S&B's plant and port facility on Milos Island, where it exploits bentonite and perlite.

Greece seeks mineral lifeboat

While economic difficulties for Greece continue, *Ananias Tsirambides* and *Anestis Filippidis* highlight the wealth of the country's mineral resources and suggest how they could contribute to assisting its financial future

Greece continues to maintain leading positions worldwide in the production and export of magnesite, bentonite, perlite, pumice and huntite. Investments in equipment of high productivity and low energy consumption for the production of products of high value and better properties are prerequisites for further development of the mining companies in the future.

The development of the mining and metallurgical industry in Greece has a strong comparative advantage over other EU countries and this should be used with obvious benefits for the national economy.

At the beginning of the 21st century the expectations of the Greek mining industry appear positive. Most privatisations have proved successful, the restructuring of the sector has yielded good results so far, and the stock market offers the possibility of funding for development programmes aimed at the production of new products and the reduction of operating costs.

However, most of the mining companies need to establish or expand their strategic alliances with international businesses in technological know-how and marketing.

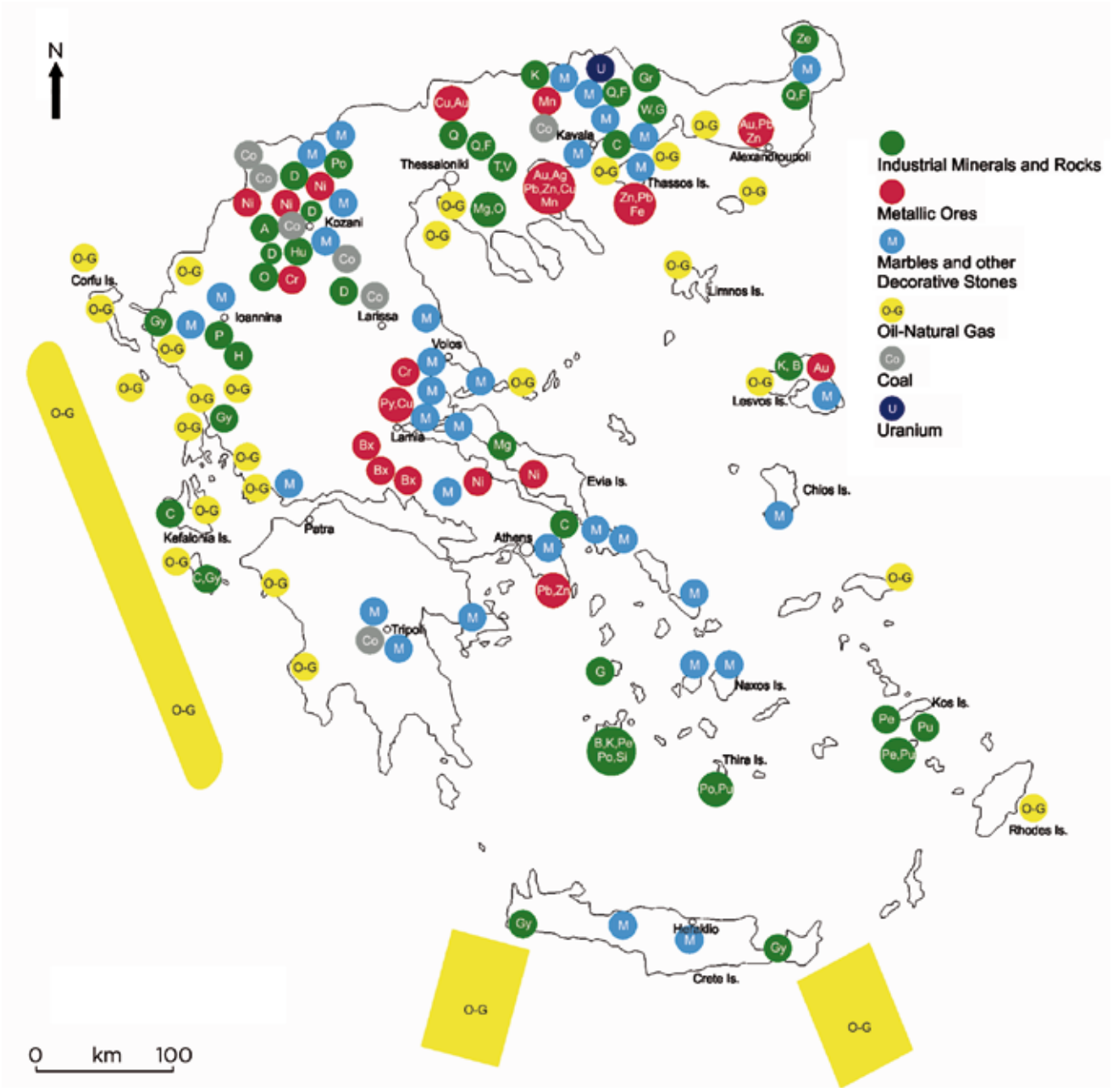
There is no doubt that the mining industry in Greece has significant strengths. But it must identify and explore the trends and opportunities of the international business environment if it wants to remain competitive and to further improve its position and prospects.

Impact of the financial crisis

The recent economic crisis in Greece has impacted the mining industry. Over the last three years, Greece has been absent from the investment list of the international firm Behre & Dolbear, specialising in investments in the mining sector, owing to the negative investment climate.

One of the necessary conditions for the immediate change of this negative climate is the creation of a stable tax system, with emphasis on the reduction of tax rates, elimination of bureaucracy, modernisation of legislation, limitation of the conditions and the significant reduction of the licensing time, and the substantial improvements in telecommunications, energy and transport.

Figure. 1. Mineral resources of Greece.



Industrial minerals & rocks

A=Attapulgite, B=Bentonite, C=White carbonates, D=Diatomite, F=Feldspars, G=Garnet, Gr=Graphite, Gy=Gypsum, H=Halite, Hu=Huntite, K=Kaolin, Mg=Magnesite, Ol=Olivine, P=Phosphorites, Pe=Perlite, Po=Pozzolan, Pu=Pumice, Q=Quartz, Si=Amorphous silica, T=Talc, V=Vermiculite, W=Wollastonite, Ze=Zeolite.

Marbles-Decorative stones

Mr=White to colored marbles, dolomites, travertines, onyxs, alabaster, sandstones, schists, volcanic rocks, zeolite-bearing tuffs.

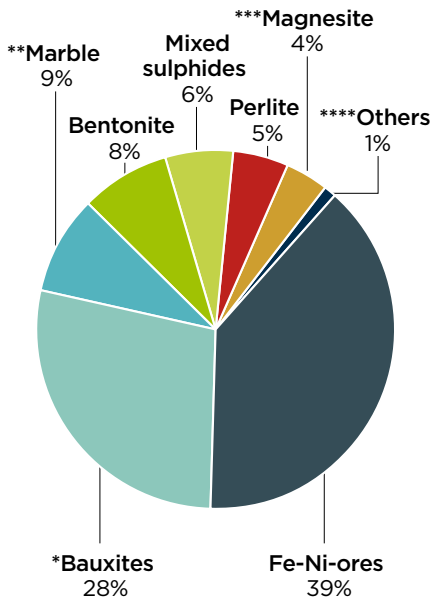
Metallic ores

Ag=Silver, Au=Gold, Bx=Bauxite, Cu=Copper, Cr=Chromium, Fe=Iron oxides, Mn=Manganese, Ni=Nickel, Pb=Lead, Py=Pyrite, Zn=Zinc.

Energy mineral resources

Co=Coal, O-G=Oil-Natural gas, U=uranium ore.

Figure. 2. Exports of minerals, rocks and metallic ores (total €608 m. 2009)



*(+alumina+aluminum), **(+microcrystalline $CaCO_3$), ***(+dead burned magnesia+caustic magnesia+refractory masses), ****(pumice+huntite+attapulgite+feldspars+gypsum+quartz+olivine).

Greek minerals by numbers

€60bn	total value of indicated reserves of industrial minerals and rocks
€72bn	total value of indicated reserves of metallic minerals
€1,362bn	total value of indicated reserves of energy mineral raw materials, of which:
	€268bn lignites exploited to produce only electricity.
	€685bn hypothetical oil reserves
	€409bn natural gas reserves

Also, Greece must soon incorporate in its law the new European policy for raw materials (the Raw Materials Initiative), reduce the projects and activities which require environmental permits, reduce the licensing time in the EU average (currently it is up to five times) and remove the premeditation of environmental impact.

Mineral resources

According to the PERC code (Pan-European Reserves and Resources Reporting Committee), the indicated reserves of the mineral resources of Greece currently exploited, and those resources presenting good prospects for exploitation, with their value are shown in Table 1.

Microcrystalline calcium carbonate, carbonate aggregates, decorative stones of carbonate composition, schists, and muds and clays for ceramics exist in abundant reserves and are not included.

Figure 1 shows the locations of the most important mineral resources of Greece.

The total value of these reserves, in our assessment is about €1.5 trillion and is four times the country's total debt (€360bn). Therefore, in just 20 years the revenue from exploitation of these resources could recoup that debt. Our conclusion is reinforced by the fact that the value of a processed mineral resource in many cases exceeds 20 times that of the raw grade.

Thus, vertically integrated mining and processing plants, which have the ability to produce finished products with high added value, will contribute much more quickly to the elimination of this debt and therefore to the rapid development of the National Economy.

The output of the last five years of raw and processed minerals, rocks and metallic ores are shown in Table 2 and the value of their exports in Table 3. The percentage contribution of these commodities in the exports of 2009 is shown in Figure 2.

Aggregates

The gross production value of carbonate gravel and sand is more than €300m pa, with an average annual increase of 6% by 2009. The number of active and idle quarries is 222. The percentage contribution of this sector in mining activity is approximately 40%.

In recent years, several rocks suitable for producing high quality hard aggregates for non-slip roads have been exploited. Such rocks are mainly andesites, diabases and gabbros. The main quarries are in Limnos, Polykastro, Yannitsa, and Mikroklissoura Grevena. The annual production of hard aggregates is limited although the demand is great.

There are 45 companies producing building materials, 3 cement companies, 80 concrete companies, and 43 companies of cement products. A mining quarry and a melting plant of amphibolites, and other rocks, to produce rockwool, has operated since 2001 in Terpni Serres.

Prices range from €4/t carbonate aggregate to €10/t hard aggregate.

Attapulgite

Large reserves of high quality attapulgite are south-east of Grevena, in the Ventzia basin. The attapulgite is accompanied by saponite. The two minerals have excellent absorbent and thixotropic properties. Geohellas Co. SA exploits the deposits, and produced 30,000 tonnes in 2010.

Bauxite/alumina

Exploitable deposits of bauxites exist in the regions of Parnassos, Gkiona, Elikona, Iti, Kallidromo, Lokrida and Domokos. Occurrences of bauxites exist at Vrontero Florina, Petralona Chalkidiki, Western Pilio, Volos, Skopelos, East Othrys, Evia, Elefsina, Nafpaktos, Kaiafas Ilia, Pylos Messinia, Amorgos, Chios.

These are brown-red, because of the contained iron oxides. But there are white colored bauxites, which are rich in aluminium and poor in iron. The mineralogical composition of bauxites of the Parnassos-Gkiona zone is: 10-30% boehmite, 20-50% diaspore, 20-25% haematite, 1-5% calcite, 1-2% quartz, 1-5% kaolinite and 0.5-2% anatase.

S&B Industrial Minerals Co. SA produces about 1m. tpa. Delfi-Distomon Co. SA (a subsidiary of Aluminium SA) follows with about 750,000 tpa, dedicated exclusively to the parent feedstock. Elmin Co. SA presents a good perspective of increasing production and exports of its bauxites exploited. Its total production of bauxite in 2010 was 1.9m tonnes.

ASA is the largest consumer of Greek bauxite, processing 1.5m tpa and producing 135,000 tpa of aluminium, much of which is exported.

Bentonite

Greece is the second country after the USA in production of bentonite, which in 2009 was 1.25m tonnes. Extraction is conducted mainly in Milos by S&B and in smaller volumes in Kimolos by Bentomine Kimolos Enterprises Co. SA.

The Milos bentonite contains mainly Ca-montmorillonite (>80%), quartz, feldspars, kaolinite and unaltered volcanic glass. Bentonite deposits have been found in the islands of Lesvos and Chios, and in the region of Mesti-Sykorrachi Evros.

S&B ranks first in the production of bentonite in Europe and is the largest exporter of bentonite in the world. For most applications S&B's bentonite is activated by treatment with soda ash, to obtain the desired physico-chemical properties.

With annual sales of bentonite exceeding 850,000 tonnes, S&B exports most output (98%) to Europe, North America, and the CIS.

The bentonite price depends on the degree of processing, the grain size and the packaging.

Carbonate materials

Calcium carbonate

White friable microcrystalline limestones are found in Zakynthos (Kounafas and Marina) and Kefalonia (Minies), which are the main

production centres of white carbonate products.

These limestones, dolomitic and calcitic marbles, and huntite, are the raw materials used in the production of carbonate fillers in Greece. The main producers are: Ionian Kalk SA, Zafranas-Petrochem Co. SA, and Dionyssos-Penteli Marbles SA.

Ionian Kalk Co. SA operates a mine and processing plant in Argostoli Kefalonia. The raw material is a microcrystalline, very pure limestone with a composition: >99.6% $CaCO_3$, <0.07% Al_2O_3, <0.02% SiO_2 and <0.01% Fe_2O_3.

The average production of ground material is 150,000 tpa, 65% of which is exported. Because of the high purity of the final products they are used as fillers of high brightness (>96%), low abrasion and low oil-absorption.

From 2004, in Sindos, Thessaloniki, Ionian Kalk of Northern Greece SA, has operated as a joint venture with Omya AG. The company has established a production unit of hydrophilic and hydrophobic products from crystalline calcium carbonate, with a capacity of 150,000 tpa.

Zafranas-Petrochem Co. SA operates its plant in Corinth. Microcrystalline white limestone from Zakynthos and tailings of dolomitic marble from Thassos and Drama, and imported talc, are the raw materials it uses. The average annual production of the plant is 100,000 tpa, 50% of which is exported.

Dionyssos-Penteli Marbles Co. SA uses tailings of marble and limestone to produce fillers. Marble filler is produced as a by-product of the main activity of the company, which is the exploitation of white marbles.

The quarry is located in Dionyssos Attica. The calcitic marble is composed of 98% calcite, 0.5% quartz, 0.5% sericite and 1% clay minerals.

The second product is from microcrystalline, soft limestone, from a quarry in Zakynthos. The average annual production of fillers is about 40,000 tpa. Some 300,000 tpa of calcium carbonate is produced for construction and other industrial applications. Since 1999 the company has produced dry mortars.

Huntite

Huntite exists in lacustrine formations of the Kozani basin. The concentrations of huntite-hydromagnesite prevail in the south-east part of the basin, where Mesozoic dolomitic limestones and dolomites are the host.

Until 2009 (when huntite/hydromagnesite was exploited by Minelco in Turkey), the huntite of Kozani (Neraida-Lefkara) was the only commercially developed deposit in the world. The deposit consists of: 95% (huntite+hydromagnesite) in relation 1:1 and 5% (aragonite+dolomite+calcite+magnesite).

Production of huntite is from two mines by White Minerals Co. SA (majority owned by Ankerpoort, a subsidiary of the Sibelco Group). At its plant near Lefkara Kozani, the company processes the extracted material from the nearby mine and produces a final product, most of which is exported. Only a domestic paper industry uses small quantities of this product as filler.

The exported material is a mixture of huntite-hydromagnesite in percentages 60% and 40%, respectively. The entire production of crude and 80% of the processed huntite is exported. Production in 2010 was 16,350 tonnes, and prices ranged from €40/t (raw) to €300/t (processed).

Other carbonates

Pure or marly limestones exist throughout the country. Sound limestones are used for the production of building or decoration stones, while the folded or fragmented stones are used to produce aggregates or other products.

Travertines are hard, fine-crystalline, solid or massive, often concretional, white to brown in color, and used as decorative stones.

Very pure dolomites, with >20% MgO, are abundant in Greece. Although their reserves in most cases are suitable for a wide range of applications, including production of caustic

Table 1. Indicated reserves and value of mineral resources of Greece.

Mineral resource	Indicated reserves ('000s tonnes)	[1]Price (€/t)	Value (m. €)
Industrial minerals & rocks			
Attapulgite	13,000	20	260
Bauxite	250,000	20	5,000
Bentonite	100,000	35	3,500
Feldspars	80,000	15	1,200
Gypsum/Anhydrite	350,000	6	2,100
Huntite	4,000	40	160
Kaolin/Clay	50,000	15	750
Magnesite	280,000	35	9,800
Olivine/Dunite	50,000	10	500
Perlite	1,200,000	10	12,000
Pumice/Pozzolan	400,000	10	4,000
Quartz	5,000	20	100
[2]Diatomite	100,000	25	2,500
[2]Garnet	1,300	30	40
[2]Graphite	650	30	20
[2]Halite	20,000	4	80
[2]Micas	800	25	20
[2]Phosphorites	500	20	10
[2]Talc	1,000	20	20
[2]Vermiculite	500	40	20
[2]Wollastonite	500	40	20
[2]Zeolites	600,000	30	18,000
		Total	**60,100**
Energy Mineral Raw Materials			
Coals (Lignite+Peat)	6,700,000	40	268,000
Natural Gas	3.5 trillion m^3	3.3/28.26 m^3	408,700
Oil	10 billion barrels	68.5	685,000
Uranium (U_3O_8)	1.80	83,500	150
		Total	**1,361,850**
Metallic Minerals			
Mixed sulphides (Lead Pb + Zinc Zn)	3,100	1,500	4,650
Nickel (Ni)	1,500	15,030	22,540
[2]Chromium (Cr)	1,200	1,960	2,350
[2]Copper (Cu)	2,600	6,020	15,650
[2]Gold (Au)	0.5	1055/ounce	18,610
[2]Manganese (Mn)	2,400	2,400	5,760
[2]Silver (Ag)	2.8	25/ounce	2,470
		Total	**72,030**
		Grand total	**1,494,000**

[1]as excavated, [2]good prospect of exploitation,
1€=1.45$ (September 2011), 1 oil barrel (159 liters) = 100$ = 68.5€,
1 MMBtu=28.26 m^3 = 4.83$ = 3.3€, 1 ounce = 28.349 g, 1 kg = 2.2 lb.

Table 2. Production ('000s tonnes) of unprocessed and processed minerals and rocks and other products.

Mineral or rock or other product	2006	2008	2010
Aggregates	70,000	81,000	65,000*
Microcrystalline $CaCO_3$	400	600	450
Feldspars	56	35.7	23
Attapulgite	7	25	30
Bauxite	2,194	2,174	1,902
Alumina	780	807.5	785
Aluminum	164.5	137	
Gypsum	900	900	470
Kaolin	40		
Pumice	801	828	413
Lignite	65,000	60,000	54,000
Magnesite	373	396.5	400
Dead burned magnesia	51	46.7	63.9
Caustic magnesia	69	70.5	67
Refractory masses	30	35.6	36.3
Marbles	2,210	1,930	1,400*
Mixed sulphides	180	272	236
Mixed sulphide ores	69	82	58
Bentonite unprocessed	1,166	1,580	1,250
Bentonite activated	962	1,263	1,020
Ni-Fe-ores	2,320	2,262	1,942
Nickel (in alloy)	18	16.6	14
Olivine	35	40	25
Perlite unprocessed	1,049	1,000	760
Perlite processed	700	600	480
Pozzolan	1,515	1,059	540
Amorphous silica	110	52.5	6
Quartz	14	16.2	12.1
Huntite-Hydromagnesite	25.7	19.6	16.4

*estimation.

Table 3. Exports (€'000s) of unprocessed and processed minerals and rocks and other products.

Mineral or rock or other product	2007	2009
Microcrystalline $CaCO_3$	29,742	25,800
Feldspars	270	254
Attapulgite	800	1,463
Bauxite	42,595	23,649
Alumina	106,497	57,309
Aluminum	171,302	89,114
Gypsum	416	300*
Pumice	5,079	2,307
Magnesite	887	482
Dead burned magnesia	11,696	5,762
Caustic magnesia	10,165	11,014
Refractory masses	7,362	7,657
Marbles	30,498	29,275
Mixed sulphide ores	58,000	38,000
Bentonite unprocessed	700	500
Bentonite activated	66,000	50,818
Nickel (in alloy)	502,373	230,127
Olivine		54
Perlite unprocessed	2,700	2,400
Perlite processed	29,200	30,140
Quartz	165	155
Huntite-Hydromagnesite	2,481	1,620
	Total 2009	**608,200**

*estimation.

calcined magnesia and refractories, the availability of high quality magnesite prevents the use of dolomite in such applications. Sound dolomites are used as decorative stones.

White, fine-crystalline and homogeneous calcitic marbles, such as those of Penteli and Paros, are very rare. Their excellent appearance is due to their transparency and their ability to reflect light.

But hundreds of quarries that produce inferior quality marbles operate in Greece. The marble industry, including other natural decorative stones, continues to be one of the most productive sectors of the Greek economy. Today, the marble industry includes about 3,000 companies (mining, processing, and trade). About 60% of total production and activity is in Macedonia. The most important centres of white marbles are found in the prefectures of Drama and Kavala (including Thassos, which is world famous for the snow-white dolomites). Today, the operating marble quarries are more than 300.

Feldspar

Rocks rich in feldspars exist in Evros (Korymvos, Protokklissia, Samothrace), Drama (Paranesti), Thessaloniki (Karteres) and Chalkidiki (Platanochori, Arnea, Ierissos, Sithonia). Usually they are intersected pegmatitic veins of great thickness and length. Among all the feldspars of the rocks above the feldspars of Paranesti are richer in potassium (K_2O up to 6%).

The most common form of feldspar in Greece is Na-feldspar, while K-feldspar is very rare. Turkey is the largest competitor of Greece in the supply of feldspars in the EU.

The requirement of the Greek ceramic industries for feldspar is about 40,000 tpa. The production (about 23,000 tpa) partially covers the needs of domestic industries of sanitaryware and glassware.

Mevior Co. SA (majority owned by Ankerpoort) extracts pegmatites rich in Na-feldspars in the area of Karteres Thessaloniki. The processing plant operates in Assiros Thessaloniki. Some 50% of production is exported to Italy, Germany, and the Czech Republic, while the rest supplies domestic industries such as:

- Youla Co. SA: the largest glass company in the region with headquarters and plant in Egaleo Attica, consumes approximately 1,200 tpa of fine-grained material (75µm) for glass tableware.
- Vitruvit Co. SA: with headquarters in Egaleo Attica and plant in Ionia Thessaloniki, consumes about 1,200 tpa of similar material for tiles and sanitaryware.

Filceram Johnson Co. SA extracted feldspars in the area of Platanochori Chalkidiki and consumes

about 30,000 tpa of coarse-grained material (0-6 mm) for floor and wall tiles. The company suspended operations at the end of 2010.

Gypsum/anhydrite

Greece host's large and high quality gypsum and anhydrite deposits, and in locations accessible for quarrying. Therefore, gypsum may be considered as an investment target of low risk. Triassic gypsum deposits aged up to the Quaternary are in the Ionian Islands, Thesprotia, Preveza, Etoloakarnania, Karditsa, Ilia, Crete, and Rhodes.

Tertiary deposits in marly formations are in Ano Viannos Crete, Karpathos, Katouna Etoloakarnania, and in Gouvalia Islet in Amvrakikos Gulf. Also, Tertiary gypsum is found in meta-alpine formations of western Greece, Ionian Islands, Crete, and Kariani Kavala. The gypsum occurrences at Sousaki and Lavrio are exceptions associated with hydrothermal activity and alteration phenomena.

Gypsum is mainly mined in eastern Crete (Altsi Sitia) and Katouna Etoloakarnania. Small excavations take place periodically in western Crete, Skopos Zakynthos, and Etoliko and Amphilochia Etoloakarnania.

The extracted material of the Altsi deposit is 80-90% gypsum, while its gangue materials are constituted by SiO_2, Fe_2O_3, Al_2O_3, and carbonate minerals of Ca and Mg. The area of Altsi is exploited for gypsum by Lava Co. SA (Lafarge Group), Interbeton Building Materials Co. SA (Titan Group), and Zervakis Co. SA.

The Katouna deposit, consisting of grey to white-grey gypsum of 80-93% purity is mined by Knauf Co. SA, and Viogyps Karvelis Co. SA.

Production of gypsum in Greece depends heavily on the cement industry. Demand for gypsum for construction applications in recent years has continually decreased owing to the economic crisis. Total production in 2010 was 470,000 tonnes, down by 50% compared with 2007.

Kaolin/clay

Kaolin occurs in the islands of Lesvos, Kimolos, Kos, and Thira, and in Sapes Rhodope and Griva Kilkis. But kaolin is periodically mined only in Milos and Lefkogia Drama. The two deposits are different in origin.

The Milos kaolin was formed by hydrothermal alteration of volcaniclastic rocks under acidic conditions and contains 13-20% Al_2O_3 and 0.3-0.6% Fe_2O_3. The low quality of the Milos kaolin is mainly due to the presence of opal silica and alunite (sulphureous mineral).

The Lefkogia kaolin is of residual type and is formed from the weathering of gneisses and schist gneisses. Besides the main mineral kaolinite there are: quartz, feldspars, and micas, and contains 18% Al_2O_3 and 2.5% Fe_2O_3.

The mineralogical and chemical characteristics of both types of kaolin make them unsuitable for high quality coatings and fillers. In Milos, S&B and Interbeton Industrial Materials (subsidiary of Titan) operate. The largest percentage (80%) of Milos' production is consumed in raw form in the domestic cement industry, while a small proportion (10%) is exported for the production of white cement.

The entire production of Lefkogia is domestically consumed by Filceram Johnson Co for floor and wall tiles. The domestic industrial needs for high quality kaolin are met by imports.

Since 1995 the production of kaolin has dropped dramatically, mainly because of a lack of good quality deposits. Muds and clays for ceramics and pottery exist in abundant reserves throughout Greece.

Magnesite

Greek magnesite ores are of vein or sedimentary type. The former are exclusively associated with ophiolites and they have been developed in serpentinites, frequently schisted, where magnesite zones are very thick and several kilometers long.

The major vein type magnesite ores (stockwork) are in Chalkidiki (Vasilika, Vavdos, Polygyros, Yerakini, Ormylia) and are the only deposits under exploitation. Similar ores exist at North Evia (Mantoudi, Limni, Troupi, Petissounas, Afrati, Pappades). Also, occurrences of magnesite are in Gomati and Nea Roda Chalkidiki, Nigrita, Kozani, Grevena, Atalanti, Ermioni, Lesvos.

The sedimentary ores of magnesite in Greece, which are not exploited, are located in the Serbia-Eani basin and Varvara and Karkara Chalkidiki hosted in clay-marly sediments.

The magnesite of Chalkidiki is high quality and contains 46.7% MgO, 1.9% SiO_2, 0.5% CaO and 0.2% (Fe_2O_3+Al_2O_3).

Grecian Magnesite Co. SA, is the largest exporter of magnesia in the EU. Most reserves, along with the processing unit, are located in Yerakini, Chalkidiki. The company exports magnesite, caustic and dead burned magnesia, and refractory masses.

Production of magnesite is 400,000 tpa and 180,000 tpa of final products (caustic and dead burned magnesia, refractory masses); 93% of output is exported mainly to the EU, but also to the USA, other European countries, the Middle East, and Australia.

Olivine/dunite

In Greece, olivine is present in various percentages in ophiolite formations or complexes that include dunites, olivinites, and peridotites. High quality deposits of olivines have been found in Vavdos Chalkidiki, Livadi Thessaloniki, Vourinos Kozani, and Perivoli Grevena.

Mining of olivine takes place in Skoumtsa Grevena (Mount Vourinos) by Thermolith Co. SA (until 2010 operated as Macedonian Olivinites Ltd.). Production in 2010 was 30,000 tonnes, a year in which the company entered the market with a new series of finished products. The future exploitation of the dunite deposits of Vavdos Chalkidiki seems very positive.

Perlite

Greece is first in exports and second in production of perlite in the world. Most of the extracted perlite is processed (crushing, sizing, drying) and 50% of that is exported. Only a small portion of the sized perlite in its expanded form is consumed domestically.

Magnesite mines at Grecian Magnesite SA's Chalkidiki site, northern Greece.

Greece is the main supplier to Europe with competing countries including Turkey, Italy, Hungary and Armenia. Also perlite is exported to the USA, the Middle and the Far East.

Perlite is extracted on the islands of Milos and Kos. Occurrences of perlite are also found in the islands of Lesvos, Gyali and Antiparos and in Evros Prefecture (Lefkimmi, Lykofos, Dadia).

Perlite is mined primarily in Milos, where the indicated reserves are 1bn tonnes.

S&B is the largest producer of perlite in Greece and the largest supplier of raw and graded perlite in the world. Aegean Perlites Co. SA is a smaller producer in the Islet Gyali.

S&B Co., apart from on Milos, periodically extracts small volumes and in Kos. The largest percentage of mined perlite is transferred to its plant in Ritsona Viotia, where expanded perlite is produced. This is distributed in the international and domestic markets by subsidiary company Isocon.

S&B and acquired companies Sarda Perlite (Italy), Saba Madencilik (Turkey) and Sino-Hellenic Industrial Minerals (China), distribute more than 600,000 tpa of graded perlite products in international markets, mainly in Europe and North America. Subsidiary Otavi Holding GmbH, produced 130,000 tpa of raw perlite in Milos. Sales of perlite in the domestic market are only 1.5% of the total production.

Perlite demand is expected to increase, owing to the consumption of perlite in new applications, such as in agriculture, in filter manufacturing, and in cryogenic applications.

In 2010, production of crude perlite was 760,000 tonnes, while that of processed was 480,000 tonnes. About 45% of total production was exported to the European market and 44% to North America.

The building industry (eg. building materials and coatings) consumes 58%, agricultural uses (eg. hydroponics and floriculture production mixes) 28%, and other uses (eg. filtration and cryogenic insulation) the remaining 14%.

Pumice/pozzolan

Pumice is one of the most important industrial raw materials of Greece. Domestic production of pumice in 2010 was 413,000 tonnes, a decrease by about 50% compared with 2007. The Lava Co. SA operates the only mine in the Gyali Islet in Eastern Aegean and has been the leading exporter of pumice in the world.

Pozzolan deposits are in Evros prefecture (Mesti, Lefkimmi, Dadia, Petrota). Pozzolan is mined in the islands of Milos and Kimolos and in Pella Prefecture (Nea Zoi, Profitis Elias, Apsalos, Xifiani).

Production of pozzolan in Greece during 2000-2009 was 1.0-1.5m tpa, but in 2010 production fell to 540,000 tonnes, the lowest of recent years.

Drilling in Elmin SA's underground bauxite mine near Lamia, on the central east coast of Greece.

Almost all pozzolan is consumed by the cement industry. Five companies are involved: Lava Co. SA (Lafarge Group), Interbeton Building Materials Co. SA (Titan Group), Bentomine Kimolos Enterprises Co. SA, Kyvos Co. SA, and Hellenic Pozzolanes Co. SA.

The cement industry Titan is supplied by all the production of the companies extracting pozzolanic earth in Pella Prefecture:

- Kyvos Co. SA with two mines: Profitis Elias Pella producing 70,000 tpa of grey pozzolan, containing 30-40% amorphous SiO_2.
- Xifiani Aridea producing 4,000-5,000 tpa of white-grey pozzolan, containing 40-50% amorphous SiO_2.
- Hellenic Pozzolanes Co. SA with two mines in Apsalos Aridea producing 8,000-10,000 tpa of white pozzolan, containing 50-55% amorphous SiO_2.

Quartz

Abundant quartz sands of terrestrial or fluvial origin for building use exist in many regions of Greece. Sand mines with or without permits operate in riverside areas of almost all of the rivers. Quartz sand of 1.2m tonnes has been found in Skalochori Kozani, which after processing gave 94-96% SiO_2 and 0.04-0.08% Fe.

Also, small deposits of quartz sand have been found in Argos Orestiko Kastoria, and of quartz pebbles of 400,000 tonnes in Achlada Florina.

Quartz sand of terrestrial or fluvial origin of high quality has not been found so far in Greece, and for this reason it is imported.

A large number of quartz veins, usually of small dimension, intercept the crystalline schist rocks of the Rhodope, Serbomacedonian, Pelagonian and Attiko-cyclatic Zones. Moreover, flint has been identified in Doriskos Evros and porcelanites in Aridea and Kozani. The quartz of Roussa Evros is of very good quality, but it has not exploited yet.

The milky quartz of vein origin partially covers the needs of the Greek ceramic industries. The reserves under exploitation are found in the Prefectures of Thessaloniki (Examili), Kilkis, Chalkidiki and Larissa, and have started the necessary procedures for the exploitation of new valuable deposits in the Prefectures of Trikala, Kozani, and Imathia.

Production of quartz is about 15,000 tpa. The annual requirement for quartz in the Greek ceramic and glass industries is about 80,000 tonnes.

The only company producing quartz is Mevior SA, whose processing unit operates in Assiros, Thessaloniki. Of the total production around 20% is exported. The rest is consumed by domestic ceramic and glass industries, for the production of sanitaryware and porcelain, and glass products (eg. Vitruvit, Ionia Porcelain, Youla, with about 1,500 tpa each).

A second feature on Greek mineral prospects for exploration and exploitation will follow in IM February 2012.

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