



# 2005 Minerals Yearbook

---

## FINLAND

---

# THE MINERAL INDUSTRY OF FINLAND

By Chin S. Kuo

Finland is an industrialized country whose economy was based primarily on exports, of which the engineering, electronics, and metals industries accounted for 50%, and the forest products industry, 30%. In 2005, a decrease in industrial activity slowed the gross domestic product (GDP) growth to 2.1%. Exports of goods and services contributed 33% of the GDP. Inflation remained low at 0.9% (International Monetary Fund, 2006<sup>§</sup>). Finland has abundant forest resources and several metals (chromite, copper, nickel, and zinc) and industrial minerals (mostly limestone and phosphate rock). Exploration activities in 2005 focused on base metals, diamond, gold, industrial minerals, and platinum-group metals. The country depended on imported raw materials for its manufactured products and energy.

Vulcan Resources Ltd. of Australia began its prefeasibility study on the Kylylahti copper-cobalt-nickel-gold deposit near Outokumpu in eastern Finland. The company also initiated a review of all geologic and geophysical data to delineate drill targets for deposit extensions and adjacent new deposits. In September, the company began a 6,500-meter (m) diamond drilling program. The drill targets included the gap between the Wallaby and the Wombat zones, the lowermost margin of the Wallaby zone, and the infill drilling of the Wallaby zone. The deposit had an estimated resource of 3.4 million metric tons (Mt) at a grade of 1.8% copper, 0.3% cobalt, 0.2% nickel, and 1 gram per metric ton (g/t) gold with a metal content of 60,000 metric tons (t) of copper and 10,000 t of cobalt. Vulcan's vision was to develop an underground mine with a production of 300,000 metric tons per year (t/yr) to 400,000 t/yr (Vulcan Resources Ltd., 2005b).

With its joint-venture partner Cambrian Mining plc of the United Kingdom (40%), Vulcan Resources (60%) began a 3,500-m diamond drilling program at the Kuhmo nickel-copper project in eastern Finland. Drilling took place on a number of targets that encompass a more than 100-kilometer (km) length of the Kuhmo-Suomussalmi greenstone belt. Infill and extension drillings at the Hietaharju and the Peura-aho deposits would be conducted. Tests of geologic, geochemical, and geophysical targets adjacent to the deposits also would be performed. Mineralization was hosted by a thick komatiite ultramafic unit and occurred at the base of the unit as massive nickel sulfide and vein deposits (Vulcan Resources Ltd., 2005a).

Tertiary Minerals plc completed the second phase of drilling at its Kaasselka gold prospect in northern Finland. The program was designed to test the depth extent of high-grade gold mineralization in the Vanha lode, the southeastern extension of the Tienvarsi lode, and the high-grade near-surface mineralization at Lampi. Five holes were drilled for a total of 750 m, and a small program of trenching was carried out at Lampi (Tertiary Minerals plc, 2005a).

Talvivaara Mining Co. Ltd. in partnership with Metso Minerals planned a bankable feasibility study in 2006 of the Talvivaara polymetallic deposits at Sotkamo. Metso Minerals had resources for and technological knowledge of rock processing and bulk materials handling process development for bioheap leaching. The deposits contained 340 Mt of ore, which was the largest known sulfide nickel resource in Europe. The ore bodies also contained substantial amounts of cobalt, copper, and zinc. Talvivaara Mining planned to use the bioheap leaching technology in its ore beneficiation process (Metso Corp., 2005).

Gold Fields Limited of South Africa formed a joint venture with North American Palladium Ltd. (NAP) to restart the Arctic Platinum Project. The project had resources of 373,000 kilograms (kg) of platinum and included the SJ Reef, the SK Reef, and the Suhanko deposits and claims south of Rovaniemi in Finland. NAP could earn a 60% interest in the project by completing a \$12.5 million exploration and feasibility study and paying Gold Fields \$45 million worth of NAP shares when NAP decides to develop a mine (Business Report, 2005<sup>§</sup>).

Agricola Resources plc, which was a uranium exploration company, completed bedrock trench sampling at Hautajarvi in northern Finland. The company reported that in trench A, samples of 10 meters of bedrock and continuous channel samples gave an average value of 0.36% uranium oxide; samples of a 5-m section of trench C gave an average value of 0.16% uranium oxide. The first diamond drill hole was planned for October 2005. The second hole, which was to be angled at 45 degrees, would be drilled into the mineralization zone to test its thickness (Agricola Resources plc, 2005<sup>§</sup>).

Sunrise Diamonds plc of the United Kingdom, which was a wholly owned subsidiary of Tertiary Minerals plc, acquired the rights to the diamond interests in Finland held by Tertiary Minerals' wholly owned subsidiary Tertiary Gold Ltd. The interests comprised the rights to three kimberlites discovered by Tertiary Gold in 2004 in a previously unknown kimberlite cluster now known as the "Kuusamo cluster" and a portfolio of 45 untested kimberlite targets in the same general area (Tertiary Minerals plc, 2005b).

European Diamonds plc reported positive results from drill samplings at its new kimberlite discovery in the Area 3 exploration zone in central Finland. The compositions of pyrope and chromite from the kimberlite were highly prospective for diamond in the Finnish part of the Karelian craton. Exploration of the kimberlite and the mineral indicators in the near vicinity continued during the field season (European Diamonds plc, 2005).

In September, Neste Oil Corp. of Finland's Porvoo oil refinery was back onstream after 5 weeks of scheduled maintenance work. In addition to maintenance, work included a number of investments designed to enhance the refinery's productivity, such as expanding the lubricant component's production capacity. Work also involved modifications made to the cooling water, electric supply, flaring, and sulfur recovery systems as

<sup>§</sup>References that include a section mark (§) are found in the Internet References Cited section.

part of the refinery's diesel project. Together with the refinery at Naantali, the company had a total refining capacity of 250,000 barrels per day (Neste Oil Corp., 2005b).

The initiation of Neste Oil's diesel project at the Porvoo refinery could increase the company's total refining margin for the production of 100 million barrels per year by more than \$2 per barrel. However, the cost estimates for the project had been increased by 10% since the investment decision was made. The new diesel production line was expected to come onstream in late 2006. If the project proceeds as planned, production of heavy fuel oil will be reduced and the refinery will be able to switch to using heavier crude oil (Neste Oil Corp., 2005a).

## References Cited

- European Diamonds plc, 2005, Encouraging results of sampling from the Area 3 kimberlite in central Finland: St. Albans, United Kingdom, European Diamonds plc press release, September 19, 1 p.
- Metso Corp., 2005, Metso to take part in Talvivaara Mine development as technological partner: Helsinki, Finland, Metso Corp. press release, December 1, 2 p.
- Neste Oil Corp., 2005a, Changes in profitability and cost estimates of the diesel project at Porvoo refinery: Espoo, Finland, Neste Oil Corp. press release, August 4, 1 p.
- Neste Oil Corp., 2005b, Neste Oil's Porvoo refinery back on stream following maintenance turnaround: Espoo, Finland, Neste Oil Corp. press release, October 3, 2 p.
- Tertiary Minerals plc, 2005a, Second phase drilling at Kaaresselka extends higher grade gold mineralization at depth: London, United Kingdom, Tertiary Minerals plc press release, March 10, 2 p.

- Tertiary Minerals plc, 2005b, Tertiary to spin-off Finnish diamond interests: London, United Kingdom, Tertiary Minerals plc press release, March 29, 2 p.
- Vulcan Resources Ltd., 2005a, Nickel drilling program commences in Finland: West Perth, Australia, Vulcan Resources Ltd. news release, September 5, 1 p.
- Vulcan Resources Ltd., 2005b, Pre-feasibility study commenced Kylylahti copper-cobalt deposit, Finland: West Perth, Australia, Vulcan Resources Ltd. news release, January 12, 2 p.

## Internet References Cited

- Agricola Resources plc, 2005 (October 17), Results of trenching at Energy Ridge, Hautajarvi, Lapland County, northern Finland, Press Release, accessed November 30, 2005, at URL <http://www.agricolaresearch.com/pressrelease17oct.html>.
- Business Report, 2005 (October 20), Gold Fields dusts off Arctic project, accessed October 24, 2005, at URL <http://www.busrep.co.za/index.php?fSectionId=563&fArticleId=2954295>.
- International Monetary Fund, 2006 (April), Finland, World Economic Outlook Database, accessed May 31, 2006, via URL <http://www.imf.org/external/pubs/ft/weo/2006/01/data/index.htm>.

## Major Source of Information

Geological Survey of Finland  
 Betonimiehenkuja 4  
 02150 Espoo  
 Finland

TABLE 1  
 FINLAND: PRODUCTION OF MINERAL COMMODITIES<sup>1</sup>

(Thousand metric tons unless otherwise specified)

Commodity <sup>2</sup>		2001	2002	2003	2004	2005
<b>METALS</b>						
Aluminum, metal, secondary	metric tons	34,488	31,076	32,619	39,266	42,061
Cadmium, metal, refined	do.	604	4	--	--	-- <sup>c</sup>
<b>Chromite:<sup>c</sup></b>						
<b>Gross weight:</b>						
Lump ore		215	216	210	240 <sup>f</sup>	235
Concentrate		350	340	329	330	326
Foundry sand		10	10	10	10	10
Total		575 <sup>3</sup>	566	549	580 <sup>f,3</sup>	571 <sup>3</sup>
<b>Cr<sub>2</sub>O<sub>3</sub> content:</b>						
Lump ore		75	75	76	84 <sup>f</sup>	82
Concentrate		130	125	125	127 <sup>f</sup>	126
Foundry sand		5	5	5	5	5
Total		210	205	206	216 <sup>f,3</sup>	213 <sup>3</sup>
Cobalt, metal, powder and salts	metric tons	3,908	4,292	4,574	5,246	6,158
<b>Copper:</b>						
Concentrate, gross weight	do.	41,146	50,494	50,875	52,864	53,489
Mine output, Cu content	do.	13,715	14,400	14,900	15,500	15,600 <sup>e</sup>
<b>Metal:</b>						
Smelter	do.	169,300	160,900	176,384	168,577	177,216
Refined	do.	119,677	127,136	135,160	132,133 <sup>f</sup>	91,187
Gold, metal, mine output	kilograms	5,552	4,666	5,409	6,222 <sup>f</sup>	3,747

See footnotes at end of table.

TABLE 1--Continued  
FINLAND: PRODUCTION OF MINERAL COMMODITIES<sup>1</sup>

(Thousand metric tons unless otherwise specified)

Commodity <sup>2</sup>	2001	2002	2003	2004	2005
<b>METALS--Continued</b>					
<b>Iron and steel, metal:</b>					
Pig iron	2,852	2,828	3,092 <sup>r</sup>	1,042 <sup>r</sup>	3,522
Ferroalloys, ferrochromium	237	248	250 <sup>e</sup>	264 <sup>r</sup>	235
Steel, crude	3,938	4,004	4,766	4,833	4,738
Semimanufactures, rolled <sup>e</sup>	3,800	3,850	3,900	3,950	4,000
Mercury metric tons	71	51	25	24	15
<b>Nickel:</b>					
Mine output, Ni content do.	27,610	41,797	39,375	44,496	40,897
Metal, electrolytic do.	51,275	49,151	45,417	40,088	34,709
Platinum kilograms	510	508	461	705	678
Selenium, metal do.	38,913	39,237	49,163	61,250 <sup>r</sup>	57,208
Silver, metal do.	23,998	29,404	31,115	37,413	24,822
<b>Zinc:</b>					
Mine output, Zn content metric tons	36,253	61,580	70,652	69,333	72,474
Metal do.	247,179	235,337	265,853	284,524	281,905
<b>INDUSTRIAL MINERALS</b>					
Cement, hydraulic	1,325	1,198	1,493	1,691	1,321
Feldspar metric tons	34,298	46,715	48,353	57,149	58,000 <sup>e</sup>
Lime	333	350	434	432	440
Nitrogen, N content of ammonia metric tons	80,000 <sup>e</sup>	87,000	77,100	60,600	59,100
<b>Phosphate rock, apatite concentrate:<sup>e</sup></b>					
Gross weight do.	750 <sup>r</sup>	800 <sup>r</sup>	799 <sup>r</sup>	838 <sup>r</sup>	823 <sup>3</sup>
P <sub>2</sub> O <sub>5</sub> content do.	277 <sup>r</sup>	270 <sup>r</sup>	290 <sup>r</sup>	306 <sup>r</sup>	300
Pyrite, gross weight	632	727	677	702	489
Sodium sulfate	30	30	28	27	26
<b>Stone, crushed:</b>					
<b>Limestone and dolomite:</b>					
For cement manufacture	1,400 <sup>e</sup>	1,400 <sup>e</sup>	1,411 <sup>r</sup>	1,628 <sup>r</sup>	1,537
For agriculture	1,000 <sup>e</sup>	1,000 <sup>e</sup>	626 <sup>r</sup>	555 <sup>r</sup>	566
For lime manufacture	350 <sup>e</sup>	400 <sup>e</sup>	424 <sup>r</sup>	316 <sup>r</sup>	342
Fine powders	350 <sup>e</sup>	400 <sup>e</sup>	579 <sup>r</sup>	670 <sup>r</sup>	629
Metallurgical <sup>c</sup>	1	1	1	1	1
Total	3,100 <sup>e</sup>	3,200 <sup>e</sup>	3,041 <sup>r</sup>	3,170 <sup>r</sup>	3,075
Quartz silica sand	148	148	112	285 <sup>r</sup>	286
<b>Sulfur:</b>					
S content of pyrite	337	359 <sup>r</sup>	341 <sup>r</sup>	336	350 <sup>e</sup>
<b>Byproduct:</b>					
Metallurgy	227 <sup>r</sup>	308 <sup>r</sup>	305 <sup>r</sup>	301	300 <sup>e</sup>
Petroleum	46 <sup>r</sup>	55 <sup>r</sup>	60	65 <sup>r</sup>	70 <sup>e</sup>
Total	273 <sup>r</sup>	363 <sup>r</sup>	365 <sup>r</sup>	366 <sup>r</sup>	370 <sup>e</sup>
Sulfuric acid	923	951	1,036	1,141	1,057
Talc	418	416	460	492 <sup>r</sup>	542
Wollastonite	20,000 <sup>e</sup>	20,000 <sup>e</sup>	17,300 <sup>r</sup>	16,763 <sup>r</sup>	15,950
<b>MINERAL FUELS AND RELATED MATERIALS</b>					
<b>Peat:</b>					
For fuel use	5,368	6,515	8,415	8,159	7,696
For agriculture and other uses	834	759	929	905	778
Petroleum refinery products thousand 42-gallon barrels	42,318	54,801	54,956	61,037	78,796

<sup>e</sup>Estimated; estimated data are rounded to no more than three significant digits; may not add to totals shown. <sup>r</sup>Revised. -- Zero.

<sup>1</sup>Table includes data available through July 25, 2006.

<sup>2</sup>In addition to the commodities listed, granite and soapstone were produced, but available information is inadequate to make reliable estimates of output.

<sup>3</sup>Reported figure.

TABLE 2  
FINLAND: STRUCTURE OF THE MINERAL INDUSTRY IN 2005

(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 Oy (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	Finnccement 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
Copper:				
Ore, Cu content	Inmet Mining Corp.		Mines at Pyhasalmi, Saattopora, and Hitura	10
Metal	Outokumpu Oyj (Government, 40%, and private investors, 12.3%)		Smelter at Harjavalta	160
Do.	do.		Refinery at Pori	125
Feldspar	SP Minerals Oy (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	do.	Mine at Orivesi	4
Do.	do.	ScanMining	Pahtavaara Mine near Sodankyla	3
Metal	do.	Outokumpu Oyj (Government, 40%, and private investors, 12.3%)	Smelter at Pori	4
Limestone	Partek Nordkalk Oy (Partek Corp., 100%)		Mines at Lappeenranta, Pargas, and Parainen	1,500
Do.	Rauma-Repola Oy		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	Outokumpu Oyj (Government, 40%, and private investors, 12.3%)		Mine at Hitura	3
Metal	do.		Smelter at Harjavalta	32
Do.	OM Group, Inc.		Refinery at Harjavalta	50
Petroleum products	Fortum Oil and Gas Oy		Plants at Naantali and Porvoo	NA
Phosphate-apatite	Kemira Oyj (Government, 98%)		Mine at Siilinjarvi	700
Do.	Outokumpu Oyj (Government, 40%, and private investors, 12.3%)		Mine at Pyhasalmi	800
Quartz and quartzite	SP Minerals Oy (Partek Corp., 50.1%, and SCR-Silbeco SA, 49.9%)		Mines at Kemio and Nilsia	250
Selenium	metric tons	Outokumpu Oyj (Government, 40%, and private investors, 12.3%)	Smelter at Pori	35
Silver	do.	do.	do.	30
Steel:				
Crude	Rautaruukki Oy (Government, 41.8%)		Plants at Halikko, Hameenlinna, Kankaanpaa, and Raahе	2,100
Do.	Fundia AB (Norsk Jenverk AS of Norway, 50%, and Rautaruukki Oy, 50%)		Plants at Aminnefors, Dalsbruk, and Koverhar	850
Do.	Ovako Oy (SKF, 50%; Wartsila, 25%; Fiskas, 20%)		Plant at Imatra	600
Stainless	AvestaPolarit		Plant at Tornio	550
Talc	Mondo Minerals Oy (BHP Billiton Group, 50%, and Plüss-Staufe AG, 50%)		Mines at Lahnaslampi, Lipsavaara, and Horsmanaho	500
Wollastonite	Partek Minerals Oy (Partek Corp., 100%)		Mine at Lappeenranta	30
Zinc:				
Ore, Zn content	Inmet Mining Corp.		Mine at Pyhasalmi	25
Metal	Outokumpu Oyj (Government, 40%, and private investors, 12.3%)		Smelter at Kokkola	260

NA Not available.