

# Physical Geology Lab – Igneous Rocks: Examination, Naming and Interpretation

Igneous rocks are named by considering two factors: **color** (composition) and **texture**. These are explained in detail on the following pages. Study these pages. For each sample you attempt to identify make your determination of color and texture before using this ID chart.

<b>Igneous Rock Identification Chart</b>				
Notes: <b>Bold items</b> are commonly encountered; others are rarely seen. Larger print indicates <b>most common types</b> . <i>Italics indicate Volcanic Products.</i>				
<b>COLOR</b> (weathered surfaces usually lighter)	<b>Light color:</b> white, light gray, pink, reddish	<b>Inter. color:</b> medium gray, greenish gray	<b>Dark color:</b> dark gray to black	<b>Dark color:</b> dark green to black
<b>COMPOSITION</b>  <b>Typical Minerals</b>	<b>Felsic</b>  quartz, K-spar, plagioclase, biotite	<b>Intermediate</b>  plagioclase, hornblende, biotite	<b>Mafic</b>  plagioclase, augite, olivine	<b>Ultramafic</b>  olivine, augite
<b>TEXTURES</b>				
<b>Pegmatitic</b>	<b>Granite Pegmatite</b>	Diorite Pegmatite	Gabbro Pegmatite	
<b>Coarse grained (phaneritic)</b>	<b>Granite</b>	<b>Diorite</b>	<b>Gabbro</b>	Peridotite (Dunite, if >80% olivine)
<i>Fine grained (aphanitic)</i>	<i>Rhyolite</i>	<i>Andesite</i>	<i>Basalt</i>	
<i>Glassy</i>	<i>Obsidian</i>			
<i>Vesicular</i>	<i>Pumice</i>		<i>Scoria</i>	
<i>Fragmental (pyroclastic)</i>	<i>Volcanic breccia or Tuff, if fragments &lt;4 mm.</i>			
<b>Porphyritic</b>	<b><u>Use with rock names if two distinct grain sizes are present; for example: porphyritic andesite.</u></b>			

## Introduction

This lab provides students with information and experience to rapidly examine hand specimens of igneous rocks and deduce a reasonable rock name from the chart on page 1, and to practice writing a brief description and interpretation of the origin of the rock, or “the story of the rock.” See the specific assignment for this week on the last page.

Please locate the Igneous Mineral Recognition Chart, the Igneous Texture Chart on the following pages, and the Igneous Rocks Identification Chart on page 1. A different version of the ID Chart is on page 108 of the lecture text. ***Please familiarize yourself with the material on pp. 99, 108 and 109 in your lecture text before coming to lab.***

Naming (“identification”) of igneous rocks is a rapid process in about 85% of the cases, even for beginners. For the other 15% there is no substitute for experience in looking at many samples, including experience with a petrographic microscope. This lab will focus on students learning to properly examine common (and easy to identify) types.

Our process is simple: make two observations then apply the observed data to an Igneous Rock Identification Chart to find the name. Then refine the name if needed by considering secondary characteristics included on the Naming Chart.

## The two basic observations are “color” and “texture.”

### Color

Determining color usually means placing the rock on a spectrum from “very light” to “very dark”. It is the average or overall color that is observed, as if looking at the rock from a distance. It is generally sufficient to assign the color to one of these three categories:

*Light, includes light gray and pink to brick red.*

*Intermediate, colors are typically medium gray to greenish gray, to brownish.*

*Dark, includes dark gray, dark green and black.*

It is critical for the student to realize color is directly related to the proportions of the 8 or so minerals that make up igneous rocks, and color is just an easy way of estimating the major mineral content of the rock. The table below lists these common minerals and gives clues to recognizing them. But, most igneous rocks can be named with little or no specific mineral data.

It is also important to realize that the minerals (and thus the color) in an igneous rock relate directly to the chemistry of the magma and to the temperature at which the mineral crystals grew. For example, a magma with abundant Fe and Mg will crystallize minerals at a higher temperature than a magma with low amounts of Fe and Mg.

The following chart details the igneous rock-forming minerals.

## Igneous Rock-Forming Mineral Recognition Chart

MINERAL	How to recognize	Temp of crystallization from magma (°C)
Quartz	Looks like gray (light, medium or smoky) glass. Almost never occurs in well-formed crystals in rocks. Does not weather.	800-650
K-spar (potassium feldspar)	Usually white to colorless to reddish or pinkish; may be altered (weathered) to soft, powdery white clay. Blocky shaped crystals common.	800-700
Muscovite (mica)	This mica is colorless to yellowish.	800-650
Biotite (mica) (M)	This mica is brown to dark-brown to black.	900-750
Plagioclase (feldspar)	White, colorless, light gray, gray; often looks gray in mafic rocks. With striations (3). Very common and abundant. Weathers to white powder.	1200-700 (!)
Hornblende (amphibole) (M)	“Jet” black, elongated crystals; weathers brownish.	1000-850
Augite (pyroxene) (M)	Black to greenish-black; short, stubby crystals; commonly weathered to soft greenish clays.	1200-1000
Olivine (M)	Green, glassy grains. Weathers to a mix of yellow-green clay and hematite.	1300-1100

### Important Notes:

- Minerals which crystallize at about the same temperature are usually found in the same rock. This fact relates directly to “Bowen’s Reaction Series” – see textbook.
- (M) = “**Mafic**” mineral: contains abundant Magnesium (Mg) and iron (Fe) and are typically brown, dark green or black in color. The overall color of an igneous rock is mainly controlled by the percentage of mafic minerals. Minerals and rocks without abundant Mg and Fe are called “**felsic**” or “silicic.”
- Striations look like very fine, straight, engraved grooves; they occur only on two of the six sides of a blocky plagioclase crystal, parallel to the crystal edges. Often they cannot be seen.

## Texture

Texture in rocks generally means the size, shape and arrangement of the mineral grains. Igneous rock textures are described by terms which are (mostly) easily understood. The following table lists the most common texture terms for igneous rocks and their meanings.

<b>Textures found in Igneous Rocks</b>	
Coarse-grained (phaneritic)	Most grains can be seen with the naked eye. Typical of plutonic rocks.
Fine-grained (aphanitic)	Most grains cannot be seen with the naked eye, though some large grains may be present (see porphyritic). Typical of volcanic rocks.
Porphyritic	Two (or three) distinctly different sizes of crystals present. The larger crystals are called <u>phenocrysts</u> and always show excellent crystal shape. The mass of smaller grains around the phenocrysts is referred to as <u>matrix</u> or <u>groundmass</u> . Usually the larger crystals are of only one mineral type. <i>This is a common texture</i> and the term is used in combination with a rock name (ex.: porphyritic basalt). "Porphyry" means a rock with this texture; used mainly in the mining industry.
Pegmatite (pegmatitic)	Most grains very coarse in size; most grains larger than 2 cm. Results from crystallization of last bits of magma containing lots of water, typically in veins and dikes. Granite is the most common rock with this texture.
Glassy	Rock from felsic magma which erupted and cooled so fast that no crystals had time to grow. Rock is usually dark gray to black due to submicroscopic crystals of magnetite (iron oxide), but very thin edges may be colorless. Edges on freshly broken samples can be extremely sharp.
Vesicular (cellular)	Rock has abundant holes, like a <u>sponge</u> . Holes may be very small or large, and result from magma being inflated by expanding gasses as it is transported to the surface (lower pressure).
Fragmental	Rock contains many broken fragments of other rocks. Usually results from <u>violent, pyroclastic volcanic eruptions</u> .

## **Interpretation -- The Story of the Rock**

Interpretation is based on experience, some basic principles of igneous rock formation, and direct observations of a sample, but interpretations are hypotheses and are subject to being wrong, and even professionals may disagree on details.

Remember, just by making the observations required to name an igneous rock, you have unconsciously constructed a series of events.

1. Just by recognizing that the rock is igneous (it looks like other igneous rocks), you have already decided that the material was once molten (magma, melted rock); and that it has cooled and probably crystallized. Remember, before it was molten, it had a life as some other solid rock.

2. In deciding on the overall color, you perform a crude chemical analysis:

*Darker=more **mafic**=more Fe & Mg (and less Si).*

*Lighter=more **felsic**=more Si (and less Mg & Fe)*

3. This overall composition provides knowledge of what was melted. Generally, felsic rocks are derived by melting continental crust, mafic rocks by melting mantle. Intermediate compositions represent mixtures of sources, or mixing of magmas.

3. If you recognized specific minerals, and estimated their percentages, you may refine the chemistry a little by referring to the chemical formulas for the minerals.

4. Most textures tell two additional pieces of the history: place of final cooling & crystallization, and rate of crystal growth:

*Coarse grained=slow cooling at depth (below the surface).*

*Fine grained=fast cooling on surface.*

*Porphyritic=two different places and rates.*

**Assignment.** After you have practiced observing color and texture, and naming several igneous rock samples, then write the "story of the rock" as well as you can for two (2) samples provided by the lab instructor. The two sample should look different. **Use the form on the next page.** Turn in this assignment before leaving class; be sure to include your name, date, and lab section letter.

Note: Use your extra lab time to practice naming many different igneous rocks; for the Lab Midterm Exam, you will need to name some igneous rocks using the charts in this handout.

Lab Section: \_\_\_\_\_ Date: \_\_\_\_\_ Name: \_\_\_\_\_

**Write the story of each rock** by writing a paragraph (use full sentences) with the following information (in this order):

- a. Description of the sample (color, minerals [when recognizable], composition, texture).
- b. Rock name.
- c. Steps in the history of the rock: where it melted, direction magma moved, where and how fast it crystallized, later weathering.

### **Story of Rock #1**

### **Story of Rock #2**