

## Using Earth Materials

Most products that we use are made from earth materials, which are also the source of the energy needed to run the machines that make products. The earth materials, on which the whole process depends, have been recycling for millions of years.

### Using minerals and rocks

**Complete the text with the most suitable words from the clue:**

*building    conductors    compounds    elements    heat    include    luster    melt    provide  
remove    strength*

#### Metals

Minerals and rocks are the source for most of the earth's metals. A few metals, such as **copper** and **gold**, can be found as pure ..... in nature. But most are found as mineral ..... of either oxygen (oxide minerals) or sulfur (sulfide minerals). Metals such as **chromium**, **tin**, **magnesium**, **aluminum**, and **iron** come from oxide minerals. Other important metals, such as **nickel**, **lead**, **zinc**, and **copper**, come from sulfide minerals.

Metals are an important group of elements because of properties that nearly all of them possess. In general, metals ..... easily. They conduct ..... and electricity. They can be hammered or pressed into different shapes without breaking. And they have a certain kind of ....., or shine.

Metals are widely used today. **Steel**, which is made mostly from iron, has great ..... Tall buildings, long bridges, ocean liners, jet planes, and automobiles depend on steel, aluminum, and other metals for their strength. Most metals have many uses. **Copper** and **aluminum**, for example, are made into wire because they are good ..... of electricity. You can certainly think of many other products that make use of the earth's metals.

#### Nonmetals

Minerals and rocks also ..... a source for important nonmetals. **Sand**, for example, is a nonmetal that is used in making cement, an important ..... material. Sand is also used in making glass and the **silicon** chips are used in computers. **Clay**, another common nonmetal, is used in making china and pottery. Kaoline, a white clay, is also used for making porcelain. **Gypsum** is used in making plaster and wallboard. **Limestone** is used in making cement and finely ground limestone is used to ..... pollution from the chimneys of brown coal power-plants. Compounds of phosphorus (**phosphates**) and of nitrogen (**nitrates**) are used in making fertilizers. Other uses of nonmetals ..... building stone, ornamental stone, and **gemstones** for jewelry. Small pieces of stone used as a surface for roads and paths are called chippings. **Flint**, a hard grey stone, was used in the past for making tools.

#### Tasks:

1. List physical properties of metals that distinguish them from nonmetals.
2. Explain and translate these words: tin, lead, ocean liners, jet planes
3. Give some examples of using metals.
4. Explain and translate these words: cement (Us), china, pottery, plaster, wallboard, fertilizer, gemstone, jewelry, flint.
5. Give some examples of using nonmetals.

## Mining

Any mineral or rock from which a needed substance can be removed cheaply enough and easily enough is called an **ore**. A thin ore body is called a **vein**.

Both metals and nonmetals are obtained from ores, which are taken from the ground by a process called **mining**. The place the ore comes from is called a **mine**.

There are two basically different types of mines—**surface mines** and **underground mines**.

### Surface mines

a) **Open-pit / opencast mine** applies to a method of cutting into a vein or a bed from above rather than digging a mine under the ground. Copper and aluminum ores are frequently mined this way.

b) **Strip mine** is another type of a surface mine. Large earthmoving equipment removes the surface materials (overburden) to get down to the ore or fossil fuel. Coal is frequently mined this way.

c) **Quarry** (=lom) is a place where stone (limestone, slate, sandstone etc.) is dug out of the ground. When the process of mining or quarrying is finished, the mine becomes abandoned, or disused.

A mined ore must be processed in order to obtain a useful substance. For some substances, such as gold or gravel, a simple **crushing** or **washing** is all that is needed. For other substances such as iron, copper, or aluminum, the ore must be further **treated with heat, chemicals, or electricity** to obtain the metal. These processing methods are referred to as **refining** the ore.

Not all minerals and rocks that contain a needed substance are used as sources for that substance. Much depends on cost. Sometimes it costs too much to remove the rock or mineral from the earth. Sometimes it costs too much to remove the needed substance from the mineral or rock through a refining process. Sometimes it costs too much in terms of what removing the material does to the earth's surface.

The total cost of obtaining and refining ores is, therefore, influenced by several factors:

- 1) the cost of removing the ore from the earth,
- 2) the cost of transporting the ore to a refinery,
- 3) the cost of refining the ore,
- 4) the cost involved because of the loss of the mined area for other purposes, especially where open-pit mining and strip mining are involved, and
- 5) the cost of restoring the mined area to something more closely resembling its original condition.

### **Tasks**

1. Describe how useful substances are obtained from rocks and minerals.

Include the terms *ore, mining, and refining*.

2. What does the total cost of obtaining and refining ores depend on?

3. Substitute the underlined word compounds: in terms of, referred to as in the text.

4. Look at some earthmoving equipment in the presentation saved in the syllabus in IS and copy the names of the machines. Find out their names in Czech.

5. Write these words in English:

ruda - ....., povrchový důl se skrývkou - .....

skrývka - ....., opuštěný lom - .....

6. Enlarge your vocabulary:

**adit** - štola (horizontální)

**hanging wall** - strop

**shaft** - šachta (vertikální)

**footwall** - počva

**slap heap** - hlušina

**deposit** - ložisko

**vein/lode** - žíla

**reef** - in mining geology, a vein of quartz containing gold.

**extraction/panning** - rýžování

7. Match some more terms and their definitions:

**Hydrothermal deposit - Mineral deposit - Overburden - Placer deposit - Quarry - Vein/lode**

A place where stone is dug out of the ground is called a .....

A thin mass of rock or a mineral, especially a thin ore body is a .....

Rock or other material of no value that lies over a deposit of useful material is .....

A mass of ore that is of value is a .....

A mineral deposit produced by liquids coming from magma that contain a large proportion of hot water is called a .....

A deposit, usually at the surface, containing a mineral of value such as gold is a .....

8. **Homework:** Watch the video about a sulfur mine in Indonesia (saved in the syllabus) or a copper mine in Chuquicamata, Chile - DVD Michael Palin, Full Circle, Part 7- 35:21 ) and write what you have seen and understood:

**Sulfur mining in Java**

1. What kind of mine is it?
2. What is its altitude?
3. What is the depth of the lake?
4. How much do the miners earn per one day?
5. How much do the farmers earn?
6. How heavy is the load on the miners' shoulders?
7. How far is the collection place?
8. What damage does this kind of mining cause?
9. Could you work one day as a sulfur miner in Java?

9. Prepare a presentation about a mine or a quarry.

Adapted from Fariel, R. - Hinds, R. - Berey, D.: Earth Science, Addison-Wesley 1987  
Definitions also from Longman Illustrated Dictionary of Geology, York Press 1982

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### Using fossil fuels

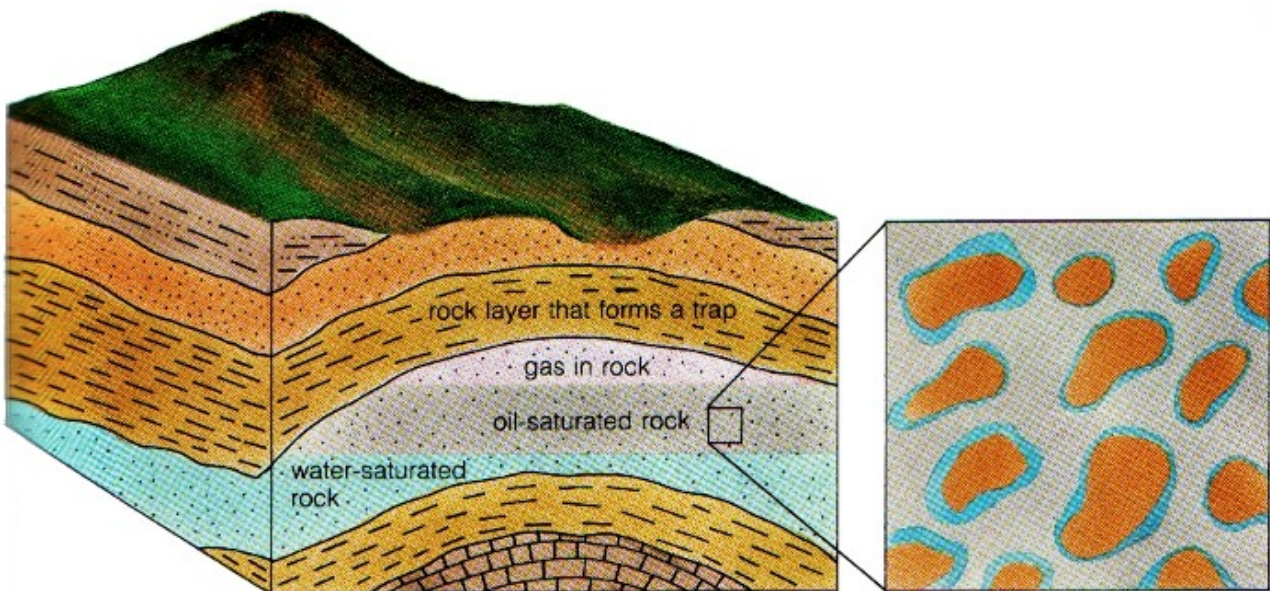
Plants and animals that lived and died long ago have been a source of very important products called **fossil fuels** - petroleum (crude oil), natural gas, and coal.

Choose the most suitable word to complete the text:

*bent fibers float fuel least next note occupy seek until through*

Both **petroleum**, whose name comes from the Greek words for rock and oil, and **natural gas** can ..... the tiny spaces between grains of sediment, and they can also fill pores and cracks in rocks. Both are actually frequently found ..... to each other.

Water is also able to penetrate nearly all pore spaces and cracks in rocks, even to great depths below the surface. Figure shows areas of a porous rock layer whose pore spaces are saturated with water, petroleum, and natural gas. The rock layer containing the water, petroleum, and natural gas has been ..... by some movement of the earth's crust. You will ....., however, that the layers of pore spaces that are filled with water or petroleum or natural gas do not bend with the rock layer. Rather, they tend to ..... their own levels.



The petroleum is located above the water because petroleum tends to ..... on water, even underground. And the natural gas, the ..... dense of the three materials, is located above the petroleum. Petroleum and natural gas move slowly up through sediments and rocks ..... they are blocked by a material that is too solid to let them pass ..... This kind of blockage is called a **trap** - that is what geologists look for when they explore for petroleum and natural gas. A trap causes an oil to accumulate. The impermeable rock(s) that make a trap effective in preventing oil from migrating further is referred to as a **cap rock**.

Traps are of two types: structural and stratigraphical. Examples of structural traps are anticlines, synclines, domes and faults. Stratigraphical traps include unconformities and variations in lithology, which gives the general character of a rock, or a sedimentary formation, more particularly as seen in exposures and hand specimens. (Longman Dictionary of Geology)

Petroleum has more uses than just about any other substance on earth. Many forms of ..... and lubricating oils and also hundreds of chemical products called petrochemicals are made from it. Petrochemicals are used to make fertilizers, insecticides, plastics, synthetic ....., and many other products that are in wide use throughout the world.

## Formation of petroleum and natural gas

*Match the beginning of each sentence with the most appropriate ending to complete the next part:*

- No one knows for sure <sup>1</sup>....  
The most common theory is that <sup>2</sup>...  
As the plants and animals died, <sup>3</sup>...  
Bacteria in the water caused <sup>4</sup>...  
At the same time, the decaying material was covered with sediment <sup>5</sup>...  
Over a long period of time, <sup>6</sup>...  
This caused heat and pressure <sup>7</sup>...  
All four factors—time, heat, pressure, and decay by bacteria— <sup>8</sup>...

- A... that washed into the sea from the land.  
B... the plant and animal remains to decay.  
C... the sediment piled up to great depths.  
D... may have changed the plant and animal remains into petroleum and natural gas.  
E... on the decayed material beneath the sediment.  
F... they formed from the remains of microscopic plants and animals that lived in the earth's oceans.  
G... their remains accumulated on the bottom of the sea.  
H... how petroleum and natural gas formed.

1. Describe how **petroleum and natural gas** become trapped beneath the earth's surface. In your description, include the terms *water, pore spaces, blockage, and trap*.
2. Describe how petroleum and natural gas may have formed.

*Choose one of the following words to complete the final part:*

*associated grade failed steel successive thought uses value*

**Coal** is a solid fossil fuel that is mined both at the surface and underground. Coal is ..... to have formed from layers of plant material, called **peat**, which became buried in a wet environment, ..... to decay completely, and then changed through heat and pressure into coal.

In the formation of coal, the plant material passes through a number of stages. With each stage, the plant material increases in hardness and in heat value. **Heat value** is the amount of heat given off by a certain amount of fuel. As the peat becomes buried under ..... layers of overlying material, heat and pressure change the peat, which is very soft, into **lignite**. Lignite is a soft coal that has a low heat ..... Continued and increasing heat and pressure turn the lignite into a better ..... of soft coal called **bituminous coal**. Finally, the great heat and pressure ..... with deep burial produces a hard coal called **anthracite coal**, which has the highest heat value of the various forms of coal.

Coal has many ..... . It can be processed to make artificial gas. It is burned to produce steam, which is then used to produce electrical power. It is used to make various chemical products. Also, bituminous coal is especially valuable because it can be changed into **coke**, a fuel used in making .....

*Describe how coal may have formed.*



*Learn some more terms:*

**Oil shale** - an argillaceous rock containing a solid material that when distilled gives off oil.

**Argillite** - a sedimentary rock with an average grain size less than 1/16 mm in diameter; clays, silts, mudstones, etc.; a hard mudstone.

**Migration** is the upward movement of oil from the rocks in which it was originally formed to other rocks that are porous and permeable.

**Permeability** is a measure of the ease with which a fluid can pass through a rock.

**Reservoir** - beds in which oil accumulates.

**Borehole** - a hole drilled into the Earth for oil, gas, water, etc. or to gain information about the rocks below the surface.

**Well-logging** - the use of physical measurements from instruments lowered down boreholes to obtain information about the rocks below the surface.

*Geothermal energy*

**Geothermal energy** is powered by heat from deep within the earth's crust. This heat is believed to come from radioactive elements in minerals and from the friction of internal movements. The outer part of the earth's core may be molten, and this heat adds to the other heat sources.

The heat in the earth is high enough in some places to melt rock and form magma. In such places, any water will be in the form of steam, which can be brought to the earth's surface and used to turn the turbines of electrical generators.

If no water is present, two **wells** can be **drilled down** into the rock. Cold water can be **forced down** one well, heated by the rock, and brought back to the surface in the other well. In some places, the rocks at depth may not be hot enough to produce steam. Even so, the returning water from such wells is hot enough to heat buildings.

***Sum up how geothermal energy may be used for heating, or even for the production of electric energy:***

***Sentence transformations:***

We believe that the heat in the earth's crust comes from radioactive elements in minerals.  
The heat in the earth's crust ...

We suppose that it also comes from the friction of internal movements.  
It is also ...

We suppose that coal formed from layers of plant material, called peat.  
Coal is ..... to have ....

We think that petroleum and natural gas formed from the remains of microscopic plants and animals that lived in the earth's oceans.  
Petroleum and natural gas ....

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