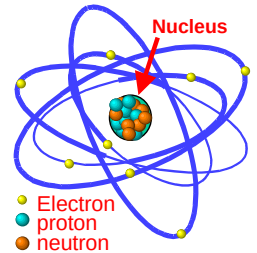


ATOMS, ELEMENTS AND MINERALS

Atoms and Elements

Browse the "[Periodic Table of Elements](http://periodic.lanl.gov/periodic/default.htm)" page at Los Alamos National Laboratory (<http://periodic.lanl.gov/periodic/default.htm>)

- An element is the simplest form to which the matter can be reduced by ordinary chemical methods, e.g., common salt (NaCl) can be broken into the elements sodium (Na) and chlorine (Cl).
- The atom of an element
 - is the smallest possible particle of an element that retains that element's properties; and
 - has a nucleus, with protons and neutrons inside it, and electrons in orbit, there being as many electrons in orbit about the nucleus as the number of protons inside the nucleus (i.e., atomic number = number of electrons or protons, atomic mass = number of protons and neutrons).



Try <http://geology.wr.usgs.gov/docs/parks/rxmin/mineral.html> to access the USGS site on the common rock forming minerals.

Mineral Characteristics

- Minerals are the basic building blocks for earth materials.
- A mineral is a naturally occurring crystalline solid with its own characteristic chemical composition (O, Si, Al, Fe, Ca, Mg, K and Na being the commonest elements on earth, minerals are often made up of these elements).
- Minerals can be (a) native elements (e.g., gold, diamond) or (b), chemical compounds (e.g., oxides, hydroxides, sulfides, sulfates halides, carbonates, phosphates and silicates).



- Minerals can belong to cubic, tetragonal, hexagonal, orthorhombic, monoclinic or triclinic crystal systems.

- **Physical properties of minerals** include color (light or dark), habit (equant, fibrous, bladed, sheet), streak, fracture, cleavage, luster (metallic, vitreous etc.), hardness (i.e., on Moh's scale), specific gravity or Density, magnetic and electrical properties, radioactivity, luminescence etc.

Major Mineral Groups

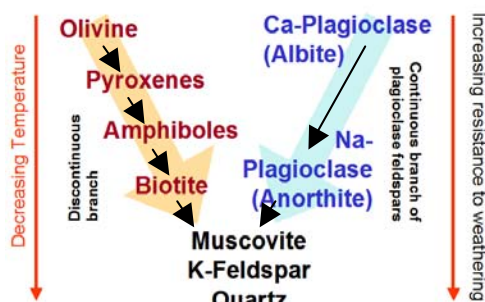
- **Silicates:** Quartz, Feldspars, Mica, Amphiboles, Pyroxenes, Olivine
- **Carbonates:** Calcite, Dolomite
- **Sulfates:** Gypsum/Anhydrite, Barite
- **Sulfides:** Chalcocite, Chalcopyrite, Pyrite, Galena, Molybdenite, Sphalerite
- **Oxides:** Magnetite, Hematite, Chromite, Cuprite, Limonite, Goethite
- **Halides:** Halite, Fluorite; **Phosphates:** Apatite
- **Native Elements:** Gold, Silver, Copper, Platinum, Diamond, Graphite

Visit "The Mineral Gallery" at <http://mineral.galleries.com/> to view the impressive collection of Amethyst Galleries Inc.



Understanding Silicate Minerals

Earth's silica content is in the crust and the mantle. Silicate minerals are therefore the most abundant of the rock forming minerals. They are primarily build around the silica tetrahedron. This silica (SiO_2) mostly occurs in combination, not as free silica or quartz. For instance, combining iron and magnesium oxides (FeO and MgO) with an equal amount of silica (SiO_2) produces the iron and magnesium silicate mineral, olivine, adding silica to which then produces pyroxenes and, subsequently, amphiboles. But the commonest rock-forming silicate mineral by far is the potassium aluminum silicate orthoclase, or K-feldspar, and its close cousins, the Ca- and Na-feldspars, or plagioclases.



Moh's scale of hardness

Hardness	Mineral	Hardness	Mineral
1	Talc	6	Feldspar
2	Gypsum	7	Quartz
3	Calcite	8	Topaz
4	Fluorite	9	Corundum
5	Apatite	10	Diamond

- **Bowen's Reaction Series**, shown alongside, proposed by N.L. Bowen in 1917, conveniently explains the common observation that rocks rich in olivine, pyroxenes and calcium-rich plagioclases weather faster at the atmospheric P and T conditions than the rocks that form at lower pressures and temperatures.

- **Want to practice writing an essay?** Visit the URL: <http://www.earthsci.gla.ac.uk/courses/l1/essay-how.htm> for an example of using Bowen's Reaction Series to write an essay.

- **Hematite and jarosite on Mars? So what?** Visit <http://marsrovers.jpl.nasa.gov/home/>, the home page of Mars Exploration Rover Mission to learn why.