

THE MINERAL INDUSTRY OF

SWEDEN

By Harold R. Newman

Sweden is endowed with significant deposits of iron ore, certain base metals (copper, lead, and zinc), and several industrial minerals (such as dolomite, feldspar, granite, ilmenite, kaolin, limestone, marble, and quartz). The country is well known for the production of high-quality steel. Because of inadequate indigenous resources, Sweden relies heavily on hydrocarbon imports; as a result, the country has developed nuclear and hydroelectric power.

In 1999, exploration, which was mostly directed toward base metals and diamonds, continued. Companies continued to delineate base and precious-metal resources, even in areas that have supported long-term mining. North Atlantic Natural Resources, which was a joint venture between Boliden Mineral AB and the Lundin Group of Canada, discovered the Storliden polymetallic deposit plus three other prospects, all in the Skellefte mining district. Other success stories include ScanMining AB's discovery of the Ersmarksberget gold-zinc deposit and several discoveries made by Boliden. Mining licences have been issued for Storliden and Ersmarksberget deposits (North Ltd., 1999).

Boliden reported high-grade polymetallic intersections from its underground drilling program within the Renström and Simon zones at its Renström Mine in northern Sweden. The drilling program was intended to better define the extent and grades of the ore zones. The Renström Mine, which started operations in 1953, has produced a polymetallic ore grading on average 7.5% zinc, 1.6% lead, 0.8% copper, 3.5 grams per metric ton (g/t) gold, and 162 g/t silver through September 1999. The deepest mining production level was at 1,010 meters (m) (Skillings Mining Review, 1999).

Exploration activity decreased in 1999 compared with that of 1998, mainly because Boliden reduced its exploration budget by half owing to its financial condition. Also, North Mining Svenska AB substantially scaled back its exploration work around the Zingruvan Mine as part of an international cost-cutting exercise (Invest in Sweden Agency, 1999, Raw materials group annual survey of Swedish exploration and mining, accessed September 27, 2000, at URL http://www.isa.se/mineralexplora/location/swedish%20juniors_h.htm).

Overall mine production was somewhat less in 1999 compared with that of 1998. North Mining's Zinkgruvan Mine and the 11 mines of Boliden accounted for most of the base metal production (table 1).

Because Sweden lacked a zinc smelter, most zinc concentrate, which was one of the largest mineral exports, was shipped to Norway. The country imported most of the raw material required to operate its copper and lead smelter (table 2).

Sweden's recycling rate for aluminum cans was high because of close cooperation among the stock producer for cans (Finspong), the can manufacturer (PLM Fosie), the collection

companies (Returpak and PLM Fosie), and the secondary smelters (Gotthard Aluminum and Finspong). Consequently, secondary aluminum production has increased in the past few years.

After acceding to the European Union (EU) on January 1, 1995, Sweden liberalized its mineral policy to parallel EU standards. The policy, which is based on the Swedish Minerals Act, 1992, eliminated laws that require foreign companies to get special permission for prospecting, annulled the State's participation in mining enterprises (so-called crown shares), and revoked all taxes and royalties except for a 28% corporate tax, which was one of the lowest in Europe. Furthermore, an exploration permit holder will not receive an exploration license until adequate financial and technical capabilities can be proven.

The most important changes to be initiated in 1999 were the introduction of the obligatory filing of data after abandonment of an area to avoid duplication of work, such as mapping, sampling and drilling, the reorganization of the mining inspectorate (Bergmästarämbetet) to increase its effectiveness, the shortened time period in the handling of exploration applications, and the elimination of some elements of discretion that have remained in the handling of exploration applications. Also, more explicit rules for environmental protection would be incorporated in the exploration permit (Geological Survey of Sweden, 1998 Mineral policy, law and ordinance, accessed July 15, 1999, at URL http://www.sgu.se/metmin/minlag_e.htm).

A code of ethics was to be adopted by the Swedish Mining Association. Subjects covered by the code states how member companies would be expected to handle landowner issues during exploration, work environment, and general environmental matters. Companies would be requested to minimize environmental impact, systematically monitor and follow up on environmental work and report on company activities in an open and correct way (Invest in Sweden Agency, 1999, Summary of recent activities in mineral exploration, accessed October 20, 2000, at URL http://www.isa.se/sectors/mineral/explorationnews/may_june1999.htm).

Boliden's Aitik copper mine, near Gällivare, was one of the lowest grade and most northerly copper mines in the world and was one of Europe's largest open pit mines. The ore is in a shear zone that appears to occur from Kiruna, Sweden, to Lake Ladoga in Russia. The gold and silver byproducts contribute substantially to the profitability of the Aitik Mine.

William Resources Inc. of Canada's open pit Björkdal gold mine, near Skellefte, entered into receivership in June 1999. A consortium of banks, which included Credit Agricole of France, BHF of Germany, and the domestic institutions of S-E Banken and Swedbank, took over the company after Williams was unable to repay the loan it had taken from the consortium to acquire and develop the operation. Low gold prices, lack of

working capital, and foreign exchange effects were cited as reasons (George, 1999).

Björkdal, which opened in 1988, produced 2,800 kilograms per year (reported as 90,000 troy ounces per year) at peak operation. In 1998, the mine produced 2,100 kilograms (reported as 67,000 troy ounces) at a cost of about \$231 per ounce. It had been Europe's largest gold mine (Mining Journal, 1999a).

Luossavaara-Kiirunavaara AB (LKAB) had iron ore mines and processing plants in Kiruna and Malmberget, a pelletizing plant in Svappavaara, and harbors at Luleå and Narvik. LKAB's Kiruna Mine was the world's largest and most modern underground iron ore mine. Kiruna, which was highly automated, produced about 20 million metric tons per year (Mt/yr) of ore. LKAB had an ongoing "KUJ 2000" project that will enable the current (1999) mining depth of 775 m to be increased to 1,045 m starting in 2000; this could add 18 years to the mine's life (Metal Bulletin Monthly, 1999).

Svenskt Stal AB (SSAB) was Scandinavia's leading manufacture of commercial steel. Most production consisted of steel sheets and plates, which were produced mainly in three SSAB subsidiaries at Borlänge, Luleå, and Oxelösund. The SSAB Oxelösund AB complex consisted of a coking plant, blast furnaces, a steel mill, and a continuous casting line for slabs and heavy plate of up to 155 millimeters in thickness. The 2-Mt/yr SSAB Tunnplant AB was an integrated steel company with a coking plant, blast furnaces, and continuous casting line for the manufacture of slab and heavy plate.

The acquisition of Gotthard Nilsson AB by Stena Metall AB made Stena the largest processor of scrap and secondary metal in Sweden. Stena accounted for about 70% of Sweden's secondary operations and has 55 steel and nonferrous scrap yards. The company processed steel and other metals, as well as rubber tires and paper (Metal Bulletin, 1999).

The Zinkgruvan Mine, the largest zinc mine in Sweden, was operated by Zinkgruvan Mining AB, which was a subsidiary of the Australian company, North Ltd. The operation was producing about 730,000 metric tons (t) of ore with an average grade of 10.7% zinc. Production was scheduled to increase to 770,000 t in 1999-2000 and to increase annually to about 850,000 t by 2003-04. Additional drilling at depth in both the Burkland ore body and the western region of the Nygruvan ore body was reported as being encouraging (North Ltd., 1999).

In the industrial minerals area, extensive changes in ownership have been reported during the past 5 to 6 years. This has been an expanding sector in Sweden, and a significant number of deposits were owned or controlled by international owners.

North Star Diamonds A/S, which was a subsidiary of Poplar Resources Ltd. of Canada, was granted an 11,300-square-kilometer (km) diamond licence in the north of Sweden. North Star was to begin drilling targets identified by stream sampling programs and aeromagnetic data interpretation. The site of the discovery of what Poplar Resources claims was Sweden's first diamonds is within the licence area and the prime target for drilling (Mining Journal, 1999b).

Limestone occurs in strata of several geologic ages throughout the country. About one-half of the industrial mineral value was contributed by limestone. Kalproduktion Storugns AB produced a significant amount of limestone. The

company mined about 2.8 million metric tons at Storugns on the Baltic Island of Gotland. About 40% of this was consumed by the metallurgical industry, and about 30% ended up as burnt lime.

Borghamnsten AB had quarries and a factory equipped to saw raw blocks of marble. The company operated a raw marble quarry at Askersund near the Glanshamar locality. Annual quarry production was about 14,000 cubic meters (m³), which gave about 2,000 m³ of marble as raw blocks.

Swedish peat area covers 6.4 million hectares (ha), which is about 15% of the country's total land area. About 865,000 ha was considered to be suitable for commercial production. Almost 8,000 ha was in production, most of which was used for fuel; the remainder was used for agriculture. Peat was used as fuel mainly in cogeneration plants for electric power and district heating.

Sweden had a well-developed transportation system, especially in the southern part of the country. There were 97,400 km of highway and 12,000 km of railroads. About 65% of waterborne cargo was handled by the five biggest ports, in decreasing order—Göteborg, Helsingborg, Luleå, Stockholm, and Malmö. Truck ferries have become an important form of transportation.

On July 1, 2000, the \$2.5 billion, 7.7-km Öresund "fixed link" bridge was scheduled to be completed and opened. It will span the water from Malmö, Sweden, to Copenhagen, Denmark, to link the two cities and to create the eighth largest region in Europe in terms of gross national product (GNP). One-fifth of the combined GNP of Sweden and Denmark came from the Öresund region, which is an area of about 3.2 million people living in a 96-km radius. Four lanes on the upper level of the bridge will be open for vehicles, and trains will roll across the lower level. A tunnel that is slightly longer than the bridge and will be used for vehicular traffic is also part of the connection. Currently (1999) travel between the two cities is either by hydrofoil or airplane (Sains, 1999).

References Cited

- George, Nicholas, 1999, Goldmine in Sweden enters receivership: Financial Times [London], no. 33951, July 5, p. 20.
- Metal Bulletin, 1999, Stena becomes Swedish scrap giant: Metal Bulletin, no. 8354, February 24, p. 15.
- Metal Bulletin Monthly, 1999, Automated ore loading at Kiruna: Metal Bulletin, no. 338, February, p. 57.
- Mining Journal, 1999a, Björkdal goes under: Mining Journal, v. 333, no. 8539, July 9, p. 31.
- 1999b, North Star granted large Swedish diamond licence: Mining Journal, v. 332, no. 8513, January 8, p. 5.
- North Ltd., 1999, Annual report—1999: Melbourne, Australia, North Ltd., 24 p.
- Sains, Ariane, 1999, The Öresund link: Europe Magazine, no. 388, July-August, p. 16.
- Skilling Mining Review, 1999, High grade polymetallic intersections found in Boliden's Swedish Renström Mine: Skilling Mining Review, v. 88, no. 46, November 13, p. 3.

Major Source of Information

Geological Survey of Sweden
Mineral Resources Information Office
Skolgatan 4
93070 Malå, Sweden

TABLE 1
SWEDEN: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity	1995	1996	1997	1998	1999 e/	
METALS						
Aluminum metal:						
Primary	94,500	98,306	98,377	95,670	96,000	
Secondary e/	23,000	24,000	24,000	25,000	25,000	
Copper:						
Mine output, Cu content	83,603	71,660	86,640	73,685	71,200	
Metal:						
Smelter:						
Primary e/	80,000	100,000	95,000 r/	90,000 r/	85,000	
Secondary e/	30,000	26,000	33,000 r/	35,000 r/	30,000	
Total	110,000	126,000	128,000	125,000	115,000	
Refined: e/						
Primary	78,000 3/	90,000	85,000	90,000	80,000	
Secondary	27,100 3/	37,000	32,000	35,000	30,000	
Total	105,100 3/	127,000	117,000	125,000	110,000	
Gold:						
Mine output, Au content	kilograms	6,528	6,145	6,777	5,944	4,400
Metal, primary 4/	do.	8,200	10,100 e/	10,000	9,000 e/	8,000
Iron and steel:						
Iron ore concentrate and pellets:						
Gross weight	thousand tons	21,634	21,020	21,893	20,930	18,558 3/
Fe content	do.	13,880	14,714	13,912	12,977	11,506 3/
Metal:						
Pig iron and sponge iron	do.	3,020	3,255	3,060	3,373	3,212 3/
Ferroalloys:						
Ferrochromium		130,170	138,110	101,842	123,958	131,140 3/
Ferosilicon		21,970	21,287	22,409 r/	22,000 r/	20,000
Total		152,140	159,397	124,251 r/	145,958 r/	151,140
Steel, crude	thousand tons	4,953	4,910	5,147	5,062	5,075 3/
Semimanufactures, rolled	do.	4,529	4,457	4,545	4,485	4,400
Lead:						
Mine output, Pb content		137,200	98,800	108,600	114,430	116,300 3/
Metal, refined:						
Primary		39,700	42,200	34,700	40,600	38,000
Secondary		51,500	41,900	51,500	52,000	48,000
Total refined		91,200	84,100	86,200	92,600	86,000
Molybdenum, oxide, roasted, Mo content e/		4,000	4,000	3,500	3,000	3,000
Nickel, metal, secondary e/		250	100	100	100	60
Selenium, elemental, refined		26	20	20 e/	20 e/	20
Silver:						
Mine output, Ag content	kilograms	268,200	271,866	304,048	299,051	284,100 3/
Metal, primary 4/	do.	261,000	301,000	300,000 e/	250,000 e/	250,000
Zinc, mine output, Zn content		167,090	160,325	155,400	164,711	175,000
INDUSTRIAL MINERALS						
Cement, hydraulic	thousand tons	2,539	2,447	2,253 r/	2,105 r/	2,100
Clays, kaolin e/	do.	460	460	450	450	450
Feldspar, salable, crude and ground		45,000	45,000	50,000	45,000	45,000
Fertilizer, manufactured: e/						
Nitrogenous	thousand tons	450	400	400	400	400
Phosphatic	do.	10	10	10	10	10
Mixed	do.	300	300	300	300	300
Graphite		--	463	1,470	3,011	3,000
Lime e/	thousand tons	530	540	600	500	500
Olivine e/	do.	50	--	--	--	--
Quartz and quartzite e/	do.	518	525	500	500	500
Sodium sulfate, synthetic e/	do.	100	--	--	--	--
Stone: e/						
Dimension: thousand tons						
Mostly unfinished		150	160	150	150	150
Granite	do.	90 3/	100 3/	100	100	100
Limestone	do.	5	5	5	5	5
Slate	do.	20	20	20	20	20
Other	do.	10 3/	10 3/	10	10	10

See footnotes at end of table.

TABLE 1--Continued
 SWEDEN: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity	1995	1996	1997	1998	1999 e/
INDUSTRIAL MINERALS--Continued					
Stone--Continued: e/					
Crushed:					
Dolomite thousand tons	700	600	600	600	600
Granite do.	3,200 3/	3,500 3/	3,500	3,500	3,500
Limestone:					
For cement manufacture do.	4,000	4,000	4,000	4,000	4,000
For lime manufacture do.	1,000	1,000	1,000	800	800
For other construction and industrial uses do.	1,700	2,000	1,800	1,600	1,600
Chalk do.	50 3/	25	30	30	30
For agricultural uses do.	450 3/	475 3/	400	400	400
For other uses do.	1,000	1,000	1,000	1,000	1,000
Total do.	8,200 3/	8,500	8,230	7,830	7,830
Sandstone do.	50	100	100	75	75
Undifferentiated do.	30,000	25,000	25,000	25,000	25,000
Other do.	700	500	500	500	500
Sulfur, byproduct: e/					
From metallurgy do.	125	100	100	73 r/	65
From petroleum do.	40	40	60	63 r/	55
Total do.	165	140	160	136 r/	120
Talc, soapstone e/	25,000	30,000	25,000	25,000	25,000
MINERAL FUELS AND RELATED MATERIALS					
Coke, metallurgical thousand tons	1,147	1,145	1,200 e/	1,150 e/	1,200
Gas, manufactured: e/					
Coke oven gas million cubic meters	500	500	500	500	500
Blast furnace gas do.	4,000	3,500	3,500	3,500	3,500
Peat:					
Agricultural use thousand cubic meters	1,052	1,084	1,100	670 r/	700
Fuel do.	2,624	2,278	2,400	390 r/	400
Petroleum:					
Refinery products: e/					
Liquefied petroleum gas thousand 42-gallon barrels	3,000	3,500	3,500	3,000	3,000
Naphtha do.	300	500	500	500	500
Gasoline, motor do.	32,000	32,500	36,932 3/	38,862 3/	38,000
Jet fuel do.	2,500	2,500	1,872 3/	1,288 3/	1,400
Kerosene do.	50	50	50	50	50
Distillate fuel oil do.	80,000	75,000	53,152 3/	56,582 3/	56,000
Residual fuel oil do.	28,000	25,000	35,304 3/	38,508 3/	38,000
Other do.	4,000	3,000	7,714 3/	7,800	7,800
Refinery fuel and losses do.	10,000	5,000	5,000	5,000	5,000
Total do.	160,000	147,000	144,000	152,000	150,000

e/ Estimated. r/ Revised. -- Zero.

1/ Table includes data available through September 2000.

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

3/ Reported figure.

4/ Includes only that recovered from indigenous ores excluding scrap.

TABLE 2
SWEDEN: STRUCTURE OF THE MINERAL INDUSTRY IN 1999

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Aluminum		Granges AB (Glencore International AG, 100%)	Sundsvall smelter at Kubikenborg	98
Cement		Cementa AB (Scancem, 100%)	Plants at Degerhamn, Skövde, and Slite	3,400
Copper:				
Ore, copper content		Boliden Mineral AB	Mines at Aitik, Garpenberg, Kankberg, Kristineberg, Langdal, Petiknas, and Renström	68
Do.		Outokumpu Oyj	Mines at Viscaria(closed)/Pahtohavare	22
Metal		Boliden Mineral AB	Smelter and refinery at Rönnskär	100
Feldspar		Berglins Malm & Mineral AB (Omya GmbH)	Mines at Beckegruvan, Hojderna, and Limbergsbo	50
Do.		Forshammar Mineral AB (Omya GmbH)	Mines at Limberget and Riddarhyttan	30
Do.		Larsbo Kalk AB (Omya GmbH)	Mines at Glanshamar and Larsbo	20
Ferroalloys		Vargon Alloys AB	Plant at Vargon	175
Gold:				
Ore, gold content	kilograms	William Resources Inc.	Björgdal Mine at Skellefta	3,000
Do.	do.	Boliden Mineral AB	Mines at Aitik, Akerberg, Kankberg, Kristineberg, Langdal, Petiknas, and Renström	2,000
Metal		Boliden Metals AB	Smelter and refinery at Rönnskär	9
Graphite		Woxna Graphite AB (Tricorona Mineral AB, 100%)	Mine and plant at Kringeltjärn, Woxna	20
Iron ore		Luossavaara-Kiirunavaara AB (Government, 98%)	Mines at Kiruna and Malmberget	28,500
Iron and steel		Svenskt Stal AB (Government, 48%)	Steelworks at Borlänge, Luleå, and Oxelosund	3,500
Kyanite		Svenska Kyanite AB (Svenska Mineral, 100%)	Quarry at Halskoberg	10
Lead:				
Ore, lead content		Boliden Mineral AB	Mines at Garpenberg, Laisvall, Langdal, Petiknas, and Renström	110
Do.		North Mining Svenska AB	Zinkgruvan Mine at Ammeberg	20
Metal		Boliden Metals AB	Smelter and refinery at Rönnskär	115
Lime		Euroc Mineral AB	Plants at Limham, Koping, and Storugns	250
Do.		Svenska Mineral AB	Plants at Rattvik and Boda	250
Limestone		Kalproduktion Storugns AB (Nordkalk AB, 100%)	Mines at Gotland Island	3,000
Marble	cubic meters	Borghamnsten AB	Quarry at Askersund	15,000
Petroleum, refined	barrels per day	Skandinaviska Raffinaderi AB	Refinery at Lysekil	210,000
Do.		BP Raffinaderi AB	Refinery at Goteborg	100,000
Do.		Shell Raffinaderi AB	do.	82,000
Do.		AB Nynas Petroleum	Refineries at Goteborg, Malmo, and Nynashamn	54,000
Silver, metal	kilograms	Boliden Metals AB	Smelter and refinery at Rönnskär	300,000
Do.	do.	North Mining Svenska AB	Zinkgruvan Mine at Ammeberg	25,000
Zinc, ore, zinc content		Boliden Mineral AB	Mines at Garpenberg, Laisvall, Langdal, and Renström	112
Do.		Zinkgruvan Mining AB (North Ltd., 100%)	Zinkgruvan Mine at Ammeberg	60