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2015 Minerals Yearbook

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The Mineral Industry of Finland

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In 2015, Finland had a highly industrialized open economy with a real GDP of about $239.2 billion at 2015 official exchange rates; this was a decrease of about 0.2% compared with that of 2014. The leading contributor to Finland's GDP was its services sector; the industrial sector accounted for only 26.9% of the country's GDP. The principal products that Finland's industrial sector produced were metals and metal products, electronics, machinery, scientific instruments, ships, and wood pulp and paper products (U.S. Central Intelligence Agency, 2017).

Finland was a member of the European Union (EU). Its main export partners were Germany (which received 13.9% of Finland's exports, in terms of value); Sweden (10.1%), the United States (7%), the Netherlands (6.6%), Russia (5.9%), the United Kingdom (5.2%), and China (4.7%). Its main import partners were Germany (which supplied 17% of Finland's imports, in terms of value), Sweden (16%), Russia (11%), the Netherlands (9.1%), and Denmark (4.1%) (U.S. Central Intelligence Agency, 2017).

Finland's mining industry was composed of the extraction and processing of metallic minerals and industrial minerals and also the production of steel. In 2015, Finland remained the leading peat producer in the world, accounting for an estimated 26% of world production. It was the leading talc producer in Europe and the ninth-ranked talc producer in the world, accounting for 4% of world production (Apodaca, 2017; Flanagan, 2017; U.S. Central Intelligence Agency, 2017).

Minerals in the National Economy

Finland had about 1,064 companies in the mining and quarrying sector, which employed about 5,476 people or about 0.2% of the total employment in the country. According to the Ministry of Employment and the Economy, Finland had 46 mines and quarries in operation in 2014. The principal facilities for the processing of copper and nickel were located at Harjavalta; those for the processing of chromite were located at Kemi, and those for the processing of zinc were located at Kokkola. Finland's deposits of chromite, cobalt, copper, iron, lead, nickel, and zinc were the foundation for the country's metal industry (Ministry of Employment and the Economy, 2015b).

Government Policies and Programs

The Government regulates Finland's mineral industry through two pieces of legislation—the Finnish Mining Act (621/2011), which governs the exploitation of metallic and industrial minerals in Finland (including soapstone and marble), and the Land Extraction Act, which governs only the extraction of gravel and sand and the quarrying of natural stone. The Finnish Mining Act regulates exploration and mining activities so that they are carried out in a socially, economically, and ecologically sustainable way. The act ensures that the concerns of environmental, civil rights, and landowning stakeholders are taken into account and that these stakeholders are included in the decision-making process for the exploration for and development of any mining projects. The act also takes other Finnish legislation into account in its application, in particular Finland's Constitution and legislation concerning the Sami regions in northern Finland. Mining operators are subject to a number of permits. Under the Mining Act (the most recent revision of which became effective on July 1, 2011), the right to exploit a deposit is based on a mining permit (which requires a more comprehensive review than under the previous version of the Mining Act) and the mining operator is required to provide a security deposit for the purpose of fulfilling termination and after-care obligations (these obligations are also more extensive than under the previous version of the Mining Act). The Finnish Safety and Chemicals Agency (Tukes) is the organization that grants and supervises the permits that are required by the Mining Act. Additional legislation provides guidelines and regulates the environmental impact of the mineral industry by requiring several types of permits that are necessary for mineral extraction in the country (Ministry of Employment and the Economy, 2011, 2015a).

Production

Finland produced mostly base metals, gold, and platinum-group metals, as well as industrial minerals. The production of mineral commodities continued to be significant in terms of tonnage and contribution to the country's economy. In 2015, mine output of nickel decreased by 51% and mine output of zinc decreased by 45%. Production of refined cobalt decreased by 23%; feldspar, by 18%; chromite, 8.6%; platinum, 6.4%; silver, 4.7%; smelter copper, 3%; and copper ore (Cu content), 2.3%. Gold mine production increased by 9.6% and that of pig iron increased by 4.8%; steel production increased by 4.7%. Data on mineral production are in table 1.

Structure of the Mineral Industry

Finland's mineral industry consists of the following two types of companies: (a) small quarry and sand and gravel pit operators, and (b) a group of large companies that operate international metal and industrial mineral production facilities and mines in Finland and abroad (United Nations, 2015, p. 1). Finland's mining companies were mostly privately owned, although the Government held an equity position in some of the major mineral producers. The mineral industry operated on a free-market basis. The country's major mineral facilities and their annual capacities are listed in table 2.

In 2015, Outokumpu Oyj (Outokumpu) and Rautaruukki Oyj (Ruukki) were Finland's two leading metal manufacturers, particularly steel and stainless steel. Ruukki was owned by Swedish steelmaker Svenskt Stål AB (SSAB) and Outokumpu

was part owned by the Government of Finland. Outokumpu operated the Kemi chromite mine in Lapland and, besides steel, produced cadmium and ferroalloys. Outokumpu also had operations in Germany, Mexico, Sweden, the United Kingdom, and the United States.

Mondo Minerals Oy (Mondo) of the Netherlands and Nordkalk Corp. (Nordkalk) were two of the principal industrial mineral producers in Finland. Mondo, which was a subsidiary of Advent International Corp. of the United States, was the second-ranked producer of talc, by quantity produced, in the world. Mondo had its main mine and processing facilities in Sotkamo and Vuonos (Mondo Minerals Oy, 2016a, b).

Nordkalk was a leading international producer of concentrated calcite, crushed and ground limestone, dolomite, limestone, quicklime, and slaked lime as well as wollastonite, which Nordkalk extracted as a byproduct of mining for limestone. In Finland, Nordkalk had mines in Lappeenranta and Parainen. All told, Nordkalk had mines in five countries and operations in 30 locations in nine countries (Nordkalk Corp., 2016).

First Quantum Minerals Ltd. (First Quantum) of Canada owned the Pyhasalmi polymetallic mine. Finland is one of the few countries in Europe where copper was still mined (First Quantum Minerals Ltd., 2016).

Commodity Review

Metals

Chromium.—Outokumpu, which was the owner and operator of the Kemi chromite mine in Lapland (and the only chromite mine in the EU), increased its estimates of the proved reserves of the mine to 50.1 million metric tons (Mt) in 2014 from the previous estimate of about 33 Mt. This increase was based on new underground drillings made below the old Surmaoja open pit. Outokumpu indicated that it had made a new excavation plan and had started preparations for underground production in the Surmaoja ore body, with a target date to begin the ore excavation of 2015. The company's chromite mine production decreased by about 8.6% in 2015 compared with that of 2014, however, and an update on the status of the excavations was not available. The company stated that the mineral resources of the Kemi Mine were 97.8 Mt and that the grade of the mineral resources was 29.4% Cr_2O_3, and the grade of the reserves was 26.0% Cr_2O_3. The mineral resources had been estimated to a depth of 1 kilometer. Outokumpu used the chromium to produce ferrochromium for the production of stainless steel at its plant in Tornio (Outokumpu Oyj, 2014).

Copper.—In 2015, Boliden AB of Sweden's copper complex in Finland consisted of two plants—the copper smelter in Harjavalta, which produced copper anodes, and the copper refinery at Pori, where copper anodes were refined into copper cathodes. The complex was known as Boliden Harjavalta. In 2015, the Harjavalta complex processed 528,000 metric tons (t) of copper concentrates, including imported concentrates. The capacity of the Harjavalta smelter was 210,000 metric tons per year (t/yr) of copper anodes and that of the Pori refinery was 155,000 t/yr of copper cathodes. The refinery also produced gold, selenium, and silver as byproducts (Boliden AB, 2017).

In 2015, First Quantum's Pyhasalmi Mine produced copper-gold-zinc ore and its Kevitsa Mine produced principally copper-nickel-gold-platinum-palladium ore. In 2015, the Kevitsa Mine produced about 17,204 t of copper content, which was a decrease of about 2% compared with that of 2014, and the Pyhasalmi Mine produced about 12,046 t, which was about a 15% decrease; these decreases in production were likely the result of operational slowdowns and the lower price of copper than in the previous year (First Quantum Minerals Ltd., 2016).

Gold.—Gold production in Finland increased by about 9.6% in 2015 as a result of the increase in the gold content of the polymetallic copper ores as well as the increase in the processing capacity at the Kittila mill that was implemented in 2014. Agnico Eagle Mines Ltd. of Canada, which owned and operated the Kittila Mine and mill in Lapland, had conducted ongoing exploration at the mine since 2010 and had increased the reserves and resources of the mine each year during that time. In 2015, the company discovered a new zone of mineralization, called the Sisar zone. The company stated that the Sisar zone was located to the east of the main Kittila Mine ore zone and was in close proximity to the existing underground infrastructure. The company expected that the Sisar zone would provide an additional source of underground ore to the Kittila mill with little additional development, provided that the results of the drillings show an economically viable deposit. The company reported an initial inferred mineral resource of 3.4 Mt grading 5.91 grams per metric ton gold, or approximately 646,000 troy ounces of gold (Agnico Eagle Mines Ltd., 2017).

Industrial Minerals

Limestone.—Nordkalk was a leading producer of limestone and limestone-based products in the world. Nordkalk's largest production site in Finland was located in Lappeenranta. At this site, Nordkalk had a quarry, a grinding plant, two flotation plants, and a lime kiln. Nordkalk employed about 151 workers in 2015 and produced mostly limestone, limestone powder, and wollastonite. Suomen Karbonaatti Oy—a subsidiary of Nordkalk also located in Lappeenranta—produced carbonate fillers and coating pigments (Nordkalk Corp., 2016).

Talc.—Mondo was a significant producer of talc in the world. In 2015, it produced an estimated 332,000 t of talc concentrate. Mondo indicated that the talc ore found in Finland is a mixture of magnesite and talc, so that a separating process had to be applied to the ore (table 1; Mondo Minerals Oy, 2016a, b).

Outlook

Given the increased interest in rare-earth minerals, exploration continues in areas of Finland that had previously produced these minerals but had stopped production. Owing to continued economic and technical feasibility issues in mining for rare-earth minerals, however, copper, gold, nickel, and silver will continue to be the most significant mineral commodities produced in Finland, as is evident in the ongoing expansion of the country's polymetallic production projects. As outlined in the Finnish Government Program for 2011–15, Government measures to promote the development and sustainable growth of the mineral industry have increased private investment in the

mining sector, although by how much was still not clear. Market prices are likely to be the determining factor in whether expansion of Finland's mineral industry continues in the long run.

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TABLE 1
FINLAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Thousand metric tons unless otherwise specified)

Commodity		2011	2012	2013	2014	2015
METALS						
Aluminum, metal, secondary	metric tons	19,531	19,530	20,768	20,829	20,225
Chromite, Cr_2O_3 content		693	425	982	1,035	946
Cobalt, refined	metric tons	10,441	10,547	10,798	12,551	9,615
Copper:						
Concentrate, gross weight	do.	47,802	104,393	145,758	163,016	165,021
Mine output, Cu content	do.	14,000	25,500	38,800	42,800	41,805
Metal:						
Smelter	do.	128,400 r	133,300 r	139,800 r	150,500 r	145,900
Refined	do.	122,100 r	125,500 r	125,100 r	140,600 r	138,900
Gold, mine output, Au content	kilograms	8,461	10,886	9,981	9,385	10,286
Iron and steel, metal:						
Ferroalloys, ferrochromium		231	288	434	441	457
Pig iron	metric tons	2,500	2,130	2,050	2,475	2,594
Steel, crude		3,985	3,759	3,517	3,807	3,988
Nickel:						
Mine output, Ni content	metric tons	18,800	19,100	19,300	19,281 r	9,382
Metal, electrolytic	do.	49,823	39,374	44,498	42,750	43,594
Platinum	kilograms	836	429	946	1,060	992
Selenium, metal	do.	88,231	92,769	72,459	93,682	93,051
Silver, metal	do.	69,344	128,200	100,890	142,360	135,720
Zinc:						
Mine output, Zn content	metric tons	64,115	52,303	40,956	46,063 r	25,332
Metal	do.	307,352	314,742	311,686	302,024	305,717

See footnotes at end of table.

TABLE 1—Continued
FINLAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Thousand metric tons unless otherwise specified)

Commodity		2011	2012	2013	2014	2015
INDUSTRIAL MINERALS						
Cement, hydraulic		1,387	1,293	1,400	1,400	1,300 e
Feldspar	metric tons	26,292	43,124	47,636	46,233	38,026
Lime		456	450	450	460	460 e
Mica:						
Biotite		32	27	42	41	38
Concentrate	metric tons	12,896	12,112	11,244	11,973	11,836
Nitrogen, N content of ammonia	do.	72,352	78,000	78,000	78,000	78,000 e
Phosphate rock, apatite, concentrate:						
Gross weight		870	858	877	946	957
P_2O_5 content[e]		307	302	309	330	333
Pyrite, gross weight		939	993	990	1,036 r	1,040
Sodium sulfate		4	--	--	--	--
Stone, crushed:						
Limestone and dolomite		2,351	2,351	2,351	3,692 r	3,130
Quartz, silica sand		312	257	260	260	198
Sulfur:						
S content of pyrite		338 e	330 e	330 e	554 r	556
Byproduct:[e]						
Metallurgy[2]		280	280	280	280	280
Petroleum		133 [2]	130	130	130	130
Total		413	410	410	410	410
Sulfuric acid		887	975	975	975	343
Talc		429	396	362	380	332
Wollastonite	metric tons	11,500	11,500	11,500	11,500	11,500
MINERAL FUELS AND RELATED MATERIALS						
Peat:						
For fuel use		6,847	5,824	6,800	6,800	16,328
For agriculture and other uses		674	676	670	670	13,200
Petroleum refinery products	thousand 42-gallon barrels	90,686	106,033	109,500	106,508 r	106,500 e

[e]Estimated; estimated data are rounded to no more than three significant digits; may not add to totals shown. [r]Revised. do. Ditto. -- Zero.
[1]Table includes data available through August 10, 2016.
[2]Sulfur content in sulfuric acid.

TABLE 2
FINLAND: STRUCTURE OF THE MINERAL INDUSTRY IN 2015

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Ammonia	Kemira Oyj (Government, 98%)	Plant at Oulu	75
Apatite	Kemira Agro Oyj (Government, 98%)	Mine and plant at Siilinjarvi	8,000
Cadmium, metal	Outokumpu Oyj (Government, 40%, and private investors, 12.3%)	Smelter at Kokkola	1
Cement	Finncement Oy (Irish Cement Ltd., 100%)	Plants at Lappeenranta and Parainen	1,020
Chromite	Outokumpu Oyj (Government, 40%, and private investors, 12.3%)	Mine at Kemi	1,000
Cobalt	Norilsk Nickel Harjavalta (MMC Norilsk Nickel, 100%)	Plant at Kokkola	15
Copper:			
Ore, Cu content	First Quantum Minerals Ltd.	Mine at Pyhasalmi	18
Do.	do.	Mine at Kevitsa	20
Do.	Boliden Kylylahti AB (Boliden AB, 100%)	Mine at Kylylahti	12
Metal	Boliden Harjavalta AB (Boliden AB, 100%)	Smelter at Harjavalta	210
Do.	do.	Refinery at Pori	155
Feldspar	SP Minerals Oyj (Partek Corp., 50.1%, and SCR-Silbeco SA, 49.9%)	Mine and plant at Kemi	50
Ferrochrome	Outokumpu Oyj (Government, 40%, and private investors, 12.3%)	Smelter at Tornio	250

See footnotes at end of table.

TABLE 2—Continued
FINLAND: STRUCTURE OF THE MINERAL INDUSTRY IN 2015

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Gold:				
Ore, Au content	metric tons	Agnico-Eagle Mines Ltd.	Mine at Kittila	5
Do.	do.	Dragon Mining Ltd.	Mines at Orivesi and Jokisivu	4
Do.	do.	Lappland Goldminers AB.	Pahtavaara Mine near Sodankyla	2
Do.	do.	Boliden Kylylahti AB (Boliden AB, 100%)	Mine at Kylylahti	1
Do.	do.	First Quantum Minerals Ltd.	Mines at Kevitsa and Pyhasalmi	1
Metal	do.	Boliden AB	Smelter at Pori	4
Limestone		Nordkalk Corp. (Rettig Group, 100%)	Mines at Lappeenranta and Parainen	1,500
Do.		Rauma-Repola Oyj	Mine at Tornio	300
Mercury	metric tons	Outokumpu Oyj (Government, 40%, and private investors, 12.3%)	Smelter at Kokkola	150
Mica		Kemira Oyj (Government, 98%)	Mine at Siilinjarvi	10
Nickel:				
Ore, Ni content		Belvedere Resources Ltd.	Mine at Hitura	30
Do.		Terrafame Oy	Mine at Sotkamo	20
Metal		Norilsk Nickel Finland (MMC Norilsk Nickel, 100%)	Smelter at Harjavalta	32
Do.		do.	Refinery at Harjavalta	50
Petroleum products	thousand 42-gallon barrels per day	Neste Oyj, 50%, and Government, 50%	Plants at Naantali and Porvoo	250
Phosphate-apatite		Yara International ASA.	Mine at Siilinjarvi	850
Quartz and quartzite		SP Minerals Oyj (Partek Corp., 50.1%, and SCR-Silbeco SA, 49.9%)	Mines at Kemi and Nilsia	250
Selenium	metric tons	Boliden AB	Smelter at Pori	35
Silver	do.	do.	do.	130
Steel:				
Crude		Rautaruukki Oyj (Government, 39.7%, and Svenskt Stål AB (SSAB), 41.3%)	Plants at Hameenlinna, Kankaanpaa, and Raahe	2,100
Do.		Fundia AB (Norsk Jenverk AS of Norway, 50%, and Ovako AB, 50%)	Plants at Aminnefors, Dalsbruk, and Koverhar	850
Do.		Ovako AB (Triton Adviser Ltd. ,100%)	Plant at Imatra	300
Stainless		Outokumpu Oyj (Government, 40%, and private investors, 12.3%)	Plant at Tornio	550
Talc		Mondo Minerals Oyj (Advent International Corp., 100%)	Mines at Lahnaslampi, Lipsavaara, and Horsmanaho	500
Wollastonite		Nordkalk Corp. (Rettig Group, 100%)	Mine and plant at Lappeenranta	40
Zinc:				
Ore, Zn content		First Quantum Minerals Ltd.	Mine at Pyhasalmi	25
Do.		Boliden Kylylahti AB (Boliden AB, 100%)	Mine at Kylylahti	2
Metal		Boliden AB	Smelter at Kokkola	315

Do., do. Ditto.