THE MINERAL INDUSTRY OF

SLOVAKIA

By Walter G. Steblez

Slovakia continued to be a modest regional producer of a variety of minerals. (*See table 1.*) Aluminum and steel were the major components of the metals sector. Steel production was based largely on imported raw materials, and aluminum production was based entirely on imported bauxite and alumina. Slovakia also produced small quantities of copper, gold, lead, and zinc. Among industrial minerals, the country registered production of barite, clays, magnesite, and salt. Brown coal and lignite and small quantities of gas and petroleum comprised Slovakia's production of mineral fuels.

The Slovak Republic remained in transition to a market economy system. In 1997, private enterprise accounted for about two-thirds of the country's gross domestic product (GDP). In 1996, the growth rate of Slovakia's GDP amounted to about 7% but was expected to decline to 6.4% in 1997 and to about 5% in 1998 (Central Intelligence Agency, 1997).

Despite the country's robust economic growth during the past 3 years, a sharp increase in private and public sector consumption, coupled with a rapid increase in money supply, a decline in exports, and a rise in imports, has raised concerns about the reemergence of inflation. This and other factors appear to have hindered foreign investment in Slovakia's economy (Central Intelligence Agency, 1997). Noteworthy developments in 1997, as well as in the previous 3 years, included the growth of investment in the country's gold and industrial minerals mining sectors.

As in other former centrally planned economy countries of Europe, severe air pollution in Slovakia has been caused by the use of high-sulfur, low-grade coal and lignite to power the country's thermal electric power stations and by the country's chemical and metallurgical industries.

Despite the division of Czechoslovakia into separate countries in 1992, legislation to protect the environment, adopted since 1990, has remained operative. CSFR Law No. 309/91 on the Protection of the Atmosphere from Polluting Substances (9/91) codifies regulations concerning air pollution by defining sources of pollution, legal obligations of pollution-source operators, air-pollution control authorities, fees and penalties associated with atmospheric pollution, and setting pollution limits. Czechoslovak Law on Environment of 12/91 sets the basic definitions and principles regarding environmental protection, as well as the obligations of "legal and physical persons (bodies)" for protecting the environment during the use of natural resources.

To ensure effective control and management of severe regional environmental pollution, Slovakia and Poland signed a cooperative agreement on environmental protection in 1996. Both countries agreed to work toward eliminating threats to the environment that could have an impact beyond each country's border.

Despite the increasing orientation of the country's foreign commerce toward Western European market economy countries in recent years, Russia and other former member countries of the Council for Mutual Economic Assistance remained Slovakia's chief partners in mineral commodity trade. Russia remained Slovakia's principal supplier of natural gas and petroleum, and Hungary and Ukraine were major suppliers of bauxite and iron ore, respectively, to Slovakia's metal industries (World Trade Organization, 1996).

Zavod Slovenskeho Narodneho Postavnia (ZSNP) at Ziar nad Hronom was Czechoslovakia's sole producer of primary aluminum. Construction of the plant began in 1951 and production started in 1953. In 1985, ZSNP planned to modernize its aluminum smelting operations by replacing the technically dated and polluting Soderberg smelting process with state-of-the-art technology. ZNSP was remaned Slovalco in 1993, following restructuring of the enterprise's assets. Initially, Slovalco, wholly owned by ZSNP, began the construction of the new smelter and ancillary facilities. The technology that was chosen for the new plant was the Hydro Aluminium 230-kA system, which allowed for fully automated control of technological process with each reduction cell under the control of a microcomputer. Also, the new aluminum reduction plant and prebaked anode workshop would achieve significantly higher labor productivity and reduce emissions of waste into the atmosphere and power consumption. To complete this project, Slovalco signed a loan agreement with the European Bank for Reconstruction and Development (EBRD) worth US$110 million. The loan extended to Slovalco by EBRD established high aluminum production standards with respect to environmental protection. These standards were coordinate with the strictest environmental protection regulations in Western Europe (Light Metal Age, 1997). Also, EBRD and Hydro Aluminium a.s. of Norway each made equity investments of US$15 million in Slovalco. The company's investment profile as of August 1998 gave ZSNP 60% of the controlling equity; Hydro Aluminium and EBRD each had 20% (Light Metal Age, 1997).

Slovalco received more than 210,000 metric tons (t) of alumina from Hydro Aluminium, which had undertaken the responsibility of supplying alumina to Slovalco until 2000. After the alumina was purchased from Eurallumina (Sardinia), it was shipped to the port of Koper in Slovenia where it was temporarily bunkered in 20,000-t silos. About 18,000 to 20,000 t were transported 850 kilometers (km) each month from this facility to Slovalco by train. Slovalco's silo held a daily level of 9,000 to 11,000 t of alumina. Petcoke was supplied by Marathon Co. of Burghausen, Germany; liquid coal tar pitch was brought in from the Czech Republic. The new aluminum smelter received electric power from six

Siemens transformer-rectifier groups. The green anode plant (carbon) had the capacity to produce 85,000 metric tons per year (t/yr) of green anodes or 65,000 t/yr of rodded anodes. The plant was built by Fives Cail Babcock (FCB) of Givors, France, in 1988. The paste plant (fume scrubber) has a Procedaire pitch fume dry scrubber, installed by FCB, that uses coke as a scrubbing medium. Coke fines are included in the paste to make new anodes. The anode baking furnace is a natural gas-heated closed system consisting of 40 sections, giving a capacity of 70,000 t/yr. There are 6 pits per section with each pit containing 18 anodes in 3 layers arranged upside down. The system was supplied by Riedhammer of Nuremberg, Germany, and included the computer-controlled measuring and regulating system, firing equipment, combustion equipment for precipitator tar, etc. The smelter potline had a nominal capacity of 108,500 t/yr of liquid metal at a current efficiency of 93%. There were five alumina point feeders and one point feeder for aluminum flouride. Process-control equipment was supplied by Hydro Aluminium a.s. to monitor and control the electric reduction cells (Light Metal Age, 1997). The new technology at Slovalco has allowed a marked 96% reduction in the total emission of fluoride [from 9.71 kilograms per metric ton (kg/t) of Al to 0.37 kg/t].

According to Belmont Resources Inc. (1996), the state-owned mining enterprise, Rudne Bane, ceased operating the antimony-producing mine and mill in the Male Karpaty foothills in May 1992. The mineral rights of the mining and beneficiation complex (the so-called Pezinok concession) were transferred to Slovgold Slovakia s.r.o. in May 1996. In 1997, Slovgold conducted negotiations with Rudne Bane for the purchase of land, buildings, and equipment to conduct gold mining operations. Slovgold was a joint venture that was 51% owned by Belmont. The mine comprised an area of 720,000 square meters, and, owing to the long-term operation of this facility (early 1900's to 1992), infrastructure and availability of supplies, equipment, and skilled and semiskilled labor were adequate.

Exploration at the Rudne Bane antimony mine in the 1980's revealed a second vein that contained commercial gold values; the original exploited antimony-bearing vein, was nearly vertical and was about 3 km in length. Exploration was conducted underground. A total of 813 samples were collected to assay gold, as well as antimony, arsenic, and silver. The vein's depth was projected to 350 meters (m) below the surface. It was open along the strike length to the property boundaries. To date, proven reserves were established at 965,065 t of ore grading 3.76 grams per metric ton (g/t) of gold and 0.28% antimony (Belmont Resources Inc., 1996).

At Kremnica, Argosy Mining Corporation of Canada reported several discoveries during the company's gold exploration work in 1997. Drilling work in 1997 continued beyond the levels assigned for the 1996 exploration program at the South Ridge Zone (southwestern edge of the main Sturec Zone). All the drill cores (18 holes) showed potentially economic gold mineralization. The southern limit of the South Ridge Zone, however, remained untested during the year (Argosy Mining Corporation, 1998b). The new Wolf Zone, about 1,500 meters (m) north of the main Sturec Zone, also showed potentially economic gold mineralization within a width span of 150 to 200 m; the area along the strike (at least 600 m long), however, remained untested. Surface mapping in the vicinity of underground exploration and the presence of a stockwork zone above the known underground mineralization in the Vratislav Zone indicated the potential for additional discoveries. The Vratislav Zone is located between the Sturec and the Wolf Zones. The Volle Henne exploration target covers an area 200 m in width and 300 m in length. A soil survey at this working showed the system trending southward toward Katarina and northeast toward Vratislav. At the Katarina Zone, exploration work was concentrated in its southern area, which is 50 m in width and 150 m in length. Here, the vein system was narrow but high grade, hosting often visible gold. At the Katarina and the Volle Henne exploration zones, historical records of surface and underground mine workings, geochemical analysis of the soil, and outcrop sampling formed the basis of Argosy's analysis. The Horna Ves exploration target area had an identified structure of about 2.5 km lengthwise and open at both ends. Old open-pit workings and outcrops had suggested a width of 10 m, and anomolous gold value showings in Slovak Government trenching work indicated a possible width of more than 60 m. Argosy's geologic interpretation suggests the potential for significant mineralization that probably was bypassed by past mining operations. Metallurgical testing and analysis were done by Hazen Research, Inc., on five ore types in the Sturec "resource." Flotation and direct cyanidation methods were used, processes similar to those used at the Kremnica Mine.

Tests showed that the metallurgical processes at Kremnica would result in a 90% metal recovery by using cyanidation and 80% to 85% by means of flotation (Argosy Mining Corporation, 1998b). The calculation of resources was done independently by Western Services Engineering, Inc., in early 1998. The estimate for the Vratislav deposit at Kremnica was undertaken by the Slovak Geological Survey in 1992; however, this study had not been audited. To date, the total geologic resource at Kremnica was estimated at 1.1 million ounces of Au and 9.0 million ounces Ag. With a 0.5 g/t gold cut-off grade, the resource amounts to 22.3 Mt of ore grading 1.54 g/t gold and 12.5 g/t silver in the Sturec, the Vratislav, and the Wolf Zones. The Sturec Zone contains about 85% of the total gold in Kremnica.

In late November 1996, Argosy reported reaching an agreement with Hell Spolocnost s.r.o., owner of the Banska Stiavnica gold mining property, 30 km south of Kremnica, to undertake a program of exploration at the site. The agreement with respect to a 14.2-square-kilometer licensed site at Banska Stiavnica would give Argosy a 75% interest in a potential commercial operation. The Banska Stiavnica gold deposit is in Neogene volcanic rocks and consists of about "120 veins within the up-domed and block-faulted central section of a hydrothermally altered volcanic caldera" (Argosy Mining Corporation, 1998a). Most of the veins dip steeply to the east and range in thickness from 0.5 to 15 m. The entire vein system is 5 km long and 4 km wide. The upper, or surface parts of the veins were very rich, especially with respect to silver. This epithermal gold deposit was the largest producer of gold in Europe during the Middle Ages and, until the cessation of mining operations in 1993, had recorded a total production of 49,760 kilograms (kg) of gold and 5,162,200 kg of silver during its entire history of exploitation. Because little modern exploration had been done at Banska Stiavnica, Argosy planned

an initial collection of data on geology and production at the site, which would be used in determining a subsequent drilling program. Recent exploration work at this site has indicated residual gold and silver resources remaining in previously unworked veins, vein margins, stope backfill, and pillars. Some mineral potential may exist at the new exploration targets of Ochsenkopf, south Terezia, central Terezia, Wolf-Spitaler, and Sobov, the first four of which were close to the new but unused Raven shaft completed in 1992. Drilling in 1997, however, showed the four targets to have been largely mined out in the tested areas (Argosy Mining Corporation, 1998a).

In Slovakia, iron ore has been mined from deposits at Nizna Slana, Roznava, and Rudnany. Currently, only siderite is mined at Nizna Slana; output has ranged from 800,000 to about 1,000,000 t/yr, and has graded from 27% to 30% Fe. The ore at Nizna Slana was barely economic, whereas the costs of mining operations at Roznava and Rudnany exceeded the selling price of the ore by 200%, requiring the termination of mining operations (Fabian, 1996). Because domestically produced iron ore could meet only a small portion of the needs of the country's steel industry, the major share of iron ore and concentrate was imported, mainly from Russia and Ukraine.

Slovakia was a significant producer of magnesite with output exceeding 800,000 t/yr. Other industrial minerals that were produced included barite, clays (bentonite and kaolin), limestone, perlite, and salt. The country also produced coal, natural gas, and petroleum. Slovakia's production of mineral fuels, however, was insufficient for domestic needs, requiring major imports, chiefly natural gas and petroleum, from the republics of the former Soviet Union.

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TABLE 1
SLOVAKIA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997
METALS						
Aluminum:						
Alumina		140,000	75,000	100,000 e/	100,000	100,000
Aluminum ingot, primary		39,000 r/	33,000	38,139	121,825 r/	127,182 2/
Antimony, mine output, Sb content e/		450	--	--	--	--
Copper:						
Mine output:						
Ore, gross weight		310,000	--	--	190,000	185,000
Concentrate:						
Gross weight		2,000	--	--	1,600	1,300
Cu content e/		500	--	--	386 r/	314 2/
Metal:						
Smelter, primary e/		3,000	3,000	3,000	3,000	3,000
Refined, primary and secondary		23,000	20,000	29,000	25,000	25,000
Gallium metal	kilograms	1,300	600	600 e/	600	600
Gold metal	do.	100 e/	372	518	540	457 2/
Iron and steel:						
Iron ore:						
Gross weight	thousand tons	920	870 r/	820	850	850
Fe content	do.	250	230	225 e/	240	250
Concentrate, Fe content	do.	450 e/	450 e/	446	436	453 2/
Metal:						
Pig iron	do.	3,205	3,330	3,207 r/	3,300	3,300
Ferroalloys, total electric furnace 3/	do.	115	124	140 e/	93 r/	95
Ferrochromium		50,600	48,555	65,260	19,900	11,394 2/
Ferrosilicon		22,000	30,000	30,000	30,000	30,000
Steel, crude	thousand tons	3,768	3,948	3,921	3,600	3,800 2/
Semimanufactures	do.	3,457	3,662	3,686	3,500	3,600
Lead, mine output: e/						
Concentrate, gross weight		3,500	3,500	3,500	3,500	3,500
Pb content		1,800	1,800	1,800	1,000 r/	1,000
Mercury		50	--	--	--	--
Tin-tungsten ore, gross weight	thousand tons	190	190	--	--	--
Zinc:						
Mine output:						
Ore, gross weight		300,000	290,000	300,000 r/	300,000	300,000
Concentrate: e/						
Gross weight		6,500	6,500	6,500	6,500	6,500
Zn content		2,900	2,800	2,800	2,800	2,800
Metal, secondary e/		1,000	1,000	1,000	1,000	1,000
INDUSTRIAL MINERALS						
Barite		31,300 r/	45,700 r/	41,600 r/	44,930 r/	62,102 2/
Cement, hydraulic e/	thousand tons	2,500	2,500	2,500	2,500	2,500
Clays:						
Bentonite		50,000 e/	60,310	74,960	74,820	79,760 2/
Kaolin		25,000	24,100	13,300 r/	23,240	22,720 2/
Diamond, synthetic e/	carats	5,000	5,000	5,000	5,000	5,000
Dolomite	thousand tons	2,500	1,700	1,800 e/	1,800	2,000
Fertilizer, manufactured: e/						
Nitrogenous, N content		170,000	170,000	170,000	170,000	170,000
Phosphatic, P_2O_5 content		120,000	120,000	120,000	120,000	120,000
Potassic, K_2O content		10,000	10,000	10,000	10,000	10,000
Mixed		50,000	50,000	50,000	50,000	50,000
Gypsum and anhydrite, crude		75,000	122,000	131,000	110,000	100,000
Lime, hydrated and quicklime e/	thousand tons	1,070 2/	1,000	1,000	1,000	1,000
Magnesite, crude		1,200,000	616,900	814,500	824,800 r/	863,600 2/
Nitrogen, N content of ammonia e/		263,000 2/	250,000	250,000	250,000	250,000
Perlite		50,000	28,270	21,850	25,160	25,000
Salt		70,000 e/	99,600	99,750	106,800	100,500 2/

See footnotes at end of table.

TABLE 1--Continued
SLOVAKIA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997 e/
INDUSTRIAL MINERALS--Continued						
Stone:						
Limestone and other calcareous stones	thousand tons	4,500	3,887	4,000 e/	4,000 e/	4,000
Quarry stone, not further described e/	thousand cubic meters	5,000	5,000	5,000	5,000	5,000
Talc		5,000 e/	4,800	5,000 e/	5,000 e/	5,000
Zeolite		25,000	12,670	9,720	6,900 e/	5,000
MINERAL FUELS AND RELATED MATERIALS						
Coal, brown and lignite	thousand tons	3,500	4,078	4,140	3,829	3,942 2/
Coke: e/						
Metallurgical	do.	1,880 2/	1,900	1,900	1,900	1,900
Unspecified	do.	300	200	200	200	200
Gas, manufactured, coke oven	million cubic meters	900 e/	291	345	307	286 2/
Petroleum:						
Crude:						
As reported	thousand tons	70	68	74	71	63 2/
Converted	thousand 42-gallon barrels	475	460	500	480	426
Refinery products e/	do.	40,500	40,500	40,500	40,500	40,000

e/ Estimated. r/ Revised.
1/ Table includes data available through December 1998. In addition to the commodities listed, arsenic, diatomite, feldspar, illite, sodium compounds, sulfur, sulfuric acid, and talc are produced, but information is inadequate to make reliable estimates of output.
2/ Reported figure.
3/ May include some FeCrSi and FeNi, if any was produced.

TABLE 2
SLOVAKIA: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousands of metric tons unless otherwise specified)

Commodity		Major operating companies 1/	Location of main facilities 2/	Annual capacity
Aluminum		ZSNP Aluminum Works	Ziar nad Hronom, central Slovakia	108
Antimony, ore		Liptovska Dubrava	Central Slovakia	50
Do.		Pezinok	West Slovakia	50
Smelter		Vajskova	Central Slovakia	2
Cement		Lietavska Lucka, Stupava, and Turna	Slovakia	5,400
Coal, brown		ULB administration	Prievidza, central Slovakia	6,800
Copper:				
Ore		Slovinky, Hodrusa-Hamre, and Rudnany	Central Slovakia	500
Refinery		Krompachy	do.	27
Gallium	kilograms	SNP Aluminum Works	Ziar nad Hronom, central Slovakia	4,000
Iron:				
Ore		Nizana Slana	Central Slovakia	1,000
Concentrate		do.	do.	1,300
Lead-zinc, ore		Banska Stiavnica	do.	200
Magnesite		SMZ administration	East Slovakia	550
Mercury	metric tons	Dubnik, Malachov, and Rudnany	Central Slovakia	150
Petroleum, refinery		Bratislava, Strazske, and Zvolen	Slovakia	NA
Steel, crude		Vychodoslvenske Zeleziarne sp (East Slovak Iron and Steel Works)	Slovakia, Kosice	4,000
Do.		Svermove zeleziarne	Slovakia, Podbrezova	600

NA Not available.
1/ All mining companies are Government owned.
2/ Names and locations of mines and crude oil refineries are identical.