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# Two scale analysis applied to low permeability sandstones

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Low permeability materials are often composed of several pore structures of various scales, which are superposed one to another. It is often impossible to measure and to determine the macroscopic properties in one step.
In the low permeability sandstones that we consider, the pore space is essentially made of micro-cracks between grains. These fissures are two dimensional structures, which aperture is roughly on the order of one micron. On the grain scale, i.e. on the scale of 1 mm, the fissures form a network.
These two structures can be measured by using two different tools [1]. The density of the fissure networks is estimated by trace measurements on the two dimensional images provided by classical 2D Scanning Electron Microscopy (SEM) with a pixel size of 2.2 micron. The three dimensional geometry of the fissures is measured by X-Ray micro-tomography (micro-CT) in the laboratory, with a voxel size of 0.6x0.6x0.6microns3.
The macroscopic permeability is calculated in two steps.
On the small scale, the fracture transmissivity is calculated by solving the Stokes equation on several portions of the measured fissures by micro-CT.
On the large scale, the density of the fissures is estimated by three different means based on the number of intersections with scanlines, on the surface density of fissures and on the intersections between fissures per unit surface. These three means show that the network is relatively isotropic and they provide very close estimations of the density. Then, a general formula derived from systematic numerical computations [2] is used to derive the macroscopic dimensionless permeability which is proportional to the fracture transmissivity.
The combination of the two previous results yields the dimensional macroscopic permeability which is found to be in acceptable agreement with the experimental measurements.
Some extensions of these preliminary works will be presented as a tentative conclusion.
References
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