

Extrusive Igneous Rocks

Extrusive igneous rocks are typically aphanitic (very fine-grained) holocrystalline (all crystalline), hypocrySTALLine (some crystals and some glass) and porphyritic, or holohyaline (all glass). In most cases the mineralogy of extrusive volcanic rocks are not visible without the aid of a petrographic microscope. As such our efforts to classify hand specimens of volcanic rocks using a hand lens may be even less satisfying than the identification and classification of phaneritic igneous rocks! Below please find some figures to help with classification, many originating from www sites created by Dr Lynn Fichter: <http://www.jmu.edu/geology/>

Igneous rock textures plotted in terms of crystallinity and grain size. Arrows indicate a range of grain sizes within a single rock.

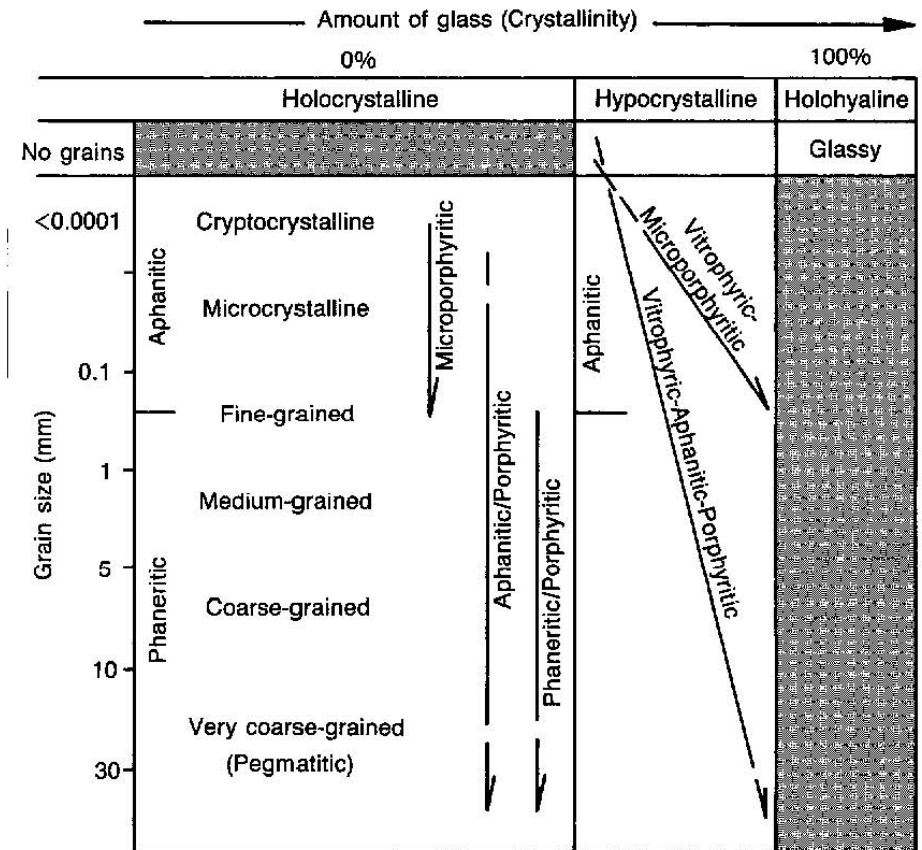
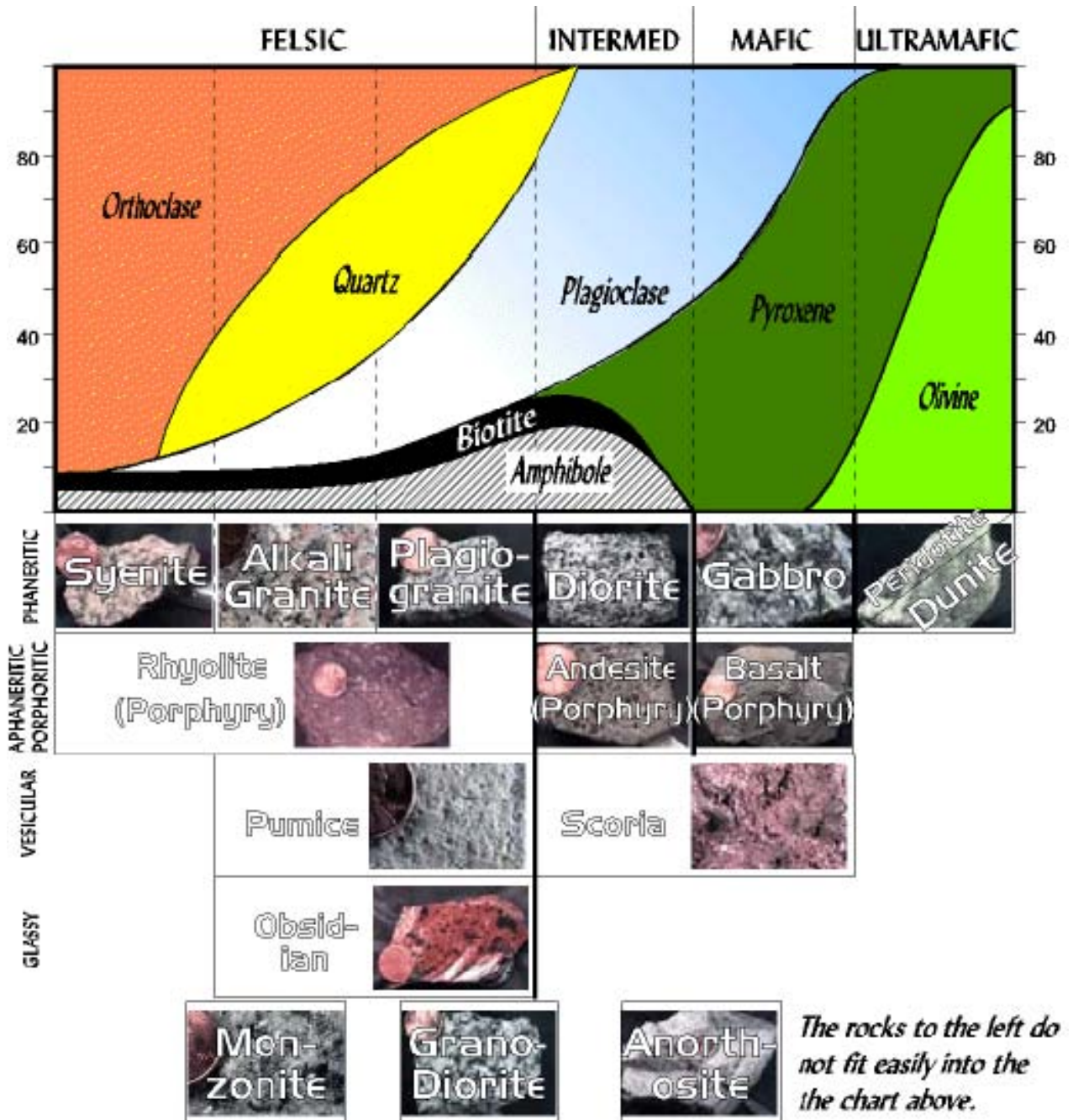


Figure 1; from Raymond, 1995

Figure 2, from: <http://www.jmu.edu/geology/>



Color/TEXTURE Identification Key for IgNEOUS Rocks

- Bowen's Reaction Series
- Percent Abundance Chart
- Composition Texture Key
- Igneous Home Page

Shaded boxes can be clicked to see a picture.

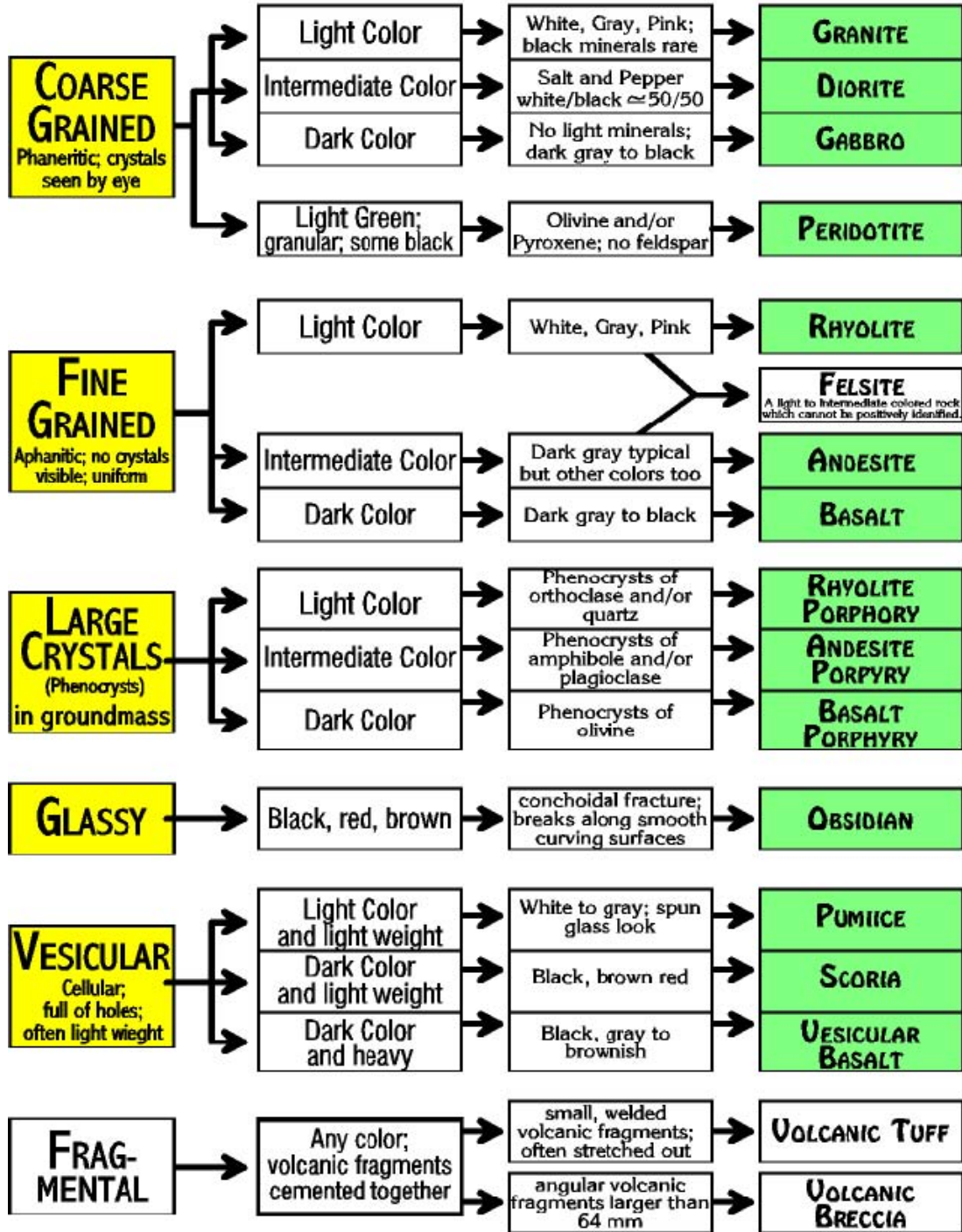


Figure 3, from: <http://www.jmu.edu/geology/>

Extrusive Igneous Rocks, IUGS Classification

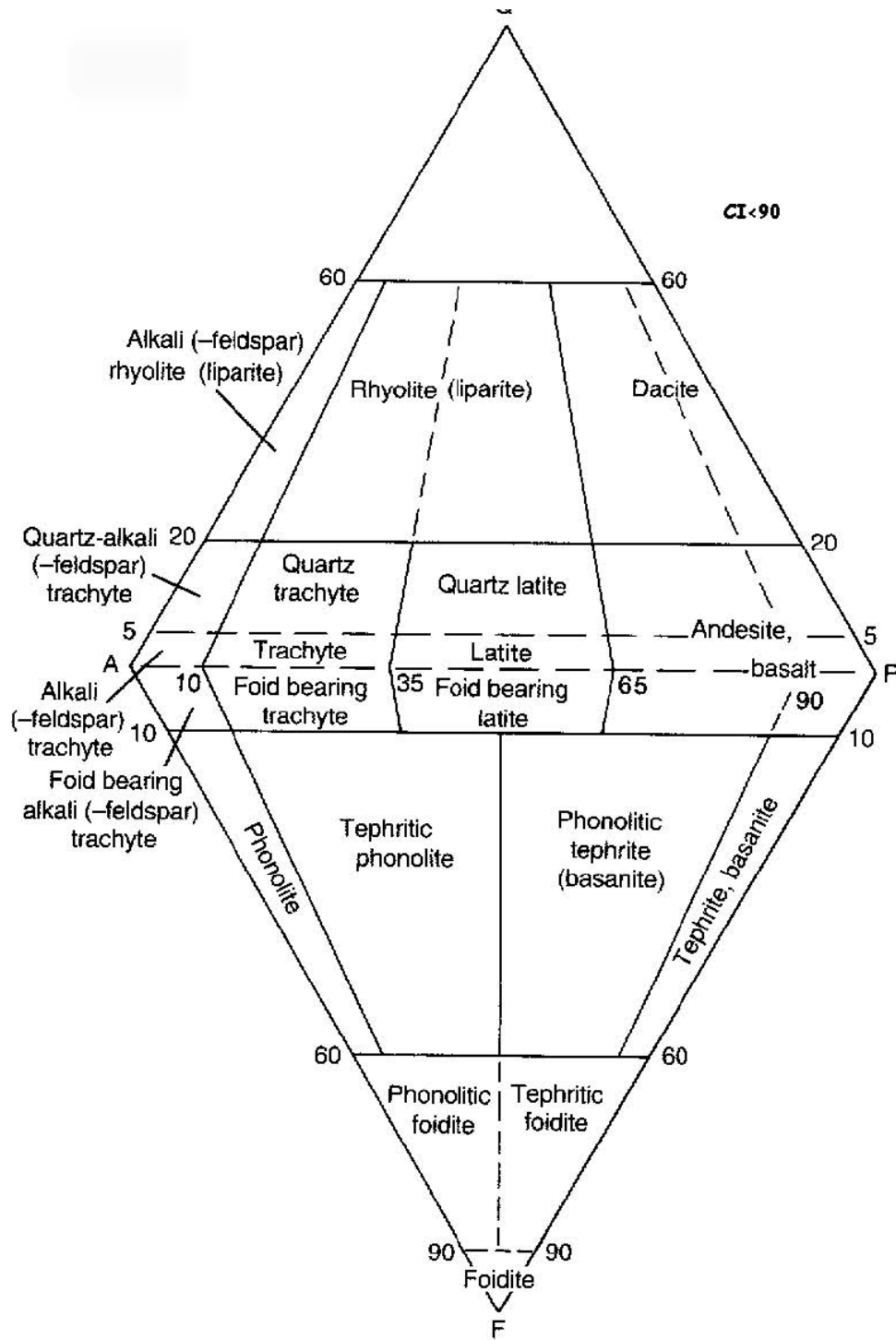


Figure 4

Magma Types and Eruptive Products

The type of magma (see table 1, below, from Stephen A. Nelson, M&RCP Ch. 9) that is present at the site of a volcanic eruption in terms of temperature, viscosity, gas content and the environment (on land or under water) dictate the types of eruptive products. More viscous, rhyolitic magmas tend to produce glassy and fragmental eruptive products. Less viscous, basaltic magmas tend to produce hypocrystalline or holocrystalline products. However, these relationships are far from consistent. Much basaltic lava is quickly cooled during underwater eruptions and consists of fragmental, holohyaline material.

Table 1

Magma Type	Solidified Volcanic Rock	Solidified Plutonic Rock	Chemical Composition	Temperature	Viscosity	Gas Content
Basaltic	Basalt	Gabbro	45-55 SiO ₂ %, high in Fe, Mg, Ca, low in K, Na	1000 - 1200 °C	Low	Low
Andesitic	Andesite	Diorite	55-65 SiO ₂ %, intermediate in Fe, Mg, Ca, Na, K	800 - 1000 °C	Intermediate	Intermediate
Rhyolitic	Rhyolite	Granite	65-75 SiO ₂ %, low in Fe, Mg, Ca, high in K, Na	650 - 800 °C	High	High

The following is taken from **Magmas, Igneous Rocks, Volcanoes, and Plutons** by Stephen A. Nelson, (<http://www.tulane.edu/~sanelson/geol111/igneous.htm> this is the source of M&RCP Ch.9) and provides background on eruptive processes and products.

Eruption of Magma

When magmas reach the surface of the Earth they erupt from a vent. They may erupt explosively or non-explosively. Non-explosive eruptions are favored by low gas content and low viscosity magmas

- Basaltic to andesitic magmas
 - Usually begin with fire fountains due to release of dissolved gases
 - Produce lava flows on surface
 - Produce Pillow lavas if erupted beneath water
- High viscosity, andesitic to rhyolitic magmas tend to explosive eruptions as a result of high gas content and generally high viscosity
 - Expansion of gas bubbles is resisted by high viscosity of magma - results in the building up of pressure
 - High pressure in gas bubbles causes the bubbles to burst when reaching the low pressure at the Earth's surface.
 - Bursting of bubbles fragments the magma into pyroclasts and tephra (ash).
 - Cloud of gas and tephra rises above volcano to produce an eruption column that can rise up to 45 km into the atmosphere.

Products of Eruption

Magmas of Basalt, Andesite, Dacite, and Rhyolite composition produce volcanic rocks distinguished on the basis of their mineral assemblage and/or chemical composition. Depending on conditions present during eruption and cooling, these magma types may form one of the following types of volcanic rocks.

Obsidian- dark colored volcanic glass showing conchoidal fracture. Such rocks are usually rhyolitic or dacitic in composition

Pumice - light colored and light weight rock consisting of mostly holes (vesicles) that were once occupied by gas, usually rhyolitic, dacitic or andesitic.

Vesicular rock-rock filled with holes (like Swiss cheese) or vesicles that were once occupied by gas. Such rocks are usually basaltic and andesitic.

Amygdaloidal basalt- if vesicles in vesicular basalt are later filled by precipitation of calcite or quartz, the fillings are termed amygdules and the basalt is termed amygdaloidal basalt.

Pyroclasts and Tephra

Pyroclasts –

The initially hot, broken fragments resulting from the explosively ripping apart of an erupting magma are called pyroclasts. Unconsolidated assemblages of pyroclasts are called tephra. Depending on size, tephra can be classified as bombs, lapilli, or ash (see figure 5).

Pyroclastic Rocks-

Rocks formed by accumulation and cementation of tephra are called a pyroclastic rocks and further discriminated by particle size. Welding, compaction and deposition of other grains cause tephra (loose material) to be converted in pyroclastic rock.

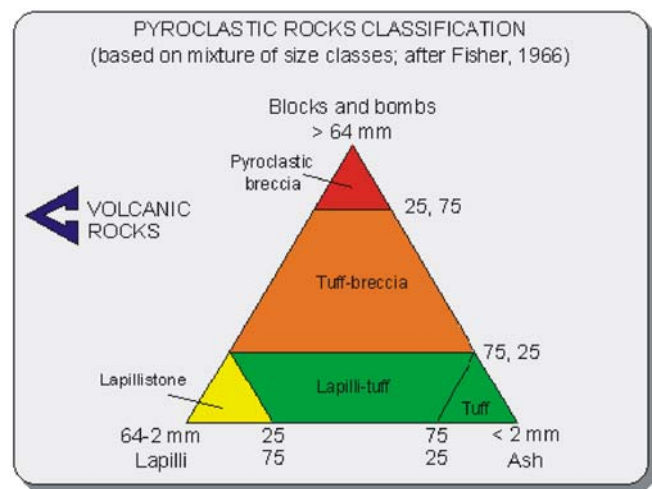
Figure 5 from:

<http://www.eos.ubc.ca/courses/eosc221/igneous/extru/pyroclastics.html>

Check out the very cool www site

Steam Explosions, Earthquakes, and Volcanic Eruptions-What's in Yellowstone's Future?

<http://pubs.usgs.gov/fs/2005/3024/>



Compile a vocabulary list with definitions from the following word list and get 5 additional points on Lab #7!!

Vocabulary List - Extrusive Igneous Rocks

Aa	Amygdaloidal	Andesite
Aphanitic	Ash	Bentonite
Caldera	Columnar Jointing	Composite Volcano
Crater	Dacite	Ejecta
Felsic	Flood Basalt	Fumaroles
Hot Spot	Ignimbrite	Island Arc
Lapilli	Lava	Lava Tube
Magma	Mid-ocean Ridge	Nuee Ardante
Obsidian	Olivine Basalt	Ophiolite Complex
Pahoehoe	Pacific Ring of Fire	Perlite
Pillow Basalt	Pitchstone	Porphyritic
Rhyolite	Shield Volcano	Strato Volcano
Tephra	Tholeiitic Basalt	Tuff
Welded Tuff	Scoria	Shard
Spatter Cone	Spilite	Vesicular Basalt Vitrophyric
Volcanic Bomb	Volcanic Breccia	Volcanic Neck

Use the following www site (or any other source, including your field guide) to provide a short definition of the above terms:

<http://volcano.und.nodak.edu/vwdocs/glossary.html>