Volcanoes and Viscosity Student Worksheet: Part 3 **Name:**

Part 3: Comparing Viscosity of different magmas

Background: Magma is molten (melted) rock below the surface. Magmas can differ in their mineral content. For example, basaltic (mafic) magma forms at the mid-ocean ridges or at hot spots under the ocean crust, and is high in iron and magnesium, but is low in silica. Silica is found in the form of little pyramid-shaped building blocks called **silica tetrahedrons**. Rhyolitic (granitic) magma forms from the partial melting of continental crust and is low in iron and magnesium, but high in silica. The silica content of a magma determines whether it is viscous or fluid. Basaltic (mafic) magma has a low silica content, andesitic (intermediate) magma has a medium silica content, while rhyolitic magma has a high silica content. As the silica content of a magma increases, the silica tetrahedrons tend to bond together into chains. In addition to the silica, magmas will contain metals such as Fe, Mg, and Ca.

Basaltic (mafic) magma is associated with volcanoes such as Mauna Loa of Hawaii, which erupt frequently but are not very explosive. Andesitic (intermediate) magma is associated with composite volcanoes such as Mount Saint Helens or Mount Vesuvius, which are explosive, but do not erupt very often. Rhyolitic (granitic) magma rarely comes to the surface. When it does, it forms a supervolcano, such as Yellowstone or the Long Valley Caldera. Such volcanoes are so explosive that they don't usually produce a volcanic cone, just a caldera where the ground collapses after a magma chamber empties itself.

Figure 1: Silica tetrahedron and metal ions (charged atoms)

Figure 2: Low Silica Magma

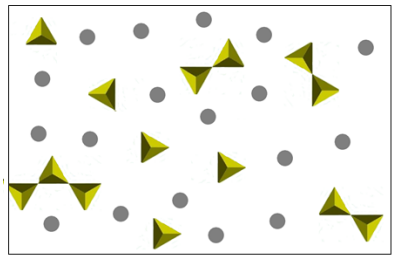
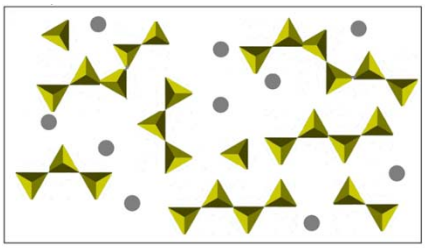


Figure 3: High Silica Magma



Conclusion Questions for Part 3

4. Based upon the figures above, which kind of magma is likely to be the most viscous?_____

5. Which kind of mama will allow gases to escape more easily? _____Explain.

6. Based on these explanations, which kind of magma will flow more easily through fissures to the surface, causing frequent volcanic eruptions?_____
7. Based on these explanations, which kind of magma will build up the most pressure from trapped gases, resulting in more explosive eruptions?_____
8. Is basaltic magma fluid or viscous?_____ Explain.

Viscosity can be measured in a unit called a Pascal-second, or Pa*s. In the Table 3 you will see the viscosity of two liquids that you observed as well as sample viscosities of basaltic, andesitic and rhyolitic magmas. Use the table to answer questions 9-12.

Table 3

water Pa*s	Corn syrup Pa*s	Basaltic magma Pa*s	Andesitic magma Pa*s	Rhyolitic magma Pa*s
.001 (1/1,000)	5.0	1,000	1,000,000	1,000,000,000,000

Conclusion Questions 9-14

9. You saw the difference between the viscosity of the water and the viscosity of the corn syrup. Is there an even greater difference between the viscosity of basalt magma and the viscosity of rhyolite magma?

10. If corn syrup and water flowed out of a volcano, which would flow farthest?

11. Volcanoes with fluid magma, have thin lava flows that travel a long distance before they harden. As a result, the slope of the volcano is very gradual. Shield volcanoes have a gradual slope. Would you expect shield volcanoes to be made of basaltic magma or andesitic magma?

12. Volcanoes containing rhyolitic magma tend to be so explosive that they spray the lava into the air, creating ash and pumice. Once the gas is released, any remaining magma flows very slowly. Why are rhyolite volcanoes so explosive?

13. If you were to get samples of the volcanic rocks around the Long Valley Caldara, what type of magma do you think you would find? _____Explain.

14. Fill out the summary chart

Summary chart

Kind of magma	Silica content (high, med, or low)	Viscosity (high, med, or low)	Frequency of eruptions (high, med, or low)	Thickness of lava flows (high, med, or low)	Explosiveness of eruptions (high, med, or low)	Shape of volcano (gradual or steep)	Example of a volcano
Basaltic							
Andesitic							
rhyolitic						Usually no cone	