

## THE MINERAL INDUSTRY OF

# GREECE

By Harold R. Newman

The mining and metal processing sectors of the economy of Greece were a small but important parts of the national economy and were highly concentrated. About 60% of the sectors' turnover was handled by five mining companies. Bauxite was the most important of Greek metal deposits, but there were also deposits of chromite, gold, iron, lead, nickel, and zinc. Aluminum was produced from domestic sources of bauxite and alumina and was important in the domestically integrated metal sector. The steel produced was mostly from imported scrap. Greece was the largest producer of bauxite and nickel in the European Union (EU).

The industrial mineral sector was more important in the national economy than the metal sector in 1997. The more important commodities were bentonite, magnesite, and perlite. Important exports were bentonite, magnesite, perlite, and pumice. Privatization efforts were continuing in the magnesite and refractories industries. Greece was the largest producer of magnesium and perlite in the EU. (*See table 1.*)

Production of mineral commodities in Greece was closely tied to the export market. Exports of such minerals as bauxite, bentonite, nickel, and perlite made up a major share of total revenues. Although about 50% of the country's minerals were exported, over the long-term, the sector's significance was slowly lessening. The mining sector's share of the gross national product was 1.7%. General trade information for Greece indicated that the other members of the EU continued to strengthen their positions as the principal destinations and sources of Greek mineral exports and imports. There was a mineral resource surplus trade balance as more minerals were exported than imported (Mining and Metals, February 1997, Tapping into Greece's mineral treasure chest, accessed April 9, 1998, at URL <http://www.ana.gr/hermes/1998/feb/mining.htm>). Selected Greek companies with major equity owners are shown in table 2.

Environmental concerns were the responsibility of the Ministry of Environment, Town Planning and Public Works. The Government took an active role in environmental programs for the protection of the environment. The general laws enacted by the Government included law 1360/76 "Siting Arrangement and Environment," the Presidential Executive Order 1180/81, and law 1650/86 "Environmental Protection," which formed the basis of the active legislative framework. For the harmonization with the EU's order 88/609 concerning emission limitations, the Government executed the Ministry decision 58751/2370/15.4.93, which also included the limits of the main pollutants from electric powerplants.

Individual industrial concerns were charged with much of the responsibility of environmental protection. The Public Power

Corporation (PPC), a state-controlled agency, had projects underway for reducing sulfur dioxide emissions for powerplants in southern Greece, and new electrostatic precipitators were being installed in the lignite powerplant operations in northern Greece. In central Greece, some fuel oil powerplant units were being modified to burn natural gas. In addition, several new projects using wind power were presently under development on the islands of the Aegean Sea (Public Power Corporation, January 3, 1997, Overview—Environment, accessed May 21, 1997, at URL <http://www.newface.gr/ppc/environm.html>).

The Government's decision to import natural gas from Russia and possibly Algeria was based, in part, on the fact that it would be much cleaner to burn natural gas than the traditional lignite.

Bauxite mining operations continued through 1997. Bauxites Parnasse Mining Co. S.A. and Silver and Baryte Ores Mining Co. S.A. merged into the Eliopoulos-Kyriacopoulos Group to form the largest mining company in Greece. However, both companies continued to operate independently. Parnasse's operations were mainly in the Itea area, and most of the production was exported. Silver and Baryte's operations were at Euboea, Helicon, and Parnassos. Delphi-Distomon S.A. continued to produce bauxite, which was sold to Aluminium de Grèce S.A.'s operation at Distomon.

Interest in gold exploration continued in 1997. The joint-venture project between Silver and Baryte and Renison Goldfields Consolidated Ltd. of Australia on the island of Milos was continuing with systematic sampling and investigation.

Northern Greece is thought to contain a significant amount of exploitable mineral resources and was receiving more attention in regards to exploration activities. According to the Institute of Geological and Mining Research, a number of multinational companies, such as RTZ-Angloamerican, Normandy-Poseidon, and Newmont Inc., expressed their interests in Greece's northern territories. A recent Greek-Bulgarian study confirmed the existence of gold and other mineral occurrences in the mountains of Rodopi Prefecture and Kaimaktsalan, along the Greek-Bulgarian border (Mining and Metals, February 1998, Greece's treasure chest, accessed April 9, 1998, at URL <http://www.ana.gr/herms/1998/feb/mining.htm>).

The Kassandra Group (Skouries and Olympias deposits) in northern Greece have produced lead, silver, and zinc for more than 30 years. The mines were bought in 1996 by TVX Hellas, an affiliate of TVX Gold Inc. of Canada, with the idea of exploiting the refractory gold ore by incorporating pressure oxidation technology into the ore-processing phase. TVX Hellas announced that at the Skouries porphyry copper deposit, drilling had indicated a "geologic resource" of 568 million metric tons

grading 0.47 gram per metric ton of gold and 0.35% copper equating to about 267,000 kilograms of gold and more than 1.9 million metric tons of copper. (These estimates did not indicate cutoff grades.) Also, surface and underground drilling continued at the Olympias deposit to confirm previous ore reserve information and the quality of the ore body (TVX Gold Inc., April 10, 1997, Greek projects update, accessed May 21, 1997, at URL <http://www.tvxgold.com/pr041097.html>).

The Kassandra ore bodies are massive sulfide strata bound replacement deposits and occur within marble layers interbedded with gneiss and amphibolite in the Kerdyllia Formation of the Serbo-Macedonian Massif, a series of Paleozoic and older rocks. Gold mineralization in the Olympias deposit is associated with arsenopyrite and pyrite. The deposit consists of two zones. The west zone is lensoid in shape; averages 11 meters (m) in thickness, 350 m along strike, and 1,500 m downdip; and is on the west flank of an anticline. The east zone 300-m in length, is arc-shaped, and averages 9 m in thickness, 250 m along strike and 550 m downdip (Northern Miner, 1997).

LARCO S.A. was a major partner in a research project financed by the EU to develop an expert system for the exploration of nickel ore. LARCO accounted for about 3% of world nickel production and exported it in the form of nickeliferous ores to European industries.

The Hellenic Mineral Mining Co. continued asbestos mining operations at the Zidani Mine near Kozani. Most of the various grades of asbestos fibers produced were exported. The fibers are suitable for mixed applications, such as asbestos cement pipes and roofing applications.

Two companies produced industrial minerals. Barytine Co. the leading producer, is a major producer of bentonite, kaolinite, and perlite most of which comes from the island of Milos. Lava Mining and Quarrying Ltd. specialized in industrial minerals with production of gypsum from the island of Crete, pozzolan from Milos, and pumice from the island of Yali.

Financial-Mining-Industrial and Shipping Corp., a state-controlled company, was acquired by Viomagn-Fimisco Ltd., a joint venture of the lignite producer Violignit S.A. and Alpha Ventures of the Alpha Credit Bank, Greece's largest investment bank. Viomagn will invest \$19.7 million to revive output of firebricks and high-quality dead-burned magnesite. Violignit had a 65% interest in Viomagn, with the rest held by Alpha Ventures (Financial Times, 1997a).

The Greek marble industry continued to expand in 1997. It played a leading role in the international dimension stone market as a result of the marble's production in almost all areas of the country, variety of uses, and many colors (ash, black, brown, green, pink, red, and multicolored).

The industry was active in three steps of processing—the quarrying and the cutting of marble blocks and the sale of the blocks and finished products. About 80% of the marble was sold as finished products; the remainder was sold in rough slab and block form.

Silver and Baryte announced that it had begun production of natural zeolite in northern Greece. The 50,000-metric-ton-per-year operation will produce five grain sizes of clinoptilolite, which has a high cation exchange capacity owing to its honeycomb crystalline structure (Industrial Minerals, 1997).

PPC was the exclusive producer of lignite, the predominant fuel in electricity generation in Greece. PPC continued exploration in the basins of Amyntaion, Elasson, Florina, Megalopolis, and Ptolemais in 1997. PPC had reserves estimated to be 6.8 billion metric tons from which 4 billion tons was estimated to be economically recoverable by open-pit mining (Public Power Corporation, May 5, 1997, Overview—Lignite mines, accessed March 5, 1998, at URL <http://www.newfaces.gr/ppc/mines.html>).

In early 1997, Greece started receiving natural gas from Russia via a \$2.7 billion pipeline that took 10 years to complete. The 520 kilometer (km) pipeline which runs south from the Bulgarian border to Athens will furnish 2.4 billion cubic meters per year of natural gas for 25 years from Gazexport, the Russian supplier. As a back-up supply, Greece will buy up to 0.6 billion cubic meters of liquefied natural gas from Sonatrach, the Algerian state gas company, which will be stored on an island near Athens (Financial Times, 1997b). Greece was the last EU country to start using natural gas.

In the petroleum sector, PPC opened bidding for concessions and received offers for three onshore areas, Achaia, Aitolokarnania, and Epirus, and three offshore areas, south of Corfu, Katakolon, and Patraikos Bay.

The railroad system in Greece, all Government owned, totaled 2,479 km, of which 1,565 km was 1.435-m standard-gauge track; 892 km, 1.000-m gauge track; 100 km, double track; and 22-km, 0.750-m narrow-gauge track. The highway and road system totaled 38,938 km, of which 16,090 km was paved, 13,676 km was crushed stone and gravel, 5,632 km was improved earth, and 3,540 km was unimproved earth. The 80-km inland waterway system consisted of three coastal canals and three unconnected rivers. The major ports were Piraeus and Thessaloniki.

## References Cited

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———1997b, Russian gas reaches Greece: Financial Times [London], January 14, 1997, p. 4.  
Industrial Minerals, 1997, Silver and Baryte zeolite production: Industrial Minerals, no. 352, p. 105.  
Northern Miner, 1997, TVX Gold calculates new resource in Greece: Northern Miner, v. 83, n. 9, p. 3.

## Major Source of Information

Institute of Geology and Mineral Exploration  
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TABLE 1  
GREECE: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/	1993	1994	1995	1996	1997 e/
<b>METALS</b>					
Aluminum:					
Bauxite	2,205,498	2,196,371	2,200,216 r/	2,451,734 r/	2,211,200 3/
Alumina, Al <sub>2</sub> O <sub>3</sub> equivalent	614,900	548,000	597,620 r/	601,580 r/	602,000
Metal:					
Primary	147,690	144,300	130,361 r/	141,295 r/	142,000
Secondary e/	3,000	3,000	3,000	3,000	
Chromite:					
Run-of-mine	3,500 e/	--	--	11,725 r/	12,000
Marketable products, concentrate	3,697	1,960	--	--	--
Iron and steel:					
Iron ore and concentrate, nickeliferous, Fe content e/ 4/	575,000	810,000	800,000	800,000	700,000
Metal:					
Steel, crude	1,031,000	847,612	939,170	950,000 e/	950,000
Ferroalloys, ferronickel e/	52,067	64,728	68,620	71,204	70,000
Lead, mine output, Pb content by analysis	28,812	28,404	20,400	11,541 r/	19,300
Manganese: e/					
Ore, crude:					
Gross weight	9,705 r/	8,600	9,850 r/	11,000 r/	10,000
Mn content	2,082	1,960	2,130 r/	2,572 r/	2,500
Concentrate:					
Gross weight	2,600 r/	2,400 r/	2,500	2,000 r/	2,000
Mn content	1,985 r/	1,768 r/	2,035 r/	1,443 r/	1,443
Nickel:					
Ore:					
Gross weight	1,570,000	1,944,018	2,069,488 r/	2,194,829 r/	2,000,000
Ni content of nickeliferous iron ore	12,940	18,182 r/	19,941	17,801 r/	17,600
Metal, Ni content of ferronickel	10,931	16,197	17,164	17,801 r/	18,000
Silver, mine output, Ag content kilograms	53,500	44,900	33,000	16,600 r/	35,900
Tin, metal, secondary e/	200	150	150	150	150
Zinc, mine output, Zn content by analysis	24,854	17,200	14,500	13,602 r/	17,800
<b>INDUSTRIAL MINERALS</b>					
Abrasives, natural, emery e/	7,100	7,500	-- r/	-- r/	--
Asbestos:					
Ore	3,626,000	4,647,033	4,920,650 r/	4,862,799 r/	4,800,000
Processed, fibers	56,940	55,502	75,003 r/	80,213 r/	80,000
Barite:					
Ore, crude	988 r/	701 r/	668 r/	671 r/	800
Concentrate	849 r/	641 r/	600 r/	530 r/	600
Cement, hydraulic thousand tons	12,618	12,636	12,000 e/	12,000 e/	12,000
Clays:					
Bentonite:					
Crude	677,578	697,773	1,115,119 r/	973,517 r/	950,000
Processed	521,115 r/	583,140	512,000 r/	764,578 r/	750,000
Kaolin:					
Crude	89,473	117,254	68,682 r/	60,453 r/	60,000
Processed	735 r/	651 r/	314 r/	300 r/	300
Feldspar	22,210 r/	35,000	27,000 r/ e/	30,000 e/	30,000
Gypsum and anhydrite	445,600	453,722	485,353 r/	546,344 r/	500,000
Magnesite:					
Crude	479,999	575,472	565,720 r/	682,346 r/	650,000
Dead-burned	66,058 r/	76,965 r/	69,543 r/	57,438 r/	58,000
Caustic-calcined	123,797 r/	151,559 r/	206,532 r/	120,072 r/	125,000
Huntite e/	12,500	11,500	12,500	12,500	13,000
Nitrogen, N content of ammonia	57,400	45,200	64,900 e/	90,400 e/	82,700 2/

See footnotes at end of table.

TABLE 1--Continued  
GREECE: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/	1993	1994	1995	1996	1997 e/
<b>INDUSTRIAL MINERALS--Continued</b>					
Perlite:					
Crude	548,574	468,699	565,479 r/	598,640 r/	600,000
Screened	350,000	371,945	431,054 r/	417,882 r/	500,000
Pozzolan (Santorin earth)	600,000	649,608	691,722 r/	745,790 r/	750,000
Pumice	670,140 r/	635,470	856,450 r/	867,450 r/	1,000,000
Salt, all types	175,159	192,000	200,000 e/	200,000 e/	200,000
Silica e/	112,000 r/	80,250 r/	68,000 r/	86,600 r/	92,000
Sodium compounds: e/					
Carbonate	750	750	750	750	750
Sulfate	6,000	6,000	6,000	6,000	6,000
Stone:					
Dolomite	55,000	78,920	92,920	23,000	50,000
Marble cubic meters	278,730 r/	160,181	379,502 r/	196,669 r/	200,000
Flysch	166,172	88,662	35,434	85,138	90,000
Quartz, processed	1,471	5,655	6,000	6,350	7,000
Sulfur:					
S content of pyrites	22,391 r/	25,637	18,737 r/	9,660 r/ e/	10,000
Byproduct:					
Natural gas e/	100,000	100,000	100,000	105,000 r/	52,000
Petroleum e/	9,000	5,000	5,000	10,000 r/	7,600
Total sulfur e/	131,391 r/	130,637	123,737 r/	124,660 r/	69,600
Talc and steatite e/	1,050 r/	400	-- r/	-- r/	--
<b>MINERAL FUELS AND RELATED MATERIALS</b>					
Coal:					
Lignite thousand tons	54,817	57,533	56,533	54,732 r/	58,000
Lignite briquets	62,000	56,000	50,000	50,000 e/	50,000
Coke, gashouse e/	15,000	13,000	14,000	15,000	15,000
Gas:					
Manufactured, gasworks e/ million cubic meters	18	15	16	15	15
Natural do.	82	38	35	38	43
Natural gas plant liquids thousand 42-gallon barrels	290	360	350 e/	350 e/	350
Petroleum:					
Crude do.	4,000 e/	3,900 e/	3,285	3,738	3,380
Refinery products:					
Liquefied petroleum gas do.	4,650	5,450	5,500 e/	5,000 e/	5,000
Gasoline do.	29,500	30,300	30,000 e/	30,000 e/	30,000
Naphtha do.	1,230	4,670	4,500 e/	4,500 e/	4,500
Mineral jelly and wax e/ do.	15	15	15	15	15
Jet fuel do.	10,100	12,700	12,000 e/	12,000 e/	12,000
Kerosene do.	78	194	150 e/	150 e/	150
Distillate fuel oil do.	24,300	27,800	26,000 e/	26,000 e/	26,000
Refinery gas e/ do.	2,100	2,100	2,000	2,000	2,000
Lubricants e/ do.	800	1,000	1,000	1,000	1,000
Residual fuel oil do.	29,400	35,400	36,000 e/	36,000 e/	36,000
Bitumen e/ do.	1,500	1,500	1,500	1,500	1,500
Petroleum coke e/ do.	525	525	500	500	500
Other e/ do.	400	400	400	400	400
Refinery fuel and losses do.	5,970	5,660	6,000 e/	5,500 e/	5,500
Total e/ do.	110,568	127,714	125,565	124,565	124,565

e/ Estimated. r/ Revised.

1/ Table includes data available through March 1998.

2/ In addition to the commodities listed, other crude construction materials are produced, but no basis exists for estimation of production.

3/ Reported figure.

4/ Iron content of the nickeliferous ore mined for its nickel content. There is no indication that this iron is recovered, except as the iron content of ferronickel.

TABLE 2  
GREECE: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Alumina	Aluminium de Grèce S.A. (Pechiney of France, 60%)	Distomon, in Boeotia area	640
Aluminum	do.	do.	160
Asbestos	Asbestos Mines of Northern Greece S.A. (MAVE) (Hellenic Industrial Development Bank-Government, 95%; International Finance Corp., 5%)	Mines at Zidani, near Kozani	110
Barite	Silver and Baryte Ores Mining Co. S.A. (Eliopoulos-Kyriacopoulos Group)	Milos Island	10
Bauxite	Bauxites Parnasse Mining Co. S.A. (Eliopoulos-Kyriacopoulos Group)	Mines in Parnasse-Ghion-Pasha areas	2,000
Do.	Eleusis Bauxites Mines, S.A. (ELBAUMIN) (National Bank of Greece)	Plant in Drama and Eleusis; mines near Drama, Itea, Kimi, and Mandra	700
Do.	Delphi-Distomon S.A.; Hellenic Bauxites of Distomin S.A.; (Aluminium de Grèce S.A.) Delphi Bauxites S.A.	Opencast mines at Delphi-Distomon area	500
Do.	Am. E. Barlos-Bauxite Hellas Mining S.A.	Mines at Distomon (Elixon), Beotia; Plant at Distomon, Beotia	300 200
<b>Bentonite:</b>			
Crude	Mediterranean Bentonite Co. S.A. (Industria Chimica Mineraria S.p.A., Italy)	Surface mines on Milos Island	20
Do.	Mykobar Mining Co. S.A. (MI Drilling Fluids)	Mines at Adamas, Milos Island Plants at Adamas, Milos Island	180 150
Do.	Silver and Baryte Ores Mining Co. S.A.	Mines at Adamas, Milos Island	500
Processed	do.	Plant at Vouidia Bay, Milos Island	400
Cement	Halkis Cement Co. S.A.	Micro-Vathi plant, west-central Euboea	3,000
Do.	Halyps Cement S.A. (Ciments Français, France)	Paralia Aspropyrgos plant, Athens	800
Do.	Heracles General Cement Co. S.A. (Industrial Reconstruction Organization [IRO], 69.8%)	Plant at Milaki Plant at Volos	1900 4600
Do.	Titan Cement Co. S.A.	Elefsis plant, Athens area Kamari plant, Boeotia Patras plant, northern Peloponnesus Salonica plant, Salonica	400 2,600 1,900 1,650
Chromite	Financial-Mining-Industrial and Shipping Corp. (FIMISCO) (IRO)	Tsingeli Mines and plant near Volos	25
Gold, Au in concentrate	TVX Hellas (TVX Gold Inc., Canada)	Kassandra Mines (Olympias, Stratoni)	25
<b>Ferroalloys:</b>			
Ferronickel, Ni content	General Mining & Metallurgical Co. S.A. (LARCO) (IRO)	Larymna Metallurgical plant	25
Lead: Mine: Pb in concentrate	TVX Hellas (TVX Gold Inc., Canada)	Kassandra Mines (Olympias, Stratoni) northeast Chalkidiki	
Lignite	Public Power Corporation (Government)	Aliveri Mine, Euboea Island Megalopolis Mine, central Peloponnesus Ptolemais Mine, near Kozani	420 7,000 28,000
Magnesite, concentrate	Viomagn-Fimisco Ltd. (Violignit S.A. 65%, Alpha Ventures 35%)	Mines at Gerorema, Kakavos, and Paraskevorema at Mantoudhi, northern Euboea Island	350
Do.	Magnomin-General Mining Co. S.A. (A subsidiary of Radex Eraclit Industrie Beteiligungs GmbH, Austria)	Mines at Vavdos, Chalkidiki Processing plant at Vavdos	68 60

TABLE 2--Continued  
GREECE: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Manganese, (battery-grade MnO <sub>2</sub> concentrate)		Eleusis Bauxite Mines Mining, Industrial and Shipping S.A. (National Bank of Greece [OAE])	Nevrokopi, Drama	4
Natural gas	million cubic meters per day	Public Petroleum Corporation (Government)	Prinos offshore gasfield and oilfield, east of Thasos Island	125
Nickel, ore		General Mining & Metallurgical Co. S.A. (LARCO) (IRO)	Agios Ioannis Mines near Larymna Mines at Euboea	500 2,500
Perlite		Silver and Baryte Ores Mining Co. S.A.	Kos and Milos Islands Plant at Pireaus	250 300
Do.		Otavi Minen Hellas S.A. (Otavi Minen AG, Germany)	Milos Island	120
Do.		Peletico Hellas S.A. (Peletico Ltd. of Cyprus)	do.	20
Do.		N. Bournas & Co.	Kos Island	75
Petroleum, refined	42-gallon barrels per day	Hellenic Aspropyrgos Refinery S.A.	Aspropyrgos	95,000
Do.	do.	Motor Oil (Hellas) Corinth Refineries S.A.	Aghii Theodori, Corinth	140,000
Do.	do.	Petrola Hellas S.A.	Eleusis	100,000
Do.	do.	Thessaloniki Refining Co. A.E.	Thessaloniki	76,000
Pozzolan (Santorin earth)		Lava Mining & Quarrying Co. Ltd. (Heracles General Cement Co. S.A.)	Quarries on Ghyali Island	800
Steel, crude		Halyvourgia Thessalias S.A. [A subsidiary of Manassis Bros. and Voyatzis S.A. (65%); the balance, 35%, owned by state-owned National Investment Bank for Industrial Development - (NIBID)]	Steelworks at Volos (operates two 35-metric-ton electric arc furnaces)	1,500 300 200
Do.		Halyvourgiki, Inc.	Steelworks at Eleusis (three 100-metric ton electric arc furnaces)	1,200
Do.		Helleniki Halivourgia S.A.	Steelworks at Aspropyrgos (two 55-ton electric furnaces)	400
Do.		Sidenor S.A. (also known as Halivorgia Voviou Ellados S.A.)	Steelworks at Nea Maguisia, near Thessaloniki (two 55-ton and two 30-ton electric arc furnaces)	350
Zinc: Mine: Zn in concentrate		TVX Hellas (TVX Gold Inc., Canada)	Kassandra Mines (Olympias, Stratoni) northeast Chalkidiki	25