

THE MINERAL INDUSTRY OF

FINLAND

By Harold R. Newman

Finland has well-established mining, mineral processing, and refining industries. The diminishing supply of indigenous metalliferous raw materials, however, required that most of the feed for smelters (100% of iron ore concentrate, 80% of zinc concentrate, and 60% of nickel matte and concentrate) be imported from various sources. Major mineral commodities produced are listed in table 1.

Government involvement in the mineral industry was considerably higher than in any of the other European Union (EU) countries. Government-owned companies—Finminers Group (hard-rock drilling, materials handling and ore processing), Kemira Oyj (chemicals), Outokumpu Oyj (base metals mining and mining technology), and Rautaruukki Oy (steel production)—dominated the domestic mineral industry, and Government organizations—the State Geologic Research Institute and the State Technological Research Center—were active in exploration and research. Because of Outokumpu and Finminers, Finland was a world leader in the technology of underground mining, ore processing, and metallurgy.

Mineral legislation and regulations are covered under the Mining Act (Kaivoslaki 503/65), the Mining Decree (Kaivosasetus 663/65), and Amendments to the Mining Law (1427/92, 1625/92, 474/94, 1571/94, 208/95, 561/95, and 1076/95). These are referred to collectively as the “Mining Law.” The mineral resources covered by the Mining Law include about 50 metallic minerals and 30 industrial minerals, as well as gems and soapstone (Kortman and others, 1996).

In Finland any individual, corporation, or foundation having its principal place of business or central administration within the EU enjoys the same rights to explore for and exploit mineral deposits as any Finnish citizen or corporation. This has encouraged foreign investment and increased exploration activities of major and junior companies. Exploration for base metals, diamond, and gold deposits was emphasized.

The major companies are listed in table 2. Outokumpu’s Kemi Mine, which was the only chromite mine in Finland, was a significant chromite producer. In 1999, output was around 1 million metric tons per year of chromite ore from two open pits. The ore was processed by a multistage concentration method that is based on the specific gravity between the minerals, as well as on their magnetic properties. The output of about 400,000 metric tons per year (t/yr) of chromite concentrates was used as raw materials at Outokumpu’s ferrochrome and stainless steel plants at Tornio.

An expansion program was announced for the Kemi Mine. Starting in 1999, the open pit operation was to be prepared for underground mining. This expansion program was to take place within a 5-year period and was expected to improve cost-effectiveness and to enable mine output to be doubled. An investment of \$80 million during the next 5 years was planned.

The chromite deposit occurs within a layered intrusion and contains an estimated 70 million metric tons (Mt) of proven and probable reserves and additional resources of about 150 Mt (Metal Bulletin, 1999a).

Although it has no primary copper mines, Finland did produce copper as an associated mineral from Outokumpu’s primary zinc mine at Pyhäsalmi. The zinc concentrate was shipped to the Kokkola smelter, and the associated copper concentrate was shipped to the Harjavalta smelter. Pyhäsalmi, together with Outokumpu’s Tara Mine in Ireland, supplied about 80% of the feed for the Kokkola smelter.

Outokumpu’s blister copper capacity was 160,000 t/yr, cathode copper capacity was 125,000 t/yr, and refined nickel capacity was 32,000 t/yr. Outokumpu announced the decision to deepen the Pyhäsalmi Mine from 1,050 meters (m) to about 1,400 m. Investigations of lower parts of the ore body increased estimated ore reserves to 17 Mt with average metal content of 1.1% copper, 2.1% zinc, and 38% pyrite. These grades are higher than the currently excavated ore (Mining Engineering, 1999).

Finland has never been a major gold producer, although exploration for gold in 1999 was being conducted by several domestic and foreign companies, as well as the Geological Survey of Finland (GSF). Activity was mainly centered on the Lapland Greenstone Belt and the Archean Greenstone Belt of eastern Finland, and the Svecofennian Schist Belt in the south.

The only remaining domestic nickel mine in operation in 1999 was Outokumpu’s Hitura Mine, which has produced more than 8 Mt of ore since 1965. After suspending operations in June 1998, the company announced it was reopening the mine in December 1999. Outokumpu stated that the mine was reopened owing to the increased nickel price and improved market fundamentals. Production was expected to be 700,000 t/yr of ore to produce 3,500 t/yr of nickel in concentrate (Metal Bulletin, 1999b).

Outokumpu, which was one of the world’s largest producers of zinc, announced that it would make a total investment of about \$90 million in the zinc plant in Kokkola, whereby the production capacity would be increased by about one-third to 225,000 t/yr from 170,000 t/yr of zinc. Implementation was expected to take about 2 years. Use of a new direct method of leaching zinc concentrates, which was developed by Outokumpu, was expected to improve metal recovery and increase friendliness to the environment (Engineering & Mining Journal, 1999).

Finncement Oy, which was a Scancem Group subsidiary, was the only cement producer in Finland. It operated two plants, both located in southern Finland. The largest plant was at Pargas and the smaller at Lappeenranta near the border with Russia.

The largest mine in Finland which was operated by Kemira Agro Oy produced apatite concentrate for a nearby fertilizer plant. SP Minerals Oy, which operated a joint-venture company of Partek Nordkalk Oy (50.1%) and SCR-Sibelco SA of Belgium, was responsible for the processing and marketing of quartz and feldspar products, molding sand, and bentonite.

Finland was one of the largest energy consumers in western Europe. Only about one-third of its energy requirements were satisfied by indigenous sources, namely, hydropower and nuclear power, peat, and wood. All other energy sources, such as coal, natural gas, and petroleum, were imported. Russia was the major source for these commodities.

The operating environment in Finland was generally favorable for exploration and mine development. The GSF identified a number of mineral deposits for which information was available. It placed emphasis on exploration for pigment minerals, such as ilmenite, high-quality carbonates, and kaolin. Also, a number of dimension stone deposits were being assessed by various companies.

Finland can be considered to be an attractive exploration target in several respects on the basis of information available from the GSF. Geoscientific data coverage is excellent,

infrastructure is highly developed with good port facilities, the high-voltage power grid is extensive, and the road network is comprehensive.

References Cited

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- Metal Bulletin, 1999a, Outokumpu mulls ways of implementing expansion: Metal Bulletin, no. 8387, June 24, p. 20.
- 1999b, Outokumpu reopens mine in Finland: Metal Bulletin, no. 8427, November 18, p. 3.
- Mining Engineering, 1999, Expansion planned for copper-zinc mine: Mining Engineering, v. 51, no. 4, April, p. 11.

Major Source of Information

Geological Survey of Finland
Betoniemiehenkuja 4
02150 Espoo
Finland

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

(Metric tons unless otherwise specified)

Commodity	1995	1996	1997	1998	1999 e/
METALS					
Aluminum metal, secondary	35,090	35,308	38,200	34,200	43,200 3/
Cadmium metal, refined	539	648	540 e/	550 e/	700
Chromite:					
Gross weight:					
Lump ore e/ thousand tons	214	210	215	220	225
Concentrate e/ do.	373	360	365	380	400
Foundry sand e/ do.	11	12	9	10	10
Total do.	598	582	589	610	635
Cr₂O₃ content					
Lump ore e/ do.	80	70	75	75	75
Concentrate do.	150	150	150 e/	150 e/	150
Foundry sand e/ do.	3	3	3	5	5
Total do.	233	223	228	230	230
Cobalt, metal, powder, and salts	3,610 r/	4,160 r/	5,000 r/	5,250 r/	6,200
Copper:					
Concentrate, gross weight	26,000	24,000	22,000 e/	25,000 e/	28,000
Mine output, Cu content	9,790	9,261	8,500 e/	9,500 e/	10,500
Metal:					
Smelter	120,577	178,675	159,000 e/	156,000 e/	149,600 3/
Refined	73,700	110,715	116,000 e/	123,000 r/ e/	114,700 3/
Gold metal kilograms	2,061	3,070	3,900	5,000 e/	5,900
Iron and steel, metal:					
Pig iron thousand tons	2,242	2,457	2,786	2,912	2,954 3/
Ferroalloys, ferrochromium do.	247	228	237	231	240
Steel, crude do.	3,176	3,301	3,687	3,932	3,956 3/
Semimanufactures, rolled do.	3,242	3,292	3,314	3,682	3,700
Mercury	90	88	63 r/	54 r/	40
Nickel:					
Mine output, Ni content	3,439	2,136	3,252	1,200 e/	730 3/
Metal, electrolytic	16,927	28,815	34,228	46,200 r/	52,800
Platinum-group metals:					
Palladium kilograms	95	182	180 e/	150 e/	150
Platinum do.	37	62	60 e/	50 e/	50
Selenium metal do.	29,690	42,000	28,000 r/	28,000 r/ e/	26,000
Silver metal do.	26,098	32,506	32,500 e/	29,700 e/	31,500
Zinc:					
Mine output, Zn content	16,385	26,294	30,800 e/	30,700 e/	20,000
Metal	176,600	176,300	175,300 e/	199,000 e/	225,000
INDUSTRIAL MINERALS					
Cement, hydraulic thousand tons	907	975	905 r/	903 r/	900
Feldspar	41,808	40,265	40,000 e/	40,000 e/	40,000
Lime thousand tons	401	394	400 e/	400 e/	400
Nitrogen, N content of ammonia	5,933	5,107	6,000 e/	6,000 e/	6,000
Phosphate rock, apatite concentrate:					
Gross weight thousand tons	671	657	650 e/	650 e/	600
P ₂ O ₅ do.	243	240	235 e/	235 e/	200
Pyrite, gross weight do.	829	813	950 e/	900 e/	800
Sodium sulfate do.	34	29	30 e/	35 e/	30
Stone, crushed:					
Limestone and dolomite:					
For cement manufacture do.	1,114	1,128	1,200 e/	1,200 e/	1,200
For agriculture do.	787	892	900 e/	900 e/	900
For lime manufacture do.	335	303	300 e/	300 e/	300
Fine powders do.	316	289	300 e/	300 e/	300
Metallurgical e/ do.	2	2	2	2	2
Total do.	2,554	2,614	2,700 e/	2,700 e/	2,700
Quartz silica sand do.	30	31	30 e/	30	30
Soapstone do.	31	--	--	--	--
Sulfur:					
S content of pyrite do.	422	425	430 e/	430 e/	500
Sulfuric acid do.	1,159	1,287	1,200 e/	1,200 e/	1,200

See footnotes at end of table.

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

(Metric tons unless otherwise specified)

Commodity	1995	1996	1997	1998	1999 e/
INDUSTRIAL MINERALS--Continued					
Sulfur--Continued:					
Byproduct:					
Of metallurgy thousand tons	215	291	290 e/	296 r/	300
Of petroleum do.	37	38	40 e/	40 e/	45
Total do.	252	329	760 e/	766 e/	845
Talc do.	464	345	350 e/	350 e/	350
Wollastonite	29,592	22,304	20,000 e/	22,000 e/	22,000
MINERAL FUELS AND RELATED MATERIALS					
Peat:					
For fuel use thousand tons	6,300	8,000 r/	7,000 r/	6,000 e/	7,000
For agriculture and other uses do.	400 r/	400 r/	400 r/	400 r/	400
Petroleum refinery products thousand 42-gallon barrels	79,000	83,000	76,643 r/	83,370 r/	83,000

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.

TABLE 2
FINLAND: 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
Apatite	Kemira Agro Oy (Government, 98%)	Mine and plant at Siilinjärvi	8,000
Ammonia	Kemira Oyj (Government 98%)	Plant at Oulu	75
Cadmium, metal	Outokumpu Oyj (Government, 40%; Insurance Co., 12.3%)	Smelter at Kokkola	1
Cement	Finn cement Oy (Scancem Group, 100%)	Plants at Lappeenranta and Pargas	1,200
Chromite	Outokumpu Oyj (Government, 40%; Insurance Co., 12.3%)	Mine at Kemi	1,000
Copper:			
Ore, Cu content	Outokumpu Oyj (Government, 40%; Insurance Co., 12.3%)	Mines at Pyhäsalmi, Saattopora, and Hitura	10
Metal	do.	Smelter at Harjavalta	160
Do.	do.	Refinery at Pori	125
Feldspar	SP Minerals Oy (Partek Corp., 50.1%; SCR-Silbeco SA, 49.9%)	Mine and plant at Kemiö	50
Ferrochrome	Outokumpu Oyj (Government, 40%; Insurance Co., 12.3%)	Smelter at Tornio	250
Gold:			
Ore, Au content tons	do.	Mine at Orivesi	4
Metal	do.	Smelter at Pori	4
Ore, Au content	do. Williams Resources Inc.	Pahtavaara Mine near Sodankyla	3
Limestone	Partek Nordkalk Oy (Partek Corp. 100%)	Mines at Lappeenranta, Pargas and Parainen	1,500
Do.	Rauma-Repola Oy	Mine at Tornio	300
Mercury	Outokumpu Oyj (Government, 40%; Insurance Co., 12.3%)	Smelter at Kokkola	150
Mica	Kemira Oyj (Government 98%)	Mine at Siilinjärvi	10
Nickel:			
Ore, Ni content	Outokumpu Oyj (Government, 40%; Insurance Co., 12.3%)	Mine at Hitura	3
Metal	do.	Smelter at Harjavalta	32
Phosphate-apatite	Kemira Oyj (Government 98%)	Mine at Siilinjärvi	700
Do.	Outokumpu Oyj (Government, 40%; Insurance Co., 12.3%)	Mine at Pyhäsalmi	800
Quartz and quartzite	SP Minerals Oy (Partek Corp., 50.1%; SCR-Silbeco SA, 49.9%)	Mines at Kemiö and Nilsia	250
Selenium	Outokumpu Oyj (Government, 40%; Insurance Co., 12.3%)	Smelter at Pori	35
Silver	do.	do.	30
Steel	Rautaruukki Oy (Government 41.8%)	Plant at Raahe	2,100
Do.	Fundia AB (Norsk Jenverk AS of Norway, 50%; Rautaruukki, 50%)	Plants at Aminnefors, Dalsbruk, and Koverhar	850
Do.	Ovako Oy (SKF, 50%; Wartsila, 25%; Fiskas, 20%)	Plant at Imatra	600
Talc	Mondo Minerals Oy (Western Mining Corp. Holdings Ltd., 50%; Plüss-Stauffer AG, 50%)	Mines at Lahnaslampi, Lipsavaara, and Horsmanaho	500
Wollastonite	Partek Minerals Oy (Partek Corp., 100%)	Mine at Lappeenranta	30
Zinc:			
Ore, Zn content	Outokumpu Oyj (Government, 40%; Insurance Co., 12.3%)	Mine at Pyhäsalmi	25
Metal	do.	Smelter at Kokkola	175