Subsoil: a resource

Building with rocks

Easily pliable limestones, sandstones and igneus rocks are often used for some specific constructions, like frames, building fronts, columns and pillars. In some rustic buildings, especially on the mountains, thin natural layers made of slate are used instead of roof tiles.
For extremely elegant buildings or monuments, marble, tufa and alabaster are widely used.
As a precious covering, sedimentary rocks with very pretty drawings are used. They are called “onyxes”. Magmatic rocks, metamorphic and especially calcareous rocks, which can be easily polished and are resistant to tear and wear are widely used for interior flooring. Instead, for road flooring, river stones or even more resistant rocks like granites, porphyries, syenite and gneiss are used. Gravel and crushed stones are used for roadbeds and railway ballasts (the ground where asphalt and tracks are set). In order to protect riverbanks, lake or sea shores, big heavy and very resistant rocks are usually used, especially compact and dark effusive and metamorphic rocks.

Iron working

Pure iron is very rare in nature. It can be found more frequently in combination with other elements inside minerals. These minerals are called iron minerals. Among them, the most important ones are haematite, pyrite and siderite. The first stage of iron mineral working occurs in hot furnaces and leads to the creation of a particular product that is called cast iron.
The hot furnace is made up of two cone trunks whose bases are interconnected and that have a cylindrical support. The furnace is 20-30 metres high and has an 8-10 metre diameter. Iron minerals, coal and fluxes (special materials that are used to eliminate that part of the minerals that cannot be used) are supplied from the top. From cast iron, through a “de-carburisation” process, steel is obtained. With a further “de-carburisation”, ductile iron is formed. De-carburisation is a cast-iron refining process. Carbon and impurities like silicon, phosphorus, sulphur and manganese are removed from the cast iron.

Bricks and ceramics

Clay is used as a raw material for different industrial productions, in particular for the production of bricks and ceramics (mainly bricks, roof tiles and tiles).
Also bentonite is important from the economic point of view. It is a special clay deriving from the alteration of volcanic ashes in a lake environment.
Bentonites are used for soil drilling (as they are able to support the hole walls), to build casting moulds in foundries, or as catalysts in oil cracking processes.
Another economically important group of clays are “fire-clays”, which are used for the production of refractory ceramics. These products resist at very high temperatures (more than 1500 °C) without being subject to any shape or volume modification.
Clays are used for many other productions: in the paper industry as a raw material for paper coating, for the production of insecticides, rubber, linoleum, and paintings..

Rocks as insulators

Asbestos is a material that was frequently used as an insulator in the past. In fact, asbestos is particularly resistant to high temperatures, and it is used for the production of cartons, fabrics and fireproof ropes. Since 1994 any use of asbestos has been prohibited, as this material releases hazardous fibres into the air, provoking serious diseases to the respiratory system. Vermiculite and perlite have been used more recently. Vermiculite is a mineral that is extremely full of water and that is “expanded” as a result of heating at 900 – 1000°C. In this way the water is rapidly expelled and the mineral, that becomes extremely light, can be used as an insulating infill for wall cavities (the space between two nearby walls that is created in order to be filled with insulating material). Perlite is an effusive rock that is used for plaster

together with chalk, cement and lime. Also pumice, a volcanic rock that is full of cavities, is often used as a thermal and acoustic insulator, after being milled and mixed to mortars.
Some types of basalts are melted at 1300 °C in order to obtain a particular vitreous material that is called “mineral wool”. This material is used as a thermal insulator, as it has the capacity to resist at temperatures around 1000 °C. Since it is an excellent acoustic insulator, it is widely used in modern buildings.

Cement and chalk

Binders are products that are used in the building sector. These substances, mixed with water, allow to obtain mortars that, after a particular chemical phenomenon (called “setting”), hardens and acquires mechanical resistance. Binders are classified into aerial and hydraulic binders, according to the kind of setting they have. The setting occurs when getting in contact with air or water. Limestones are raw materials for the production of lime, which is used to obtain the popular mortar that is largely applied in the building sector. Hydraulic limes harden both in the air and under the water, therefore they have “hydraulic” properties. This particular type of limes is obtained by firing marly limestones, i.e. calcareous rocks containing clay. Pozzolana is a volcanic tofa (a rock resulting from the cooling of magma that comes out of the subsoil during volcano eruptions) that contains both small grains of vitreous substance and different kinds of silicates. If pozzolana is mixed with lime the result is a binder with hydraulic properties. Rocks made of limestone with 25% of baked clay at 1500 °C lead to the production of one of the most popular hydraulic binders, which is called Portland cement. Natural chalk is used to prepare rapidly hardening chalk and filling chalk.

A defend from radiations

The growing use of natural or artificial (radioisotopes) radioactive elements in medicine, and of industrial nuclear techniques, brought up the need for the creation of completely insulated environments, in order to prevent harmful radiations from spreading. Men have managed to study and produce buildings, concrete and plasters that do not allow radiations to go through. The inerts that are used to produce these cement agglomerates are made of special granulates obtained through barita fragmentation ($BaSO_4$). Barita is quite a common mineral that contains barium (Ba), an element that is able to prevent nuclear radiations from spreading. When the binder needs to have a particular mechanical resistance, a corundum granulate (Al_2O_3) is used as a supplementary inert, since its hardness is highly suitable for the desired objective.

Glass

The main raw material to produce glass is silicon. Silicon is present in nature inside sand and in some compact rocks (quartzites). The sands that are used are very pure and fine. The materials, pulverized, are heated at 1200 – 1400 °C for a few hours. Then, after a slow cooling, the mass is subject to moulding. The melted mass is moulded and, in order to prevent the product from breaking, it is necessary to gradually cool it down. The glass, completely cooled, is then subject to several refining operations.
Glass sheets without flaws can be used to produce mirrors. The reflecting surface can be obtained by applying a thin layer of white metal on the glass: the layer can be made of silver for precious mirrors, lead for dark mirrors, tin and aluminium for ordinary mirrors.

Diamond

The most precious gem is the diamond, made of carbon. The characteristics that make it so valuable are: its hardness, un-alterability, brightness and transparency. The most common diamonds are usually colourless. However the most popular ones tend to have a pale yellow or brown colour. Red, green and blue diamonds are extremely rare and expensive. India is the country where the first deposits were discovered. Now those deposits have been exhausted, while relevant quantities are still present in Brazil and South Africa.

Opals and emeralds

Opal is one of the most fascinating gems in the world thanks to its changing colours. The mineral is made of hydrated

silica (SiO2.nH2O, this means that the mineral structure also includes water molecules) and it is shapeless. The most appreciated varieties are: noble opal, milky and with vivacious iridescence, harlequin opal, and fire opal, which is more transparent than noble opal and has a bright orange colour.
The turquoise variety has a cerulean colour and looks like porcelain. The most beautiful examples come from Iran, while the American turquoise variety is less valuable since it is more degradable.
The name emerald comes from the Greek "smaragdos", which means green stone. The most ancient deposits, exploited by Pharaohes, were located on the Egyptian coast of the Red Sea. At the moment, most of the production comes from Columbia, Brazil and the Ural Mountains. The green colour of emeralds is due to the presence of vanadium and chromium oxide.

Aquamarine, rubies, sapphires...

Aquamarine, a sea-blue stone, probably owes its colour to the presence of iron. The main deposits are located in different areas of Brazil, Ural Mountains and Madagascar.
Extremely small and clear crystals were found on the Island of Elba. Ruby and sapphire represent the most valuable varieties of corundum. The colour of ruby can range from pink to red, also very dark red. Ruby is one of the most precious stones and its colour derives from the presence of chrome oxides. Sapphire is less expensive and less precious than emerald and ruby. Its colour varies from light blue to deep blue and derives from the presence of titanium and iron. The main deposits of sapphire and ruby are located in Myanmar, Thailand and Sri Lanka. Topaz is a stone that can have different colours (light yellow, dark yellow, pink, red, light blue, greenish) and can reach big dimensions. The main deposits are in Brazil and Russia.