

IRON ORE

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Iron ore production in the United States fell by 10%, according to estimates by the U.S. Geological Survey (USGS). Consumption rose by 2.5% above the 2002 level, which was the lowest since at least 1942. World iron ore production and consumption rose in 2003. Brazil was the leading producer of iron ore in terms of iron content, while China was the top gross tonnage producer and by far the leading consumer (tables 1, 16). For the second consecutive year world iron ore trade increased, while prices rose dramatically.

The supply of iron ore is critical to the United States and all industrialized nations because it is the basic raw material from which iron and steel are made. Scrap can be considered a supplement to iron ore in the steelmaking process but is limited as a major feed material owing to inadequate supply of high-quality scrap. Alternatives, such as direct reduced iron (DRI), are also available, and their use continues to grow.

Commercially, iron ore is usually an oxide, the primary minerals of which are hematite (Fe_2O_3) and magnetite (Fe_3O_4). 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 99% of iron ore is used in the iron and steel industry. Ore is put into a blast furnace and smelted to produce molten iron, which is then converted to steel by removing most of the remaining carbon in a basic oxygen furnace (BOF). Almost all molten iron goes directly to the BOF, eliminating the molds. The blast furnace product is usually referred to as pig iron.

Iron ore consumption in 2003 was 61 million metric tons (Mt), a rise of slightly more than 1 Mt from that of 2002. There was an average of 30 blast furnaces active during 2003, up slightly from that of 2002 when the average number of blast furnaces operating was 29, the lowest since 1961. Accordingly, pig iron production at 40.6 Mt in 2003 was slightly above that of 2002, which had been the lowest since 1982. Crude steel production at 94 Mt increased by 2% compared with that of 2002.

Steel demand remained constant at revised 2002 levels of 107 Mt. The large difference between ore production and steel demand is explained by examining the minimill sector and net imports of iron ore substitutes. In 2003, 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 as feedstock; instead they use iron and steel scrap and some DRI.

In 2003, iron ore substitute net imports at 2.9 Mt were one-third of their volume for 2002 owing mainly to a 23% net increase in steel scrap exports and a 46% decrease in semifinished steel product imports. Iron ore substitutes include DRI, iron and steel scrap, pig iron, and semifinished steel. Use of imported pig iron or semifinished steel allows steelmakers to increase steel shipments without increasing blast furnace production. Major production increases require restarting blast furnaces and hiring new personnel. Iron ore substitutes allow the highly cyclical steel business to avoid the shutdown of recently opened blast furnaces

and the layoff of recent hires when demand falls. So, a small increase in steel production coupled with a minor fall in demand in 2003 resulted in iron ore consumption rising only slightly from 2002 levels, the lowest in decades.

Legislation and Government Programs

The Minnesota Taxpayers Association presented a draft assessment that showed that the Minnesota mining industry had a tax burden three to five times greater than that of other industries in the State. Also, the State's net iron ore production tax of more than US\$1.75 per metric ton was far greater than the US\$0.27-per-ton tax in Michigan or the US\$0.44-per-ton tax in eastern Canada. The assessment also investigated the effect on the local economies of reducing these mining taxes (Hohnstadt, 2003b; Skillings Mining Review, 2003b). The Minnesota taconite production tax raised US\$72.3 million in 2003 based on average production of 31.1 Mt from 2000 to 2002. This included US\$7.9 million from the State's general fund to cover bankruptcy proceedings for EVTAC Mines, LLC (Minnesota Department of Revenue, 2003§¹).

Work continued in 2003 on a cooperative agreement among the U.S. Department of Energy (DOE), Mesabi Nugget LLC, and other partners on the Mesabi Nugget project. (More information can be found in the "Current Research and Technology" section.) This project is a 2-year program involving the construction of a pilot plant and the production of iron nuggets for use in electric arc furnaces, BOF, and foundry applications. The process uses low-grade ore to produce nuggets (96%-plus iron) (U.S. Department of Energy, 2003§, 2004§).

Structure of the Industry

On December 31, 2002, Cleveland-Cliffs Inc. acquired an additional 32.3% interest in the Empire Mine in Michigan, boosting its ownership in Empire to 79%, with the remaining 21% belonging to Ispat Inland Inc. (Cleveland-Cliffs Inc., 2003, p. 17). This, combined with a purchase earlier in 2002 of an additional 45% interest in the Tilden Mine, gave Cliffs control of both Michigan iron ore operations (Pinkham, 2002). Cliffs' aggressive acquisition of iron ore assets during the past few years has led to the restructuring of its business in Michigan and Minnesota. In addition to consolidation of the Tilden and Empire Mines into the Cliffs Michigan Mining Company (CMMC), Cliffs has begun to restructure its overall organization (American Metal Market, 2003a; Metal Bulletin, 2003c).

EVTAC filed for bankruptcy protection and closed operations in May. With contracts expiring at the end of 2002, EVTAC

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

was unable to negotiate the necessary pellet sales contracts with existing customers to remain in business (American Metal Market, 2003c). In December 2003, United Taconite LLC [jointly owned by Cliffs (70%) and China's Laiwu Steel Group, Ltd. (30%)] was formed through the purchase of the ore mining and pelletizing assets of Eveleth Mines, LLC (Cleveland-Cliffs Inc., 2003, p. 17; Nelson, 2003§). With the purchase of the assets of Eveleth Mines by Cliffs and Laiwu, mine production was immediately begun to avoid a long winter shutdown (Cleveland-Cliffs Inc., 2003§).

In mid-2003, International Steel Group completed its purchase of the 62.3% share of Hibbing Taconite Co. (Hibbtac) assets previously owned by Bethlehem Steel Corporation (Fortner, 2003; Bloomquist, 2003a§).

U.S. Steel Corporation, which had been in negotiations with an investor group for the sale of its Minntac operations, suspended plans for the sale and, instead, negotiated the purchase of the iron ore assets of bankrupt National Steel Corporation-Keewatin Taconite. U.S. Steel had previously announced a US\$500 million deal that included the sale of 80% of Minntac. Instead, in May, it completed the purchase of all principal assets, including the iron ore pellet operations of National Steel for an aggregate purchase price of approximately US\$1.05 billion. This, combined with a new labor agreement with the United Steelworkers of America, indicated a decision by U.S. Steel to remain involved in upstream activities (Skillings Mining Review, 2003c; Bloomquist, 2003b§).

Production

Domestic iron ore production at 46.4 Mt in 2003 decreased by 10% from that of 2002. The eight taconite mines in Michigan and Minnesota accounted for virtually all domestic iron ore production. Six of these operated on the Mesabi iron range in northeastern Minnesota. Domestic iron ore supply (production minus exports) met 65% of domestic demand in 2003 compared with an average of 69% from 1999 through 2002.

The USGS develops U.S. iron ore production data through an annual "Iron Ore" survey, which provides 100% of production listed 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 are then compiled jointly by AIOA and the American Iron and Steel Institute (AISI).

Michigan.—Michigan accounted for almost 27% of usable ore output in 2003. Pellets accounted for 99.5% of total production. The Tilden Mine in Michigan's Upper Peninsula had anticipated a 10% drop in production owing to an aberration in ore mineralization that caused low throughput rates and recoveries for the first half of the year. Additionally, flooding in the Upper Peninsula caused by a dam failure and subsequent loss of power supply to the Empire and Tilden Mines idled the mines from mid-May through early June, when production began to increase to prior levels (American Metal Market, 2003b; Metal Bulletin, 2003g).

Minnesota.—Minnesota produced more than 73% of the usable iron ore in the United States in 2003. All the State's

production came from open pits on the Mesabi iron range. Minnesota pellet production is summarized as follows: a) Ispat Inland produced 2.9 Mt of pellets and pellet chips—73% was flux pellets; 25%, acid pellets; and 2%, pellet chips; b) Northshore Mining Company, the site of the iron nugget pilot plant, produced 4.9 Mt of standard pellets; c) U.S. Steel produced 4.5 Mt of pellets from its Keewatin Taconite operations and 14.1 Mt of pellets from its Minntac operations; d) United Taconite, including the defunct EVTAC operations, produced 1.6 Mt of pellets; and e) Hibbtac produced 8.1 Mt of pellets (Kakela, 2004). Hibbtac began to produce higher compression pellets, which create fewer fines, for one of its owners—Stelco, Inc. (Fortner, 2003; Bloomquist, 2003a§). U.S. Steel sold 152,000 metric tons (t) of taconite pellets to Taishan Iron & Steel Co. Ltd., a midsized steelmaker in China. The pellets were to be loaded out to Canadian National rail cars in unit trains of 10,200 t during a period of 1 month and transported to Prince Rupert—an ocean port in British Columbia, Canada—with final destination to Laiwu City, China (Skillings Mining Review, 2003d).

Consumption

Iron ore consumption rose by 2.5% to 61 Mt. Pig iron production at 40.6 Mt was 14% below the 10-year average of 46 million metric tons per year (Mt/yr) for 1994-2003 and slightly above that of 2002, when it dropped to the lowest level since 1986. Raw steel production by BOF fell to 46 Mt compared with the 10-year (1993-2002) average of 52 Mt. A strong correlation between the number of active blast furnaces and iron ore consumption is apparent. In the 10-year period (1993-2002), the average number of active blast furnaces declined each year. In 1992, there were 43; in 2002, that number had fallen to 29 before rising again to 30 in 2003. The blast furnaces in operation at the end of each month during 2003 ranged from 29 to 31. Consumption of iron ore, including agglomerates, reported to the AISI by integrated producers of iron and steel totaled 60 Mt, including 50 Mt of pellets; 9 Mt of sinter, briquettes, and other products; and 0.2 Mt of natural coarse ore. Of the ore consumed, 75% was domestic; 14%, from Canada; and 11%, from other countries. Other iron-bearing materials charged to blast furnaces included mill scale, slag scrap, and steel furnace slag.

The three consumption numbers used in this annual review are listed in tables 1, 6, and 7. The first consumption number (60.6 Mt in 2003), in table 1, is the sum of the ore consumed by ore type reported by the AISI, the ore consumed in DRI production, and the ore consumed in nonsteel uses (American Iron and Steel Institute, 2004, p. 84). The second consumption number (60.4 Mt in 2003), in table 6, is the ore consumed in U.S. iron and steel plants by type of ore reported by the AISI. The third consumption number (also 60.6 Mt in 2003), in table 7, is actually 62,000 t higher than the consumption figure reported in table 1, although this difference is not apparent owing to rounding. This consumption figure is the ore consumed in U.S. iron and steel plants by ore type as reported by the AISI plus the ore consumed in DRI production (0.32 Mt in 2003) and nonsteel uses (0.79 Mt in 2003) as reported to the USGS by U.S. steel companies. Additional data on iron ore consumption in nonsteel

end uses were compiled from information gathered from USGS surveys.

Price

The average free-on-board mine value of domestic ore shipped in 2003 was US\$26.86 per ton, 3% higher than in 2002. This value approximates commercial selling price less cost of mine-to-market transport. Iron ore prices rose worldwide in 2003. The price for Hamersley Iron Ore Pty. Ltd. and Mount Newman Mining Co. Pty. Ltd. fine ores for fiscal year 2003 (April 2003 to March 2004) on the Japanese market was 30.83 cents per 1% iron per long ton unit, up by 9% compared with that of 2002 (United Nations Conference on Trade and Development, 2004, p. 77). The price for lump ore was settled at 39.35 cents per 1% iron per long ton unit, an increase of 9% compared with that of 2002. The lump to fine premium for Australian ore sold to Japan was 8.52 cents per 1% iron per long ton unit. There were even greater price percentage increases in Europe of 12% for the Australian ore. In spite of iron ore prices having declined in real terms through 2002, the price of Carajas [Brazil] fines, an ore grade produced by Companhia Vale do Rio Doce S.A. (CVRD) and sold to Europe, when denominated in U.S. dollars, reached its highest price in the past 8 years at 31.95 cents per 1% iron per metric ton (United Nations Conference on Trade and Development, 2004, p. 75).

Transportation

Great Lakes U.S. flag transport of iron ore fell by 11% to 39 Mt from 2002 levels, its lowest level in 5 years. Overall, the Great Lakes dry-bulk commerce in iron ore fell by 6% to 50 Mt from 2002 levels, the lowest level in the past decade. Increased shipments at the end of 2003 reflected increased consumption of iron ore by the steel industry at yearend (Lake Carriers' Association, 2004§). In January 2003, Lakes Huron and Michigan were 18 to 20 inches below the long-term average, affecting loads that lake freighters could carry. A late start to the shipping season and winds that caused ice jams in and around the Duluth, MN-Superior, WI, harbor in mid-April resulted in Great Lakes shipping delays (Brisset, 2003§; Duluth News Tribune, 2003§). The U.S.-flag Great Lakes fleet peaked, in terms of capacity in service, in December, with 56 vessels or 90.3% of hauling power (Lake Carriers' Association, 2004§).

Foreign Trade

Net imports in 2003 were 5.8 Mt, which represented 9.6% of domestic consumption. Exports remained the same, while imports rose slightly. Almost 99% of U.S. iron ore exports (6.8 Mt) was pellets, and more than 98% of exports was shipped via the Great Lakes to Canadian steel companies. U.S. imports totaled 12.6 Mt, of which Brazil's share decreased to 40%; Canada's share increased strongly to 55%.

World Industry Structure

Demand.—Increases in iron ore demand continue to be driven by growth of the Chinese economy. In spite of new capacity

and collapse of internal steel demand in Commonwealth of Independent States (CIS) countries, leading to increased steel exports, supplies of iron ore are expected to remain tight until 2006. DRI growth rate has again risen, with production expected to grow by 10 Mt by 2008. Fines are expected to continue to have a large share of the export market owing to restricted availability of lump ore and Chinese refineries' strong dependence on fine ore (Llamosas, 2003; Mining Journal, 2003g). The three major producers, CVRD of Brazil, Rio Tinto plc of the United Kingdom, and BHP Billiton Limited (BHPB) of Australia, accounted for 30% of world iron ore production. The strong growth in demand should be met with opening of additional capacity. Capacity growth is apparently in balance with depleting resources and increasing demand, especially from China (Ericsson, 2003).

The China Iron & Steel Association predicted that blast furnaces in China would increase from 487 Mt/yr at the end of 2003 to 599 Mt/yr in 2005 and 652 Mt/yr in 2010. Pig iron production capacities for the same periods were forecast to be 218 Mt/yr, 313 Mt/yr, and 391 Mt/yr, respectively (TEX Report, 2003a). Strong demand for iron ore in India led to major price increases. Prices in 2003 reached Re2,400 compared with Re700 in 2002 (Metal Bulletin, 2003q).

Production.—World production at 1.16 billion metric tons (Gt) broke the record set in 2002 by more than 5%. World production first exceeded 1 Gt in 1995 and has been above that level since then. Australia's and Brazil's combined share of production from 1999 through 2003 averaged 31%. In 2003, iron ore was produced in 47 countries, with production exceeding 1 Mt in 24 of those countries.

Consumption.—Global iron ore consumption is not measured directly, but there are indicators that clearly show whether it rose or fell—production of pig iron, DRI, crude steel, and imports of iron ore. Pig iron and DRI production tend to be direct indicators of iron ore consumption, while crude steel is less direct because part of steel production comes from scrap-consuming minimills. Imports of iron ore are not a direct indicator of iron ore consumption in any country that produces iron ore, but if a country's ore production is static, imports may be a good indicator of consumption. World consumption of iron ore increased as the result of an almost 8% increase in pig iron production. Of the five countries that had 5% or more of world pig iron production from 1996 through 2003, only the United States had negative growth. All others had increases, as follows: China, 89%; Russia, 30%; Japan, 10%; and Germany, 6%. Of the five countries that had 5% or more of world pig iron production in 2003, only the United States had a decrease (-2.7%) in production. All others increased, as follows: China, 19.7%; Brazil, 8.0%; Russia, 4.5%; and Japan, 1.4% (United Nations Conference on Trade and Development, 2004, p. 86-87). In 2003, China surpassed Japan as the world's leading importer of iron ore.

World crude steel production rose by 7% from 2002 to 2003. Four countries accounted for 5% or more of world production in 2003. Of those countries, China produced more than 38 Mt more crude steel in 2003 than in 2002. The others (Japan, Russia, and the United States) combined produced 5 Mt more crude steel in 2003 than in 2002. These countries along with Germany and the Republic of Korea were also the ones that accounted for 5% or more of world crude steel production for the years 1996 through 2003. China's production rose by 117% during that period,

while that of the United States fell by about 5% (United Nations Conference on Trade and Development, 2004, p. 88-90).

Trade.—World iron ore imports rose by 8% and exceeded 570 Mt. After very large increases in imports for the past 3 years (27% in 2000, 32% in 2001, and 21% in 2002), China posted another sharp rise to 148 Mt in 2003 from 112 Mt in 2002—a gain of 33%. From 1995 through 2003, four countries accounted for more than 58% of world iron ore imports. Germany's share of imports in that period fell to 5.9% from 10.0%, Japan's share fell to 23.2% from 27.4%, and the Republic of Korea's share fell to 7.6% from 8.0% after peaking at 9.3% in 2001. China's share rose during this 9-year period to 26.0% from 9.4%.

Australia's and Brazil's combined share of world iron ore exports fell to 64.0% in 2003 from 64.5% in 2002. In decreasing order of market share of 2003 iron ore exports, Australia held 32.3%; Brazil, 31.7%; India, 9.5%; Canada, 4.7%; and South Africa, 4.1%. These countries represent more than 80% of world iron ore exports. Seaborne iron ore trade was 515 Mt in 2003, surpassing the record of 482 Mt set in 2002 (Caemi Mineração e Metalurgia S.A., 2004, p. 6). Corporate control of seaborne iron ore trade is fairly concentrated, with CVRD alone controlling about 33% of the market and the big three—CVRD, Rio Tinto, and BHPB—controlling almost 70% (Ericsson, 2004).

World Review

Australia.—Aztec Resources decided to proceed with redeveloping the Koolan Island deposit, off the west coast of Western Australia, following the conclusion of an independent report stating that reserves amounted to 24.9 Mt grading 67% iron. In the last quarter of 2003, Aztec's geologists completed a reconnaissance of the main deposit, which consists of a main ore body and four satellite ore bodies. A drilling program to delineate strike extensions to the ore bodies and to seek additional resources was planned for February 2004 (Metal Bulletin, 2003b; Aztec Resources, 2003§).

Mount Gibson Iron Limited began mining at its Tallering Peak deposit in October. The first shipment of ore was scheduled for January 2004. The mine was expected to produce at a rate of 1.6 Mt/yr with a life of 8 to 10 years depending on the results of exploration drilling. Ore production for the life of the mine has been sold. Subject to environmental approvals in 2004, Mount Gibson planned to begin development of a 1.5-Mt/yr hematite mine within the Extension Hill and Iron Hill deposits in the Mount Gibson range, with the first shipments of ore planned for the second quarter of 2005 (Clarke, 2003c; Mount Gibson Iron Limited, 2004).

OneSteel Limited, the leading manufacturer of steel long products in Australia, decided to proceed with an A\$6 million feasibility study of a large magnetite ore deposit at its South Middleback Range iron ore mine. This could considerably extend the life of its Whyalla steel plant in South Australia, 50 kilometers (km) away. The current mine, a hematite deposit, is expected to be depleted in 2020. The study's goal was to determine whether the magnetite can be economically mined and used as feed at Whyalla. The study indicated that by converting the steelworks to use magnetite feed, a reduction in raw steel production costs

could be achieved. OneSteel also signed a 5-year contract with Henry Walker Eltin Ltd. (HWE) to construct and operate an ore beneficiation plant to extend the life of the hematite mine. OneSteel's Whyalla plant, which had its blast furnace relined in 2002, uses 2 Mt/yr of iron ore and has crude steel capacity of 1.2 Mt/yr (Clarke, 2003d; Metal Bulletin, 2003ab).

BHP-Billiton Iron Ore began operating its Mining Area C (MAC) project in October with the first shipment of iron ore slated to leave Finucane Island on Port Hedland in January 2004. The ore, which will be sold under the MAC trademark, is a Marra Mamba-type ore consisting of 65% lump and 35% fines. Marra Mamba ore is generally suitable for calcining to provide feed for direct reduction furnaces. More than 900,000 t of MAC ore was used in extensive trials to confirm acceptance of the ore. The "C deposit" is the first area within the larger MAC to be mined. Contractor HWE was chosen to manage the mine and ore processing facilities. The C deposit is owned by the Posmac joint venture, which is 20% owned by Republic of Korea-based steelmaker Pohang Iron & Steel Co. Ltd. (Posco). Posco will take at least 3 Mt/yr for 25 years. The remaining ore is destined for China and Japan. The majority owner in Posmac is the Mount Goldsworthy joint venture. Mount Goldsworthy is owned 85% by BHPB and by Japanese traders Itochu International Inc. (8%) and Mitsui & Co. (7%). The mine opening was to be accompanied by expansion of rail and port facilities. Before the mine became operative, BHPB decided to accelerate and add to these expansions to bring their capacity in Western Australia to 100 Mt/yr by the second quarter of 2004. Under the original program announced in April 2002, the capacity of MAC was to be incrementally expanded to 15 Mt/yr by 2011. This capacity, involving the addition of a second crusher, was to be available by the first quarter of 2004. Similarly, the original schedule provided for expansion of overall capacity to 100 Mt/yr by 2011. This capacity was also to be available at the port by the first quarter of 2004, without additional expenditure.

Capacity on the Newman to Port Hedland rail line was to be expanded to 100 Mt/yr by the second quarter of 2004. Capital expenditure for additional sidings and ore cars increased ore processing capability at MAC, and accelerated prestripping at Mount Whaleback was expected to be US\$50 million. In addition, BHPB approved the installation of a 5-km overland conveyor and additional ore handling facilities at Yandi. The new facilities were expected to raise capacity by 3 Mt to 42 Mt/yr in the first quarter of 2004 and to improve operating efficiencies. Capital expenditure for this brownfield expansion was expected to be US\$27 million. BHPB also undertook studies for further expansion of the Western Australian iron ore business, should the market warrant, to 120 Mt/yr. All these expansions were in response to the continued increase in Chinese iron ore consumption (Clarke, 2003a; Metal Bulletin Monthly, 2003; Mining Journal, 2003b; BHP Billiton Limited, 2003§). The expansions resulted in a new quarterly production record of 23.0 Mt during the December 2003 quarter. This was 20% higher than the December 2002 quarter and 5% higher than the September 2003 quarter (BHP Billiton Limited, 2004§).

In 2002, Hope Downs Management Services Pty. Ltd. (HDMS), developer of the Hope Downs iron ore deposit, requested that the Western Australian Supreme Court grant HDMS access to BHPB's Mount Newman to Port Hedland rail line near the Hope Downs deposit. The court denied their request

stating that HDMS had no legal standing under the 1987 Rail Transport Agreement. HDMS and the Western Australian State government appealed and won. The court said that the Hope Downs project was well enough established to require BHPB to negotiate with HDMS. The ramifications of the ruling were felt throughout the West Australian iron ore industry, particularly by Fortescue Metals Group Limited, which had hoped that HDMS could be persuaded to join them in building a third railway. The Rail Transport Agreement concerns third party access provisions to infrastructure, which are a common feature of the Western Australian State agreements throughout the resource sector. A considerable portion of the State's mining and petroleum industry operates under more than 60 agreements which date back to the 1950s. The Iron Ore State Agreement Acts, in particular, feature third party provisions to critical infrastructure, such as ports and railways, to foster new developments in the sector. These provisions were put in place by governments of the day with a long-term view to having economic and efficient infrastructure operating in the Pilbara region (Metal Bulletin, 2003n; Prospect, 2003). HDMS secured letters of intent for future iron ore purchases from steel mills in China (15 Mt/yr), Europe (3.5 Mt/yr), and Japan (4.7 Mt/yr). This represents support for more than 80% of the first 5 years of planned production from the project (Hope Downs Management Services Pty. Ltd., 2004§).

In September, Portman Ltd. approved spending US\$13.8 million for construction at its Northern Tenement iron ore mining areas of Windarling and Mount Jackson in Western Australia. Ore from these deposits was expected to extend the life of the company's main Koolyanobbing deposit to about 10 years from around 4 years currently. The ore from the new deposit will be hauled 100 km to the Koolyanobbing processing plant. Construction was to start in October 2003, and production, in March 2004. Portman received final regulatory clearance in September when the Australian Federal Government gave conditional environmental approval. Delay in approvals and strong demand for iron ore, particularly from China, forced Portman to send shipments of 80% high-grade Koolyanobbing ore for more than a year, depleting reserves considerably and leaving less ore to blend with lower grade Northern Tenements ore (Metal Bulletin, 2003ad; Mining Journal, 2003k). The Cockatoo Island iron ore mine ceased production while its owners, Portman and HWE, conducted a technical review. Portman accepted recommendations of the feasibility study to complete a second stage sea wall when a geotechnical study confirmed that the sea wall would be stable and that dewatering using sumps and pumps would be fully adequate for the task (Metal Bulletin, 2003ae; Portman Ltd., 2004§).

The expansion plans for Robe River Iron Associates' West Angelas Mine originally called for the mine to reach production of 20 Mt/yr in 2009. That production rate was brought forward to 2007, then to the second quarter of 2004, about 5 years ahead of the initial date. In December, Robe announced that it had approved a US\$105 million expansion to the West Angelas Mine to 25 Mt/yr (Metal Bulletin, 2003al; Rio Tinto plc, 2003c§).

Hamersley Iron Pty. signed a 25-year iron ore contract with Wuhan Iron & Steel Co. (China) to supply about 3 Mt/yr. The agreement is part of Wuhan's plan to increase its steel production (Metal Bulletin, 2003am). In October, Hamersley shipped iron ore from its Yandicoogina Mine through Robe River's Cape

Lambert Port facilities for the first time. Rio Tinto and the other Robe River joint venture participants reached an agreement in-principle for shipment of Hamersley's Yandi ore from Cape Lambert to Nippon Steel in Japan in late September 2003 (Mining Journal, 2003m; Rio Tinto plc, 2003a§). Hamersley achieved record production and shipments in the fourth quarter of 2003, bringing shipments to 74.3 Mt/yr (Rio Tinto plc, 2004§). Rio Tinto was examining a 25% capacity expansion to 69 Mt/yr at its Cape Lambert Port in Western Australia, which handles the output from the company's Robe River iron ore operations (Mining Journal, 2003l). In April 2003, Hamersley began construction of its newest mining project, Eastern Range, 10 km east of its Paraburdoo Mine, with commissioning planned for April 2004. The mine, a joint venture between Hamersley and China's Shanghai Baosteel Group Corporation, reported reserves of 100 Mt. As part of the joint venture agreement, Baosteel will take 10 Mt/yr of ore for 20 years. The contract between Hamersley and Baosteel may necessitate development of the nearby 100-Mt Western Range deposit. Situated between Paraburdoo and the Channar Mine, the existing conveyor between these mines was to be used to move Eastern Range ore to the plant at Paraburdoo. Hamersley's plan was to phase Paraburdoo out and Eastern Range in. After 2004, Paraburdoo was not expected to contribute much high-grade ore (Clarke, 2003b; Metal Bulletin, 2003l).

In December, Rio Tinto approved plans to invest US\$920 million to expand its Hamersley iron ore operation in Western Australia. The world's second leading iron ore producer, Rio Tinto planned to increase capacity of its Hamersley Iron Division by more than 50% to 116 Mt/yr. Rio Tinto planned to spend US\$685 million to upgrade the capacity of its port facilities at Dampier by 40 Mt/yr by late 2005. Another US\$200 million was to be spent at its Yandicoogina Mine to raise output to 36 Mt/yr. Existing capacity was about 20 Mt/yr, although a current project to increase output to 24 Mt/yr was nearing completion. Construction on both projects received board approval and was scheduled to begin in December 2003, subject to environmental, heritage, and other approvals. The Yandicoogina Mine expansion was expected to be commissioned in early 2005. Completion of the port expansion was scheduled for late 2005, with progressive commissioning from early 2005. The first stage of the port expansion included a new stockyard, the extension of the Parker Point wharf, and a new car dumper. In the next stage, a second shiploader was to be added at Parker Point and a further extension of the wharf to allow for three ships to be tied up at once. If the expansion of Robe's Cape Lambert port takes place, the capacity of Rio Tinto's two Western Australian ports was expected to exceed 185 Mt/yr.

Studies were progressing into providing additional rail, power, and other infrastructure to complement the Cape Lambert port and mine requirements. Pilbara Rail, formed by Rio Tinto to run the rail services of both Hamersley and Robe River, had capacity of more than 140 Mt/yr. Hamersley accounted for 80 Mt/yr of this total, while Robe River's Pannawonica Mine to Cape Lambert line accounted for 40 Mt/yr, and Robe's West Angelas Mine to Cape Lambert line accounted for 20 Mt/yr. Hamersley planned to increase its capacity along the rail network to 88 Mt/yr from 80 Mt/yr by March 2004. About 50 km of new double-track had been laid in the main Tom Price-Dampier section of Pilbara Rail's system, and a further 100 km

was under consideration. Ore cars and locomotives were on order. At the port at Dampier, Hamersley had two double-train dumpers, one at Parker Point and one at East Intercourse Island, which have a combined unloading capacity of about 82 Mt/yr (Rio Tinto plc, 2004, p. 3, 6-7; 2003d§; Phaceas, 2003§).

Brazil.—Brazilian steel producer Companhia Siderúrgica Nacional's (CSN) planned expansion of its Casa de Pedra iron ore mine in Minas Gerais State was approved, and work was begun. The US\$200 million to US\$220 million expansion was to take place in two stages—first to lift capacity of the mine to 20 Mt/yr from 14 Mt/yr in 1½ years. The timing of the second phase, which would increase capacity to 30 Mt/yr, was market dependent. The project was linked to CSN's plan to enlarge its port facilities at Septiba in Rio de Janeiro State. Ore is transported from the mine to the port on a railway owned by CVRD. In addition to supplying its own needs, CSN sells about 7 Mt/yr of iron ore to other Brazilian steelmakers (Metal Bulletin, 2003f; Mining Journal, 2003d).

All CVRD customers have signed contracts to take iron ore for 3 to 10 years. This replaced the previous system whereby most sales to China were on a spot market basis, by specific orders of 12-month maximum duration. CVRD reported exploration in Minas Gerais State showed that iron ore reserves at Itabira, in the Southern System were 1.13 Gt, almost double previous estimates. The discoveries considerably lengthen mine life, which now is expected to produce 43 Mt/yr for the next 20 years. According to CVRD, Ferteço Mineração S.A. and Mineração Brasilieras Unidas S.A. (MBR) have 19 Gt additional reserves in Minas Gerais, and proven and probable reserves in the Northern System are about 4.4 Gt (Hohnstadt, 2003a; Metal Bulletin, 2003e).

CVRD decided in 2001 to reconfigure its core business and exit the long haul dry bulk business by selling 14 ships, 2 of them in 2003. CVRD's subsidiary Navegação Vale do Rio Doce S.A. (DOCENAVE) still has three ships to sell. CVRD also concluded its relationship with CSN. As part of the transactions CVRD, through its subsidiary Mineração Tacumã Ltda. acquired the largest railway in Latin America Ferrovia Centro-Atlântica S.A. from CSN. These consolidations of rail and port activities allowed CVRD to increase efficiency in the transport of iron ore and other materials. Work on CVRD's railways was made possible by loans of US\$300 million from the Japan Bank for International Cooperation (Kinch, 2003d; Companhia Vale do Rio Doce S.A., 2003d§-e§, 2004b§).

CVRD planned to expand production capacity by 17 Mt/yr in early 2004—14 Mt/yr at Carajas in the Northern System and 3 Mt/yr at Gongo Soco in the Southern System. The US\$144 million expansion at Carajas to raise production to 70 Mt/yr was originally planned for 2005. The expansion was accelerated because iron ore demand had grown much faster than expected. This increased demand had two additional results—first, CVRD bought 5.1 Mt of iron ore from third parties to satisfy its customers, and second, port congestion increased to the extent that CVRD incurred US\$21 million in demurrage in the first half of the year. To satisfy this strong demand, the brownfield expansions at Carajas and Gongo Soco were to be accompanied by greenfield mine developments in the Southern System at the Fabrica Nova and Brucutu Mines. The Fabrica Nova Mine was to

be developed by Minas de Serra Geral SA [a 50-50 joint venture between CVRD and JFE Steel Corp. (Japan)] and was scheduled to begin production at 10 Mt/yr in early 2005. Production was planned to rise to 15 Mt/yr at a total capital cost of US\$84 million based on reported reserves of 450 Mt. JFE was to take 2 Mt/yr under a 12-year contract, mainly to supply its Philippines-based sintering business. The Brucutu Mine was scheduled to be commissioned in 2006 with production of 12 Mt/yr. Production from the new mines—Fabrica Nova and Brucutu—was to replace production from existing mines—Capanema, Corrego de Meio, and Timbopepa—scheduled for closure. Equipment from Capanema was to be moved to Fabrica Nova. The mine expansion was to be accompanied by a 15 Mt/yr export capacity expansion in early 2004—10 Mt/yr in the Northern System's Port of Ponta da Madeira and 5 Mt/yr in the Southern System's Port of Tubarao. At the Ponta da Madeira marine terminal, the new capacity would be brought to 74 Mt/yr (Kinch, 2003b; Mendes de Paula, 2003; Metal Bulletin, 2003d; Mining Journal, 2003e, h).

BHPB sold its interest in Sweet River Investments Ltd. (an 11.56% owner of Valepar SA), which in turn was a major shareholder (about 27%) in CVRD. BHPB's interest corresponded to 2.1% of CVRD's total capital. CVRD acquired 50% of the ordinary shares and 40% of the preferred shares of Caemi Mineração e Metalurgica S.A. (Caemi) from Mitsui & Co. for US\$426 million, thus acquiring 60.2% of the total capital of Caemi. Caemi owned 84.75% of MBR, an iron ore producer, in which CVRD already owned a 5% stake. MBR operated four mines—Capao Xavier, Jangada, Pico, and Tamandua—in the Iron Quadrangle region in the State of Minas Gerais and had a maritime terminal at Guaiba, State of Rio de Janeiro. Caemi indirectly held 27.91% of MRS Logistica S.A., a railroad company with the capacity to carry 100 Mt/yr of cargo, and owned 50% of Quebec Cartier Mining Company (QCM), a Canadian iron ore and pellet producer. With full control of Caemi, CVRD controlled almost 100% of Brazil's iron ore industry with a sales volume exceeding 160 Mt/yr. The primary benefit to CVRD will come from synergies gained from combining the operations of its iron ore subsidiary Ferteço with MBR. The mines of the two companies are next to each other, and both use the same railroad to ship their products to port. The MBR deposits greatly reinforce CVRD's reserves of both hematite and itabirite ore in Minas Gerais State, where the best grades in CVRD's own Southern System were becoming depleted. Mitsui, having sold its part of Caemi to CVRD, bought a 15% stake in Valepar for US\$830 million. The Japanese trading company, which was the world's fourth leading iron ore mining company, was a buying agent for the Japanese steel mills and was expected to help CVRD with price negotiations. CVRD will manage the Corrego do Feijao and Fabrica iron ore mines and Fabrica pelletizing plant, located in the Iron Quadrangle. CVRD's 2003 production, a record 186.0 Mt, increased by 10% from that of 2002 (Kinch, 2003a; Metal Bulletin, 2003aj; Companhia Vale do Rio Doce S.A., 2003a§, c§, 2004a§).

MBR reached its production goal of 36 Mt/yr in 2003 ahead of its 2005 projection. More than 31 Mt of ore was exported, and the balance went to the domestic market. This concluded a US\$370 million investment program underway since 1999,

when MBR's capacity was 26 Mt/yr. The conveyor being built to carry ore from Capao Xavier to MBR's Guaiba Island export terminal was expected to be completed at the end of 2004, raising its capacity to about 31 Mt/yr. MBR's expansion has involved an increase in production at the Pico and Tamandua Mines and the commissioning of the Jaganda and Capao Xavier Mines, while the Agua Claras and Mutuca Mines have been depleted and phased out. MBR expected to produce 40 Mt/yr of ore in 2004, with process plant improvements at Jangada and Vargem Grande, new long-distance conveyor belts transporting ore from Tamandua and Capitao do Mato to the Vargem Grande processing plant, and additions of a car dumper and a stacker-reclaimer at the Guaiba Island sea terminal completed in 2002 (Kinch, 2003e; Caemi Mineração e Metalurgia S.A., 2004, p. 30-31).

Canada.—The Labrador Iron Ore Royalty Income Fund (LIORIF) reported that Iron Ore Company of Canada (IOC) arranged for financing of working capital and existing debt with Rio Tinto and Mitsubishi Corp. of Japan. The bank facility for working capital was increased to US\$130 million. Rio Tinto and Mitsubishi also agreed to purchase shares of IOC for US\$60 million. LIORIF did not participate in either financing. After giving effect to the equity financing, the shareholders' interests in IOC will be Rio Tinto, 58.72%; Mitsubishi, 26.18%; and LIORIF, 15.10% (Skillings Mining Review, 2003a). IOC and Wabush Mines Ltd. agreed to study the use by Wabush of IOC concentrates in its Pointe Noire pelletizer in Quebec. The two companies, which already collaborate in such areas as transport and logistics, operate mines close to each other just outside Labrador City. By using IOC concentrate, Wabush could be able to increase output from its 6-Mt/yr plant, restricted in recent years to 4.5 Mt/yr, and IOC could free up 1 Mt/yr pellet capacity for export sale. Another area of cooperation involved the manganese content of output from Wabush's Scully Mine, which has been increasing to the point that two of its customers, Dofasco Inc. and Stelco Inc., found it difficult to handle this ore in their blast furnaces. IOC and Wabush performed laboratory scale tests to see if they could reduce the manganese content in Wabush pellets by blending their concentrates (Jones, 2003).

The Quebec government agreed to provide financing to QCM, which planned to invest Can\$350 million to keep its Mont-Wright iron ore mine operating for another 20 years. QCM's open pit mine, 800 km northeast of Montreal, has 18 Mt/yr of iron ore concentrate production capacity. QCM also operates a pellet plant at Port-Cartier, Quebec, with production capacity of 9 Mt/yr. Pursuant to an agreement reached in 2001 with the European Commission, Caemi was committed to sell its stake in QCM (Metal Bulletin, 2003ag).

China.—Maanshan Iron & Steel Co., Ltd. (MI&S) brought its Gaocun Mine back into operation. According to the China Iron & Steel Association, domestic ore mining costs decreased last year, while technical improvements raised the average grade of Chinese beneficiated ore by about 1% (Paxton, 2003a). The development of Kunming Iron & Steel Co.'s (Kisco) Dahongshan iron ore project took a major step forward after Kisco secured financing from several private Chinese investors. Kisco was joined by Dib Mining and Resources, a private Australian company, which was to invest about US\$240 million in the mine located 300 km from Kunming. New equipment, including a processing plant, was to

be installed at Dahongshan to increase production to 4 Mt/yr in 3 to 5 years. Ore was to be transported from the mine to Kisco's three blast furnaces by pipeline. In the interim, Kisco would rely on both domestic and imported iron ore for feed. The state-owned mill imported about 1.2 Mt/yr from several countries and sourced up to another 2 Mt/yr within China. Kisco's Dahongshan iron ore project was first considered 10 years ago, but the company was forced to postpone the plan as a result of insufficient funding and a lack of interest from potential joint-venture partners (Metal Bulletin, 2003x; Mining Journal, 2003f).

China's Baotou Iron & Steel Group was awarded rights to a 50-Mt iron ore deposit in Inner Mongolia Province. Development of the deposit has advantages compared with importing and transporting ore to company plants. Baotou sourced some feed from a mine 100 km away. The new mine is located about 300 km north of Baotou. The Chinese Government has offered US\$36 million in loans to improve Inner Mongolia's rail and road network, including providing a link between the new project and the existing rail (Mining Journal, 2003c).

The Chinese iron and steel industry had matured to a point where it was moving away from spot market purchases of iron ore and taking a long-term view. There were long-term contracts in the past, such as the Channar Mine, but agreements in 2003 showed a definite trend toward a longer term. Shaoguan Iron & Steel signed a 10-year iron ore contract with Samarco Mineração S.A. The southern Chinese steelmaker planned to build a 5-Mt/yr integrated steelworks in Huizhou, Guangdong Province (Metal Bulletin, 2003ai). Another Chinese steelmaker, Hangzhou Iron & Steel Co. Ltd., signed a supply contract with Samarco to provide Hangzhou with 1 Mt/yr of ore for a 3-year period. The integrated plant, Zhejiang Dexin Iron & Steel, with an expected capacity of 5.8 Mt/yr of pig iron and 6.0 Mt/yr of finished steel, was to be built on a greenfield site in the port city of Ningbo (Wong, 2003).

CVRD and Shanghai Baosteel Group Corp. signed an agreement and an addendum to an existing contract that would cover a period extending from 2006 through 2016. The existing contract, signed in 2001, called for CVRD to supply 6 Mt/yr, reaching 14 Mt/yr in 2010. Under the new agreement, CVRD sales to Baosteel were to reach 20 Mt/yr by 2010 (TEX Report, 2003e; Companhia Vale do Rio Doce S.A., 2003b§). CVRD also signed a supply contract with MI&S for 25 Mt spanning 6 years. Starting from the beginning of April 2004, CVRD was to supply as much as 4 Mt/yr to MI&S until March 2010. These imports would be supplemented by 3 Mt/yr of production from MI&S's three captive mines in Abhui Province. MI&S produced 5.38 Mt of crude steel in 2002 with a near-term goal of 8 Mt/yr (Paxton, 2003b).

Jiuquan Iron & Steel Company (Jiugang), the leading steel producer in northwestern China, signed an agreement to take delivery in 2003 of 500,000 t of iron ore pellets from Kazakhstan's Sokolovo-Sarbaisky Mining and Processing Industrial Association (SSGPO). The 1-year trial could begin a long-term cooperation between Jiugang and the mine. The Chinese mill would like to import increasing quantities of iron ore to replace diminishing reserves of its own low-grade ore. SSGPO was to beneficiate the ore at its plant in the Kustana region of northern Kazakhstan before delivering it

by rail through the border station at Druzhba-Alasanko. After beneficiation, the iron content would be about 60% compared with 30% for untreated local ores. Jiugang requires about 5 Mt/yr of iron ore. The majority was supplied by the company's own Jingtieshan and Hengshan Mines. Jingtieshan, the larger of the two mines, produced 4.16 Mt of run-of-mine ore in 2002, yielding 2.24 Mt of iron concentrate (Metal Bulletin, 2003t).

China has been improving and constructing transportation infrastructure so that it can import more iron ore. In December 2002, Shanghai Baosteel opened its new US\$210 million port on Ma Ji Shan Island, close to the mouth of the Yangtze River. The unloading berth has a water depth of 26 meters (m) and two unloaders, enabling discharge for vessels of 250,000 to 300,000 deadweight tons (dwt). The stockpile yard covers 0.1 square kilometer, enough to store 1.08 Mt of ore. A loading berth was provided with two 4,500-ton-per-hour stacking-and-carrying machines. Iron ore unloaded at Majishan Harbor was transferred to 35,000- to 50,000-dwt handy-size vessels and then transported to Chinese steelmakers along the Yangtze River (TEX Report, 2003d).

Construction of China's largest port was begun at Dailun in the country's northeast to handle 300,000-dwt vessels. The ore handling capacity was initially 10 Mt/yr, increasing to 15 Mt/yr at a future date. As a result, ore transport costs would be reduced by 40%, and major steelmakers in the region would be able to increase steel production (TEX Report, 2003b). To further improve the transportation system in China, seven Chinese and Taiwanese shippers planned to form a cape-size vessel pool system. The system would consist of Hong Kong-based shipping companies, such as China Maritime Transportation Co., Grand Sea Trade Shipping Agencies Ltd., Unique Shipping (HK) Ltd., and Wah Kong Ship Management (HK) Ltd., as well as Taiwanese shipping companies, such as Oak Maritime (HK) Ltd. and U-Ming Marine Transport Corp. It was expected that a fleet comprising 50 cape-size vessels would be available within a few years (TEX Report, 2003c).

China's emergence as the world's leading iron ore consumer is related to the country's increased need for iron ore for steel production, as evidenced by the increased role of imports, and the subsequent expansion of China's port facilities. These Chinese iron ore requirements are affecting the availability of ore on world markets and will have strong economic influences on those countries that export iron ore to China (Kirk, 2003a, b).

India.—Tata Iron & Steel Co. (Tisco) expected to double exports of iron ore from its mines in 2003. The company exported 0.73 Mt of iron ore in the fiscal year ending March 2003 (FY03) from its mines situated in the States of Jharkhand and Orissa. In FY03 iron ore exports from Haldia, with 4 Mt/yr capacity, were 2.7 Mt, more than 50% greater than those of the previous year. Tisco's reserves reportedly were more than 344 Mt, 170 Mt at Noamundi and 174 Mt with more than 65% iron content at Joda East. Tisco's mines at Noamundi and Joda East could be expanded to meet export demand (Metal Bulletin, 2003j). India's National Mineral Development Corp. (NMDC) planned to export 3 Mt of iron ore to China in fiscal year 2004 (FY04) independent of state-owned Minerals & Metals Trading Corp. (MMTC) through which most exports were shipped. NMDC exported about 2.1 Mt of ore in FY03. Iron ore demand in India was booming and NMDC could not spare much for

export. NMDC expected to produce 19.5 Mt of ore in FY04, up from 17 Mt in FY03. NMDC's production target for fiscal year 2005 (FY05) was 21 Mt; the company hoped to sell 21 Mt in FY04 and 23 Mt in FY05. Sales exceed production through shipping of stocks (Metal Bulletin, 2003z).

The Mormugoa Port Trust (MPT) increased iron ore shipping capacity by 3 Mt/yr by deepening the port's draft to 15 m from 13 m. Of the record 23 Mt of iron ore shipped from Goan ports during FY03, 19.6 Mt passed through MPT (Metal Bulletin, 2003k). Ennore Port Ltd. planned to construct a temporary iron ore terminal consisting of a jetty where stockpiled ore would be conveyed to 3,000 to 5,000-t-capacity barges, which transfer the ore to the ships for export. The system, which was commissioned in June 2004, will handle approximately 2 Mt/yr of ore for 3 years, while consideration is given to a larger port project. The cost of the US\$1.1 million facility will be borne by India's state-owned MMTC, the leading exporter of iron ore through the nearby Port of Chennai, which may close in 3 years because of problems with pollution (Metal Bulletin, 2003af).

Hy-Grade Pellets Limited (the iron ore pelletizing joint venture between international steel trader Stemcor Minerals Ltd. and India's Essar Steel Ltd.) proposed to produce 3 Mt/yr of pellets by the end of FY04; it produced 2.65 Mt in FY03. Demand for pellets was rising in the Indian market, and the company could export only 0.5 Mt in FY03. The export target for FY04 was expected to be about the same. Construction of a slurry pipeline to carry fine ore from NMDC's Bailadila Mines to the Vizag pellet plant was started, and 30 km of pipeline was built. Before the 2003 monsoon season, another 70 to 80 km was to be constructed, and the pipeline completed in 2004. Hy-Grade Pellets also started work on a 7-Mt/yr beneficiation plant at the mine site expected to be completed in 2004. Rail transport cost of fines from the mines to Vizag would be greatly reduced when the pipeline is complete. The beneficiation plant was to allow better-quality pellet feed to be pumped to Vizag, improving the quality of pellet output. Rail freight rates for iron ore shipments in 2003-04 from Bailadila to the Vizag pellet plant were reduced but still represented more than 120% of the cost of iron ore (Metal Bulletin, 2003o, p).

India's leading customer, China's steel industry, reportedly preferred to negotiate with Indian ore producers and traders, not with MMTC, which it considered a monopoly. Indian producers feared that bottlenecks in rail and dock facilities within India would restrict exports. Dumping facilities used to unload rail cars at the Ports of Chennai and Paradip were inadequate. As a result of this and other problems, exporters incurred high demurrage charges, which reduced their profit margins. However, India had advantages in exporting its iron ore to China. Cargoes only took between 10 and 15 days to arrive at their destination, and freight charges were lower than from Brazil. Additionally, India could provide ore with higher iron content and lower gangue than ores from Australia, India's main rival in China. Australia, however, with production dominated by Rio Tinto and BHPB, could offer more homogenous ore than India could because Indian exports were blended from many small mines. While Indian ports can only handle vessels with capacities of up to 130,000 dwt, their competitors in Australia can handle far larger vessels (Metal Bulletin, 2003r).

Iran.—After a delay of almost 3 years, National Iranian Steel Co. (Nisco) and Japan's Kobe Steel Ltd. were ready to start building a 3.4-Mt/yr iron ore pelletizing plant. In 2000, the two companies signed a US\$82.4 million deal to construct the plant near Yazd in central Iran, but financing and other arrangements for the project were not completed until 2003. The plant construction was to be completed in mid-2006, with trial runs scheduled for completion by the end of 2006 (McCulloch, 2003).

Kazakhstan.—At the SSGPO Sokolovskiy pit, iron ore production was being increased to 6 Mt/yr from the original design capacity of 3 Mt/yr. SSGPO's Katcharskiy Mine was having a belt conveyor installed to reduce expensive road haulage (Mining Journal, 2003i).

Pakistan.—Pakistan Steel Mills Corporation Ltd. expected to cut imports of iron ore by 10% in 2003 after signing an agreement with a new domestic iron mining company. Pakistan Steel was to take delivery of 100,000 t of iron ore from Bolan Mining Enterprise (BME), a 50-50 joint venture between the Pakistani Government and the Baluchistan Provincial government. BME recently started mining the Dilband iron ore deposit in Baluchistan and planned to install a beneficiation plant to secure a long-term agreement with Pakistan Steel (Metal Bulletin, 2003ac).

Russia.—Xilin Iron & Steel Co. in northeastern China was looking at a project to develop iron ore reserves across the border in Russia. Representatives of the state-owned mill were in talks with the Government of Russia's Jewish Autonomous Region regarding investment in the Kimkan deposit. Xilin would take the majority of iron ore mined at the site for use in its blast furnaces; excess ore would be exported or sold to Russian steel producers. Negotiations involved the government of Heilongjiang Province, China, and Japan's Sumitomo Corp. Kimkan reportedly has reserves of 190 Mt at an average iron content of 33%. The deposit is located west of Khabarovsk, which is close to the border with Heilongjiang Province. Ore throughput would be 1.5 Mt/yr, yielding 0.5 Mt of iron concentrate. The Jewish Autonomous Region had two other iron ore deposits with combined reserves of 530 Mt. However, Kimkan was the most likely candidate for development owing to low phosphorus content and its location 5 km from rail links (Metal Bulletin, 2003an).

The Russian Government considered removing a 6.5% export tax on iron ore. According to Rudprom, an association of domestic producers, iron ore exports rose by 23.5% to 3.97 Mt in the first quarter of 2003 from the same period in 2002. Non-CIS countries accounted for 60% of Russian iron ore exports in the first quarter of 2003. Authorities in the Urals' Chelyabinsk region announced a license competition to develop the Techinskoye iron ore field with applications accepted until the end of July 2003. The winner was to be licensed to develop and mine Techinskoye through 2040. Iron ore deposits at the field are tentatively estimated to be about 70 Mt with iron content at 35.4%. The competition required iron ore extraction to begin no later than the second quarter of 2007 and a capacity of 2 Mt/yr to be achieved by the second quarter of 2009 (Metal Bulletin, 2003s, ah).

Joint-Stock Company Olenegorsky Mining Beneficiation Complex (GOK) said that its iron ore deposits in the Murmansk region were expected to be exhausted within 10 years. Olenegorsky extracted iron ore from surface mines with limited

reserves, but additional reserves could become available if an underground operation were started. A decision was expected to be taken in late April following review of preliminary documentation. The main drawback to developing an underground mine was the 10-year or longer period required to recoup the investment. The project's costs were estimated to be US\$15 million to US\$16 million. Olenegorsky is controlled by Severstal Joint-Stock Company, which won the competition for mine rights in 2002. In the same year, Olenegorsky mined 10.6 Mt of ore to produce 3.8 Mt of concentrates and projected 2003 production to be 3.36 Mt of concentrates (Metal Bulletin, 2003aa).

Russia's Korshunovsky GOK (KGOK) was close to emerging from bankruptcy administration that started in 1998. The 500,000-metric-ton-per-month (t/mo) iron ore producer was idle from April to November 2002 and restarted production because of an agreement with Chelyabinsk Integrated Iron & Steel Works (Mechel). KGOK, located in Siberia's Irkutsk region more than 2,000 km from Chelyabinsk in the southern Urals, was built to supply concentrates to the Western-Siberian Iron & Steel Works. Later in the year, KGOK was operating profitably, supplying more than 300,000 t/mo to Mechel. Kachkanarsky GOK shipped a trial 4,500-t shipment of pellets to VoestAlpine AG's mill in Linz, Austria. Kachkanarsky hoped that this would be a step towards the company's larger presence in the iron ore market of Western Europe. Lebedinsky GOK reported an output of 7 Mt of iron ore in the first quarter of 2003, an increase of 4% more than that of the same period of 2002 (Metal Bulletin, 2003u, y).

South Africa.—United Kingdom-based Anglo American plc entered the iron ore industry in 2002. In February, Anglo American increased ownership in Kumba Resources Limited by 10.5% for US\$112 million, bringing its share to 20.1%. In October, Anglo American further increased its stake to 35.3%, triggering a purchase offer to Kumba's shareholders. This resulted in raising Anglo American's share in Kumba to 66.6%. Kumba produced 18.2 Mt of lump and 11.4 Mt of fine iron ore in 2003. The total acquisition cost of the 66.6% share of Kumba was estimated by Anglo American to be US\$1.05 billion. Kumba's acquisition by Anglo American encountered significant review with the Industrial Development Corporation (IDC) of South Africa concerning the development of iron ore resources in Northern Cape Province. The IDC had opposed the increase of Anglo American's ownership of Kumba. As part of the agreement, Anglo American agreed to divest its shares of Anglovaal Mining Ltd. (Avmin), which was an owner of significant reserves and producer of 5 Mt/yr of iron ore at Beeshoek Mine in Northern Cape Province. The divestiture of Avmin resulted in a US\$89 million profit based on the favorable rand-to-U.S.-dollar exchange rate in effect at the time of the transaction (Anglo American plc, 2003; Metal Bulletin, 2003a, v; Mining Journal, 2003a, j). At mid-year, Kumba announced plans to increase production rates to 70 Mt/yr by 2010 from 28 Mt/yr in 2003. Kumba planned to develop the Sishen South Mine to produce 9.1 Mt/yr; to increase Sishen Mine production to 38 Mt/yr; to develop two iron mines in West Africa, Belinga in Gabon and Faleme in Senegal; and to share 50% in the development of the Hope Downs Mine in Australia. Kumba also dropped the Guelb El Aouj project in Mauritania (Metal Bulletin, 2003m, w, ak).

Sweden.—Luossavaara-Kiirunavaara Aktiebolag (LKAB) produced 13.7 Mt of ore at its Kiruna operations and 7.8 Mt at

Malmberget in 2003. This was an iron ore production increase of almost 6% more than the 2002 production. LKAB planned to continue efficiency increases through 2006 to reach its stated production goal of 23 Mt/yr of iron ore (Luossavaara-Kiirunavaara Aktiebolag, 2004, p. 12-13).

Venezuela.—State-controlled CVG Ferrominera Orinoco (FMO) completed an upgrade of its Punta Cuchillo plant, raising pellet capacity to 390 metric tons per hour (t/hr) from 340 t/hr (Metal Bulletin, 2003i). This upgrade was part of FMO's overall plan, which also included a US\$230 million iron ore concentrator plant to be built at Puerto Ordaz and related infrastructure valued at US\$100 million. The 8-Mt/yr concentrator plant, to be completed in 2006, would allow FMO to mine lower grade ore reserves. The new concentrator plant reportedly was essential for FMO to reach its target production rate of 25 Mt/yr of iron ore. As of yearend 2003, the contracting efforts were underway, but financing had not been finalized (Kinch, 2003c; Metal Bulletin, 2003h).

Current Research and Technology

The Mesabi Nugget demonstration plant, using new technology developed by Kobe Steel Ltd.'s subsidiary Midrex Technologies, Inc., operated an initial trial run to produce 5 t of iron nuggets in late May 2003. The plant operated successfully for 35 continuous days in June and July. High-quality iron nuggets produced at the pilot plant were used by Steel Dynamics in their electric arc furnace in Butler, IN. The project produced iron nuggets of 96% to 98% iron content using noncoking coals with low emissions. The program was to be supported by the DOE through September 2004. Negotiations were underway at yearend 2003 to develop a full-scale plant with a capacity of 0.3 to 0.5 Mt/yr at Hoyt Lakes, MN (Midrex Technologies, Inc., 2003§; Cheeley, Klawonn, and McClelland, 2004§).

In April 2003, Rio Tinto started construction in Australia on its proposed 0.8-Mt/yr HIs melt[®] plant at Kwinana, Western Australia, and was on schedule for its commissioning in late 2004. The HIs melt[®] process, a revolutionary direct iron smelting technology, produces a premium-grade hot metal from iron ore fines and noncoking coal. It is claimed to be both environmentally friendly and an alternative to traditional blast furnaces as a means of providing low-cost iron for electric arc furnaces. The Kwinana project was to operate as a joint venture among Rio Tinto, Nucor Corporation, Mitsubishi, and China's Shougang Corporation, in order of ownership participation. A license for this new technology had been granted to China's Laiwu Steel Group to build a plant similar to the one currently being constructed at Kwinana (Western Australian Department of Industry and Resources, 2003, p. 49; Rio Tinto plc, 2003b§).

Outlook

Most iron ore produced in the United States is sold directly to the domestic steel industry although some domestic ore is traded for Canadian ore and subsequently shipped to China. This domestic 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 2003

USGS Minerals Yearbook. Any growth of the U.S. iron ore industry within the next few years will be tied to the growth of the integrated steelworks along the Great Lakes. Significant expansion in the domestic iron ore industry may be possible if a direct-reduction process, such as Midrex's ITmk3[®], proves to be economical for Great Lakes steel producers. If there is DRI development, then the iron ore industry will be able to supply the expanding minimill sector of the U.S. steel industry.

Steel alloy products require a purity that can not be readily achieved with scrap. For this reason, imported DRI already plays an important role among coastal U.S. steel producers. Domestically produced DRI could become competitive further inland where cheaper power is available. However, on a global scale, even with strong DRI growth during the next decade, DRI will not replace more than a fraction of the world's blast furnace production. The blast furnace will remain the mainstay of the iron and steel industry during the midterm.

Analysis of international imports of iron ore and production of iron ore and pig iron—key indicators of iron ore consumption—clearly indicates that the future of the international iron ore industry will depend on the continuing growth of iron ore consumption in China. China's increased activity in overseas joint ventures, escalating imports of iron ore, and high domestic production of low-grade ores indicate that iron ore consumption will continue to grow, although a larger portion of the consumption will be satisfied by imports.

References Cited

- American Iron and Steel Institute, 2004, 2003 annual statistical report: Washington, DC, American Iron and Steel Institute, 111 p.
- American Metal Market, 2003a, Cleveland-Cliffs cuts management by 22%: American Metal Market, v. 111, no. 30-5, August 1, p. 4.
- American Metal Market, 2003b, Cliffs recalling workers as two mines ramp up: American Metal Market, v. 111, no. 24-3, June 18, p. 5.
- American Metal Market, 2003c, Evtac, lacking orders, seeks ch. 11 shelter: American Metal Market, v. 111, no. 18-1, May 5, p. 1-2.
- Anglo American plc, 2004, Annual report 2003: London, United Kingdom, Anglo American plc, 112 p.
- Caemi Mineração e Metalurgia S.A., 2004, Annual report 2003: Rio de Janeiro, Brazil, Caemi Mineração e Metalurgia S.A., 68 p.
- Clarke, Jo, 2003a, BHP Billiton prepares to launch MAC iron ore project: Metal Bulletin, no. 8809, September 29, p. 25.
- Clarke, Jo, 2003b, Eastern Range to feed long-term alliance with Shanghai Baosteel: Metal Bulletin, no. 8790, July 14, p. 21.
- Clarke, Jo, 2003c, Mount Gibson begins mining at Talling Peak: Metal Bulletin, no. 8812, October 20, p. 26.
- Clarke, Jo, 2003d, OneSteel aims to prolong life of Whyalla: Metal Bulletin, no. 8768, April 28, p. 21.
- Cleveland-Cliffs Inc., 2004, Annual report 2004: Cleveland, OH, Cleveland-Cliffs Inc., 61 p.
- Ericsson, Magnus, 2003, Squeeze for iron ore?: Metal Bulletin Monthly, no. 392, August, p. 10-11.
- Ericsson, Magnus, 2004, Iron ore breaks new records: Mining Journal, July 2, p. 18-20.
- Fortner, Larry, 2003, Jack Tuomi keeps score on safety at Hibbtac: Skillings Mining Review, v. 92, no. 8, August, p. 12.
- Hohnstadt, Ivan, 2003a, CVRD—Growing forward: Skillings Mining Review, v. 92, no. 11, November, p. 7.
- Hohnstadt, Ivan, 2003b, Minnesota's iron ore production tax is heavy duty: Skillings Mining Review, v. 92, no. 11, November, p. 26.
- Jones, Bob, 2003, IOC looks at feeding concentrates to Wabush: Metal Bulletin, no. 8757, March 17, p. 21.
- Kakela, P.J., 2004, Iron ore in 2004: Skillings Mining Review, v. 93, no. 7, July, p. 6-18.

Kinch, Diana, 2003a, Billiton move signals new era for CVRD: *American Metal Market*, v. 111, no. 1-2, January 7, p. 4.

Kinch, Diana, 2003b, CVRD takes the long-term view: *Metal Bulletin*, no. 8775, May 22, p. 25.

Kinch, Diana, 2003c, FMO plans to start building concs plant next year: *Metal Bulletin*, no. 8817, November 24, p. 27.

Kinch, Diana, 2003d, Logistics swap to boost CVRD rail empire: *Metal Bulletin*, no. 8767, April 24, p. 15.

Kinch, Diana, 2003e, MBR may bring forward 36m-tpy target: *Metal Bulletin*, no. 8760, March 27, p. 15.

Kirk, W.S., 2003a, China's emergence as the world's leading iron ore-consuming country—Part 1: *Skilling's Mining Review*, v. 92, no. 7, July, p. 5-7, 26.

Kirk, W.S., 2003b, China's emergence as the world's leading iron ore-consuming country—Part 2: *Skilling's Mining Review*, v. 92, no. 8, August, p. 6-8, 13.

Luossavaara-Kiirunavaara Aktiebolag, 2004, Annual report 2003: Lulea, Sweden, Luossavaara-Kiirunavaara Aktiebolag, 62 p.

Llamas, Jorge, 2003, The advent of a new era: *Metal Bulletin*, no. 8801, August 28, p. 16.

McCulloch, Russ, 2003, Iran steelmaker, Kobe Steel to build pellet plant after three-year delay: *American Metal Market*, v. 111, no. 11-3, March 19, p. 5.

Mendes de Paula, Germano, 2003, Japan out, China and Korea in: *Metal Bulletin*, no. 8792, July 21, p. 18.

Metal Bulletin, 2003a, Anglo seizes chance to raise stake in Kumba: *Metal Bulletin*, no. 8814, November 3, p. 36.

Metal Bulletin, 2003b, Another island mine may reopen in Australia: *Metal Bulletin*, no. 8794, July 31, p. 16.

Metal Bulletin, 2003c, Cleveland-Cliffs cuts managerial workforce: *Metal Bulletin*, no. 8795, August 4, p. 15.

Metal Bulletin, 2003d, CVRD capacity will rise 17 million tpy in early 2004: *Metal Bulletin*, no. 8799, August 18, p. 15.

Metal Bulletin, 2003e, CVRD identifies new Itabira iron reserves: *Metal Bulletin*, no. 8790, July 14, p. 15.

Metal Bulletin, 2003f, CVRD uses option to buy Casa de Pedra ore: *Metal Bulletin*, no. 8769, May 1, p. 18.

Metal Bulletin, 2003g, Flooding forces Cliffs to idle two mines: *Metal Bulletin*, no. 8775, May 22, p. 25.

Metal Bulletin, 2003h, FMO announces concs plant project: *Metal Bulletin*, no. 8805, September 11, p. 13.

Metal Bulletin, 2003i, FMO nears completion of pelletizer upgrade: *Metal Bulletin*, no. 8778, June 2, p. 18.

Metal Bulletin, 2003j, Freed from captivity—Tisco's iron ore mines to export: *Metal Bulletin*, no. 8764, April 10, p. 17.

Metal Bulletin, 2003k, Goan ports see record iron ore exports: *Metal Bulletin*, no. 8766, April 17, p. 17.

Metal Bulletin, 2003l, Hamersley Iron looks beyond 95 million tonnes: *Metal Bulletin*, no. 8790, July 14, p. 22.

Metal Bulletin, 2003m, Hope Downs also waits on result of IDC dispute: *Metal Bulletin*, no. 8754, March 6, p. 18.

Metal Bulletin, 2003n, Hope Downs wins railway access: *Metal Bulletin*, no. 8815, November 10, p. 27.

Metal Bulletin, 2003o, Hy-Grade Pellets to increase iron ore production: *Metal Bulletin*, no. 8767, April 24, p. 16.

Metal Bulletin, 2003p, Indian industry welcomes rail freight rate reductions: *Metal Bulletin*, no. 8754, March 6, p. 17.

Metal Bulletin, 2003q, Indian iron ore miner links with buyers: *Metal Bulletin*, no. 8810, October 6, p. 32.

Metal Bulletin, 2003r, Indian iron ore—Poised to take advantage of freer trade: *Metal Bulletin*, no. 8756, March 13, p. 21.

Metal Bulletin, 2003s, Iron ore field in the Urals put up for sale: *Metal Bulletin*, no. 8787, July 3, p. 16.

Metal Bulletin, 2003t, Jiuquan links with Kazakh ore supplier: *Metal Bulletin*, no. 8761, March 31, p. 15.

Metal Bulletin, 2003u, Kachkanarsky sends trial pellet shipment: *Metal Bulletin*, no. 8771, May 8, p. 18.

Metal Bulletin, 2003v, Kumba and IDC sign vague alliance: *Metal Bulletin*, no. 8772, May 12, p. 13.

Metal Bulletin, 2003w, Kumba reveals plans to expand to 70 million tpy: *Metal Bulletin*, no. 8787, July 3, p. 15.

Metal Bulletin, 2003x, Kunming secures investors for iron ore expansion: *Metal Bulletin*, no. 8786, June 30, p. 16.

Metal Bulletin, 2003y, Mechel considers offer for ore plant: *Metal Bulletin*, no. 8751, February 24, p. 15.

Metal Bulletin, 2003z, NMDC plans to export 3m tonnes of iron ore to China: *Metal Bulletin*, no. 8798, August 14, p. 16.

Metal Bulletin, 2003aa, Olenegorsky's iron ore deposits close to exhaustion: *Metal Bulletin*, no. 8761, March 31, p. 13.

Metal Bulletin, 2003ab, OneSteel to study magnetite iron ore base: *Metal Bulletin*, no. 8752, February 27, p. 17.

Metal Bulletin, 2003ac, Pakistan Steel signs offtake deal with new iron ore miner: *Metal Bulletin*, no. 8743, January 27, p. 17.

Metal Bulletin, 2003ad, Portman approves iron ore expansion: *Metal Bulletin*, no. 8810, October 6, p. 32.

Metal Bulletin, 2003ae, Portman halts output at Cockatoo: *Metal Bulletin*, no. 8777, May 29, p. 16.

Metal Bulletin, 2003af, Putting the ore into Ennore: *Metal Bulletin*, no. 8798, August 14, p. 16.

Metal Bulletin, 2003ag, Quebec to help fund QCM investment: *Metal Bulletin*, no. 8815, November 10, p. 30.

Metal Bulletin, 2003ah, Russia may abolish iron ore export tax: *Metal Bulletin*, no. 8805, September 11, p. 13.

Metal Bulletin, 2003ai, Shaoguan secures iron ore supply deal with Samarco: *Metal Bulletin*, no. 8811, October 13, p. 40.

Metal Bulletin, 2003aj, Treading daintily: *Metal Bulletin*, no. 8764, April 10, p. 11.

Metal Bulletin, 2003ak, West Africa provides third focus for Kumba: *Metal Bulletin*, no. 8754, March 6, p. 18.

Metal Bulletin, 2003al, West Angelas to reach full capacity by second-quarter 2004: *Metal Bulletin*, no. 8811, October 13, p. 40.

Metal Bulletin, 2003am, Wuhan takes Hamersley ore: *Metal Bulletin*, no. 8801, August 28, p. 13.

Metal Bulletin, 2003an, Xilin steelworks explores Russian iron ore project: *Metal Bulletin*, no. 8739, January 13, p. 17.

Metal Bulletin Monthly, 2003, Posmac iron ore joint venture is finalised: *Metal Bulletin Monthly*, no. 390, June, p. 65.

Mining Journal, 2003a, Anglo to make Kumba offer: *Mining Journal*, v. 341, no. 8761, November 7, p. 376.

Mining Journal, 2003b, BHP Billiton brings iron-ore expansion forward: *Mining Journal*, v. 341, no. 8747, August 1, p. 75.

Mining Journal, 2003c, Chinese iron-ore mining rights awarded: *Mining Journal*, v. 341, no. 8763, November 21, p. 419.

Mining Journal, 2003d, CSN to revive iron-ore expansion: *Mining Journal*, v. 340, no. 8718, January 10, p. 19.

Mining Journal, 2003e, CVRD follows suit: *Mining Journal*, v. 341, no. 8750, August 22, p. 127.

Mining Journal, 2003f, Dib Mining in Chinese iron-ore venture: *Mining Journal*, v. 341, no. 8753, September 12, p. 198.

Mining Journal, 2003g, Iron-ore boom analysed: *Mining Journal*, v. 341, no. 8759, October 24, p. 328.

Mining Journal, 2003h, Japanese iron-ore development: *Mining Journal*, v. 341, no. 8744, July 11, p. 20.

Mining Journal, 2003i, Kazakhstan—A resources giant: *Mining Journal*, v. 340, no. 8721, January 31, p. 2.

Mining Journal, 2003j, Keeping hold: *Mining Journal*, v. 340, no. 8735, May 9, p. 314.

Mining Journal, 2003k, Koolyanobbing environmental solution: *Mining Journal*, v. 340, no. 8730, April 4, p. 237.

Mining Journal, 2003l, Rio Tinto considers Cape Lambert boost: *Mining Journal*, v. 341, no. 8754, September 19, p. 220.

Mining Journal, 2003m, Rio Tinto ships Yandi ore through Robe River port: *Mining Journal*, v. 341, no. 8757, October 10, p. 287.

Mount Gibson Iron Limited, 2004, Annual report: Perth, Australia, Mount Gibson Iron Limited, 44 p.

Paxton, Robin, 2003a, Imports eclipse turnaround in Chinese iron ore output: *Metal Bulletin*, no. 8755, March 10, p. 25.

Paxton, Robin, 2003b, Maanshan and CVRD sign iron ore deal: *Metal Bulletin*, no. 8798, August 14, p. 16.

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

Prospect, 2003, Third party access decision welcomed by department: *Prospect*, December 2003-February 2004, p. 22.

Rio Tinto plc, 2004, 2003 annual review: London, United Kingdom, Rio Tinto plc, 52 p.

Skilling's Mining Review, 2003a, IOC arranges debt and equity financing:

Skillings Mining Review, v. 92, no. 1, January, p. 7.
 Skillings Mining Review, 2003b, Minnesota's taxation of iron ore mining under scrutiny: Skillings Mining Review, v. 92, no. 8, August, p. 13.
 Skillings Mining Review, 2003c, National Steel sale to US Steel complete: Skillings Mining Review, v. 92, no. 6, June, p. 20.
 Skillings Mining Review, 2003d, US Steel shipping pellets to China: Skillings Mining Review, v. 92, no. 12, December, p. 3.
 TEX Report, 2003a, China progresses rapidly expansion of steelmaking facilities: TEX Report, v. 35, no. 8377, October 8, p. 3.
 TEX Report, 2003b, China starts construction of Dailun port to support steel industry in northeast area: TEX Report, v. 35, no. 8264, April 22, p. 4.
 TEX Report, 2003c, Chinese and Taiwanese shipping companies to form Capesize vessel pool system: TEX Report, v. 35, no. 8239, March 17, p. 6.
 TEX Report, 2003d, Port expansion and development planned to support Chinese steel industry: TEX Report, v. 35, no. 8303, June 18, p. 14.
 TEX Report, 2003e, Shanghai Baosteel and MBR have reached long-term iron ore agreement: TEX Report, v. 35, no. 8402, November 14, p. 2.
 United Nations Conference on Trade and Development, 2004, The iron ore market—2003-2005: Geneva, Switzerland, United Nations Conference on Trade and Development, May, 90 p.
 Western Australian Department of Industry and Resources, 2003, Western Australian iron ore industry 2003: East Perth, Australia, Western Australian Department of Industry and Resources, 58 p.
 Wong, K.L., 2003, Chinese mill secures Samarco support for new steelworks: Metal Bulletin, no. 8804, September 8, p. 20.

Internet References Cited

Aztec Resources, 2003 (January 30), December 2003 quarterly report, accessed February 4, 2004, at URL <http://www.aztecresources.com.au/read/2391141274>.
 BHP Billiton Limited, 2003 (July 25), BHP Billiton accelerates expansion of Western Australian iron ore business, News Release, accessed February 4, 2004, via URL <http://www.bhpbilliton.com/bb/newsCentre>.
 BHP Billiton Limited, 2004 (January 29), BHP Billiton production report for the quarter ended 31 December 2003, News Release, accessed February 8, 2004, via URL <http://www.bhpbilliton.com/bb/newsCentre>.
 Bloomquist, Lee, 2003a (April 23), Court OKs Bethlehem sale, Duluth News Tribune, accessed April 23, 2003, via URL <http://www.duluthsuperior.com/mld/duluthsuperior/business>.
 Bloomquist, Lee, 2003b (February 11), Minntac sale put on hold, Duluth News Tribune, accessed April 23, 2003, via URL <http://www.duluthsuperior.com/mld/duluthsuperior/news>.
 Brisset, Jane, 2003 (April 18), Ice turns ships into frozen assets, Duluth News Tribune, accessed April 18, 2003, via URL <http://www.duluthsuperior.com/mld/duluthsuperior/business>.
 Cheeley, Rob, Klawonn, Rob, and McClelland, James, 2004, Status of developing iron & steelmaking technologies, new technologies nearing commercial reality, accessed August 9, 2004, via URL <http://www.midrex.com>.
 Cleveland-Cliffs Inc., 2003 (November 25), Cliffs and Laiwu Steel receive bankruptcy court approval for purchase of assets of Eveleth Mines, Press Release, accessed November 26, 2003, via URL <http://www.cleveland-cliffs.com/MediaPressRoom>.
 Companhia Vale do Rio Doce S.A., 2003a (March 31), CVRD acquires Mitsui stake in Caemi, accessed February 22, 2004, via URL http://www.vale.com.br/default_en.asp.
 Companhia Vale do Rio Doce S.A., 2003b (December 15), CVRD and Baosteel signed long term agreements, accessed February 15, 2004, via URL http://www.vale.com.br/default_en.asp.
 Companhia Vale do Rio Doce S.A., 2003c (September 2), CVRD concludes the acquisition of Caemi, accessed February 21, 2004, via URL http://www.vale.com.br/default_en.asp.
 Companhia Vale do Rio Doce S.A., 2003d (November 7), CVRD concludes the restructuring of logistics companies, accessed February 21, 2004, via URL http://www.vale.com.br/default_en.asp.
 Companhia Vale do Rio Doce S.A., 2003e (June 30), CVRD sells Docenave ships, Press Release, accessed February 22, 2004, via URL http://www.vale.com.br/default_en.asp.
 Companhia Vale do Rio Doce S.A., 2004a (January 28), 2003 production

report, accessed March 8, 2004, at URL <http://www.vale.com.br/files/ProductionReport%202003i.pdf>.
 Companhia Vale do Rio Doce S.A., 2004b, Annual report, accessed August 10, 2004, via URL http://www.vale.com.br/default_en.asp.
 Duluth News Tribune, 2003 (January 23), Great Lakes water levels falling again, accessed January 23, 2003, via URL <http://www.duluthsuperior.com/mld/duluthtribune>.
 Hope Downs Management Services Pty. Ltd., 2004 (October 1), Market support secured from Japanese mills, accessed February 11, 2004, via URL <http://www.hopedowns.com>.
 Lake Carriers' Association, 2004 (March), 2003 statistical annual report, accessed August 10, 2004, at URL <http://www.lcaships.com/03stats.pdf>.
 Midrex Technologies, Inc., 2003, Update—Mesabi Nugget ITmk3® plant starts up, accessed August 9, 2004, via URL <http://www.midrex.com>.
 Minnesota Department of Revenue, 2003 (September), Minnesota mining tax guide, accessed July 13, 2004, via URL <http://www.taxes.state.mn.us/taxes/special/mineral/publications/reports>.
 Nelson, Wayne, 2003 (October 23), Transportation cost breakthrough made EVTAC deal a 'go', accessed July 14, 2004, via URL <http://www.businessnorth.com>.
 Phaceas, John, 2003 (December 5), Rio pumps cash into Pilbara ore, The Western Australian, accessed December 5, 2003, at URL <http://www.thewest.com.au/20031205/business-home-stp116628.html>.
 Portman Ltd., 2004 (January 20), Quarterly report for the period ended 31 December 2003, accessed February 12, 2004, at URL http://www1.portman.com.au/uploads/portman-32-2-yohro_77.pdf.
 Rio Tinto plc, 2003a (October 3), Hamersley Iron ships first Yandi ore through Cape Lambert port, Media Release, accessed February 13, 2004, at URL <http://www.riotinto.com/media/media.aspx?id=657>.
 Rio Tinto plc, 2003b (August 28), HIs melt signs agreement for technology transfer into China, Media Release, accessed February 13, 2004, at URL <http://www.riotinto.com/media/media.aspx?id=623>.
 Rio Tinto plc, 2003c (December 10), West Angelas expansion receives joint venture approval, Media Release, accessed February 13, 2004, at URL <http://www.riotinto.com/media/media.aspx?id=705>.
 Rio Tinto plc, 2003d (December 4), Yandicoogina Mine, Media Release, accessed February 13, 2004, at URL <http://www.riotinto.com/media/media.aspx?id=701>.
 Rio Tinto plc, 2004, Fourth quarter 2003 production report, Media Release, accessed February 12, 2004, at URL <http://www.riotinto.com/investor/media.aspx?id=716>.
 U.S. Department of Energy, 2003 (April), The Mesabi Nugget research project—New ironmaking technology of the future—High quality iron nuggets using a rotary hearth furnace, accessed July 26, 2004, at URL http://www.eere.energy.gov/industry/steel/pdfs/mesabi_nugget.pdf.
 U.S. Department of Energy, 2004 (July 20), Mesabi Nugget pilot plant successfully demonstrates the innovative ITmk3® ironmaking process, News Release, accessed July 26, 2004, via <http://www.oit.doe.gov/cfm/fullarticle.cfm?id=836>.

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

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.
 Skillings Mining Review.

Skillings Minnesota Mining Directory, annual.
 State of Minnesota, Mining Tax Guide, 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.

TABLE I
 SALIENT IRON ORE STATISTICS¹

(Thousand metric tons and thousand dollars unless otherwise specified)

	1999	2000	2001	2002	2003
United States:					
Iron ore, usable, less than 5% manganese: ²					
Production	57,700 ^r	63,100 ^r	46,200 ^r	51,600 ^r	46,400
Shipments:					
Quantity	58,500	61,000	50,600	51,500	44,500
Value	1,550,000	1,560,000	1,210,000	1,340,000	1,200,000
Average value at mines dollars per metric ton	26.47	25.57	23.87	26.04	26.86
Exports:					
Quantity	6,120	6,150	5,610	6,750	6,770
Value	243,000	246,000	229,000	249,000	248,000
Imports for consumption:					
Quantity	14,300	15,700	10,700	12,500	12,600
Value	399,000	420,000	293,000	313,000	328,000
Consumption, iron ore and agglomerates	75,100	76,500	67,300	59,100 ^r	60,600
Stocks, December 31:					
At mines, plants and loading docks ³	5,710	9,150	3,800	4,090 ^r	4,910
At receiving docks ⁴	2,770	2,860	1,960	1,820	1,630
At consuming plants	17,900	16,800	12,300	12,400	10,900
Total ⁵	26,400	28,800	18,000	18,300 ^r	17,500
World, production ⁶	1,020,000	1,080,000 ^r	1,050,000 ^r	1,100,000 ^r	1,160,000 ^e

^eEstimated. ^rRevised.

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

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

³Excludes byproduct ore.

⁴Transfer and/or receiving docks of lower Great 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 2003, 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	Iron content	Crude ore	Usable ore	Iron contained
					(in usable ore)	(natural percent)			
Lake Superior:									
Michigan ²	1,330	2,710	36,700	12,400	7,580	61.0	13.59	4.59	2.80
Minnesota	3,340	5,760	117,000	34,000	21,700	63.8	20.26	5.91	3.77
Total or average	4,670	8,460	153,000	46,400	29,300	63.1	18.13	5.49	3.46
Other States ³	9	11	--	2	1	54.0	--	0.18	0.09
Grand total or average	4,670	8,480	153,000	46,400	29,300	63.1	18.11	5.48	3.46

-- Zero.

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 and South Dakota.

TABLE 3
CRUDE IRON ORE MINED IN THE UNITED STATES IN 2003, 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	36,700	--	36,700
Minnesota	6	117,000	--	117,000
Total	8	153,000	--	153,000
Other States	1	--	--	--
Grand total	9	153,000	--	153,000

-- Zero.

¹Excludes byproduct ore.

²Data 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 2003, BY DISTRICT, STATE, AND TYPE OF PRODUCT¹

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

District and State	Direct			Total
	shipping ore	Concentrates	Agglomerates ²	
Lake Superior:				
Michigan	60	--	12,400	12,400
Minnesota	--	76	33,900	34,000
Total	60	76	46,300	46,400
Other States ³	--	2	--	2
Grand total	60	78	46,300	46,400

-- 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 2003^{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	87	--	12,100	12,200	60.8	W
Minnesota	--	79	32,300	32,400	53.7	\$907,000
Total reportable or average	87	79	44,400	44,500	55.6	907,000
Other States ³	--	2	--	2	54.0	W
Grand total or average	87	81	44,400	44,500	55.6	907,000 ⁴

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.

⁴Includes only values for Minnesota to avoid disclosing proprietary data.

TABLE 6
CONSUMPTION OF IRON ORE AT U.S. IRON
AND STEEL PLANTS, BY TYPE OF PRODUCT¹

(Thousand metric tons)

Type of product	2002	2003
Blast furnaces:		
Direct-shipping ore	234	193
Pellets	48,400	50,400
Sinter ²	8,880	8,850
Total	57,500	59,500
Steelmaking furnaces:		
Direct-shipping ore	61	492
Pellets	417 ^r	345
Sinter ²	138 ^r	134
Total	616 ^r	971
Grand total	58,100 ^r	60,400

^rRevised.

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	Miscellaneous ⁴	Subtotal		Nonsteel end uses ⁷	Total
					integrated iron and steel plants ⁵	Direct-reduced iron for steelmaking ⁶		
2002	52,900	301	5,620	1	58,800	705 ^r	828 ^{r,e}	60,300 ^r
2003	53,800	133	5,650	--	59,500	315 ^r	791 ^r	60,600

^rEstimated. ^eRevised. -- 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	2002		2003	
	Quantity	Value	Quantity	Value
Canada	6,700	247,000	6,650	240,000
Other	59	1,510	121	7,740
Total	6,750	249,000	6,770	248,000

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	2002			2003		
	Quantity (thousand metric tons)	Value (thousands)	Unit value ^{3,4} (dollars per metric ton)	Quantity (thousand metric tons)	Value (thousands)	Unit value ^{3,4} (dollars per metric ton)
Concentrates	62	849	13.59	6	135	22.25
Coarse ores	1	115	133.96	3	168	60.29
Fine ores	12	393	31.66	40	936	23.50
Pellets	6,610	245,000	37.09	6,700	246,000	36.72
Briquettes	--	--	--	(5)	4	78.72
Other agglomerates	71	2,460	34.65	18	761	41.47
Roasted pyrites	2	145	62.74	2	109	53.44
Total	6,750	249,000	36.86	6,770	248,000	36.65

-- Zero.

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.

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 or type of product	2002			2003		
	Quantity (thousand metric tons)	Value (thousands)	Unit value ^{3,4} (dollars per metric ton)	Quantity (thousand metric tons)	Value (thousands)	Unit value ^{3,4} (dollars per metric ton)
Country:						
Australia	567	5,390	9.50	128	1,110	8.63
Brazil	5,750	135,000	23.52	4,980	118,000	23.71
Canada	5,540	157,000	28.37	6,970	196,000	28.07
Chile	319	6,750	21.16	296	6,510	22.01
Peru	86	1,090	12.77	77	1,280	16.52
Sweden	44	1,040	24.00	88	4,270	48.73
Venezuela	49	3,270	67.35	21	480	22.54
Other	108	2,890	26.62	37	1,060	28.34
Total	12,500	313,000	25.10	12,600	328,000	26.07
Type of product:						
Concentrates	431	9,680	22.45	985	20,800	21.12
Coarse ores	6	249	42.75	24	627	25.86
Fine ores	3,370	53,300	15.82	2,320	39,000	16.86
Pellets	8,250	240,000	29.09	8,790	258,000	29.36
Briquettes	39	3,120	81.00	--	--	--
Other agglomerates	355	6,140	17.28	477	9,570	20.05
Roasted pyrites	12	361	31.26	7	344	48.47
Total	12,500	313,000	25.10	12,600	328,000	26.07

-- Zero.

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 2003, 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	(3)	--	128	--	--	--	128
Brazil	364	--	1,750	2,790	72	(3)	4,980
Canada	311	--	263	5,990	405	--	6,970
Chile	256	--	40	--	--	--	296
Peru	--	--	77	--	--	(3)	77
Sweden	54	--	33	--	--	--	88
Venezuela	--	21	--	--	--	--	21
Other	--	3	28	--	--	6	37
Total	985	24	2,320	8,790	477	7	12,600

-- 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 2003¹

Type of product	Country of origin	Average unit value ² (dollars per metric ton, gross weight)
Concentrates	Canada	17.57
Fine ores	Australia	8.61
Do.	Brazil	16.48
Pellets	do.	28.90
Do.	Canada	29.58

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	2002		2003	
	Quantity	Value	Quantity	Value
Baltimore, MD	4,290	88,900	3,330	73,300
Charleston, SC	290	9,570	106	3,490
Chicago, IL	945	18,800	1,220	21,000
Cleveland, OH	1,630	48,400	3,270	93,000
Detroit, MI	303	11,600	247	8,920
Mobile, AL	1,150	31,400	75	2,090
New Orleans, LA	3,690	98,400	4,150	119,000
Philadelphia, PA	7	297	82	3,140
Tampa, FL	10	466	16	941
Other	146	5,040	100	3,020
Total	12,500	313,000	12,600	328,000

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

²Includes agglomerates.

Source: U.S. Census Bureau.

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

(Thousand metric tons and thousand dollars)

Country	2002		2003	
	Quantity	Value	Quantity	Value
Brazil	3,220	91,500	2,790	80,800
Canada	5,040	149,000	5,990	177,000
Total	8,250	240,000	8,790	258,000

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 2002	Fiscal year 2003
Australia:			
Hamersley Iron Proprietary Limited and Mount Newman Mining Company Proprietary Limited	Lump ore	36.13	39.35
Do.	Fines	28.28	30.83
Robe River Iron Associates	do.	22.55	24.58
BHP Billiton (Yandi)	do.	26.60	28.98
Brazil:			
Companhia Nipo-Brasileira de Pelotizacao (Nibrasco)	Pellet feed	45.23	49.66
Companhia Vale do Rio Doce (Carajas)	Fines	25.86	28.14
Companhia Vale do Rio Doce (Itabira)	do.	25.36	27.64
Minerações Brasileiras Reunidas Societe Anonyme	Lump ore	26.74	29.32
Do.	Fines	25.84	28.17
Samarco Mineração Societe Anonyme	Pellet feed	21.30	23.91
Canada, Iron Ore Company of Canada (Carol Lake)	Concentrates	24.60	26.81
Chile:			
Minera del Pacifico Societe Anonyme (Huasco)	Pellets	42.15	46.28
Minera del Pacifico Societe Anonyme (El Romeral)	Fines	19.64	20.31
India:			
Minerals and Metals Trading Corporation (Bailadila)	Lump ore	35.03	38.15
Do.	Fines	27.15	29.59
Peru, Shougang Hierro Peru Societe Anonyme	Pellet feed	19.28 ^r	21.02
South Africa			
Kumba Resources Limited (Iskor)	cents per dry metric ton unit Lump ore	29.25	31.85
Do.	do. Fines	21.51	23.45

^rRevised.

¹Free on board shipping port basis.

Source: Trust Fund Project on Iron Ore Information, Iron Ore 2003.

TABLE 16
IRON ORE: WORLD PRODUCTION, BY COUNTRY¹

(Thousand metric tons)

Country ⁴	Gross weight ²				Metal content ³					
	1999	2000	2001	2002	2003 ^e	1999	2000	2001	2002	2003 ^e
Algeria	1,336	1,645	1,291 ^r	1,202 ^r	1,378 ^s	680	830 ^e	650 ^r	610 ^r	700
Australia	154,268	167,935	181,553	182,704	187,219	95,223	104,226	112,592	113,548	116,355
Austria ^e	1,752 ^s	1,800	1,800	1,900	1,800	500 ^s	500	575	575	575
Azerbaijan ^e	--	NA	NA	NA	NA	--	NA	NA	NA	NA
Bosnia and Herzegovina ^e	150	150	150	150	150	50	50	50	50	50
Brazil	194,000	212,576 ^r	210,000	212,000 ^r	212,000	128,040 ^r	141,106 ^r	139,400 ^r	140,000 ^r	140,000
Bulgaria	699	559	464 ^r	373 ^r	375	223	178	148 ^r	119 ^r	120
Canada ⁶	33,900	35,427 ^r	26,981 ^r	30,969	31,000	21,650	22,744	17,186 ^r	19,820 ^r	19,800
Chile	8,345	8,729	8,834	7,269 ^r	7,300	5,215	5,455	5,437 ^r	4,398 ^r	4,420
China ^{6,7}	237,000	223,000	220,000	231,000	261,000	78,200	73,500	72,600	76,200	83,000
Colombia	576	660	637	688 ^r	625 ^p	317	363	350	378 ^r	344 ^p
Egypt	2,700 ^e	1,900	2,600	2,300	2,900	1,350	950	1,300	1,150 ^e	1,450
France ^e	250	--	--	--	--	35	--	--	--	--
Germany	100	--	--	--	--	14	--	--	--	--
Greece ⁸	1,600	1,500	1,500	1,500	1,500	600	575	575	575	575
Guatemala	11	16	15	15 ^e	15	7	11	10	10	10
India	70,220	75,950	79,200	94,300 ^{r,e}	105,500	44,940	48,600	50,700	60,300 ^{r,e}	67,500
Indonesia	584	489 ^r	469 ^r	379 ^r	245 ^s	320 ^e	269 ^e	258 ^e	261	140
Iran ⁹	10,776	12,370	10,300	11,300	16,000	5,300	6,100	5,100	5,600	7,200
Japan	1	1	1	1	1	1	1	(10)	(10)	(10)
Kazakhstan	9,091	16,160	14,140	15,423	17,311 ^s	5,200	9,200 ^e	8,000	8,700	9,800
Kenya	NA	1	1	1	1	NA	(10) ^e	(10)	(10)	(10)
Korea, North ^e	3,800	3,800	4,200	4,100 ^r	4,300	1,100	1,200	1,200	1,150 ^r	1,300
Korea, Republic of	410	336	195	157 ^r	150	229	188	109	88 ^r	85
Macedonia ^e	15	15	15	15	15	9	9	9	9	9
Malaysia	337	259	376	404	597 ^s	216	168	241	259 ^r	382
Mauritania	10,400	11,345 ^r	10,302 ^r	9,600 ^e	10,100	7,475 ^r	7,500 ^r	6,700	6,200 ^r	6,500
Mexico ¹¹	11,475	11,325	8,783	9,900 ^r	11,200	6,885	6,795	5,270	5,943 ^r	6,747
Morocco	7	6 ^r	8	9 ^r	4 ^s	4 ^r	4 ^r	4 ^r	5 ^r	2
New Zealand ¹²	2,303	2,692	1,636	1,700 ^{r,e}	1,900	691	808	480 ^e	510 ^{r,e}	570
Nigeria	--	25	25	25	--	--	9	9	9	--
Norway	520	543 ^e	500	515	515	355	369 ^e	340 ^e	350	350
Peru	3,949 ^r	4,144 ^r	4,564	5,494 ^r	5,229 ^s	2,715	2,813 ^r	3,087 ^r	3,105 ^r	3,542
Portugal ¹³	16	15 ^e	15	15 ^e	15	7	6 ^e	5 ^e	5	5
Romania ^e	131	116 ^r	292 ^r	341 ^r	315	71	55 ^r	76 ^r	89 ^{r,s}	79 ^s
Russia	81,311	86,630	82,500	84,236	91,760 ^s	46,900	50,000	48,000 ^e	49,000	53,000
Serbia and Montenegro ^e	50	50	--	--	--	--	15	--	--	--
Slovakia	479	477	435 ^r	326 ^r	325	167 ^r	167 ^r	152 ^r	114 ^r	114
South Africa ¹⁴	29,508	33,707	34,757	36,484	38,086 ^s	18,442	21,570	22,240	23,350	24,000
Sweden	18,558	20,557	19,486	20,300 ^{r,e}	21,500	11,506	13,556	12,811	13,300 ^{r,e}	14,100
Thailand	123	(10)	(10)	570	10 ^s	61	(10)	(10)	285	5

See footnotes at end of table.

TABLE 16--Continued
IRON ORE: WORLD PRODUCTION, BY COUNTRY¹

(Thousand metric tons)

Country ⁴	Gross weight ²				Metal content ³					
	1999	2000	2001	2002	2003 ^e	1999	2000	2001	2002	2003 ^e
Tunisia	219	182	204	198	164	120	98	109 ^e	105	87
Turkey	4,846	4,076	3,932	4,500	3,700	2,600	2,200	2,100 ^e	2,400 ^e	2,000
Uganda:										
Limonite	3	2	--	--	--	2 ^e	1 ^e	--	--	--
Other	(10)	2	1	-- ^r	--	(10) ^e	2 ^e	1	-- ^r	--
Ukraine	47,769	55,883	54,650	58,900	62,498 ^s	26,200	30,600 ^e	30,000 ^e	32,300	34,300
United Kingdom	1	1	1	1	1	1	1 ^e	1 ^e	(10)	(10)
United States	57,749	63,089	46,192	51,570	46,447	36,530	39,703	29,263	32,499	29,286 ^s
Venezuela	14,051	17,353	16,902	16,684 ^r	17,954	9,292	11,092	10,817	11,100 ^r	11,900
Vietnam	300	300	300	300	300	165	165	165	165	165
Zimbabwe	599	451	361	272	367 ^s	300	226 ^e	184 ^e	139	188 ^s
Total	1,016,289 ^r	1,078,251 ^r	1,050,568 ^r	1,100,089 ^r	1,163,770	559,921 ^r	603,976 ^r	588,304 ^r	614,774 ^r	640,754

^eEstimated. ^pPreliminary. ^rRevised. ^{NA} Not available. ⁻⁻ Zero.

¹Table includes data available through July 16, 2004.

²Insofar 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 imported 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.

³Data represent actual reported weight of contained metal or 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.

⁴In addition to the countries listed, Cuba may also produce iron ore, but definitive information on output levels, if any, is not available.

⁵Reported figure.

⁶Series represented gross weight and metal content of usable iron ore (including byproduct ore) actually produced, natural weight.

⁷China'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.

⁸Nickeliferous iron ore.

⁹Data are for year beginning March 21 of that stated.

¹⁰Less than 1/2 unit.

¹¹Gross weight calculated from reported iron content based on grade of 60% iron.

¹²Concentrates from titaniferous magnetite beach sands.

¹³Includes manganese iron ore.

¹⁴Includes magnetite ore as follows, in thousand metric tons: 1999--2,200; 2000--2,854; 2001--2,552; 2002--2,557; and 2003--2,307.

TABLE 17
 IRON ORE: WORLD PELLETTIZING CAPACITY,
 BY CONTINENT AND COUNTRY IN 2003

	Rated capacity (million metric tons, gross weight)
North America:	
Canada	27.5
Mexico	12.0
United States	53.6
Total ¹	93.1
South America:	
Brazil	48.2 ^e
Chile	4.7
Peru	3.5
Venezuela	10.3
Total ¹	66.7
Europe:	
Netherlands	4.6
Russia ²	65.0
Slovakia	0.5
Sweden	16.1
Turkey	1.5
Total ¹	87.7
Asia:	
Bahrain	4.0
China	40.0
India	10.8
Iran	9.0
Japan	4.0
Total ¹	67.8
Oceania, Australia	4.5
Grand total ¹	319.8

^eEstimated.

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

²Includes Kazakhstan and Ukraine.

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