

The Mining History of the Island of Milos

The genesis of the greek land

Hundreds of millions of years ago, the land of Greece was covered by the sea. The sea floor, from the Ionian Sea to Asia Minor, had a peculiar morphology, which formed the basis for the creation of the greek peninsula with its high central mountain ranges. In the location of the Pindos massif, there was a deep submarine trench - the Pindos trench. The Ionian trench extended farther west, while a high wall - the Gabrovo ridge - separated the two trenches.



VUE DU PORT DE MILO.

The sea floor assumed this form approximately 180 million years ago (in the early Mesozoic era) and maintained it for another 150 million years until the Oligocene. In this inconceivably long period of time, the two trenches filled with sediment from the weathering of far-off mountain masses or from shells of marine animals and remains of microorganisms, which fell like everlasting rain as they died and settled on the sea floor.

Meanwhile, 140 million years ago, in the early Cretaceous, a major orogenic event elevated the so-called Pelagonian range, a narrow strip of land including the northernmost part of Macedonia (Pelagonia), Mt. Olympus, Eastern Thessaly and Northern Euboea, above sea level. The so-called Attic-Cycladic mass, including Attica, South Euboea and most Cycladic Islands, is regarded as the extension of that mountain range.

Thirty five million years ago (late Eocene), when the Pindos trench had already filled up, a real cosmogony occurred in the depths of the Greek earth, caused by the violent convergence and collision of continental plates (the African and the Eurasian plates). Following a mighty upward push, the trench sediments materials folded and rose, forming the impressive Pindos ridge. Alpine folding also occurred during this period.

Millions of years went by. After the Pindos

trench, the Ionian trench filled up in its turn, mainly with weathering products, while in the early Miocene (15 million years ago), another tectonic event caused the emergence of the largest part of Western Greece. Thus, Aegeis came up from the bottom of the sea as a solid and undivided land mass covering approximately the present area of Greece from the Ionian sea to Asia Minor and to the south of Crete.

Three million years ago (middle-upper Pliocene) explosive volcanic activity occurred as a result of a new collision of continental plates, which -through its various stages- created the minerals mainly mined in Milos today.

At the end of the Pliocene (two million years ago), the Mediterranean waters began to move. This was the beginning of the formation of the Aegean sea.

As the centuries passed, the sea moved inland, slowly but surely. The land mass of the Aegeis became fragmented in some places, and submerged in others. Huge lakes were formed.

The final stage was completed during the Pleistocene (2 million - 10,000 years ago), by which time, following a series of land submersions from sea transgressions, the land of Greece had essentially assumed its final form, while the volcanic activity had subsided 100,000 years before.



Silica



Barite



Gypsum



Manganese Ore



Obsidian

The principal volcanoes of Greece -those of Aegina, Methana, Milos, Kimolos, Polyaiagos, Folegandros, Thera, Nisyros and Kos- formed a 220 km long volcanic belt extending along the borders of a submerged land mass and became "laboratories" of valuable minerals, which man has used ever since prehistoric times.

All these cosmogenic events, which we have attempted to describe in an extremely abbreviated form, resulted in shaping the geographic and tectonic features of the land of Greece, consisting of six main and several secondary geotectonic zones, which contain a great variety of igneous, sedimentary and metamorphic rocks including an equally wide variety of ores and minerals.

There is no doubt that there exists a causal relationship between the genesis of minerals and certain geologic activities, such as magmatic activity, sedimentation, weathering and dynamic metamorphism of rocks. These activities have played a determining role in the formation of Greece during the various geologic periods. The result of these complex processes are a variety of deposits, as already mentioned, some of which occur in considerable quantities compared with the size of the country.

It was only natural that this great variety of useful rocks, ores and minerals should give rise to a significant mining history in Greece, which goes back to remotest times and whose beginning are lost in the haze of legend.

The evolution of mankind - The first men on Cyclades islands

Unquestionably, man or even the anthropoids preceding man have been inseparably linked to the earth since they first appeared on this planet, and they were greatly dependent on mineral materials. After an extremely slow process of evolution of the species, which lasted hundreds of thousands of years, the various kinds of pithecanthropus primates made their

presence felt on earth: Pleiopithecus, Dryopithecus, Oreopithecus, Australopithecus. They all struggled to survive, and it is truly amazing that they succeeded in an extremely unfavourable and hostile environment, characterised by climatic changes hardly bearable to living organisms, and cataclysmic tectonic events.

During the unceasing succession of centuries, they evolved morphologically and mentally. Thus, some 500,000 years ago, the first man to stand up right (homo erectus) appeared, followed, about 100,000 years ago, by the Neanderthal man, and finally, 35,000 years ago, by homo sapiens, intelligent contemporary man.

Primitive man, recognising the useful properties of hard stones, used them to make his first tools and weapons, and these remained the same for a very long period of time. The Paleolithic era is considered to occur almost contemporaneously with the appearance of homo erectus and it lasts to about 8000 B.C., i.e. for 500,000 years at least. In the ensuing middle and then the Neolithic, which lasted at least, as far as Greek pre-history is concerned, for more than 5,000 years or from 8000 to 2800 or 2700 B.C., tools are perfected and some are polished for use, among other things, in the processing of wood. At the end of the Neolithic, man stands at the dawn of a new era, known for the introduction and then general utilization of metals: the Bronze Age.

Skulls and other finds from beings who lived in the Paleolithic have been discovered in many parts of the world: In Transvaal, Tanzania, Zambia, China, Algeria, Belgium, France, Italy, Russia, Greece, etc. This is not of particular consequence: what is significant is the history and the culture of the various groups who lived in specific geographical areas.

The oldest traces of human habitation located in the Cyclades date back to the end of the 5th millennium B.C. The mild Cycladic climate favoured early settlements and the strategic geographic location of the islands supported the development of one of the earliest civilizations in Europe.



A panoramic view of the Voudia bay first installations of Silver & Baryte Ores Mining Co. S.A (today S&B Industrial Minerals S.A.)

Due to its volcanic origin, the subsoil of Milos contained considerable quantities of obsidian, a smooth and hard, grey-to-black rock, which lent itself to making tools and weapons. This obsidian was of extraordinary quality and Milos was the only source of supply. Small quantities of obsidian, most probably coming from Milos, recently found in the Greek mainland were examined by geochronology methods and part were dated to the 11th millennium B.C., namely to the upper Paleolithic, and part to 7250 B.C., the Mesolithic period.

These findings indirectly point, not only to the existence of the most ancient known navigation in the world, but also to the presence of human beings on Milos as early as the late old stone age, that is earlier than any of other Cycladic islands.

However that may be, it is certain that by Neolithic, when commerce had begun to flourish in the Aegean, Milos exported obsidian to Crete and to other Aegean islands, to mainland Greece and to Asia Minor. A significant piece of information is that stonework containing large quantities of obsidian from Milos was discovered in a very ancient pre-ceramic settlement at Knossos dating from the 7th millennium B.C.

Later, beginning in the old palace period (down to 1400 B.C.), a trading station for obsidian operated in the town of Phylakopi, which flourished throughout the 2nd millennium B.C. All this leads to the conclusion that unlike the other Cycladic islands, the inhabitants of Milos discovered and exploited obsidian, an inexhaustible source of island wealth, at a fairly early stage.

Increasing requirements for the manufacture of more sophisticated stone tools for all kinds of uses before, but also after, the advent of copper in the Aegean (3000 B.C.), could only be satisfied

by the use of flint and obsidian. Thus, the demand for Melian obsidian led part of the population to work in quarrying and processing the rock and in the organisation of its trade, which was undertaken principally by the second town of Phylakopi, built around 2000 B.C. It can be said, therefore, that obsidian played an important part in the economic growth of the island during the above-mentioned periods.

The everlasting importance of the Greek mineral wealth

If we attempt a more general review of mineral exploitation in Greece during the 3rd and 2nd millennia B.C., we must note that there was no noteworthy mining activity in this early period. There were however, fairly large quantities of native and alluvial gold in Northern Greece (Macedonia, Thrace, Thassos), the exploitation of which is associated with the first mines in Greek territory. The sources of metals that were used subsequently, in the period between 1125 and 800 B.C. is unknown. One must bear in mind that there are no ancient writings referring specifically to minerals and mines, with the exception of "on Stones" by Theophrastus who was born in Eressos, Lesbos in the year 372 B.C., though occasional or fragmentary references to mining, metal processing and metallurgical activity occur in several ancient writers, historians and geographers, such as Hesiod, Aristotle, Strabo, Diodorus, Herodotus, Xenophon, Pliny, Plutarch, and others.

However, beginning during the period of Greek antiquity, which includes the last eight centuries B.C., Rhodopi, Mt. Pangaeon, Thassos, Laureotica, Kythnos, Serifos, Sifnos etc.

grew into important mining centres, while Milos had developed mining and trade of a variety of minerals for special uses, which will be referred to in what follows.

There is no doubt that Laurion is the leading site of ancient Greek mining activity. When silver production started there is unknown, possibly in 1500 B.C. or even earlier. Xenophon wrote in 355 B.C.: "It is clear that the activity is very ancient but when it started, no one can attempt to say".

The fact is that in ancient Greek times, from the 8th down to the 1st century B.C., 3,500 tons of silver and 1,400,000 tons of lead were produced in Laurion. It is well known that Laurion silver played a significant role in the history of the ancient city-state of Athens. That role was immeasurably important and decisive at certain historical moments not only for Athens but for Greece in its entirety. Increased silver production three years prior to the sea-battle of Salamis enabled the Athenians to defeat the Persians. Irrespective of that, Laurion developed an admirable mining and metallurgical technique over the centuries.

The minerals of Milos

The subsoil of Milos did not contain sufficient quantities of minerals from which metals could be extracted. However, it did include a variety of minerals for specialised uses. The following were mined and traded:

Sulphur: Large quantities of sulphur were mined in Milos in the ancient Greek era. It was used for disinfecting, antiseptic and religious purposes.

Porous stone: Used in what were then considered large buildings and public edifices.

Trachyte: Large quantities of this mineral were quarried in Milos. It was used to make millstones used in the grinding of cereals or harder materials. It was possibly exported to Laurion to be used in ore crushing.

Kaolin: Used by painters to produce white paint. Also used in pottery.

Pumice: Used in polishing mosaics, skins, etc.

Alunite (alum): Used in the preparation of medicines as an active material or an ingredient of drugs.

In addition, some quartz sands and various composite siliceous minerals were undoubtedly used for some applications.

Even in the ensuing centuries of decline in the Aegean islands, during the Roman and the early Byzantine periods, quarrying continued in Milos.

For reasons which are beyond the scope of this presentation, the Romans prohibited the operation of all Greek mines with only some limited-time exceptions. Quarries were not included in the ban. Quarrying products and minerals of use to building, architecture, sculpture, medicine and other arts and sciences were abundant in Greece and of incomparable quality. So, thanks to its mineral products, which were unique and highly prized throughout the Roman empire, Milos experienced considerable economic prosperity under the Roman rule. Production of trachyte, sulphur, alunite, and pumice, used for polishing the famous Roman mosaics, continued.

Alunite was a product in short supply as it was considered the best in the empire. Sulphur arrived in Roman ports on board special vessels, while armeniac bole, another much sought-after Melian mineral, a coagulate of silica manganese hydroxides and a slightly reddish-tainted iron was used in medicine for the arrest of bleeding.

From the beginning of the Byzantine era onwards, millstones were much in demand and they were exported as far away as Egypt and Italy. In fact, a "Kommerkion" or customs house for minerals was set up in Milos.

It is well known that the Byzantine administration failed to realize the importance of rational exploitation of the abundant and varied mineral wealth in the Empire as a means of enhancing its power. Its interest was limited mainly to gold, silver and precious stones. This tragic mistake in combination with its indifference to the development of all sectors of the economy, eventually led to chaos and to its pitiful end in 1453 A.D.

The mistake was repeated by the Ottoman Empire and led it to the same end as Byzantine era. During the period of Turkish rule, only a few small mines operated in Greece: Thassos, Euboea, Sifnos and Thrace, and even these operated at rudimentary level. The only efficient and productive mines were in Chalkidiki, the famous "mademochoria" (metal villages).

In Milos, the inhabitants avoided intensive mining, otherwise the Turkish rulers would only increase their taxation. It should not be overlooked that the inhabitants of the Cycladic island lived for a considerable part of the Turkish rule under a regime of triple domination: Turks, Latins and pirates. Indeed after the unprecedented assaults of Barbarossa in the 16th century, few islands, including Milos, remained inhabited. Nevertheless, Milos with its spacious port, continued to export sulphur, alum and salt from its famous salt pans, alongside a number of agricultural products. The Melians also made hand-mills which they exported to Constantinople, Egypt, the Peloponnese, Zante, Cephalonia and Ancona.

Between 1600 and 1700 A.D. the island had brisk commercial activity, possibly due to the buying and selling of the pirates' loot.



Quartz



Perlite



Sulphur



Bentonite



Kaolin

The exploitation of the mineral wealth of Milos

Following liberation from Turkish rule, the Greek state begins to deal in a rather more or less systematic way with mines, some 30 years after its establishment.

On August 24, **1861**, the first law "On mines and quarries" is published in the Government Gazette. Until then, only small quantities of lignite, emery, Thera earth, gypsum and millstones were mined.

In **1862**, the first Concession is issued in the name of Vas. Melas concerning the exploitation of sulphur at the site of Palioremma on Milos. This concession was subsequently extended to other sites. It has to be noted that a few years later, developments concerning the exploitation of the Laurion mines began, that led to the notorious Laurion Affair (1871-73) which resulted in the resignation of two governments.

To return to Milos, the sulphur mines were in full production by **1890**, turning out some 15,000 tons annually. Production was stopped in 1905.

In **1886**, the "Sifnos-Euboea Company" mined galena for lead and silver in the area of Triades, after three years of previous mining activity for related minerals in the same area.

The extraction of a manganese (pyrolusite) deposit at the site of Vani began in **1890**. This activity was permanently discontinued in 1928.

In **1899**, the importance of the Kaolin found on Milos was revealed. Kaolin production in the 1960's amounted to 100,000 tons annually. The Klonaridis plant, built in 1925 as a Kaolin processing plant, was recently renovated by the ORYMIL Company to serve as a centre for cultural events.

In **1934** the Silver & Baryte Ores Mining Co. S.A. acquired the rights to mine barite and established itself on Milos, in the area of Voudia. A serious effort began to ensure industrial



production of Milos mineral products. The company gradually grew to an impressive size and is now a leading producer of bentonite and perlite.

In **1952** the G. Bourlos company settled on Milos and began mining and selling kaolin and bentonite. G. Bourlos was a chemical engineer and a pioneer in the study of Greek bentonite since a considerable part of our knowledge about this mineral is due to his efforts.

In **1952**, the Svoronos brothers with the Zannos brothers and H. Triantis established the company known as "Milos Sulphur Mines S.A." Jas. Svoronos had taken out a patent on a process for extracting sulphur from sulfate-containing rocks in 1938.

In **1953**, MYKOBAR settled on Milos and started mining bentonite. In 1955 the first bentonite shipments were exported and a little later, in 1957, the first perlite shipments followed, after the great importance of perlite had been recognized in 1954.

In **1955** the company known as "M. Pamicaill S.A.", an affiliate of TITAN CEMENT S.A., acquired 50% of EMCHE, which was established on Milos since 1947, and started mining kaolin. In 1956, the quarrying of millstones was discontinued.

In **1958**, Sulphur Mines S.A. failed and a little later (1961), Eleusis Bauxites S.A. of the Skalistiris Group purchased the Milos Sulphur Mines. Still later (1978) these passed to M.B. & N. Enterprises S.A.

In **1988**, "Lava" S.A., an affiliate of AGET, a greek cement producing company, became established on Milos and started mining pozzolan from 1990 on.

In **1992**, following an international tender, Silver & Baryte Ores Mining Co. S.A. acquired relevant mining rights and started prospecting for deposits of epithermal gold on Milos.

Finally, to complete the story, we must mention the efforts extended by the Public Power Corporation to exploit geothermal energy. After a leakage in the facilities of the geothermal field and the resulting problems, the work which had been started a few years earlier in association with MITSUBISHI of Japan was suspended indefinitely. Also, the Milos salt pans, a state-owned enterprise and an old state monopoly, were conceded for exploitation to Greek Salines S.A. in 1985.

At present, Milos is the greatest production and processing center for bentonite and perlite in the European union. Seven hundred thousand tons of bentonite and 450,000 tons of perlite are mined and undergo the first stage of processing on Milos. More than 90% of these quantities is exported. Apart from these two basic minerals, Milos exports kaolin, pozzolane and silicates and continues to produce small quantities of baryte.

This is the mining history of Milos. To avoid making its presentation too tedious, I have tried to vary it by the addition of some geological and historical data. Still, I believe that even lay persons must realize that Milos contains such a large variety of rocks, ores and minerals that they make the island itself a great mining museum.

I think that the intention of the founding company, Silver & Baryte Ores Mining Co. S.A., in establishing the Mining Museum was indeed to create a miniature of that far greater one and to present it not only to the inhabitants of Milos but to all the Greeks, as the first museum dedicated solely to mining in the country. The absence of a mining museum in Greece was certainly inconsistent with such a rich and incomparable mining history going back to the remotest antiquity. A museum of this nature is certainly to inspire admiration by the wealth of its exhibits and of the information presented.

General conclusion

Ever since the Neolithic period, Milos has largely relied on mining, processing and trading obsidian. Now, ten thousand years later, Milos still relies largely for its economic growth and the improvement of the living standard of its inhabitants, on the exploitation of its mineral wealth.



Milos Isl.



Legend

- | | |
|-----------|---------------|
| Bentonite | Silica |
| Kaolin | Pozzolan |
| Zeolites | Manganese Ore |
| Barite | Millstones |
| Perlite | Obsidian |
| Sulphur | |



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