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2D thermo-mechanical-chemical coupled numerical models of interactions between a cooling magma chamber and a visco-elastic host rock

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A recent focus of studies in geodynamic modeling and magmatic petrology is to understand the coupled behavior between deformation and magmatic processes. Here, we present a 2D numerical model of an upper crustal magma (or mush) chamber in a visco-elastic host rock, with coupled thermal, mechanical and chemical (TMC) processes. The magma chamber is isolated from deeper sources of magma and it is cooling, and thus shrinking. We quantify the mechanical interaction between the shrinking magma chamber and the surrounding host rock, using a compressible visco-elastic formulation, considering several geometries of the magma chamber.

We present a self-consistent system of the conservation equations for coupled TMC processes, under the assumptions of slow (negligible inertial forces), visco-elastic deformation and constant chemical bulk composition. The thermodynamic melting/crystallization model is based on a pelitic melting model calculated with Perple_X, assuming a granitic composition and is incorporated as a look-up table. We will discuss the numerical implementation, show the results of systematic numerical simulations, and illustrate the effect of volume changes due to crystallization on stresses in the host rocks.