

# The Geological Earth

## Sample Test GenSci 102 Test # 1 Environment: Earth

Name: \_\_\_\_\_

Date: \_\_\_\_\_

L. S. Fichter  
Department of Geology and Environmental Science  
James Madison University

*Write Your People Soft (Not Social Security) Number  
on the Scantron Card*

**DO NOT OPEN THE TEST  
UNTIL EVERY ONE IS SETTLED AND READY TO START**

This is a **CLOSED NOTE/CLOSED BOOK TEST**. You may have nothing with you while taking it except writing materials.

### INSTRUCTIONS FOR TESTS

- ☞ Note that your test score is not your test grade. Check with the posted curve to convert your test score into a grade.
- ☞ Timing: you have exactly the class time to take the test, no more.
- ☞ The questions are a mixture of True/False or Multiple Choice.
- ☞ Drawing, diagrams, figures required for certain questions are often at the back of the test. You may pull that sheet off to make it easier to answer questions.
- ☞ Different questions may have different values, as indicated with each set of questions.
- ☞ Multiple choice questions may have 3, 4, 5, or as many as 20 choices. When there are more than 5 choices they are distributed among more than one question number, as below. These questions are always placed in a box to indicate that they belong together to answer one question, as in the example below.
- ☞ Unlike other Scantron tests given on campus, many or most questions on these tests must be left blank to have a correct answer. Often on other tests a blank row means a wrong answer. That is not true here. For example, the 15 choices below require only one answer, so at least two rows must be left blank.
- ☞ Some multiple choice questions may have more than one answer scattered among the 15 to 20 choices available. This means that some rows may have more than one answer chosen, while another row may have no answers chosen. This is normal on these tests.

**Feature A** on the cross section is identified by which **ONE** of the terms; leave the other 14 blank.

1.	1A,	1B,	1C,	1D,	1E
2.	2A,	2B,	2C,	2D,	2E
3.	3A,	3B,	3C,	3D,	3E

- ☞ Wrong spellings are not part of the test. I do not deliberately make minor , or try to be confusing or ambiguous. If something seems strange assume it is an honest mistake and answer the question as best you can.
- ☞ However, questions may be subtle and complex, read them carefully.

**Note that your grade for the test will be based on a curve drawn over the distribution of raw scores. I draw the curve by hand, but have no need to have a specific percentage of A's, B's, C's etc. In fact, I would like everyone to do well, but will draw the most fair curve I can based on how everyone in the class does. I ignore the computer generated percentages.**

**Your total score will be sent to you via e-mail. The total score is not your grade, but I will e-mail the curve ranges to you so you have an idea how you did.**

**Multiple Choice questions are worth 2 points,  
Except where noted otherwise; All True/False are worth 1 point.**

**Questions are more or less in the order of class presentation**

## **PP1 - Earth is an Open System**

### **MULTIPLE CHOICE:**

The Earth is different from the other planets because . . . (True=Yes; False=No. None, one, more than one may be true)

1. T/F. It formed from processes different from the other planets.
2. T/F. It is a different size from all the other planets.
3. T/F. Meteorite impacts early in its history affected its evolution differently from the other planets.
4. T/F. Rotated more rapidly during its formation.
5. T/F. Is the only planet to have formed with abundant water.

Ever since the time of Isaac Newton, science . . . . (True=Yes; False=No. None, one, more than one may be true)

6. T/F. Must be based on observations of the natural world.
7. T/F. Must be agreed upon by the majority of scientists.
8. T/F. Must be mathematically describable.
9. T/F. Must be able to make accurate predictions based on the outcomes of laws of nature (equations) describing the behavior of the system.
10. T/F. Argues that, following the second law of thermodynamics, the natural outcome of all the laws of nature is an equilibrium state.
11. Which of the following are used to measure *entropy*? Choose more than one.
  - A. How rapidly the system can evolve.
  - B. The amount of disorder in the system.
  - C. The "r" value of the system.
  - D. The amount of energy available to do work.
  - E. How open or closed the system is.

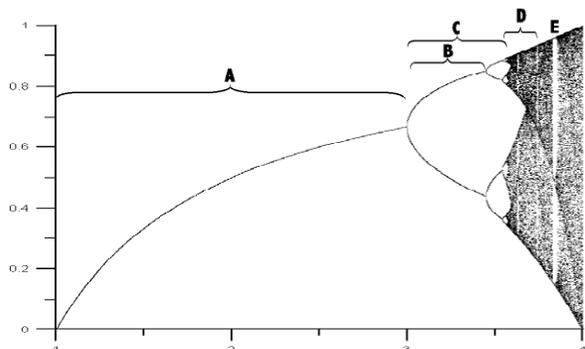
## **PP1 - Chaos and Complex Systems Theory**

### **The Logistic System**

#### **MULTIPLE CHOICE:**

12. Which of the following is the correct equation for the  $X_{next}$  model (only one)?

- A.  $X_{next} = r(X + 1 - X)$
- B.  $X_{next} = rX(1 - X)$
- C.  $X_{next} = rX(-1)$
- D.  $X_{next} = rX(X - 1)$
- E.  $X_{next} = rX^2(1 - X)$

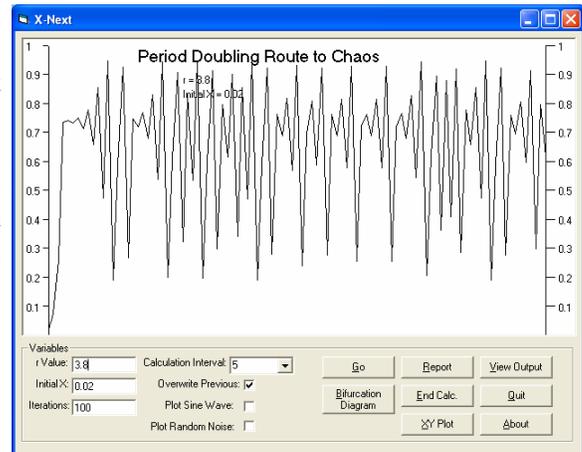


13. Identify by the letters in the bifurcation diagram those  $r$  values where the system attenuates to equilibrium.

A      B      C      D      E

14. T/F. The population fluctuations in the logistic graph to the right where  $r = 3.8$  demonstrates that the changes in population size are unpredictable, but this does not mean the changes are random.

15. T/F. The population fluctuations in the logistic graph to the right where  $r = 3.8$  may not follow a recognizable, repeating pattern but they are still deterministic.



**3 POINTS EACH:** The syllabus makes the following statement: *You are required to take a general education science course not just to learn about the natural world, but to learn about scientists, how we think, how we solve problems, and what scientists can and cannot do (and still being doing science) so that you can better understand and evaluate the influence of science in your life.* The next questions explore this issue.

Quote #1 - "Science is a paradox. To do science is to seek Truth, but Truth can never be found. The best we can do is approach Truth by discovering what can't be True. By knowing what can't be True we limit and thus approach what can be True."

Quote #2 - "Truth is the child of time, not of authority. Our ignorance is infinite, let's whittle away just one cubic millimeter. Why should we still want to be so clever when at long last we have a chance of being a little less stupid."

Quote #3 - "One of the main reasons for the poverty of science is that it is supposed to be rich. The aim of science is not to open the door to everlasting wisdom, but to set a limit on everlasting error."

16. T/F. Quote #1 is *implying* that we can eventually discover scientific truth, it will just take a long time.
17. T/F. Quote #2 is saying the problem we humans have had throughout history is believing we can rely on authorities (experts) who can tell us the answer to things.
18. T/F. Quote #3 is saying that the great advantage of science is not so much what we can learn but the mistakes we can be prevented from making.
19. T/F. "Being a little less stupid" in quote #2 and "set a limit on everlasting error in quote #3 are saying just about the same thing.

## PP2 - How Do Things Evolve?

20. The general evolutionary algorithm is:
- Select, Differentiate, Amplify
  - Differentiate, Amplify, Select
  - Fractionate, Amplify, Select
  - Differentiate, Select, Amplify
  - Elaborate, Select, Differentiate

The three mechanisms of evolution are (listed alphabetically below): (True=Yes; False=No)

21. T/F. Cellular Automata
22. T/F. Elaboration
23. T/F. Fractionation
24. T/F. Self Organized Criticality
25. T/F. Self-organization

Cellular Automata are self organizing because: (True=Yes; False=No):

26. T/F. The computer programmer wrote the steps by which the computer forms the patterns.
27. T/F. They are simply the working out of an algorithm - the local rules of behavior which results in recognizable patterns every time.
28. T/F. There is some unknown process happening behind the scenes to create the order we see.

### **PP3 - Open System Earth?**

29. T/F. The Earth probably evolved differently from Venus because Venus dissipates its energy by conduction, while Earth dissipates its energy by convection.
30. T/F. During the origin of the Earth the major energy sources driving the systems were tectonic, chemical, and solar.
31. T/F. The large shield volcanoes on Mars indicate it dissipated its internal energy primarily by direct transfer.

### **PP4 - Rock Forming Minerals**

32. T/F. In the silica tetrahedra the silicon and oxygen atoms are always held together by strong covalent bonds, while the different silica tetrahedra are bound together by weaker ionic bonds between the oxygen atoms and some metallic cation, such as iron or magnesium.
33. T/F. The reaction principle says that, because minerals are stable only under the conditions at which they form, higher temperature minerals react with the melt to form lower temperature minerals with different compositions, or different crystal structures.
34. T/F. Feldspars are unlike any of the other minerals in Bowen's Reaction series in that they contain aluminum tetrahedra as well as silica tetrahedra.
35. T/F. An alumina tetrahedra in a mineral means that the mineral requires one more electron than a mineral with all silica tetrahedra, and this is supplied by a positively charged metallic cation, such as calcium, sodium, or potassium.

### PP5 - Igneous Rocks

**Igneous Rock Identification.** From the choices in the table to the right, identify the rock(s) with the composition in Bowen’s Reaction Series below. May be more than one choice; choose all that clearly apply.

Choose From Among These	
1A - Alkaligranite	2A - Gabbro
1B - Andesite	2B - Obsidian
1C - Anorthosite	2C - Plagiogranite
1D - Basalt	2D - Rhyolite
1E - Diorite	2E - Ultramafic

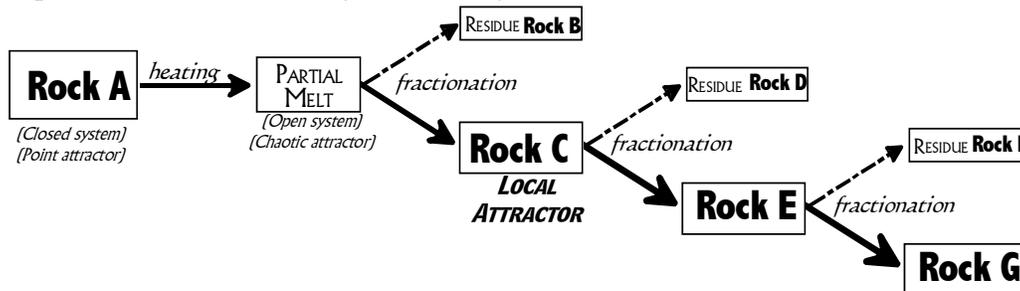
<p>36. 1A 1B 1C 1D 1E 37. 2A 2B 2C 2D 2E</p>	<p>38. 1A 1B 1C 1D 1E 39. 2A 2B 2C 2D 2E</p>	<p>40. 1A 1B 1C 1D 1E 41. 2A 2B 2C 2D 2E</p>	<p>42. 1A 1B 1C 1D 1E 43. 2A 2B 2C 2D 2E</p>
--	--	--	--

### PP6 - Lava and Volcanoes

- 44. T/F. In general, the lower one goes on the reaction series the more explosive the volcanic eruptions become.
- 45. T/F. On Earth volcanoes are always found only along divergent and convergent plate boundaries.

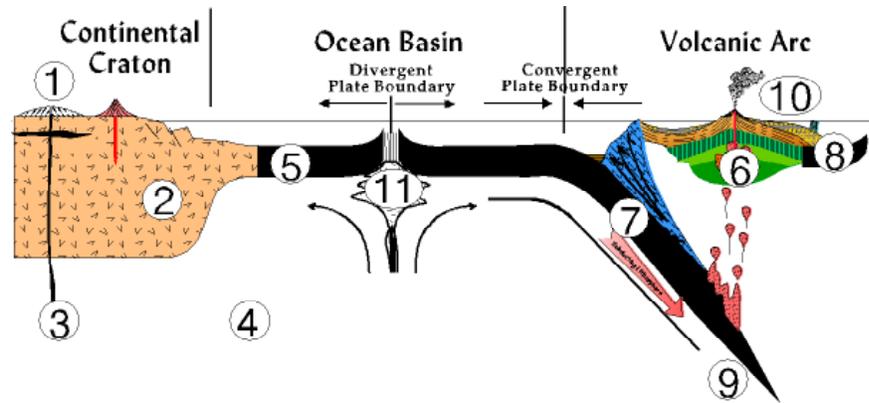
### PP7 - Fractionating Evolution of Igneous Rocks

These next questions deal with the diagram “How Igneous Rocks Evolve” below.



- 46. T/F The only way for fractionation to take place in an igneous rock is through partial melting.
- 47. T/F The partial melt in the diagram has a combined composition of Residue Rock B and Rock C, which is the same composition as rock A.
- 48. T/F In the process of evolution by fractionation, Rock B will always be higher in Bowen’s reaction series than Rock C.
- 49. T/F Rock G being at the end of the fraction sequence is an alkaligranite, or its rhyolite aphanitic equivalent.

To the right is a drawing of a portion of the earth's crust with various locations identified by number. The questions ask you to identify the rocks most likely to be found at these numbered locations. Be sure to make distinctions between aphanitic and phaneritic rocks and where they form.



**Location 1 in Cross Section:** Identify the rock(s) most likely to be found at this Location (1 choice)  
 50. A=Alkaligranite, B=Andesite, C=Anorthosite, D=Basalt, E=Diorite.  
 51. A=Gabbro, B=Plagiogranite C=Rhyolite, D=Ultramafic

**Location 2 in Cross Section:** Identify the rock(s) most likely to be found at this Location (2 choices).  
 52. A=Alkaligranite, B=Andesite, C=Anorthosite, D=Basalt, E=Diorite.  
 53. A=Gabbro, B=Plagiogranite C=Rhyolite, D=Ultramafic

**Location 6 in Cross Section:** Identify the rock(s) most likely to be found at this Location (1 choice).  
 54. A=Alkaligranite, B=Andesite, C=Anorthosite, D=Basalt, E=Diorite.  
 55. A=Gabbro, B=Plagiogranite C=Rhyolite, D=Ultramafic

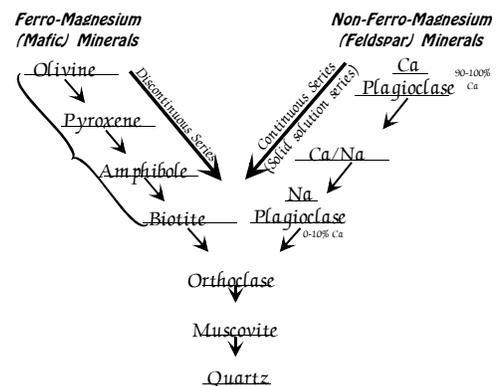
**Location 4 in Cross Section:** Identify the rock(s) most likely to be found at this Location (2 choices).  
 56. A=Alkaligranite, B=Andesite, C=Anorthosite, D=Basalt, E=Diorite.  
 57. A=Gabbro, B=Plagiogranite C=Rhyolite, D=Ultramafic

**Location 5 in Cross Section:** Identify the rock(s) most likely to be found at this Location (2 choices).  
 58. A=Alkaligranite, B=Andesite, C=Anorthosite, D=Basalt, E=Diorite.  
 59. A=Gabbro, B=Plagiogranite C=Rhyolite, D=Ultramafic

## PP8- Sedimentary Rock Origin and Classification

In weathering one thing we are interested in are the fates of the cations and anions in the minerals in Bowen's reaction series. Recall how these chemicals behave for the questions below.

- 60. T/F. *Exfoliation* is a type of *frost wedging* that results in curved layers of rock peeling off of a batholith like layers in an onion.
- 61. T/F. Mechanical weathering tends to decrease in importance downstream while chemical weathering increases in importance.
- 62. T/F. Hydrolysis is a form of chemical weathering where water and oxygen attack the minerals in a rock and break them down.



63. T/F. Sodium will tend to be less abundant in a sedimentary rock than in an igneous rock because its solubility fractionates it into water to make the water salty during weathering.
64. T/F. The result of chemical weathering fractionation is to always produce a shale with a chemical composition lower on the reaction series than the original igneous rock it weathered from.
65. T/F. A sedimentary environment is not a *place* because we define them by the rocks that get deposited in them.
66. T/F. It does not matter the nature of the sourceland or the composition of the sourceland rock; evolutionary processes *always* result in exactly the same evolutionary end products: quartz sand, (clay) shale, and limestone.

## PP9 - Follow the Energy

### Multiple Choice

The features that make or define a fractal object fractal are (True=Yes; False=No. Only two are true):

67. T/F. Follow power law relationships.
68. T/F. Are generated by an iterative, evolutionary process.
69. T/F. Have patterns within patterns within patterns.
70. T/F. Have dimensions like 2.5.
71. T/F. The size of an object depends on the side of the ruler measuring it.

Events that follow a power law have which of the following properties or features.(True=Yes; False=No. All that apply; none, one, some, all?):

72. T/F. Do not have an average size.
73. T/F. Are the result of non-linear processes.
74. T/F. Are an evolutionary systems.
75. T/F. Means that even a very large number of small events have little or impact on the evolution of the system.
76. T/F. Are graphed as a straight line with a negative slope (slope down to right) on a log-log graph.
77. T/F. Tell us that extremely large events must be the result of some process that normally do not occur in the system.

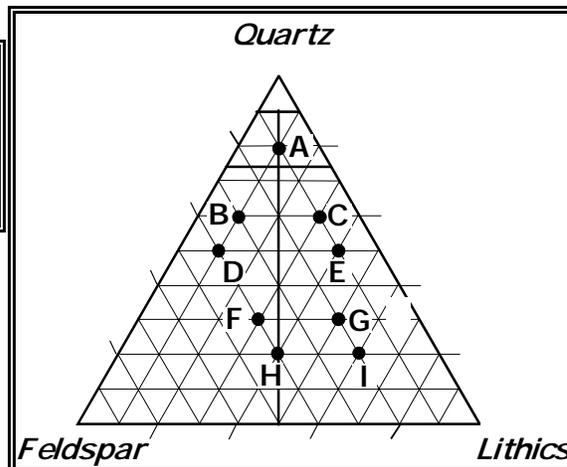
## PP10 - Sedimentary Environments

### READING TERNARY DIAGRAMS

A rock with 50% quartz, 40% lithics, 10% feldspar would plot at which lettered location on the ternary diagram?

78. Location A=A, B=B, C=C, D=D, E=E  
 79. Location A=F, B=G, C=H, D=I

80. If Rock B is a sandstone, its complete name (all components included in the name) would be:  
 A. Quartz, lithic, feldspathic SS.  
 B. Feldspathic, quartz, lithic SS.  
 C. Lithic, quartz, feldspathic SS.  
 D. Feldspathic, lithic, quartz SS.  
 E. Lithic, feldspathic, quartz SS.



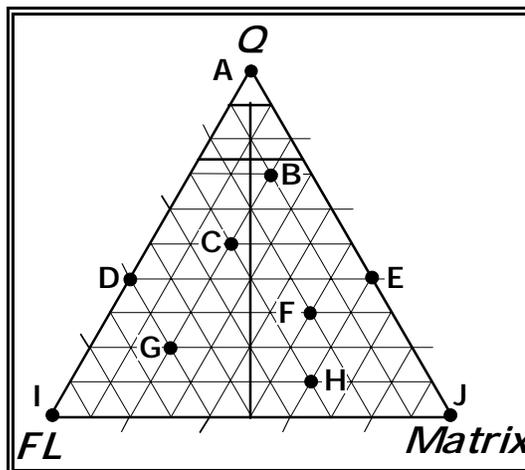
### Q/FL/Matrix Diagram to right:

If a sediment starts with a composition of **D** and undergoes complete weathering but no transportation and sorting its composition would plot at? If none leave all blank.

81. Location A=A, B=B, C=C, D=D, E=E  
 82. Location A=F, B=G, C=H, D=I, D=J

Sediments that are the result of complete weathering, transportation, sorting, and deposition (two choices).

83. Location A=A, B=B, C=C, D=D, E=E  
 84. Location A=F, B=G, C=H, D=I, D=J



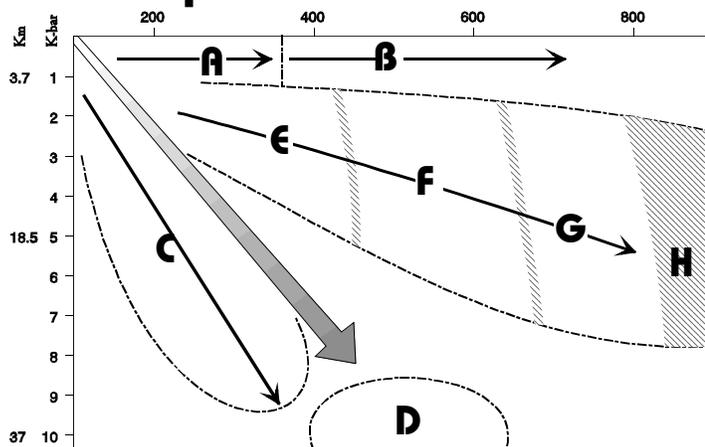
### Figures "Depositional Environments" and "Sedimentary Rock Evolution" at back of test

The following questions compare how rocks on the Depositional Environmental diagram relate to rocks on the Sedimentary Rock Evolution model.

85. On the block diagram titled "Depositional Environments" at the back, the sequence of environments in a long system are which of the following choices (not all environments may be present, but those that are must be in the right order).  
 A 1, 2, 3, 7, 8, 10, 11, 17                      C 4, 1, 2, 3, 7, 8, 10, 12, 11, 16, 17  
 B 1, 4, 2, 9, 10, 11, 16, 17                      D 1, 4, 2, 3, 10, 11, 17, 16
86. T/F. J and O are essentially the same maturity of rock even though they have different origins.  
 87. T/F. Environment 16 is likely to contain sediment N.  
 88. T/F. Rock A on the Sedimentary Rock Evolution diagram could show up in depositional environment 1.

### PP10 - Metamorphism

- 89. T/F. In Barrovian metamorphism, beginning with a shale parent rock, the evolutionary sequence goes shale ⇒ slate ⇒ phyllite ⇒ schist ⇒ gneiss ⇒ migmatite ⇒ magma.
- 90. T/F. When we find metamorphic rocks exposed at the earth's surface it means this area was at one time at the bottom of a very high mountain range.



Identify the type of metamorphism associated with the labeled field on the phase diagram above.

<p><b>Barrovian</b> metamorphism (mark all letters that apply)</p> <p>91. Location A=A, B=B, C=C, D=D, E=E</p> <p>92. Location A=F, B=G, C=H,</p>	<p><b>Blue Schist</b> metamorphism (mark all letters that apply)</p> <p>93. Location A=A, B=B, C=C, D=D, E=E</p> <p>94. Location A=F, B=G, C=H,</p>
---	---

### MINERAL/ROCK IDENTIFICATIONS ON POWER POINT

**MULTIPLE CHOICE:** 3 points each. The choices are in the box to the right, but the same choices are present on each slide.

MINERALS STUDIED IN CLASS			
1A	Amphibole	2A	Ca Plagioclase
1B	Biotite	2B	Na Plagioclase
1C	Muscovite	2C	Pyroxene
1D	Olivine	2D	Quartz
1E	Orthoclase	2E	

**Mineral Specimen 1**

<b>MINERAL:</b> Identify from Bowen's Reaction Series					
95.	1A	1B	1C	1D	1E
96.	2A	2B	2C	2D	

**Mineral Specimen 2**

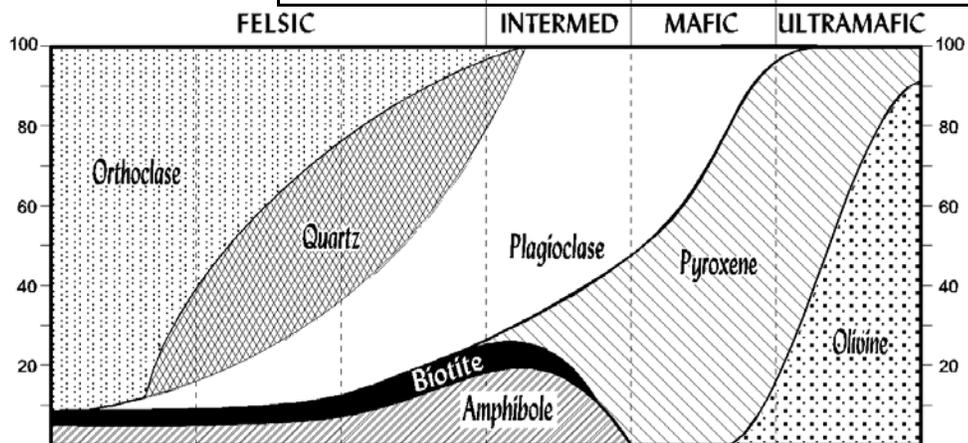
<b>MINERAL:</b> Identify from Bowen's Reaction Series					
97.	1A	1B	1C	1D	1E
98.	2A	2B	2C	2D	

**Mineral Specimen 3**

99.	1A	1B	1C	1D	1E
100.	2A	2B	2C	2D	

**Identify the Igneous Rocks**  
**Using the choices in the table**  
**to the right. Percent**  
**abundance chart is available in**  
**case it helps you.**

Igneous Rock Selections		
1A Andesite (porphyry)	2A Granite-Alkali	3A Scoria
1B Anorthosite	2B Granite-Plagio	3B Ultramafic
1C Basalt (porphyry)	2C Obsidian	3C
1D Diorite	2D Pumice	3D
1E Gabbro	2E Rhyolite (porphyry)	3E



**Igneous Rock Specimen 1**

Identify from specimen.					
101.	1A	1B	1C	1D	1E
102.	2A	2B	2C	2D	2E
103.	3A	3B			

**Igneous Rock Specimen 2**

Identify from specimen.					
104.	1A	1B	1C	1D	1E
105.	2A	2B	2C	2D	2E
106.	3A	3B			

**Igneous Rock Specimen 3**

Identify from specimen.					
107.	1A	1B	1C	1D	1E
108.	2A	2B	2C	2D	2E
109.	3A	3B			

**Igneous Rock Specimen 4**

Identify from specimen.					
110.	1A	1B	1C	1D	1E
111.	2A	2B	2C	2D	2E
112.	3A	3B			

**Igneous Rock Specimen 5**

Identify from specimen.					
113.	1A	1B	1C	1D	1E
114.	2A	2B	2C	2D	2E
115.	3A	3B			

Each identification is worth 3 points.

Volcano/Lava Flow Selections			
1A	AA	2A	Dome
1B	Caldera	2B	Fissure
1C	Cinder	2C	Pahoehoe
1D	Columnar	2D	Pillow
1E	Composite (Strato)	2E	Shield

### Volcano/Lava Flow Example A

Identify from slide illustration.

- |      |    |    |    |    |    |
|------|----|----|----|----|----|
| 116. | 1A | 1B | 1C | 1D | 1E |
| 117. | 2A | 2B | 2C | 2D | 2E |

### Volcano/Lava Flow Example B

Identify from slide illustration.

- |      |    |    |    |    |    |
|------|----|----|----|----|----|
| 118. | 1A | 1B | 1C | 1D | 1E |
| 119. | 2A | 2B | 2C | 2D | 2E |

### Volcano/Lava Flow Example C

Identify from slide illustration.

- |      |    |    |    |    |    |
|------|----|----|----|----|----|
| 120. | 1A | 1B | 1C | 1D | 1E |
| 121. | 2A | 2B | 2C | 2D | 2E |

### Volcano/Lava Flow Example D

Identify from slide illustration.

- |      |    |    |    |    |    |
|------|----|----|----|----|----|
| 122. | 1A | 1B | 1C | 1D | 1E |
| 123. | 2A | 2B | 2C | 2D | 2E |

***Double check Your People Soft Number On the Scantron Card to Make Sure The Bubbles are Filled***

