

# IGNEOUS ROCKS – born from fire

**Intrusive, Plutonic**  
*Coarse grained*

## Gabbro

augite and  
plagioclase



**Extrusive, Volcanic**  
*Fine grained groundmass*

## Basalt

olivine

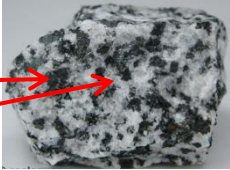


*Dark, high in mafics  
(Fe, Mg)*

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

**DO NOT React With Acid**

Grains visible  
or rock feels gritty

Grains > GRAVEL

Angular  
Gravel Grains

**BRECCIA**

Rounded  
Gravel Grains

**CONGLOMERATE**

Grains < but still visible

Grains distinct &  
visible even under  
a microscope

**SAND  
STONE**

**Scratch Glass**

No grains, may feel  
gritty or be glassy

Feels gritty but can't see  
particles even with microscope;  
scratches fingernail readily

**SILT  
STONE**

Conchoidal fracture glassy;  
dull luster; many colors

**CHERT**

Feels smooth; does not  
scratch fingernail;  
often layered

**SHALE**

Black, light weight  
smudgy or shiney

**COAL**

White, pink, clear  
crystalline, softer  
than fingernail

**Salty taste;** three perfect  
right angle cleavages;  
clear, gray,

**ROCK SALT  
(HALITE)**

Softer than finger nail; pink or  
white; fibrous thick plates,  
or dense

**GYPSUM**

**Softer Than Glass**

**React With Dilute HCl**

**Reacts with  
dilute  
hydrochloric  
acid (HCl)**

**Abundant fossils  
present, whole or  
broken**

Fine grained matrix  
(micrite) with many fossils  
or fossil fragments

**FOSSIL  
LIMESTONE**

Porous, light weight;  
broken shell fragments;  
tan to whitish

**COQUINA**

Miniature spheres about 1mm  
in diameter, like tiny pearls;  
white, gray, blue-gray common

**OOLITIC  
LIMESTONE**

White, powdery  
feels gritty; reacts vigorously  
with acid

**CHALK  
LIMESTONE**

Fine grained; smooth, dense;  
often conchoidal fracture, or  
irregular blocky

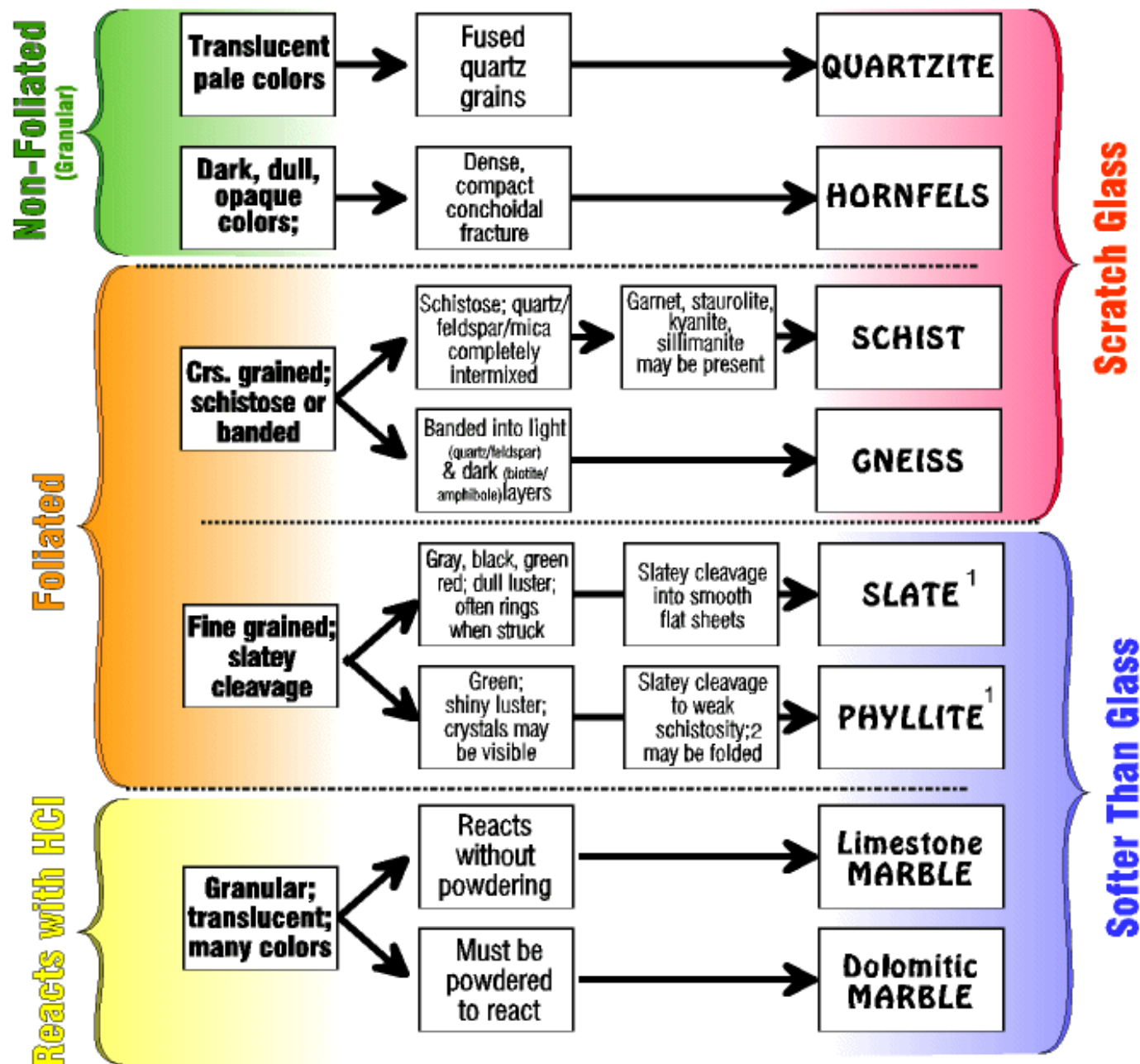
**MICRITE  
LIMESTONE**

**Rock must be  
powdered to react  
with acid (HCl)**

Must be powdered to react  
with acid; dull luster; gray, tan  
white, plus many other colors

**DOLOMITE**

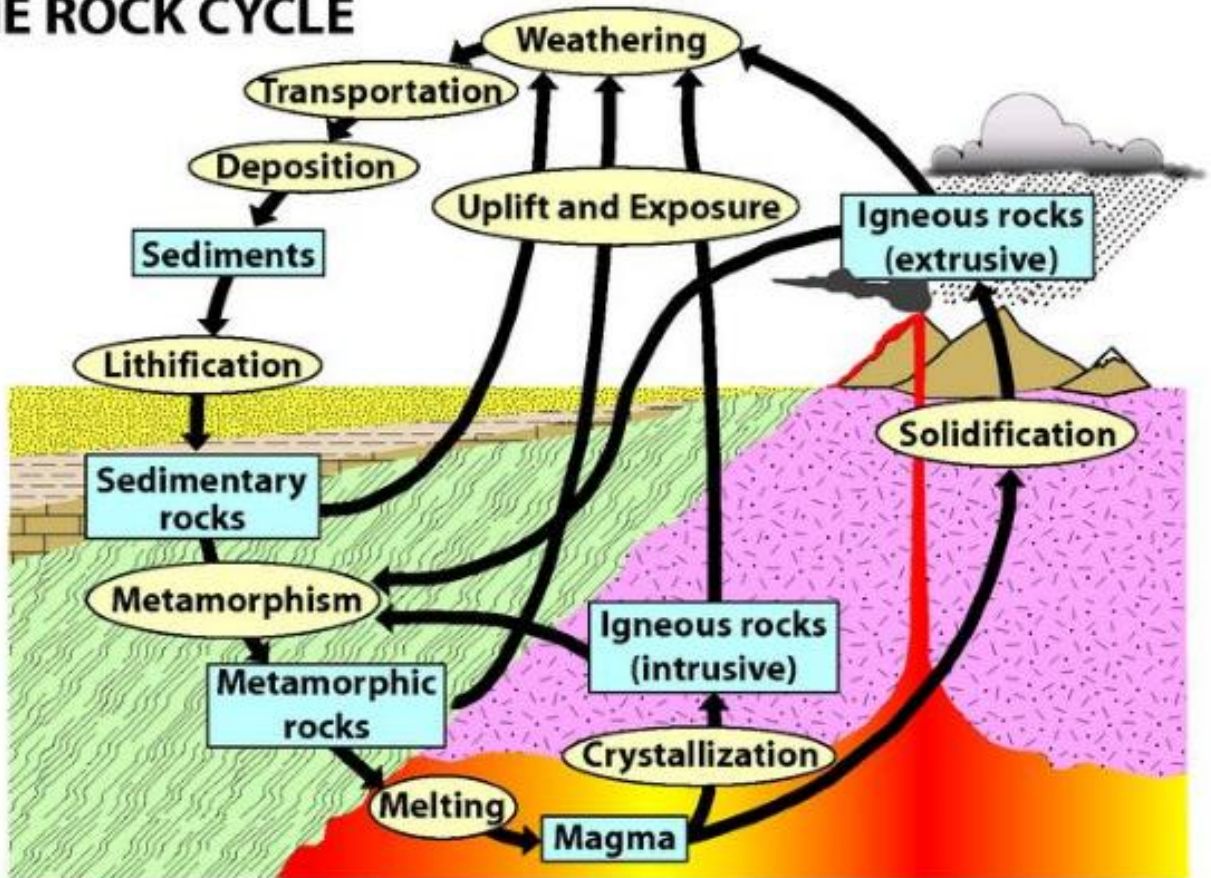
# Metamorphic Rocks



<sup>1</sup> (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 molten rock (magma). Example: granite and basalt

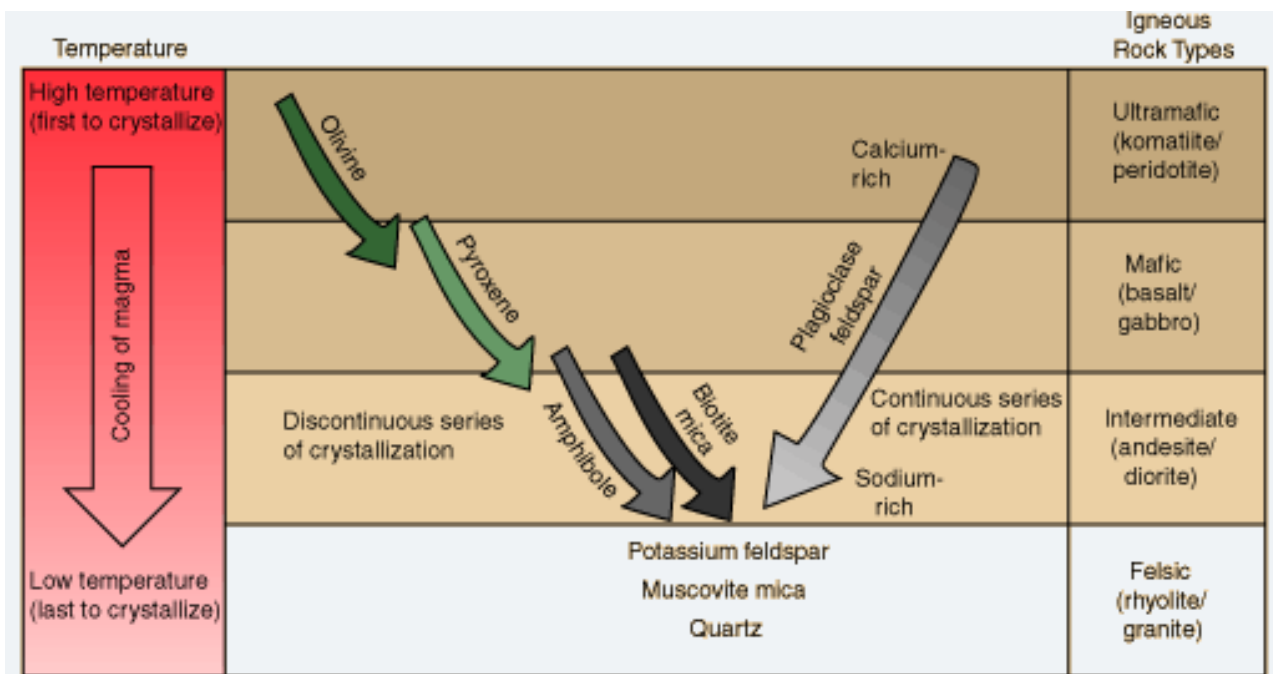
## Sedimentary Rocks -

Rocks that are formed 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