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# Permeability evolution during densification of magma

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Constraint of the gas permeability of magmas is of key importance to estimating outgassing timescales and the evolution of pore-space overpressure. Once magma develops a permeable pore phase over a sufficient lengthscale, densification will ensue. Densification can be driven by surface tension during the minimisation of internal surface area, by gravitational compaction or by anisotropic shear strain. In all cases, the evolution of permeability is not well constrained. We provide a suite of experiments using both natural and synthetic magmas with a wide range of initial pore volume fractions and geometries. In the first subset of experiments we bathe the magma in argon and measure the temporal evolution of the porosity during surface-tension driven densification. In the second subset, we apply an additional uniaxial load to the magma. In both scenarios we measure the gas permeability before and after experimentation. We find that there are unique trajectories of the porosity permeability relationship depending on the densification mechanism. This demonstrates the paucity of simple models for the description of porosity permeability relationships in magmas. We propose that densification should happen rapidly in volcanic conduits between eruptions and that permeable outgassing scenarios may be complicated by this process.