Lab 7: Igneous rock-forming minerals 80 pts

Introduction

In the previous lab you learned the important physical properties of minerals and to recognize the minerals or Moh's Hardness Scale. In this exercise, you will learn to recognize several of the major minerals that are found in igneous rocks. Successful completion of this lab is critical for mastery of subsequent lab material!

Igneous rocks can be quite variable in their chemical composition and mineral content. However, the generally similar physical and chemical processes by which most magmas are first formed and then crystallize to solid igneous rocks result in there being only a relatively limited number of major igneous rock forming minerals. There are, of course, several dozen less common minerals which make up minor parts of many igneous rocks. For that matter, there are several hundred minerals which can be found in at least a few igneous rocks.

Procedure

Part 1 (30 pts): Follow the same procedure for the identification of minerals that you used in the Moh's Hardness Lab, using the mineral identification tables provided, to identify minerals 1-10 in your mineral unknown set. You may also refer to the chart of igneous rock-forming silicate minerals included in this exercise. Name each mineral after first listing it's properties on your mineral identification form at the end of this lab.

Part 2 (50 pts): Let your instructor check to be sure you have properly identified these minerals before you continue on to complete the following questions.

QUESTIONS

1. Of the 10 minerals you've identified, only 8 are silicate minerals that are common igneous rock forming minerals. The other two are common accessory minerals. List the silicate minerals and the major elements contained in them below (you may list the elements or put the chemical formula down): **(8 pts)**

Mineral	Elements

2. In both lecture and your reading you have studied the structures of silicate minerals; the various ways in which the silica tetrahedron can be bound to other silica tetrahedra to make up the structures of the various silicate minerals. In the table below, the five major types of silicate structures are listed in the left-hand column. In the second column, please list the minerals having that particular silicate structure, using examples from among the eight silicate minerals you have studied in this lab exercise. List the hardness of each mineral in the third column and the number of cleavages of each mineral in the fourth column. **(10 pts)**

Silicate structure	Example(s)	Hardness	Cleavage
Single tetrahedral			
Single chain silicate			
Double chain silicate			
Sheet silicate			
Framework silicate			

3. Referring to the table above, can you suggest any relationship between the type of silicate structure of a mineral, and the presence and number of cleavages of that mineral, and the mineral hardness? Please make a general statement of your conclusions. **(6 pts)**

4. Referring to the chemical composition of the eight silicate minerals studied in this lab, can you make any general statement as to the general colors of those minerals containing iron and/or magnesium versus those minerals that do not contain iron or magnesium? **(2 pts)**

_____

_____

5. Of the eight igneous rock-forming minerals, which one would be most resistant to attack by mechanical weathering and why? **(2 pts)**

_____

_____

6. Of the eight igneous rock-forming minerals, which minerals would be the most susceptible to chemical weathering? (Hint: Consider the chemical reaction of the metal iron when exposed to air and water as compared to the chemical reaction of glass (silica) when exposed to air and water.) **(4 pts)**

_____ _____ _____ _____

(most) (least)

7. Look-alikes. Referring to your description of the eight igneous rock-forming minerals of the previous question, which minerals would be most difficult to distinguish from each other? There are two (possibly three) pairs of minerals that could very easily be confused with each other. What are these two (or three) pairs of minerals and how can you tell them from each other (even though this may not always be possible to do with small grains)? **(6 pts)**

a._____and._____distinguished from each other by _____

b._____and._____distinguished from each other by _____

c._____and._____distinguished

from each other by _____

Sand-sized Mineral Grains

8. By this time we hope you have learned to identify relatively large specimens of the eight common igneous rock-forming minerals. Now consider what the appearance of these minerals would be if you encountered them as small, sand-sized grains. Please describe the properties you might be able to observe if the minerals were sand-size grains rather than the large grains. The eight minerals are listed below. Please complete the chart for the remaining six and describe what the small grains look like and how they differ from each other. Examples of small grains of each mineral are available in the lab and study room; you will want to refer to them before attempting to answer this question. **(9 pts)**

Vial #	Mineral	Description of small grains
	Biotite	
	Hornblende	
	Muscovite	silvery (or white), one cleavage (flakes)
	Olivine	green, glassy, no cleavage
	Orthoclase	
	Plagioclase	
	Pyroxene	
	Quartz	

9. Considering the mineral associations that occur in igneous rocks, please answer the following questions **(3 pts)**

a) Will quartz and olivine ever occur in the same rock?_____

b) What color is a rock containing quartz likely to be?_____

c) What color is a rock containing augite likely to be?_____

Igneous Rock-Forming Silicate Minerals

Rock-forming group	Mineral Name	Prinicipal Cations *in addition to* Si^{4+}	Silicate structure	Cleavage	Hardness	Associated Minerals in Igneous rocks
Ferro-magnesium (mafic)	Olivine	Mg^{2+}, Fe^{2+}	Single tetrahedron	Conchoidal fracture	6.5-7	Usually with augite &/or Ca-plagioclase (anorthite)
	Augite	Ca^{2+}, Mg^{2+}, Fe^{+}	Single chain of tetrahedra	2 fair cleavages @ 90º	5.5	Usually with Ca-plagioclase (anorthite); sometimes with hornblende &/or olivine
	Hornblende	Na^{+}, Mg^{2+}, Fe^{+}	Double chain of tetrahedra	Two good cleavages, oblique (56º - 124º)	5.5	Usually with Na-plagioclase (albite) & orthoclase; sometimes with augite, biotite & quartz
	Biotite	K^{+}, Mg^{2+}, Fe^{2+}	Sheet of tetrahedra	One perfect basal cleavage	2-2.5	Usually with hornblende, quartz, orthoclase or Na-plagioclase (albite)
Non-Ferro-magnesium (silicic)	Plagioclase Albite Anorthite	 Na^{+} Ca^{2+}	3-D Al-Si framework	2 good cleavages @ 90º *with* striations	6	Ca-plagioclase usually with olivine % augite. Na-Plagioclase usually with hornblende, biotite, muscovite &/or quartz
	Orthoclase	K^{+}	3-D Al-Si framework	2 good cleavages @ 90º without striations	6	Usually with Na-plagioclase, muscovite, quartz, biotite & hornblende
	Muscovite	K^{+}	Sheet of tetrahedra	One perfect basal cleavage	2-2.5	Usually with orthoclase, quartz; sometimes with Na-plagioclase & biotite
	Quartz	Only Si^{4+}	3-D Si framework	Conchoidal fracture	7	Usu. w/orthoclase, Na-plagioclase; sometimes w/ muscovite, biotite & hornblende

Mineral Identification Form-iGNEOUS ROCK=FORMING MINERALS

#	Hard-ness	Luster	Color	Streak	Specimen Structure	Cleavage or Fracture	Heft	Misc. Properties	Name & Chemical Formula
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									