About Minerals

The Rock Cycle

ROCKS! WHAT ARE THEY? Rocks are aggregates of any combination of minerals (Quartz, Calcite, Galena), elements (S-sulfur, Au-Gold), solid organic material (coal), and/or other rocks.

ROCKS = MINERALS ± ELEMENTS ± SOLID ORGANICS ± OTHER ROCKS

IGNEOUS ROCKS are the parent rocks of all other rocks. They form from the cooling and crystallization of magma. These include intrusive that crystallize below the earth's surface (Granite/Gabbro) and extrusive that crystallize above the earth's surface (Rhyolite/Basalt/Pumice).

Igneous rocks are classified according to color, texture, specific gravity and mineral composition. Specific gravity and mineral composition are similar for both intrusive and extrusive igneous rocks.

Common minerals in igneous rocks are: quartz, feldspars and iron/magnesium. Felsic or light colored rocks (rhyolite/granite) have a high quartz content and low iron/magnesium. Intermediate rocks have relatively equal amounts of light (quartz and feldspars) and iron/magnesium minerals. Mafic or dark colored rocks have a greater percentage of iron/magnesium minerals than the lighter quartz/feldspar minerals.

The specific gravity for igneous rocks ranges from 2.3 to 3.3. Specific gravity is the mass of an object compared to an equal mass of water at 4 degrees C. The felsic and intermediate rocks have less mass than the mafic rocks due to the lower percentage of dark iron/magnesium minerals.

Intrusive igneous irregular rock bodies are called batholiths. Tabular igneous bodies that cut across the bedding of sedimentary rocks are called dikes. Igneous bodies that are parallel to sedimentary bedding are called sills.

Colors of igneous intrusive rocks can be light, almost white, dark green to black and in between colors with varying tones of grays, pinks and red. Their texture is coarse grained with minerals visible to the naked eye. The minerals are typically interlocking and more or less of the same size.

Granite Light-intermediate color
Grandodiorite Light-intermediate color
Diorite Intermediate-dark color
Gabbro Dark color

Extrusive (volcanic) igneous rocks have poorly developed crystal faces and take on a variety of shapes. Depending upon the amount of gas trapped in the lava and the viscosity of the magma determines the type of rock. Their color is usually light but can be dark green to black and in between colors with varying tones of grays, pinks and red. Their texture is fine grained, minerals are unidentifiable with the naked eye.

Rhyolite Light-intermediate color
Pumice Light-intermediate
Obsidian Light-Dark Black
Andesite Intermediate-dark color
Basalt Dark color

SEDIMENTARY ROCKS are formed by the weathering (physical and chemical) of igneous, metamorphic and other sedimentary rocks. The weathered fragment are transported via water, air or ice before they are deposited and transformed. Sediments are transformed into rocks by: cementation, usually calcite, silica or iron oxides that glue the fragments together. Compaction, fragments being squashed together. Re-crystallization, which produces interlocking textures. Sedimentary rocks are generally layered or bedded and range in size from inches to thousands of feet thick.

Mechanical Weathering: The process by which a rock is broken down into smaller and smaller fragments by external physical forces. It does not cause changes in chemical composition of a rock.

Running water: transports loose sediments down river to a point where it is deposited. Larger heavier fragments are the first to be deposited while smaller lighter fragments are transported further and are rounded from the abrasion encountered during transportation.

Glacier ice: Frozen ice erodes earth materials from landslides, avalanches and frost action. Glaciers pick up rock material by means of abrasion. As the glacier moves across bedrock it drags rocks, boulders, pebbles, sand and silt across the floor ripping up the bedrock as it passes. Porous and fractured rocks are broken by expanding forces caused by water freezing within the rock.

Wind: Wind typically carries small particles and is very capable of eroding and transporting large amounts of sediments.
Ocean waves: The energy of waves crashing against the shore or cliff produce a wave cut terrace or platform. They also cause the abrasion rocks and sand particles as they are transported along the shore.

Chemical weathering: The transformation of the original material into a different one. Particle size is very important in the process of chemical weathering. The greater the surface area of a particle the more susceptible it is to chemical weathering. Other factors that contribute to chemical

weathering are: climate, moisture, plants and animals. Oxidation is one form of chemical weather when iron minerals or rocks containing iron minerals are susceptible to oxidation/rusting when exposed to the atmosphere.

Sedimentary rocks have a wide range of colors that include red, brown, gray, yellow, pink, black, green and purple. The most important colors are the iron bearing compounds, brown, red, yellow and green. Red rocks owe their colors to the fine hematite and green rocks to chlorite and lack iron oxide. Their texture ranges from very fine grained (crystalline) to very coarse grained conglomerates. The three major types of sedimentary rocks are mud rocks, sandstones and carbonate rocks.

Mud rocks: Approximately 65% of considered mud rocks (shale). The particles include clay to course silt. These particles are suspended in water and can settle and accumulate only in still waters such as lakes, deltas and lagoons.

Sandstone/Conglomerate: About 20 to 25% of sedimentary rocks are sandstones. These accumulate in areas of high energy environments of moving fluids such as rivers and beaches. Sandstones consist of particles of very fine to very coarse grained sand. Conglomerates can have particles up to boulders in size. The particles vary in shape from angular to rounded and are poorly sorted to well sorted. The shape of the particle is determined by the amount of abrasion that it encountered.

Carbonate: These cover about 10 to 15% and are made up chiefly of calcium carbonate and deposited by either inorganic or organic chemical processes. Approximately 90% of the carbonate rocks are from marine organisms. Inorganically formed carbonate rocks are from calcite that has been precipitated.

METAMORPHIC ROCKS: These are formed from the results of pressure and/or temperature changes. Examples would include areas where an igneous intrusion forces its way through the earth's crust resulting in pressure and temperature changes due to force and friction. Metamorphism can also occur in areas of stress such as faulting and folding of rock or in areas of plate tectonics such as the oceanic crust colliding into the continental crush. The principal characteristic of metamorphic changes is that they occur while the rock is solid.

Texture characteristics are very important in classifying metamorphic rocks. They range from very fine grained to coarse grained minerals. Metamorphic rocks can be divided into two textural groups, foliated (layered) and unfoliated (not layered).

Foliation: Parallel layers of minerals of different composition giving the rock a distinctive planar to platy feature.

Rock Cleavage: A property of a rock that allows for easy breaking along parallel planes or surfaces. Metamorphic rocks tend to break or cleave most easily along planes parallel with foliation.

Slaty: Cleavage is present along planes separated by microscopic dimensions. The planes are smooth and regular. (Slate)

Phyllic: Cleavage fragments are barely visible to the naked eye. Fragments are thicker than slaty cleavage and the cleavage planes are somewhat more irregular. (Phyllite)

Schistose: Cleavage in the form of flakes, clearly visible. Rough cleavage surfaces. (Schist)

Gneissic: Coarse foliation or banding in which the bands are of different mineral composition. Bands are usually 1/8 of an inch think. Cleavage planes are irregular and rough. (Gneiss)

Unfoliated: No preferred orientation of minerals. The rock has no preferred orientation of breakage. (Quartzite and Marble).

Original Rock/Metamorphic Rock
Claystone/Slate
Claystone, Siltstone/Chlorite Schist
Basalt, Gabbro/Biotite Schist
Granite/Chlorite Gneiss
Calcite/Dolomite, Marble
Quartz-rich Sandstone/Quartzite

PLATE TECTONICS:

The earth is always shifting and moving. The oceanic plate is made of dense basaltic rock and the continental plate is made of lighter felsic igneous rock and sedimentary and metamorphic rocks. When the oceanic plate collides with the continental plate it is pushed beneath the continental plate. This subduction process carries the rock to increased temperature and pressure zones within the earth's crust and mantle, eventually causing the rock to become molten magma. New sources of volcanic or intrusive igneous rocks can form from the material to begin another cycle.

The relative abundance of the three rock groups in the earth's crust:
Igneous 65%
Metamorphic 27%
Sedimentary 8%