Geophysical Research Abstracts
Vol. 14, EGU2012-8467, 2012
EGU General Assembly 2012

The sensitivity of conduit flow models to basic input parameters: there is no need for magma trolls!

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Many conduit flow models now exist and some of these models are becoming extremely complicated, conducted in three dimensions and incorporating the physics of compressible three phase fluids (magmas), intricate conduit geometries and fragmentation processes, to name but a few examples. These highly specialised models are being used to explain observations of the natural system, and there is a danger that possible explanations may be getting needlessly complex. It is coherent, for instance, to propose the involvement of sub-surface dwelling magma trolls as an explanation for the change in a volcanoes eruptive style, but assuming the simplest explanation would prevent such additions, unless they were absolutely necessary.

While the understanding of individual, often small scale conduit processes is increasing rapidly, is this level of detail necessary? How sensitive are these models to small changes in the most basic of governing parameters? Can these changes be used to explain observed behaviour? Here we will examine the sensitivity of conduit flow models to changes in the melt viscosity, one of the fundamental inputs to any such model. However, even addressing this elementary issue is not straight forward. There are several viscosity models in existence, how do they differ? Can models that use different viscosity models be realistically compared? Each of these viscosity models is also heavily dependent on the magma composition and/or temperature, and how well are these variables constrained? Magma temperatures and water contents are often assumed as "ball-park" figures, and are very rarely exactly known for the periods of observation the models are attempting to explain, yet they exhibit a strong controlling factor on the melt viscosity. The role of both these variables will be discussed. For example, using one of the available viscosity models a 20 K decrease in temperature of the melt results in a greater than 100% increase in the melt viscosity. With changes of this magnitude resulting from small alterations in the basic governing parameters does this render any changes in individual conduit processes of secondary importance?

As important as the melt viscosity is to any conduit flow model, it is a meaningless parameter unless there is a conduit through which to flow. The shape and size of a volcanic conduit are even less well constrained than magma's temperature and water content, but have an equally important role to play. Rudimentary changes such as simply increasing or decreasing the radius of a perfectly cylindrical conduit can have large effects, and when coupled with the range of magma viscosities that may be flowing through them can completely change interpretations. Although we present results specifically concerning the variables of magma temperature and water content and the radius of a cylindrical conduit, this is just the start, by systematically identifying the effect each parameter has on the conduit flow models it will be possible to identify which areas are most requiring of future attention.