

Metamorphism - Overview

- Metamorphism literally means to “*change form*.”
- It refers to a change in mineral composition and texture of a rock which is subjected to high temp and pressure in Earth.
- These changes occur at various depths beneath Earth's surface, from 2 - 3 km depth down deep to the crust - mantle boundary.

Reference:

Tarbuck and Lutgens
Pages 47 - 51

- It can act on any rock type including Igneous, Sedimentary, and even other Metamorphic rocks.

- It can vary in degree:

low grade metamorphism (Shale to Slate), a rock that is slightly changed,

high grade metamorphism (Granite to Gneiss), a rock that undergoes a HUGE change so the identity of the original rock cannot be determined.

- During metamorphism the rock undergoing change must remain in a solid state as the changes take place, for once it melts it is then considered igneous activity.

Metamorphism **changes texture** by:

- 1) re-crystallization of minerals, and
- 2) reorganization of minerals

Three Metamorphic agents **cause rocks to change** are:

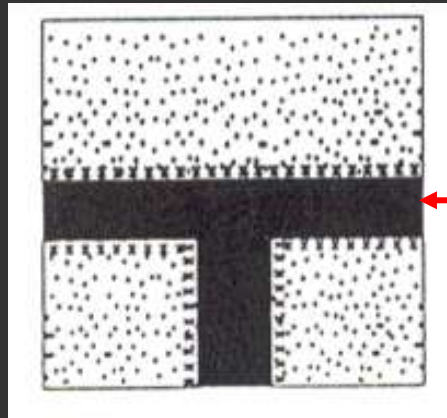
- 1) increased heat
- 2) increased pressure
- 3) chemically active fluids

Metamorphism most often occurs in one of two **geologic settings**:

- 1) during mountain building (regional metamorphism)
- 2) surrounding masses of molten rock (contact meta.)

Sample Problem - 1

What feature is represented by “xxxx” in the diagram below?



Once molten rock

- (A) contact metamorphism
- (B) faulting
- (C) regional metamorphism
- (D) unconformity

Sample Problem - 2

Which rock was subjected to the highest temperature and pressure conditions?

- (A) gneiss
- (B) marble
- (C) shale
- (D) slate

Classification of Metamorphic Rocks

- Metamorphic processes cause many changes in existing rocks, including increased density, formation of larger crystals, foliation, and formation of new minerals.
- Metamorphic rocks are generally classified as;
 - 1) Foliated Rocks
 - 2) Non-Foliated Rocks

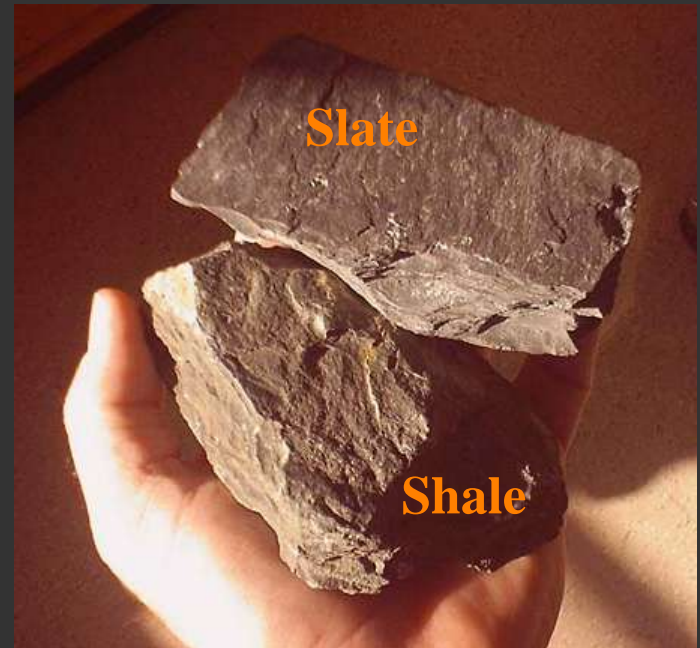
Reference:

Tarbuck and Lutgens
Pages 197, 202-204
CD 437-443

Foliated Rocks Include:

1) Slate

- Forms from low-grade metamorphism of shale.
- Fine-grained foliated rock. but foliation is not visible.
- Has excellent rock cleavage and splits easily. This property makes slate useful for tiles and billiard tables.



2) Phyllite

- Forms from intermediate-grade metamorphism of slate.
- Fine-grained foliated rock, with visible foliation.
- New minerals are often formed. For example, Garnet.



3) Schist

- Forms from high-grade metamorphism of phyllite.
- Coarse-grained foliated rock, with distinct foliation.
- These rocks are “platy” and can be split into flakes or slabs.
- New minerals are often formed. For example, Garnet.



4) Gneiss

- Forms from high-grade metamorphism of schist.
- Coarse-grained foliated rock, with distinct foliation.
- These rocks display elongated and granular minerals which give the rock a dark and light banded appearance.
- Most common minerals are quartz and feldspar.



Non - Foliated Rocks Include:

5) Marble

- Coarse crystalline network of calcite grains that form as a result of recrystallization. The parent rock of marble is Limestone.
- During recrystallization of limestone, bedding, fossils, and other sedimentary features are destroyed.
- Marble is used for statues and gravestones.



6) Quartzite

- Forms when silica sand grains and silica cement recrystallize to form a coarse grained silica. The parent rock of quartzite is quartz sandstone.
- Moderate to high-grade metamorphism fuses the sand grains. Sometimes outlines of the original grains may be seen, called *ghosting*.
- Quartzite is very hard.



Sample Problem

Which is the sequence for the metamorphism of clay?

Answer:

- (A) gneiss → shale → schist → slate
- (B) gneiss → shale → slate → schist
- (C) shale → slate → gneiss → schist
- (D) shale → slate → schist → gneiss