Development of the Stokes-Darcy coupled flow code for simulating the geothermal system in geological time scale.

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The geothermal systems of subduction zones are of great interest as a resource of geothermal energy. In order to evaluate the sustainability and assess the environmental impact of geothermal systems it is important to model their formation and their dynamic evolution. We use numerical simulations to quantitatively investigate the dynamics of crustal deformation coupled with fluid and melt generation for periods ranging from tens of thousands up to millions years. Numerical codes solving Darcy's and Stokes equations are commonly used to simulate fluid flow in porous media and solid crust deformation in the geological time scale (e.g. Bauville et.al. 2015), respectively. However, these earlier numerical simulations did not address both the solid rock deformation and porous fluid flow in a coupled manner without large simplification.
This presentation reports the preliminary results of the development of a coupled simulation code solving Stokes and Darcy equations. The governing equations are based on the work of Katz et. al (2007) which deals with compaction pressure in addition to the hydrostatic and dynamic pressure. Our implementation is designed to include concepts of fracture network commonly used in the engineering field of ground water simulation. We use a hybrid discretization scheme with 1) finite difference method with marker in cell scheme for the Stokes part and 2) finite volume method with unstructured grid for the Darcy part. The non-linear equations of the system are solved by a JFNK frame work (Furuichi and May, 2015). We will perform a series of numerical experiments to demonstrate the feasibility of our developed code.

Keywords: Stokes flow, Darcy flow, nonlinear solver

