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Numerical investigation on the role of viscosity and volatiles on magma mixing

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The mixing of magmas of distinct temperature and/or distinct bulk composition is a common phenomenon occurring in magma chambers. Mixing is determined by a Rayleigh-Taylor instability which occurs due to the density contrast between the lighter incoming magma and the host one. Magma viscosity and amount of volatiles play a key role in determining the time scale of mixing and the mixing efficiency. We numerically investigate the effect of viscosity and volatiles on magma mixing in an elliptical chamber. Thermodynamics, phase equilibria and rheological properties are modelled with constitutive equations for real magmas. The model solves the equations for multicomponent magmatic mixtures, accounting for the mass conservation of each end member magma and the momentum and energy conservation of the mixture. The numerical scheme is based on the Galerkin Least-square stabilized space-time finite element method. The simulation results show that mixing in magma chambers can be faster than commonly perceived, resulting in many situations in short mixing time scale.