IGNEOUS ROCKS – born from fire

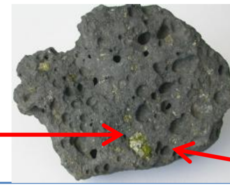
Intrusive, Plutonic *Coarse grained*	Extrusive, Volcanic *Fine grained groundmass*	
Gabbro augite and plagioclase	**Basalt** olivine	*Dark, high in mafics (Fe, Mg)*
Diorite hornblende plagioclase *may or may not contain quartz*	**Andesite** plagioclase	*Gray or mixed, intermediate composition*
Granite Microcline (pink) and quartz, biotite	**Rhyolite**	*Light, pink or with orthoclase/ microcline*

Gabbro

augite and plagioclase

Basalt

olivine



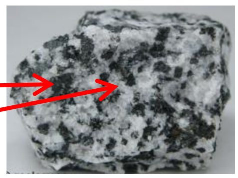
Dark, high in mafics (Fe, Mg)

Extrusive rocks may contain "floating crystals called phenocrysts

Diorite

hornblende

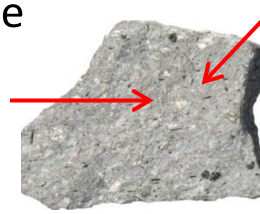
plagioclase



may or may not contain quartz

Andesite

plagioclase



Gray or mixed, intermediate composition

Granite

Microcline (pink) and quartz, biotite

Rhyolite

Light, pink or with orthoclase/ microcline

Very coarse grained

Pegmatite

Quartz and potassium feldspar

Crystals often several cm in size

Glassy, quenched from lava

Obsidian

Scoria

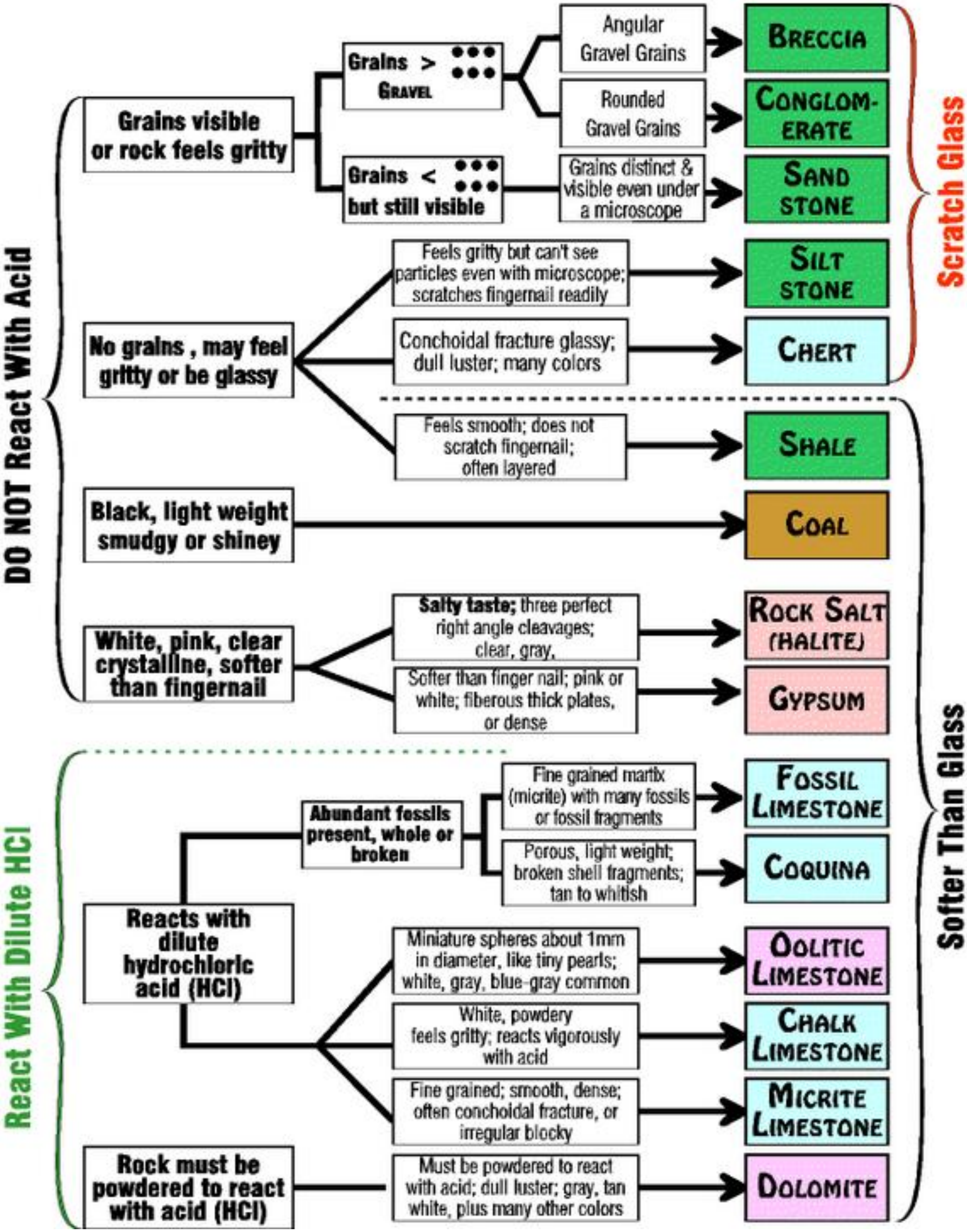
Dark, basaltic, but with very low density

Pumice

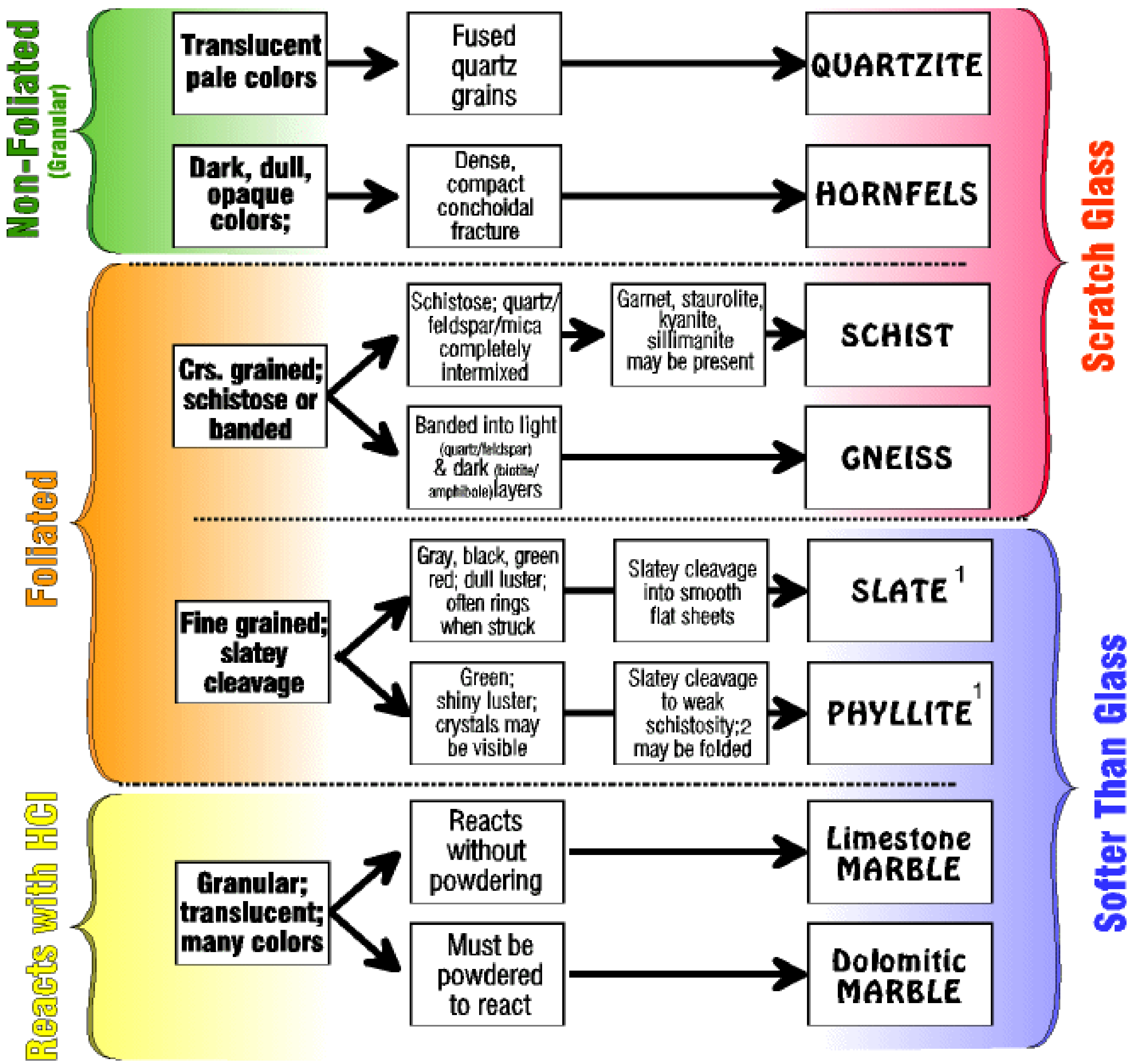
Light , rhyolite composition, very low density due to porosity

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

Key to the Identification of Basic Sedimentary Rocks

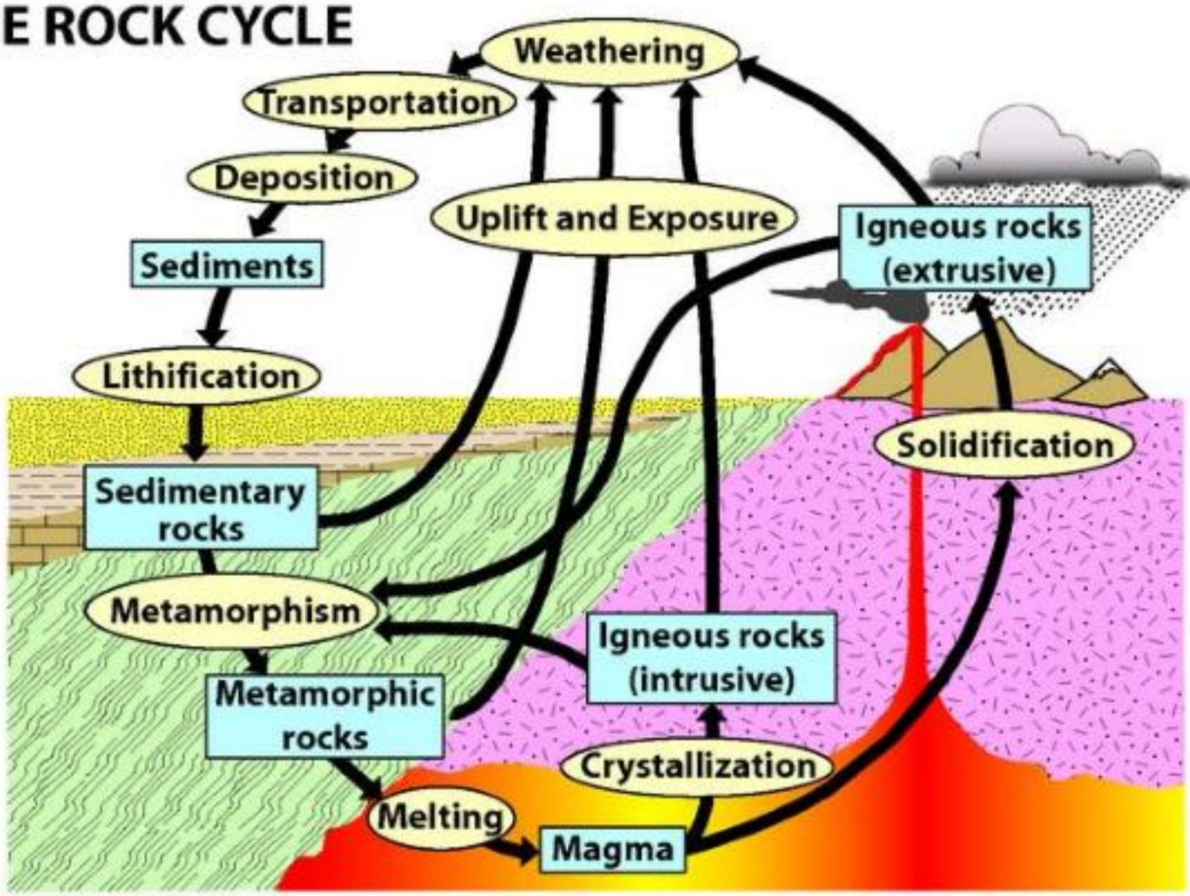


Metamorphic Rocks



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

THE ROCK CYCLE

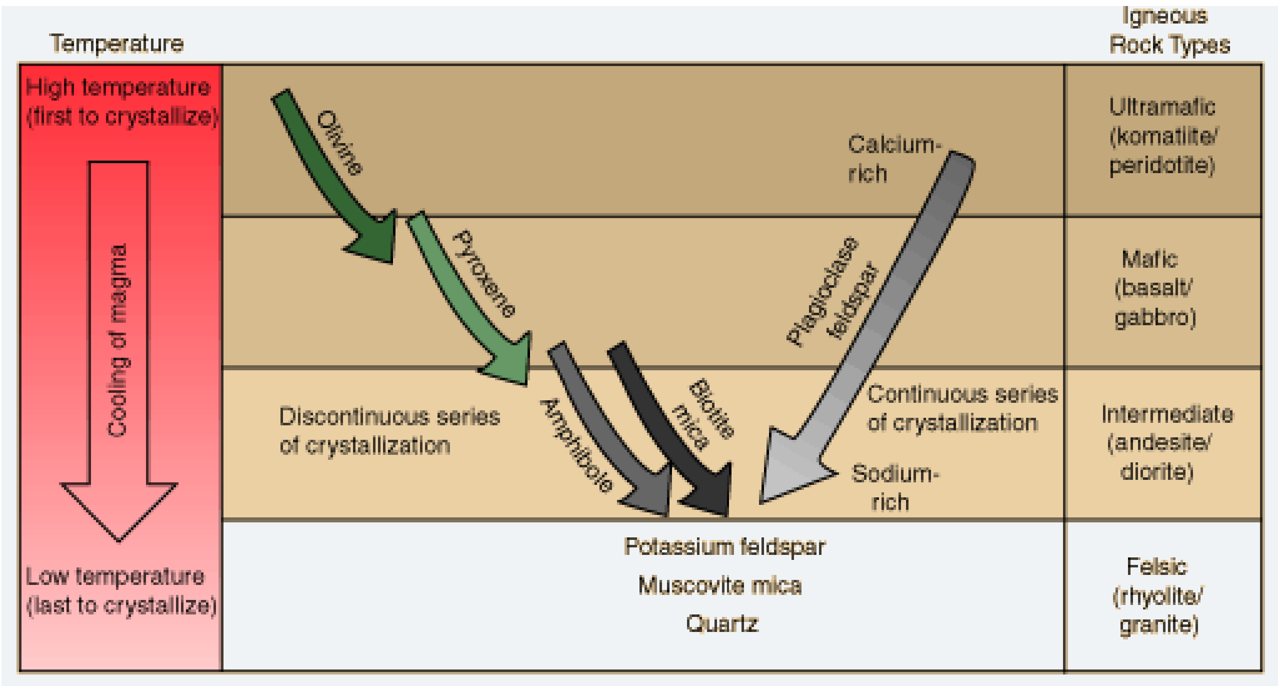


Igneous Rocks -
Rocks that form from the cooling of motlen rock (magma), Example: granite and basalt

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