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Simulation of the Eruption of a Volatile-Rich Magma Column

G. Gisler
University of Oslo, Physics of Geological Processes, Oslo, Norway (galen.gisler@fys.uio.no, +47 22855101)

The composition and dynamics of volcanic jets and plumes are constrained by the form and composition of the erupting column and its interaction with the country rock on the way to the surface. Simulations of a mixed, volatile-rich magma column erupting through both ductile and brittle media have been performed with the adaptive-mesh multi-material finite-volume code Sage. In both ductile and brittle regimes, a downward return flow is observed around the periphery of the plume, contributing to the ablation, erosion, and entrainment of the country rock. Penetration at the tip of the erupting column is enhanced when the volatile component (supercritical water in this case) separates from the bulk flow (middle frame), followed by acceleration of the bulk flow and the formation of a nozzle. The dynamics of the jet that is formed when the column breaks the surface depends on these subsurface developments. We explore effects of differences in the volatile richness of the mixture and of the material properties of the country rock.