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The Mineral Industry of Finland

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In 2016, Finland, which was a member of the European Union (EU), had a highly industrialized open economy with a real gross domestic product (GDP) of about $240 billion[1] compared with approximately $233 billion (revised) in 2015. The leading contributor to Finland's GDP in 2016 was the services sector; followed by the industrial sector, which accounted for 27.2% of the country's GDP. The principal products that Finland's industrial sector produced in 2016 were chemicals, electronics, machinery, metals and metal products, scientific instruments, ships, and wood pulp and paper products (Statistics Finland, 2017a; U.S. Central Intelligence Agency, 2018).

In 2016, Finland was the leading producer of peat and mica in the world, with approximately 29% and 21% of the world's production, respectively. Finland was also a leading producer of selenium, ranking eighth in the world with about 3% of the world's production (Anderson, 2018; Apodaca, 2018a, b; Jasinski, 2018).

Minerals in the National Economy

In 2016, about 6,000 people were employed in Finland's mining and quarrying sector, which represented about 0.2% of the total labor force in the country. The mining and quarrying sector contributed about 0.4% to the country's total GDP, and the construction and manufacturing sectors contributed 6.8% and 16.9%, respectively. In 2016, the total inward foreign direct investment (FDI) was valued at $119.4 billion, from which about $270 million was invested in the mining sector (Statistics Finland, 2017a; 2018a, b; Vasara, 2018, p. 25).

The majority of investments in Finland's mining sector came from international sources. According to the Ministry of Economic Affairs and Employment, Finland's allocation of domestic capital to fund the mining sector and related activities was limited. The role of the Government of Finland in mineral exploration decreased significantly in the 2000s. As of 2016, the only Government agency that participated in exploration activities was the Geological Survey of Finland (GTK). Regarding exploration, the GTK focused on assessing and modeling potential ore-rich areas (Vasara, 2018, p. 10, 28).

Industrial minerals were, for the most part, extracted and processed domestically, whereas small amounts of metallic ores were transported for refining in other parts of Europe and Asia. The Government of Finland, in conjunction with mining companies, provided support for infrastructure projects, such as roads and railways that were built as part of developing mining projects. In 2016, chromium concentrate was one of only a few mineral commodities for which production was sufficient to meet domestic demand, while the production of sulfur concentrate exceeded domestic demands. The country's degree of self-reliance for nickel was 42%; for copper, 31%; and for zinc, 14% (Vasara, 2018, p. 21, 25–26).

Government Policies and Programs

The Government of Finland regulates its mineral industry through the Finnish Mining Act (621/2011, effective on July 1, 2011), which regulates the mining of metallic and industrial minerals in the country, and the Land Extraction Act (555/1981, effective on July 24, 1981), which regulates only the extraction of sand and gravel and the quarrying of natural stone. The Mining Act enables exploration and mining-related activities and regulates them so that they are carried out in an ecologically, economically, and socially sustainable way. The act ensures that, in the development and exploration of any mining projects, civil rights and environmental and landowner concerns are included in the decisionmaking process. The Mining Act also takes other legislations into account, such as Finland's Constitution and legislation concerning the Sami regions in northern Finland. The Ministry of Economic Affairs and Employment is responsible for the development, general guidance, and monitoring of activities under the Mining Act. The Finnish Safety and Chemicals Agency (TUKES) acts as the mining authority that enforces compliance with the Mining Act, and grants and supervises all permits required by the Mining Act. The Government decides on matters related to the redemption permits for a mining area and on mining permits concerning the production of thorium and uranium (Finlex Data Bank, 1981, 2011).

Production

Finland produced mostly base metals, gold, and platinum-group metals, as well as industrial minerals. In 2016, increases in the production of the following commodities were reported: mica, by 342%; nickel (mine production, Ni content), 120%; zinc (mine production, Zn content), 81%; nickel (metal), 41%; refined cobalt, 29%; platinum, 19%; copper (gross weight), 17%; palladium, 15%; copper (Cu content), 14%; chromium (gross weight and Cr_2O_3 content) and limestone, 13% each. Decreases in production were reported for biotite, which decreased by 71%; feldspar, 51%; pyrite (gross weight and sulfur content), 31% each; silver (mine production), 13%; quartz silica, 11%; and primary smelted copper, 10%. Data on mineral production are in table 1.

Structure of the Mineral Industry

Finland's mining industry was engaged in the extraction and processing of industrial and metallic minerals as well as the production of steel. Foreign enterprises own the majority of the metallic mineral mines in the country, although the Government held an equity position with some of the major mineral producers. In 2016, metallic ores were mined from

[1]Where necessary, values have been converted from euro area euros (EUR) to U.S. dollars (US$) at an annual average exchange rate of EUR0.90=US$1.00 for 2016 and EUR0.90=US$1.00 for 2015.

34 operations in Finland, and industrial minerals were extracted from 27 mines. According to the Ministry of Economic Affairs and Employment, not all industrial mineral facilities were active in any given year (Vasara, 2018, p. 10, 12–13).

The Finnish mining and quarrying sector comprised about 970 companies. The mineral industry consists of two types of companies: (a) small quarry and sand and gravel pit operators, and (b) large companies that operate metallic and industrial mineral facilities and mines in Finland and abroad. The principal facilities for the processing of copper and nickel were located at Harjavalta in the Satakunta region, those for the processing of chromium were located at Kemi, and those for the processing of zinc were located at Kokkola in the Central Ostrobothnia region (United Nations, 2015, p. 1; Statistics Finland, 2018b).

Mondo Minerals B.V. (Mondo) of the Netherlands and Nordkalk Corp. (Nordkalk) were two of the principal industrial mineral producers in Finland. Mondo had its main mine and processing facilities in Sotkamo, Kainuu region, and in Vuonos in southeastern Finland. In Finland, Nordkalk had mines at Lappeenranta in the South Karelia Region, and in Parainen and southern Finland (Mondo Minerals B.V., 2018; Nordkalk Corp., 2018).

First Quantum Minerals Ltd. (First Quantum) of Canada owned the Pyhasalmi polymetallic mine. Outokumpu Oyj (Outoumpu) and Rautaruukki Oyj (Ruukki) were the leading companies in Finland in the metals manufacturing industry, in particular steel and stainless steel. OutoKumpu and Ruuki were partly owned (40% and 39.7%, respectively) by the Government. OutoKumpu operated the Kemi chromium mine in Lapland, and also produced cadmium, ferroalloys, and steel. The country's major mineral facilities and their annual capacities are listed in table 2.

Mineral Trade

In 2016, the country's total exports were valued at $57.6 billion compared with about $59.9 billion in 2015; the total value of imports was $61.1 billion compared with $60.5 billion in 2015. The country's top products exported in 2016 included chemicals, electronics, machinery and equipment, and metals and metallic products; the top imported products included chemicals, electronics, machinery, transportation equipment, and mining and quarrying products. Finland's leading export partners were Germany (which received 13.1% of Finland's exports), Sweden (10.7%), the United States (7.6%), the Netherlands (6.7%), Russia (5.7%), and China (5.2%). Finland's leading import partners were Germany (which supplied 14.9% of Finland's imports), Russia and Sweden (11.2% each), China (7.4%), the Netherlands (6.1%), and France (4.1%) (Statistics Finland, 2017b).

Commodity Review

Metals

Copper.—In 2016, copper production (mine output, Cu content) in the country totaled 48,000 metric tons (t), which was an increase of about 14% compared with 42,000 t produced in 2015. On June 1, Boliden Mineral AB (Boliden) of Sweden acquired all the shares from First Quantum pertaining to the Kevitsa Mining Oy (Kevitsa) and its subsidiary FinnEx Oy. Kevitsa (a copper-nickel open pit mine located in northern Finland) started operations in 2012 and produced concentrates containing copper, gold, nickel, palladium, and platinum. The acquisition provided a stable supply of copper and nickel to Boliden's Harjavalta smelter, which was located in the southern part of the country. The Harjavalta smelter was considered a small-sized copper smelter in terms of production tonnage, although it was considered the largest nickel smelter in the region. The smelter also produced gold, silver, and sulfuric acid as byproducts. Additionally, Boliden owned and operated the Kylylahti polymetallic mine (acquired in 2014), from which metal concentrates of copper, gold, and zinc were processed mainly at the Harjavalta smelter (Boliden AB, 2017, p. 7, 14, 22–24, 84).

In 2016, First Quantum owned and operated the polymetallic operations of the Pyhasalmi Mine. In 2016, the Pyhasalmi underground mine, which is located in central Finland, produced 14,795 t of copper, 490,480 t of pyrite, and 20,800 t of zinc. The company expected the Pyhasalmi Mine to reach its last full year of operation in 2018 owing to depletion of the ore. The company forecasted production in 2018 of 10,000 t of copper, 15,000 t of zinc, and 700,000 t of pyrite (First Quantum Minerals Ltd., 2017).

Gold.—In 2016, the production of gold in Finland totaled 8,865 kilograms (kg), which was an increase of about 7.6% compared with 8,242 kg (revised) produced in 2015. In November, Dragon Mining Ltd. (Dragon) of Australia received permission from the Government to process ore from the Kaapelinkulma gold mine located in Vammala, southern Finland. The Kaapelinkulma Mine, which would become Dragon's third gold mine in the country, had already received the environmental permits and the mining concession. The company, which had two other gold mines located at Jokisivu and Orivesi, projected that the Kaapelinkulma Mine would begin operations in 2017 and expected approximately 160,000 metric tons per year of ore to be mined (Dragon Mining Ltd., 2017, p. 5, 7, 11).

In November 2016, Rupert Resources Ltd. of Canada announced that it had completed the acquisition of the Pahtavaara gold mine, the mill, and the exploration permits at a cost of $2.5 million. The mine, which has been in production for about 15 years, is located in the central Lapland gold belt in Finland (Rupert Resources Ltd., 2016).

Nickel.—In 2016, the production of nickel increased significantly to 20,654 t of mine production, which represented an increase of 120% from the 9,383 t (revised) produced in 2015. On June 30, Terrafame Ltd. announced the completion of assets acquisition for the Talvivaara polymetallic mine. The mine, which produced nickel and zinc, is located in Sotkamo, Kainuu Region, and was formerly owned by Talvivaara Mining Co. Plc. The first full year of production for the Talvivaara Mine was 2016. Production was 9,554 t of nickel compared with 578 t of nickel in 2015 (Terrafame Ltd., 2016a, b; 2017).

Zinc.—In 2016, production of zinc increased by 81% to 45,852 t of mine production from 25,332 t (revised) in 2015. The Talvivaara Mine, which completed a full year of production in 2016, had output of 22,575 t of zinc compared with 1,812 t of zinc produced in 2015. Smelter zinc production totaled 290,599 t

in 2016, which was a decrease of about 5% compared with the 305,717 t produced in 2015. In 2016, Boliden also owned and operated the Kokkola zinc smelter, which produced zinc and zinc alloys as well as silver concentrate and sulfuric acid. The majority of the zinc concentrate that was fed into the Kokkola smelter came from Boliden mines located in Finland, Ireland, and Sweden (Terrafame Ltd., 2016a, b; Boliden AB, 2017, p. 23).

Industrial Minerals

Limestone.—Nordkalk's largest production site in Finland was located in Lappeenranta. At this location, Nordkalk had a quarry, a grinding plant, and two flotation plants. In 2016, Nordkalk employed about 150 workers and produced mainly limestone and limestone powder (Nordkalk Corp., 2018).

Outlook

The production of metallic mineral commodities, such as copper, gold, nickel, and zinc, will most likely continue to be the most significant commodities in Finland's mineral industry. The increase in production of these commodities during 2016 was in part a result of new facilities, such as the Talvivaara Mine, coming on line. Another mine that will most likely contribute to the increase in metallic production in the near future is the Kaapelinkulma gold mine. First Quantum expects its Pyhasalmi Mine to be depleted after 2018, however, which could affect Finland's total production of metals after 2018. Foreign direct investments in the mining sector along with world market prices of commodities could determine 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, gross weight, unless otherwise specified)

Commodity[2]		2012	2013	2014	2015	2016
METALS						
Aluminum metal, secondary	metric tons	19,530	20,768	20,829	-- [r]	--
Chromium, mine, chromite, concentrate	do.	425,217	981,752	1,034,750	946,188	1,070,281
Cobalt, Co content:						
Mine production	do.	1,381	2,061	2,104	2,119	2,308
Refinery production	do.	10,562 [r]	10,798	12,551	9,615	12,393
Copper:						
Mine production, concentrate:						
Gross weight		104	146	163	165	193
Cu content		26	39	43	42	48
Refinery production, Cu content:						
Primary		127 [r]	121 [r]	132 [r]	128 [r]	132
Secondary	metric tons	4,000	3,700	4,000	4,000 [e]	4,000 [e]
Smelter production, Cu content:						
Primary		150 [r, e]	155 [r, e]	169 [r, e]	167 [r, e]	150
Secondary	metric tons	4,000 [r, e]	3,700 [r, e]	4,000 [r, e]	4,000 [r, e]	4,000
Ferrochromium		229 [r]	434	441	457	470
Gold, mine production, metal, Au content	kilograms	10,886	9,981	9,385	8,242 [r]	8,865
Iron and steel:						
Pig iron	metric tons	2,130,000	2,050,000	2,475,000	2,594,000	2,670,000 [e]
Raw steel		3,759	3,517	3,807	3,988	4,102
Nickel, Ni content:						
Mine production, undifferentiated or other	metric tons	19,590 [r]	19,440 [r]	18,730 [r]	9,383 [r]	20,654
Intermediate production, matte	do.	12,915	8,662	8,363	17,000	17,000 [e]
Chemicals	do.	6,144	4,700	6,100	7,365	7,500 [e]
Metal	do.	40,131	39,500	36,500	60,709 [r]	85,424
Platinum-group metals, mine production, primary:						
Palladium, Pd content	kilograms	1,100 [e]	1,100 [e]	902	784	901
Platinum, Pt content	do.	429	946	1,060	992	1,178
Selenium, metal	do.	92,769	72,459	93,682	93,051	104,420
Silver, mine production, Ag content	do.	128,200	100,890	148,011 [r]	135,720	118,180
Zinc:						
Mine production, Zn content	metric tons	52,303	40,956	43,000 [r, e]	25,332	45,852
Smelter production, primary	do.	314,742	311,686	302,024	305,717	290,599
INDUSTRIAL MINERALS						
Cement, hydraulic		1,293	1,300 [r, e]	1,250 [r, e]	1,300 [e]	1,300 [e]
Feldspar, mine production	metric tons	43,124	47,636	46,233	38,026	18,549
Lime[e]		450	450	460	470 [r]	470
Mica:						
Biotite		27	42	42 [r]	38 [r]	11
Concentrate	metric tons	12,112	11,244	11,973	11,836	52,310
Nitrogen, ammonia, N content	do.	78,000	78,000	78,000	78,000	78,000 [e]
Phosphate rock, apatite, concentrates:						
Gross weight		858	877	946	957	940
P_2O_5 content[e]		310 [r]	320 [r]	350 [r]	350 [r]	340
Stone, crushed:						
Limestone, including dolomite		2,351	2,351	3,692	3,130	3,539
Unspecified, quartz silica sand		111 [r]	90 [r]	88 [r]	104 [r]	93
Sulfur compounds, sulfuric acid		750 [r, e]	750 [r, e]	1,722 [r]	1,760 [r]	1,768
Sulfur:						
Byproduct, S content:						
Metallurgy		330	316	336	336	340
Petroleum		122	130 [e]	130 [e]	130 [e]	130
Pyrite:						
Gross weight		993	990	990	1,040 [r]	719
S content[e]		375 [r]	347 [r]	353 [r]	556	384

See footnotes at end of table.

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

(Thousand metric tons, gross weight, unless otherwise specified)

Commodity[2]		2012	2013	2014	2015	2016
INDUSTRIAL MINERALS—Continued						
Talc		396	362	380	332	346
Wollastonite	metric tons	11,500	11,500	11,500	-- [r]	--
MINERAL FUELS AND RELATED MATERIALS						
Peat:						
Fuel use		5,824	6,800	6,800	8,800 [r]	6,800 [e]
Horticultural use, including other uses		676	670	670	920 [r]	670 [e]
Petroleum, refinery production	thousand 42-gallon barrels	106,033	109,500	106,508	106,500 [e]	107,000 [e]

[e]Estimated. [r]Revised. do. Ditto. -- Zero.

[1]Table includes data available through March 15, 2018. All data are reported unless otherwise noted. Estimated data are rounded to no more than three significant digits.

[2]In addition to the commodities listed, sodium sulfate may have been produced in Finland, but available information was inadequate to make reliable estimates of output.

TABLE 2
FINLAND: STRUCTURE OF THE MINERAL INDUSTRY IN 2016

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
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
Chromium		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
Do.		Boliden Kylylahti AB (Boliden Mineral AB, 100%)	Mine at Kylylahti	NA
Copper:				
Ore, Cu content		First Quantum Minerals Ltd.	Mine at Pyhasalmi	18
Do.		Boliden Kevitsa Mining Oy (Boliden Mineral AB, 100%)	Mine at Kevitsa	20
Do.		Boliden Kylylahti AB (Boliden Mineral AB, 100%)	Mine at Kylylahti	12
Do.		Terrafame Group Oy	Mine at Talvivaara, Sotkamo	NA
Metal		Boliden Harjavalta AB (Boliden Mineral 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 Kemio	50
Ferrochromium		Outokumpu Oyj (Government, 40%, and private investors, 12.3%)	Smelter at Tornio	250
Gold:				
Ore, Au content	metric tons	Agnico-Eagle Mining Ltd.	Mine at Kittila	6
Do.	do.	Boliden Kylylahti AB (Boliden Mineral AB, 100%)	Mine at Kylylahti	1
Do.	do.	Dragon Mining Ltd.	Mines at Orivesi and Jokisivu	4
Do.	do.	Endomines AB	Mine at Pampalo, Ilomantsi	NA
Do.	do.	Boliden Mineral AB	Mines at Kevitsa and Pyhasalmi	1
Do.	do.	Rupert Resources Ltd.	Pahtavaara Mine near Sodankyla	2
Metal	do.	Boliden Mineral AB	Smelter at Harjavalta and refinery at Pori	4

See footnotes at end of table.

TABLE 2—Continued
FINLAND: STRUCTURE OF THE MINERAL INDUSTRY IN 2016

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Iron ore		First Quantum Minerals Ltd.	Mine at Pyhasalmi	NA
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.		Boliden Kylylahti AB (Boliden Mineral AB)	Mine at Kylylahti	NA
Do.		Boliden Kevitsa Mining Oy (Boliden Mineral AB)	Mine at Kevitsa	NA
Do.		Terrafame Group Oy (Terrafame Ltd.)	Mine at Talvivaara, Sotkamo	20
Metal		Boliden Kylylahti AB (Boliden Mineral AB)	Plant at Kaavi	NA
Do.		Boliden Harjavalta AB	Smelter at Harjavalta	NA
Do.		Norilsk Nickel Finland (MMC Norilsk Nickel, 100%)	do.	32
Do.		do.	Refinery at Harjavalta	50
Nitrogen, ammonia, N content		Kemira Oyj (Government, 98%)	Plant at Oulu	75
Petroleum products	thousand barrels per day	Neste Oyj, 50%, and Government, 50%	Plants at Naantali and Porvoo	250
Phosphate, apatite		Kemira Agro Oyj (Government, 98%)	Mine and plant at Siilinjarvi	8,000
Do.		Yara International ASA	Mine at Siilinjarvi	850
Platinum-group metals		Boliden Kevitsa Mining Oy (Boliden Mineral AB, 100%)	Mine at Kevitsa, Sodankyla	NA
Quartz and quartzite		SP Minerals Oyj (Partek Corp., 50.1%, and SCR-Silbeco SA, 49.9%)	Mines at Kemio and Nilsia	250
Selenium	metric tons	Boliden Mineral AB	Refinery at Pori	35
Silver	do.	do.	Smelter at Harjavalta and refinery at Pori	130
Steel:				
Raw		Rautaruukki Oyj (Government, 39.7%, and SSAB AB, 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
Stone:				
Dolomite		Juuan Dolomiittikalkki Oy	Mine at Paltamo, Reetinniemi	NA
Do.		SMA Mineral AB	Mine at Pieksamaki and Tornio	NA
Limestone		Nordkalk Corp. (Rettig Group, 100%)	Mines at Lappeenranta and Parainen	1,500
Do.		Rauma-Repola Oyj	Mine at Tornio	300
Sulfur		First Quantum Minerals Ltd.	Mine at Pyhasalmi	NA
Do.		Boliden Mineral AB	Smelter at Harjavalta	NA
Talc		Mondo Minerals BV (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 Mineral AB, 100%)	Mine at Kylylahti	2
Do.		Terrafame Group Oy	Mine at Talvivaara, Sotkamo	NA
Metal		Boliden Mineral AB	Smelter at Kokkola	315

Do., do. Ditto. NA Not available.