Igneous Rocks – Laboratory 3

_____

(name)

BACKGROUND

Igneous rocks are solids that have solidified from a silicate liquid. Silicate liquids that are found within the Earth's interior are called **magma** while silicate liquids that flow out along the Earth's surface or seabed are called **lava**. If magma solidifies below the Earth's surface, then the resulting rock is **intrusive**. In contrast, if lava solidifies, then the resulting rock is **extrusive**. In some instances magma along with solidified chunks and fragments of the conduit walls are blown out of a central vent of a volcano. This material is collectively referred to as **tephra** or **pyroclasts**, and accumulations of such material are called **pyroclastic deposits**.

Texture is a term that refers to the proportion of crystals/minerals in a rock, the size of component minerals or rock fragments, and the way that individual grains or fragments are arranged relative to each other. When magma cools slowly deep in the Earth's interior individual crystals are allowed to grow to rather large sizes as neighboring crystals do not interfere with their growth. Such rocks are composed of nothing but crystals that are all large enough to see with the naked eye. The resulting texture is referred to as **phaneritic** (Figure 1)

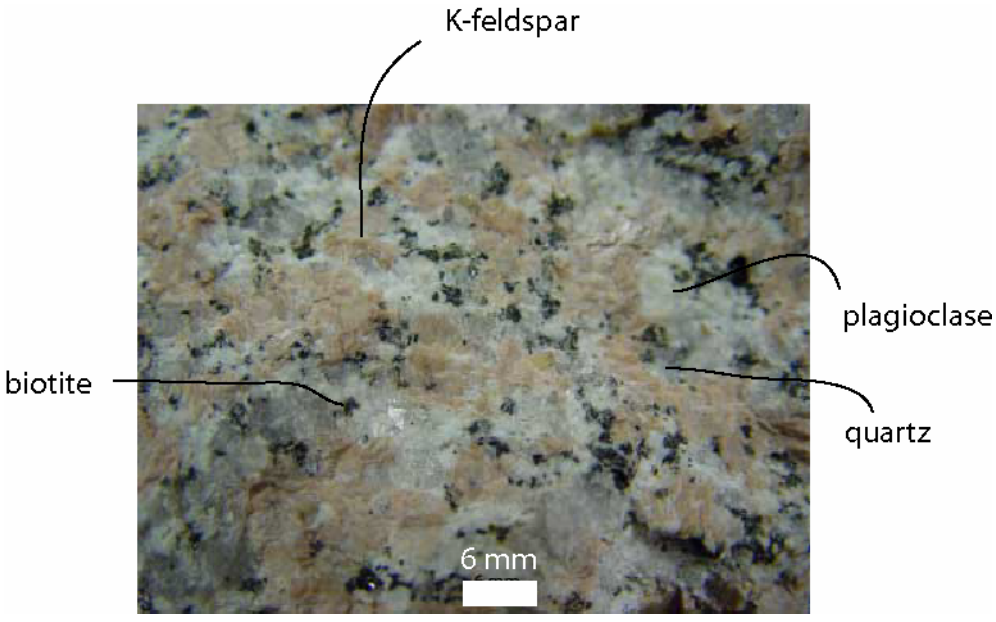

Figure 1. Phaneritic textured granite. Note that K-feldspar (pink) and plagioclase (creamy colored) are ~6 mm in size while quartz (gray) and biotite (black) are about 1 mm in size. Because of their large size each crystal is easily visible with the naked eye.

In contrast to magma that cools slowly deep in the Earth, when hot lava meets the Earth's atmosphere or hydrosphere it cools quickly, and as a result the growth of crystals is abruptly stopped. In fact, it is common that cooling is so rapid that lava is quenched to glass or the resulting rock mass is composed of grains so small that individual crystals can not be recognized with the naked eye. The former texture is referred to as **vitric** (Figure 2) and the latter as **aphanitic** (Figure 3). Hence, the textures of extrusive rocks derived from the effusion of lava differ significantly from those derived from the slow cooling of magma deep in the Earth's interior.

Figure 2. Flow banded rhyolitic lava. Black layers are composed of a volcanic glass called obsidian. Sample is from Mono-Inyo Craters volcanic chain, California. http://volcanoes.usgs.gov/Products/Pglossary/rhyolite.html

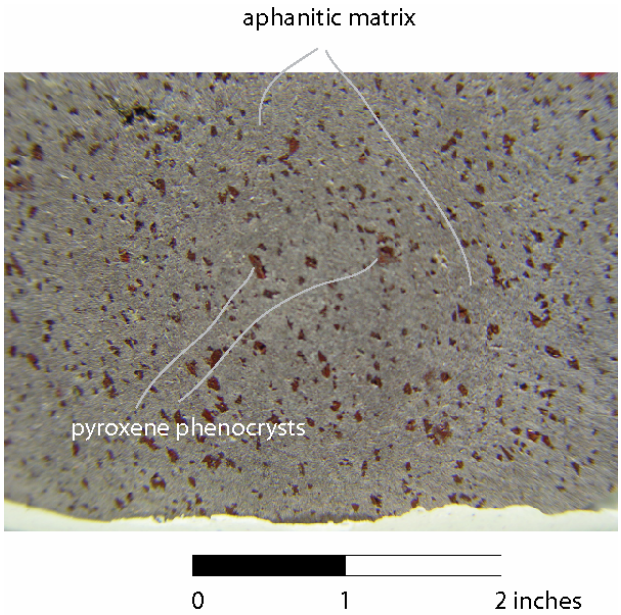

Figure 3. A sawed slab showing the prevalence of aphanitic material in a pyroxene basalt. Pyroxene crystals are brown in color and are ~1/8 inch in size. The matrix is gray in color and is devoid of visible crystals; hence, it is described as aphanitic.

In some instances magma while traversing the lithosphere will pool to form a **magma chamber**. If residence in a magma chamber is of such duration that crystals begin to take form, and if residence is then interrupted by a surge of magma rising to the Earth's surface or seabed to become lava, then after complete solidification the resulting texture of the rock mass will have components that might be ascribed to both phaneritic and aphanitic types. An example is shown below (Figure 4) where large crystals that are clearly visible to the naked eye are surrounded by aphanitic material. Such a texture is referred to as **porphyritic**. The large visible crystals are called **phenocrysts**, and the aphanitic material the **matrix**.

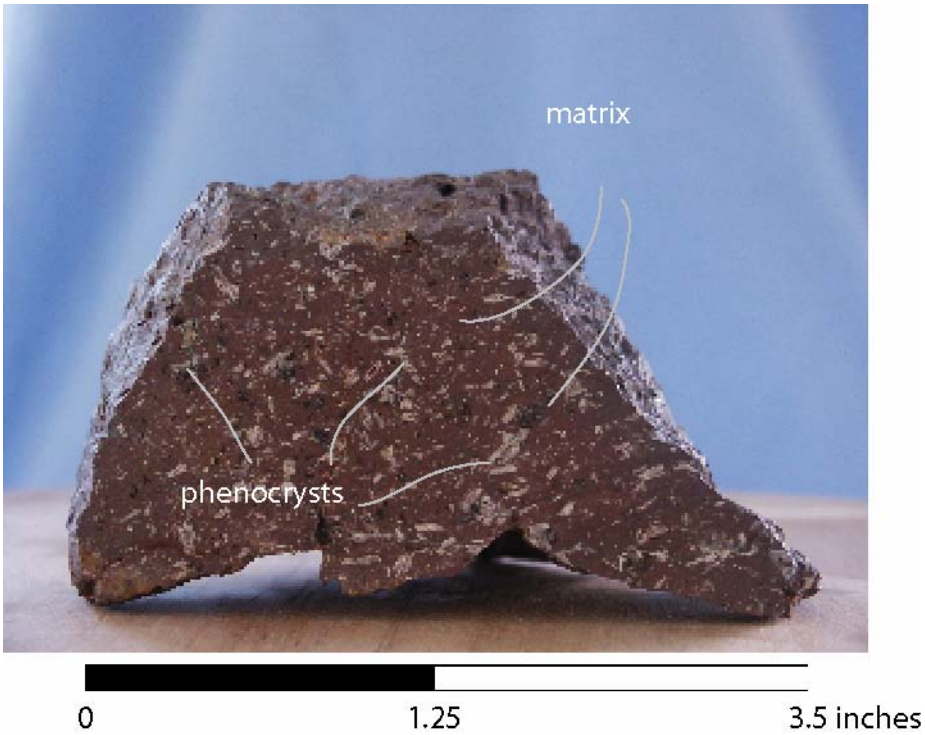

Figure 4. The components of porphyritic texture are matrix and phenocrysts (also see Figure 3). The creamy colored phenocrysts in the photograph are feldspar, while the matrix is brown.

Material that is erupted out of a volcano is classified on the basis of the size of constituent components. **Bombs** and **blocks** are greater than 64 mm in size. To help you remember and visualize this size the diameter of a standard tennis ball is ~64 mm (Figure 5).

Figure 5. Remember the diameter of a tennis ball is ~64 mm.

Bombs differ from blocks by not having angular outlines. Bombs typically were partially liquid or plastic-like when erupted. As a result they tend to take on aerodynamic forms as they are hurled through the air (Figure 6). A rock composed of bombs is called **agglomerate**. A rock composed mostly of angular blocks is called a **pyroclastic breccia**.

Figure 6. Bombs hurled out of Mauna Kea Volcano, Hawaii. Photograph by J.P. Lockwood, July 10, 1982.
Source: http://volcanoes.usgs.gov/Products/Pglossary/bomb.html

In Figure 6, note the penny for scale. The diameter of a penny is 2 cm or 20 mm. Is the small spindle shaped clast in the middle of the photograph really a bomb?

Lapilli range in size from 2 mm to 64 mm (Figure 7). A rock composed of lapilli sized fragments is called a **lapillistone** or **lapilli tuff**.

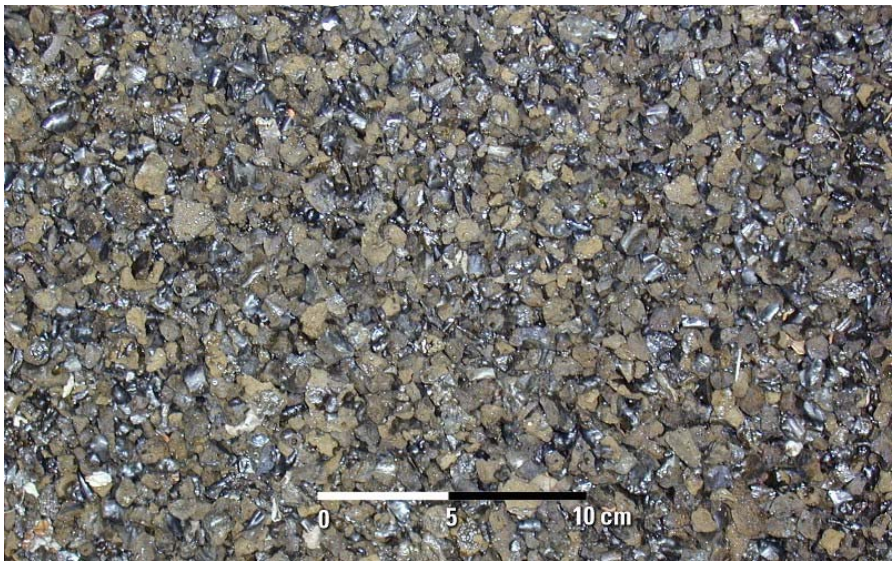

Figure 7. Lapilli derived from eruption of Kilauea Volcano in 1959.
Source: http://volcanoes.usgs.gov/Products/Pglossary/lapilli.html

The finest type of tephra is called **ash** (Figure 8). It is less than 2 mm in size, and a rock composed of such material is called a **tuff**.

Figure 8. Volcanic ash collected in Randle, Washington, located about 40 km NNE of Mount St. Helens. Photograph by D.E. Wieprecht.
Source: http://volcanoes.usgs.gov/Products/Pglossary/ash.html

THE LABORATORY

Your instructor will go over with you a variety of igneous rocks that display some of the above features. As each rock is discussed please fill in the key characteristics that distinguish it from other types of rocks in the attached table.

Table 1. Key igneous rocks and their characteristics

Rock Type	***Key Characteristics***
Granite	
Diorite	
Gabbro	
Rhyolite	
Andesite	
Basalt	
Peridotite	
Scoria	
Pumice	
Lapilli tuff	
Obsidian	