Significance of viscous folding in magma mixing

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Mixing between mafic and felsic magmas in shallow level magma chambers is considered as a primary factor triggering volcanic eruptions. Recent developments in microfluidics have enabled us to better understand the complex processes associated with magma mixing from the hybrid rocks of the Ghansura Rhyolite Dome (GRD) of Proterozoic Chotanagpur Granite Gneiss Complex (CGGC), Eastern India.

The hybrid rocks from GRD have formed due to the mixing of a phenocryst-rich basaltic magma and host rhyolite magma. The hybrid products have preserved amphibole-rich microzones (ARM) in contact with fine grained felsic zones. The ARM dominantly consist of amphibole surrounded by other mineral phases like biotite and plagioclase. Amphibole crystals occurring in the core of ARM are actinolite, while those occurring in the rim are of hornblende composition. Veins of amphibole have been observed moving out from the ARM into the felsic zones. An interesting feature about the amphibole veins is that as they venture into the felsic zones amphibole converts to biotite, and also the veins undergo viscous folding. Amphibole display pargasite substitution from the core of the ARM to its margin and further extending into the veins where the mineral is completely replaced by biotite.

From mineral chemical, textural and thermometric analyses we infer that when mafic magma, containing phenocrysts of augite, came in contact with felsic magma the two remained as separate entities at first due to pronounced thermal and rheological contrasts. The first interaction that took place between the two phases is diffusion of heat from the hotter mafic magma to the colder felsic magma followed by diffusion of elemental components between them. The diffusion of cations from the felsic to the mafic system like H^{+}, Al^{3+} and other cations reacted with the clinopyroxene phenocrysts in the mafic magma to form amphibole crystals. The formation of amphibole crystals in the mafic system greatly increased the viscosity of the system allowing the amphibole crystals to venture into the adjacent felsic magma as veins. As these veins traversed in the felsic medium, they were acted upon by compressive stress and underwent viscous folding to enhance mixing between the two magmas.