Geophysical Research Abstracts
Vol. 17, EGU2015-9796, 2015
EGU General Assembly 2015

Benchmarking transport solvers for fracture flow problems

Piotr Olkiewicz (1) and Marcin Dabrowski (1,2)

(1) Computational Geology Laboratory, Polish Geological Institute - NRI, Wrocław, Poland (piotr.olkiewicz@pgi.gov.pl), (2) Physics of Geological Processes, University of Oslo, Norway

Fracture flow may dominate in rocks with low porosity and it can accompany both industrial and natural processes. Typical examples of such processes are natural flows in crystalline rocks and industrial flows in geothermal systems or hydraulic fracturing. Fracture flow provides an important mechanism for transporting mass and energy. For example, geothermal energy is primarily transported by the flow of the heated water or steam rather than by the thermal diffusion. The geometry of the fracture network and the distribution of the mean apertures of individual fractures are the key parameters with regard to the fracture network transmissivity. Transport in fractures can occur through the combination of advection and diffusion processes like in the case of dissolved chemical components. The local distribution of the fracture aperture may play an important role for both flow and transport processes.

In this work, we benchmark various numerical solvers for flow and transport processes in a single fracture in 2D and 3D. Fracture aperture distributions are generated by a number of synthetic methods. We examine a single-phase flow of an incompressible viscous Newtonian fluid in the low Reynolds number limit. Periodic boundary conditions are used and a pressure difference is imposed in the background. The velocity field is primarily found using the Stokes equations. We systematically compare the obtained velocity field to the results obtained by solving the Reynolds equation. This allows us to examine the impact of the aperture distribution on the permeability of the medium and the local velocity distribution for two different mathematical descriptions of the fracture flow. Furthermore, we analyse the impact of aperture distribution on the front characteristics such as the standard deviation and the fractal dimension for systems in 2D and 3D.