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Rheology and textures of experimental 3-phase magma mixing

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Hybrid rocks, enclaves, crystal dispersion and zonation (...) are common natural features caused by magma mixing. Such a process has been suggested to trigger volcanic eruptions, during or soon after the replenishment of a differentiated magma chamber by a hotter mafic magma. However, so far little experimental work on magma mixing has been performed under realistic strain rate and P-T conditions. In particular, because of the technical difficulties associated to the implementation of deformation experiments at high pressures, most work has been performed at atmospheric pressures.
We have thus performed high pressure torsion experiments with a Paterson Press using two contrasted magma compositions: a synthetic haplotonalitic composition ($SiO_2 \approx 69$, close to trachyte-rhyolite compositions), and a natural basalt from Santorini Volcano (Greece). The first series of experiments was done between 900-1200°C at 300 MPa, with viscosity contrasts between both magmas varying from 0 to $\sim$ 4 Log units. Results reveal that the transition from unmixed to mixed magmas occurs over a short temperature interval (<10°C) and that mixing and mingling both occur at a very low viscosity contrast only. SEM images show natural-like mixing textures whereas microprobe analyses reveal concomitant basalt melting and mixing producing andesitic melts. Further experiments including hydrous magmas are in progress; to consider water is essential because water has a profound influence on magma properties. These experiments will be a clue in the understanding of such a common process which possibly leads to eruptions.