Mineral deposits

Fossil fuels

Modern industrial society consumes high quantities of energy for heating, transport and industries. The main energy sources are natural fuels, and in particular fossil fuels.

Fossil coals originate in the subsoil from plant material that come from ancient forests, subject to chemical and physical processes for millions of years. During that period plant material looses hydrogen, oxygen and nitrogen, but acquires carbon, therefore increasing its heating value. The younger coal, which still has a relevant content of water, is called peat. Anthracite, instead, has a high content of carbon and a high heating value. The process that leads to carbon enrichment continues until graphite is formed. Graphite is a mineral consisting only of carbon. These fuels are typical of lands that originated 280 – 350 million years ago (Carboniferous period), as the previous period had been characterized by the growth of large forests with wooden trunk. Hydrocarbons, instead, are a particular type of organogenic rocks and result from the decay of organisms without oxygen. These substances accumulate on porous rocks and can be present in solid (bitumen), liquid (oil) and gaseous (natural gas) state. They are very light materials that move up to the top through permeable rock layers. When a rock layer hampers their movement, they accumulate and form a deposit.

What is a mineral deposit?

By mineral deposit we mean those areas where minerals and rocks are extracted to be later used by men. It is necessary to specify that, from a formal point of view, we can talk about mineral deposits only if the quantity and quality of rocks and minerals allow men to economically exploit the resource. Some metallic minerals that are exploited in the industrial field (for example mercury) are now present in limited quantities and areas and may be depleted in just a few years' time, making recycling compulsory or forcing to replace these substances with other ones.

Deposits and mines in Italy

In Italy most of the mines that existed at the beginning of the century have been closed. Quite large deposits of mercury (as cinnabar) are present on Amiata Mountain and fluorine minerals are extracted in Sardinia mines in Silius. Instead, iron mines (located in Cogne, in Val D'Aosta region, on Elba island and Sardinia) and coal mines (in Sulcis area, Sardinia) have been abandoned due to the low concentration of minerals and high production costs when compared to other deposits abroad. More important is the production of the so-called "second-category" materials, like limestones, marble, granites, clays, travertine, sands, etc. In particular, Italy is the world-leading supplier of pumice stone, as its production accounts for half of the total world production. Extracted pumice stone mainly comes from Lipari. Moreover, Italy ranks second in Europe, just after Germany, in the production of raw steel and cement. Italy is the world leader in the production of feldspathic minerals (silicates), as it produces a fourth of the global production. The exports of natural stones (above all marble) all around the world are very developed. Marble in Italy is located in many areas. The most important geographical areas for the production of white marble is Tuscany, specifically on Apuane Alps. Lazio, Lombardy, Puglia and Veneto are other very important areas for the extraction of coloured marble.

Extraction activities in 5000 B.C.

The first extraction techniques date back to the Neolithic period (5000 B.C.): the stone was extracted mainly with the use of sticks and picks. Around 3000 B.C., in Egypt, a new technique was adopted and it was still used until a short time ago in small caves without modern equipment. It consisted of inserting some wooden wedges into the cracks of rocky walls. Once they were wet, their volume increased and with their pressure they caused the rocks to come apart. This method was used in ancient times also by the Romans. Another technique consisted of inserting iron wedges by hitting them on the top with heavy sticks. At the beginning of the 18th century the use of explosives developed: dynamite was inserted into underground passages inside the rocks. This provoked a big quantity of stones to fall down. However this procedure resulted to be disadvantageous due to the excessive waste of material. It also resulted dangerous for workers.

Extraction activity in recent times

At the end of the 9th century the helicoidal-wire technique developed. A motor-driven thread goes through the cutting area. The thread, during functioning, is constantly cooled down by the water: in this way it is possible to extract big blocks. At the moment there are many mechanical tools to be used for extractions: the most popular tool is the diamond-thread cutter. A steel cable, of 6 mm diameter, on which small diamond cylinders are inserted, slides on the rock. This technique is twenty times faster than the helicoidal wire. Another innovative technology that is used for extractions in caves is called “water-jet”: it consists of excavating with a high pressure water-jet, which is able to break the rock. Once it is extracted, the material is transformed (it is cut into blocks or sheets and its surface is treated) and used for different applications.

Metals

Men extract many minerals from the subsoil. Subsequently, by means of suitable refining techniques, the substances to build products, machines and tools are obtained. Metals are an example of this procedure: iron, copper, aluminium, zinc, cobalt, manganese, titanium, chromium and platinum can be worked easily and have the capacity to transmit electric power. In most of the rocks, the quantity of useful minerals is quite low. Therefore, the extraction is convenient only if the needed mineral has formed a deposit, and is present in a large quantity in a specific area. At the moment, the current situation of metal reserves rises many worries about the future. This is why people are now looking for new deposits.
In fact it was discovered that large quantities of metal minerals are present on sea floors. More precisely, they are “polymetallic nodules”, which are full of manganese and iron, with lower quantities of sodium, calcium, strontium, copper, cobalt, cadmium, nickel and molybdenum. Approximate estimates concluded that sea floors contain a reserve of around 2000 million tons of nodules from which precious metals could be extracted. This particular reserve is 1800 times as high as all mines on emerged land. Also clay, sand (for example silicon sands for glass production) and potassium minerals are extremely abundant.

Exploiting the subsoil

All subsoil resources will be exhausted sooner or later. Therefore rocks and minerals will not be extracted by men forever. This is why, like with energy, it is necessary to use them in an appropriate, efficient way, without wasting them and above all, supporting and encouraging the recycle of materials. But, apart from the problem of limited availability of subsoil resources, there are many more general problems related to pollution deriving from extraction activities. In fact, among those human activities with a high environmental impact, there certainly is the extraction of lithoids (clay, sand, gravel, stones, etc.) on water streams, hillsides or plains. Very often quarry owners abandon the quarry in such a degraded condition that it is no longer possible to recover it. For a few years different operations have been promoted, aiming at the environmental restoration of these quarries. The main objective is the reinsertion of the previously excavated areas into the surrounding environment, respecting the landscape, the quality of the water and of the soil that are located close to the mine, and which are often heavily polluted due to extraction activities. The best restoration is obtained if the quarry exploitation plan includes from the very beginning the recovery of the entire area, instead of waiting for the depletion of the resources and the end of the activities. In fact, it is much more difficult to act afterwards. Restoration works have to be carried out during excavation and not afterwards. In order to do so, it is possible to use the machines and equipment that are already present in the building site, with a clear reduction of costs.

Rehabilitation of a mine

As for outdoors quarries in flat areas, the excavated area can be partially filled with the same land that was previously removed, and covered with agricultural humus. For this reason during activities in the quarry it is important not to mix the removed plant material with waste material. If, instead, the ground of a clay quarry gets in contact with a water table, it will be possible to convert the excavation area into a small lake. These lakes can be used for fishing, leisure activities, fish farming, irrigation, as a natural oasis, or can be devoted to water sports. As an example, we can mention the Fornace CARENA Park in Cambiano (TO), and the Ecological park of Unieco, in Fosdondo, Correggio Emilia;

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As for quarries located on a hillside, basically there is a need to reinsert the excavated area into the surrounding landscape, while guaranteeing the stability of the slope. It is necessary to rapidly obtain a vegetation cover that allows to efficiently consolidate the slope and mitigate erosions. A particular attention has to be devoted to the possibility to convert former quarries into dumps. With regard to clay, quarries are located on poorly permeable rocks that have the right characteristics to be considered as an appropriate “container” for polluting substances. Clays are indicated by the EEC as rocks that are able to solve the problem of radioactive waste. It can be concluded that the negative effects that derive from extraction activities can be widely limited if prevention is done during planning phases. And finally, it is important to highlight that the excavated area, once it has been recovered, is extremely fragile as an ecosystem. This is the reason why it has to be constantly controlled.