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The Mineral Industry of Finland

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In 2012, Finland's real gross domestic product (GDP) measured in terms of purchasing power parity was $200.7 billion, which was a decrease of 0.2% from that of 2011. The leading contributor to Finland's GDP in 2012 was its services sector; industry accounted for 27.1% of the country's GDP. The principal products that Finland's industrial sector produced in 2012 were electronics, metal and metal products, paper products, scientific instruments, ships, and wood pulp. Finland was a member of the European Union (EU). Its main export partners were Sweden (which received 11.1% of Finland's exports, in terms of value), Russia (9.9%), Germany (9.4%), the Netherlands (6.4%), the United States (6.1%), the United Kingdom (5.1%), and China (4.6%). Its main import partners were Russia (which supplied 17.8% of Finland's imports, in terms of value), Sweden (14.8%), Germany (13.9%), the Netherlands (8%), and China (4.4%) (U.S. Central Intelligence Agency, 2013).

Minerals in the National Economy

In 2012, Finland had 46 mines and quarries that were regulated under the Finnish Mining Act, and several feasibility projects were ongoing. Metallic minerals mining and the processing and refining of metals were the principal areas of the Finnish mineral industry that had grown and demonstrated a potential to contribute to the exports of Finland. Employment had increased owing to mining operations, particularly in eastern and northern Finland. About 3,500 people were employed in the mineral sector in Finland in 2011, which was the latest year for which data were available. This number was expected to increase to 5,000 in the near future in line with the expected growth in the mineral industry, particularly in the area of metallic minerals. The Government of Finland had promoted the mineral industry through such measures as the building of infrastructure and developing areas where mining takes place, constructing roads and railways, and providing funding for research. Finland was a regionally significant processor and refiner of chromite, copper, nickel, and zinc. The principal facilities for the processing of copper and nickel were located at Harjavalta, those for the processing of chromium 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. Finland was the leading talc producer in Europe and the sixth-ranked talc producer in the world (Invest in Finland, 2011; Ministry of Employment and the Economy, 2014a; United Nations, 2013; Virta, 2013).

Government Policies and Programs

The Government of Finland regulates its mineral industry through two main laws: the Finnish Mining Act, which regulates the exploitation of metallic and industrial minerals in Finland, including soapstone and marble, and the Land Extraction Act, which regulates only the extraction of gravel and sand and the quarrying of natural stone. The objective of the Finnish Mining Act (621/2011) is to enable exploration and mining activities and regulate them so that they are carried out in a socially, economically, and ecologically sustainable way. The Act ensures that environmental, civil rights and landowner concerns are taken into account in the decisionmaking process for the development and exploration of any mining projects. The Act also takes other Finnish law 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 revised Mining Act, which became effective on July 1, 2011, the right to exploit a deposit is based on a mining permit, and the review of permits is more comprehensive than under the original Mining Act. The mining operator's termination and reclamation obligations are also more extensive, including the requirement to provide a security deposit for the purpose of fulfilling reclamation obligations. The Finnish Safety and Chemicals Agency (Tukes) is the organization that grants and supervises the permits that are required by the Mining Act. Finnish law also provides environmental protection guidelines and requires several types of environmental permits for the exploitation of the mineral resources of the country (Ministry of Employment and the Economy, 2011, 2014b).

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 volume and contribution to the country's economy. In 2012, production of copper concentrate increased by 118%; silver metal, by 84.9%; feldspar, by 64%, gold metal mine output, by 27.8%, and nickel content of mine output, by 26.6%. Data on mineral production are in table 1.

Structure of the Mineral Industry

The Finnish mineral industry consists of the following two types of companies: (a) small stone quarry and sand and gravel pit operators, and (b) a group of large companies that operate international metal and industrial mineral operations and mines in Finland and abroad (United Nations, 2013).

Outokumpu Oyj (Outokumpu) and Rautaruukki Oyj (Ruukki) were the two leading metals manufacturing companies in Finland. They specialized in manufacturing steel and stainless steel. Outokumpu also operated the Kemi chromite mine in Lapland and, in addition to steel, also produced cadmium and ferroalloys. Outokumpu was no longer reporting mercury

production in Finland, although some production as byproduct was likely. Outokumpu also had operations in the United States, Germany, Mexico, Sweden, and the United Kingdom.

Mondo Minerals Oyj (Mondo) of the Netherlands and Nordkalk Corp. (Nordkalk) were two of the principal industrial mineral producers in Finland. Mondo (a subsidiary of Advent International Corp. of the United States) was the second-ranked producer of talc, by volume, in the world. Mondo had its main mine and processing facilities in Sotkamo and Vuonos (Mondo Minerals Oyj, 2014a).

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

First Quantum Minerals Ltd. (First Quantum) of Canada owned the Pyhasalmi copper mine. Finland was one of the few countries in Europe where copper was still being mined. The Pyhasalmi Mine had previously been owned by Inmet Mining Corp. of Canada; however, the company was purchased in 2011 by First Quantum (First Quantum Minerals Ltd., 2014).

Finland's mining companies were mostly privately owned, although the Government held an equity interest 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.

Commodity Review

Metals

Chromium.—Outokumpu operated the Kemi chromite mine in Lapland and used the chromium for its production of stainless steel at its plant in Tornio. Outokumpu reported that the Kemi Mine had ore reserves of 33 million metric tons. The Kemi Mine was the only chromite mine within the EU (Outokumpu Oyj, 2014, p. 2).

Cobalt.—OM Group Inc. of the United States (OMG) announced in 2012 that it would divest itself of its advanced materials business, which included its cobalt production business. According to OMG, during 2012 and through the date of the sale of this section of the company in January 2013, it would continue to manufacture inorganic products using unrefined cobalt and other materials for automotive systems, construction and mining, industrial end markets, and the mobile energy storage and renewable energy markets. The divesture of the advanced materials business was to include the sale of the cobalt refinery facility in Kokkola, Finland, to the joint venture Freeport Cobalt OY, which was majority owned by a subsidiary of Freeport-McMoRan Copper & Gold Inc. of the United States (OM Group Inc., 2013, p. 5–6).

Copper.—Boliden AB'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. The Harjavalta smelter had the capacity to produce 210,000 metric tons per year (t/yr) of copper, which was cast into copper anodes. Sulfur was recovered as a byproduct. The copper anodes were then shipped to the Pori refinery where the anodes were refined into copper cathodes. The capacity of the refinery was 155,000 t/yr. The refinery also produced gold and silver as byproducts. In 2012, the complex processed 516,027 metric tons (t) of copper concentrates, 247,709 t of nickel concentrates, and 124,527 t of copper cathodes (Boliden AB, 2013).

Gold.—Agnico-Eagle Mines Ltd. of Canada owned the Kittila Mine in the Lapland region. In 2012, the mine had a new record production of about 5,474 kilograms (kg) of gold content with an 88.3% recovery rate. This increase in production was owing to ongoing exploration and discovery and an increase in the processing capacity that, in 2012, expanded the identified Kittila mineralization in the Rimpi and the Roura deposit areas. The company was evaluating a 25% throughput expansion that could be operational by 2015. Further expansions were envisioned, as the deposit appeared to be significantly richer and thicker beneath the Rimpi zone (Agnico-Eagle Mines Ltd., 2013, p. 10).

Dragon Mining Ltd. of Australia owned and operated the Vammala plant located in the Sastamala region in southern Finland within the Tampere schist belt. The Vammala plant had the capacity to process 300,000 t/yr of ore and had crushing, milling, and flotation facilities that processed ore from the Orivesi and the Jokisivu gold mines, which are located 80 kilometers (km) to the northeast and 40 km to the southwest of the plant, respectively. In 2012, the Orivesi Mine produced 149,232 t of ore at an average grade of 3.50 grams per metric ton (g/t) gold and the Jokisivu Mine produced 141,443 t of ore at an average grade of 2.67 g/t gold. In 2012, the Vammala plant produced 684 kg of gold at a recovery rate of 76.8% (Dragon Mining Ltd., 2013).

Nickel.—The two main producers of mined nickel in Finland were Talvivaara Mining Co. plc (Talvivaara), which owned a polymetallic mine at Sotkamo, and Belvedere Resources Ltd. of Canada (Belvedere), which owned a mine and other installations in Hitura. Talvivaara reported that it was expecting to produce between 25,000 and 30,000 t of nickel in 2012. Talvivaara's Sotkamo nickel project was the world's first bioheap-leach project for nickel. It was centered on two polymetallic deposits—the Kolmisoppi and the Kuusilampi deposits, which are located about 30 km southwest of Sotkamo in eastern Finland. The deposits constitute one of the largest known nickel sulfide resources in Europe (Talvivaara Mining Co. plc, 2012, p. 7).

Belvedere produced about 2,200 t of nickel from its Hitura Mine in 2012. The mine had restarted operations in July 2010 but was likely be put on care-and-maintenance status in 2013 because keeping the mine active was not economically feasible given the projected prices of nickel in 2013 and beyond. Belvedere continued with its current expansion of the mine, however, and further expansion was also projected (Belvedere Resources Ltd., 2013, p. 13).

Industrial Minerals

Limestone.—Nordkalk Corp. which was part of the Rettig Group of Germany, was a leading producer of limestone and

limestone-based products in the world. Nordkalk's largest production site (in terms of volume of production) in Finland was located in Lappeenranta, where the company had a quarry, a grinding plant, two flotation plants, and a lime kiln. Nordkalk subsidiary Suomen Karbonaatti Oy, which was also located in Lappeenranta, produced carbonate fillers and coating pigments (Nordkalk Corp., 2013, 2014).

Talc.—Mondo was a significant producer of talc in the world. In 2012, the company produced an estimated 396,000 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 has to be applied to the ore (Mondo Minerals Oyj, 2014b).

Wollastonite.—Nordkalk was the only European producer of wollastonite in 2012. Nordkalk produced all its grades of wollastonite at its facilities in Lappeenranta. The company launched a new generation of high-aspect-ratio wollastonite fillers. The new fillers were designed for thermoplastic and thermoset applications (Nordkalk Corp., 2013).

Outlook

Finland's production of nickel and zinc is likely to increase, as projects to increase production capacity are expected to reach the production stage in the near future. The increased market interest in rare-earth minerals has reignited interest in areas of Finland that had previously been producing these minerals but had stopped because of economic and technical feasibility issues. Copper and silver production is expected to continue to be a significant element of the Finnish mineral industry, particularly as facilities are expanded to include multimetallic production projects. Market prices will determine whether expansion of the Finnish 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		2008	2009	2010	2011	2012[e]
METALS						
Aluminum, metal, secondary	metric tons	24,706	17,885	20,736 [r]	19,531	19,530
Chromite:						
Cr_2O_3 content		614	247	598 [r]	693 [r]	425 [2]
Of which:						
Foundry sand		5	5	NA [r]	NA [r]	NA [r]
Lump ore		85	80	NA [r]	NA [r]	NA [r]
Total		90	85	NA [r]	NA [r]	NA [r]
Cobalt, refined	metric tons	6,301	4,665	9,413	10,441	10,547 [2]
Copper:						
Concentrate, gross weight	do.	47,077	49,730	51,222 [r]	47,802 [r]	104,393 [2]
Mine output, Cu content	do.	13,000	14,600	14,700	16,000	NA
Metal:						
Smelter	do.	174,354	139,710	153,853 [r]	156,017 [r]	156,000
Refined	do.	137,953	105,549	146,344 [r]	148,639 [r]	148,000
Gold, metal, mine output	kilograms	4,148 [r]	5,749	7,628 [r]	8,461 [r]	10,814 [2]
Iron and steel, metal:						
Ferroalloys, ferrochromium		234	123	283 [r]	231 [r]	288 [2]
Pig iron	metric tons	2,943 [r]	2,042	10,033 [r]	12,145 [r]	12,000
Steel, crude		4,418	3,078	4,023	3,985	3,759 [2]
Mercury	kilograms	33,120	6,210	9,315 [r]	-- [r]	--
Nickel:						
Mine output, Ni content	metric tons	4,303	4,400	29,448 [r]	63,209 [r]	80,000
Metal, electrolytic	do.	51,936 [r]	40,800	41,317 [r]	49,823 [r]	46,275 [2]
Platinum	kilograms	214	265	718 [r]	836 [r]	830
Selenium, metal	do.	58,069	66,028	66,094 [r]	88,231 [r]	92,769 [2]
Silver, metal	do.	59,375	60,019	64,751 [r]	69,344 [r]	128,200 [2]
Zinc:						
Mine output, Zn content	metric tons	51,900	56,415	55,562	64,115	51,467 [2]
Metal	do.	297,722	295,049	307,144 [r]	307,352	314,742 [2]
INDUSTRIAL MINERALS						
Cement, hydraulic		1,633	1,052	1,215 [r]	1,387 [r]	1,300
Feldspar	metric tons	45,250	2,312	28,013 [r]	26,292 [r]	43,124 [2]
Lime		482	410	463 [r]	456 [r]	450
Mica:						
Biotite		57	54 [r]	38 [r]	32 [r]	27 [2]
Concentrate	metric tons	10,706	7,855 [r]	13,809 [r]	12,896 [r]	12,112 [2]
Nitrogen, N content of ammonia	do.	73,868	68,379	78,380 [r]	72,352 [r]	72,000
Phosphate rock apatite concentrate:						
Gross weight		780 [e]	660	817 [r]	870 [r]	870
P_2O_5 content		NA	234	289	307	300
Pyrite, gross weight		510	679	706 [r]	939 [r]	940
Sodium sulfate		22	NA	NA	4 [r]	4
Stone, crushed:						
Limestone and dolomite:						
Dolomite		NA	NA	NA	81 [e]	81
For cement manufacture		1,807	1,132 [r]	1,495 [r]	1,600 [r]	1,600
For agriculture		647	687	646 [r]	450 [r]	450
For lime manufacture		317	191 [r]	234 [r]	220 [r]	220
Fine powders		650	650	650	NA	NA
Metallurgical[e]		1	1	1	NA	NA
Total		3,422	2,661 [r]	3,026 [r]	2,350 [r, e]	2,350
Quartz silica sand		3,160	2,241	267 [r]	312 [r]	310

See footnotes at end of table.

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

(Thousand metric tons unless otherwise specified)

Commodity[2]		2008	2009	2010	2011	2012[e]
INDUSTRIAL MINERALS—Continued						
Sulfur:						
S content of pyrite		226	154	150 [e]	338	330
Byproduct:[e]						
Metallurgy		331	274	275	280	280
Petroleum		117	127	125	133 [2]	130
Total		448	401	400	410	410
Sulfuric acid		956	851	949 [r]	887 [r]	890
Talc		528	375 [r]	419 [r]	429 [r]	396 [r, 2]
Wollastonite	metric tons	15,600	9,200 [r]	12,100 [r]	11,500 [r]	11,500
MINERAL FUELS AND RELATED MATERIALS						
Peat:						
For fuel use		6,933	5,576	7,533 [r]	6,847 [r]	6,800
For agriculture and other uses		1,552	876	867 [r]	674 [r]	670
Petroleum refinery products	thousand 42-gallon barrels	95,325	95,000	88,137 [r]	90,686 [r]	90,000

[e]Estimated; estimated data are rounded to no more than three significant digits; may not add to totals shown. [r]Revised. do. Ditto. NA Not available.
-- Zero.
[1]Table includes data available through November 18, 2013.
[2]Reported figure.

TABLE 2
FINLAND: STRUCTURE OF THE MINERAL INDUSTRY IN 2012

(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	NA
Copper:				
Ore, Cu content		First Quantum Minerals Ltd.	Mine at Pyhasalmi	10
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 Kemio	50
Ferrochrome		Outokumpu Oyj (Government, 40%, and private investors, 12.3%)	Smelter at Tornio	250
Gold:				
Ore, Au content	metric tons	Agnico-Eagle Mines Ltd.	Mine at Kittila	5
Do.	do.	Dragon Mining Ltd.	Mines at Orivesi and Jokisivu and plant in the Sastamala region	4
Do.	do.	Lappland Goldminers AB.	Pahtavaara Mine near Sodankyla	2
Metal	do.	Boliden AB	Smelter at Pori	4
Limestone		Nordkalk Corp. (Rettig Group, 100%)	Mines at Lappeenranta, Pargas, 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.		Talvivaara Mining Co. plc.	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 barrels per day	Neste Oil Oyj, 50%, and Government, 50%	Plants at Naantali and Porvoo	NA
Phosphate-apatite		Yara International ASA.	Mine at Siilinjarvi	1,000
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 AB	Smelter at Pori	35
Silver	do.	do.	do.	30
Steel:				
Crude		Rautaruukki Oyj (Government, 39.7%)	Plants at Halikko, Hameenlinna, Kankaanpaa, and Raahe	2,100
Do.		Fundia AB (Norsk Jenverk AS of Norway, 50%, and Rautaruukki, 50%)	Plants at Aminnefors, Dalsbruk, and Koverhar	850
Do.		Ovako AB (Triton Adviser Ltd., 100%)	Plant at Imatra	600
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
Metal		Boliden AB	Smelter at Kokkola	260

Do., do. Ditto. NA Not available.