

On Variations of the Magma Equation

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We introduce a refined two-phase flow model that provides a systematic derivation of the classical magma equation. After revisiting its historical origin and physical interpretation, we motivate the adoption of an extended constitutive framework in which the Cauchy stress tensor depends not only on the density but also on its spatial gradient, thereby incorporating dispersive and nonlocal effects in a consistent continuum setting. We then outline a coherent analytical roadmap for the investigation of the resulting model, encompassing linear stability analysis, multiple-scale and weakly nonlinear asymptotics, and the characterization of finite-amplitude wave phenomena. As a first step, we present preliminary results on the linear stability of the uniform state, highlighting the role of density gradients in the selection and localization of unstable modes.