

AIM: How do metamorphic rocks form?

Unit 3: Rocks and Minerals: How does the Earth make rocks?

By the end of class, you should be able to:

- Explain how metamorphic rocks are formed
- Distinguish between contact metamorphism and regional metamorphism
- Define foliation, low-grade, and high-grade metamorphism
- Read and interpret the scheme for Metamorphic Rock Identification
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Do Now: Quietly begin reading the article below and answer the questions throughout.

From MSNBC.com

Giant crack in Africa may create a new ocean Study: Volcanic boundaries in Ethiopia may break apart in large sections

A 35-mile rift in the desert of Ethiopia will likely become a new ocean eventually, researchers now confirm. The crack, 20 feet wide in spots, opened in 2005 and some geologists believed then that it would spawn a new ocean. But that view was controversial, and the rift had not been well studied. A new study involving an international team of scientists and reported in the journal *Geophysical Research Letters* finds the processes creating the rift are nearly identical to what goes on at the bottom of oceans, further indication a sea is in the region's future. The same rift activity is slowly parting the Red Sea, too.

Using newly gathered seismic data from 2005, researchers reconstructed the event to show the rift tore open along its entire 35-mile length in just days. Dabbahu, a volcano at the northern end of the rift, erupted first, then magma pushed up through the middle of the rift area and began "unzipping" the rift in both directions, the researchers explained in a statement today.

What type of boundary do you think is found at this rift? _____

Draw a picture of what the rift must look like. Label the magma coming up at the center, and label where the newest rock and oldest rock can be found.

"We know that seafloor ridges are created by a similar intrusion of magma into a rift, but we never knew that a huge length of the ridge could break open at once like this," said Cindy Ebinger, professor of earth and environmental sciences at the University of Rochester and co-author of the study.

The result shows that highly active volcanic boundaries along the edges of tectonic ocean plates may suddenly break apart in large sections, instead of in bits, as the leading theory held. And such sudden large-scale events on land pose a much more serious hazard to populations living near the rift than would several smaller events, Ebinger said.

Why is it more likely for volcanoes and earthquakes to occur in these areas than in New York? _____

"The whole point of this study is to learn whether what is happening in Ethiopia is like what is happening at the bottom of the ocean where it's almost impossible for us to go," says Ebinger. "We knew that if we could establish that, then Ethiopia would essentially be a unique and superb ocean-ridge laboratory for us. Because of the unprecedented cross-border collaboration behind this research, we now know that the answer is yes, it is analogous."

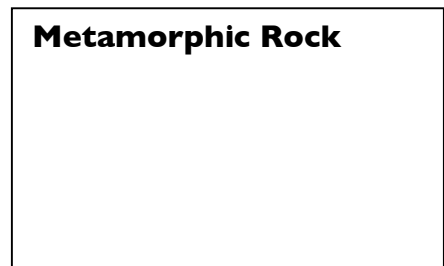
The African and Arabian plates meet in the remote Afar desert of Northern Ethiopia and have been spreading apart in a rifting process — at a speed of less than 1 inch per year — for the past 30 million years. This rifting formed the 186-mile Afar depression and the Red Sea. The thinking is that the Red Sea will eventually pour into the new sea in a million years or so. The new ocean would connect to the Red Sea and the Gulf of Aden, an arm of the Arabian Sea between Yemen on the Arabian Peninsula and Somalia in eastern Africa.

Before this discovery, what two pieces of evidence did scientists have to support the theory that the seafloor was spreading? _____

If plates are drifting apart and create new oceans, why doesn't the earth get any bigger? Explain in detail! _____

Brainpop video:

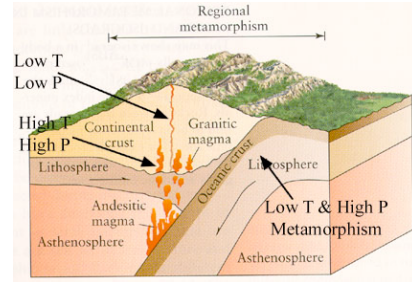
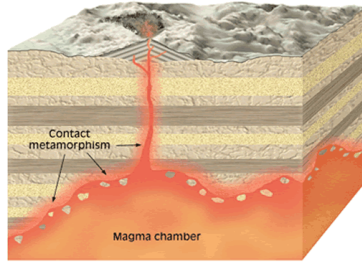
- 1) What happens when you keep adding lots of heat and pressure to existing rocks?
- 2) What happens when there isn't enough heat./pressure to melt the rocks?
- 3) What is one easy way to identify metamorphic rocks? Draw a picture in the box to the right.



Key terms/concepts

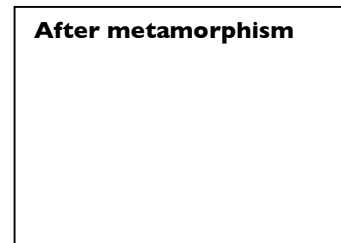
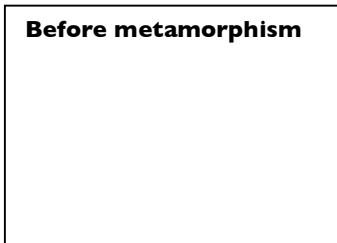
Notes/Explanations

- 1) **Metamorphic rocks** form when _____
- 2) There are two types of metamorphism
 - a. **Contact metamorphism:** _____
 - b. **Regional metamorphism:** _____



- 3) There can be different levels of metamorphism: **low grade metamorphism** is when _____
- high grade metamorphism** occurs when the conditions are close to when _____
- a. High-grade metamorphism can cause **recrystallization**: when heat and pressure causes _____

Example of recrystallization: Granite → Gneiss



- b. When crystals realign, this can cause the rock to look like it has bands or layers of mineral crystals called _____

Try It Out:

- 1) Name 3 rocks that are foliated (you would see bands of crystals lined up):
- 2) Name 3 rocks that are nonfoliated:
- 3) Anthracite coal is a metamorphic rock that comes from the metamorphism of which sedimentary rock?
- 4) Marble results from the metamorphism of what two types of rocks?
- 5) Name 3 rocks that occur because of regional metamorphism (when crustal plates collide):
- 6) Name a rock that results from contact metamorphism:
- 7) What causes contact metamorphism?

Summary & Reflection:

Name _____ Date _____ Section _____

Unit 3: Rock and Mineral Game Assignment Sheet: Part I

You can work alone or with a group on this assignment. You will be designing a game that uses information from this unit on rocks and minerals. The purpose of the game is for the people playing it to review information about rocks and minerals. You will be graded by your classmates based on the logic (do the rules make sense, do your questions make sense), clarity (do you elaborate and use examples from class), and creativity of your game. You will be graded by me based on the information that you cover in your game (do you use vocabulary words, diagrams, and skills that we learned in class?)

During this period, you will be organizing your ideas for the game and making a list of facts/skills/vocabulary that you will include in your game.

Group members:

What will your game be similar to? (Example: Jeopardy, Scrabble, Scategories, Taboo)? _____

What supplies will you need to make your game and who will be responsible for getting them?

List at least 15 **vocabulary** words that students will need to know or will learn by playing your game:

List at least 2 **skills** that students will need to know in order to play your game (Example, how to interpret the rock cycle diagram, how to identify a rock using a flowchart, how to read the scheme for identification)

On the back of this slip, list **at least 10 pieces of information** that students will need to know for your game.