

THE MINERAL INDUSTRY OF FINLAND

By Harold R. Newman

On January 1, 1995, Finland acceded to the European Union. At that time amendments to the Finnish Mining Law took effect which allow any individual, corporation, or foundation having its principal place of business or central administration within the EU to enjoy the same rights to explore and exploit deposits of minerals and ores as any Finnish citizen or corporation. Increased foreign activity in exploration has already resulted in the discovery of a major diamond field in northern Finland by Malmikaivos Oy.

Government involvement in the mineral industry was considerably higher than in any of the other EU countries. Government-owned companies; Finnminers Group (hard-rock drilling/loading and ore processing), Kemira Oy (chemicals), Outokumpu Oy (base metals and mining technology), and Rautauukki Oy (steel production), dominated the domestic mineral industry, while Government organizations, the State Geologic Research Institute and the State Technological Research Center, were active in exploration and research.

In spite of the relative scarcity of natural resources, Finland wields considerable influence on the global mining industry. Because of Outokumpu and Finnminers, Finland is a world leader in underground mining technology, ore processing, and metallurgy.

The country has a well established mineral processing and refining industry, however, the diminishing supply of indigenous metalliferous raw materials required most of the feed for smelters to be imported (100% of iron ore concentrate, 80% of zinc concentrate, and 60% of nickel matte and concentrate). There was a decline of metallic ore production while output of industrial minerals remained fairly constant. (*See table 1.*)

The major mineral resources companies are shown in table 2. The only chromite mine in Finland, Outokumpu's Kemi Mine on the coast of the Gulf of Bothnia, has estimated proven and possible ore reserves of about 70 Mt. This was the most significant chromite deposit in Europe. By the end of 1995, some 19 Mt of ore had been produced. Current output was reported to be around 1 Mt/yr.

Although it has no primary copper mines, Finland does produce copper as an associated mineral from Outokumpu's primary zinc mine at Pyhäsalmi. Expansion and modernization of Outokumpu's copper and nickel production lines, which use domestic and imported feedstock, were completed at Harjavalta and Pori and full production

reportedly was reached at yearend. The project raised blister copper capacity from 110,000 t/yr to 160,000 t/yr, cathode copper production from 70,000 t/yr to 125,000 t/yr, and nickel capacity from 18,000 t/yr to 32,000 t/yr.

Finland has never been a major gold producer although the Lapland greenstone belt in northern Finland hosts a number of gold occurrences. Outokumpu's Saattopora Mine produced 2.1 Mt of ore grading 3.3 grams per ton (g/t) gold and 0.3% copper from 1988 to mid-1995 when reserves were exhausted and the mine was closed.

Terra Mining Oy's Pahtavaara Mine was scheduled to start operation in June 1996, with a planned output of 400,000 t/yr of ore grading 3-4 g/t gold. Estimated reserves would allow for a 5 year production life. Exploration for gold was being conducted by several companies, both domestic and foreign, as well as the Geological Survey of Finland (GSF). Activity was mainly centered on the Lapland Greenstone Belt, the Archean Greenstone Belts of eastern Finland and the Svecofennian Schist Belt in the south.

The only remaining domestic nickel mine in operation in 1995 was Outokumpu's Hitura Mine. Both the Enonkoshi Mine and the Vammala mine was closed in 1994. Hitura has produced over 8 Mt ore grading 0.55% nickel and 0.20% copper since 1965.

All steel production in Finland was from imported concentrates and iron pellets. Two-thirds of the raw material came in the form of fines from Sweden's Luossavaara-Kiirunavaara AB. The balance came from Russia in the form of iron pellets from Kostamus and fines from Olenogorsk. Outokumpu Steel Oy was in the process of expanding capacity at its Tornio plant to 540 mt/a hot- and cold-rolled stainless steel at a reported price of \$340 million.

The only mine producing zinc in 1995 was Outokumpu's Pyhäsalmi Mine at Pyhajarvi. The zinc concentrate was shipped to the Kokkola smelter while the associated copper concentrates 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. Exploration in the vicinity of the existing mines led to the discovery of a small zinc deposit at Mullikkorame, just north of the Pyhäsalmi Mine.

According to GSF, Malmikaivos Oy discovered a series of kimberlite bodies in northern Finland. Malmikaivos, a subsidiary of Ashton Mining of Australia, has discovered some 30 kimberlite pipes, half of which were

diamondiferous. Two pipes, which were closely studied, were reported to contain substantial quantities of clear and colorless diamonds. A surface sample of 23 metric tons (t) was taken from a pipe with a 2 hectare (ha) area, which yielded some 26 carats per 100 t (ct/100 t), mostly of good quality. Another pipe, slightly over 1 ha, contained 13 to 26 ct/100 t based on a 9.4 t sample. Several other companies were active in diamond exploration, none of whom had issued any preliminary findings at yearend.

Finnminerals Oy was the largest producer of paper-grade talc in Europe and Finland's sole producer of talc. Previously part of the largest European paper conglomerate, UPM-Kymmene, Finnminerals was to be sold to Western Mining Corp. Holdings Ltd. of Australia (50%) and Plüss-Staufer AG of Switzerland (50%). The company also has talc slurry plants in the Netherlands and Sweden.

GSF has 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 was one of the largest energy consumers in western

Europe. Only about one-third of its energy requirements were satisfied by indigenous sources, namely, hydro and nuclear power, peat, and wood. All other energy sources, such as coal, natural gas, and petroleum were imported.

Finland had a total of 5,924 km of railroads, of which 1,445 km was electrified and 480 km had multiple tracks. Nearly 99% was state-owned and operated by the Finnish State Railways. Most of the 77,000 km of highways were in the more densely populated southern part of the country. There were about 3,700 km of inland waterways suitable for steamers. There were five major ports, Helsinki, Oulu, Pori, Rauma, and Turku.

The GSF has identified a number of mineral deposits for which information is available. The likelihood of additional discoveries may be enhanced with the entrance of foreign companies into the Finnish mineral industry. Despite recent discoveries, the future of the Finnish mineral industry rests mainly on metallurgy. As a result of the expansion of Harjavalta and Pori smelters, Outokumpu is expected to be involved in new foreign ventures to be assured a source of raw material.

TABLE 1
FINLAND: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity	1991	1992	1993	1994	1995 e/
METALS					
Aluminum metal, secondary	22,100	27,300	29,900	35,466	36,000
Cadmium metal, refined	593	590	785	876	850
Chromite:					
Gross weight:					
Lump ore e/ thousand tons	320	250	191	225	250
Concentrate e/ do.	133	229	300	341	350
Foundry sand e/ do.	20	20	20	7	10
Total do.	473	499	511	573	610
Cr₂O₃ content:					
Lump ore e/ do.	65	54	45	76	80
Concentrate do.	120	130	170	150	150
Foundry sand e/ do.	5	3	3	3	3
Total do.	190	187	218	229	233
Cobalt, metal, powder, and salts	1,503	2,100	2,150	3,000	3,610
Copper:					
Concentrate, gross weight	43,883	37,397	44,154	34,410	35,000
Mine output, Cu content	11,732	10,246	11,131 r/	13,243	12,000
Metal:					
Smelter	90,055	110,502	107,201	129,265	130,000
Refined	64,455	70,948	73,373	69,177	70,000
Gold metal kilograms	1,831	1,559	1,385	1,372	1,400
Iron and steel, metal:					
Pig iron thousand tons	2,331	2,452	2,535	2,597	2,600
Ferroalloys, ferrochromium do.	190	187	218	254	300
Steel, crude do.	2,890	3,076	3,255	3,419	3,176
Semimanufactures, rolled do.	2,480	2,300 e/	2,300 e/	3,121	3,242 2/
Lead, mine output, Pb content	1,333	576	--	--	--
Mercury	74	85	98	83	90
Nickel:					
Concentrate, gross weight	121,259	135,200	127,400	107,865	110,000
Mine output, Ni content	9,090	9,270	8,290	7,652	4,382
Metal, electrolytic	13,847	14,781	14,777	16,902	16,927 2/
Platinum-group metals: e/					
Palladium kilograms	100	100	100	96	100
Platinum do.	283	269	--	37	--
Selenium metal do.	35,200	30,000	30,400	29,690	30,000
Silver metal do.	30,322	27,168	15,896	26,098	25,000
Zinc:					
Concentrate, gross weight	108,000	59,500	42,400	41,971	42,000
Mine output, Zn content	42,552	32,817	22,529	16,916	16,000
Metal	170,398	170,523	170,934	173,200	170,000
INDUSTRIAL MINERALS					
Cement, hydraulic thousand tons	1,324	1,129	835	864	900
Feldspar	53,337	47,470	51,477	43,483	42,000
Lime e/ thousand tons	225	241 2/	250	421	350
Mica	4,693	5,134	4,488	5,591	5,000
Nitrogen, N content of ammonia	23,600	10,000 e/	10,000 e/	11,894	12,000
Phosphate rock, apatite concentrate:					
Gross weight thousand tons	472	555	628	657	650
P ₂ O ₅ content do.	171	201	227	236	235
Pyrite, gross weight do.	724	653	691	839	840
Sodium sulfate e/ do.	33	30	30	36 2/	36
Stone, crushed:					
Limestone and dolomite:					
For cement manufacture thousand tons	1,714	1,554	1,005	1,047	1,100
For agriculture do.	1,120	796	1,035	898	900
For lime manufacture do.	397	364	348	343	350
Fine powders do.	634	475	568	382	400
Metallurgical e/ do.	4	2	2	2	2
Total do.	3,869	3,191	2,958	2,672	2,752
Quartz silica sand do.	201	169	167	71	75
Soapstone do.	28	28	27	29	30

See footnotes at end of table.

TABLE 1--Continued
FINLAND: PRODUCTION OF MINERAL COMMODITIES^{1/}

(Metric tons unless otherwise specified)

Commodity	1991	1992	1993	1994	1995 e/	
INDUSTRIAL MINERALS--Continued						
Sulfur:						
S content of pyrite	do.	369	350 e/	350 e/	465	400
Byproduct:	do.					
Of metallurgy	do.	227	225	225 e/	-- r/	--
Of petroleum e/	do.	40	32	32	41 2/	40
Total	do.	636	607	607 e/	506	440
Sulfuric acid e/	do.	1,300	1,320 2/	1,300	1,084	1,200
Talc	do.	361	371	399	395	400
Wollastonite		27,844	27,842	26,796	27,757	28,000
MINERAL FUELS AND RELATED MATERIALS						
Peat:						
For fuel use	thousand tons	2,308	5,103	3,945	4,000 e/	5,000
For agriculture and other uses	do.	220	355	350	550 e/	500
Petroleum refinery products e/	thousand 42-gallon barrels	72,500	73,000	76,000	80,486 2/	80,000

e/ Estimated. r/ Revised.

^{1/}Table includes data available through May 1996.

^{2/}Reported figure.

TABLE 2
FINLAND: STRUCTURE OF THE MINERAL INDUSTRY FOR 1995

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Ammonia	Kemira Oy (Government 98%)	Plant at Oulu	75
Cadmium, metal	Outokumpu Oy (Government 40% and Insurance Co. 12.3%)	Smelter at Kokkola	1
Cement	Partek Cement Oy (Partek Corp. 50% and Metra Corp. 50%)	Plants at Lappeenranta and Pargas	1,200
Chromite	Outokumpu Oy (Government 40% and Insurance Co. 12.3%)	Mine at Kemi	730
Copper:			
Ore, Cu content	Outokumpu Oy (Government 40% and Insurance Co. 12.3%)	Mines at Pyhäsalmi, Saattopora, and Hitura	10
Metal	Do.	Smelters at Harjavalta and Pori	160
Feldspar	Lohja Oy (Metra Corp. 100%)	Mines and plants at Haapaluoma, Kemio, and Peraseinajok	50
Ferrochrome	Outokumpu Oy (Government 40% and Insurance Co. 12.3%)	Smelter at Tornio	230
Gold:			
Ore, Au content	tons Do.	Mines at Orivesi and Saattopora	4
Metal	do. Do.	Smelter at Pori	4
Limestone	Partek Minerals Oy (Partek Corp. 100%)	Mines at Kolari, Lappeenranta, and Pargas	1,900
Do.	Lohja Oy (Euroc, 100%)	Mines at Mustio and Sipoo	1,650
Do.	Rauma-Repola Oy	Mine at Turmio	300
Mercury	tons Outokumpu Oy (Government 40% and Insurance Co. 12.3%)	Smelter at Kokkola	150
Mica	Kemira Oy (Government 98%)	Mine at Siilinjarvi	10
Nickel:			
Ore, Ni content	Outokumpu Oy (Government 40% and Insurance Co. 12.3%)	Mine at Hitura	3
Metal	Do.	Smelter at Harjavalta	32
Phosphate-apatite	Kemira Oy (Government 98%)	Mine at Siilinjarvi	700
	Outokumpu Oy (Government 40% and Insurance Co. 12.3%)	Mine at Pyhäsalmi	800
Quartz and quartzite	Lohja Oy (Euroc, 100%)	Mines at Kemio and Nilsia	250
Selenium	tons Outokumpu Oy (Government 40% and Insurance Co. 12.3%)	Smelter at Pori	35
Silver	do. Do.	Do.	30
Steel	Rautaruukki Oy (Government 68.76%)	Plant at Raahe	2,100
Do.	Fundia AB (Norsk Jenverk AS of Norway 50% and Rautaruukki 50%)	Plants at Aminnefors, Dalsbruk, and Koverhar	850
Do.	Ovako Oy (SKF 50%, Wartsila 25%, and Fiskas 20%)	Plant at Imatra	600
Talc	Finminerals Oy (United Paper Mills 100%)	Mines at Lahnaslampi, Lipsavaara, Luikanlahti, and Poljivari	500
Wollastonite	Partek Minerals Oy (Partek Corp. 100%)	Mine at Lappeenranta	30
Zinc:			
Ore, Zn content	Outokumpu Oy (Government 40% and Insurance Co. 12.3%)	Mines at Pyhäsalmi and Mullikkoräme	25
Metal	Do.	Smelter at Kokkola	175