Effects of water content on crystal settling in silicic magma chambers

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Crystal settling plays a fundamental role in controlling compositional evolution in magma chambers regardless of the presence or the absence of convections. Effects of water content on settling velocity in silicic magma chambers are investigated numerically. The settling velocity of a particle (crystal) in a concentrated suspension is generally less than the Stokes' velocity. This is partly because the downward movement of particles causes an equal volumetric flow rate of displaced fluid relative to which the particles must move. Furthermore, for a given relative velocity, the average velocity gradients, and hence shear stress, will be greater in a concentrated suspension. On the other hand, the rate of crystal settling is accelerated by decrease of melt viscosity (increase of melt water content). Therefore the settling velocity is basically controlled by balance of the rate of crystallization and change in melt viscosity. Present model takes account of this balance using Richardson-Zaki's velocity. In the case of a magma chamber with less than 4 wt.% melt water content and with 20-30 vol.% crystals, the crystal settling accelerates throughout the cooling history. In the case of a magma chamber with more than 6 wt.% melt water content and with 20-30 vol.% crystals, by contrast, the crystal settling decelerates. These results imply that the crystal-poor magmas erupt from initially water-rich magma chambers.

The melt water contents in the Unzen dacite are currently analysed in glass inclusions by IR spectroscopy. We will show the relationships between the melt water contents and crystal fraction and discuss the implications of this model on the origin of the variation in crystal fraction in natural silicic magmas.