

Topic 4 – Minerals & Rocks
"If it's not grown, it's mined"

A. **Minerals** –(page 16 of ESRT) Minerals are solids that occur or form naturally and they are non-living. Also, minerals are uniform substances (homogeneous), and have crystalline structure.

⇒ **Rocks are made of one or more minerals.**

1. **Chemical composition:** (pg. 11 of ESRT)

- a) Some minerals can be made of just **one element** like Gold (Au), Copper (Cu), Mercury (Hg), Silver (Ag) and many others.
- b) Other minerals are composed of **compounds** like Quartz (SiO_2), Calcite (CaCO_3), Galena (PbS) and many others.
- c) Some minerals are made of the same element, but are completely different like Diamonds (C) and Graphite (C).

*In your way of thinking, **explain** how Diamonds and Graphite could have such different characteristics even though they are both made of Carbon (C).*

2. **Physical properties:** The physical properties of a mineral do not change, and are determined by the **internal arrangement of elements or compounds** that make up that particular mineral.

⇒ You will be required to test minerals for their properties and identify them by name, while using a chart similar to page 16 of your ESRT.

a) **Mineral Breakage** – The way a mineral breaks is a distinguishing property of that particular mineral. A mineral is said to show **Cleavage** or **Fracture** depending on how it breaks.

⇒ You can observe this property without damaging the mineral sample, so please do not break or crush them.

i) **Cleavage** – A mineral shows cleavage when it breaks along flat **even surfaces** called cleavage planes.

ii) **Fracture** - A mineral shows fracture when it breaks unevenly and a common type is conchoidal fracture. Quartz shows this circular and rough breakage and although they are not minerals glass and obsidian break conchoidally too.

b) **Luster** – This property describes how a mineral reflects light or in other words does the mineral shines.

i) **Metallic luster** is when a mineral has shiny look like polished metal.

ii) **Nonmetallic luster** of a mineral can range from a little shiny to dull.

c) **Hardness** – This property is often the “clincher” when trying to identify a mineral by name. We test this property by scratching the unknown mineral with something we know the hardness of like glass or a fingernail. We know the hardness of glass to be 5.5 so if the mineral can scratch glass, then it is harder than 5.5.

⇒ Friedrich Moh created *Moh’s Scale of Hardness* that provides ten standard minerals of known hardness. In addition, there are some common objects that we know the hardness of and we use them to test minerals.

Index Mineral	Scale	Common Objects
Diamond	10	
Corundum	9	
Topaz	8	
Quartz	7	Steel file (6.5)
Orthoclase	6	
Apatite	5	Glass (5.5) Knife blade (5.1)
Fluorite	4	Wire Nail (4.5)
Calcite	3	Penney (3.5) Fingernail (2.5)
Gypsum	2	
Talc	1	

d) **Streak** - A mineral’s streak is obtained by scratching or rubbing it against a white porcelain plate. The **powder** left behind is the mineral’s streak and can be very helpful in identification. Some minerals will leave **no streak** and others will leave a streak of color that is not always the same as the mineral’s exterior color.

e) **Color** – The color of a mineral is not always a good identifying property because light colored minerals are often discolored by impurities. For instance, quartz can be clear, white, orange, purple and green.

Rocks are classified based on their **origin** (how they formed). Almost all rocks consist of minerals. Some rocks are monomineralic and others are polymineralic. There are **3** basic types of rocks: **igneous, metamorphic and sedimentary**.

B. Igneous Rocks – (page 6 of ESRT) Igneous rocks form from the cooling and the **solidification** or **crystallization** of molten (liquid) rock.

1. Formation of Igneous Rx - Liquid rock solidifies (solidification) when it cools and mineral crystals grow by the process of crystallization. The result is a mass of rock that consists of **intergrown mineral crystals** of various minerals.

Explain the difference between lava and magma.

2. Classification:

- a) Intrusive igneous rocks - These rocks form **beneath** the Earth's surface in magma chambers called **intrusions**. **Intrusive igneous rocks** have **large crystals** because the liquid magma cools and solidifies more slowly, enabling crystal growth.
- b) Extrusive igneous rocks – These rocks form **above** the Earth's surface in structures called **extrusions**. **Extrusive igneous rocks** have **small crystals** because the liquid lava cools and solidifies more quickly, not allowing too much crystal growth.

Why do you think intrusive rocks cool more slowly than extrusive rocks?

Your answer



Our answer

3. Identification:

- a) Texture- This refers to the size of the crystals within an igneous rock.
- i) **Coarse (big) texture** is when the majority of the crystals are larger than 1mm. Coarse texture is found in **intrusive igneous rocks**.
- ii) **Fine texture** is when the majority of the crystals are smaller than 1mm. Fine texture is found in **extrusive igneous rocks**.
- iii) **Glassy texture** is when there are **no crystals** and this is because the lava cooled so fast that there was no time for crystal growth.
- b) Mineral Composition – After texture has been observed, the type of the minerals within the rock should be considered to identify the rock. The mineral type can be inferred by the **color of each crystal**. This is **not exact** but it can be used successfully to identify igneous rocks.

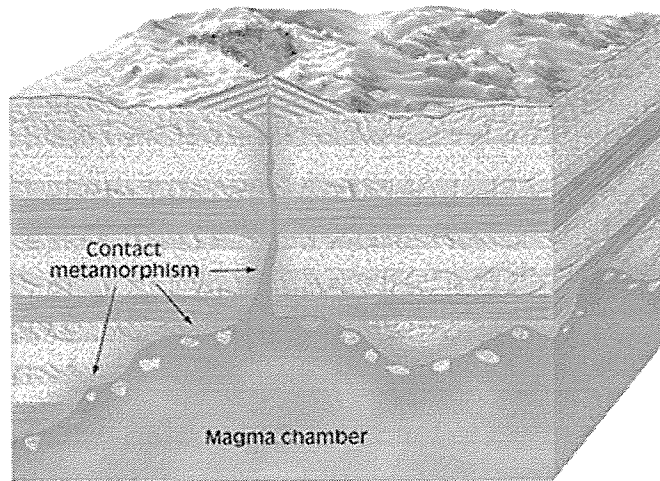
Use the chart on page 6 of your ESRT to identify the following igneous rocks.

- a) What is the name of the intrusive igneous rock that has a lot of white and pink crystals with a few black crystals?
- b) What is the name of the igneous rock that has glassy texture and is Felsic?
- c) What is the approximate percentage of Quartz in Granite?
- d) What extrusive rock(s) contains a large percentage of pyroxene and has crystal grain size less than 1 mm?

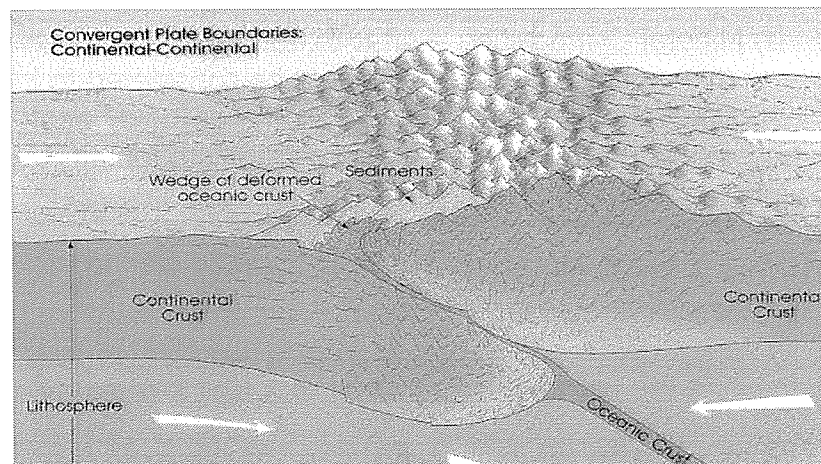
C. Metamorphic rocks - Rocks that form from **other rocks** after they are subjected to extreme **heat and pressure**.

1. Formation of metamorphic Rx - When rocks are exposed to extreme heat and/or pressure, the minerals will recrystallize. This process is called **recrystallization** and it takes place deep within the Earth. It is very important to understand that metamorphic rocks **do not** form by complete melting.

a) Contact metamorphism occurs at the interface between an igneous intrusion and the surrounding rock.



b) Regional metamorphism occurs in the "crunch zone" between two continents during a continent to continent collision. Much more pressure and heat are present during this type of metamorphism.



2. **Characteristics:**

- a) **Foliation** – Metamorphic rocks that are foliated show some alignment of crystals. It can also refer to the flattening of crystals like in the rock schist.
- b) **Banding** – This is the way metamorphic rocks show alternating “bands” of similar minerals.
- c) **Distorted layers** – If a sedimentary rock undergoes metamorphism, the layers can be folded or bent in many directions.
- d) Metamorphic rocks have **high densities** due to the pressure.

D. **Sedimentary Rocks** – (page 7 of ESRT) Form from the accumulation of sediments that come from preexisting rocks and/or organic material. Most sedimentary rocks form under water.

1. **Formation of sedimentary rocks:**

- a) **Cementation** – Parts of rocks (called sediments) are held together by minerals like a natural cement. Some examples are silica and calcite.
- b) **Compression** – The weight of overlying sediments pressing down on deeper sediments causes them to become tightly packed together (or compressed). Over time, the weight of overlying sediments increases and the presence of natural cements like silica and calcite cause the sediments to become a sedimentary rock.

What happens to the salt in "salt water" when evaporation takes place?

c) Chemical action – As ocean water evaporates, the minerals accumulate on the ocean floor. Over millions of years, they form layers of minerals, which form sedimentary rocks by cementation and compression. **Examples:** Chemical Limestone, and Dolostone.

d) Biological processes – When the remains of once living organisms accumulate and form layer, they become sedimentary rock by cementation and compression. **Examples:** Coal and Fossiliferous Limestone.

2. **Classification:**

- a) **Clastic Sedimentary Rocks** consist only of **fragments** of other rocks, which have been weathered, eroded. This is the most abundant type of sedimentary rocks.
- b) **Nonclastic Sedimentary Rocks do not** consist of fragments of other rocks, but instead can be formed by chemical action or biological processes.

3. **Identification:**

- a) They are dull and earthy in appearance.
- b) They can have fossils (unlike igneous and metamorphic rx.).
- c) They often have distinct layers called strata or beds.
- d) Sediment size is important in identifying specific clastic sedimentary rx.

Additional notes on Rocks:

⇒ Most of the Earth's lithosphere is made of Igneous Rock, but 75% of the lithosphere is covered by a "thin" layer of Sedimentary Rock.

⇒ Igneous and Metamorphic Rock form many mountains around the world.

E. Rock Cycle – (page 6 of ESRT) Rocks of all types are constantly being "recycled" into other types of rocks.

⇒ Igneous Rx can be weathered and eroded and the sediments will eventually be deposited and form Sedimentary Rx.

⇒ Metamorphic Rx can be weathered and eroded and the sediments will eventually be deposited and form Sedimentary Rx.

⇒ Sedimentary Rx can experience pressure and heat and recrystallize (partially melt) into Metamorphic Rx or become completely melted into magma and eventually cool and form Igneous Rx.

Some Possible Extra Credit Assignments: (see me for more details if you are interested in one of these or something of interest to you)

1. *What are some common uses for minerals?*
2. *What are natural resources and what is the inevitable problem associated with them?*
3. *Compare and contrast renewable natural resources and nonrenewable.*
4. *What are fossil fuels and how do they form?*
5. *Explain some of the problems caused by most of the world's petroleum being produced in a small number of countries.*
6. *What are some alternative energy sources and which is the best according to you and why?*
7. *What is the Mining Act of 1865 and what problems has it caused?*