THE MINERAL INDUSTRY OF

UKRAINE

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Ukraine continued to be a major producer of coal, ferroalloys, ilmenite, iron ore, manganese ore, and steel. Also, the country had been a lesser producer of a number of other mineral products, including alumina, aluminum, cadmium, germanium, secondary lead, magnesium, mercury, rutile, uranium ore, secondary zinc, zircon, zirconium, and a large number of industrial minerals, including dolomite, graphite, kaolin, limestone fluxes, potash, quartz, salt, soda ash, and a variety of building materials. As has been the case with nickel where mining has ceased, it is possible that for certain other mineral products the country has ceased or sharply reduced production.

Ukraine's mineral industry was dominated by ferrous metals production. At the end of the Soviet period, Ukraine was the U.S.S.R.'s leading iron ore producer and second-ranking steel producer (after Russia). In 1998, Ukraine ranked seventh among world iron ore producers and eighth among steel producers, producing more than 50 million metric tons (Mt) of iron ore and almost 25 Mt of crude steel (Fenton, 1999; Kirk, 1999). It has the world's second largest manganese reserves and had been producing low-grade manganese ore at a rate that made it the world's leading producer in volume of output as recently as 1992 (Jones, 1995). Even though economic difficulties and the decline in demand in domestic and traditional markets in the former Soviet Union (FSU) and East Europe have cut output almost by one-half, Ukraine still ranked as the world's third largest manganese producer in terms of gross weight of ore and fifth largest in terms of manganese content of the ore in 1998 (Jones, 1998, Manganese, accessed April 14, 1998, at URL http://minerals.usgs.gov/minerals/pubs/commodity/manganese/4204498.pdf).

There also is in place in Ukraine a very large metal-consuming sector, in the form of the FSU's second largest machine-manufacturing and metal-working industry, after that of Russia. Reflecting its former role in the Soviet machine-building industry, Ukraine specialized in heavy machine manufacturing, generally producing the equipment that requires large quantities of steel to produce. Ukraine was noted for the production of metallurgical and mining excavation equipment (Kramatorsk); machinery used in electricity generation, such as turbines and generators (Kharkiv); transportation equipment [e.g., automobiles in Zaporizhzhya and Lutsk, heavy transport trucks in Kremenchug, and locomotives (the largest locomotive plant in the FSU is in Luhansk)]; shipbuilding [Mykolayiv (three shipyards specializing in deep-sea vessels) and Kherson]; agricultural machinery (e.g., tractor engine production in Kharkiv and plants in Kharkiv and Dnipropetrovs'k); machine tools; and machinery for the food-processing industry (Levine and Bond, 1998).

In addition, about one-third of the U.S.S.R.'s defense industrial capacity—including tank production, naval shipbuilding (including aircraft carriers), electronics, aircraft components, and armaments—was in Ukraine. Also, there was a wide range of metal working activity, such as the ball-bearing plant in Lutsk, which supplied automobile, truck, tractor, and bus plants in Ukraine, Belarus, and Russia with needed inputs. This metal-consuming sector, by and large, was spatially coincident with the ferrous metals industry, from which it derived most of its inputs (Levine and Bond, 1998).

According to the Chief of the Ukrainian State Geology Committee, the mineral industry was in a difficult situation despite its large production of mineral products . It inherited from the FSU an industry characterized by an intensive yet incomplete use of deposits, which, in many cases, has resulted in their premature depletion. Furthermore, little attention was paid to exploring for precious and nonferrous metals. Deposits that were developed often were not of the highest quality and were not developed to compete economically on world markets (Uryadovyy Kuryer, 1998).

Practically all Ukrainian enterprises for mining raw materials for the ferrous metals industry, the country's major mineral industry, including mining limestone and manganese, was part of the state firm Ukrrudprom, which accounted for more than 95% of the country's production capacity for this sector (Kovalenko and others, 1998). Ukrrudprom was a state-owned organization administered by the Ministry of Industrial Policy and the State Property Fund. The Government continued its ongoing effort to privatize, at least in part, many of the enterprises that comprised Ukrrudprom. However, a number of Ukrrudprom's enterprises, including some iron ore mines, were not slated for privatization (Interfax Mining and Metals Report, 1999b).

Ukrainian specialists described the general situation in Ukraine's ferrous metals sector in 1998 as being very serious. The companies that were part of Ukrrudprom were working under strained economic conditions that included a scarcity of fuel, lack of operating capital, long-standing debts and unpaid receipts, and other difficulties prevented them from conducting normal operations. Problems were compounded by more difficult mining conditions. The majority of underground mines were operating at depths of more than 1,000 meters (m), and open pits, at depths of more than 300 m (Gornyy Zhurnal, 1998).

In the Soviet era, funds to replenish capacities were obtained from the Government budget. This was, however, no longer the case, which resulted in a sharp curtailment in investment. From 1990 to 1997, there was more than a fivefold decrease in capital investment in the ferrous metals sector. If this situation were not corrected, ferrous metals mining in Ukraine could cease in 3 to 5 years. The situation with tailings ponds was described as being catastrophic because many of the major mining concerns had

less than 2 years of space remaining for tailings (Gornyy Zhurnal, 1998).

Another factor holding back development in the mineral production sector was the extensive use of barter, which prevented enterprises from accumulating necessary capital for investing in equipment and technology that would improve their competitiveness. In an effort to improve economic performance in the mineral sector, it was announced in October 1998, that Ukrainian metallurgical plants would be discouraged from bartering in an experiment designed to stimulate production. According to a Presidential decree on reducing barter in the economy, the experiment would be conducted between January 1 and July 1, 1999. The benchmark by which levels of barter would be judged would be the average volume of barter deals between January and September 1998, and for enterprises with a long production cycle, barter conducted in 1997 also would be included. The program includes tax incentives to reduce barter and penalties for enterprises that do not comply (Interfax Mining and Metals Report, 1998f).

With the end of Government subsidies and price controls, enterprise production costs more than doubled. Costs were increasing, particularly for transport. The situation regarding the condition of equipment and availability of spare parts was considered dire. Although Ukraine manufactured 37.4% of all mining equipment in the FSU, the majority of equipment needed for mining and milling was manufactured abroad, and the industry lacked funds to purchase this equipment. Furthermore, the machinery manufactured in Ukraine and that purchased from other countries of the FSU was not state-of-the-art. Ukraine had created a program to retool its mining equipment manufacturing plants to produce equipment that used to be produced in other countries of the FSU and to produce new state-of-the-art machinery for domestic use and export (Gornyy Zhurnal, 1998; Remkha, 1999).

One of the problems confronting the ferrous metals sector was determining the volume of steel that the country should produce to satisfy its domestic requirements and for export. Prior to the dissolution of the Soviet Union, the amount produced was determined on the basis of orders from the Government's central planning apparatus, which determined specific levels of production and specified who the consumers would be and their level of consumption. Although some elements of the old contracting system still exist within Ukraine, Ukrainian steel producers are having to calculate to whom they can sell their output and in what quantities on the basis of world market conditions (Dolzhenkov, 1999). Consumption patterns within the FSU have drastically changed. Ukraine has been exporting to world markets, where it will need to increase its markets for its steel products and machinery and to avoid trade sanctions against its exports.

In the nonferrous metals sector, Ukraine was producing a larger percentage of its output for export markets. Ukraine was a large alumina producer with production centered at the Mykolayiv alumina refinery and was also a major mining center for titanium raw materials. In 1998, the Mykolayiv refinery, with the capacity to produce more than 1 million metric tons per year (Mt/yr) of alumina and employing about 6,500 workers, was selling almost all its alumina to aluminum smelters in Russia and to the Tajik aluminum smelter in Tajikistan. Mykolayiv operated entirely on imported raw material (Interfax-M&CN, 1998).

Ukraine was the only major producer of titanium ore in the FSU but was exporting all titanium ore intended for metal production because it had ceased domestic sponge production at the Zaporizhzhya titanium-magnesium plant. Ukraine was making an effort to initiate gold mining and was seeking investors to develop some identified deposits. The country also had identified a copper deposit in the Volyn' region for which it was seeking investment (Interfax-M&CN, 1998).

Although the country produced some oil and gas, Ukraine remained primarily a coal producer. The coal sector, however, was facing problems at least as serious as those faced by the ferrous metals sector, and the future of the coal industry would depend on it being fundamentally restructured to increase efficiency.

To address these severe problems, the Government formulated a plan for the development of the mining and metallurgical sector that stressed the development of domestic and export markets and the closing of unprofitable enterprises. The thrust of the program is to increase enterprise profitability and the competitiveness of Ukrainian products (Gornyy Zhurnal, 1998). According to this program, passed in October 1998 by the Ukrainian Parliament (Verkhovna Rada), the Government would develop a list of strategic enterprises with a view to improving Government management and for setting a procedure for their privatization. Also, the Parliament proposed amendments to a number of regulatory acts regarding energy and transport to make metals more competitive (Interfax Mining and Metals Report, 1998e). The Program for the Development of the Mineral and Raw-Material Base of Ukraine Until the Year 2000 provides for prospecting and developing deposits of mineral fuels and exploring for additional reserves for mining companies that have insufficient active reserves. Exploration will be conducted, particularly for those commodities for which there is a demand on the world market, including graphite, ilmenite, kaolin, manganese ore, and zirconium. Ukraine also planned to build its own base for developing minerals, such as copper, gold, and rare earths. A goal will be to initiate production of minerals for which Ukraine was import dependent and to increase exports of minerals (Uryadovyy Kuryer, 1998).

In October 1998, the Ukrainian cabinet approved the formation of a new metals lobby, the Association of Ferrous Metals Producers (UkrAPchermet). The Association would lobby governmental, legal, and international agencies on behalf of exporters and would coordinate work in various fields. The Association was formed to address the issue that exporters often had been acting at their own discretion and without a single coordinated policy or sufficient knowledge of the legislation of the countries to which they were exporting. As a consequence, ferrous metals exporters often were losing international lawsuits, suffering losses, and losing shares of international markets (Interfax Mining and Metals Report, 1998e).

According to the Chief of the State Geology Committee, there was a need to restructure the geological sector. The Ukrainian State Geology Committee comprised 18 geological prospecting companies. In addition, there were three branch institutes and one design organization. In total, including joint stock companies, there were almost 30,000 people employed in

geologic work. However, under prevailing economic conditions, there was no possibility of replenishing capital stocks or paying arrears. To overcome these difficulties, a plan was developed in which the geological sector would be split into two parts. The first part would constitute state-owned enterprises and organizations, regional geological centers, scientific research institutes, and educational institutions, and the second part, joint stock companies prospecting for commercial minerals and other activities aimed at making these companies self-financing and profitable. The Government would maintain a 51% ownership stake in these prospecting companies. Through this restructuring, it would be possible to prospect for many minerals that Ukraine lacked in the next few years (Uryadovyy Kuryer, 1998).

In May 1998, the Department for the Gold Industry was set up within Ukraine's Ministry of Industrial Policy. Ukraine was not producing gold, and the new Department would implement state policy in creating a gold mining and processing industry. Ukrainian experts believed the country could be producing at least 22 to 25 metric tons per year (t/yr) of gold. The new Department would act as the gold mining industry's central organization for state control. Among its main tasks would be to encourage development in the mining, production, and use of precious metals and rare-earth metals, to coordinate activities of organizations within the executive branch concerned with the gold industry, and to create a regulatory base and to formulate a unified policy for scientific and technical support for the gold and jewelry industry. The Department would coordinate scientific activity for the Zoloto Ukrainy (Gold of Ukraine) program. One of the Department's key function would be to attract investment in the gold industry (Interfax Mining and Metals Report, 1998d).

In 1998, Ukraine's gross domestic product decreased by 1.7%, and industrial output, by 1.5% compared with that of 1997. (Natsional'nyy bank Ukraini, Osnovni Makroekonomichni Pokazaniki, accessed August 31, 1999, at URL http://www.bank.gov.ua/Macro/rok_96_99.htm; Ukraine Macroeconomic Policy Project, Quarterly Indicators 1998, accessed September 1, 1999, at URL http://www.hiid.economy.org.ua/qindicators/q1998.htm). In 1998, the values of output by sector, in current prices, compared with those of 1997 was as follows: production in the ferrous metals sector decreased by 6.8%; in the fuel sector, by 0.7%; and in the power sector, by 0.3%. However, production in the nonferrous metals sector increased by 12.4%; in the chemicals and petrochemicals sector, by 0.9%; and in the construction materials sector, by 4.1% compared with those of 1997 (Interfax Statistical Report, 1999).

In terms of reported percentage changes in volume of physical output, there was a decrease in ferrous metal production in 1998 compared with that of 1997; production of iron ore concentrate fell by 3.3%; of pellets, by 14.1%, and of agglomerate, by 25.4% (Interfax Mining and Metals Report, 1999e). For metallurgical products, the physical volume of output of rolled steel decreased by 8.96%, and that of steel pipes, by 17.62% compared with those of 1997. Production of cement increased by 9.63% compared with that of 1997, and production of coal, Ukraine's main energy fuel, increased by 1.57%. Output of natural gas fell by 1.16%, and that of oil and gas condensate by 5.72%. Output of refinery products, however, increased by 4.04% (Interfax Statistical Report, 1999). [These reported percentage increases or decreases in physical volume of output detailed above, while very close, do not correspond exactly with reported production numbers in table 1 usually because of issues regarding the number of significant digits or of rounding or the reporting of production numbers in separate sources from those reporting percentage changes.]

Ferrous metals constituted about 70% of Ukraine's total exports (Interfax Mining and Metals Report, 1998c). In August, Ukraine's metal exporters began feeling the effect of the Russian economic crisis as Russian importers were not able to pay for previously ordered products (Interfax Mining and Metals Report, 1998g). In 1998, Ukraine's iron ore exports fell by 15.8% compared with that of 1997 to 18.2 Mt, which included a fall in iron ore concentrate exports by 20.9% to 4.9 Mt; of pellets, by 12.7% to 6.5 Mt; and of sintered ore, by 18.2% to 6.4 Mt (Interfax Mining and Metals Report, 1999e).

Ukraine was in possession of many essential, already developed raw material sources and metallurgical facilities in close proximity to each other; a generally favorable location along the western border of the FSU and frontage on the Black Sea; a trained and relatively inexpensive labor force; and a large number of diverse metal-consuming industries with functional linkages to the iron and steel mills. However, it is still not clear exactly where the country's industries comparative advantage will lie. Ukraine has developed its resources and processing and manufacturing facilities to a scale at which it could be an important producer of ferrous metals and machinery, provided that investment for modernization is forthcoming and is directed into activities that are economically rational.

Commodity Review

Aluminum

Production Status.—Ukraine's Mykolayiv refinery was among the world's largest alumina-producing plants with the capacity to produce more than 1.2 Mt/yr of alumina. Ukraine also produced a much smaller amount of alumina at the Zaporizhzhya aluminum smelter as feed for the smelter. Mykolayiv exported more than 94% of its output, with 60% of its exports going to Russia and 30% to Tajikistan (Interfax Mining and Metals Report, 1998b). In 1998, Mykolayiv increased output by 23.7% to 1.064 Mt compared with that of 1997 (Interfax Mining and Metals Report, 1999b).

Production Development.—Following a series of planned upgrades, the Mykolayiv alumina refinery planned to sustain output at 1.3 Mt/yr (Interfax Mining and Metals Report, 1999b).

Coal

Reserves.—Ukraine reportedly possessed a reserve base of 46 billion metric tons of coal, of which 10.1 billion metric tons was reportedly considered to be extractable reserves. Of these extractable reserves, 10 billion tons was coals (Bundesanstalt für Geowissenschaften und Rohstoffe, 1996, p. 35). Hard coal reserves are in the Donets and Lviv-Volhynskiy basins, and brown coal reserves are in deposits in the Zhitomir, Cherkassy,

and Kirovgrad regions (Bundesanstalt für Geowissenschaften und Rohstoffe, 1996, p. 30).

Production Status.—Ukraine experienced a steady decline in coal production from 1988 until 1997 when production began to rise (Interfax Mining and Metals Report, 1999c). Coking coal accounted for about 40% of total output. About 60% of the coal produced was for powerplants and public utilities. Thermoelectric powerplants became the main domestic coal consumer as consumption in other areas of the economy fell. As of 1996, thermal powerplants accounted for 46% of marketable coal consumption compared with 20% in 1988. However, Ukraine was unable to meet its demand either for coal for powerplants or for coking coal from its own production and was importing coal from Poland and Russia (Alipov, 1997). As of 1997, coal was being extracted from 244 underground mines and 7 open pits, which were united into 24 coal extraction companies (Alipov, 1997).

More than 90% of Ukraine's coal production was from the Donets basin. Mines in the Donets basin are deep, with the average mine depth about 700 m. A significant number of mines are more than 1,000 m deep. In all mines in the Donets basin, gas poses a serious danger, and the safety risks from gas and dust are increasing (Bundesanstalt für Geowissenschaften und Rohstoffe, 1996, p. 35-41). In Ukraine, 5.5 miners died in accidents for every 1 Mt of coal produced (Interfax Mining and Metals Report, 1998a). Approximately 80% of the coal mined from the Donets basin required processing to be marketable, and this percentage will increase to 90%. Coal processing facilities often used outdated equipment and technology as a large number of the plants were more than 25 years old and some more than 50 years old (Bundesanstalt für Geowissenschaften und Rohstoffe, 1996, p. 35-41). More than 500 cages, 51% of all conveyers, 35% of all pumping units, and 23% of all underground equipment were in need of replacement (Interfax Mining and Metals Report, 1998a). The country had the capacity to produce up to 35 Mt/yr of coking coal, which exceeded the country's consumption needs. However, the quality of the coking coal mined was decreasing, and coking coal reserves were being depleted (Bundesanstalt für Geowissenschaften und Rohstoffe, 1996, p. 35-41).

Production Development.—Coal will continue to provide fuel for about 50% of the country's electricity generation, and Ukraine will continue to need to import coal (Alipov, 1997). A large number of mining operations were not economic and required subsidies. Owing to the depths of the mines and the high cost of mining coal, the country will face a major problem in acquiring funds to renovate mines or to develop new mines in the Donets basin. A major goal will be to restructure the coal mining industry to make it a cost competitive producer by concentrating efforts to develop the newer mines that could be profitably exploited by using modern technology and to close older uneconomic mines (Bundesanstalt für Geowissenschaften und Rohstoffe, 1996, p. 35-41). As of the start of 1999, Ukraine had slated 29 coal mines for closure. This was in accordance with plans to rank the country's mines according to their profitability. Coal mines were to be ranked in four groups, on the basis of an assessment of how much state support they needed to operate. Mines in the least profitable fourth group would get state support only to reimburse the cost of their liquidation, mothballing, and social maintenance expenditures. The Coal Ministry originally wanted to consign about 70 mines to the fourth group. The decision to include only 29 mines was the result of a compromise with the unions (Interfax Mining and Metals Report, 1999d).

Ferroalloys

Production Status.—Ukraine had three electric furnace ferroalloy plants—the Zaporizhzhya, Stakhanov, and Nikopol; the Nikopol plant was one of the world's largest ferroalloy plants. These plants produce a variety of manganese ferroalloys and ferrosilicon. Ukraine had two plants that produced blast furnace ferroalloys, the Konstantinovka and the Kramatorsk (Mazur, 1996).

Production Development.—Plans called for ferroalloy production to stabilize at about 1.55 Mt/yr. Excess production capacity was to be converted to producing ferroalloys not in production, including ferrochrome, ferrotitanium, ferrovanadium, and other similar ferroalloys (Mazur, 1996).

Graphite

Reserves.—Ukraine had more than 50% of the FSU's graphite reserves. The largest quantity was in the Kirovgrad region, which was assessed to have 7 Mt of reserves of graphite in 126 Mt of ore, of which 6.2 Mt in 97.2 Mt of ore was declared minable (Bundesanstalt für Geowissenschaften und Rohstoffe, 1996, p. 56).

Production Status.—The Zavalyevskiy graphite mining complex in Ukraine had the capacity to produce almost 50% of the FSU's graphite production. Graphite production in Ukraine has decreased by more than 80% since 1992 when Ukraine was producing about 33% of the graphite in the FSU. As of 1997, it was producing about 22% of the FSU's graphite output (Troitsky, Petrov, and Grishaev, 1998, p. 55).

Iron and Steel

Production Status.—In 1998, Ukraine ranked eighth among world steel producers (Fenton, 1999). About 55% of Ukraine's steel output was from open hearth furnaces; more than 43%, from basic oxygen converter furnaces; and less than 2%, from electric furnaces (Levine and Bond, 1998). As a large integrated steel maker, Ukraine produced high- and low-carbon steels and low-alloy steels. In 1997, Ukraine's steel industry employed 480,000 workers with an estimated average worker-hour per metric ton production rate of 19.5 compared with 4.1 in Organization for Economic Cooperation and Development (OECD) countries. Energy intensity of steel production is two to three times higher than in OECD countries. Apparent steel consumption in Ukraine in 1998 was 31% of the 1992 consumption level. With the fall in domestic consumption, as well as the fall in consumption in the FSU following the dissolution of the Soviet Union, Ukraine began to depend heavily on world export markets for selling its steel products (Organization for Economic Cooperation and Development, Cooperation between OECD and Russia and Ukraine in the steel sector, news release, December 21, 1998, accessed September

29, 1999, at URL http://www.oecd.org/news_ane_events/release/nw98-126a.htm).

In 1997, Ukraine was exporting 73% of its steel output to world markets. Owing to the fact that Ukrainian steel was generally of lower quality than that being sold on world markets, Ukraine has been penetrating world markets mainly on the basis of the low price of its steel, which was priced 10% to 20% below world market price levels. However, Ukraine encountered trade barriers against its steel exports that have been erected in a number of export markets (Dolzhenkov, 1999).

Production Development.—Following a meeting of the OECD's Steel Committee at OECD headquarters in Paris in November 1998 and an in-depth discussion of the steel sector in Russia and Ukraine, Committee members and observers reached agreement on a series of findings and recommendations. These included agreeing to consider ways of cooperating in the restructuring and environmental clean-up of these two countries' steel sectors, as well as in the promotion of sound business and marketing principles with regard to steel exports from these two countries (Organization for Economic Cooperation and Development, Cooperation between OECD and Russia and Ukraine in the steel sector, news release, December 21, 1998, accessed September 29, 1999, at URL http://www.oecd.org/news_ane_events/release/nw98-126a.htm). Owing to the fact that Ukrainian machine-manufacturing industries are not efficient consumers of steel, Ukraine steel production will remain at a high level to satisfy internal consumption needs. However, Ukraine will have to improve the quality of its steel products to significantly expand its export markets (Dolzhenkov, 1999).

Iron Ore

Reserves.—Economic (balansovye) reserves classified according to the reserve system of the FSU were reportedly 32.9 billion metric tons. Of these reserves, 67.2% were in the Krivoy Rog basin, which has Lake Superior district-type ore, with the remainder in the Belozerskiy, Kerchenskiy, Kremenchug, and Priazovskiy iron ore regions (Kornienko, 1999). Of total reserves, 2 billion metric tons was considered to be rich ores suitable for being mined by underground methods (Mazur, 1996).

Production Status.—In 1998, Ukraine ranked seventh in the world in iron ore production (Kirk, 1999). The majority of open pits were mining at depths below 300 m, and the majority of underground mines operated at depths below 1,000 m (Kovalenko and others, 1998). The largest iron ore producers in 1998 were the Inguletskiy mining and beneficiation complex extracting 10.6 Mt. The Yuzhniy mining and beneficiation complex extracting 7.6 Mt, the Poltaviskiy mining and beneficiation complex extracting 6.5 Mt, and the Silvern mining and beneficiation complex extracting 5.8 Mt, all in the Krivoy Rog basin (Interfax Mining and Metals Report, 1999a). Since the dissolution of the Soviet Union, iron ore production in Ukraine has fallen by about 50%.

Production Development.—A priority goal is to solve problems associated with water in mines and to maintain the working capabilities of mines and open pits under conditions of decreased production. Products of Ukraine's iron ore mining and beneficiation enterprises have not been meeting world market standards in terms of iron content or percentages of harmful admixtures. A goal of the industry is to raise the quality of output by introducing state-of-the-art technologies for processing ores (Mazur, 1996).

Kaolin

Reserves.—Ukraine has 4 kaolin-producing regions with 20 deposits, of which 12 are under development. The Prosyanovskoye deposit in the Dnepropetrovsk region was one of the largest kaolin deposits in the FSU and had been producing about 50% of Ukraine's kaolin output. Total kaolin reserves were reportedly 303 Mt of primary kaolin and 71.1 Mt of secondary kaolin, of which 141.3 Mt of the primary kaolin reserves was under development, and 53.9 Mt of the secondary kaolin reserves was under development (Bundesanstalt für Geowissenschaften und Rohstoffe, 1996, p. 57-60).

Production Status.—Since the dissolution of the U.S.S.R, kaolin production has fallen by about 70%. Ukraine was still producing more than 80% of the marketed kaolin in the FSU (Troitsky, Petrov, and Grishaev, 1998, p. 75). Uzbekistan had a huge stockpile of kaolin for which it was seeking markets and conceivably could challenge Ukraine as the FSU's major kaolin supplier. Primary kaolin is used mainly in the ceramics, detergent, paper, pharmaceuticals, rubber, and other industries and secondary kaolin is used primarily as a fire insulation material. Feldspar concentrates and quartz sands were byproducts of kaolin production in Ukraine (Bundesanstalt für Geowissenschaften und Rohstoffe, 1996, p. 57). The paper industry in Russia was the largest consumer of kaolin in the FSU, consuming about 200,000 t/yr. Russia imported about 150,000 t/yr of kaolin from Ukraine. Production from the Prosyanovskoye deposit was used in the production of alpax at the Zaporizhzhya aluminum plant (Troitsky, Petrov, and Grishaev, 1998, p. 75).

Manganese

Reserves.—Ukraine contained about 75% of the FSU's manganese reserves (Danil'yants, Zavertkii, and Kharchenkov, 1999). The balansovye reserves of manganese ore in reserve categories A, B, and C1 total about 2.2 billion metric tons. These reserves were in the Nikopol basin. Within the Nikopol basin, the Ordzhonikidze sector (West Nikopol) accounted for 310 Mt, the Marganets (East Nikopol) sector accounted for 280 Mt, and the Bol'shoy Tokmak deposit accounted for 1,582 Mt (Jones, 1994). There are three types of ores—oxide, carbonate, and mixed oxide-carbonate ores. The average grade of the oxide ore was 28.6% manganese (Mn); the oxide-carbonate ore, 25.6% Mn; and the carbonate ore, 22% Mn. Since 1975, Ukraine has been mining oxide-carbonate and carbonate ores in addition to the richer oxide ores, which are being depleted. The carbonate ores were more difficult to process and were not as suitable for producing high-grade concentrate (Bundesanstalt für Geowissenschaften und Rohstoffe, 1996, p. 47-48).

Production Status.—In 1998, Ukraine was the world's third largest producer of manganese ore by gross weight and fifth largest producer in terms of manganese content (Jones, 1998,

Manganese, accessed April 14, 1998, at URL http://minerals.usgs.gov/minerals/pubs/commodity/manganese/4204498.pdf). However, Ukraine was producing only one-seventh the peak amount of manganese concentrate it produced in 1985. Ukraine had accounted for more than 85% of the manganese produced in the Soviet Union. Since the dissolution of the U.S.S.R. and the end of Soviet political and economic control in East Europe, the demand for manganese in this region, which was the primary consuming area, has fallen sharply. The country's manganese output was consumed domestically at ferroalloys plants and steel mills, but the output of these domestic industries also fell sharply.

Production Development.—Plans called for stabilizing production at 1998 levels at the Marganets and Ordzhonikidze complexes and putting development on hold at the Tavricheskiy complex. Plans called for upgrading technology at existing enterprises and for replacing worn equipment at mines and processing plants (Gornyy Zhurnal, 1998). With the loss of markets in the FSU and East Europe, Ukraine was having a difficult time finding new foreign markets for its ores. The high phosphorous content of the ores and their low grade compared to ores from other leading world producers, such as Australia and South Africa, made it difficult for Ukraine to compete in a number of world markets (Levine and Bond, 1998). There was a demand for manganese in the country's domestic ferrous metals industries, and the country's success in increasing its ferrous metals production will also affect the level of manganese production.

Titanium

Reserves.—Ukraine was the only country in the U.S.S.R. that mined titanium ore. Mine output had supported sponge production at Zaporizhzhya (formerly Zaporozh'ye) in Ukraine and pigment production at plants at Sumy and Armyansk on the Crimean Peninsula (Ukraine), as well as processing facilities in Russia (Berezniki) and Kazakhstan [Oskemen (formerly Ust'-Kamenogorsk)]. Ukraine's titanium mine output came from two secondary placer fields. At the Irsha deposit, buried sands along the channel of the Irsha River (near Zhitomir) and sands in areas exposed to seasonal flooding began to be worked in 1951. The titanium-bearing horizons in the sands, which were 2 to 8 m in thickness at depths ranging from 3 to 12 m, contained 1.2% to 4.8% ilmenite, yielding a lower grade ilmenite concentrate (50% to 56% TiO_2), served as a feedstock for pigment production. Unlike Irsha, the second major Ukrainian placer field, the Verkhnedneprovsk (Upper Dnieper), contains heavy mineral sands that include ilmenite, rutile, and zircon; the largest output from this field came from the Malyshevskiy deposit. Lower grade ilmenite concentrates from Verkhnedneprovsk (50% to 56% TiO_2 content) were used in pigment production, and some of the higher grade concentrates (56% to 65% TiO_2) were directed toward sponge production. Another part of the higher grade concentrates was directed to ferrotitanium output at the Klyuchevsk ferroalloys plant in Russia. Rutile concentrates from this field found special uses in the production of welding-rod coatings, among other things (Levine, Gambogi, and Bond, 1995).

Production Status.—In 1998, Ukraine was thought to be the world's third largest producer of rutile and ninth largest producer of ilmenite (Gambogi, 1999a, b). Titanium sponge production at Zaporizhzhya, the FSU's first titanium sponge plant, had ceased in 1996. Production capacity at Zaporizhzhya was estimated to be 20,000 t/yr.

Mining at the Irsha field featured a combination of dredging, hydraulic operations, and shallow open pit workings, depending upon the workability of the sands and their location relative to the water table and the main river channel (Levine, Gambogi, and Bond, 1995).

Production Development.—The country planned to restart sponge production in 1999 at the Zaporizhzhya plant. The immediate obstacles to maintaining levels of titanium mine output in the Republic reflect a lack of capital for new mine development and not the absence of reserves. The entire reserves at the dredging fields of the original deposits at Irsha have been exhausted. Since the early 1970's, mining has been shifting to new deposits with reserves that are only a fraction of those of the initial placers. The reserves at the Irsha and Lemnen deposits were, to a significant extent, already exhausted, and there could be a sharp decline in the production of concentrates beyond 2000. The capital required to bring on-stream new deposits in the Irsha field [Stremigorodskiy, a residual placer (weathering crust), and Torchinskiy, an alluvial placer] was believed to be so large as to lie beyond the capacity of the Irsha Enterprise without the assistance of outside investors (Levine, Gambogi, and Bond, 1995).

Development at Stremigorodskiy was a priority of Soviet titanium-industry planners during the 1980's but was discontinued by the end of the decade because of its proximity to the site of the Chernobyl' nuclear powerplant. Stremigorodskiy, however, again appeared to be a priority in plans for future development (Levine, Gambogi, and Bond, 1995).

The Malyshevskiy deposit in the Verkhnedneprovsk field was divided into three sectors—Western, Central, and Eastern—with the Western (which had the most favorable mining conditions) being the first to undergo development. The first three open pit mines at Malyshevskiy were fully depleted by the mid-1970's, and reserves at three more mines had been exhausted by 1990. Reports indicated that a seventh pit was being worked in 1998. Unlike the situation at the Irsha fields, reserves at the Malyshevskiy deposit were thought to be adequate for roughly 25 more years, although a substantial decline in output at pit No. 7 was believed to be imminent. Considerable development potential exists in the Eastern sector of the deposit, but far the Verkhnedneprovsk Mining and Metallurgical Integrated Works lacked sufficient capital to fund the mine design and construction work necessary to bring new capacity on-line. Longer term plans to open a new Matronovskiy deposit confront similar difficulties (Levine, Gambogi, and Bond, 1995).

Zirconium

In 1998, Ukraine was thought to be a leading world producer of zirconium concentrates (Hedrick, 1999). Zirconium was commercially mined as a coproduct from the Verkhnedneprovsk placer field from heavy mineral sands that included ilmenite, rutile, and zircon. Zirconium metal and compounds were

commercially produced at plants in Ukraine. In general, for every 4 to 5 of ilmenite extracted, about 1 t of zircon was produced. Ukraine was the only supplier of zircon in the FSU, although Russia produced some baddeleyite concentrate (O'Driscoll, 1998).

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TABLE 1
UKRAINE: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1994	1995	1996	1997	1998 e/
METALS						
Alumina e/		1,070,000	1,100,000	1,000,000	1,075,000 r/	1,291,000 2/
Aluminium, primary		100,000 e/	98,000	90,000 e/	100,500	106,700 2/
Cadmium, metal e/		10 2/	15	25	25	25
Germanium e/		22 2/	22	22	22	22
Iron and steel:						
Iron ore, marketable		51,300,000	50,400,000	47,600,000	53,000,000 e/	50,700,000
Metal:						
Pig iron		21,200,000	20,000,000	18,143,000	20,561,000	20,840,000
Ferroalloys: e/						
Blast furnace:						
Ferromanganese		30,000	25,000	25,000	30,000	30,000
Spiegeleisen		3,000	2,500	2,500	2,500	2,500
Electric furnace:						
Ferromanganese		170,000	170,000	170,000	160,000	150,000
Ferronickel		23,000 2/	23,000 2/	8,300 2/	--	--
Ferrosilicon		300,000	300,000	300,000	300,000	300,000
Silicomanganese		600,000	600,000	600,000	560,000	500,000
Other		25,000	25,000	25,000	25,000	20,000
Total		1,151,000	1,145,500	1,130,800	1,077,500	1,002,500
Steel:						
Crude		23,798,000	22,309,000	22,100,000	25,600,000	24,085,000 2/
Finished		16,900,000	16,600,000	17,045,000 r/	19,525,000 r/	17,776,000 2/
Pipe		1,600,000	1,500,000 e/	2,001,300 r/	1,844,300 r/	1,519,300 2/
Lead, refined (secondary) e/		9,000	10,000 r/	21,000	11,000 r/	9,000
Magnesium, primary e/		12,000	10,000	5,000	3,000	1,000
Manganese:						
Marketable ore		2,979,000	3,200,000	3,070,000	3,040,000	2,226,000 2/
Mn content e/		1,050,000	1,100,000	1,040,000	1,030,000	755,000
Mercury e/		50 2/	40	30	25	20
Nickel, mine output, metal content e/		1,400 2/	1,400	500	--	--
Silicon e/		1,400 2/	1,400	1,000	1,000	1,000
Titanium:						
Ilmenite concentrate e/		530,000	359,000 2/	250,000 r/	250,000 r/	250,000
Rutile concentrate e/		80,000	112,000 2/	50,000	50,000 r/	50,000
Metal, sponge		5,000 e/	300	--	-- e/	--
Zinc, metal, secondary e/		14,000	5,000	2,000	2,000	--
Zirconium concentrates, ZrO_2 content e/		16,000 r/	8,000 r/	12,000 r/	16,000	16,000
INDUSTRIAL MINERALS						
Cement		11,400,000	7,600,000	5,017,000 r/	5,098,000 r/	5,589,000 2/
Graphite e/		30,000	30,000	25,000	25,000	25,000
Nitrogen, N content of ammonia		3,000,000 e/	3,100,000	3,300,000	3,400,000 e/	3,300,000
Potash, K_2O content		168,000	110,000	75,000 r/ e/	60,000 r/	60,000
Salt e/		3,500,000	3,000,000	2,800,000	2,500,000	2,500,000
Sulfur, native		368,000 r/	238,000 r/	168,000 r/	100,000 e/	97,000
MINERAL FUELS AND RELATED MATERIALS						
Coal		94,900,000 r/	84,400,000 r/	74,800,000 r/	58,479,000 r/	59,395,000 2/
Coke		17,000,000	15,000,000 e/	14,800,000 r/	13,000,000 e/	13,000,000
Natural gas	thousand cubic meters	18,300,000	18,170,000	18,408,000 r/	18,131,000 r/	17,920,000 2/
Petroleum:						
Crude:						
As reported	gravimetric tons	4,200,000	4,100,000	4,097,100	4,131,200	3,894,800 2/
Converted	42-gallon barrels	30,900,000 r/	30,100,000 r/	30,100,000 r/	30,400,000 r/	28,600,000 2/
Refinery products		NA	NA	13,477,000	12,833,000	13,510,000 2/
Uranium concentrate, U content e/		500	500	500	500	500

e/ Estimated. r/ Revised. NA Not available.

1/ Table formatted by Glenn J. Wallace, International Data Unit; includes data available through September 10, 1999.

2/ Reported figure.

TABLE 2
UKRAINE: STRUCTURE OF THE MINERAL INDUSTRY IN 1998

(Metric tons unless otherwise specified)

Commodity	Major operating facilities	Location 1/	Annual capacity e/
Alumina	Mykolayiv refinery	Mykolayiv (Nikolayev)	1,200,000.
Do.	Zaporizhzhya (Dneprovsk) refinery	Zaporizhzhya (Zaporozhye)	245,000.
Aluminum, primary	Zaporizhzhya (Dneprovsk) smelter	do.	110,000.
Coal:			
Hard	Donets coal basin with about 225 mines produces more than 90% of Ukraine's coal	Donetska (Donetskaya), Dnipropetrovska (Dnepropetrovskaya) and Luhanska (Luganskaya) oblasts	130,000,000.
Do.	Lviv-Volynskiy basin produces remainder from 18 mines	Western Ukraine	6,000,000.
Brown	Dneprovskoye basin	Central Ukraine	7,000,000.
Ferroalloys	Nikopol ferroalloys plant	Nikopol	250,000 (ferromanganese).
Do.	do.	do.	1,200,000 (silicomanganese).
Do.	do.	do.	3,000,000 (manganese sinter).
Do.	Stakhanov plant	Luhansk	NA (ferrosilicon).
Do.	Zaporizhzhya plant	Zaporizhzhya	300,000 (ferrosilicon). 160,000 (silicomanganese). NA (ferrochrome). NA (ferromanganese). 40,000 (manganese metal).
Graphite	Zavalyevskiy graphite complex	Zavalyeviskiy deposit	80,000.
Iron ore	Underground mining:		
Do.	Krivbassruda production association with 16 mines	Kryvyy Rih (Kryvoy Rog) basin	30,000,000.
Do.	Eksplutatsionnaya Mine of the Zaporizhzhskiy iron ore complex	do.	3,500,000.
Do.	Open pit mining: Yuzhniy, Novokrivorozhskiy, Tsentralnyy, Severnyy, Inguletskiy, Poltaviskiy and Kamysh-Burunskiy mining and beneficiation complexes	do.	90,000,000 (total).
Kaolin	Prosyanovskoye mining and beneficiation complex	Dnepropetrovsk region	NA.
Lead, secondary	Ukrtsink plant	Kostyantynivka (Konstantinovka)	70,000.
Magnesium	Zaporizhzhya plant	Zaporizhzhya	10,000.
Do.	Khlorvinil concern	Kalush	20,000.
Manganese ore, marketable	Ordzhonikidze, Marganets mining and beneficiation complexes	Nikopol basin	7,000,000 (total).
Do.	Tavricheskiy mining and beneficiation complex (under development)	Bolshoy Tomak basin	
Mercury	Nikitovskiy mining and metallurgical complex	Donets basin	120.
Nickel	Pobuzhhskiy mining and metallurgical complex, comprising three open pit mines and smelter	Pobuga region	7,000 (nickel in ferronickel).
Potash	Khlorvinil production association, Stebnik potash plant	Pricarpathian region	300,000 (K_2O).
Steel, crude	Alchevsk plant	Alchevsk (Kommunarsk)	4,500,000.
Do.	Azovstal plant	Mariupol	4,000,000.
Do.	Dneprospetssstal	Zaporizhzhya	1,400,000.
Do.	Dneprovsk plant	Dniprodzerzhynsk (Dneprodzerzhinsk)	3,850,000.
Do.	Dneprovsk plant	Dnipropetrovsk (Dnepropetrovsk)	1,900,000.
Do.	Donetsk plant	Donetsk	1,300,000.
Do.	Yenakiyeve plant	Yenakiyeve (Yenakiyevo)	3,100,000.
Do.	Il'yich plant	Mariupol	7,300,000.
Do.	Kirov plant	Makeyevka	4,000,000.
Do.	Kryvyy Rih plant	Kriyvyy Rih	10,650,000.
Do.	Zaporizhzhya plant	Zaporizhzhya	2,300,000.
Sulfur	Sera production association	Rozdol mining complex mines, Rozdol, Soroks, Zhidachev Deposits. Yavorov complex mines. Nemirov and Yazov deposits in (Lvivska) (Lvovoskaya) and Kyyivska (Kievskaya) oblasts	1,500,000 (total).
Titanium ore	Irshanskiy mining and beneficiation complex	Irsha River valley	250,000 (ilmenite concentrate).
Do.	Verkhnedneprovskiy mining and metallurgical complex	Verkhnedneprovsk region	120,000 (ilminite concentrate). 40,000 (rutile concentrate).

See footnotes at end of table.

TABLE 2
UKRAINE: STRUCTURE OF THE MINERAL INDUSTRY IN 1998

(Metric tons unless otherwise specified)

Commodity	Major operating facilities	Location 1/	Annual capacity e/
Titanium, metal	Zaporizhzhya plant	Zaporizhzhya	20,000.
Uranium	Zheltye Vody complex	Northern part of Kryvyy Rih basin	NA.
Zinc, secondary	Ukrtsink plant	Kostyantynivka	25,000
Zirconium ore	Verkhnedneprovskiiy mining and metallurgical complex	Verkhnedneprovsk region	30,000 (zircon).
Zirconium, metal and compounds	Pridneprovskiy chemical plant	Dniprodzerzhyns'k	NA.
Do.	Kharkiv physical-technical institute	Kharkiv	NA.

e/ Estimated. NA Not available.
1/ Old name or spelling, if applicable, given in parentheses.