

Title: Mixed Methods for Two-Phase Darcy-Stokes Mixtures of Partially Melted Materials with Regions of Zero Porosity

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Abstract: The Earth's mantle, or an ice sheet, involves a deformable solid matrix phase within which a second phase, a fluid, may form due to melting processes. The mechanics of this system is modeled as a dual-continuum, with at each point of space the solid matrix being governed by a Stokes system and the fluid melt, if it exists, being governed by a Darcy law. This system is mathematically degenerate when the porosity (volume fraction of fluid) vanishes. We develop the variational framework needed for accurate approximation of this Darcy-Stokes system, even when there are regions of positive measure where only one phase exists. We then develop an accurate mixed finite element method for solving the system and show numerical results that illustrate its convergence behaviour and performance.

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