

IRON ORE

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Iron ore production in the United States rose by 12%, but consumption fell to its lowest level since 1991. World iron ore production and consumption rose in 2002. Brazil was the largest producer of iron ore in terms of iron content, and China was by far the largest consumer. Iron ore trade increased and prices fell. Pig iron and steel production rose.

Iron ore is essential to the economy and national security of the United States. As the basic raw material from which iron and steel are made, its supply is critical to any industrial country. Scrap is used as a supplement in steelmaking but is limited as a major feed material because the supply of high-quality scrap is limited. However, alternatives, such as direct reduced iron (DRI), were available, and their use is growing.

Iron ore is a mineral substance which, when heated in the presence of a reductant, will yield metallic iron. It almost always consists of iron oxides, the primary forms of which are the minerals magnetite (Fe_3O_4) and hematite (Fe_2O_3). Taconite, the principal iron ore mined in the United States, has a low (20% to 30%) iron content and is found in hard, fine-grained, banded iron formations. About 98% of iron ore is used in the iron and steel industry. Ore is put into a blast furnace and smelted to produce molten iron. The molten iron is moved to a basic oxygen furnace (BOF) where it is converted to steel by removing most of the remaining carbon. In the past, a high percentage of the molten iron was poured into molds resembling pigs, hence the name pig iron. Although today almost all molten iron goes directly to the BOF, eliminating the step, which produces pig iron, the product of the blast furnace is usually referred to as pig iron.

To understand the state of the U.S. iron ore industry in 2002, the following data are enlightening. Iron ore consumption in 2002 was 59 million metric tons (Mt), its lowest level for at least as far back as 1965. There was an average of 29 blast furnaces active during the year. This average was the lowest for at least as far back as 1961. Accordingly, pig iron production at 40 Mt was the lowest since 1982. Crude steel production, on the other hand, at 92 Mt increased by 2%. Similarly, steel demand rose by 3% to 114 Mt. This apparent discrepancy between ore production and steel demand is explained by examining the minimill sector and net imports of iron ore substitutes. In 2002, for the first time, the minimill sector of the steel industry produced more than 50% of the crude steel in the United States. Minimills do not use iron ore for their feedstock; instead they use iron and steel scrap and some DRI. Net imports of iron ore substitutes at 7.8 Mt were 13% higher than those of 2001. Iron ore substitutes include DRI, iron and steel scrap, pig iron, and semifinished steel. Semifinished steel is produced in the form of blooms, billets, and slabs. Imported iron ore substitutes in the form of pig iron or semifinished steel allows steelmakers to increase shipments without having to increase production from the blast furnace. A major increase in production would entail restarting blast furnaces and hiring new personnel. The steel business is highly cyclical, and when demand falls, as it inevitably does, the steelmakers will not have to shut down recently opened blast furnaces and lay off recently hired personnel. So, despite increases in both steel production and demand in 2002, iron ore consumption fell to its lowest level in decades.

Legislation and Government Programs

The State of Michigan passed bill 516, the Michigan Minerals Credit Bill, which provides a \$1-per-ton tax credit to any steel company that purchases pellets from the Tilden Mine (Mining Journal, 2002¹).

The U.S. Department of Energy (DOE) signed a cooperative agreement with Mesabi Nugget LLC. (More information can be found under Current Research and Technology.) The Mesabi Nugget research project is a 2-year program involving the construction of a pilot plant that would produce iron nuggets to use as feedstock by the North American steel industry. Under the terms of the agreement, DOE will provide \$5 million in funding to the project—\$2 million in the first year; followed, on a contingent basis, by \$3 million in the second year. The agreement does not cover the \$15 million cost of constructing the plant and requires at least a 50% match of DOE's contribution from Mesabi Nugget for plant operations (Robertson, 2002a).

Ispat Inland Mining Co. received a \$107,000 grant from DOE to fund a 3-year computer simulation study that is intended to help the taconite operation determine ways to increase pellet production, while using the same level of or less energy. "Improving Taconite Processing Plant Efficiency by Computer Simulation," as the project is called, is being done in conjunction with the Natural Resources Research Institute's Coleraine Laboratory and the University of Minnesota (Skillings Mining Review, 2002e; Ramsay, 2002§).

Structure of the Industry

Restructuring of Operations in Michigan and Minnesota.—In January, Cleveland-Cliffs Inc. acquired Algoma Steel Co.'s 45% interest in the Tilden Mine in Michigan, boosting its ownership in Tilden to 85% (Pinkham, 2002).

¹References that include a section mark (§) are found in the Internet References Cited section.

Bethlehem Steel Corp., the bankrupt majority owner of Hibbing Taconite Co., indicated that it wanted to sell the Minnesota taconite operation. In July, Cliffs bought 8% of Bethlehem's equity in Hibtac, increasing its ownership in Hibtac from 15% to 23% (Bloomquist, 2002a§; Duluth News Tribune, 2002a§).

Cliffs announced that it had entered into an agreement with Ispat Inland Steel Company (a subsidiary of Ispat International N.V.) effective December 31, 2002, that restructured the ownership of the Empire Mine in Michigan. The second Michigan mine had been operating under an interim agreement between Cliffs and Ispat Inland since LTV Corporation ceased operations and rejected its 25% ownership in Empire early in 2002. At that time, Cliffs owned 35% of Empire and Ispat Inland owned 40%. Under the agreement, Cliffs has acquired the entire 25% interest previously owned by LTV plus a 19% interest in the mine from Ispat Inland. As a result, the mine is now owned 79% by Cliffs and 21% by Ispat Inland (Cleveland-Cliffs Inc. 2003§). In August, Cliffs increased its ownership of the Wabush Mine in northeastern Canada by about 4% (Cleveland-Cliffs Inc., 2003, p. 2).

The 6.9 Mt increase in Cliffs' share of 2002 production compared with that of 2001 reflected the company's increased ownership in the four mines and increased production at all mines except Empire (Cleveland-Cliffs Inc., 2003, p. 16).

Cliffs started 2002 with 12.2 Mt of production capacity and ended the year with 19.5 Mt. This raised Cliffs' share of North American production capacity from 15% to 25% (Cleveland-Cliffs Inc., 2003, p. 2).

U.S. Steel Corp. signed a letter of intent to sell its Minntac taconite mine and three additional operations. In the \$500 million deal, New York-based Apollo Management L.P. would acquire the Minntac Mine, which employs about 1,550 people. Minntac employment and production levels were expected to remain the same. Existing collective bargaining agreements would remain in place, along with certain unspecified employee benefit obligations. All employees and managers at Minntac, and at the other facilities involved in the sale, will become part of the new business (Bloomquist and Brissett, 2002§; Goert, 2002§).

Restructuring Effects on Cleveland-Cliffs Inc.—Consolidation in the world and U.S. iron ore industries has occurred for two reasons: 1) steel companies have wanted to get out of the iron ore business to concentrate on their core business of making steel, and 2) iron ore producers have wanted to grow by acquiring other iron ore producers. In the United States this consolidation has had a major effect on Cliffs, the preeminent North American iron ore company. Cliffs has managed and has had full or part ownership of iron ore mines for many years, traditionally operating its iron ore business through partnerships with various integrated steel companies. The company managed and held minority ownership positions in several partnership mines. Its current status is as follows: Cliffs manages the Empire and Tilden Mines in Michigan, the Hibbing Taconite and Northshore Mines in Minnesota, and the Wabush Mine in Canada. Cliffs owns 79% of the Empire Mine, 23% of Hibbing Taconite, 100% of Northshore, 85% of Tilden, and 26.8% of the Wabush Mine (Cleveland-Cliffs Inc., 2003, p. 43).

United States integrated steel mills, Cliffs' partners, found that they needed to change the way they did business. Some ownership changes were the result of integrated steelmakers going out of business. With increased competition from overseas producers and high legacy costs, U.S. steelmakers needed their cash flow for making steel, not mining iron ore. As steelmakers sold their iron ore properties, Cliffs bought them, leading to a restructuring of the North American iron ore industry. With its major customers in the North American steel industry also going through a significant restructuring, Cliffs' strategy is to gain a larger share of the integrated steel market for iron ore pellets by increasing mine ownership and entering into long-term pellet sales contracts. Cliffs has become less of a mine manager and more of a merchant.

In 2002, Cliffs became the sole provider of iron ore to three large steel mills. In January, Cliffs reached an agreement with Algoma Steel Inc. to be the sole supplier of iron ore for a 15-year period. In April, Cliffs entered into a long-term agreement to be the sole supplier to International Steel Group Inc. (ISG), for a 15-year period beginning in 2002. Cliffs also announced that it had invested \$13 million in ISG common stock, representing 7% of ISG's equity. Sales to ISG in 2002 were expected to be between 1.5 and 2 Mt. Sales over the remainder of the contract will depend on ISG's pellet requirements. ISG plans to produce more than 4.5 million metric tons per year (Mt/yr) of steel. At that production level, annual pellet requirements were expected to be about 5 Mt. Pellet sales during the 15-year contract term could total more than 70 Mt, generating more than \$2 billion in revenue. Pellets sold under the contract would come from Cliffs managed mines in Michigan and Minnesota. In August, Cliffs restructured a supply deal with Rouge Industries in which it agreed to lend \$10 million to Rouge in exchange for becoming its sole supplier of iron ore pellets. As a result, Rouge, which bought less than 1 Mt of pellets in 2001, would buy 1.3 Mt in 2002 and was expected to buy 3 Mt/yr beginning in 2003 (Metal Bulletin, 2002e; Pinkham, 2002; Skillings Mining Review, 2002a§).

Production

Domestic iron ore production, at 51.6 Mt, increased by 12% from that of 2001. The eight taconite mining operations in Michigan and Minnesota accounted for virtually all domestic iron ore production. Six of these operations were on the Mesabi Iron Range in northeastern Minnesota: EVTAC Mining LLC, Hibbing Taconite Co., Inland Steel Mining Co., Minntac, National Steel Pellet Co., and Northshore Mining Co. The two taconite operations on the Marquette Iron Range in the Upper Peninsula of Michigan were the Empire and the Tilden Mines. Domestic iron ore supply (production minus exports) satisfied 76% of domestic demand in 2002, compared with an average of 70% from 1990 through 2002.

U.S. production data for iron ore are developed by the U.S. Geological Survey (USGS) by means of the annual "Iron Ore" survey, which provided 100% of total production shown in tables 1 through 4. This information is supplemented by employment data, mine inspection reports, and information from consumers. The American Iron Ore Association (AIOA) provided data on ore shipments from loading docks on the upper Great Lakes, as well as receipts at transfer docks and furnace yards nationwide. The dock and steel plant data were compiled jointly by AIOA and the American Iron and Steel Institute (AISI).

Iron ore was produced by 10 companies. Two other companies did not produce ore, but shipped it from stockpiles. The producing companies operated 10 mining operations, 9 iron ore concentration plants, and 8 pelletizing plants. Of the two iron ore producers that did not produce pellets, one produced iron ore as a byproduct of gold mining, and the other produced direct-shipping ore, which requires minimal processing. Of the 10 mining operations, all were open pit. Virtually all ore was concentrated before shipment, and 99% was pelletized. In 2002, combined United States and Canadian production represented 7.6% of the world output of usable ore. Trends in world mine production since 1998 are shown on a country basis in table 16.

Productivity in the Lake Superior District, in terms of tons of usable ore produced per worker hour in 2002, was 5.5, a large increase from that of 2001.

Low-grade ores of the taconite type mined in Michigan and Minnesota accounted for 99.8% of total usable domestic ore production. U.S. production of pellets totaled 51.3 Mt. The average iron content of usable ore produced was 63.0%. Fluxed pellet's share of total pellet production has risen steadily to 66% in 2002 from 42% in 1993.

Michigan.—Michigan accounted for 22.8% of the output of usable ore in 2002. Pellets accounted for 99.3% of total production. The Empire Mine in the Upper Peninsula of Michigan, which was closed at the beginning of the year, opened in late March (Skillings Mining Review, 2002b).

Minnesota.—Minnesota produced 77.0% of the national output of usable ore in 2002. All of the State's production came from open pit mines on the Mesabi Range.

In September, officials at EVTAC Mining announced that part-owner AK Steel would not buy any pellets in 2003 and another part-owner, Stelco, would buy only one-half of what it usually bought. In November, EVTAC laid off 37 hourly employees to reduce production costs. Also, in November, EVTAC requested a \$3 million loan to cope with a projected cash shortage. The loan was made and was to be repaid in 2003 (Bloomquist, 2002b§-d§; Tyssen, 2002§).

In January, Hibbing Taconite informed its workers that it was planning to shut down for 8 weeks during the year because of weak domestic demand for iron ore. One shutdown was scheduled through the month of February and the other in July or August. Hibtac restarted the plant in early March, without difficulty. The second shutdown was postponed (Bloomquist, 2002e§; Mesabi Daily News, 2002§; Skillings Mining Review, 2002c). Hibtac moved its one billionth ton of all-material on March 30. All-material is made up of overburden, waste rock, and ore (Skillings Mining Review, 2002d).

In October 2001, National Steel Pellet Co. announced that it would close its facility for 8 weeks, beginning October 28. The taconite operation resumed operations on the first day of 2002. In March, National Steel Corp. (the parent company of National Steel Pellet Co.) filed for Chapter 11 bankruptcy protection. In December 2001, National Steel Corp. announced its intention to sell National Steel Pellet Co., and in late 2002, was holding discussions with U.S. Steel Corp. and two other potential buyers (Skillings Mining Review, 2002g; American Metal Market, 2002b; Bloomquist, 2002f§).

U.S. Steel's Minntac Mine completed a 6-year, \$50 million upgrade of its concentrator that will help the plant increase efficiency and reduce costs. The upgrade included a complete refurbishing of the iron ore processing equipment, new structural steel, and replacement of the piping that feeds the magnetic separators and transfers the tailings and the concentrated ore. Two other improvements were a sophisticated upgrade to the lubrication system and the addition of a vastly improved state-of-the-art computer control system that monitors every aspect of the plant's processing function, from pit to pellet. The upgrades took place during the winter months and were scheduled during planned agglomerator shutdowns. The new monitoring system enabled Minntac to reduce unscheduled downtime by sending warning signals about such conditions as the rising temperature in an electric motor and when bearings were about to fail. A single employee can keep track of all functions and immediately call pending problems to the attention of maintenance personnel. Because of the investment, Minntac has improved its iron recovery despite processing lower grade ore, improved the quality of its pellets, and reduced operating costs (Duluth News Tribune, 2002b§; Skillings Mining Review, 2002b§).

Consumption

Iron ore consumption fell by 13% to 59 Mt. Pig iron production at 40 Mt was 15% below the 10-year average of 48 Mt/yr for 1992-2001 and dropped to its lowest level since 1986. Raw steel production by the basic oxygen furnace fell to 50 Mt compared with the 10-year (1993-2002) average of 58 Mt. As would be expected, there is a very strong correlation between the number of active blast furnaces and iron ore consumption. In the 10-year period (1993 through 2002), the number of active blast furnaces declined each year by one. In 1992 there were 43; in 2002 that number had fallen to 29.

The number of blast furnaces in operation during the year ranged from 26 to 31. Consumption of iron ore, including agglomerates reported to the AISI by integrated producers of iron and steel, totaled 58 Mt. This included 48 Mt of pellets; 8 Mt of sinter, briquettes, etc.; and 0.3 Mt of natural coarse ore. Of the ore consumed, 79.9% was of domestic origin, 7.5% came from Canada, and 12.6% came from other countries. Other materials consumed in sintering plants included mill scale, flue dust, limestone and dolomite, slag and slag scrap, and coke breeze. Other iron-bearing materials charged to blast furnaces included mill scale, slag scrap, and steel furnace slag.

Iron ore consumption is reported in several ways. The three consumption numbers used in this annual review are listed in tables 1, 6, and 7. The following explains why more than one consumption number is used and how each of them is derived. The first consumption number (59.0 Mt in 2002) is in table 1 and is the sum of the quantity of ore consumed by ore type as reported by the AISI and the quantities of ore consumed in DRI production and ore consumed in nonsteel uses, as reported to the USGS; the AISI number is reported in short tons and is converted to metric tons (American Iron and Steel Institute, 2003, p. 84). The second consumption number (57.6 Mt in 2002) is in table 6 and is the quantity of ore consumed in U.S. iron and steel plants by type of ore as

reported by the AISI; the number has been converted from short tons, as it is listed in the AISI annual report, to metric tons (American Iron and Steel Institute, 2003, page 84). The third consumption number (60.0 Mt in 2002) is in table 7 and is the quantity of ore consumed in U.S. iron and steel plants by type of ore as reported by the AISI plus two other numbers that are the quantities of ore consumed in DRI production (0.47 Mt in 2002) and nonsteel uses (0.68 Mt in 2002) as reported to the USGS.

Data on consumption of iron ore for nonsteel end uses were compiled from information gathered from USGS surveys.

Prices

The average free-on-board mine value of domestic ore shipped in 2002 was \$26.04 per metric ton, higher than that of 2001. This average value should approximate the average commercial selling price less the cost of mine-to-market transportation. International iron ore prices fell in 2002. The price for Hamersley Iron Ore Pty. Ltd. and Mount Newman Mining Co. Pty. Ltd. fine ores for fiscal year 2002 (April 1, 2002, to March 31, 2003) in the Japanese market was 35.00 cents per 1% iron per long ton unit, down 2% compared with that of 2001 (United Nations Conference on Trade and Development, 2003, p. 75). The price for lump ore was settled at 42.73 cents per 1% iron per long ton unit, a decrease of 3.6% compared with that of 2001. The lump ore to fine ores premium for Australian ore sold to Japan, was 7.73 cents per 1% iron per long ton unit. There were similar price percentage decreases in Europe. Iron ore prices have declined over the long term as well. The price of Carajás fines, a grade of ore produced by Companhia Vale do Rio Doce (CVRD) and sold to Europe, when denominated in U.S. dollars and adjusted for inflation using the U.S. Consumer Price Index for All Urban Consumers, fell by 34% from 1990 through 2001.

Transportation

An iron ore shipping terminal that handles pellets destined for ISG's blast furnace will be moved from Lorain, OH, to Cleveland, OH. The Lorain pellet terminal is about 56 kilometers (km) (35 miles) west of Cleveland and was designed to accommodate conventional self-unloading vessels. The \$2.5 million project by the Cleveland-Cuyahoga Port Authority should save ISG, which now owns LTV's Cleveland mills, \$1 million per year in shipping costs (American Metal Market, 2002a).

Foreign Trade

Net imports in 2002 were 5.7 Mt, which came to 17.4% of domestic consumption. Exports rose by 20% and imports by 17%. Almost all exports consisted of pellets shipped via the Great Lakes to Canadian steel companies, which are partners in U.S. taconite producers in Michigan and Minnesota. Brazil's share of U.S. imports was 47%; Canada's was 44%.

World Review

Production.—World production at 1.080 billion metric tons (Gt) broke the record set in 2000 of 1.060 Gt. World production first exceeded 1 Gt in 1995 and has been above that level since then. In terms of iron content of global iron ore production, there are the big two and then all others. Australia and Brazil's combined share of production from 1998 through 2002 averaged 40%. Iron ore was produced in 43 countries with production exceeding 1 Mt in 24 of those countries. Among the nine nations with more than a 2% share of combined 1998-2002 world production, only Canada and the United States had decreases in production over that 5-year period.

Consumption.—World iron ore consumption rose. On a global basis, iron ore consumption is not measured directly, but there are indicators that clearly show whether consumption rose or fell. These indicators are the production of pig iron, DRI, crude steel, and imports of iron ore. Pig iron and DRI production are direct indicators of iron ore consumption. Crude steel production is less direct because part of a steel-producing country's steel production may come from minimills, which use varying quantities of scrap rather than iron ore. Iron ore imports are not a direct indicator of iron ore consumption in any country that produces iron ore, but if there is reason to believe that a country's ore production is static, imports can be a strong indicator of consumption.

World consumption of iron ore increased as the result of a 5% increase in pig iron production. Of the countries that had 5% or more of world pig iron production from 1995 through 2002, two (United States, -21%, and Germany, -2%) had negative growth during the period. All others had increases as follows: China, 62%; Russia, 16%; and Japan, 8%. Of the countries that had 5% or more of world pig iron production in 2002, only the United States had a decrease (-4%) in production. All others had increases as follows: China, 16%; Japan, 3%; and Russia, 3%.

World crude steel production rose by 6%. Six countries accounted for 5% or more of world production in 2002. Of those countries, China produced 31 Mt more crude steel in 2002 than in 2001. The others (Germany, Japan, the Republic of Korea, Russia, and the United States) combined produced 10 Mt more in 2002 than in 2001. These countries were also the ones that accounted for 5% or more of world crude steel production for the years 1998 through 2002. China's production rose by 58% during that period, while that of the United States fell by 7%.

Trade.—World iron ore imports rose by 8% and exceeded 500 Mt for the first time. After very large increases in imports in the past 2 years (27% in 2000 and 32% in 2001), China posted another sharp rise to 112 Mt in 2002 from 92 Mt in 2001. This was a gain of 21%. From 1993 through 2002, four countries accounted for more than 5% of world iron ore imports. Germany's share of imports in

that period fell from 9.3% to 8.6%, Japan's share fell from 29.3% to 25.1%, and the Republic of Korea's share fell from 9.1 Mt to 8.4 Mt after peaking at 9.6 Mt in 2001. China's share rose from 8.4% to 21.7%.

Australia and Brazil's combined share of world iron ore exports rose to 67.5% in 2002 from 66.1% in 2001. In decreasing order of market share of 2002 iron ore exports, Australia held 34.3%, Brazil, 33.2%, India, 6.1%, and Canada, 5.0%. No other exporting country had as much as 5%.

Seaborne iron ore trade reached 482 Mt in 2002, a significant increase over the 450 Mt in 2001 and exceeding the historic record of 455 Mt set in 2000 (Minerações Brasileiras Reunidas S.A., 2002).

Current Research and Technology

Construction was begun on a pilot plant to demonstrate the commercial readiness of a new method of ironmaking. The new technology, called ITmk3, was developed by Kobe Steel Ltd. of Japan and its subsidiary Midrex Technologies, Inc., which began research on the process in 1996. Construction began after Kobe Steel signed an agreement with Mesabi Nugget, LLC. Cliffs, Kobe Steel, along with subsidiaries of Steel Dynamics Inc. and Ferronomics Inc. are the owners of Mesabi Nugget. The project was intended to further develop the ITmk3 Process at a scaled-up level in anticipation of commercial operation. Its product, iron nuggets, is chemically similar to pig iron and is about the size of a taconite pellet (1.25 centimeters or ½ inch). The nuggets are a value-added product because they can be produced at the mine site (Robertson, 2002a; Skillings Mining Review, 2002f; Kobe Steel Ltd., 2002§).

Rio Tinto plc announced that it would spend A\$400 million (US\$208 million) to expand its HIs melt plant at Kwinana in Western Australia. The HIs melt process is a new direct iron smelting technology, developed largely by Rio Tinto in Australia. The project was to operate as a joint venture between Rio Tinto (60%) through its subsidiary HImet Corporation), U.S. steelmaker Nucor Corporation (25%), Mitsubishi Corporation (10%) and Chinese steelmaker Shougang Corporation (5%). Under the terms of the agreement, Nucor would have the right to use the HIs melt technology in any of its plants. After the expansion, the Kwinana operation would have a capacity of as much as 800,000 metric tons per year (t/yr) of high-quality pig iron (96% iron content). Kwinana has port, rail, and site infrastructure. Construction was scheduled to begin in the fourth quarter of 2002. The plant was expected to be commissioned in late 2004 and reach full production in the first half of 2006. The HIs melt process involves the injection of iron ore fines directly into a bath of molten iron via water-cooled lances. The process is claimed to be an environmentally friendly way of producing iron. It reportedly offered an alternative to the traditional blast furnace and a means of providing low-cost iron units for electric arc furnaces (Mining Journal 2002a; Robertson, 2002b; Rio Tinto plc, 2002§).

Argentina.—Hiero Patagónico Rionegrino SA (Hiparsa), owned 99% by the Rio Negro Province government, was put up for sale. Its facilities, the Sierra Grande Mine and the Punta Colorado pellet plant, have been idle since 1994 because of low pellet prices (Metal Bulletin, 2002b).

Australia.—Australian iron ore producer ABM Mining agreed to purchase the debt obligations of its Savage River project in Tasmania. The transaction would allow the mine and its associated Port Latta pellet plant to continue operations (Metal Bulletin, 2002a).

Australian contract-mining company Henry Walker Eltin had its existing mining contract for BHP Billiton Iron Ore's (BHPBIO) Orebody 25 extended for an additional 13 months (Mining Journal, 2002b). BHP Billiton also extended an existing contract with Leighton Contractors Pty. Ltd. at the Yarrrie-Nimingarra Mine (Mining Journal, 2002c). The new 33-month contract is worth about \$95 million and is an extension of a 4-year-old contract. The Yarrrie-Nimingarra Mine is expected to be depleted in 2005 (TEX Report, 2002a).

BHP Billiton announced approval for the development of a new iron ore mine at Mining Area C and an expansion of its Port Hedland port and rail facilities, both in the Pilbara region of Western Australia. Capital costs for the two projects were expected to be \$213 million for development of the new mine and \$351 million for BHP Billiton's Products and Capacity Expansion Program (PACE) for Port Hedland. The mining area C development has the potential to increase BHPBIO's iron ore production by as much as 15 Mt/yr by 2011. The PACE was expected to increase BHPBIO's export capacity to 81 Mt/yr by 2004 from 67 Mt/yr and provide the foundations for expansion to more than 90 Mt/yr by 2011, an increase of more than 40%. As part of the mining area C development, BHP Billiton entered into a joint venture with Pohang Iron & Steel Co. Ltd. (POSCO) of the Republic of South Korea, whereby POSCO will acquire a 20% interest in the "C Deposit" section of mining area C. Under the agreement, POSCO has committed to purchase a minimum of 3 Mt/yr of ore following initial rampup and to maintain a long-term strategic alliance with BHP Billiton for supply of other iron ore products (BHP Billiton, 2002a§).

All necessary approvals and agreements were in place for construction of the new mine to commence immediately, with full-scale mining of the C Deposit sublease to begin in 2003. Development of the PACE project was to commence later in the year subject to final regulatory approvals. Mining Area C is 37 km from BHP Billiton's existing Yandi mine and contains the largest undeveloped Marra Mamba resource in the Pilbara. The resource reportedly was estimated at 890 Mt with significant further exploration potential. C Deposit is on the northern flank of mining area C and reportedly has a proven and probable reserve of 201 Mt (BHP Billiton, 2002a§).

The new mining area C development will include the following:

- construction of a 38-km railway spur, linking Mining Area C operations to Yandi;
- installation of infrastructure including power, water, airstrip and access roads, and
- accommodation facilities for a construction workforce of 500 and a permanent operations workforce of 150.

Expansion of the port facilities will include the following:

- development of a new western stockyard;
- a major upgrade and enhancement of dust suppression systems;
- an upgrade of the underharbor tunnel conveyor to 10,000 metric tons per hour (t/hr) from 4,500 t/hr;
- establishment of an additional lump rescreening facility, and
- extension of existing shipping berths.

The first phase of the port expansion will increase capacity to 81 Mt/yr by 2004 from 67 Mt/yr and will require a workforce of approximately 400. About 20 new permanent positions will be created by the port expansion. Capital expenditure for PACE includes the installation of more modern and efficient dust suppression systems at the port facility and was expected to cost about \$33 million. Under the joint-venture arrangement, ownership of the C Deposit development will be BHP Billiton (65%), POSCO (20%), CI Minerals Australia Pty Ltd (8%), and Mitsui Iron Ore Corporation (7%) (BHP Billiton, 2002a§).

As part of the expansion of Mining Area C, BHPBIO ordered 120 ore rail cars valued at about \$8 million. The cars were scheduled to be delivered by August 2003 (Metal Bulletin, 2002c).

BHP Billiton announced late in the year that it had approved a project to produce a new, high value, lump pisolite iron ore product at its Yandi mine in Western Australia. Approval for the \$15 million Yandi Lump Project followed the signing of letters of intent with a number of major Japanese customers to purchase Yandi lump. BHP Billiton was to deliver as much as 4 Mt/yr of lump pisolite product. Modifications were to be made to the existing Ore Handling Plant No. 2 (OHP2) to support onsite production of fine and lump ores, without affecting the quality of either product. BHP Billiton was undertaking feasibility studies to expand the Yandi Mine's capacity from its current level of 32 Mt/yr. The Yandi Mine has produced lump on a trial basis since 1999, shipping more than 2 Mt to customers. These trials indicated that Yandi lump performance was suitable for the ironmaking process (BHP Billiton, 2002b§).

A \$25 million primary crusher and conveyor system was built at the BHP Billiton Yandi Mine. The new primary crusher and 5.3-km conveyor, together with modifications to the existing OHP2, will raise the capacity from 38 Mt/yr to the 42 Mt/yr. The additions increased the flexibility of the Yandi mining operation by reducing truck haulage distances (Metal Bulletin, 2002i; Mining Journal, 2002d; BHP Billiton Iron Ore, written commun., April 30, 2003).

Rio Tinto's wholly owned Hamersley iron ore unit signed a \$68 million joint-venture mining agreement with China's largest steelmaker Shanghai Baosteel Group Corp. Hamersley will supply Baosteel with a total of 200 Mt of iron ore products averaging 10 Mt/yr during the joint venture's 20-year life. The ore will come from the new mine, 10 km east of the Paraburdoo mine in Western Australia's Pilbara region. Perth-based Hamersley will hold a 54% equity share of the venture with Baosteel holding the remaining 46%. The Rio Tinto unit will build and operate the mine. Subject to relevant government approvals, construction of the mine was to begin in 2002, with the first iron ore due to be shipped in about 2004 (West Australian, 2002§).

Hamersley closed its Brockman Mine from early in the year until late in the year for refurbishing. The shortfall of 4 Mt/yr was made up by other operations (Metal Bulletin, 2002i).

Hamersley increased the loading capacity at its Parker Point port in Western Australia by rebuilding the ore screening plant. The increased capacity will allow the company to cut shiploading times. The screens are used to remove dust and size the iron ore a final time prior to loading (Mining Journal, 2002e).

The Robe River Iron Associates' \$450 million West Angelas Mine was formally opened at an August 24 ceremony. The mine, 53% owned by Rio Tinto, was the Pilbara region's newest iron ore mine. It contained a reported 440 Mt of Marra Mamba ore, regarded as the next generation of Australian iron ore. This was the first Marra Mamba ore to be marketed as a stand-alone product. The West Angelas operation consists of an open pit mine, an ore processing plant that produces lump and fine ores, stockpiles, reclaimers, and train loading facilities. It is 110 km west of Mount Newman in Western Australia. From the mine, ore is moved via rail 330 km to Robe River's port facilities at Cape Lambert, where it is stockpiled before being loaded onto ocean vessels. Capacity at Cape Lambert was expanded to 50 Mt/yr to handle West Angelas products. The expansion was accomplished by extending a wharf and adding a second shiploader. Operational flexibility was enhanced because the shiploaders can be configured to load either one or two vessels simultaneously. Ore production at West Angelas began in April. Trial shipments were made to selected customers in May and commercial shipments began in July. The mine will produce at an initial rate of 7 Mt/yr, rising to about 20 Mt/yr by 2006, in line with customer demand. Six Japanese steel mills have reached agreements with Robe River on 5-year contracts to take West Angelas ore (Skillsing Mining Review, 2002h; TEX Report, 2002b).

Hamersley operations, Brockman, Marandoo, Mount Tom Price, and Yandicoogina collectively produced 57.6 Mt of iron ore in 2002. Production at the joint venture Channar Mine was 10.4 Mt. The Robe River joint venture, partially owned by Rio Tinto, produced 35.9 Mt. The Robe River production was from The Mesa J and West Angelas Mines (United Nations Conference on Trade and Development, 2003, p. 31).

The developers of the Hope Downs iron ore deposit failed in their attempt to have the Western Australia Supreme Court grant them access to BHP Billiton's Mount Newman to Port Hedland railway line. The Hope Downs deposit is close to the rail line. The ruling means that Hancock Prospecting and South African iron ore miner Kumba Resources Ltd. will have to spend \$165 million to build their own 325-km railway line. This brought the development cost to \$770 million. The court ruled that Hope Downs had no legal standing under the 1987 Rail Transport Agreement because it was not yet an operator of an iron ore mine (Metal Bulletin, 2002j; Weir, 2002b§).

Mount Gibson Iron Ltd. purchased the Tallering Peak iron ore deposit in Western Australia from Kingstream Steel Ltd. on August 1. Tallering Peak is 130 km east of the Port of Geraldton. Mount Gibson began developing the deposit and was expecting to begin production in the second quarter of 2003. Tallering Peak was reported to have hematite resources estimated at 39.5 Mt at grades of

between 52.7% iron and 60.8% iron, and magnetite resources estimated at 48.2 Mt, with grades of between 28.9% and 34.4% Fe. Mount Gibson plans to mine and ship 1.5 Mt/yr of hematite ore from the mine. Production capacity would be doubled to 3 Mt/yr by commissioning in 2004, a second mine at Mount Gibson, 250 km to the southeast of Geraldton. With the addition of the new deposit, combined with its existing Mount Gibson deposit, the Western Australia mining company reportedly has a total of 27.65 Mt of hematite ore (Metal Bulletin, 2002q, r; Mining Journal, 2002f).

Mount Gibson signed a port services agreement with the Geraldton Port Authority (GPA) for the unloading of trains, handling and stockpiling of ore, and loading of ore carriers. The GPA entered a contract to deepen the port to permit the loading of 60,000-Mt iron ore carriers. Dredging began during the year and was expected to be completed in July 2003. The company planned to build a 150,000-Mt-capacity iron ore storage facility on land leased from the GPA, with the train unloader, conveyor systems, and 1,800-t/hr shiploader being provided and operated by the Port Authority. Mount Gibson signed a contract with Glencore International AG, whereby Glencore will purchase the 1.5 Mt/yr production from Mount Gibson (Mount Gibson Iron Ltd., 2002; TEX Report, 2002c).

Portman Ltd. had planned an expansion in its rate of iron ore production at Koolyanobbing, near Southern Cross, to 6 Mt/yr in 2003 and 8 Mt/yr in 2004. Portman was forced to put those plans on hold after the company revealed that it lacked the required ore reserves. Portman then planned to increase its production from the 2002 rate of 4.6 Mt/yr to 6 Mt/yr by the end of 2003. Also on hold was the building of a railway extension to move ore from Koolyanobbing to the Port of Esperance rather than the expensive use of trucks then employed. Portman was dealt another blow after failing to get environmental approval for its Koolyanobbing expansion because of an endangered flowering bush. The Environmental Protection Authority rejected Portman's plans to mine the Windarling Range and Mount Jackson tenements at Koolyanobbing because the flowering bush *Tetratheca*, already endangered, could become critically endangered (Weir, 2002c§, d§).

Brazil.—Companhia Siderúrgica Nacional operated its captive mine, the Casa de Pedro, producing 13.1 Mt (United Nations Conference on Trade and Development, 2003, p. 26).

The Brazilian Government and its development bank, Banco Nacional de Desenvolvimento Economico e Social, sold a 28% interest in CVRD. The offering was the third and final phase of Brazil's privatization of CVRD. The Government no longer holds an equity interest in CVRD, although it holds a veto power over major decisions made by the company (Mining Journal, 2002g).

CVRD had sales of 163 Mt of iron ore, of which 28 Mt was pellets in 2002 (Companhia Vale do Rio Doce, 2003, p. 20, 21). The company produced 157.4 Mt of iron ore, including pellets. Production was from CVRD's northern and southern systems Serra Geral and Samitri, and excluding Ferteco, Samarco, and Urucum (United Nations Conference on Trade and Development, 2003, p. 25).

In 2002, 9.9% of CVRD's electricity consumption was generated by its own powerplants. With the investments scheduled, based on concessions to build and operate new plants, the company was expected to be able to meet about 50% of its projected consumption by the end of the decade. By making investments in hydroelectric facilities, CVRD expects to be able to protect itself from the price volatility of carbon fuels. CVRD, its subsidiaries, affiliated companies, and joint ventures were responsible for 4.5% of Brazil's electricity consumption during the year. CVRD had stakes in 10 hydroelectric stations, three of which were in operation. Two more were scheduled to come online in 2003 and five were waiting for the start of construction. The investments to build powerplants and in the licensing of future power projects came to \$78 million in 2002. CVRD's portion of two powerplants was directed to its Timbopepa and Itabira operating units enabling them to reduce energy costs by \$13 million (Companhia Vale do Rio Doce, 2003, p. 32-33).

CVRD planned to invest \$39.6 million to increase the production capacity at Fábrica Nova to 15 Mt/yr in 2009. Another \$8.5 million was to be used to replace equipment and boost capacity of the pelletizing plants at Tubarão from 25 Mt/yr to 28 Mt/yr in 2005 (Companhia Vale do Rio Doce, 2003, p. 46).

The Brazilian Ministry of Finance, through a note issued by the Secretaria de Acompanhamento Economico (SEAE), recommended the approval of CVRD's acquisition of several Brazilian iron ore companies made by CVRD in 2000 and 2001, including Mineração Socoimex, Samitri, Ferteco, and Caemi. Pursuant to the note from SEAE, CVRD must sign a formal commitment with the Conselho Administrativo de Defesa Economia (CADE), according to the following guidelines:

1. The iron ore prices charged by CVRD to domestic steel producers will be equal to the price charged to international clients minus transportation costs.
2. CVRD global reference prices must be publicly disclosed.
3. The commitment must have a 20-year term, which may be extended by CADE.
4. CVRD will be subject to penalties if it does not comply with the commitment with CADE.

CADE is the Federal agency in Brazil responsible for enforcing antitrust regulations. The recommendation clears the way for CVRD to proceed with its long-planned restructuring of Caemi to take advantage of production and logistics synergies between Caemi subsidiary Mineração Brasileira Reunidas S.A. (MBR) and Ferteco Mineração S.A. (Ferteco). CVRD's recent acquisitions have given it direct or indirect control of more than 95% of Brazil's iron ore industry. The acquisitions led Brazilian steelmakers to voice fears over possible local iron ore supply distortions. However, the increasingly globalized nature of iron ore and steel industries and their pricing strategies, as well as the evident need for iron ore producers to achieve scale economies in view of recent price erosion, have in recent months led the market to accept ownership concentration in iron ore as virtually inevitable. CVRD was to be required to charge the Brazilian steelmakers the same iron ore prices as it charges in the international market, minus export costs, including sea freight, port charges, and mine-to-port rail freight (Kinch, 2002a; TEX Report, 2002d).

CVRD is putting a development plan into operation at its southern system iron ore mines, following the company's mine acquisitions in the area. The southern system will raise production to 88 Mt in 2010 from an estimated 72.7 Mt of ore in 2002. The southern system plan involves a substantial boost in production at its Minas Centrais complex to 21.5 Mt in 2010 from 12.3 Mt in 2002. Output at the Itabira complex will increase slightly to 42 Mt in 2010 from this year's 39.5 Mt, while production at the Mariana

complex will rise to 20.5 Mt in 2010 from 18.8 Mt in 2002. Production from other mine acquisitions will rise to 4 Mt in 2010 from 2.1 Mt in 2002 (Kinch, 2002d).

CVRD's Itabira complex was expected to maintain production at a level of 42 Mt/yr for more than 20 years after reaching production at this level in 2007. The Mariana complex was to undergo changes as production from the Capanema Mine, which was expected to be depleted in 2003, comes to a halt. This production was to be replaced by output from former Samitri Mine Fábrica Nova. Ore from the Fábrica Nova will be beneficiated by the Timbopeba Mine plant 10 km away, using Capanema's conveyor belt. Timbopeba's reserves were expected to be depleted in 2006, when its production too will be replaced by production from the Fábrica Nova. During the next few years, it is expected that iron ore from the Fazendão Mine will be used to feed the beneficiation plant at the former Samitri Mine (part of the Alegria complex). In the Minas Centrais area, the Gongo Soco Mine, formerly owned by Socoimex, will cease production in 2010. The shortfall will be made up by the Brucutu Mine, which is expected to start up in 2006 and increase its production continuously until reaching 18 Mt/yr in 2010. Also in this area are the Gandarela reserves, which are expected to be developed in a joint CVRD-Ferteco-MBR project (Kinch, 2002c).

CVRD had a new shiploader installed at its iron ore terminal in São Luis, the port that serves Carajás. The shiploader has a capacity to load 8,000 t/hr and will be used to load vessels of 200,000 dead weight tons (dwt). A dedicated conveyor system was also installed. The other two loaders already operating at the terminal are the Pier I shiploader, which is the world's largest with a capacity of 20,000 t/hr for vessels of as much as 350,000 dwt and the Pier II shiploader with a capacity of 8,000 t/hr for vessels of as much as 150,000 dwt (Skillings Mining Review, 2002i).

A joint-venture project between CVRD and Nucor Corp. to establish a pig iron plant in Brazil to feed Nucor's U.S. steelworks was expected to be approved by the yearend (Kinch, 2002b).

CVRD inaugurated its 12th iron ore pellet plant. The plant, at the Port of Ponta da Madeira, São Luis, is the only pellet plant at the port and the only one to use ore from Carajás. Plant production capacity is 6 Mt/yr, bringing CVRD's combined pellet capacity to 43 Mt/yr. The plant uses the same traveling grate process used at the seven pellet plants at Tubarão. Total capital expenditure for the project was \$408 million. The \$408 million comprises investments in plant construction, and all the infrastructure for the project. The plant will lead to a boost in CVRD's Carajás mine and logistics capacity to 62 Mt/yr by the yearend 2003 or early 2004, up from the 56 Mt/yr in 2002 (Metal Bulletin, 2002f; Skillings Mining Review, 2002a).

Caemi Mineração e Metalurgica S.A. (Caemi), 85% owner of MBR, announced plans to develop its Capão Xavier iron ore deposit. The new mine is expected to begin production in the second half of 2003 with production of as much as 8 Mt/yr of lump and fine ores during a 17-year period. Located in Minas Gerais, the deposit reportedly contains 140 Mt of ore (Mining Journal, 2002h).

MBR obtained financing to implement an expansion program that involved starting two new mines and additional handling capacity at Septiba port. MBR was developing the Tamanduá and Capitão do Mato mines, which will replace the Aguas Claras and Mutuca mines. The Aguas Claras mine was expected to be depleted of ore late in the year. The Tamanduá Mine was producing at close to its capacity, and the Capitão do Mato was almost ready to begin operations. At the company's Guaíba Island export terminal at Septiba in Rio de Janeiro State, a second railcar dumper and a third stacker-reclaimer were assembled. These installations boosted the port's capacity from the previous 28 Mt/yr to about 31 Mt/yr. MBR produced 32.7 Mt of iron ore (Metal Bulletin, 2002p; TEX Report, 2002e; United Nations Conference on Trade and Development, 2003, p. 26).

Ferteco (a subsidiary of CVRD) ordered four 150-ton haul trucks (Mining Journal, 2002i). Ferteco produced 18.9 Mt in 2002 (United Nations Conference on Trade and Development, 2003, p. 26).

Samarco Mineração S.A. completed a dredging and improvement project in May at its Ponta Ubu port terminal in Espírito Santo State. The result was that the port can now handle ships of as much as 200,000 dwt, compared with a previous ship maximum size of 170,000 to 180,000 dwt. The port improvements took 6 months to complete and increased the shiploading rate to 7,000 t/hr. The overall capacity of the terminal is 15 Mt/yr. Samarco produced 15.0 Mt of ore including pellets during the year. CVRD has a 50% interest in Ferteco (Metal Bulletin, 2002w; United Nations Conference on Trade and Development, 2003, p. 26).

Canada.—Coowners of Quebec Cartier Mining Co. (QCM) did not reach their goal of selling the Canadian iron ore producer, but found a way to significantly reduce their ownership. Caemi and Dofasco Inc., a Canadian steelmaker, had been trying to sell the iron ore producer, but depressed prices in the iron ore market made it difficult. Dofasco announced late in the year that it had struck a deal to sell part of QCM to unnamed outside investors in a move to significantly restructure the company. The restructuring was designed to finance further development and help sustain the company's ability to operate competitively in an increasingly global iron ore market (Metal Bulletin, 2002v). QCM produced 12.2 Mt of ore in 2002 (United Nations Conference on Trade and Development, 2003, p. 24).

Rio Tinto increased its share of The Iron Ore Company of Canada (IOC) to 58.7%. IOC produced 12.8 Mt of iron ore during the year. Wabush Mines had output of 4.5 Mt of ore (United Nations Conference on Trade and Development, 2003, p. 24).

China.—In Hebei Province, a new iron ore mine went into production primarily to supply Handan Steel and other steelworks in the Province. In Anhui Province, the Longqiao Mine was to have begun operations with completion of the project scheduled for 2005. The mine began sinking a 558-meter shaft capable of hoisting 1 Mt/yr of ore. The first stage of the project was expected to be completed by the end of 2004, at which time the mine is expected to produce 525,000 t/yr of iron concentrate. The mine will also produce copper and sulfur concentrates. Longqiao reportedly hosts reserves of more than 100 Mt, of which magnetite is the primary ore (TEX Report, 2002f; Engineering & Mining Journal, 2003§).

Kunming Iron & Steel, after the depletion of ore at its four existing iron ore mines made an initial investment of more than \$10 million to begin developing a new iron ore deposit. The new mine, Dahongshan, some 300 km from Kunming, reportedly contains 350 Mt of ore. Construction was to begin in 2002, with mining to start in 2003 (Metal Bulletin, 2002n).

Jiangsu Shagang Group Co. signed a letter of intent with ThyssenKrupp Stahl in 2001 to move a 2.1 Mt/yr-capacity integrated steelworks from Dortmund, Germany, to China. Dismantling of the equipment began in February 2002 (TEX Report, 2002g).

Shanghai Baosteel Group Corporation (officially Baogang), on December 21, opened its new port on Ma Ji Shan Island, close to the mouth of the Yangtze River. The \$210 million facility has a capacity of 10 Mt/yr and can accommodate vessels of 250,000 to 300,000 dwt (TEX Report, 2002h).

Guinea.—At the Simandou project, drilling by Rio Tinto plc confirmed the potential for high-grade hematite resources containing more than 1 Gt of material with low aluminum, phosphorous and silica. The Guinean Government signed an agreement allowing Rio Tinto to undertake future development of the resources (Rio Tinto plc, 2003, p. 19).

India.—Orissa's Government agreed to grant iron ore leases to Bhushan Steel as a captive source of feedstock for its proposed 1.2 Mt/yr steel plant to be set up in Jharsuguda District (Metal Bulletin, 2002d). A railway from Orissa State to the Port of Paradeep was being constructed. The line, expected to be completed in 2003, was expected to reduce railway freight charges by \$4 per ton. It is also expected to help raise exports. The 155-km railway will reduce the distance to the port by 300 km (Metal Bulletin, 2002s).

Ennore Port Ltd., one of the first private ports to be developed to handle bulk and liquid cargoes, approved a proposal to develop an iron ore handling facility. Chennai Port, which handles 8 Mt/yr of iron ore from Bellary Hospet, was expected to cease iron ore exports by early 2005. Ennore plans to develop a berth for iron ore that would be capable of handling vessels of 225,000 t or more (Metal Bulletin, 2002k).

The National Mineral Development Corp. (NMDC) completed the development of the numbers 10 and 11A iron ore deposits in the Bailadila area of Chattisgarh State. The new mines were expected to produce 2.4 Mt/yr of lump ore and 2 Mt/yr of fine ore when in full production, a level that was expected to be reached in April 2003 (Metal Bulletin, 2002t). NMDC also agreed to develop the Daitari iron ore deposit in Orissa for Neelachal Ispat Nigam (NINL). NMDC operates iron ore mines in Chattisgarh and Karnataka, but had been unable to obtain properties in Orissa, where most of India's new iron ore mining projects are found. So NMDC took an equity position in INIL to finance the development of an iron ore mine in Daitari to feed the NINL steel plant with about 2 Mt/yr to 2.5 Mt/yr (Metal Bulletin, 2002u).

Sesa Goa, the largest private sector producer and exporter of iron ore in Goa, was developing a second iron ore mine in Orissa. The Jalahuri Mine will be a small satellite operation to the main Sesa Goa in Orissa. The company also acquired iron ore mines in Karnataka, which have a capacity of about 2 Mt/yr. These moves are part of Sesa Goa's plans to shift production away from Goa, where its reserves are expected to last no more than 15 years (Metal Bulletin, 2002x, y).

Iran.—The Gol-e-Gohar Iron Ore Co. was expected to award a contract late in the year for the construction of a 4-Mt/yr pellet plant near its mine 380 km from Bandar Abbas. The company chose Lurgi technology for the plant. The mine produced about 2.5 Mt during the year and expected output to rise to 3.5 Mt in 2003. Mining is done at the number 1 anomaly, which reportedly had reserves of 200 Mt. Plans call for the anomaly to feed the pellet plant, which was expected to begin operations in about 3 years. Gol-e-Gohar (owned 51% by Iran's state-sector mining and metallurgical holding company Imidro and 49% owned by Bank Sepah) serves the Mobarakeh and Khouzestan steel plants in Iran and sells about 1 Mt/yr to the Gulf Industrial Investment Co., a 4-Mt/yr pellet plant in Bahrain. The new plant will feed the planned Hormuzgan steelworks near Bandar Abbas. Iran's other main iron ore mine, Chador Malu Mining and Industrial Co., which has the same ownership as Gol-e-Gohar, is planning to build a 4 Mt/yr pellet plant at Ardakan, not far from the Chador Malu Mine. Construction of the plant was expected to take 4 years. Chador Malu produces 4 Mt/yr of pellet feed. Its beneficiation plant has three lines with 5 Mt/yr of capacity, which will be increased to 6 Mt/yr and then to 8.5 Mt/yr with the addition of two more lines (Metal Bulletin, 2002h).

Kazakhstan.—The Sokolov-Sarbai Mining Production Association concluded an export agreement with China. The company produced 13.1 Mt of concentrates and pellets during the year (United Nations Conference on Trade and Development, 2003, p. 21).

Mauritania.—Société Nationale Industrielle et Minière, the only domestic iron ore producer, had an output of 9.6 Mt (United Nations Conference on Trade and Development, 2003, p. 21).

Norway.—Ivanhoe Mines Ltd. abandoned the Sydvaranger Mine after failing to find a way to make it profitable (United Nations Conference on Trade and Development, 2003, p. 19).

Peru.—Shougang Hierro Peru S.A. operating the Marcona Mine produced 5.0 Mt of ore (United Nations Conference on Trade and Development, 2003, p. 27).

South Africa.—The large London-based mining company, Anglo American Plc., for some time has wanted to enter the iron ore industry with its large profit margins. In March, the company acquired a 9.29% interest in Kumba, with an option to acquire a further 10.47% from Stimela Mining. By yearend, however, Kumba announced to its shareholders that the necessary competition and regulatory approvals had not been granted. Anglo American also acquired 44.9% of Anglovaal Mining Ltd., which has a 50.3% shareholding in Assmang Ltd., owner of the 5-Mt/yr Beeshoek iron ore mine (Mining Journal, 2002j, k; TEX Report, 2002i).

Anglo American signed a memorandum of understanding (MOU) with the South African Government covering the future development of the Kalahari iron ore resource in the Northern Cape Province. The MOU was intended to pave the way to establishing a public-private partnership to ensure that the iron ore resources in the Kalahari region are developed to their full potential. The Government was represented in the MOU by the Departments of Trade and Industry, Public Enterprises, and Minerals and Energy. The MOU provides that the signatories ensure that the corporate entities which own or operate the Northern Cape iron ore assets will maintain their head office in South Africa, or establish their primary listing on the Johannesburg Securities Exchange (Mining Journal, 2002k).

South Africa's state-owned port operator Portnet has signed a cooperation agreement with the Chinese Port of Qingdao that was expected to help Kumba increase exports to northeast China. Kumba exports about 10 Mt/yr of iron ore to China. The deal was

designed to enable Kumba to increase the quantity of iron ore it exports to northeast China from 2.2 Mt in 2002 to 4 Mt/yr within the next few years. The agreement was to stand for 10 years (Metal Bulletin, 2002g).

Kumba negotiated a new freight agreement with Transnet Ltd. for the transport of iron ore from the Sishen Mine in the Northern Cape to Saldanha Bay. Transnet is the holding company for the state-owned rail company Spoornet, which owns the company Ores, which manages the Sishen-Saldanha line. The deal allocates 23.5 Mt/yr of shipping capacity to Kumba, slightly more than the last agreement. Included are 1.8 Mt for the Saldanha steelworks and an additional 1.8 Mt for the export market. Kumba exported about 20 Mt of ore in 2001. The new contract incorporates the ore previously handled by other contracts (Metal Bulletin, 2002m). Kumba produced 28.6 Mt and Assmang Limited produced 4.5 Mt. The Anglo American controlled Highveld Steel & Vanadium operates the captive Mapochs vanadium/iron ore mine, consistently producing 2.5 Mt/yr (United Nations Conference on Trade and Development, 2003, p. 23).

Sweden.—LKAB increased the production capacity in its KK3 pellet plant in Kiruna by 700,000 t/yr boosting its capacity to 5 Mt/yr. This expansion was part of a project to make pellets from higher phosphorus ore, which released more low phosphorus ore for fines production (Metal Bulletin, 2002o). LKAB produced 20.3 Mt of ore in 2002 (United Nations Conference on Trade and Development, 2003, p. 19).

Ukraine.—Inguletsky GOK, the largest domestic iron ore producer, produced 12.4 Mt in 2002 (United Nations Conference on Trade and Development, 2003, p. 21).

Venezuela.—The state-controlled CVG Ferrominera Orinoco produced 20.9 Mt of ore in 2002 (United Nations Conference on Trade and Development, 2003, p. 28).

Outlook

The domestic iron ore industry is totally dependent on the steel industry for sales. This dependence is not expected to change in the near future. Information about steel industry trends is provided in the Outlook section in the Iron and Steel chapter of the 2002 USGS Minerals Yearbook. For the near term, growth of the U.S. iron ore industry is tied to the growth of the integrated steelworks along the Great Lakes. Significant expansion in the domestic iron ore industry may be possible if one or more direct-reduction processes prove to be economic for existing and potential Great Lakes producers. If this development occurs, the iron ore industry can supply the rapidly expanding minimill sector of the U.S. steel industry. Steel alloy products require lower residual element content than can be readily achieved with scrap. For this reason, imported DRI already plays a role in the coastal regions of the United States; at the same time, domestically produced DRI could become competitive further inland where cheaper power is available. However, on a global scale, no matter how spectacular DRI growth is during the next decade, DRI will not be able to replace more than a fraction of the world's blast furnace production. The blast furnace is expected to remain the mainstay of the iron and steel industries in most developed countries during the next 25 years.

The fortunes of the international iron ore industry will depend to a large degree on the continuing growth of iron ore consumption in China. The available evidence indicates that iron ore consumption will continue to grow and increasingly more of that consumption will be satisfied by imports.

References Cited

- American Iron and Steel Institute, 2003, Annual statistical report: American Iron and Steel Institute, 130 p.
- American Metal Market, 2002a, Iron ore terminal to be moved from Lorain, Ohio, to Cleveland: American Metal Market, v. 110, no. 68-5, May 17, p. 6.
- American Metal Market, 2002b, National dancing with three potential suitors: American Metal Market, v. 110, no. 89-3, October 9, p. 4.
- Cleveland-Cliffs Inc., 2003, Annual report: Cleveland, Ohio, Cleveland-Cliffs Inc., 47 p.
- Companhia Vale do Rio Doce, 2003, Annual report: Rio de Janeiro, Brazil, Companhia Vale do Rio Doce, 143 p.
- Kinch, Diana, 2002a, Brazil approves CVRD's iron ore domination: Metal Bulletin, no. 8736, December 31, p. 13.
- Kinch, Diana, 2002b, CVRD-Nucor pig iron plant may start up in 2004: Metal Bulletin, no. 8672, May 9, p. 17.
- Kinch, Diana, 2002c, CVRD ready for growth in new areas: Metal Bulletin Monthly, no. 378, June, p. 33.
- Kinch, Diana, 2002d, CVRD unveils plans for southern system: Metal Bulletin, no. 8695, August 1, p. 15.
- Metal Bulletin, 2002a, ABM debt buyback breathes new life into Savage River: Metal Bulletin, no. 8708, September 19, p. 18.
- Metal Bulletin, 2002b, Argentinian iron ore mine put up for sale: Metal Bulletin, no. 8691, July 15, p. 15.
- Metal Bulletin, 2002c, BHP Billiton buys wagons: Metal Bulletin, no. 8717, October 21, p. 18.
- Metal Bulletin, 2002d, Bhushan Steel gets iron ore leases in Orissa for hot coil project: Metal Bulletin, no. 8677, May 27, p. 33.
- Metal Bulletin, 2002e, Cliffs rejigs contracts with Rouge and Bethlehem: Metal Bulletin, no. 8694, July 29, p. 21.
- Metal Bulletin, 2002f, CVRD to limit S o Luis pellets to 1m tonnes in 2002: Metal Bulletin, no. 8701, August 22, p. 14.
- Metal Bulletin, 2002g, Deal boosts Kumba's access to China: Metal Bulletin, no. 8722, November 7, p. 18.
- Metal Bulletin, 2002h, Gol-e-Gohar adds 4m tpy pellet plant: Metal Bulletin, no. 8733, December 16, p. 16.
- Metal Bulletin, 2002i, Hamersley closes Brockman mine for refurbishment: Metal Bulletin, no. 8645, January 31, p. 20.
- Metal Bulletin, 2002j, Hope dashed in railway ruling: Metal Bulletin, no. 8707, September 19, p. 12.
- Metal Bulletin, 2002k, India's iron ore exporters all for Ennore: Metal Bulletin, no. 8676, May 23, p. 21.
- Metal Bulletin, 2002l, New plant boosts Yandi iron ore output: Metal Bulletin, no. 8686, June 27, p. 22.
- Metal Bulletin, 2002m, Kumba and Transnet sign new freight deal: Metal Bulletin, no. 8663, April 8, p. 30.
- Metal Bulletin, 2002n, Kunming I&S seeks to expand mining activities: Metal Bulletin, no. 8649, February 14, p. 23.
- Metal Bulletin, 2002o, LKAB nudges capacity up despite weak western markets: Metal Bulletin, no. 8652, February 25, p. 18.
- Metal Bulletin, 2002p, MBR wins finance to expand iron ore mining: Metal Bulletin, no. 8649, February 14, p. 22.
- Metal Bulletin, 2002q, Mount Gibson completes takeover of Tallering Peak iron ore deposit: Metal Bulletin, no. 8697, August 8, p. 17.
- Metal Bulletin, 2002r, Mount Gibson to start mining Tallering Peak in Q2 2003: Metal Bulletin, no. 8703, September 2, p. 22.
- Metal Bulletin, 2002s, New rail line will help India's exports increase: Metal Bulletin, no. 8651, February 21, p. 20.

Metal Bulletin, 2002t, NMDC completes new iron ore projects: Metal Bulletin, no. 8726, November 21, p. 17.

Metal Bulletin, 2002u, NMDC secures access to ore in Orissa: Metal Bulletin, no. 8695, August 1, p. 14.

Metal Bulletin, 2002v, QCM shareholders agree restructuring: Metal Bulletin, no. 8735, December 23, p. 14.

Metal Bulletin, 2002w, Samarco upgrades Ubu iron ore port for larger vessels: Metal Bulletin, no. 8683, June 17, p. 13.

Metal Bulletin, 2002x, Sesa Goa expands in two states: Metal Bulletin, no. 8665, April 15, p. 17.

Metal Bulletin, 2002y, Work starts on Sesa Goa's second Orissa mine: Metal Bulletin, no. 8666, April 18, p. 20.

Minerações Brasileiras Reunidas S.A., 2002, Annual report: Rio de Janeiro, Brazil, Minerações Brasileiras Reunidas S.A., 101 p.

Mining Journal, 2002a, Aker wins HIs melt contract: Mining Journal, v. 339, no. 8709, November 1, p. 308.

Mining Journal, 2002b, Anglo tightens hold on Kumba: Mining Journal, v. 339, no. 8713, November 29, p. 373.

Mining Journal, 2002c, CVRD sale success: Mining Journal, v. 338, no. 8678, March 29, p. 225 & 223.

Mining Journal, 2002d, First AC drive haul trucks for Brazil: Mining Journal, v. 339, no. 8697, August 9, p. 95.

Mining Journal, 2002e, Hamersley improves ship loading: Mining Journal, v. 339, no. 8699, August 23, p. 140.

Mining Journal, 2002f, HWE completes Yandi crusher: Mining Journal, v. 339, no. 8692, July 5, p. 7.

Mining Journal, 2002g, HWE iron ore extension: Mining Journal, v. 338, no. 8677, March 22, p. 214.

Mining Journal, 2002h, Leighton extends iron-ore contract: Mining Journal, v. 339, no. 8708, October 25, p. 293.

Mining Journal, 2002i, New mine for Caemi: Mining Journal, v. 339, no. 8702, September 13, p. 184.

Mining Journal, 2002j, Political MoU in SA iron ore: Mining Journal, v. 339, no. 8716, December 20/27, p. 431.

Mining Journal, 2002k, Talling Peak iron-ore deposit sold: Mining Journal, v. 339, no. 8681, April 19, p. 285.

Mount Gibson Iron Ltd., 2002, Annual report, Perth, Australia, Mount Gibson Iron Ltd., 44 p.

Pinkham, Myra, 2002, North American miners seek survival strategies: Metal Bulletin Monthly, no. 378, June, p. 31.

Robertson, Scott, 2002a, Department of Energy to provide funds for Mesabi Nugget pilot plant: American Metal Market, v. 110, no. 89-2, October 8, p. 4.

Robertson, Scott, 2002b, Nucor making progress with HIs melt, Decatur: American Metal Market, v. 110, no. 91-2, October 22, p. 3.

Rio Tinto plc, 2003, Annual review: London, United Kingdom, Rio Tinto, 39 p.

Skills Mining Review, 2002a, CVRD inaugurates world's most automated iron ore pellet plant: Skills Mining Review, v. 91, no. 7, April 6, p. 3.

Skills Mining Review, 2002b, Empire iron mine to resume operation in late March: Skills Mining Review, v. 91, no. 6, March 23, p. 18.

Skills Mining Review, 2002c, Hibbing Taconite reaches 1 billion ton milestone: Skills Mining Review, v. 91, no. 7, April 6, p. 8.

Skills Mining Review, 2002d, Hibac schedules 2002 shutdowns: Skills Mining Review, v. 91, no. 1, January 5, p. 3.

Skills Mining Review, 2002e, Ispat-Inland receives three-year DOE grant: Skills Mining Review, v. 92, no. 8, April 20, p. 15.

Skills Mining Review, 2002f, Kobe begins construction of iron nugget project experimental furnace: Skills Mining Review, v. 91, no. 16, August 17, p. 19.

Skills Mining Review, 2002g, National Steel Pellet restarts operations: Skills Mining Review, v. 91, no. 1, January 5, p. 3.

Skills Mining Review, 2002h, Robe River opens the West Angelas Mine in Australia's Pilbara Region: Skills Mining Review, v. 91, no. 17, September 7, p. 6.

Skills Mining Review, 2002i, Third shiploader ordered for Carajás iron ore terminal: Skills Mining Review, v. 91, no. 12, June 22, p. 20-21.

TEX Report, 2002a, Approval of CVRD's acquisitions recommended by Brazilian ministry: TEX Report, v. 34, no. 8190, December 26, p. 18.

TEX Report, 2002b, China's port Ma Ji Shan opens as Orient's largest ore center: TEX Report, v. 34, no. 8189, December 25, p. 2.

TEX Report, 2002c, China to exploit new iron mines positively due to its increasing steel production: TEX Report, v. 34, no. 8079, July 12, p. 2-3.

TEX Report, 2002d, Demand for iron ore in eastern area of China to increase further: TEX Report, v. 34, no. 8003, March 25, p. 8.

TEX Report, 2002e, Extension of operating contract at Yarrrie-Nimingarra iron ore mine: TEX Report, v. 34, no. 8143, October 18, p. 10.

TEX Report, 2002f, Kumba warns its shareholders in deal with Anglo American: TEX Report, v. 34, no. 8191, December 27, p. 18.

TEX Report, 2002g, MBR to increase production scale to 36.6 million tons in 2007: TEX Report, v. 34, no. 8092, July 31, p. 16.

TEX Report, 2002h, Mount Gibson Iron has acquired Talling Peak iron deposits: TEX Report, v. 34, no. 8095, p. 16.

TEX Report, 2002i, Opening ceremony of West Angelas iron mine to be held on August 24: TEX Report, v. 34, no. 8106, August 23, p. 2.

United Nations Conference on Trade and Development, 2003, The iron ore market—2002-2004: United Nations Conference on Trade and Development, May, 88 p.

Internet References Cited

BHP Billiton, 2002a (April 3), BHP Billiton approves mining area C development and Port Hedland capacity expansion, Press Release, accessed on April 29, 2003, at URL http://www.bhpbilliton.com/bb/newsCentre/newsReleaseDetail.jsp?id=News%2F2002%2FNR_BHPBilliton030402.xml&title=BHP+Billiton+Approves+Mining+Area+C+Development+and+Port+Hedland+Capacity+Expansion.

BHP Billiton, 2002b, (January 30), BHP Billiton approves Yandi lump project, Press Release, accessed on April 29, 2003, at URL http://www.bhpbilliton.com/bb/newsCentre/newsReleaseDetail.jsp?id=News%2F2002%2FNR_BHPBillitonNewsRelease300102.html.

Bloomquist, Lee, 2002a (August 18), Cliffs waiting on Bethlehem to complete Hibtac deal, Duluth News Tribune, accessed August 19, at URL <http://www.duluthsuperior.com/mld/duluthsuperior/news/3885540.htm?template=contentModules/printstory.jsp>.

Bloomquist, Lee, 2002b, (November 1), EVTAC to lay off 37 workers—Taconite Mining: The Eveleth plant is looking for ways to cut expenses while it seeks more pellet orders, Duluth News Tribune, accessed November 4, 2002, at URL <http://www.duluthsuperior.com/mld/duluthsuperior/business/4419361.htm?template=contentModules/printstory.jsp>.

Bloomquist, Lee, 2002c (November 2), EVTAC officials have high hopes for temporary financing plan—Mining: The company is seeking an IRRRB loan to sustain operations until taconite customers are found, Duluth News Tribune, accessed November 4, 2002, at URL <http://www.duluthsuperior.com/mld/duluthsuperior/business/4427995.htm?template=contentModules/printstory.jsp>.

Bloomquist, Lee, 2002d (November 7), EVTAC gets loan, strings attached—Taconite: The IRRRB agrees to help the struggling pellet producer with a \$3 million short-term loan, Duluth News Tribune, accessed November 12, 2002, at URL <http://www.duluthsuperior.com/mld/duluthsuperior/4463804.htm?template=contentModules/printstory.jsp>.

Bloomquist, Lee, 2002e, (March 5), Hibtac restarts plant, accessed on March 5, 2002, at URL <http://www.duluthsuperior.com/mld/duluthsuperior/279476.htm?template=contentModules/printstory.jsp>.

Bloomquist, Lee, 2002f, (March 7), National Steel goes bankrupt, accessed on March 7, 2002, at URL www.duluthsuperior.com/mld/duluthtribune/2807402.htm.

Bloomquist, Lee, and Brissett, Jane, 2002 (October 17), U.S. Steel to sell Minntac, accessed on October 17, 2002, at URL <http://www.duluthsuperior.com/mld/duluthtribune/4301729.htm?template=contentModules/printstory.jsp>.

Cleveland-Cliffs Inc., 2003 (January 13), Cliffs increases ownership of Empire Mine, Press Release, accessed on June 9, 2002, at URL <http://www.cleveland-cliffs.com/MediaPressRoom>.

Duluth News Tribune, 2002a (July 25), Cliffs buys larger stake in Hibtac, Duluth News Tribune, accessed July 25, 2002, at URL <http://www.duluthsuperior.com/mld/duluthsuperior/news/3731720.htm?www.duluthsuperior.com/mld/duluthsuperior/news/3885540.htm?template=contentModules/printstory.jsp>.

Duluth News Tribune, 2002b, (May 6), Minntac Mine refurbished, accessed May 6, 2002, at URL <http://www.duluthsuperior.com/mld/duluthsuperior/2002/05/04/business/3196647.htm?template=contentModules/printstory.jsp>.

Engineering & Mining Journal, 2003 (January 1), Longqiao Iron Mine begins construction of main shaft, accessed October 30, 2003, at URL http://e-mj.com/ar/mining_asia_38.

Goert, Janna, 2002 (October 16), U.S. Steel to sell Minntac—Officials say jobs, salaries, benefits not affected, accessed on October 18, 2002, at URL http://www.virginiamn.com/placed/index.php?sect_rank=0&story_id=122649&refer_url=.

Kobe Steel Ltd., 2002 (March 1), Construction of Mesabi Nugget Plant to begin/ITmk3® process to be demonstrated in Minnesota, Press Release, accessed on June 9, 2003, at URL <http://www.midrex.com/info/press.asp?c=view&articleid=16>.

Mesabi Daily News, 2002, (May, 31), Hibbing Taconite shutdown in July is postponed, Mesabi Daily News, accessed on June 3, 2002, at URL [http://www.virginiamn.com/placed/index.php?sect_rank=&story_id=111243&refer_url=unknown origin](http://www.virginiamn.com/placed/index.php?sect_rank=&story_id=111243&refer_url=unknown%20origin).

Mining Journal, 2002 (July 26), CCI locks in deal with big customer, accessed on July 26, 2002, at URL <http://www.upgroup.com/journal/main2.html>.

Ramsay, 2002 (April 6), Ispat Inland receives research grant, Mesabi Daily News, accessed April 8, 2002, at URL [http://www.virginiamn.com/placed/index.php?sect_rank=&story_id=104053&refer_url=\[unknown origin](http://www.virginiamn.com/placed/index.php?sect_rank=&story_id=104053&refer_url=[unknown%20origin).

Rio Tinto plc, 2002 (April 24), Commercial-scale HIs melt plant to be built in Western Australia, Press Release, accessed on May 6, 2002, at URL [http://www.riotinto.com/news/showMedia Release.asp?id=513](http://www.riotinto.com/news/showMedia%20Release.asp?id=513).

Skillsings Mining Review, 2002a (April 12), Cliffs in long-term agreement to supply pellets—Invests in International Steel Group Inc., accessed on May 23, 2002, at URL http://skillsings.duluth.com/index.php?story_id=104624.

Skillsings Mining Review, 2002b, (May 17), U.S. Steel completes \$50 million concentrator upgrade, accessed on May 23, 2002, at URL http://www.skillsings.duluth.com/index.php?sect_rank=2&story_id=108294&refer_url=%3A%2F%2Fskillsings.duluth.com%2Findex.php%3FSession_noCache%3Db35b2cb3cf4b49cde96ca63b10f3af.

Tyssen, Linda, 2002 (September 27), EVTAC owner won't buy pellets—AK Steel declines any 2003 orders; part-owner Stelco will cut by half, Mesabi Daily News, accessed September 27, 2002, at URL http://www.virginiamn.com/placed/index.php?sect_id=121003&refer_url=...

Weir, Michael, 2002a (December 10), EPA halts Portman plans for expansion, accessed on December 10, 2002, at URL <http://www.thewest.com.au/20021210/business/tw-business-home-sto81364.html>.

Weir, Michael, 2002b (September 19), Hope Downs track play gets derailed, The West Australian, accessed on September 19, 2002, at URL <http://www.thewest.com.au/20020919/business/tw-business-home-sto72221.html>.

Weir, Michael, 2002c (February 19), Portman digs up record \$21m net, The West Australian, accessed February 19, 2002, at URL <http://www.thewest.com.au/20020219/business/tw-business-home-sto45011.html>.

Weir, Michael, 2002d (July 26), Portman dips 10pc on ore downgrade, The West Australian, accessed July 26 2002, at URL <http://www.thewest.com.au/20020726/business/tw-business-home-sto65533.html>.

West Australian, The, 2002 (June 21), Rio Tinto finalises \$124m Baosteel deal, accessed Jun 21, 2002, at URL <http://www.thewest.com.au/20020621/business/tw-business-home-sto61263.html>.

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

Iron. Ch. in United States Mineral Resources, Professional Paper 820, 1973.

Iron Ore. Ch. in Metal Prices in the United States through 1998, U.S. Geological Survey Special Publication, 1999.

Iron Ore. Ch. in Mineral Commodity Summaries, annual.

Iron Ore. Mineral Industry Surveys, monthly.

Other

American Iron and Steel Institute.

American Iron Ore Association.

American Metal Market.

Association of Iron and Steel Engineers.

Company annual reports to stockholders and 10-K reports to Securities and Exchange Commission.

Engineering and Mining Journal.

Institute on Lake Superior Geology.

International Iron and Steel Institute.

Iron and Steel Society.

Iron Ore. Ch. in Mineral Facts and Problems, U.S. Bureau of Mines Bulletin 675, 1985.

Lake Carriers' Association.

Metal Bulletin and Iron Ore Databook.

Mining Journal and Mining Annual Review.

Natural Resources Canada.

Roskill Information Services Ltd. reports.

Skillsings Mining Review.

State of Minnesota:

 Mining Tax Guide, annual.

 Minnesota Mining Directory, annual.

TEX Report, The, and Iron Ore Manual, annual.

United Nations Conference on Trade and Development:

 Intergovernmental Group of Experts on Iron Ore.

 Trust Fund Project on Iron Ore Information.

U.S. Department of Energy, Energy Information Administration.

U.S. Department of Labor, Mine Safety and Health Administration.

U.S. Department of State, unclassified dispatches.

TABLE 1
SALIENT IRON ORE STATISTICS¹

(Thousand metric tons and thousand dollars unless otherwise specified)

	1998	1999	2000	2001	2002
United States:					
Iron ore (usable, less than 5% manganese):²					
Production	62,931	57,749	63,089	46,192	51,570
Shipments	63,200	58,500	61,000	50,600	51,500
Value	\$1,970,000	\$1,550,000	\$1,560,000	\$1,210,000	\$1,340,000
Average value at mines dollars per metric ton	31.14	26.47	25.57	23.87	26.04
Exports	6,000	6,120	6,150	5,610	6,750
Value	\$245,000	\$243,000	\$246,000	\$229,000	\$249,000
Imports for consumption	16,900	14,300	15,700	10,700	12,500
Value	\$517,000	\$399,000	\$420,000	\$293,000	\$313,000
Consumption (iron ore and agglomerates)	78,200	75,100	76,500	67,300	59,000
Stocks, December 31:					
At mines, plants and loading docks ³	6,020	5,710	9,150	3,800	3,210
At receiving docks ⁴	4,080	2,770	2,860	1,960	1,820
At consuming plants	20,500	17,900	16,800	12,300	12,400
Total ⁵	30,600	26,400	28,800	18,000	17,400
World, production ⁶	1,050,000	1,020,000	1,060,000 ^r	1,040,000 ^r	1,080,000 ^e

^eEstimated. ^rRevised.

¹Data are rounded to no more than three significant digits, except "Production, and value;" may not add to totals shown.

²Direct-shipping ore, concentrates, agglomerates, and byproduct ore.

³Excludes byproduct ore.

⁴Transfer and/or receiving docks of Lower Lake ports.

⁵Sum of stocks at mines, consuming plants, and U.S. docks.

⁶Gross weight.

TABLE 2
 EMPLOYMENT AT IRON ORE MINES AND BENEFICIATING PLANTS, QUANTITY AND TENOR OF ORE PRODUCED,
 AND AVERAGE OUTPUT PER WORKER-HOUR IN THE UNITED STATES IN 2002, BY DISTRICT AND STATE¹

District and State	Average number of employees	Worker- hours (thousands)	Production (thousand metric tons)				Average per worker-hour (metric tons)		
			Crude ore	Usable ore	Iron contained (in usable ore)	Iron content natural (percent)	Crude ore	Usable ore	Iron contained
Lake Superior:									
Michigan ²	1,220	2,300	33,100	11,800	7,170	60.9	14.42	5.12	3.12
Minnesota	3,510	7,020	132,000	39,700	25,300	63.7	18.83	5.66	3.60
Total or average	4,740	9,310	165,000	51,500	32,400	63.0	17.74	5.53	3.48
Other States ³	5	9	104	106	55	52.0	11.76	11.94	6.21
Grand total or average	4,740	9,320	165,000	51,600	32,500	63.0	17.74	5.53	3.49

¹Data are rounded to no more than three significant digits, except "Average per worker-hour, crude ore" and Average per worker hour, usable ore;" may not add to totals shown.

²Does not include professional or clerical workers at mines, pelletizing plants, maintenance shops, or research lab workers.

³Includes California, New Mexico, and South Dakota.

TABLE 3
 CRUDE IRON ORE MINED IN THE UNITED STATES IN 2002,
 BY DISTRICT, STATE, AND MINING METHOD^{1,2}

(Thousand metric tons unless otherwise specified and exclusive of ore containing 5% or more manganese)

District and State	Number of mines	Open pit	Underground	Total quantity
Lake Superior:				
Michigan	2	33,100	--	33,100
Minnesota	6	132,000	--	132,000
Total	8	165,000	--	165,000
Other States	2	104	--	104
Grand total	10	165,000	--	165,000

-- Zero.

¹ Excludes byproduct ore.

² Data are rounded to no more than three significant digits; may not add to totals shown.

TABLE 4
 USABLE IRON ORE PRODUCED IN THE UNITED STATES IN 2002, BY DISTRICT,
 STATE, AND TYPE OF PRODUCT¹

(Thousand metric tons and exclusive of ore containing 5% or more manganese)

District and State	Direct shipping ore	Concentrates	Agglomerates ²	Total
Lake Superior:				
Michigan	86	--	11,700	11,800
Minnesota	--	38	39,700	39,700
Total	86	38	51,300	51,500
Other States ³	104	2	--	106
Grand total	190	40	51,300	51,600

-- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Data may include pellet chips and screenings.

³Includes California and South Dakota.

TABLE 5
SHIPMENTS OF USABLE IRON ORE FROM MINES IN THE UNITED STATES IN 2002^{1,2}

(Exclusive of ore containing 5% or more manganese)

District and State	Gross weight of ore shipped (thousand metric tons)				Average iron content, natural (percent)	Value (thousands)
	Direct shipping ore	Concentrates	Agglomerates	Total		
Lake Superior:						
Michigan	96	--	11,700	11,800	60.9	W
Minnesota	351	52	39,200	39,600	62.9	\$1,050,000
Total reportable or average	447	52	50,900	51,400	62.4	1,050,000
Other States ³	112	3	--	115	52.9	W
Total withheld	--	--	--	--	--	291,000
Grand total or average	559	55	50,900	51,500	62.4	1,340,000

W Withheld to avoid disclosing company proprietary data. -- Zero.

¹Includes byproduct ore.

²Data are rounded to no more than three significant digits; may not add to totals shown.

³Includes California and South Dakota.

TABLE 6
 CONSUMPTION OF IRON ORE AT U.S. IRON
 AND STEEL PLANTS, BY TYPE OF PRODUCT^{1,2}

(Thousand metric tons)

Type of product	2001	2002
Blast furnaces:		
Direct-shipping ore	249	234
Pellets	55,200	48,400
Sinter ²	9,090	8,880
Total	64,600	57,500
Steelmaking furnaces:		
Direct-shipping ore	20	61
Pellets	13	--
Sinter ²	144	--
Total	177	61
Grand total	64,700	57,600

-- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes briquettes, nodules, and other.

Source: American Iron and Steel Institute.

TABLE 7
U.S. CONSUMPTION OF IRON ORE, BY END USE^{1,2}

(Thousand metric tons and exclusive of ore containing 5% or more manganese)

Year	Blast furnaces	Steel furnaces	Sintering plants ³	Miscella- neous ⁴	Subtotal integrated iron and steel plants ⁵	Direct-reduced iron for steelmaking ⁶	Nonsteel end uses ⁷	Total
2001	57,300	35	4,560	--	61,900	1,800	756	64,400
2002	52,900	301	5,620	1	58,800	470	675	60,000

-- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes agglomerates.

³Excludes dust, mill scale, and other revert iron-bearing materials.

⁴Sold to nonreporting companies or used for purposes not listed.

⁵Data from American Iron Ore Association.

⁶U.S. Geological Survey estimates based on production reports compiled by Midrex Corp.

⁷Includes iron ore consumed in production of cement and iron ore shipped for use in manufacturing paint, ferrites, heavy media, cattle feed, refractory and weighing materials, and for use in lead smelting.

TABLE 8
 U.S. EXPORTS OF IRON ORE, BY COUNTRY OF DESTINATION^{1,2}

(Thousand metric tons and thousand dollars)

Country	2001		2002	
	Quantity	Value	Quantity	Value
Canada	5,560	227,000	6,700	247,000
Other	51	1,840	59	1,510
Total	5,610	229,000	6,750	249,000

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes agglomerates.

Source: U.S. Census Bureau.

TABLE 9
U.S. EXPORTS OF IRON ORE, BY TYPE OF PRODUCT^{1,2}

Type of product	2001			2002		
	Quantity (thousand metric tons)	Value (thousand dollars)	Unit value ^{3,4} (dollars per metric ton)	Quantity (thousand metric tons)	Value (thousand dollars)	Unit value ^{3,4} (dollars per metric ton)
Concentrates	74	1,140	15.42	62	849	13.59
Coarse ores	1	101	100.92	1	115	133.96
Fine ores	22	694	32.07	12	393	31.66
Pellets	5,490	226,000	41.26	6,610	245,000	37.09
Briquettes	⁽⁵⁾	8	683.42	--	--	--
Other agglomerates	21	883	42.85	71	2,460	34.65
Roasted pyrites	1	32	39.75	2	145	62.74
Total	5,610	229,000	40.90	6,750	249,000	36.86

-- Zero.

¹Data are rounded to no more than three significant figures, except unit value; may not add to totals shown.

²Includes agglomerates.

³Unit values shown are calculated from unrounded data.

⁴Weighted average calculated from unrounded data by dividing total value by total tonnage.

⁵Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 10
U.S. IMPORTS OF IRON ORE, BY COUNTRY AND TYPE OF PRODUCT^{1,2}

Country and type of product	2001			2002		
	Quantity (thousand metric tons)	Value (thousand dollars)	Unit value ^{3,4} (dollars per metric ton)	Quantity (thousand metric tons)	Value (thousand dollars)	Unit value ^{3,4} (dollars per metric ton)
Australia	576	4,840	8.41	567	5,390	9.50
Brazil	4,260	104,000	24.44	5,750	135,000	23.52
Canada	4,530	133,000	29.47	5,540	157,000	28.37
Chile	711	17,400	24.42	319	6,750	21.16
Peru	71	1,030	14.49	86	1,090	12.77
Sweden	70	2,570	36.77	44	1,040	24.00
Venezuela	87	6,500	74.70	49	3,270	67.35
Other	350	23,300	66.45	108	2,890	26.62
Total	10,700	293,000	27.51	12,500	313,000	25.10
Concentrates	598	13,200	22.02	431	9,680	22.45
Coarse ores	28	786	28.02	6	249	42.75
Fine ores	4,050	84,000	20.74	3,370	53,300	15.82
Pellets	5,500	181,000	32.83	8,250	240,000	29.09
Briquettes	65	6,000	92.48	39	3,120	81.00
Other agglomerates	397	8,050	20.27	355	6,140	17.28
Roasted pyrites	7	330	44.38	12	361	31.26
Total	10,700	293,000	27.51	12,500	313,000	25.10

¹Data are rounded to no more than three significant digits, except unit value; may not add to totals shown.

²Includes agglomerates.

³Unit values shown are calculated from unrounded data.

⁴Weighted average calculated from unrounded data by dividing total value by total tonnage.

Source: U.S. Census Bureau.

TABLE 11
U.S. IMPORTS OF IRON ORE IN 2002, BY COUNTRY AND TYPE OF PRODUCT^{1, 2}

(Thousand metric tons)

Country of origin	Concentrates	Coarse ores	Fine ores	Pellets	Briquettes and other agglomerates	Roasted pyrites	Total
Australia	--	--	499	--	67	--	567
Brazil	--	--	2,530	3,220	--	--	5,750
Canada	79	--	141	5,040	288	--	5,540
Chile	290	--	29	--	--	--	319
Peru	--	--	85	--	--	(3)	86
Sweden	44	--	--	--	--	--	44
Venezuela	--	--	10	--	39	--	49
Other	18	6	73	--	--	11	108
Total	431	6	3,370	8,250	394	12	12,500

-- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes agglomerates.

³Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 12
 AVERAGE UNIT VALUE FOR SELECTED IMPORTS OF IRON ORE IN 2002¹

Type of product	Country of origin	Average unit value ² (dollars per metric ton gross weight)
Concentrates	Canada	17.86
Fine ores	Australia	8.66
Do.	Brazil	17.26
Pellets	do.	28.45
Do.	Canada	29.50

¹Includes agglomerates.

²Weighted averages of individual customs values.

Source: U.S. Census Bureau.

TABLE 13
U.S. IMPORTS OF IRON ORE, BY CUSTOMS DISTRICT^{1,2}

(Thousand metric tons and thousand dollars)

Customs district	2001		2002	
	Quantity	Value	Quantity	Value
Baltimore	3,720	79,800	4,290	88,900
Charleston	94	5,390	290	9,570
Chicago	1,330	33,300	945	18,800
Cleveland	630	20,000	1,630	48,400
Detroit	905	29,300	303	11,600
Mobile	673	33,100	1,150	31,400
New Orleans	2,940	81,800	3,690	98,400
Philadelphia	80	2,590	7	297
Tampa	154	4,530	10	466
Other	130	3,270	146	5,040
Total	10,700	293,000	12,500	313,000

-- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes agglomerates.

Source: U.S. Census Bureau.

TABLE 14
U.S. IMPORTS OF PELLETS, BY COUNTRY¹

(Thousand metric tons and thousand dollars)

Country	2001		2002	
	Quantity	Value	Quantity	Value
Brazil	1,360	39,300	3,220	91,500
Canada	3,810	119,000	5,040	149,000
Norway	24	653	--	--
Peru	--	--	--	--
Sweden	--	--	--	--
Venezuela	--	--	--	--
Other	310	21,600	--	--
Total	5,500	181,000	8,250	240,000

-- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 15
SELECTED PRICES FOR IRON ORE IN THE JAPANESE MARKET

(Cents per dry long ton unit of iron unless otherwise specified)

Country and producer	Ore types	April 1-March 31	
		Fiscal year 2001	Fiscal year 2002
Australia:			
Hammersley Iron Pty. Ltd. and Mount Newman Mining Co. Pty. Ltd.	Lump ore	38.03	36.13
Do.	Fines	28.98	28.28
Robe River Iron Associates	do.	23.10	22.55
Savage River Mines Ltd.	Pellets	45.28	--
Brazil:			
Companhia Nipo-Brasileira de Pelotizacao (Nibrasco)	do.	47.85	45.23
Companhia Vale do Rio Doce (Carajas)	Fines	26.48	25.86
Companhia Vale do Rio Doce (Itabira)	do.	25.98	25.36
Minerações Brasileiras Reunidas S.A.	Lump ore	28.15	26.74
Do.	Fines	26.48	25.84
Samarco Mineração S.A.	Pellet feed	21.82	21.30
Canada, Iron Ore Co. of Canada (Carol Lake)	Concentrates	25.20	24.60
Chile:			
Minera del Pacifico S.A. (El Algarrobo)	Pellets	44.59	42.15
Minera del Pacifico S.A. (El Romeral)	Fines	20.12	19.64
India:			
Minerals and Metals Trading Corp. (Bailadila)	Lump ore	36.87	35.03
Do.	Fines	26.43 ^r	27.15
Peru, Empresa Minera del Hierro del Peru S.A.	Pellet feed	19.75	19.22
South Africa			
Kumba Resources (IsCOR)	cents per dry metric ton unit Lump ore	30.79	29.25
Do.	do. Fines	22.04	21.51

^rRevised. -- Zero.

^lFree on board shipping port basis.

Source: Trust Fund Project on Iron Ore Information, Iron Ore 2002.

TABLE 16
IRON ORE: WORLD PRODUCTION, BY COUNTRY^{1,2}

(Thousand metric tons)

Country ⁵	Gross weight ³					Metal content ⁴				
	1998	1999	2000	2001	2002 ^c	1998	1999	2000	2001	2002 ^c
Algeria	1,783	1,336	1,645	1,732 ^r	2,100	900	680	830	790	1,060
Australia	155,731	154,268	167,935	181,553	182,704 ⁶	99,419	95,223	104,226	112,592	113,548 ⁶
Austria	1,797	1,752	1,800 ^e	1,800 ^e	1,900	500	500	500 ^e	575 ^e	575
Azerbaijan ^c	7	--	NA	NA	NA	4	--	NA	NA	NA
Bosnia and Herzegovina ^c	150	150	150	150	150	50	50	50	50	50
Brazil	197,500	194,000	210,000	210,000	210,000	124,210	124,000	125,000 ^e	125,000 ^e	125,000
Bulgaria	895 ^r	699 ^r	559 ^r	325 ^r	300	250 ^r	223 ^r	178 ^r	92 ^r	90
Canada ⁷	37,808	33,900	33,740	27,119 ^r	30,969	24,082	21,650	22,744	18,186 ^r	20,750
Chile	9,112	8,345	8,729	8,834 ^r	8,850	5,694	5,215	5,455	5,520 ^r	5,515
China ^{e,8}	247,000	237,000	223,000	220,000	231,000	81,200	78,200	73,500	72,600	76,200
Colombia	526 ^r	576	660	637 ^r	650	282 ^r	317	363	350 ^r	358
Egypt	3,001	2,700 ^e	1,900 ^r	2,600 ^r	2,300	1,500	1,350	950 ^r	1,300 ^r	1,150
France ^c	250	250	--	--	--	75	35	--	--	--
Germany	200	100	--	--	--	28	14	--	--	--
Greece ^{e,9}	NA	1,600	1,500	1,500	1,500	NA	600	575	575	575
Guatemala	5	11	16	15	15	3	7	11	10	10
India	72,532	70,220	75,950	79,200	80,000	48,000	44,940	48,600	50,700 ⁶	51,200
Indonesia	560	584	489	469	475 ⁶	310 ^e	320 ^e	269 ^e	258 ^e	261
Iran ¹⁰	10,536	10,776	12,700	10,300 ^r	11,300	5,200	5,300	6,100 ^r	5,100 ^r	5,600
Japan	2	1	1	1	1	1	1	1	(11)	(11)
Kazakhstan	8,693	9,091	16,160	14,140	15,423	4,900	5,200	9,200 ^e	8,000	8,700
Kenya	NA	NA	1	1 ^e	1	NA	NA	(11) ^e	(11)	(11)
Korea, North ^c	2,900 ^r	3,800 ^r	3,800 ^r	4,200 ^r	4,300	850 ^r	1,100 ^r	1,200 ^r	1,200 ^r	1,300
Korea, Republic of	486	410	336	195	200	272	229	188	109	110
Macedonia ^c	15	15	15	15	15	9	9	9	9	9
Malaysia	376	337	259	376 ⁶	404 ⁶	243	216	168	241	260
Mauritania	11,400	10,400	10,400	10,300 ^r	9,600	7,410	6,800 ^r	6,800 ^r	6,700 ^r	6,300
Mexico ¹²	10,557	11,475	11,325	8,783 ^r	9,000	6,334	6,885	6,795	5,270 ^r	5,400
Morocco	9	7	6	8 ^r	2	6	4	4 ^e	5 ^r	1
New Zealand ¹³	2,120	2,303	2,692	1,636 ^r	1,500	635 ^e	691	808	480 ^e	450
Norway	637	520	543 ^e	500	515	382	355	369 ^e	340 ^e	350
Peru	4,439	4,230	4,231	4,564 ^r	4,580 ^p	2,850	2,715	2,750 ^r	2,950 ^r	2,960 ^p
Portugal ¹⁴	16	16	15 ^e	15 ^e	15	7	7	6 ^e	5 ^e	5
Romania ^c	459	131	--	--	--	85	71	--	--	--
Russia	72,343	81,311	86,630	82,500 ^e	84,236 ⁶	41,700	46,900	50,000	48,000 ^e	49,000
Serbia and Montenegro ^c	100	50	50	--	--	31	15	15	-- ^e	--
Slovakia	479	479	477	470 ^e	450	215	200	200 ^e	200 ^e	200
South Africa ¹⁵	32,948	29,508	33,707	34,757	36,484 ⁶	20,400	18,442	21,570	22,240	23,350
Sweden	20,930	18,558	20,557 ^r	19,486 ^r	20,000	12,977	11,506	13,556 ^r	12,811 ^r	13,000
Thailand	91	123	100	(11) ^r	570 ⁶	46 ^e	61	50	(11) ^r	285
Tunisia	220	219	182	204 ^r	198 ⁶	119	120	98	109 ^{r,e}	105 ⁶

See footnotes at end of table.

TABLE 16--Continued
IRON ORE: WORLD PRODUCTION, BY COUNTRY^{1,2}

(Thousand metric tons)

Country ⁵	Gross weight ³					Metal content ⁴				
	1998	1999	2000	2001	2002 ^e	1998	1999	2000	2001	2002 ^e
Turkey	5,885	4,846	4,076	3,932	4,500	3,200 ^e	2,600	2,200	2,100 ^e	2,400
Uganda:										
Limonite	NA	3	2	-- ^r	--	NA	NA	1 ^e	-- ^e	--
Other	(11) ^e	(11)	2	1 ^r	1	(11) ^e	(11) ^e	2 ^e	1 ^e	1
Ukraine	50,758	47,769	55,883	54,650 ⁶	58,900 ⁶	28,000	26,200	30,600 ^e	30,000 ^e	32,300
United Kingdom	1	1	1 ^r	1	1	1	1	1 ^e	1 ^e	(11)
United States	62,931	57,749	63,089	46,192	51,570 ⁶	39,724	36,530	39,703 ^e	29,263	32,499 ⁶
Venezuela	16,553	14,051	17,353 ^r	16,902 ^r	18,000	11,014	9,292	11,092	10,817 ^r	11,500
Zimbabwe	372	599	451	361	272	190 ^e	300 ^e	226 ^e	184 ^e	139
Total	1,050,000 ^r	1,020,000 ^r	1,060,000 ^r	1,040,000 ^r	1,080,000	573,000 ^r	555,000 ^r	587,000 ^r	575,000 ^r	593,000

^eEstimated. ^pPreliminary. ^rRevised. NA Not available. -- Zero.

¹Table includes data available through July 16, 2003.

²World totals, U.S. data (2001), and estimated data are rounded to no more than three significant digits; may not add to totals shown.

³Insofar as availability of sources permit, gross weight in this table represent the nonduplicative sum of marketable direct-shipping iron ores and iron ore concentrates; iron agglomerates produced from impure iron ores have been excluded under the assumption that the ore from which such materials are produced has been credited as marketable ore in the country where it was mined.

⁴Data represent actual reported weight of contained metal ore are calculated from reported metal content. Estimated figures are based on latest available iron content reported, except for the following countries for which grades are U.S. Geological Survey estimates: Azerbaijan, Kazakhstan, North Korea, and Ukraine.

⁵In addition to the countries listed, Cuba and Vietnam may also produce iron ore, but definitive information on output levels, if any, is not available.

⁶Reported figure.

⁷Series represented gross weight and metal content of usable iron ore (including byproduct ore) actually produced, natural weight.

⁸China's gross weight iron ore production figures are significantly higher than that of other countries, because China reports crude ore production only with an average Fe content of 33%, whereas other countries report production of usable ore. Source: Mineral Resources of China, Chinese Institute of Geology and Mineral Resources Information, Iron Ore Section 2, China Building Materials Industrial Press, 1993, p. 9 Nickeliferous iron ore.

¹⁰Data are for year beginning March 21 of that stated.

¹¹Less than 1/2 unit.

¹²Gross weight calculated from reported iron content based on grade of 60% Fe.

¹³Concentrates from titaniferous magnetite beach sands.

¹⁴Includes manganiferous iron ore.

¹⁵Includes magnetite ore as follows, in thousand metric tons: 1998--2,211; 1999--2,200; 2000--2,854; 2001--2,552; and 2002--2,557.

TABLE 17
 IRON ORE: WORLD PELLETIZING CAPACITY,
 BY CONTINENT AND COUNTRY IN 2002

	Rated capacity (million metric tons, gross weight)
North America:	
Canada	27.6
Mexico	13.7
United States	56.3
Total ¹	97.6
South America:	
Argentina	2.0
Brazil	48.2
Chile	4.4
Peru	3.7
Venezuela	10.3
Total ¹	68.6
Europe:	
Belgium	0.7
Netherlands	4.4
Norway	1.4
Russia	34.0
Slovenia	0.5
Sweden	16.4
Turkey	1.5
Ukraine	32.0
Total ¹	90.9
Africa, South Africa	0.6
Asia:	
Bahrain	4.0
China	35.0
India	11.5
Iran	9.0
Japan	4.0
Kazakhstan	8.4
Total ¹	71.9
Oceania, Australia	4.5
Grand total ¹	334.1

¹Data may not add to totals shown because of independent rounding.

Sources: International Iron and Steel Institute, Brussels, Belgium; United Nations Commission on Trade and Development; Trust Fund on Iron Ore Information; U.S. Geological Survey.