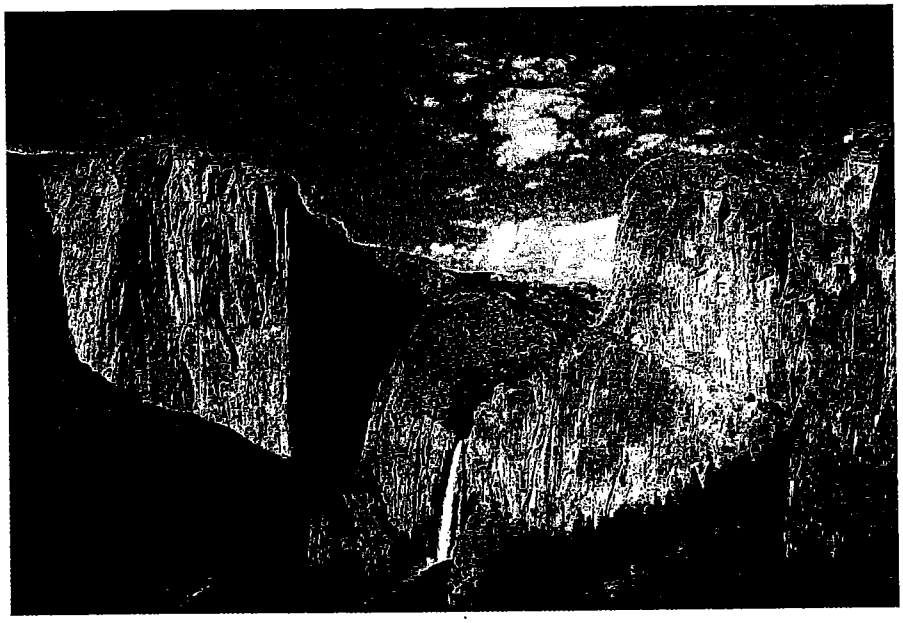
19 Rock Formation

Roughpoint Forest Ranger Ormond wanted to help the hikers identify their rock. Her plan was to figure out if the rock was kimberlite by using her knowledge of how rocks are formed.

In this activity, you will gather more information on rock formation to help Ranger Ormond identify the hikers' rock.

CHALLENGE

How are rocks formed?



MATERIALS

For each student

- 1 Student Sheet 19.1, "Talking Drawing: Rock Formation"
- 1 Student Sheet 19.2, "Directed Reading Table: Rock Formation"

READING

Use Student Sheets 19.1 and 19.2 to prepare you for the following reading.

Finding Resources

People have been trying to dig down into the earth for hundreds of years. One reason is to collect more information about the earth itself. Another reason is to gather the natural resources that are found in the earth's crust.

For example, the coal that you examined in Activity 12, "Observing Natural Resources," is mined from the earth's crust. Coal is burned to produce the energy needed to generate electricity. The first coal mines were shallow, but over time, people have had to dig deeper. Modern coal mines are as deep as 1 kilometer (km) below the surface.

Coal: A Sedimentary Rock

Digging deeper doesn't always mean you'll find more coal. Coal is a special type of rock. It formed when large numbers of dead plants in swampy areas collected on top of each other. Over millions of years, these plants were buried by layers of **sediments** (SED-ih-ments). Sediments are parts of rocks, shells, and dead organisms that have been worn down into small pieces, often by the effects of wind and water. When sediments settle on top of each other, they form layers that can eventually harden together. These hard layers form **sedimentary** (sed-ih-MENT-air-ee) rocks. The pressure of these layers on top of the buried plant material caused it to change into coal.

This photo from the 1930s shows a miner deep below the earth. Wagons carrying coal were rolled out of the mine on the tracks.

Some areas of the world have more of one kind of natural resource than other areas. Coal is found all over the world, though the United States, China, and India are three countries that have a lot of buried coal. Because coal is burned to produce electricity, countries that have a lot of coal usually sell it to countries that have less. The cost of a ton of coal can range from $17 to $50, with an average price of about $32 per ton.

The most common igneous rock on earth is basalt (buh-SALT). It forms as iron- and magnesium-rich lava cools and solidifies.

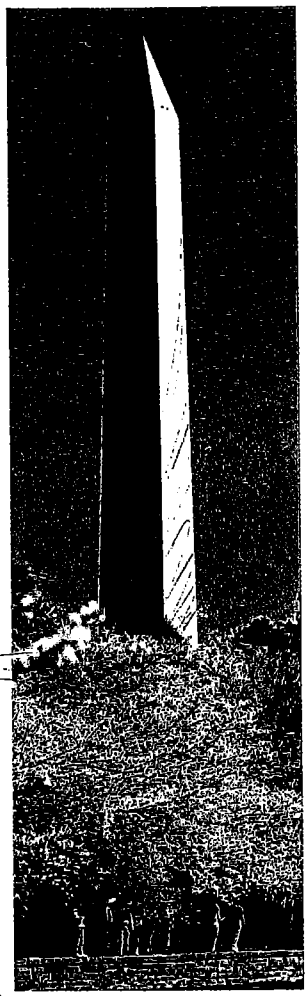
Kimberlite: An Igneous Rock

Another natural resource found in the earth's crust is diamonds. Diamonds are usually found in a relatively rare rock known as kimberlite. Many people mine kimberlite looking for diamonds. Rocks like kimberlite form from the cooling of magma. **Magma** (MAG-muh) is the hot melted rock found deep inside the earth. Sometimes it cools in the earth's crust and the rocks are pushed slowly to the surface. Sometimes it erupts from volcanoes and cools on top of the earth's crust. Rocks formed from cooling magma are called **igneous** (IG-nee-us) rocks. Kimberlite and other igneous rocks are found all over the world, including in the United States. The price of kimberlite depends on whether it contains any diamonds and the size and quality of the diamonds if it does.

Marble: A Metamorphic Rock

All types of rocks can become buried in the deeper layers of the earth's crust. These deeper layers are under more pressure and are hotter than the surface. Over time, high temperature and/or high pressure can cause one rock to change into another. For example, limestone, a soft sedimentary rock, can become marble, a much harder rock.

Rocks that have changed because of heat and/or pressure are known as **metamorphic** (met-uh-MOHR-fik) rocks. People use many meta-



The outside of the Washington Monument in Washington, D.C. is made from white marble from the state of Maryland.

morphic rocks, such as marble, in their homes and other buildings because of their beauty and strength. Marble can be found naturally all over the world in countries such as Belgium, France, and the United States. On average, the cost of marble is $200 per ton, depending on its quality.

People continue to dig into the earth's crust to gather natural resources and learn more about this planet. As they go deeper, they too are faced with the challenge of handling high temperatures and pressures. How far down will humans be able to mine safely? Only time will tell.

Finding Fossils in Sedimentary Rock

Most fossils are found in sedimentary rocks. Fossils are often formed during the gradual layering of sediments such as sand. For example, when a plant or animal died millions of years ago, sometimes it quickly became covered with a layer of sand or mud. If the soft remains of the plant or animal broke down, leaving an imprint of its shape (or its shell) in the rock, it became a fossil. You examined this type of fossil in Activity 12, "Observing Natural Resources." In other cases in which fossils were formed, the organic material of the plant or animal was slowly replaced with minerals, creating a rock that shows details of the dead organism. There are all kinds of fossils in countries all over the world, but they are not always easy to find.

The cost of fossils varies even more than the price of coal. Some fossils are inexpensive enough to be sold by weight, with hundreds of fossils costing only a few dollars. In other cases, a single fossil can cost thousands of dollars. The price of fossils can go into the millions when everyone wants the same fossil. Factors that influence the cost of a fossil include its quality and rarity. Regardless of its price, each fossil provides information about the life that has existed on earth.

ANALYSIS

1. What are the three different ways in which rocks can form?
2. Why is coal a non-renewable resource?
3. Copy the three lists of words shown below.

List 1	List 2	List 3
heat	magma	rock formation
pressure	igneous	sedimentary
kimberlite	volcano	metamorphic
metamorphic	sediments	plastic

   a. In each list, look for a relationship among the words. Cross out the word or phrase that does not belong.

   b. In each list, circle the word or phrase that includes all the other words.

   c. Explain how the word or phrase you circled is related to the other words in the list.

4. Create a concept map using the following 14 words.

coal	marble
fossils	metamorphic
igneous	sedimentary
layers	rock
kimberlite	volcanoes
magma	temperature
minerals	pressure

5. Do you think fossils are still being formed on earth? Why or why not?
6. **Reflection:** Do you think the cost of an object reflects its true value? Why or why not?