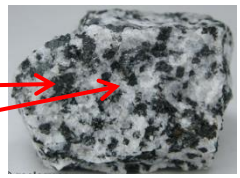
IGNEOUS ROCKS – born from fire

Intrusive, Plutonic
Coarse grained

Gabbro
augite and plagioclase

Diorite
hornblende
plagioclase



may or may not contain quartz

Granite
Microcline (pink) and quartz, biotite

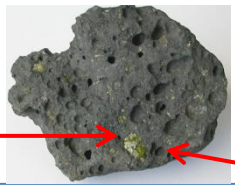
Very coarse grained

Pegmatite
Quartz and potassium feldspar

Crystals often several cm in size

Extrusive, Volcanic
Fine grained groundmass

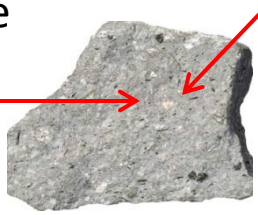
Basalt
olivine



Dark, high in mafics (Fe, Mg)

Extrusive rocks may contain "floating crystals called phenocrysts

Andesite
plagioclase



Gray or mixed, intermediate composition

Rhyolite

Light, pink or with orthoclase/ microcline

Glassy, quenched from lava

Obsidian

Scoria

Dark, basaltic, but with very low density

Pumice

Light , rhyolite composition, very low density due to porosity

Scoria and pumice solidify from lava thrown into the air, lots of gaseous material is trapped and resultant rock has very low density, vugs/holes in rock are gas vesicles

IGNEOUS ROCKS -- terms

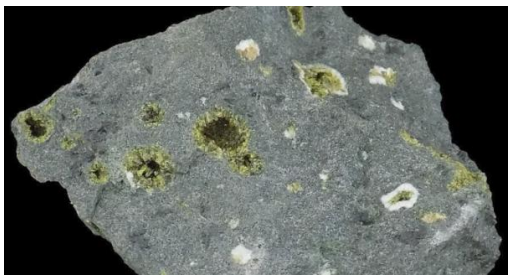
Mafic -- rocks containing iron, magnesium, typically dark in color (i.e. basalt, gabbro), typically originating from oceanic plates (minerals to watch for – olivine, pyroxene)
Felsic – rocks containing potassium, aluminum, sodium, typically lighter in color (i.e. rhyolite, granite, pumice), typically originally from vulcanism in continental plates (minerals to watch for – orthoclase, muscovite, lots of quartz)

Intrusive (plutonic) -- rocks formed from magma well below the surface, crystals grow to appreciable/visible size (i.e. granite, diorite, gabbro)
Extrusive (volcanic) - rocks formed from magma at (or near) the earth's surface, fine grained, cannot see crystals (at least not in matrix) (i.e. rhyolite, andesite, basalt)

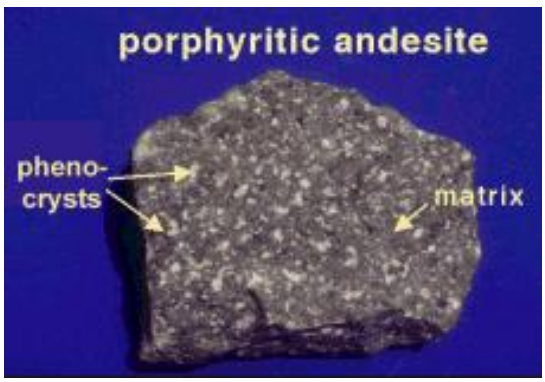
Phaneritic -- coarse-grained igneous rock (a textural term, not genetic)
Aphaneric -- fine-grained igneous rock (a textural term, not genetic

Vesicular – igneous texture found in volcanic/extrusive rocks where holes/vugs occur resulting from gas bubbles trapped as magma/lave froze

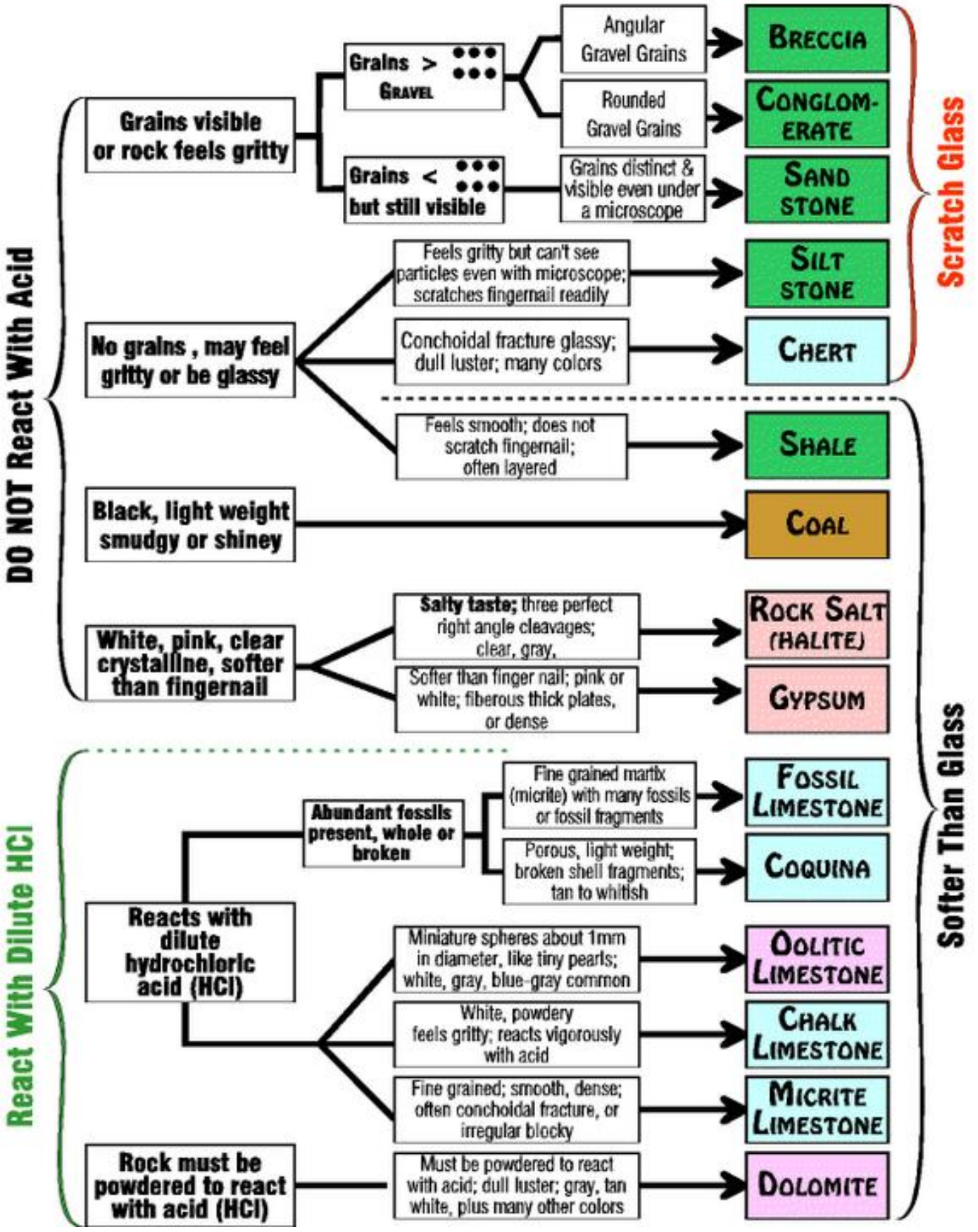
Amygdaloidal -- textural term used for extrusive rocks where vesicules have been later filled by minerals (i.e. epidote, quartz, etc.). In this case the minerals in the vesicles did NOT Crystallize from the magma, but from surface waters that passed through the rock much Later.



Porphyry - an igneous rock with one mineral (called a **phenocryst**) exhibiting a grain size larger than the remainder of the minerals (called the **groundmass** or **matrix**). Generally, the phenocryst grew while the magma was deeper and crystallization we slow, the groundmass grew when remaining magma froze more rapidly at a shallower depth. (i.e. olivine in basalt, plagioclase feldspar in andesite).



Key to the Identification of Basic Sedimentary Rocks



Biochemical Sedimentary Rocks on the Science Olympiad List

Limestone is a sedimentary rock, composed mainly of skeletal fragments of marine organisms such as coral, forams and molluscs. Its major materials are the minerals calcite and aragonite, which are different crystal forms of calcium carbonate ($CaCO_3$).

About 10% of sedimentary rocks are limestones. The solubility of limestone in water and weak acid solutions leads to karst landscapes, in which water erodes the limestone over thousands to millions of years. Most cave systems are through limestone bedrock.

Limestone has numerous uses: as a building material, an essential component of concrete (Portland cement), as aggregate for the base of roads, as white pigment or filler in products such as toothpaste or paints, as a chemical feedstock for the production of lime, as a soil conditioner, or as a popular decorative addition to rock gardens.

Varieties of limestone

CHALK is soft, white, porous and composed of the calcite shells of microscopic organisms.

OOLITIC limestone consists of spherical grains of calcite chemically precipated and cemented by burial.

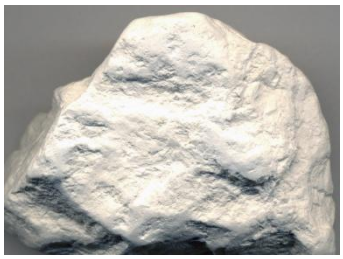
TRAVERTINE is deposited by mineral springs, often hot like in Yellowstone, but also in caves. Deposition is rapid and often layered.

COQUINA is fossil hash, shell fragments weakly cemented

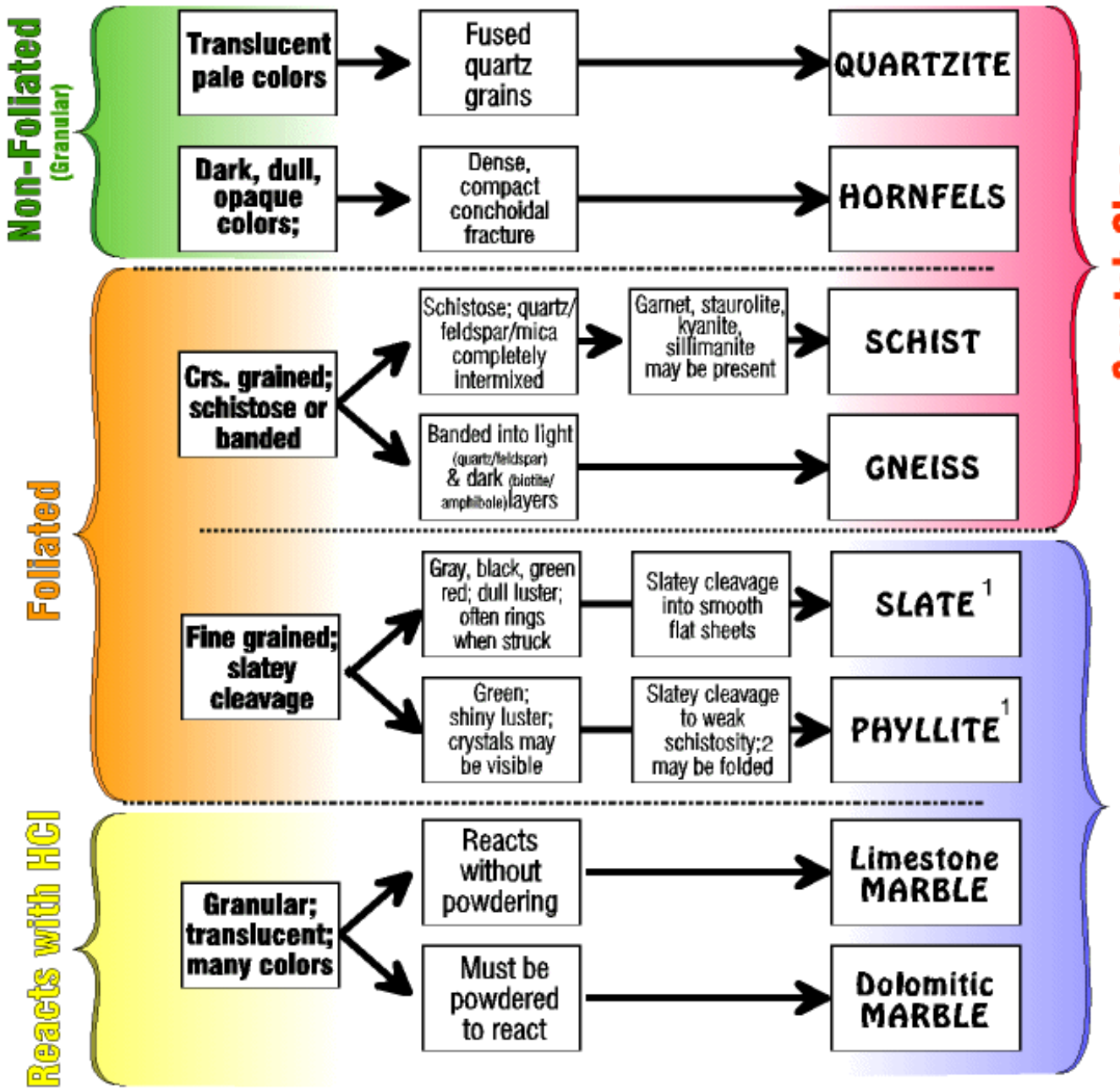
FOSSILIZED LIMESTONE: Limestone is often formed in marine environments where shelled organisms lived and they often get captured in the carbonate sediment, and then rock.

DOLOSTONE is carbonate rock made of dolomite rather than calcite.

DIATOMITE is made of tiny silicate shells called diatoms. It is very porous, but not permeable. It floats like pumice. Great absorbant (i.e. kitty litter), also a filtering agent, mechanical pesticide, etc.



Metamorphic Rocks



1 (Shale), slate, and phyllite complete intergrade with each other. Distinctions may be difficult.

Metamorphic Rocks on the Science Olympiad List

Slate is a fine-grained, foliated, homogeneous metamorphic rock derived from an original shale-type sedimentary rock composed of clay or volcanic ash through low-grade regional metamorphism. It is the finest grained foliated metamorphic rock.[1] Foliation may not correspond to the original sedimentary layering, but instead is in planes perpendicular to the direction of metamorphic compression.[1]

Phyllite is a type of foliated metamorphic rock created from slate that is further metamorphosed so that very fine grained white mica achieves a preferred orientation.[1] It is primarily composed of quartz, sericite mica, and chlorite.[2]

Phyllite has fine-grained mica flakes in a preferred orientation, whereas slate has extremely fine clay flakes that achieve a preferred orientation, and schist has large flakes in a preferred orientation.[1] Among foliated metamorphic rocks, it represents a gradation in the degree of metamorphism between slate and schist.[*citation needed*]

Mica Schist

Schist (pronounced /ʃɪst/ *SHIST*) is a medium-grade metamorphic rock[1] with medium to large, flat, sheet-like grains in a preferred orientation (nearby grains are roughly parallel). It is defined by having more than 50% platy and elongated minerals,[2] often finely interleaved with quartz and feldspar.[3] These lamellar (flat, planar) minerals include micas, chlorite, talc, hornblende, graphite, and others.

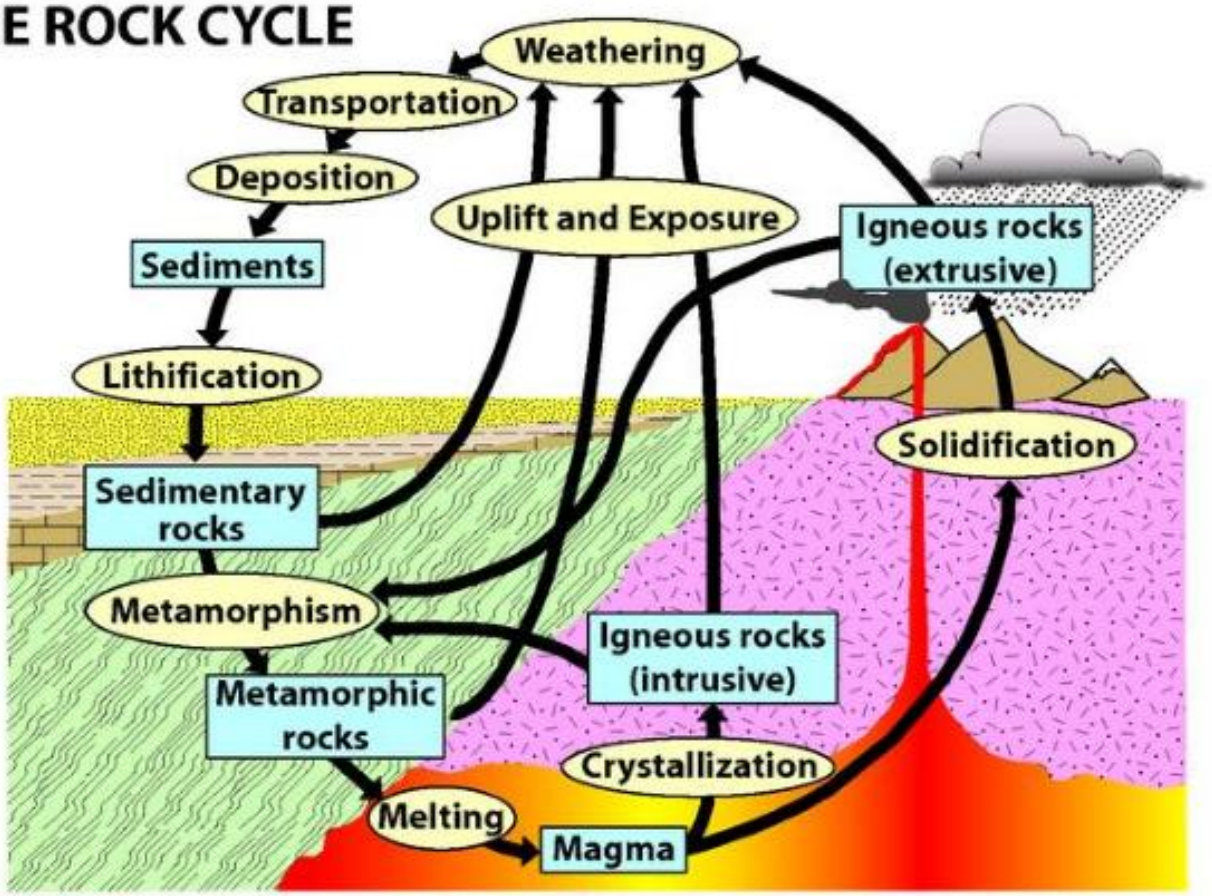
Garnet Schist

Gneiss (/ˈnaɪs/) is a common distributed type of rock formed by high-grade regional metamorphic processes from pre-existing formations that were originally either igneous or sedimentary rocks. It is often foliated (composed of layers of sheet-like planar structures). The foliations are characterized by alternating darker and lighter colored bands, called "gneissic banding".

Marble is a metamorphic rock composed of recrystallized carbonate minerals, most commonly calcite or dolomite.

Quartzite (from German: *Quarzit*[1]) is a hard, non-foliated metamorphic rock which was originally pure quartz sandstone.

THE ROCK CYCLE

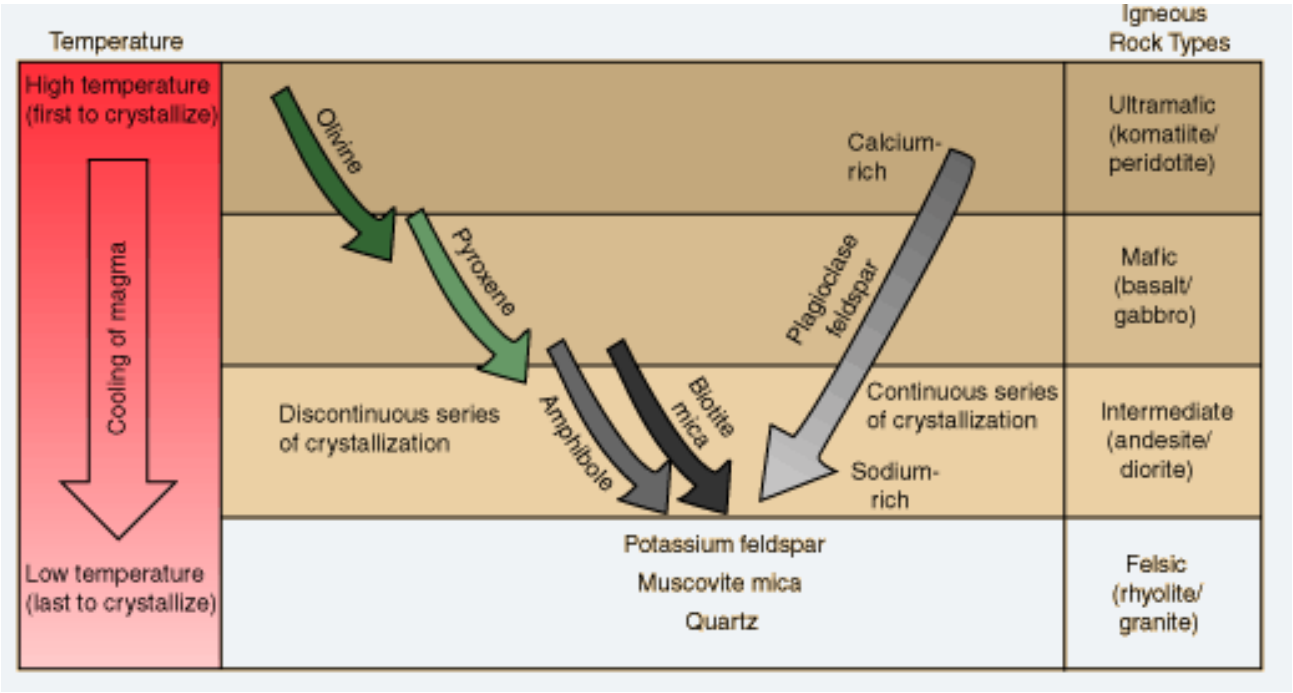


Igneous Rocks -
Rocks that form from the cooling of motlen rock (magma), Example: granite and basalt

Sedimentary Rocks -
Rocks that are fromed from pieces of other rocks, Example: sandstone, or that are deposited from the ocean by chemical processes, Example: limestone

Metamorphic Rocks -
Rocks that are changed by heat and pressure without melting, Example: gneiss

Bowen's Reaction Series



Bowen determined that specific minerals form at specific temperatures as a magma cools. At the higher temperatures associated with mafic and intermediate magmas, the general progression can be separated into two branches. The continuous branch describes the evolution of the plagioclase feldspars as they evolve from being calcium-rich to more sodium-rich. The discontinuous branch describes the formation of the mafic minerals olivine, pyroxene, amphibole, and biotite mica.

The weird thing that Bowen found concerned the discontinuous branch. At a certain temperature a magma might produce olivine, but if that same magma was allowed to cool further, the olivine would "react" with the residual magma, and change to the next mineral on the series (in this case pyroxene). Continue cooling and the pyroxene would convert to amphibole, and then to biotite. Mighty strange stuff, but if you consider that most silicate minerals are made from slightly different proportions of the same 8 elements, all we're really doing here is adjusting the internal crystalline lattice to achieve stability at different temperatures.

At lower temperatures, the branches merge and we obtain the minerals common to the felsic rocks - orthoclase feldspar, muscovite mica, and quartz