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Approaching volcanic sources using a finite element, numerical modelling of fluid-rock interaction based on the space-time discontinuous Galerkin method.

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Mass transport beneath volcanoes induce stress variations at the walls of the plumbing system which are recorded at the free surface in terms of ground deformation and seismic signals. The correct understanding of these data thus represents a crucial step toward the quantitative assessment of volcanic processes. Although challenging, the physical-numerical simulation of fluid-rocks interaction can open interesting perspectives to the development of links between ground-truth data and processes. In this work we describe implementation of a method for the simulation of two-way dynamical coupling between magmatic fluids and their hosting rocks. The method is based upon a finite-element formulation with space-time discontinuous variables which naturally includes moving grids without needs of ALE formulation. For the fluid part, it is able to compute the fluid dynamics and thermo-dynamics of a multi-phase, multi-component incompressible-to-compressible homogeneous mixture. Dynamical coupling at the walls of the reservoir hosting the fluid is attained by imposing continuity of stresses and displacements at the fluid-rock interface. The finite-element solution to the elasto-dynamic problem allows to naturally accounting for the material heterogeneities, free surfaces of arbitrary roughness, and large displacements. The method can also be extended to model visco-elastic and visco-plastic materials, and propagation of fractures. Implementation of the code in a parallel C++ library permits the simulation of large-scale problems with reasonable computing times.