ES 104: Laboratory # 7 (Summer 2022)
IGNEOUS ROCKS

Before you start the lab, watch the following two short Youtube video clips on igneous rocks:
https://www.youtube.com/watch?v=7m8tevimgco
https://www.youtube.com/watch?v=laVDypLGdbs

Introduction

Igneous rocks form from the cooling and crystallization of molten rock material. This can occur below the surface of Earth forming *intrusive rocks* (also called *plutonic rocks*) or on or above the surface as *extrusive rocks* (also called *volcanic rocks*). As a generalization, extrusive igneous rocks cool rapidly when compared with intrusive igneous rocks.

The rate of cooling has a profound influence the size of the crystal grains formed in the igneous rock, so 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. If cooling is slow, atoms have plenty of time to migrate to the growing nuclei of growing crystals, thereby enlarging these mineral grains. So, a longer cooling time results in larger crystal grains. Intrusive igneous rocks have *coarse-grained textures*, including *pegmatitic* (crystals larger than 10 mm). Because of their rapid cooling, extrusive igneous rocks generally have fine-grained textures, including *porphyritic*, *glassy*, and *frothy*.

In addition to texture, the mineral **composition** also determines the appropriate classification of an igneous rock. Determining composition of an igneous rock is not always easy, particularly because as the texture gets finer, the individual mineral grains become 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*.

Objectives

- Learn to recognize the major types of igneous rocks
- Understand the significance of texture and composition in the formation of igneous rocks

Useful Websites

- http://csmres.jmu.edu/geollab/Fichter/IgnRx/Ighome.html
- http://seis.natsci.csulb.edu/basicgeo/IGNEOUS_TOUR.html

Name_____

Lab day _____Lab Time_____

Pre-lab Questions – Complete these questions before coming to lab.

1. What are the three main classes of rocks and how does each of them form?

2. Draw and label a diagram of the rock cycle **on the back** of this sheet. Be sure to show the three classes of rocks and how the relate with one another.

3. What are the differences between an extrusive and intrusive igneous rock?

4. Define the following igneous rock terms:

   a. Coarse grained

   b. Fine grained

   c. Porphyritic

   d. Felsic

   e. Mafic

   f. Magma

   g. Lava

Part A – Identification of Igneous Rocks

Classification of igneous rocks is based on texture (grain size) and chemical composition (often related to color). Identify the rocks in the study set using the rock identification chart. Begin by describing the texture and color of the rock. Use a ruler to measure the average grain sizes. You should be able to identify minerals present in the coarse-grained and porphyritic rocks. To identify visible mineral grains, use the same mineral identification procedures that you used in Lab 6. Fill in the identification table (Table 2) with your observations, then use the classification chart (Table 1) to assign correct names to the lab specimens. **Do not copy information from table 1 onto table 2 that you cannot see in the rocks**. The abbreviations in table 1 are defined at the bottom.

Table 1: Igneous Rock Classification

See footnotes below for abbreviations

Chemical Composition to right→	**Felsic (light colored** except obsidian**)**	**Intermediate**	**Mafic (dark colored)**	**Ultramafic (green)** (light-colored exception)
Mineral content to right→ **Texture** shown below	10-20%QUARTZ K-SPAR>PLAG <15% FERRO-MAGS†	NO QUARTZ PLAG> K-SPAR >20% FERROMAGS	NO QUARTZ NO K-SPAR SOME PLAG +>40% FERRO-MAGS	NO QUARTZ NO K-SPAR NO PLAG 100% FERROMAGS
Very coarse grained most grains > 10 mm across	PEGMATITE	DIORITE	GABBRO	PERIDOTITE
Medium and coarse grained (average grain size 1 – 10 mmacross)	GRANITE	DIORITE	GABBRO	PERIDOTITE
Fine grained (average grain size < 1 mm across)	RHYOLITE	ANDESITE	BASALT	--
Porphyritic (large grains imbedded in fine grained matrix)	PORPHYRITIC RHYOLITE	PORHYRITIC ANDESITE	PORPHYRITIC BASALT	--
Glassy	OBSIDIAN		--	--
Frothy, foamy‡	PUMICE		SCORIA	

†**FERROMAGS** = Ferromagnesian silicate minerals: biotite, hornblende, augite, olivine
PLAG = Plagioclase Feldspar; **K-SPAR** = Potassium Feldspars: orthoclase, microcline

‡**FROTHY** or **FOAMY** rocks are mostly made of void space. They will have very low densities and there will be no visible mineral crystals.

Table 2: Igneous Rock Description Table.

SAMPLE #	**TEXTURE** ‡ (see note below)	**CHEMICAL COMPOSITION*** (see table 1 and note below)	**MINERALS †** *(If you can see them,* list name and % *Or write 'too small to see' if you cannot)*	**ROCK NAME** (see table 1)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

‡If the rock is medium-grained, coarse-grained or porphyritic in texture, then identify the minerals present and state their relative percents in the mineral column.

*Be sure your chemical composition is from Table 1, don't just state color.

†Only include information in this column that you can see in the rock specimens

Part B – Igneous Rock Varieties

Sample A: 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. What is the term used to describe this texture? (see prelab)

2. Describe and identify the mineral that forms the larger crystals.

3. Identify the rock (use correct name from Table 1 on page 7.3).

4. Describe the cooling history of this rock. Support your interpretation with observations of the textural features in the sample. See your textbook for additional information.

Sample B: Observe the textural characteristics in a **fine-grained igneous rock**.
Examine Sample B and answer the following questions.

1. Can you identify any of the minerals present in this sample?

2. What problem do you encounter when trying to identify minerals in a fine-grained rock?

3. Identify the rock (use correct name from Table 1 on page 7-3).

4. Compare this Sample B with Sample A. List two features that would help you distinguish these two rocks.

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

Examine Sample C and answer the following questions.

1. Identify (name) the different mineral grains present in this rock, and give a brief description of each one (color, shape, cleavage, relative size).
   a.

   b.

   c.

   d.

(more?)

2. Identify the rock (use correct name from Table 1 on page 7.3).

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

4. Describe the shape and size of the pink mineral grains. Since cleavage is consistent throughout a single mineral grain, you can use the extent of a flat, shiny cleavage surface to determine the boundaries and shape of the individual mineral grains.

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?

6. Using Bowen's Reaction Series, predict the first two minerals to be consumed upon melting of **this (Sample C)** rock.

Name_____

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POST-LAB ASSESSMENT

1. Describe the procedure you would follow to determine the name of a specific igneous rock.

2. What factor determines the size of the crystals in igneous rocks?

3. What general principles can be used to determine the order in which mineral crystals form in a cooling magma? Consider the crystallization histories of rocks A and C (in part B) of this lab, and include some of your observations of these rocks in your answer.