



The Earth is a living planet and its intense internal and external geological activity generates a wide variety of rocks.

What is rock?

It is the material that makes up the Earth's crust and mantle. It is natural in origin and has a solid state. Rocks are mainly made up of minerals (a single one, such as with marble, or various, as with granite), but may also contain glass (as with basalts), fossils (limestone) and even organic matter (coal). Rocks are classified into three large groups by origin: igneous, sedimentary and metamorphic.

And a mineral?

Minerals are the main component of rocks, and their main characteristics are their crystalline structure and a defined chemical composition. In other words, their atoms are arranged in a regular network or pattern. Minerals are solid and formed by physical and chemical geological processes. They have specific physical properties such as luster, cleavage, hardness, tenacity and density, while other properties, such as colour or fluorescence, can vary.

Magmatic or igneous rocks

These are formed by the cooling of magma produced by the fusion of rock at high pressure and temperature inside the Earth. When magma cools slowly at great depth, it forms plutonic rocks (such as granite), whereas if the magma reaches the surface, it cools very quickly, forming volcanic rocks (such as basalt).

Sedimentary rocks

These are formed through physical, chemical or biological processes on the Earth's surface. Weathering by atmospheric agents, mineral alteration and biological processes breaks down rocks, producing sediments that are transported by water or wind, often far from their original location, where they are eventually deposited, consolidated and cemented (e.g. sandstone and conglomerate). Biological and biochemical action can also create new types of rock (limestone, travertine and coral reefs), as can the evaporation of sea water (chalk, salt), among other processes.

Metamorphic rock

When rocks in the lithosphere (the outermost rigid layer of the Earth) converge and collide due to the movement of tectonic plates, they are subjected to immense pressures and temperatures that, without melting them, transform their mineralogical and structural composition (e.g. marble, serpentine).

ROCK, THE RAW MATERIAL

IGNEOUS ROCKS

1 PEGMATITE (Les, Catalonia)

Pegmatites are intrusive, or plutonic, igneous rocks mainly composed of quartz, feldspar and mica. They are characterised by a distinctive texture made up of large crystals, sometimes measuring several centimetres, and their rich mineral composition. They are very hard and strong, formed in the final stages of magma crystallisation, and often have striking banding in their composition. Because they are so hard and formed of large crystals, they are difficult to sculpt and polish, but are highly prized as ornamental stones. The exhibited piece is a blue pegmatite, with alternating, gently folded bands of feldspar and quartz.

Sample provided by the quarry Azul Aran, S.A.

2 GRANITE (Órrius, Catalonia)

Granite is an intrusive igneous rock formed out of cooling magma deep within the Earth's crust. The cooling occurs at high pressures and temperatures and is therefore very slow, allowing well-developed crystals to form. Granite is primarily composed of quartz and feldspars, along with accessory minerals like black biotite, as seen in this specimen. Granite is a very hard rock that is difficult to polish. It is commonly used as a construction material. Granite can have a wide variety of textures and colours. Thus, there are white, grey, pink, blue, black and red granites, like those quarried in Aswan, Egypt, which were used to carve the great monuments of the Pharaonic Era.

Sample provided by the quarry Pedracor, S.A.

3 BASALT (Fogars de la Selva, Catalonia)

Basalt is a volcanic igneous rock formed by the rapid cooling of magma that reaches the Earth's surface. Under these conditions, crystals either cannot form or are very small, resulting in a homogeneous, dark grey rock. Cooling also causes the lava to retract, which then consolidates into columns, often with a hexagonal base. It is a massive, homogeneous and very strong rock, suitable for outdoor sculptures. The spectacular columnar morphology of basalt, with its geometric faces, is a sculpture in itself, while its slenderness evokes the standing human figure. The exhibition includes a small column with a trapezoidal base, and also a fragment of a column with a pentagonal base and polished face. You can see the very fine-grained texture of the volcanic rock, which may have small pores and inclusions of minerals such as olivine, pyroxene and feldspar.

Sample provided by the quarry Can Sapoia, S.L.

4 CALCITE AND FLUORITE VEIN (Sant Fost de Campsentelles, Catalonia)

Hot water containing dissolved minerals can flow through cracks in rocks, and under certain conditions, this process can lead to precipitation, forming what are known as mineral veins or lodes. Uncommon and often highly valued minerals can form in these veins. They may contain metals with economic value or minerals that can be used for small-scale sculptures. The exhibited piece has large white calcite and violet-tinged fluorite crystals, in contact with the granite host rock for the vein. This sample is highly fluorescent under ultraviolet light, where the fluorite crystals appear as purple and the calcite crystals deep red.

Sample provided by the quarry Canro, S.A.

SEDIMENTARY ROCK

5 GYPSUM var. ALABASTER (Rodén, Zaragoza)

Alabaster is the very fine-grained, massive variety of gypsum. Gypsum is a rock composed of the mineral of the same name, formed in environments where seawater can evaporate, causing dissolved minerals to precipitate. These sedimentary environments are termed evaporitic and are also involved in salt formation. Gypsum crystallises in a variety of forms, one of which is alabaster, a massive, very fine-grained gypsum, usually white and translucent in appearance. It is a very soft mineral, which can be scratched by just a fingernail. This makes it very easy and pleasing to work with, producing spectacular transparencies. However, its softness means it is very delicate, unsuitable for outdoor sculptures, and requires very careful handling. The exhibited piece is a massive nodular alabaster gypsum, featuring a cut and polished nodular, while the rest of the rock is in its natural state.

6 SPELEOTHEM (Gavà, Catalonia)

Speleothems are a type of limestone that forms from the precipitation of calcite in caverns, such as in stalactites or stalagmites. Carbonate-saturated water flowing through fissures in limestone massifs, where dissolution and reprecipitation constantly occur, produces the spectacular modelling and shapes found in karst caves, such as in El Garraf in Catalonia, or the El Drac caves in Mallorca. Speleothems are sculptures in their own right, and the precipitation process creates a multitude of shapes and reliefs with intricate banded and radial internal textures. In the exhibited sample you can see a reddish speleothem with radial textures, in contact with grey calcareous rock.

7 BIOCLASTIC LIMESTONE var. BROCCATELLO OR RIBBON JASPER (Tortosa, Catalonia)

Bioclastic limestone is a sedimentary rock formed by accumulation, compaction and cementation of organic remains on the seabed. It is a strong, homogeneous, very compact type of rock, which can be polished to a very high quality. The distinctive texture and jaspered aspect of the rock is produced by numerous fragments of marine fossils, and its striking appearance has earned it the names 'broccatello' and 'ribbon jasper'. In Roman times, the stone was greatly prized and known as Dertosa Marmor. It was exported throughout the Iberian Peninsula and even to Rome, the very capital of the Empire, for use as stone slab and architectural elements. The Cathedral of Saint Mary of the Ribbon in Tortosa is built from this mineral. The sample from an old abandoned quarry in Tortosa. The limestone is fluorescent under ultraviolet light.

8 MICRITIC LIMESTONE (Garraf, Catalonia)

Garraf Stone is a micritic limestone, a sedimentary rock formed in marine environments, often containing fossils of bivalves and other organisms. It consists of extremely fine-grained calcite particles and is a massive, fairly homogeneous rock, usually grey or brown in colour. Limestone is a very common and abundant rock, much used as a building material. It has a medium hardness, making it easy to cut, and it can be polished to a high quality. This sample was obtained from the La Falconera quarry, the first quarry in Garraf at the time. It probably provided most of the material used to build the facade and columns of the La Pedrera - Casa Milà building.

Sample provided by Promsa Grup Ciments Molins.

9 BIOCLASTIC LIMESTONE (Ulldecona, Catalonia)

Ulldecona bioclastic limestone is a sedimentary rock formed from the deposition and compacting of fossil fragments of marine organisms, such as shells and corals, consolidated by a calcite cement. The rock has a great textural richness, a homogeneous mechanical behaviour and great strength. This means it can be cut and worked, while its carbonated composition means it can be polished to a high quality. The distinctive texture and characteristic beige-orange colour of Ulldecona limestone was highly appreciated and frequently used by Gaudí in his works, and is still being used to build the Sagrada Família Basilica. The flooring and interior coverings of the La Pedrera - Casa Milà building are also made of slabs of Ulldecona limestone.

Sample provided by Marbres Castell, S.A.

10 MONTJUIC SANDSTONE (Barcelona, Catalonia)

Sandstone is a sedimentary rock formed by the accumulation of grains of sand in deltaic and beach environments, which are then cemented together to become a hard rock. The type and proportion of cement determines the hardness and behaviour of the rock. Montjuic sandstone is characterised by its siliceous cement, making it much stronger than other types of sandstone. Montjuic sandstone shaped the relief of the hill and was extracted from several quarries, from Roman times to well into the 20th century. The quarries can still be seen in places like La Foixarda, the Sot del Migdia, and the stage of the El Grec Theatre. The Barcelona wall, cathedral and most of its old town were built using this stone. Some of the columns in this room in La Pedrera - Casa Milà are also made of Montjuic sandstone. Can you tell which ones?

Piece of Montjuic sandstone, showing its rough texture, like sandpaper, caused by the cemented grains of sand.

11 FLINT (Montblanc, Catalonia)

Flint, also known as chert or chalcedony, is a variety of microcrystalline silica that occurs in nodules within sedimentary rocks such as limestone. It is an extremely hard material, which breaks in conchoidal fractures, producing very sharp edges. Flint was known and used in prehistoric times to make arrowheads, knives and other utensils, and also as firestone. Thus flint played a major role in the Stone Age. Its transparency and glassy lustre have made it a material for sculpture, despite its extreme hardness, the challenges of polishing it and its tendency to break in a concave manner. Onyx and agate are banded varieties of microcrystalline silica. The sample is a blue flint nodule showing the conchoidal fracture that generates sharp, cutting edges.

12 OOLITIC LIMESTONE (Azilal, Morocco)

Oolitic limestone is a sedimentary rock formed by the accumulation of spherical concretions (ooliths) on the seabed. Ooliths are small radial growths of calcite that form around inorganic nuclei of sand-sized particles, which are then cemented together to produce a rock. It is often porous, with medium to low hardness, which means it can be easily worked by sculptors. However, when not strongly cemented together, it can be fragile and tends to chip over time. Piece of black oolitic limestone with a polished surface.

Sample provided by Tazouta Quarry.

13 ARGILLACEOUS LIMESTONE (Cambriils, Catalonia)

Limestone deposits occur in marine environments and in some contexts they are influenced by alluvial currents that contribute fine-grained sediments. Argillaceous limestone forms in such conditions, such as deltaic environments, where a proportion of clay minerals is incorporated into the structure of the rock. It is a soft rock with a low degree of cementation which is easy to carve and can be given an excellent polish. However, it is not very durable, requires delicate handling and is unsuitable for outdoor sculptures. The exhibited sample is an argillaceous limestone with a yellowish-ochre colour, showing the softness of its texture.

METAMORPHIC ROCK

14 CORDIERITE AND STAUROLITE SCHIST (Arres, Catalonia)

Schist is a metamorphic rock formed under high pressure and temperature when tectonic plates collide and form mountains, such as the Pyrenees and the Alps. The process transforms pre-existing rocks in the Earth's crust, causing the growth of minerals, which are then oriented due to the immense pressure, generating foliation or planes of weakness. The high temperature also causes the growth of new minerals. This piece is a schist of muscovite and biotite, which mark the foliation of the rock. Within the rock you can see eye-shaped cordierite crystals and also staurolite in small brown prisms. Despite the rock's beautiful texture, its foliation means it is likely to break in planes, making it unsuitable for sculpture.

15 BIOTITE SCHIST (Les, Catalonia)

Schists are metamorphic rocks primarily composed of mica crystals (biotite and muscovite) with a planar morphology. This orientation defines the foliation planes or schistosity, along which the rock easily fractures. This preferred orientation of the minerals gives schists a highly nacreous lustre when viewed along the foliation planes, and a dull lustre when viewed perpendicularly to the foliation. Schist and slate have traditionally been used as building materials for roofs and flagstones. The exposed sample is a schist formed from black biotite mica, recrystallised to form a homogeneous block.

16 MARBLE (Carrara, Italy)

Marble is a rock formed by the metamorphism of limestone. High pressures and temperatures within the Earth's crust recrystallise and homogenise the rock structure, increasing its grain size and forming a regular mosaic of calcite crystals with geometric faces. Small impurities in the original rock produce the striking veining seen in certain types of marble. Historically, marble has been sculptors' favourite stone due to its medium hardness, which makes it easy to carve, and its high strength, pure white colour and excellent translucence.

Here you can see three pieces from the famous Carrara quarries. Two of the pieces are uncut blocks of natural marble, while the third is a cube of cut and polished marble.

17 BLUE MARBLE

Marble is a rock formed by a single mineral: calcite. When marble is pure it tends to be white, but in nature it can have a variety of colours, due to small inclusions, impurities or trace amounts of other elements, resulting in significant variations in colour. Thus you can find pink, grey, blue, reddish and black marbles. Strictly this type of rock. Other materials, such as limestone and even granite and serpentine, are often sold as marble, due to its prestige.

Sample provided by the Marble Technology Centre.

18 GRANITE-SCHIST CONTACT (Les, Catalonia)

In this sample you can see the contact between an intrusive igneous rock, granite, and a biotite schist, as the schist undergoes metamorphism due to the high temperature and pressure to which it is subjected. In this rock, you can see the contact between the white granite, an igneous rock formed by the cooling of magma, and its enclosing rock, which is a biotite schist.

In this piece, the granite is white, homogeneous, massive and very strong, with beautiful black tourmaline crystals. By contrast, the schist is composed of black biotite, with a nacreous lustre, showing pronounced foliation causing it to fracture along planes.

Sample provided by the quarry Azul Aran, S.A.

19 MARBLE (Naut Aran, Catalonia)

Marble can have different textures, depending on where and how it is formed. Carrara marble is highly prized for its homogeneity, pure white colour and fine grain size. There are also other types of marble, such as the sample here, which has a pink tone and in which you can clearly see the polygonal mosaic texture of the calcite crystals.

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