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GS 104: Laboratory # 7
IGNEOUS ROCKS

Introduction

Igneous rocks form from the cooling and crystallization of molten rock material. This can occur below the surface of the earth forming *intrusives* (also called *plutonics*) or on or above the surface as *extrusives* (also called *volcanics*).

One of the processes that has a profound influence on the character of an igneous rock is the rate of cooling. The **textures** of igneous rocks tell us much about the rate of cooling of the rock and thus whether their origin is plutonic or volcanic. As a generalization, extrusive igneous rocks cool rapidly when compared with intrusive igneous rocks. The difference in cooling rate governs the size of the crystal grains in the resulting igneous rock because if there is a long time, atoms have plenty of time to aggregate on the surface of the growing nuclei of various minerals, thereby enlarging the mineral grains. Thus, the longer the time the larger the crystal grains. Intrusive igneous rocks have coarse-grained textures, including *phaneritic* and *pegmatitic*. Because of their rapid cooling, extrusive igneous rocks have textures that are generally fine grained, including *aphanitic*, *porphyritic*, glassy, and frothy.

In addition to texture, the mineral **composition** also determines the appropriate name of an igneous rock. This is not always easy, particularly because as the texture gets finer the individual mineral components get too small to be seen easily. In these cases, the color of a rock becomes helpful. As a general rule, dark rocks are typically *mafic* and light colored rocks are typically *felsic*; note there are a few important exceptions to be aware of.

Be sure to define the terms in italics in your notes.

Objectives

- to learn to recognize the major types of igneous rocks
- to understand the significance of texture and composition in the formation of igneous rocks

Part A – Identification of Igneous Rocks

Classification of igneous rocks is based on texture (grain size) and mineral composition (often related to color). Using the classification chart (Table 1), you should be able to assign correct names to the lab specimens. Identify the rocks in the study set using the rock identification chart. Begin by describing the texture and color of the rock. You should be able to identify minerals present in the phaneritic and porphyritic rocks. Fill in the identification table (Table 2).

Table 1: Igneous Rock Classification Table.

		COMPOSITION			
		Felsic (light colored)	Intermediate	Mafic (dark colored)	Ultramafic
TEXTURE		QUARTZ (10-20 %) ORTHO > PLAG < 15 % FERROMAGS	NO QUARTZ PLAG > ORTHO > 20 % FERROMAGS	NO QUARTZ NO ORTHO PLAG + > 40 % FERROMAGS	NO QUARTZ NO ORTHO NO PLAG 100 % FERROMAGS
	Pegmatitic (>coarse grained)	PEGMATITE	--	--	--
	Phaneritic (coarse grained)	GRANITE	DIORITE	GABBRO	PERIDOTITE
	Aphanitic (fine grained)	RHYOLITE	ANDESITE	BASALT	--
	Glassy	OBSIDIAN		--	--
	Frothy or Cellular	PUMICE		SCORIA	--

FERROMAGS = FERROMAGNESIAN SILICATE MINERALS (E.G., BICOTITE, HORNBLLENDE, AUGITE, AND OLIVINE)
 PLAG = PLAGIOCLASE; ORTHO = ORTHOCLASE
 PORPHYRITIC TEXTURE IS ADDED TO THE ROCK NAME (E.G, PORPHYRITIC BASALT)

Table 2: Igneous Rock Description Table.

Sample Number	Texture	Composition	Rock Name
1	Phaneritic	Mafic	Gabbro
2	Glassy	Felsic	Obsidian
3	Porphyritic	Felsic	Rhyolite
4	Phaneritic	Intermediate	Diorite
5	Porphyritic	Intermediate	Andesite
6	Porphyritic	Mafic	Basalt
7	Frothy	Felsic	Pumice
8	Phaneritic	Felsic	Granite
9	Frothy	Mafic	Scoria
10	Phaneritic	Ultramafic	Peroxite

Part B - Igneous Rocks Supplemental Questions

Observe the textural characteristics in **an igneous rock with larger crystals in a fine-grained matrix**. Examine Sample # A and answer the following questions.

1. Identify the rock by giving it a correct name. Andesite
2. Describe and identify the mineral that forms the larger crystals.

It has glass luster & is dark & has
2 cleavage planes that meet at 120° & 60°

Hornblende

3. Interpret the cooling history of this rock. Support your interpretation with observations of the textural features in the sample.

This rock cooled slowly first, allowing the large hornblende crystals to grow. Then it cooled quickly allowing the fine grained matrix to form.

Observe the textural characteristics in a **fine-grained igneous rock**.

Examine Sample # B and answer the following questions.

1. Identify the rock by giving it a correct name. Basalt
2. Can you identify any of the minerals present in this sample? What problem do you encounter when trying to identify minerals in a fine-grained rock?

No, it is too fine grained to
see individual mineral grains.

3. Compare this sample with the matrix of Sample # A. List two features that would help you distinguish these two rocks.

The dark color of B indicates a
more mafic composition than sample A.

Observe the textural characteristics in a **coarse-grained igneous rock**.

Examine Sample # C and answer the following questions.

1. Identify the rock by giving it a correct name. Pegmatite

2. Briefly describe (i.e., color, shape, and relative size) and identify the different minerals present in this rock.

Large, rectangular crystals, pink → Orthoclase

Medium, dark, rectangular crystals → biotite

Small, clear, irregular crystals → quartz.

3. Describe the shape and relative size of the quartz. Can you see crystal faces? Is it larger or smaller than the other minerals?

Small, irregularly shaped crystals

4. Describe the shape and relative size of the pink mineral.

Large, rectangular crystals

5. Based on your observations, do you think the quartz crystallized before or after the pink mineral? Explain. Where do the dark minerals fit into the crystallization sequence?

Orthoclase grains have geometric shape, exhibiting crystal form. This means that there was plenty of space for crystal growth when the orthoclase formed, so it formed first. The quartz grains crystallized second, filling in the gaps and taking on irregular shapes. According to Bowen's reaction series, the dark mineral (biotite) formed before

6. Using Bowen's Reaction Series, predict the first two minerals to be consumed upon the orthoclase melting of this rock.

Quartz, then muscovite, then orthoclase