The Greek island of Milos

Milos is one of the less visited of the Aegean islands, though it has achieved its own fame as the site where the classical sculpture of the Venus de Milo was unearthed. The statue is now in the Louvre in Paris, but a notice marks the spot where it was found and the Milos archaeological museum has a replica. The original was carved in marble so it could not have been quarried locally; unlike most Aegean islands that are made of limestones, Milos is volcanic. It forms part of an island arc that includes the rather better known island of Santorini. The volcanism is caused by the remnants of the Tethys oceanic plate being subducted under the Aegean-Anatolian micro plate, driven by the northwards movement of the African plate. Volcanism on Milos was from 3 million to 10,000 years before present, but hydrothermal activity continues and has been responsible for much of the mineral riches of the island. Milos is made almost totally of rhyolite, though in different forms and variously subjected to subsequent hydrothermal alteration.

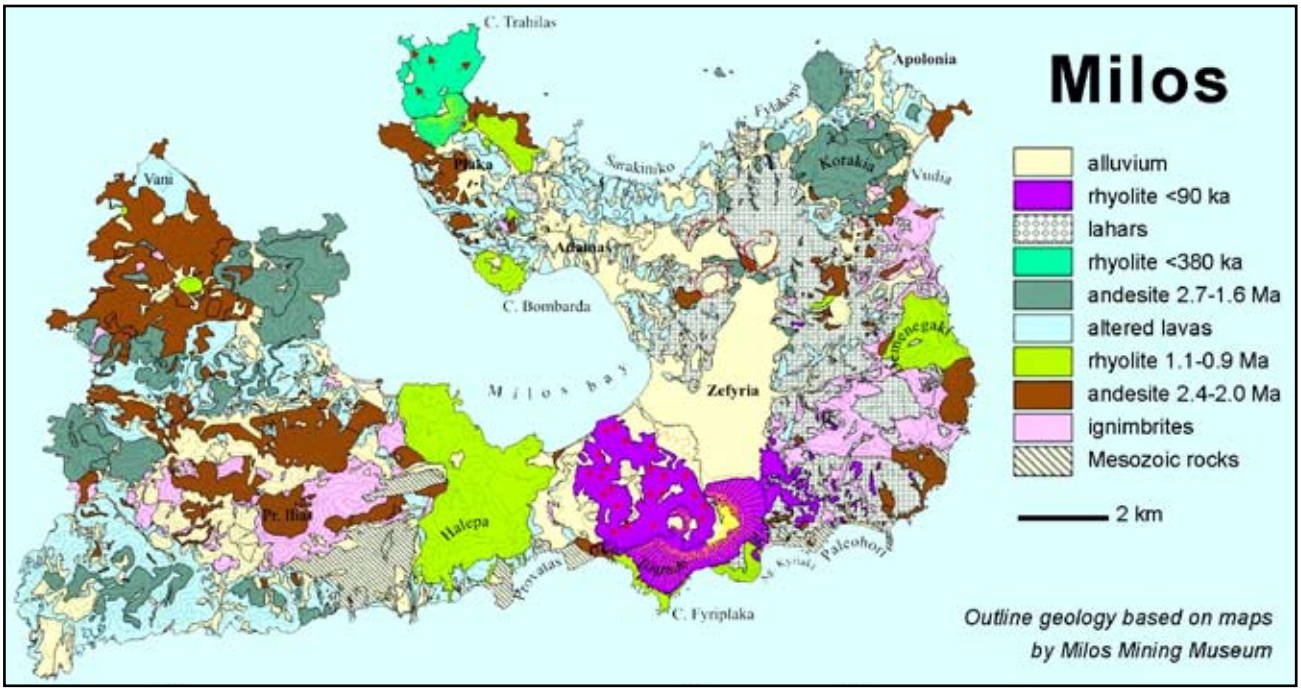
A geological visit to Milos should start at the excellent Mining Museum which has a fine display of the island's minerals, with explanations of their economics and mining history. The Museum produces a series of seven Geotrail leaflets (also at www.miloterranean.gr) containing maps for walks and drives to locations of geological, botanical and antiquarian interest. Each Geotrail gives the time required to complete it, by car, by bike or on foot. Most of the routes are a mix of tarred road, tracks and a few foot paths. We found it best to drive the tarred roads, as stopping is generally easy, and then hike the rough tracks to see more. Most roads are good, but the mine trucks make their presence felt.

Contact between columnar rhyolite and bedded tuff.

Milos shows similarity with Santorini as its large bay is another flooded caldera, with headlands of rhyolite on each side of the bay's entrance. Southeast of the bay, a large topographic bowl is another volcanic crater on the same northwest-southeast alignment.

The first mineral to be exploited on Milos was obsidian, in Neolithic times. It occurs in bands within the rhyolitic tuffs, and looks very similar to chert in limestones. There are two areas of old mining with extensive waste tips of obsidian flakes. The stone was partly shaped on site, but the lack of partly-finished tools indicates that "cores" were exported before finishing.

A major modern export is perlite. This is formed when rhyolite lava is erupted under water and absorbs large quantities of sea water in microscopic bubbles that give its surface a distinctive pearl-like appearance. The now-uplifted lava flows show characteristic submarine features. Perlite is easily sawn and has been the main building material on the island. Its modern use is in the manufacture of crushed perlite, which is exported



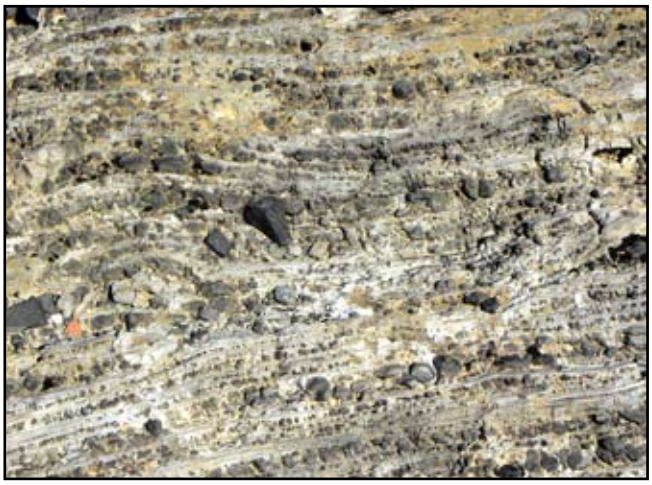
A touch of steam indicating hydrothermal activity.

in bulk carriers. When heated to 900°C, crushed perlite expands explosively to 10 or 20 times its volume, forming a very lightweight flaky material. This is used as insulation in cryogenic industrial processing plants, and is also used as a growing substrate for horticulture.

Further economic minerals found on Milos are all the result of the ongoing hydrothermal activity. Sulphur has been collected for use as an agricultural fungicide for many years. Manganese was mined commercially until around 1920. Veins in the tuffs yielded silver and barite in the past, and gypsum has also been exploited from the tuff veins on a small scale.

Hydrothermal alteration of the feldspars within the tuffs produces a mixture of clay minerals that is dominated by montmorillonite. This is quarried on a massive scale, and the clays are exported in bulk carriers. Most of the product is marketed as bentonite, which has the useful property of being able to absorb two to

Tuff boulders within diatomite.



Bands of obsidian fragments within a well-bedded tuff.

three times its own volume of water because its main component is the montmorillonite. Bentonite's main industrial uses are as a binding agent (to be mixed with sand to make moulds for iron casting) and as drilling mud (with a density high enough to carry chippings up the drill string to the surface); it is also well known as cat litter. Exports from Milos also include smaller quantities of alumite that is used in the pharmaceutical industry, and kaolinite that goes into the manufacture of pottery, paint and paper.

Tourism comes second to mining in economic value to Milos. There are many beautiful beaches of near-white sand, and some of those on the north coast are backed by blindingly white cliffs. On closer inspection these cliffs can be seen to be made up of three white rocks - tuff, limestone and diatomite, all of which were deposited in water. The tuff is mainly pumice and has many fossil burrows, whereas the Neogene limestone is contains many bivalves. The diatomite is blindingly white and can be seen to consist of laminations about a millimetre thick. In places the diatomite surrounds boulders of pumice, which in turn contain fragments of obsidian. The diatomite looks very similar to chalk, but is made of the silica shells of microscopic diatoms.

In spite of the mining activity, Milos is a very beautiful island. It has some fascinating volcanic geology, is covered with wild flowers in spring, and is an important stopping place for migratory birds; a fine place to visit, and easily reached by plane or ferry from Athens or Piraeus.

Alan Filmer

One of the large bentonite quarries.