Student Lab Sheet

Gases in Magma

Volcano	Kilauea Summit	Momotombo
Tectonic Style	Hotspot	Convergent Plate
Temperature	1170°C	820°C
Gases in magma in percent		
H_20	37.1	97.1
$C0_2$	48.9	1.44
$S0_2$	11.8	0.50
H2	0.49	0.70
CO	1.51	0.01
H_2S	0.04	0.23
HCl	0.08	2.89
HF	---	0.26

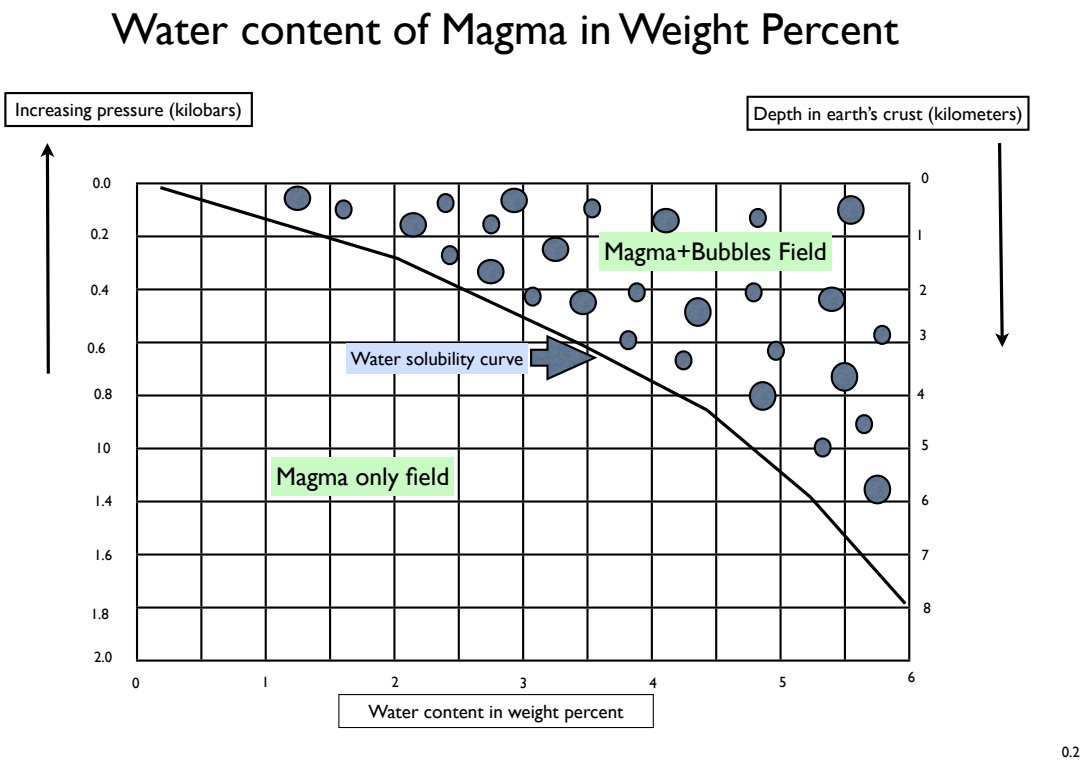
The table above shows the different gases found in magma at a hotspot volcano and at a convergent boundary volcano. Notice that the hotspot has the highest percentage of CO_2 and the convergent boundary volcano has the highest content of H_2O or water vapor. These gases, in the chart above, are in solution in the magma chamber.

A good way to see the impact of gas in solution is to take a carbonated beverage and look for the gas bubbles inside the bottle. You see very few bubbles because the gas is in solution. It is only when you release the pressure by unscrewing the cap (releasing pressure) that you see the gas bubbles form and rise to the top of the bottle. In fact, if you shake the bottle and then unscrew the top you'll see the contents of the bottle erupt all over. The same phenomenon happens when the magma rises and the pressure decreases. Just like in the soda bottle, when pressure is reduced the gases in solution will start to form gas bubbles as shown in the graph below. The gas will continue to expand, increasing its volume as pressure continues to decrease. This expansion of gases creates a tremendous amount of force that will propel the magma and the surrounding rock in a volcanic eruption. Other minerals and compounds as well as the eruptive style can impact the eruption. For example, if the magma is higher in silica it can contribute to the violence of the eruption. In the Valles Caldera both the geochemistry of the magma and the expansion of gases created a 12-mile in diameter crater that we know as Valles Caldera.

Questions:

1. In the space below use a cross sectional diagram to show the convergent boundary volcano and a hotspot. Illustrate the differences between the two types of volcanoes in your cross section.

2. Discuss the source of magma with your lab partner. What would make the geochemistry different between the two types of volcanoes?



To answer the following lab questions you can use the "Water Content of Magma in Weight Percent" graph above.

Sample Question: If you have 3.8 % water weight that has moved up to .9 kilobars of pressure will the magma contain gas bubbles? Notice that you can read the pressure on the left side of the graph or the depth in kilometers on the right side of the graph. Using a ruler mark a line that goes up (representing the path of the magma with a certain weight percent of water content) from 3.9% water and then make a line that goes across from .9 kb and notice where the two lines intersect. They do not meet on the side of "magma and bubble field" so the magma will not include gas bubbles.

3. If magma at 3 % water weight left the chamber and moved up to a depth of 1 km would the magma have gas bubbles?

4. At what point would magma cross the solubility curve at 5% water weight?

5. At .4kb of pressure what would be the depth of the earth's crust in km?

The higher the weight percent of water the (sooner or later) the magma crosses over the water solubility curve. Circle the correct response.

6. What would be the depth at which 6% water weight magma develops gas bubbles?