

Every Rock Tells a Story



THE ROCKY FLATS EXAMINER

Diamonds in Roughpoint National Forest?

Two hikers may have found diamonds when they were exploring an out-of-the-way section of Roughpoint National Forest last Saturday. Sara Biddle, one of the hikers, said, "We saw something sparkle in a layer of folded rock halfway up a cliff. The rock layers were real wavy and it looked like they had been squeezed together. It was too high up for us to get a sample. We did collect a rock that looked like it had broken off from the upper part of the cliff." According to

Roughpoint Forest Ranger Jesse Ormond, it takes several days of hiking to get to that part of the forest. The only other way to reach it is by helicopter. "Before we spend a lot of time and money going out there, we want to make sure that they could really be diamonds," said Ranger Ormond. "One way to do that is to examine the rock they found. Some natural resources are more common in certain types of rocks. For example, diamonds are often found in a rock called kimberlite. If the hikers' rock is kimberlite, there is a greater chance that they saw diamonds."

Ranger Ormond wants to help the hikers identify their rock. His plan is to figure out if the rock is kimberlite by using his 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?

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 natural resources that are found in the crust.

Geologists searching for valuable natural resources such as diamonds or copper look for clues to help find them. One clue that geologists sometimes use is the fact that some natural resources are found in certain types of rocks. For example, copper is often found in basalt rock. A geologist looking for copper might be more interested in searching in an area containing basalt rock and not kimberlite rock. Look at the table below. It lists rocks that can contain certain natural resources.

Table 1: Finding Natural Resources

ROCKS SUCH AS	MAY CONTAIN
basalt, sandstone, limestone	copper
granite, rhyolite	topaz
kimberlite	diamond

Coal: A Sedimentary Rock

Coal is another natural resource 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 can be as deep as one kilometer below the surface of the earth.

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Digging deeper doesn't always mean 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. Sediments are parts of rocks, shells, and dead organisms that have been worn down into 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 rocks. The pressure of these layers on top of the buried plant material caused it to change into coal.

Some parts of the world contain more of a particular natural resource than others. The United States, China, and India are three countries that have a lot of buried coal. Because coal is used to produce electricity, countries that have a lot of coal usually sell it to countries that have less of it. The cost of a ton of coal can range from \$17 to \$50, with an average price of about \$32 per ton.



Countries where a lot of coal is found are shown in gray.

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 to look for diamonds. Rocks like kimberlite form from the cooling of magma. Magma 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 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 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 rocks. People use many metamorphic rocks such as marble in their homes and other buildings because of the

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beauty and strength of this kind of rock. Marble can be found 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 through the crust of the earth 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 go? Only time will tell.

Fossils: a Special Type of Sedimentary Rock

Most fossils are found in sedimentary rocks because they formed from the gradual layering of sediments such as sand. For example, when a plant or animal died millions or years ago, it could have quickly become covered with a layer of sand or mud. Sometimes, the soft remains of the plant or animal broke down, leaving an imprint of its shape (or its shell) in the rock. In other cases, the organic material of the plant or animal was slowly replaced with minerals, creating a rock that shows details of the dead organism. All kinds of fossils can be found in countries all over the world, but they are not always easy to find.

The cost of fossils varies even more than 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.

Questions

1) Look again at Table 1, "Finding Natural Resources." Which rocks or resources do you recognize?

2) The word "sediment" means small pieces of material such as rock, soil, and clay. What type of sediment do you think each of the following rocks is made of?

a) sandstone _____

b) mudstone _____

3) How can rocks be used to find certain resources? _____

4) What are the different ways in which rocks can form? Describe each process. _____

5) What do you think Ranger Ormond should do next? Explain your reasoning. _____

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Reading Guide

	What is it?	How is it formed?	Where can it be found?	How valuable is it?
Coal				
Kimberlite				
Marble				
Fossil				

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Ranger Ormond has now taken the hikers' rock back to forest headquarters. He wants to know if it is an igneous rock like kimberlite. Igneous, metamorphic, and sedimentary rocks often look different from each other because they are formed differently. Ranger Ormond wants to compare the hikers' rock to samples of igneous, sedimentary, and metamorphic rocks that are stored at headquarters. The names of the samples have been identified but their descriptions have become lost. You must determine which rock samples are of which rock type (igneous, sedimentary or metamorphic).

Challenge: Can you classify rocks based on a description of the rock type?

Materials

1 rock sample collected by the hikers; 8 rock samples (coal, gabbro, gneiss, granite, limestone, obsidian, phyllite and sandstone); 1 magnifying lens

Procedure

Part A: Identifying Rock Types

- 1) Work with your partner and use the magnifying lens to examine a rock sample.
- 2) Compare the rock to the identifying characteristics shown in Table 1 below.
- 3) Discuss with your partner which identifying characteristics the rock appears to have.

Table 1: Identifying Rock Types

Rock Type	Formed by	Some Identifying Characteristics
Igneous	cooling of magma	Surface can be as smooth as glass. OR Individual crystals can be large enough to be seen by the human eye. If crystals are visible, they often appear to interlock like pieces of a puzzle.
Sedimentary	tiny rock pieces cementing together	Can contain fossils. Can sometimes see or feel individual sediments such as sand or pebbles. Can be more crumbly than other rock types. Can sometimes feel lighter than other rock types.
Metamorphic	high heat and/or high pressure of the earth	Often see different bands of color sandwiched together. Crystals can be very small and hard to see.

- 4) Record your observations on the Rock Data Worksheet. Focus on those observations that help you identify the rock as either igneous, metamorphic, or sedimentary.
- 5) Identify the rock as igneous, sedimentary, or metamorphic on the worksheet.
- 6) Exchange the rock with another pair of students. Repeat Steps 1-5 until you have examined all eight rock samples.

Part B: Identifying the Hikers' Rock

- 7) Your teacher will now give you a sample of the rock collected by the hikers.
- 8) Work with your group to compare it to the identifying characteristics shown in Table 1.
- 9) Record your observations of the hikers' rock on the Rock Data Worksheet.
- 10) Identify the hikers' rock as igneous, sedimentary, or metamorphic on the worksheet.

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Questions

1) Do all rocks of the same type, such as all igneous rocks, look the same? Support your answer with evidence from your observations. _____

2) What characteristic was most useful in identifying each type of rock listed below? Explain.

a) igneous _____

b) metamorphic _____

c) sedimentary _____

3) Your cousin calls to tell you she found the coolest rock while she was at camp. She knows you have been studying rocks at school, and she asks you what type of rock she has. Which of the following facts would be the most helpful to you to begin to identify the type of rock? Explain your reasoning.

The rock is light gray in color.

The rock is shiny.

The rock was found high on the slope of an extinct volcano.

The rock is small enough to fit in her hand.

4) Help Ranger Ormond decide what to do by examining the table below. Remember, diamonds are sometimes found in kimberlite, but not in garnet schist.

Table 2: Comparing Rocks

	Kimberlite	Garnet schist
Color	gray	gray
Contain garnets?	no	sometimes
Rock type	igneous	metamorphic

a) Based on your observations of the rock sample, which rock do you think the hikers found?

b) Support your answer with evidence from your investigations. _____

c) Could the hikers have seen diamonds? Explain. _____

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Rock Data Worksheet

Name of Rock	Observations of Identifying Characteristics	Igneous, Metamorphic or Sedimentary?
1 Obsidian		
2 Phyllite		
3 Limestone		
4 Gabbro		
5 Gneiss		
6 Granite		
7 Coal		
8 Sandstone		
Hikers' Rock		