

Chapter 2: Getting Around in Geology

Earth Systems consists of:

1. Lithosphere: solid rock and soil at the surface
2. Atmosphere: the air
3. Hydrosphere: bodies of water and ice (cryosphere)
4. Biosphere: its living realm

The spheres are inter-related, and changes in one sphere typically result in the changes in the other spheres.

System- set of components or parts that work together to perform a particular function.

⇒ All systems require energy to operate

⇒ Sources:

1. Internal Heat Engine - from the decay of radioactive elements at the earth's core.
2. External Heat Engine - comes from the sun, which is responsible for powering surficial as well as atmosphere processes.

Earth Materials

(Atoms → Elements → Minerals → Rocks → Continents)

Elements – substances that cannot be changed into other substances by normal chemical methods.

Atom – smallest part of an element that still retains the properties of that element.

⇒ The weight of the atom is found in the nucleus, which contains:

- a. Proton
- b. Neutron

⇒ Orbiting outside the nucleus are electrons, which are negatively charged.

Atomic mass (Protons + Neutrons)

4

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Atomic Number (# of protons)

Most atoms are electrically neutral
(the number of protons is
equal to the number of electrons)

Ions are atoms that develop a charge when the number of protons does not equal the number of electrons.

- a. Cations – Positively charged (more protons than electrons) Ex: Sodium
- b. Anions – Negatively charged (more electrons than protons) Ex: Chlorine

Many Cations and anions bond to form ionically bonded minerals, like Halite (NaCl).

Isotopes are forms of an element that have different atomic masses, or differing numbers of neutrons.

Examples: Uranium

Carbon

Minerals

In order to be a mineral, you must meet the following criteria:

1. Naturally Occurring
2. Inorganic
3. Solid
4. Narrow range of chemical composition
5. Characteristic physical properties
6. Crystalline structure
7. Stable over a range of temperatures and pressures

Mineral groups

A. Nonsilicates

1. Ores
 - a. Sulfides
 - b. Oxides
 - c. Hydroxides
2. Evaporates
 - a. Sulfates
 - b. Halides
 - c. Borates
3. Others
 - a. Carbonates
 - b. Native Elements

B. Silicates – combination of O and Si. (the silica tetrahedron)

1. Nesosilicate
2. Sorosilicate
3. Cyclosilicate
4. Phyllosilicate
5. Inosilicate
6. Tectosilicate

The silicates are frequently referred to as rock forming minerals.

Mineral Identification

Minerals are identified according to their physical properties.

Physical Properties:

Rocks

⇒ defined as consolidated or poorly consolidated aggregates of one or more mineral, glass or solidified organic matter (such as coal) that cover the earth's crust.

There are three types:

1. Igneous
2. Sedimentary
3. Metamorphic

Igneous Rocks

Key terms – Plutonic vs. Volcanic (magma vs. lava)

Mafic vs. Felsic

Phaneritic vs. Aphanitic

Igneous Rock Textures:

Sedimentary Rocks

Key terms – Clastic vs. Chemical vs. Biogenic or organic

Sedimentary Structures

1. Stratification
2. cross-bedding
3. water marks
(ripples, rolls, swash, mud cracks)

Fossilization

Metamorphic Rocks

Foliated vs. Nonfoliated

“Rock Defects” or the “attitude of rock”

Strike and Dip

Joints vs. folds vs. faults

Geologic Time

Relative Dating vs. Absolute Dating

Radiometric Dating

Alpha vs. Beta Decay

The Age of the Earth

The players:

1. Archbishop Ussher
2. Lord Kelvin
3. Bertran Boltwood
4. John Joly
5. James Hutton

Radiometric Dating Techniques

Parent Daughter
 ^{238}U to ^{206}Pb

^{237}U to ^{207}Pb

^{232}Th to ^{208}Pb

^{40}K to ^{40}Ar

^{14}C to ^{14}N

Earth's oldest Stuff

Crust

Rock

Sedimentary Rock

Fossils

Case Studies

Minerals, Cancer and OSHA – fact and fiction

A Girls best friend and other Gems

Minerals, Cats and Litter Belt