AIM 7 | What are igneous rocks?

There was a time when there were no rocks. Billions of years ago, the earth was just a huge ball of burning gases. As this ball traveled through space it started to cool. The cooling changed the gases to liquids. Then more cooling took place. Some of the liquids changed to solid rock.

Rocks that have hardened from liquids are called *igneous* [IG nee us] *rocks*. The word "igneous" comes from the Greek word for fire.

All rocks did not cool the same way. Some cooled slowly, deep under the earth's surface. Others cooled quickly, near or on the surface. Different speeds of cooling made different size crystals.

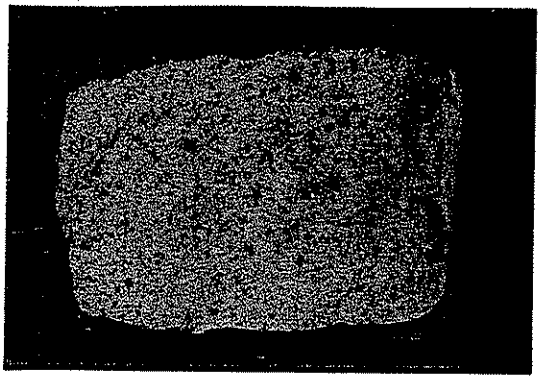
- Slow cooling formed rocks with large crystals.
- Rapid cooling formed rocks with small crystals.
- Extra-fast cooling formed rocks with no crystals.

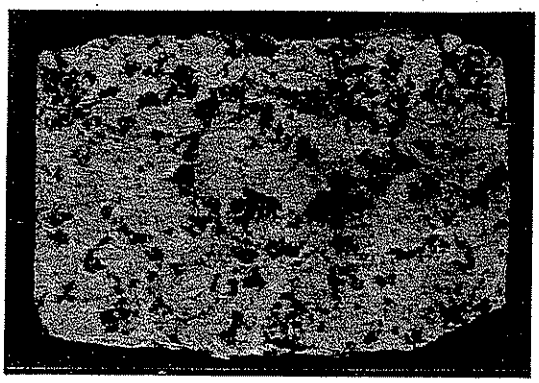
The longer the cooling, the larger the crystals. The shorter the cooling, the smaller the crystals. If we know this, we can look at a rock and tell if it cooled slowly or quickly.

In some places, there are still hot, melted minerals in the ground. Some of this is slowly turning to rock. The hot, melted matter under the ground is called *magma* (MAG mah). Sometimes magma forces its way to the surface. Then it is called *lava*. Lava forms cone-shaped mountains. Most people call these mountains *volcanoes*.

SOME IGNEOUS ROCKS

I.

A. 

B. 

Granite is the most common igneous rock on the earth's surface. Both of these rocks are granite.

1. **a)** Which one has *larger* grains? _____

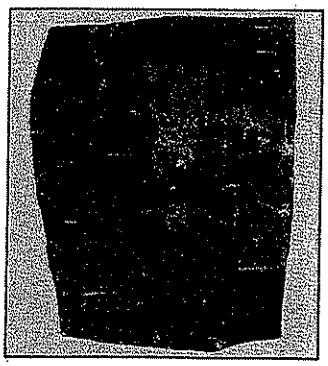
   b) This shows that it cooled _____. (slowly, quickly)

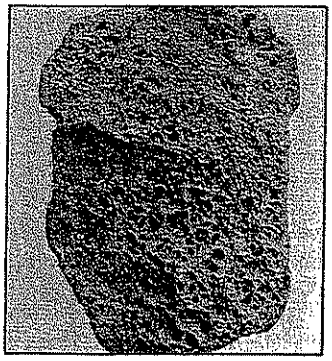
2. **a)** Which one has *smaller* grains? _____

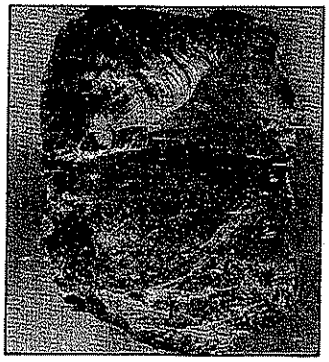
   b) This shows that it cooled _____. (slowly, quickly)

3. Which one cooled *deeper* under the ground? _____

II.

C. 

D. 

E. 

Basalt crystals are very tiny. You need a microscope to see them.

Pumice has many holes. But these holes are not grains. They were made by gases.

Obsidian is called "natural glass."

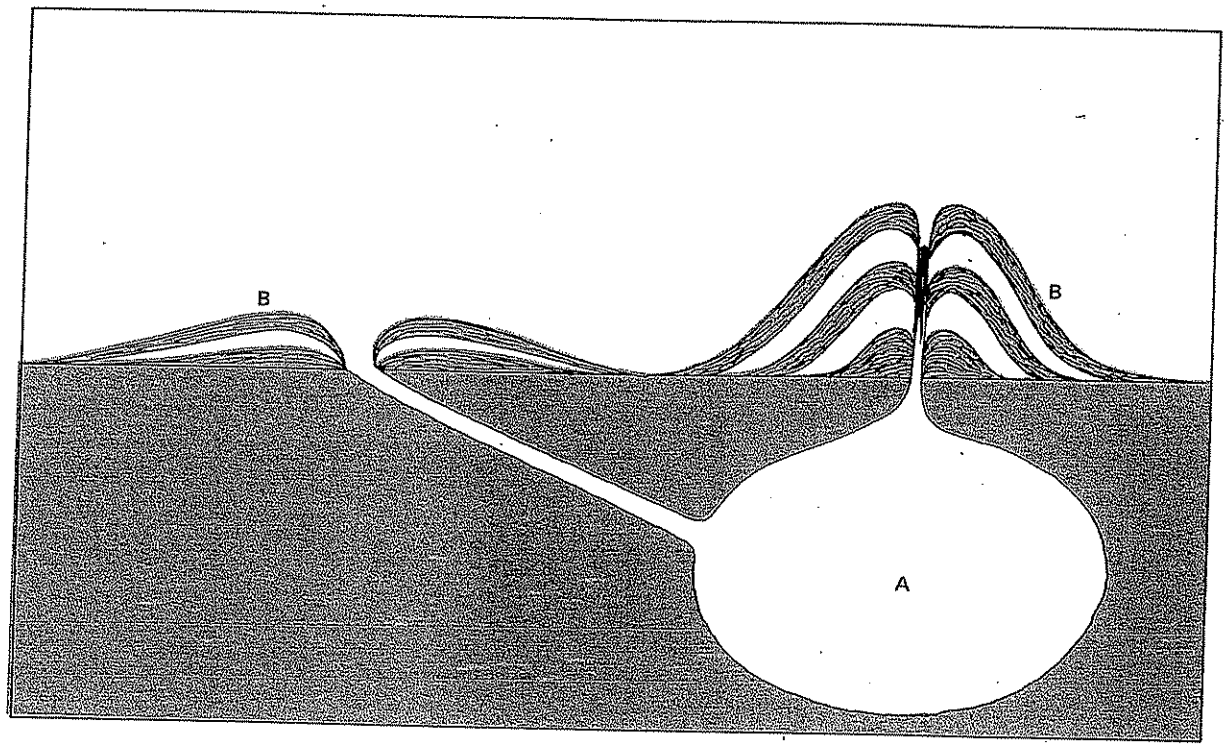
Pumice and obsidian have *no* crystals.

4. Basalt grains are small because of _____ cooling. (fast, slow)

5. Pumice and obsidian cooled _____. (extra fast, extra slow)

WHAT DOES THE DIAGRAM SHOW?

Study this diagram. Then answer the questions below. You will have to figure out the answers from facts you have learned.



This diagram shows two mountains built from underground materials. It also shows the underground materials that built them.

1. Lava is found at _____ (A, B).
2. Magma is found at _____ (A, B).
3. Magma cools _____ (slowly, rapidly) because it is _____ (under the ground, above the ground).
4. Lava cools _____ (slowly, rapidly) because it is _____ (under the ground, above the ground).
5. Large-grain rocks form from _____ (lava, magma).
6. Rocks with small grains or no grains at all form from _____ (lava, magma).
7. Granite has _____ (large, small, no) grains.
8. Pumice has _____ (large, small, no) grains.
9. Granite may form at _____ (A, B).
10. Pumice may form at _____ (A, B).

COMPLETING SENTENCES

Complete the sentences with the choices below. Two of these may be used twice.

large	melted	granite
magma	lava	crystal
small	volcano	slowly

1. Igneous rocks were formed from _____ minerals.
2. Melted rock under the ground is called _____.
3. Melted rock that comes to the surface is called _____.
4. Lava may form a mountain called a _____.
5. An example of an igneous rock formed from magma is _____.
6. Granite grains are _____ in size because granite cooled _____.
7. Grain size is another way of saying _____ size.
8. Basalt crystals are _____ in size.
9. Melted minerals that cool slowly form _____ size crystals.
10. Melted minerals that cool rapidly form _____ size crystals.

MATCHING

Match the two lists. Write the correct letter on the line next to each number.

1. _____ magma
2. _____ lava
3. _____ crystal
4. _____ large grains
5. _____ small grains

a) grain
b) from fast cooling
c) melted minerals on the surface
d) melted minerals below the ground
e) from slow cooling

TRUE OR FALSE

Write T on the line next to the number if the sentence is true. Write F if the sentence is false.

1. _____ Magma is solid.
2. _____ Magma contains minerals.

3. _____ All rocks were once liquid.

4. _____ Magma is melted rock that has come to the surface.

5. _____ Lava cools faster than magma.

6. _____ Granite formed underground.

7. _____ Granite cooled rapidly.

8. _____ Granite has small grains.

9. _____ Lava rocks usually have large grains.

10. _____ Fast cooling causes small grains.

11. _____ Basalt is an igneous rock.

12. _____ Basalt cooled slowly.

13. _____ Basalt has small grains.

14. _____ Pumice was formed deep underground.

15. _____ Pumice has no grains.

THROW ONE OUT In each of the following sets of terms, one of the terms does *not* belong. Circle that term.

1. granite, fine grain, coarse grain

2. granite, slow cooling, fast cooling

3. granite, formed above ground, formed underground

4. very slow cooling, very fast cooling, no crystals

5. lava, underground, above ground

REACHING OUT One of the rocks discussed in this Aim can *float on water.*

1. Which rock is it? _____

2. Why can it float? _____

AIM 8 | What are sedimentary rocks?

The tallest mountain in the world is Mount Everest, in Asia. People have risked their lives trying to climb it. But someday, Mount Everest will be completely worn away. It is wearing away right now, a little bit at a time. It will take millions of years for Mount Everest to wear away, but it will happen.

There are forces in nature that keep breaking rocks into smaller and smaller pieces. These broken pieces are called *fragments*. Pebbles, gravel, sand, and clay are some kinds of rock fragments.

Fragments are moved about by water, wind, and frozen water called *glaciers* [GLAY sherz]. The fragments settle in a new place and begin to pile up. The settled fragments are called *sediment* [SED uh ment]. Sediment is always laid down in flat layers. *Sediment can harden into solid rock.*

Rock that is formed from hardened sediment is called *sedimentary* (sed uh MENT ree) *rock*. Sediment can harden into sedimentary rock in two ways:

1. from the pressure of its own weight, or
2. by cementing. Minerals dissolved in water "glue" the sediment together.

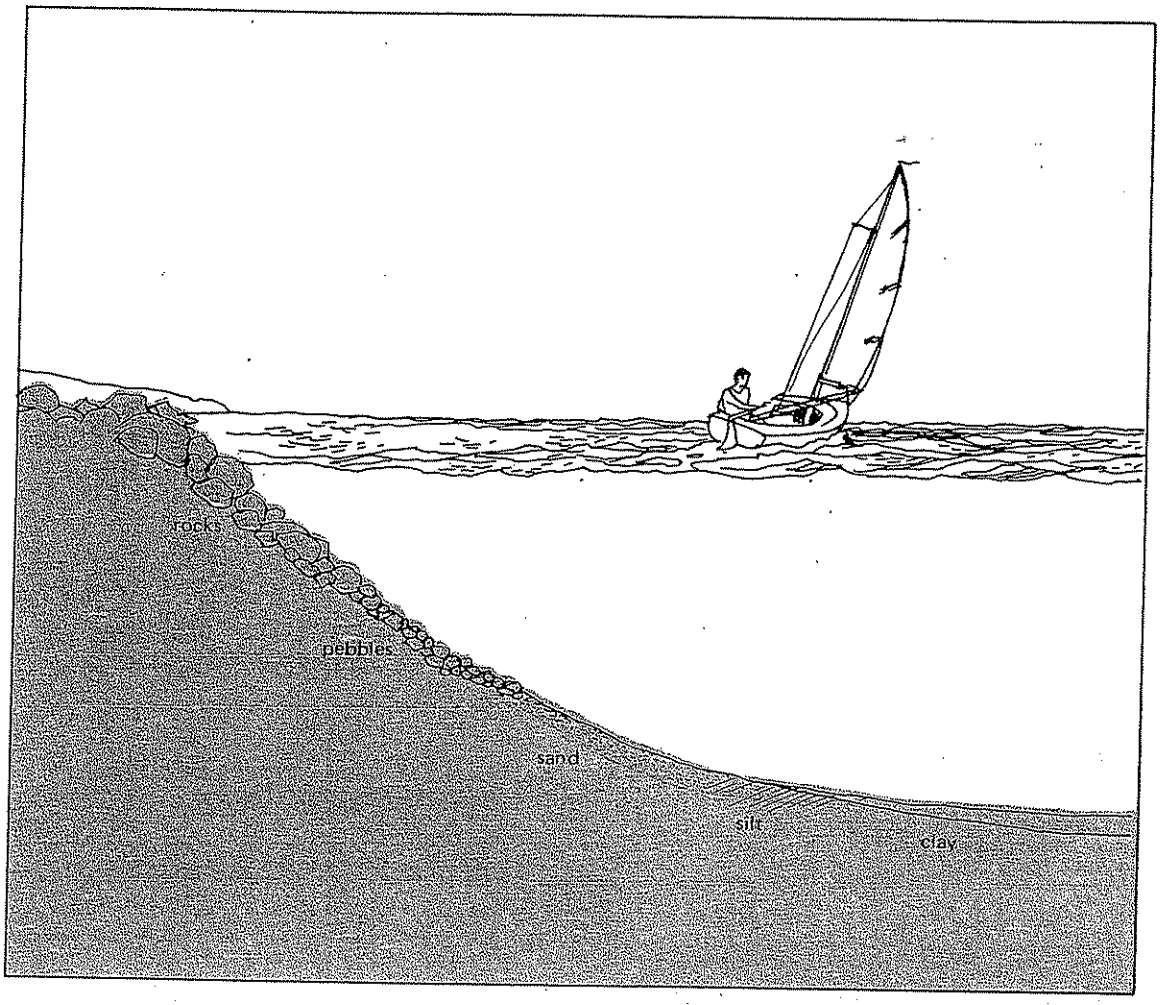
Most sediment builds up under water. The thickest sediment is found where rivers empty out into shallow oceans. Some sediment comes from living matter, such as coal that has hardened from dead trees.

Different kinds of sediment form different kinds of sedimentary rocks.

WHAT DOES THE PICTURE SHOW?

Look at the picture. Then answer the questions.

A.



Rivers carry much sediment. When a river empties into a lake or ocean, it drops its sediment. The heaviest sediment settles first. Then the lighter sediment settles.

1. List the kinds of sediment this diagram shows. _____

_____

2. **a)** Which sediment is the heaviest? _____

   b) Which is the lightest? _____

   c) Which was laid down first? _____

   d) Which was laid down last? _____

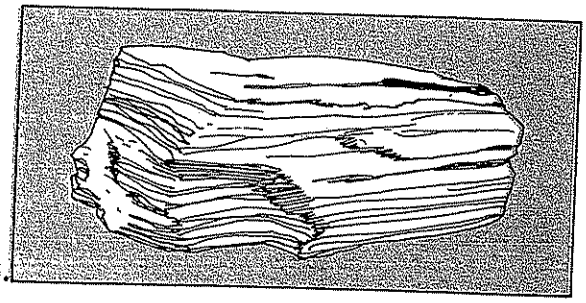
3. Choose one. Put a check (✓) on the line before the correct statement.

   _____ **a)** Oceans supply water to rivers.

   _____ **b)** Rivers supply water to oceans.

EXAMPLES OF SEDIMENTARY ROCKS

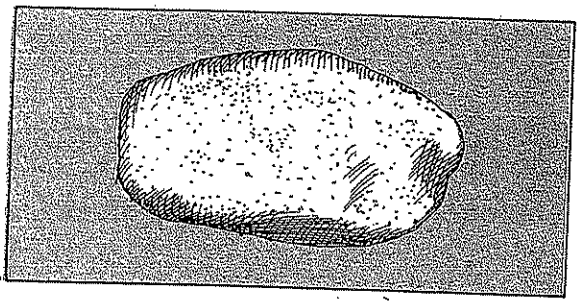
B.



Shale is a sedimentary rock. It was formed from mud and clay pressed together by nature.

Shale is a very soft rock. It breaks easily.

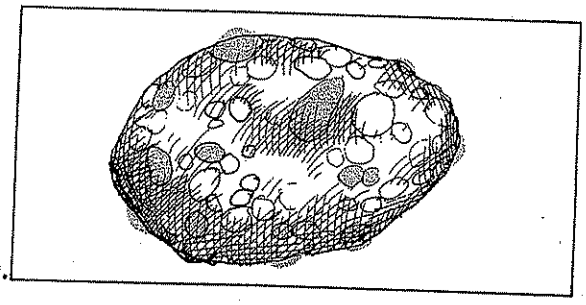
C.



Sandstone was formed in water from sand grains. Minerals dissolved in the water cemented the grains together.

Sandstone grains are held together loosely. They can be rubbed off easily.

D.

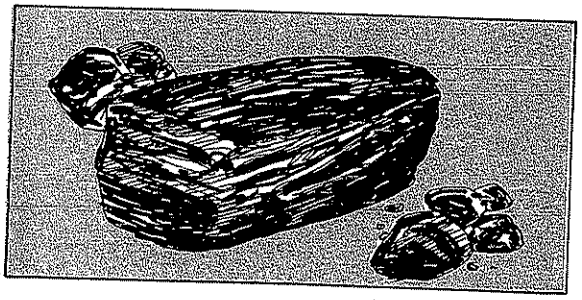


A *conglomerate* is a sedimentary rock. It is made of grains of sand and pebbles.

The grains were cemented together by minerals dissolved in water.

Conglomerate is also called *puddingstone.*

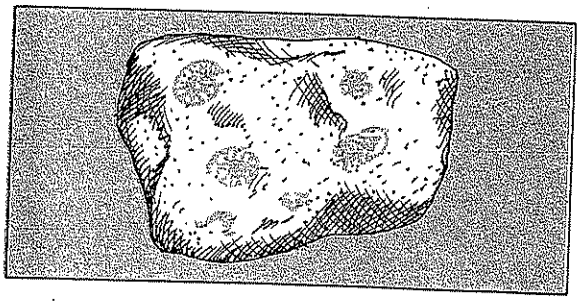
E.



Soft coal is considered a sedimentary rock.

Soft coal was formed from layers of dead plants.

F.



Limestone is a sedimentary rock formed from the shells of dead sea animals.

COMPLETING SENTENCES

Complete the sentences with the choices below.

cementing	moving water	limestone
sand	pebbles	sedimentary
fragments	clay	breaks up
wind	sizes	gravel
under water	shale	pressure
silt	glaciers	

1. Nature _____ big rocks into smaller and smaller pieces.
2. Broken pieces of rock are called _____.
3. Rock fragments make up the sediment for a group of rocks called _____ rocks.
4. Sediment comes in different _____.
5. Examples of sediment are: _____, _____, _____, _____, and _____.
6. Sediment is moved by _____, _____, and _____.
7. Fragments harden into sedimentary rocks in two ways. The two ways are from _____ and by _____.
8. The sedimentary rock made from mud and clay is called _____.
9. The sedimentary rock made from the shells of sea animals is called _____.
10. Most sedimentary rocks were formed _____.

MATCHING

Match the two lists. Write the correct letter on the line next to each number.

1. _____ sedimentary rocks
2. _____ limestone
3. _____ shale
4. _____ in water
5. _____ sediment

a) anything that settles

b) where most sediment builds up

c) group of rocks formed from rock fragments

d) formed from mud and clay

e) formed from shells of sea animals

TRUE OR FALSE Write T on the line next to the number if the sentence is true. Write F if the sentence is false.

1. _____ All rocks are sedimentary rocks.
2. _____ Sedimentary rocks came before igneous rocks.
3. _____ Sedimentary rocks are made of rock fragments.
4. _____ Most sedimentary rocks were formed under water.
5. _____ All sedimentary rocks were hardened by natural cement.
6. _____ Nature only wears things down. *(Think about this one carefully.)*
7. _____ Sedimentary rocks can come from other sedimentary rocks.
8. _____ Sand fragments settle faster than pebbles do.
9. _____ Most fragments are carried away by moving water.
10. _____ Sediment is laid down in slanted layers.

WORD SCRAMBLE Unscramble each of the following to form a word or term that you have read in this Aim.

1. GENTSFRAM _____
2. MESTDINE _____
3. SEENOTMIL _____
4. VAGLER _____
5. HALES _____

REACHING OUT What are some of the forces in nature that wear down rocks?

AIM 9 | What are metamorphic rocks?

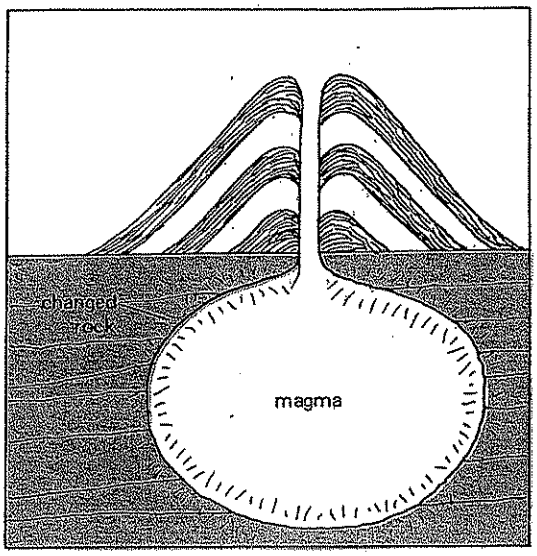
Many things we use are changed over from what they were to begin with. Glass, plastic and synthetic fabrics do not look like the raw materials they came from. Many of the things we use were changed. Some things were changed by heat and pressure.

Heat and pressure can change many things. They can even change rocks. The name for changed-over rocks is *metamorphic* [met uh MOR fik] *rocks*. Metamorphic comes from Greek words meaning "change" and "form."

Metamorphic rocks are formed deep in the earth where there is high temperature and great pressure. The heat and pressure change one kind of rock into another kind of rock. The new rocks become harder than the old rocks. They also look different. Sometimes the minerals in the rocks change too.

The pressure that changes rocks can also tilt and fold them. Folding can lift rocks and make them into high mountains.

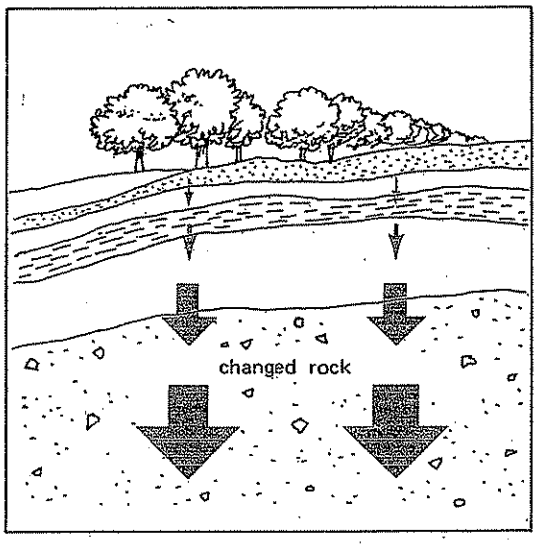
There are many kinds of metamorphic rocks. *Slate* is a metamorphic rock. Slate is changed-over shale. *Marble* is another metamorphic rock. Marble is changed-over limestone.



A.

Heat, by itself, can change rocks.

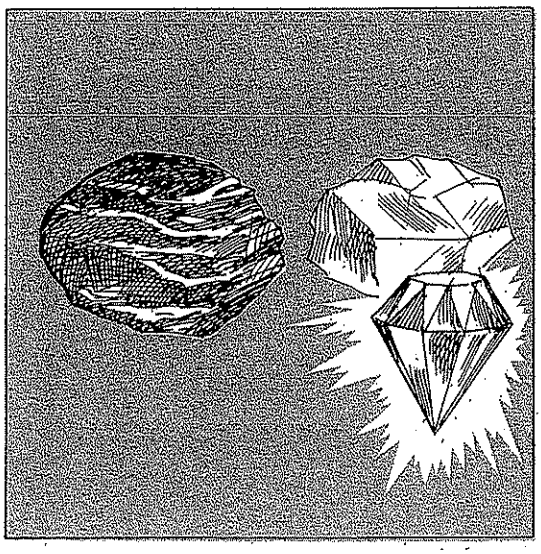
Heat from magma may change the rocks next to the magma.



B.

Heat and pressure together can change rocks.

The weight of layer upon layer of rocks causes pressure. Pressure builds heat. Heat and pressure change rocks.



C.

Coal is mostly carbon. So is diamond.

Diamond is changed-over carbon.

COMPLETING SENTENCES

Complete the sentences with the choices below.

slate	marble	igneous
great pressure	harder	fold
look	mountains	metamorphic
sedimentary	great heat	

1. Rocks formed from melted minerals are called _____ rocks.
2. Rocks formed from sediment are called _____ rocks.
3. Changed-over rocks are called _____ rocks.
4. Two things that can change rocks to other kinds of rocks are _____ and _____.
5. Pressure makes rocks become _____ than they were.
6. Heat and pressure can change the way rocks _____.
7. Pressure on rocks can make rocks tilt or _____.
8. Folded rocks can become _____.
9. Heat and pressure change shale to _____.
10. Heat and pressure change limestone to _____.

MATCHING

Match the two lists. Write the correct letter on the line next to each number.

1. _____ metamorphic rocks
2. _____ heat and pressure
3. _____ slate
4. _____ marble
5. _____ deep in the earth

a) was once shale
b) place where metamorphic rocks form
c) changed-over rocks
d) was once limestone
e) change rocks

SOME COMMON METAMORPHIC ROCKS

Original Rock		Metamorphic Rock	Uses
limestone	changes to	marble	buildings
shale	changes to	slate	roof shingles blackboards slate walks
granite	changes to	gneiss	buildings monuments
soft coal	changes to	hard coal	fuel
sandstone	changes to	quartzite	buildings

TRUE OR FALSE

Write T on the line next to the number if the sentence is true.
Write F if the sentence is false.

1. _____ Metamorphic rocks are changed rocks.
2. _____ Metamorphic rocks are harder than the original rocks.
3. _____ Only heat can change rocks.
4. _____ Slate is harder than shale.
5. _____ Sedimentary rocks were formed on a slant.
6. _____ Coal is harder than diamond.
7. _____ Minerals in a rock can change the way they look.
8. _____ Slate changes to shale.
9. _____ Gneiss is harder than granite.
10. _____ Our planet is always changing.

WHICH CAME FIRST?

In each of the pairs below, one of the things came from the other. On the line next to each pair, write the name of the thing that came *before* the other.

1. sand or sandstone? _____
2. quartzite or sandstone? _____
3. shale or mud? _____
4. slate or shale? _____
5. granite or gneiss? _____
6. marble or limestone? _____
7. plants or soft coal? _____
8. hard coal or soft coal? _____
9. diamond or coal? _____
10. limestone or tiny sea animals? _____
11. sedimentary rocks or sediment? _____