineral holders have an active local presence with fee offices and resource information locally available.

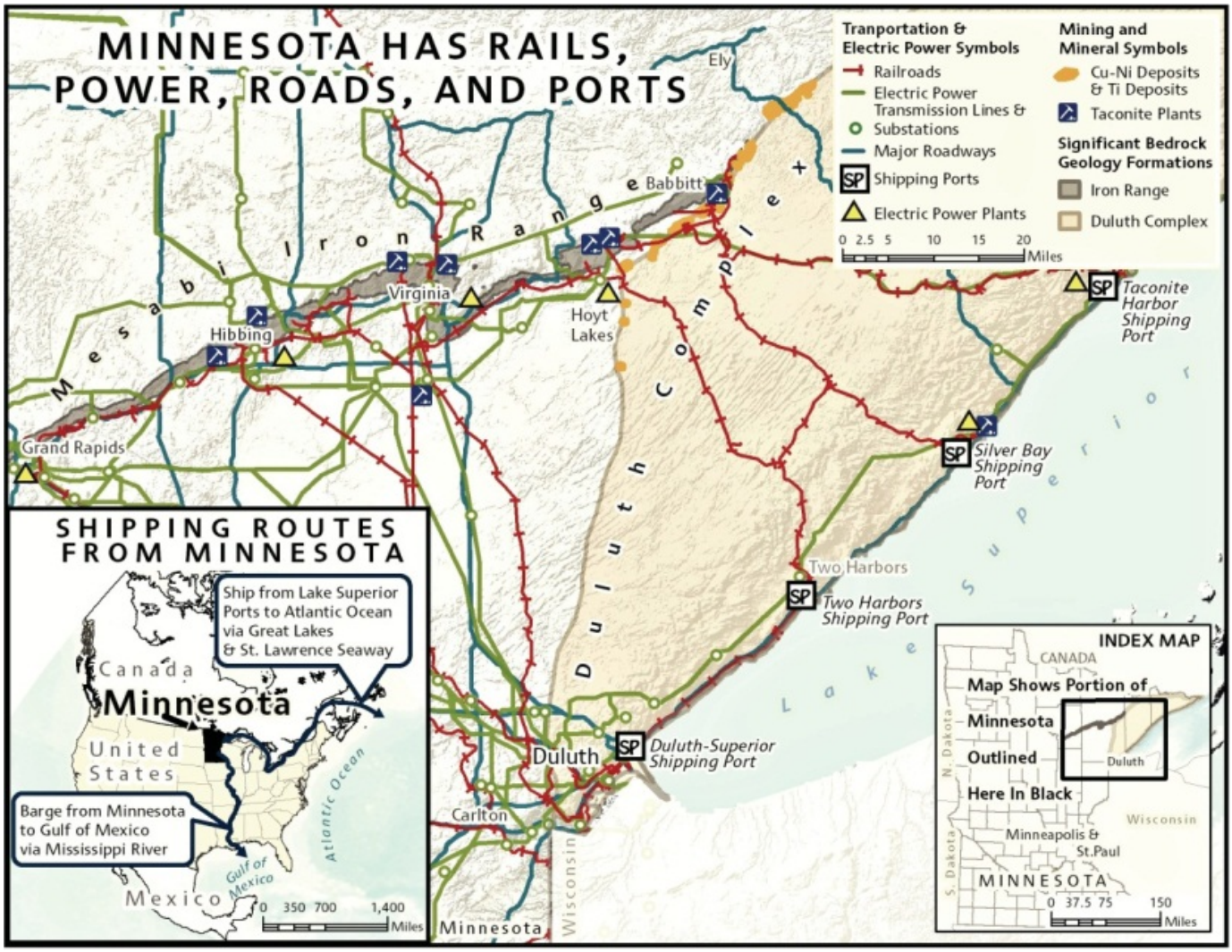
Regulation and Permitting

The two principal regulatory and permitting authorities are the state's Department of Natural Resources and the Pollution Control Agency. Rules for permitting iron mining operations have been in place nearly 35 years. For commercial operations, the rules require a mandatory Environmental Impact Statement before the approval of any permits. The major issues will generally relate to water appropriation and discharge and in some cases air emissions. The history of the mining industry in Minnesota demonstrates that permit conditions can be satisfactorily met.

Trained Workers and Support Industries

Minnesota has a strong system of universities, technical/vocational institutions, and public and private colleges. Its labor force is highly educated. Minnesota's high-school completion rate is better than 90 percent. About half of these graduates pursue some kind of post-secondary education. Decades of iron mining have fostered the growth of mining-related industries. The taconite mining industry purchases goods and services from a supply chain of hundreds of supplier/vendor businesses in more than 200 communities. Whether you need drill bits or shovel repairs or geophysical consultants, you can find them in Minnesota.

Student using Hibbing Community College's 793-F Caterpillar haul truck simulator, one of the few in a North American college or university. This state-of-the-art simulator was purchased with a US$1.4 million grant provided by the State of Minnesota's Job Skills Partnership Program.



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