# The development of a three-phase compaction model to study phase separation in silicic magma reservoirs

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We develop a model for phase separation in magma reservoirs containing a mixture of silicate melt, crystals and fluids (exsolved volatiles). The model we propose is based on the 2-phase damage theory approach of Bercovici and coworkers (Bercovici et al., 2001;2003) which allows us to consider interface (in the macroscopic limit) between phases that can deform depending on the mechanical work and phase changes taking place locally in the magma. The compaction models rely on a constitutive pore-scale model to relate porosity and fluid pore volume to effective permeabilities and melt-crystal, melt-fluid interface densities. In this first analysis of three-phase compaction, we solve the 3-phase compaction equations numerically for a simple 1-D problem where we focus on the effect of exsolved fluids on the efficiency of melt-crystal separation considering the competition between viscous and buoyancy stresses only. The simulations show a dramatic difference between two (melt-crystals) and three (melt-crystals-exsolved volatiles) compaction-driven phase separation. We find that the presence of a lighter, significantly less viscous fluid hinders melt-crystal separation. We will also discuss future directions for improving the model, and specifically, the role of solid phase repacking on compaction.

Bercovici, D., Y. Ricard, and G. Schubert (2001), Two-

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phase model for compaction and damage 1. General Theory, J. Geoph. Res., 106 (B5), 8887–8906.

Bercovici, D., and Y. Ricard, (2003), Energetics of a two-phase model of lithospheric damage, shear localization and plate-boundary formation, Geophys. J. Int, 152, 581– 596.