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Mass and heat flow in deformable fracturing porous media

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ABSTRACT

A coupled thermo-hydrodynamic-mechanical (THM) computational model for multiphase flow in a fracturing porous medium has been developed [1]. It considers mass flow, convective and conductive heat transfer, solid and fluids compressibility, buoyancy, phase change, thermal interactions, wall friction, slip between phases and leakage. The conceptual model ascribe the geometry to be constituted of three domains: a matrix domain, a fracture domain, and a matrix-fracture domain. The averaging theory has been utilized for describing the balance equations in the matrix domain, and the Navier-Stokes equations have been utilized for the fluid flow in the fracture domain. The governing equations are solved using a mixed discretization scheme in which the standard finite element method (FEM) and the extended finite element (XFEM) are coupled. The model has been utilized to simulate the thermo-hydrodynamic-mechanical forces in driving crack propagation during CO_2 geosequestration process. The domain is assumed 70m x 70m, consisting of three layers with an initial crack as shown in Fig. 1a. Fig. 1b shows the distribution of CO_2 saturation, with emphasis on the leakage at the crack tip , and Fig. 2c shows the crack opening.

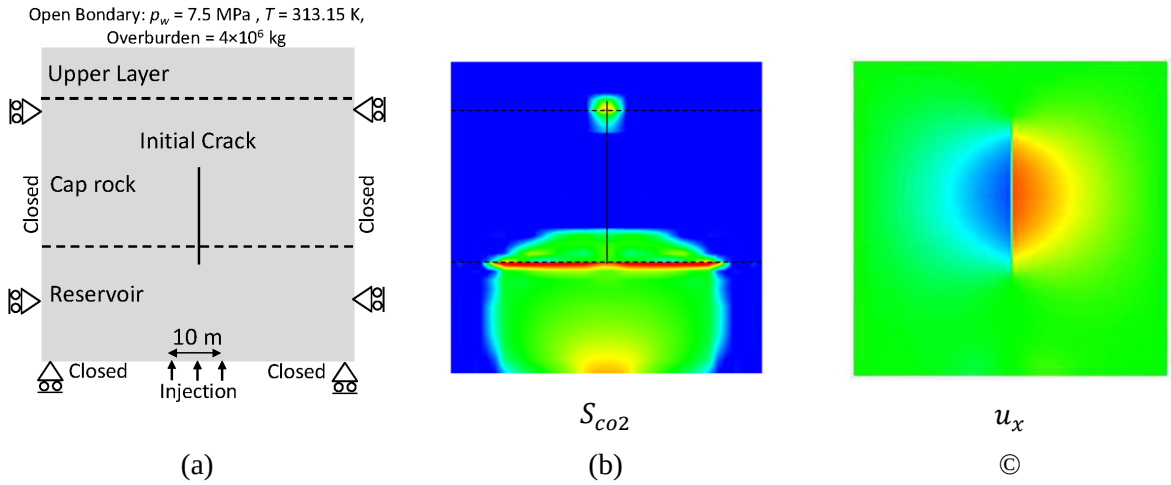

Fig.1 CO_2 geosequestration: (a) geometry and boundary conditions, (b) CO_2 saturation and (c) horizontal displacement.

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[1] M.M. Arzanfudi, R. Al-Khoury, "Thermo-hydrodynamic-mechanical multiphase flow model for crack propagation in deformable porous media", *International Journal for Numerical Methods in Fluids*, Vol. **84**: pp. 635-674, (2017).