

MINERALS & THE ROCK CYCLE

GEOLOGY IN THE NEWS: Rock from Russian mine contains 30,000 diamonds

Q: Why do we care about rocks & minerals?

A: They are common raw materials that can be used for construction, jewelry, & technology.

I. BASIC CHEMISTRY

- **Atoms**- building blocks of matter; made up of protons, neutrons, electrons
- **Atomic number**- number of protons; assigns the atoms to a specific element
- **Element**- substances that cannot be broken down chemically; all the same type of atoms
- When we have minerals, we're basically putting together different amounts of the elements O, Si, Al, Fe, Ca, Na, K, Mg
- Building molecules
 - o Electrons exist in shells- each shell can hold a certain number of electrons
 - o Atoms want to fill their shells
- Ions & ionic bonds
 - o Exchanging electrons
 - o One ion takes an electron and becomes an anion, one gives an electron up and becomes a cation, both atoms are more stable
 - o Common in some minerals

II. WHAT IS A MINERAL?

- 5 criteria something must meet to be a mineral
 1. Non-synthetic: must form in nature on its own
 2. Inorganic: must be nonliving & must not include any organic molecules

3. Crystalline: atoms organized in a very orderly pattern (opposite is amorphous)
4. Solid: state is determined by temperature & pressure
5. Set chemical composition: simple chemical formula
 - Some substitutions occur when minerals form

III. MINERAL PROPERTIES

- **Color**- notice it right away, tricky to use to identify minerals
 - o Olivine is always the same, quartz has many colors
- **Streak**- color of the mineral when ground into a powder; usually same color as mineral but some are very different & useful for identification
 - o Hematite is black with a red-brown streak
- **Moh's scale**- 1 is softest mineral (talc), 10 is hardest (diamond); it is fine to give a range
 - o Tools: fingernail, penny, knife
 - o If your measurement is off by <1 it's probably fine
- **Luster**- reflectivity; how shiny the mineral is
 - o Metallic, vitreous, resinous, greasy, silky, dull, pearly
- **Effervescence**- bubbly; react when exposed to weak acids
 - o Calcite effervesces when exposed to HCl
- **Crystal form**- what shape the mineral is
 - o Halite crystals are usually cubes
 - o Problem: many minerals don't get to grow in the shape they want to
- Breakage patterns
 - o **Fracture**- no pattern to the break (quartz)
 - o **Cleavage**- break on flat planes (halite)
- **Striations**- straight lines on cleavage planes; can pretty much only be seen in the light; very diagnostic
- Some minerals are magnetic
- Sulfur-bearing minerals smell like rotten eggs
- Halides have a strong, salty taste
 - o There is a good way and a bad way to taste a mineral

IV. COMMON MINERAL GROUPS

- Minerals are grouped by the anion it contains, many groups exist
- **Sulfides** (S) & **Oxides** (O)
 - o Tend to have very simple chemical formulas (metal + S or O)
 - o Metallic in appearance (pyrite: Fe + S)
 - o Usually rare & expensive
- **Sulfates** (SO₄)
 - o Commonly used for construction & plaster
- **Phosphates** (PO₄)
 - o Relatively rare
 - o Important component of most fertilizers, plants need P
 - o One of primary minerals in bones & teeth
- **Carbonates** (CO₃)
 - o Pretty common at the surface of the earth because they are formed by organisms (shells)
 - o Effervescent
- **Silicates** (SiO₄)
 - o Most common in minerals- $\frac{3}{4}$ of Earth's crust is made of Si & O
 - o **Tetrahedron**- O is 4 corners, Si is in the middle
 - o **Polymerization**- sticking tetrahedrons together
 - o 2 tetrahedra never share more than 1 O atom between them
 - o Types of silicates- depend on polymerization
 - **Island silicates**- tetrahedron is alone
 - **Chain silicates**- adding at both ends
 - **Sheet silicates**- flat, 2-D sheet of rings, cleave on flat surface
 - **Framework silicates**- 3-D, very common (quartz, etc.)

V. THE ROCK CYCLE