A VISIT TO THE SUBDUCTION FACTORY OF ALPINE CORSICA, FRANCE

Corsica, the native land of Napoleon, is a French island separating the Tyrrhenian Sea from the Gulf of Lyon in the western Mediterranean. Corsica has had a long and complex history, as ownership has been disputed several times by France and the Republic of Genova – now Italy – and the island has even been independent for a short while (1755–1769). The result is a mixing of different cultures – the "Corsican" language is actually quite similar to Italian – and a distinct identity.

The Nonza serpentinite beach (bottom right) and the Canari asbestos mine beyond. The beach is recent and is composed of mining debris thrown into the sea and returned naturally to the coast during the 20th century. The mine was exploited for asbestos between 1948 and 1965.

The Roman San Michele church in Murato built by the Pisans in the 12th century exhibit remarkable naive motifs. Image courtesy of Doug Rumble, Carnegie Institution

The Santa Reparata chapel (Morosaglia, Alpine Corsica), initially built by the Pisans in the 11th century, is composed of various schists from Alpine Corsica. The granites of Hercynian Corsica are in the background.

Corsica is home to natural wonders in its mountains and along its coast, and it also boasts fantastic geology. The geological map of Corsica depicts two main ensembles: to the west and south is Hercynian Corsica, composed mainly of Precambrian to Permian continental basement, and to the northeast is Alpine Corsica, which is equivalent to the Tethyan western Alps and Apennines.

Alpine Corsica is one of the world's best-preserved and best-exposed examples of subduction geology. Closely associated ophiolites and continental basement rocks are exposed in a relatively narrow and accessible mountain belt, and they span the complete range of metamorphic conditions of shallow to deep subduction. For centuries, the belt has been a source of a variety of natural resources. For instance, serpentinites are widespread in Alpine Corsica and have been exploited for various applications from very ancient times. The spectacular setting and still huge environmental impact of the Canari mine in Cape Corsica remind us that it was among the biggest asbestos producers in Europe in the mid-20th century (more than 30,000 tonnes in 1961). Waste material from the mine was dumped into the sea, and then it returned to the coast where it produced the dark and immense serpentinite beach at Nonza. In the mountains of Cape Corsica and in the Castagniccia region ("chestnut region"), one can find the remains of small mines formerly exploited mainly for iron and copper. Some of them go back to very ancient times as mining in neighbouring Elba Island started with the Romans. Mining is now over, but it was often brutally ceased with little consideration for environmental impacts.

The wide lithological variability of Alpine Corsica has inspired a multitude of different architectural styles over time. The San Michele church in Murato (12th century) is a wonderful example of Pisano Romanic style, with alternating greenstone and marble derived from the surrounding ophiolites. The cathedral of Nebbio (Romanic, 12th and 13th centuries) is entirely made of calcarenite from the nearby Miocene Saint Florent basin. Throughout Cape Corsica and the Castagniccia region, churches and bell towers dominate the traditional villages, which are built of local marble, calcschist, serpentinite and eclogite.

Alpine Corsica is home to fantastic subduction petrology and mineralogy. The geological "beauties" of Alpine Corsica make this a unique high-pressure mountain belt. A drive through the metamorphic terrane of Alpine Corsica provides a natural cross-section through the blueschist–eclogite transition of a subducting slab. The high-pressure mineral assemblages typical of subduction zone metamorphism are extremely well preserved. These include carpholite, aragonite, glaucophane, omphacite and lawsonite. Although these minerals are also characteristic of the metamorphic history of other well-known mountain belts, such as the western Alps and the Cyclades, their preservation during exhumation is indeed quite rare owing to severe overprinting during decompression. Delicate minerals such as lawsonite, carpholite and aragonite are widely preserved in the blueschist and eclogite facies rocks of Corsica, where only weak overprinting occurred during exhumation to the surface.

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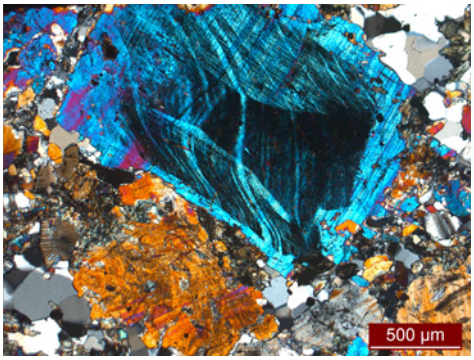
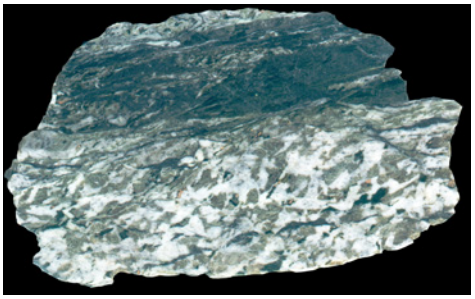
Weak deformation and overprinting in Alpine Corsica provide an exceptional view of the processes of fluid–rock interaction during subduction. Fluid–rock interaction was locally intense along lithological boundaries and generated unique petrological features. In the Mount San Petrone area (Parc naturel régional de Corse, Castagniccia region), rocks composed almost exclusively (>70%) of the hydrous mineral lawsonite (lawsonitites) are found in metasedimentary and gneissic sequences in contact with serpentinites. These dense rocks are remarkable as they can potentially carry huge amounts of water (lawsonite contains ~12% water) into the deep Earth. At the southern end of Cape Corsica, just above the famous vineyards of Patrimonio, complex stacking of carbonate-rich metasedimentary rocks and serpentinites is observed. At the interface between the two lithological assemblages, fluid-mediated carbonate reduction occurred during subduction, producing graphite and wollastonite. This is an unexpected occurrence of wollastonite, which is more typically found in skarns formed by high-temperature fluid–rock interaction in contact-metamorphic aureoles. The reduction process was remarkably efficient as it generated high concentrations of graphite (up to several weight percent) with high cristallinity under low-temperature conditions (less than 500 °C, whereas the industrial synthesis of similar graphite requires temperatures above 2000 °C).



Photomicrograph (crossed polarizers) of a lawsonite-rich metasomatic rock from the Monte San Petrone unit (Castagniccia region). Formed at eclogite facies conditions, the rock consists mainly of lawsonite and quartz. The large lawsonite blast in the centre includes abundant graphite exhibiting a complex superposition of textural zoning, including hour-glass sector zoning and relicts of the former folded schistosity.

Serpentinite boudins in a metasedimentary matrix, Cape Corsica. Note the reaction zone at the interface between the two lithologies.



Scan of blueschist facies pseudotachylyte cutting Cima di Gratera gabbro, Cape Corsica. Width of view = 12 cm. Image courtesy of Torgeir Andersen, University of Oslo

The city of Saint Florent has been an important harbor in western Corsica through the ages, as indicated by various remarkable landmarks, including the citadelle, built by the Republic of Genova in the 15th century. In the background, the Miocene Saint Florent limestone (where the Patrimonio wine grows) and the Schistes Lustrés complex form the ridge of Cape Corsica (also seen in the banner photo above).

At the base of Mount Gratera, in the same area, a unique occurrence of subduction-related, high-pressure pseudotachylyte is found in a fossil blueschist facies fault zone separating metagabbro and peridotite. The pseudotachylyte is interpreted as having formed during deep earthquakes in the Alpine palaeosubduction zone.

Alpine Corsica offers a fantastic and largely unexplored setting for subduction zone petrological studies, compared to other belts such as the nearby western Alps. The rocks of Alpine Corsica have seen increasing interest in the last few years, heralding a period of exciting new research in this unique area.

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