1106-AC-580 **Todd Arbogast*** (arbogast@ices.utexas.edu), Inst. for Computational Engng. and Sciences, 1 University Station C1200, Austin, TX 78712, and **Marc A Hesse** and **Abraham L Taicher**.
Approximation of a Degenerate Elliptic Equation Arising from a Two-Phase Mixture Modeling the Motion of the Earth's Mantle.

We consider the linear but degenerate elliptic system of two first order equations $\mathbf{u} = -\phi\nabla p$ and $\nabla\cdot(\phi\mathbf{u})+\phi p = \phi f$, where the *porosity* $\phi \geq 0$ may be zero on a set of positive measure. The model equation we consider has a similar degeneracy as that arising in the equations describing the mechanical system modeling the dynamics of partially melted materials, e.g., in the Earth's mantle, and the flow of ice sheets, e.g., in the polar ice caps and glaciers. In the context of mixture theory, ϕ represents the phase variable separating the solid one-phase ($\phi = 0$) and fluid-solid two phase ($\phi > 0$) regions. Two main problems arise. First, as ϕ vanishes, one equation is lost. Second, after we extract stability or energy bounds for the solution, we see that the *pressure* p is not controlled outside the support of ϕ. After an appropriate scaling of the pressure, we can show existence and uniqueness of a solution over the entire domain. We then develop a stable mixed finite element method for the problem, and show some numerical results. (Received September 02, 2014)