Name_____ February 8, 2010

Florida Atlantic University PETROLOGY -- MIDTERM ONE KEY

True-False - Print the letter T or F in the blank to indicate if each of the following statements is true or false. Illegible answers are wrong. (1 point each)

- 4 <u>F</u> 1. A biotite-hornblende granite contains more biotite than hornblende.
- 3 <u>F</u> 2. In the IUGS classification scheme, the letter F refers to feldspars, including alkali and plagioclase.
- 8 <u>T</u> 3. If a rock is found in the middle of the QAP part of the IUGS diagram, it is silica excessive.
- 2 <u>T</u> 4. If a rock has P + M > 90%, it should be classified using the "gabbroic" diagram.
- 2 <u>T</u> 5. Rocks with an aphanitic texture are composed of either glass, or crystals too small to be seen with the unaided eye, or a mixture of these two.
- 0 <u>F</u> 6. During nucleation, the surface area/volume ratio is low.
- 1 <u>T</u> 7. In a magma chamber lacking magma movement, the rate of diffusion controls the rate of dissipation of the heat of crystallization.
- 1 <u>F</u> 8. Systems in which the cooling rate is rapid usually maintain equilibrium.
- 9 <u>T</u> 9. As they travel deeper in the mantle, the velocity of both P and S waves increases.
- 9 <u>F</u> 10. Pyrophyllite is a dioctahedral triphormic phyllosilicate. There are two layers in the structure, one tetrahedral, and one octahedral.

Multiple-Choice - Choose the best response to each statement or question. Print the letter corresponding to your choice in the blank. (1 point each)

- 8 <u>B</u> 1. Large crystals formed by relatively slow cooling of magma below the earth's surface are called:
 - A. Phaneritic
 - B. Phenocrysts
 - C. Pyroclasts
 - D. Xenocrysts

- 9 <u>C</u> 2. In a chemical classification of igneous rocks, a rock with 48 wt % silica would be: A. Felsic
 - B. Intermediate
 - C. Mafic
 - D. Ultramafic

4 <u>C</u> 3. A rock with 45% dark minerals would have which color classification?

- A. Leucocratic
- B. Melanocratic
- C. Mesotype
- D. Poikilitic
- 7 <u>D</u> 4. In the IUGS chemical classification scheme, what two variables are plotted? A. Wt % silica, Wt % alumina
 - B. Wt % calcium, Wt % alumina
 - C. Wt % alkali (Na₂O + K_2O), Wt % alumina
 - D. Wt % alkali (Na₂O + K_2O), Wt % silica
- A 5. In the IUGS classification scheme for pyroclastic rocks based on fragment size, tuff is composed mainly of what sized fragments?
 A. < 2 mm
 B. 2 64 mm
 C. > 64 mm
 - D. Both B and C
- 1 <u>C</u> 6. Igneous minerals which form during solidification due to interactions between crystals and melt are said to be:
 - A. Equant
 - B. Phenocrysts
 - C. Primary
 - D. Secondary
- 8 <u>C</u> 7. A rock is composed of predominantly subhedral crystals. The rock texture may be described as:
 - A. Equant
 - B. Idiomorphic
 - C. Hypidomorphic
 - D. Xenomorphic
- 1 <u>A</u> 8. The most common metal on earth is:
 - A. Aluminum
 - B. Calcium
 - C. Iron
 - D. Titanium

A 9. In recent years, a treasure trove of meteorites has been discovered at which of the following localities?
 A. Allan Hills, Antarctica
 B. Great Slave Lake, Canada
 C. Lake Baikal, Russia
 D. Rift zone, Africa

3 <u>D</u> 10. Silicate minerals make up approximately what percent of the earth's crust?

- A. 32
- B. 52
- C. 72
- d. 92
- 1 <u>B</u> 11. What is the configuration of the silicate anionic group?
 - A. Trigonal planar
 - B. Tetrahedral
 - C. Octahedral
 - D. Cubic

Fill-Ins - Write in the word or words which best completes each statement or answers each question. (1 point per blank)

- 15 3. Perthite is described as, "The host is K-spar, with albite lamellae appearing as a coherent intergrowth." What does the term coherent mean, as it is used here?

COHERENT MEANS THE EXSOLVED PHASE LATTICES HAVE A SPECIFIC

RELATIONSHIP TO THE HOST LATTICE

31.5 4-5. What is the chemical difference between orthopyroxenes and clinopyroxenes? How does it affect their structure?

THE PYROXENE STRUCTURE HAS TWO DISTORTED OCTAHEDRAL SITES, M1 AND M2. IN ORTHOPYROXENES, THE CATIONS ARE MAGNESIUM, IRON, OR A MIXTURE. BOTH HAVE THE SAME SIZE, AND CAN OCCUPY EITHER M1 OR M2, CREATING AN ORTHORHOMBIC STRUCTURE. IN CLINOPYROXENES, CALCIUM IS PRESENT IN ADDITION TO Mg AND Fe. SINCE Ca IS LARGER, THE STRUCTURE IS DISTORTED, BECOMING MONOCLINIC. **Matching I** - Match the property in column one with the correct silicate subclass in column 2. (1 point each) Answers may be used once, more than once, or not at all.

Column 1

Column 2

- 2 <u>C</u> 1. This sub-class has the lowest Si:O ratio, 1:4. Minerals include the garnets, the olivine series, and zircon
- 0 <u>B</u> 2. Two very important mafic groups, the pyroxenes and the amphiboles, belong to this subclass. Both have chain structures.
- 0 <u>D</u> 3. The micas and chlorites are two important groups in this subclass, which gets it name from the Greek word for "leaf."
- 5 <u>F</u> 4. This subclass consists of threedimensional structures, and includes the most common minerals in the crust of the earth
- <u>5</u> <u>E</u> 5. Two silica anionic groups share a corner in this subclass, which includes epidote and hemimorphite
- 3 <u>F</u> 6. Many major rock-forming minerals belong to this subclass. Examples include albite, anorthite, microcline, orthoclase, citrine, and amethyst.
- 5 <u>D</u> 7. Kaolinite is a dioctahedral variety, and serpentine a trioctahedral variety of diphormic members of this subclass.

- A. Cyclosilicate
- B. Inosilicate
- C. Nesosilicate
- D. Phyllosilicate
- E. Sorosilicate
- F. Tectosilicate

Matching II - Match the descriptions from column 1 with the correct silicate group from column 2. Answers may be used once, more than once, or not at all. (1 point each)

Column 1

Column 2

- <u>1</u> <u>J</u> 1. A major mineral in the earth's mantle. The end members of one series include fayalite and forsterite.
- 8 <u>L</u> 2. The minerals at the bottom of a four-sided structure used to describe the chemistry of this group are enstatite and orthoferrosilite. Along the upper edge we fine diopside and hedenbergite.
- 4 <u>H</u> 3. Ca-bearing species of the group are uvarovite, grossularite, and andradite. Non calcium species include pyrope, almandine, and spessartite.
- 8 <u>A</u> 4. Three tri-morphs of this group, very important in metamorphic petrology, are kyanite, andalusite, and sillimanite.
- 10 <u>G</u> 5. Minerals like nepheline, leucite, and sodalite characterize this group, commonly seen in rocks in the APF triangle of the IUGS classification.
- 14 <u>K</u> 6. The name of this important mineral group comes from words meaning "oblique" and "break", in allusion to their triclinic structure.
- 4 <u>O</u> 7. Jasper, chert, chalcedony, and chrysoprase are cryptocrystalline vanities of a major mineral in this group.
- 9 <u>C</u> 8. The cummingtonite-grunerite and tremolite-actinolite series are parts of this group.

- A. Al_2SiO_5
- B. Alkali feldspar
- C. Amphibole
- D. Chlorite
- E. Clay
- F. Epidote
- G. Feldspathoid
- H. Garnet
- I. Mica
- J. Olivine
- K. Plagioclase feldspar
- L. Pyroxene
- M. Pyroxenoid
- N. Serpentine O. Silica
- O. Sinca
- P. Zeolite

Diagrams and Figures - A series of slides will be shown. Each of these is a photo or a diagram previously seen in class. Diagrams may have been altered to remove labels, etc. Answer each question as the slide is shown. (1 point each)

1-2. Describe the texture of the augite seen in this photo, and briefly interpret its origin.

THE FEATHERY AUGITE CRYSTAL NUCLEATED ON THE SURFACE OF THE PLAGIOCLASE, AND GREW OUTWARD, INTO THE MELT. THIS WAS THEN QUENCHED, PRODUCING A GLASS.

8 3-4. Describe two features seen in this plagioclase crystal.

THE CRYSTAL DISPLAYS A CARLSBAD TWIN, AS WELL AS CONCENTRIC ZONING.

- 0 <u>B</u> 5. The texture seen in this photo is:
 - A. Dehydration rim
 - B. Graphic
 - C. Ophitic
 - D. Sieve
- 6. Describe the feature seen next to the geologic hammer in this photo of andesite on Mount Rainier.

FLOW BANDING

- 2 <u>C</u> 7. What type of twinning is seen in this photo?
 - A. Carlsbad
 - B. Cross-hatch
 - C. Deformation albite
 - D. Tartan

Short Answer - Write a complete, concise answer to one of the following three questions. Diagrams (labeled) may be used to supplement your written answers, where appropriate. 4 points Ihad intended you to answer all three questions, but forgot to change the instructions. Therefore the test was 52 points, and will be 13% of your total grade. You will have a chance at the other 2% later.



IGNEOUS ROCKS.

1. Use the diagram in Figure 1 to explain how an intrusive porphyry might form.

DIFFERENT MINERALS IN THE SAME MELT EXHIBIT BEHAVIOR AS SHOWN IN THE DIAGRAM, BUT A DIFFERENT TEMPERATURES. AT ANY GIVEN TEMPERATURE, ONE MINERAL MIGHT BE AT A POSITION SIMILAR TO THAT LABELED T_a IN THE DIAGRAM. SUCH A MINERAL WILL NUCLEATE FEW GRAINS, BUT THESE WILL GROW LARGE. FOR A SECOND MINERAL, THE SAME PHYSICAL TEMPERATURE WILL CORRESPOND TO A POSITION SUCH AS THAT LABELED T_b IN THE DIAGRAM.. THIS MINERAL WILL NUCLEATE MANY GRAINS, BUT THEY WILL ALL BE SMALL. SUCH A ROCK, WITH LARGE GRAINS EMBEDDED IN MANY SMALLER GRAINS, RESEMBLES A PORPHYRITIC TEXTURE IN EXTRUSIVE

Question #	Times Answered	Points Missed	Average Missed
1	5	6.5	1.3
2	1	0.5	0.5
3	12	10	0.8

2. Explain what a deuteric autometamorphic process is. Name and describe what is happening in one example of a deuteric process.

AS INTRUSIVE IGNEOUS ROCKS COOL SLOWLY, THEY WILL PASS THROUGH A RANGE OF TEMPERATURES USUALLY ASSOCIATED WITH METAMORPHOSIS, ROUGHLY 300-800°C. THE MINERALS IN THE ROCK MAY BE ALTERED. IF THE REACTIONS INVOLVE WATER, THEY ARE TERMED DEUTERIC. EXAMPLES:

1) URALIZATION, IN WHICH PYROXENE IS CONVERTED TO AMPHIBOLE

2) BIOTITIZATION, IN WHICH EITHER PYROXENE OR AMPHIBOLE IS CONVERTED TO BIOTITE

3) CHLORITIZATION IN WHICH A MAFIC MINERAL IS CONVERTED TO CHLORITE

4) SERITIZATION IF THE CONVERSION OF FELSIC MINERALS TO VERY FINE-GRAINED WHITE MICA

5) SAUSSURIZATION IS THE REACTION OF CALCIC PLAGIOCLASE TO FROM NEARLY PURE ALBITE PLUS EPIDOTE

6) SERPENTINIZATION IS THE BREAKDOWN OF ANHYDROUS MAFIC MINERALS TO FORM SERPENTINE MINERALS 3. What formula is used to determine the variation of pressure with depth within the earth? (List the formula, and define all terms in the formula) Examine Figure 2. It is clearly that pressure is nearly a linear function of depth within the mantle, but deviates considerably in the core. Explain this behavior, using the above formula.



THE FORMULA IS: $P = \rho gh$, where P = pressure $\rho = density$ g = acceleration due to gravityh = the height of the column of material above the object

WITHIN THE MANTLE DENSITY AND THE HEIGHT OF THE COLUMN INCREASE AS DEPTH INCREASES, WHILE G DECREASES, ALL IN LINEAR MANNERS. AT THE TOP OF THE OUTER CORE, DENSITY INCREASES RAPIDLY AND NON-LINEARLY, AS SILICATES ARE REPLACED BY IRON-NICKEL.

Figure 2

Midterm 1 Results

46.0	
45.5	
45.0	B+
42.5	
42.0	B-
40.0 - 2	C+
39.5 - 2	
39.0	C
36.0	D+
34.0	D
31.0	D-
30.5	
30.0	
29.0 - 2	
25.5	F

 $\mathbf{MEDIAN} = \mathbf{39.5}$

MEAN = 36.4 (70.0%)