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Magma reservoir formation and evolution: insights from physical modelling

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Magmatic bodies are typically constructed incrementally by amalgamation of pulses of magma over periods of time ranging from tens of thousands to millions of years. This process has been documented in different settings and for a large variety of magmatic compositions, from basaltic to rhyolitic.
The dynamics and outcome of these processes are strongly dependent on the physical properties of the magmas involved, such as viscosity and density, which in turn are influenced by their crystal and volatile contents, as well as on the depth and temperature of the intrusive body. Mingling and mixing can take place under certain set of conditions, or different batches can just accumulate in different regions maintaining their individuality.
Our study is focussed on the shallow-level high-silica granites of the Larderello-Travale intrusive complex (Italy). Zircon crystals from these rocks exhibit a large scatter in 206Pb/238U ages and significant variability in oxygen and hafnium isotope composition. Textural evidence and thermal simulations seem to suggest that zircon from these rocks are antecrysts that crystallized at depth and were subsequently recycled and juxtaposed within the same rock volume during ascent and final emplacement.Our goal is to determine whether convective processes are able to originate such small-scale heterogeneities during emplacement, and under which conditionsA set of numerical simulations of the fluid dynamics of the arrival of new magma into shallow reservoirs, exploring different sets of initial conditions, allowed us to define the parameters that control the evolution of the system. Convection and mixing can only be initiated under a limited range of density and viscosity contrasts, therefore providing insights on the state of the system at the time of interaction. Comparison with geochemical data can further reduce the viable parameters' set and put tight constraints on the evolution of the magma body in terms of emplacement pressure and temperature, and end-member compositions.