# Interpreting Igneous Rocks

**Most of this lab is to help you learn the material. Do it. Most will become part of your notes. The only part to turn in will be the last two pages. Please get a hardcopy of those from the teacher <u>after</u> doing everything else.**

<u>Background</u>

Igneous rocks cooled from molten rock underground (magma) or on the surface (lava). Two of their characteristics are very helpful. In this lab, you will observe those characteristics and use them to learn about the volcanoes the rocks came from.

<u>Objectives</u>

1. to recognize, identify, and interpret igneous rock <u>composition</u>
2. to recognize, identify, and interpret igneous rock <u>texture</u>
3. to infer magma viscosity from igneous rock composition
4. to observe the characteristics of common igneous rocks and use them to understand volcano characteristics, eruptions, and hazards

<u>Materials</u>

- large chart to keep the rocks and minerals organized
- pencil / pen / marker / crayon / etc.
- minerals found in common igneous rocks: amphibole, biotite, feldspar, muscovite, olivine, pyroxene, quartz
- common igneous rocks: andesite, basalt, diorite, gabbro, granite, obsidian, pumice, rhyolite, scoria
- hand lens
- Igneous Rock presentation

<u>Procedure</u>: you may work in pairs. If you get stuck for more than 90 seconds, ask the teacher.

<u>Part A: Main Minerals in Common Igneous Rocks</u>

1. Obtain one sample of each mineral and rock and place them on the grid in the appropriate box. <u>Keep them in order so you can return them to the proper bin at the end of the lab.</u> If you get any mixed up, ask for help sooner rather than later; the teacher will not get mad at only having to fix a few of them.

2. Observe the characteristics of the rocks you have. Group the samples however you can by their characteristics (spend no more than 3-4 minutes on this). Write down the categories you come up with (smooth-rough, dark-light, spotted-solid color, chewy-fluffy, etc.). Put each sample back on your grid when you are done.

3. Samples A-D are the first rocks to examine. Try to identify which minerals (see also slides 11-12) are in each of those rocks; list them in order of abundance:

A:

B:

C:

D:

4. What is the main difference between samples A-D?

Part B: Igneous Rock Composition

5. All of these igneous rocks are made of the same minerals, just in different proportions. Those minerals are easiest to see in samples A-D, so those rocks can help us figure out the proportions of minerals in the other rocks. Consider sample A: is it mainly a light or a dark color? Write "A" in the appropriate box below. What about sample D? Put it in the right box below. Now consider sample E: is it mainly a light or a dark color? What about sample G? What about all of the other rocks? Put each rock into the appropriate box below by color:

| light color | intermediate color | dark color |
|---|---|---|
| | | |

N.B., there is ONE exception to the relationship between color and mineral composition, so have your teacher check your work before you move on.

The minerals are made of different chemical elements and compounds, but each rock has all the minerals, just in different proportions.  Therefore, the rocks are not really made of different ingredients, just different amounts of the same ingredients.  However, those amounts can have a big impact - just imagine lemonade with half the sugar and twice the lemons!

6. Look at slide 3 on the ppt.  What is the most significant compound in rocks from the Cascade volcanoes?

7.  From slide 3, what is the approximate spread of the percentages for this compound; i.e. what is the lowest percentage of this compound and what is the highest percentage?  Round off your answers.

It turns out that the percentage of this compound, silica, determines most of the properties of the magma and therefore the volcano, including how it will erupt and the hazards it will produce.  As a result, determining this percentage is vital when studying volcanoes.

Slide 4 shows the chemical structure of the silica molecule.  The small atom at the center of the pyramid is silicon, and the large atoms at the four corners are oxygen.  These oxygen atoms develop an attraction to oxygen atoms at the corners of other silica molecules; i.e. they like to stick together.  The more of them that there are in magma, the more of them will stick together, and the gooier the magma will be.

8.  Will magma with a low silica percentage flow more like hot maple syrup or warm caramel?  How do you know?

9.  Will magma with a high silica percentage flow more like hot maple syrup or warm caramel?  How do you know?

How do we figure out how much silica is in the rocks and therefore the magma? From the minerals!  Feldspars have a high silica content, and quartz is almost pure silica.  Therefore, the rocks with more quartz and feldspar (slide 11) have a higher silica content.  These rocks, and the magma they cool from, are termed *felsic* (from <u>fel</u>dspar and <u>si</u>lica). Rocks with a low silica content are richer in magnesium and iron compounds (slide 12), so these rocks, and the magma they cool from, are called *mafic* (from <u>ma</u>gnesium and the Latin for iron).

10. Which of the rocks are felsic? How do you know?

11. Which of the rocks are mafic? How do you know?

Scientists refer to how thick or thin magma or lava is by its *viscosity*. Viscosity is defined as a fluid's <u>resistance</u> to flow: higher viscosity fluids flow slowly, lower viscosity fluids flow faster.

12. Arrange the following fluids in order from low viscosity to high viscosity: caramel, honey, maple syrup, silly putty, vegetable oil, and water.

13. If your maple syrup doesn't come out fast enough for you to enjoy your Saturday morning waffles right away, what do you do to make it flow faster?

14. Therefore, what two variables determine the viscosity of <u>any</u> fluid (including magma / lava)?

## <u>Part C: Igneous Rock Texture</u>

Normally "texture" refers to how smooth or rough something feels, but not in geology. For rocks, <u>texture</u> refers to the size of the pieces it's made out of. There are three main textures for igneous rocks: <u>coarse</u>, <u>fine</u>, and <u>glassy</u>.

Rocks with a coarse-grained texture are made of pieces that are are normally approximately the same size and are all big enough to see easily: one to a few mm across.  These pieces are minerals that crystallized from lava or magma as it slowly cooled.  The longer it took the molten material to cool, the larger the crystals were able to grow.

15. Which samples are the coarse rocks?

Fine-grained rocks are made of pieces too small to see with the naked eye but may be discernible with a lens.  These rocks still have crystals, but they are very small, indicating that the rock cooled faster than a rock with coarse grains.

16. Which samples are the fine rocks?

Some igneous rocks have large crystals embedded within a matrix of much finer crystals.  These are called porphyritic and are named for their fine-grained counterparts (e.g. rhyolite porphyry or andesite porphyry).

Glassy rocks do not necessarily look like glass; the term just means the rocks have no crystals in them.  The same chemical elements are in the rock, they just cooled so fast that they formed an amorphous  blend instead of crystals.  Some glassy rocks do look glassy, but many others look frothy.  Neither type shows any mineral crystals, because neither type has any crystals at all.  However, glassy rocks may show dirt or other imperfections, so be careful not to confuse those with mineral crystals, which ain't there!

17. Which samples are the glassy rocks?

How quickly the magma or lava cools depends on how deep it is when it forms. The deeper it is, the harder it is for heat to escape from the magma, the longer it takes the magma to cool into a rock, and the coarser the rock's texture is. These rocks are called <u>intrusive</u> or plutonic (from Pluto, Roman god of the underworld).  Magma close to the surface, or lava on the surface, can cool much faster, so those rocks have a fine or even a glassy texture.  They are called <u>extrusive</u> or volcanic (from Vulcan, smith to the Roman gods).

18. Where did samples A-D form?  How do you know?

19. Where did samples E-G form?  How do you know?

20.  Where did samples H-L form?  How do you know?

21. Will the coarse rocks help us learn much about volcanoes?  Why or why not?

22. Which rocks in your collection will help us learn about volcanoes?  Why? These are not just igneous rocks, they are volcanic igneous rocks, and they are the ones that will unlock volcanoes' secrets for us.

23.  Identify all of your rocks!  Now that you know how to recognize and identify their composition (#5, #10, and #11) and their texture (#15-17), use slides 28-29 to help you list them by name below.

A:

B:

C:

D:

E:

F:

G:

H:

J:

K:

L:

Now answer the questions on the Igneous Rock Lab Summary.  They are the only part of this lab that you will actually turn in.  The rest you should keep for your notes: you are responsible for all of this information.