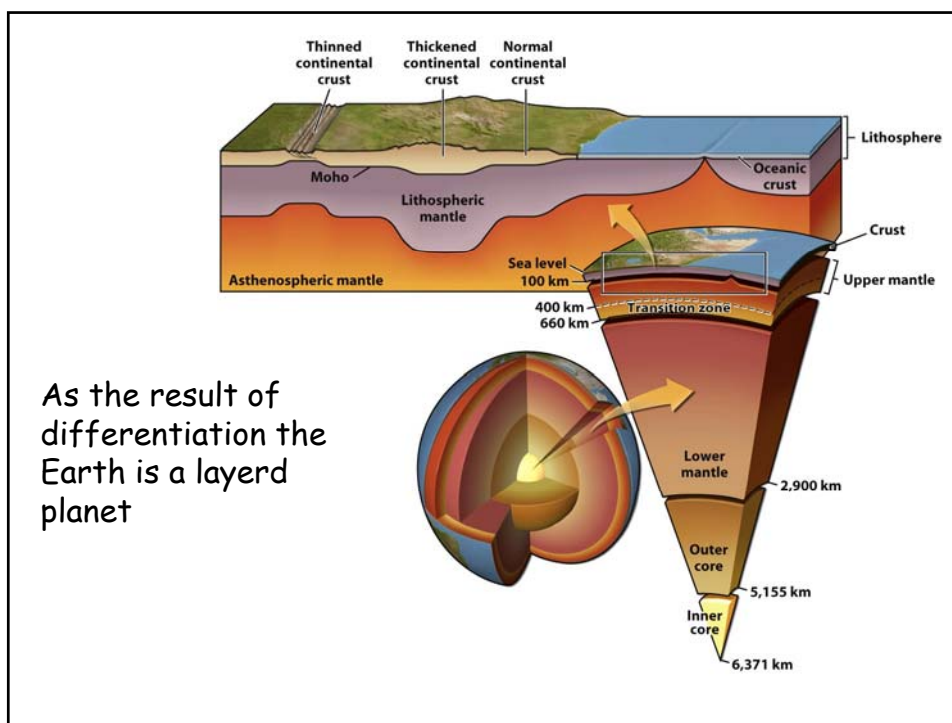


Mineralogy I

Physical Properties

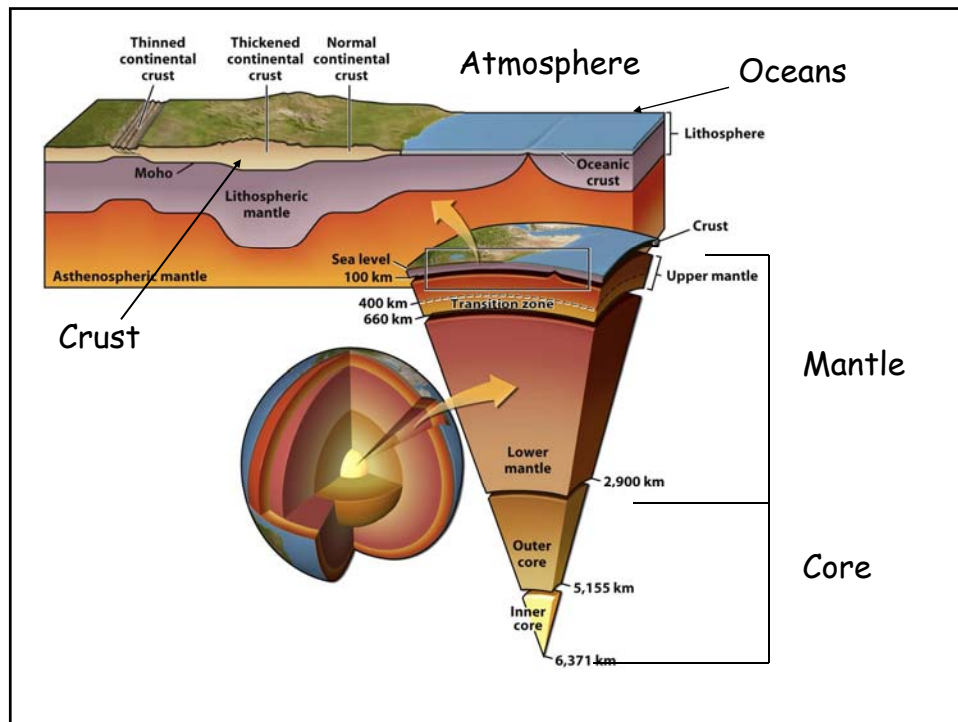
The composition of the Earth was
caused by two events:

- 1) Condensation from the solar nebula
- 2) Differentiation



The Earth consists of:

- 1) The core: mostly Fe and Ni metal, some of which is molten
- 2) The mantle: mostly O with Mg, Si,
- 3) The crust: mostly O with Si, Al, Na, K
- 4) The ocean: mostly H₂O with variable amounts of salts
- 5) The atmosphere: N₂, O₂, H₂O, CO₂ and other gases



The solid portions of the Earth (the crust, mantle and core) are made out of rocks.

There are three types of rocks:

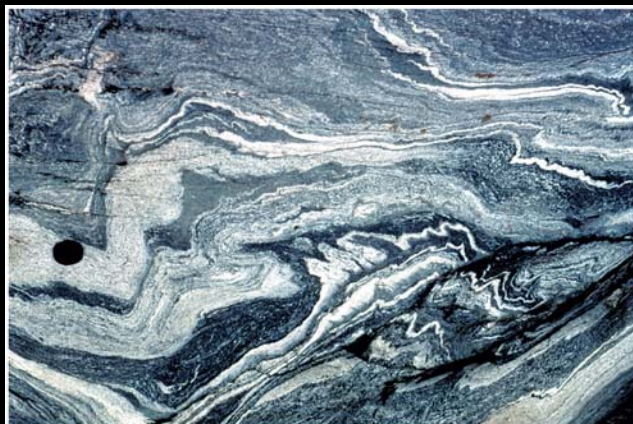


Igneous rocks crystallize from melts



bedding

Sedimentary rocks form from sediments



Recrystallization of igneous or sedimentary rocks at elevated temperature and pressure forms **metamorphic** rocks.

Before we can discuss rocks, we must understand minerals.

A mineral:
Is naturally occurring
Is an inorganic solid
Is formed by geologic processes
Has a definite chemical composition
Has an orderly arrangement of atoms



Diamond is a mineral
because it occurs in
nature

Cubic zirconia is not a
mineral because it doesn't





Coal is not a mineral because it is a mixture of organic compounds



Calcite from a shell is a (biogenic) mineral because calcite also forms by non-biogenic processes

Other biogenic solids (such as kidney stones) are not minerals because they don't occur by geologic processes

Quartz has a definite composition (SiO_2), as does olivine ($(\text{Mg,Fe})_2\text{SiO}_4$)

Olivine is a **solid solution**. It does not have a fixed composition, but one that varies within defined limits.

Substances that have an orderly arrangement of atoms are called **crystalline** substances.

Under the proper circumstances these substances may form crystals, which are a morphological manifestation of the atomic arrangement.



Obsidian
(volcanic glass) is
not a mineral
because:

1) It doesn't
have a definite
chemical
composition

2) It isn't a crystalline substance

Geologists identify minerals in hand sample
using their **physical properties**

1) Color

2) Streak

3) Luster

4) Hardness

5) Specific gravity

6) Crystal habit

7) Cleavage & fracture

8) Special properties

The color of a mineral is determined by which wavelengths of light are transmitted and which are absorbed.



Milky quartz contains lots of microscopic fluid inclusions

Rose quartz contains minor amounts of Mn

The streak of a mineral is the color it would have when it is finely ground.



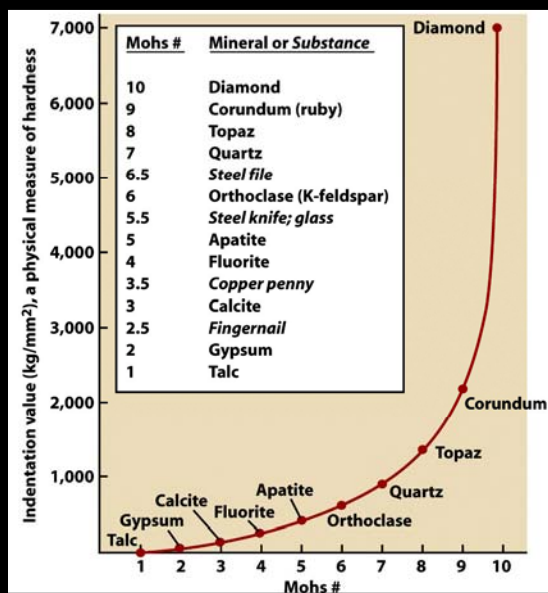
Minerals with metallic luster reflect all the light off the surface

Minerals with glassy luster transmit all the light



The hardness of a mineral reflects the strength of its chemical bonds.

The hardness of a mineral is calibrated against *Moh's Hardness Scale*.

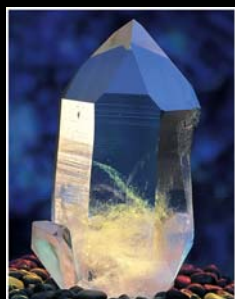


A mineral higher on Moh's scale will scratch any mineral that is lower on the scale.

The specific gravity of a mineral is the ratio between the density of the mineral and the density of water.

Quartz has a S.G. = 2.5' lead has a S.G. = 11.0

The crystal shape is a function of the arrangement of the atoms - i.e. crystal structure



Hexagonal - quartz (SiO_2)

Cubic - Pyrite (FeS_2)





Octahedral: Diamond

Rhombohedral: calcite (CaCO_3)



Cleavage occurs when minerals break along preferred planes in a crystal structure.



A good example is mica, which has one perfect cleavage

Another example is calcite, which has three directions of cleavage



Special properties include:

- 1) **Magnetic:** Only a few minerals are magnetic - *magnetite* (Fe_3O_4) is the major one.
- 2) **Taste:** *Halite* (NaCl) has a salty taste.
- 3) **Effervescence:** *Calcite* (CaCO_3) fizzes in dilute HCl