Yield strength of rocks from microtomography and the upscaling using percolation theory

J. Liu[1], R. Freij-Ayoub[2], A. Karrech[2], B. Clennell[2], and K. Regenauer-Lieb[1,2]

[1]*School of Earth and Environment, the University of Western Australia, 35 Stirling Hwy, Crawley WA 6009, Australia*
[2]*Earth Science and Resource Engineering, CSIRO, 26 Dick Perry Avenue, Kensington, WA 6151, Australia*

ABSTRACT: In this paper we establish a workflow of upscaling rock properties from microtomography using percolation theory. We focus initially on evaluating the multi-scale yield strength of rocks. The novel aspects of this study are: (1) determining the size of mechanical representative volume element by using upper and lower bounds of dissipation based on thermodynamic computations; (2) Finite element simulations of rock failure are performed at micro-scale for different confining stress; the plasticity law used is Drucker-Prager, and cohesion and the angle of internal friction are deduced; (3) critical exponents for the scaling laws of percolation theory are applied to mechanical parameters through a novel technique using derivative models created by a shrinking/expanding algorithm. We use a microtomographic data set of a carbonate sample to test these procedures. We present promising preliminary results of the new method for deriving scaling laws of yield strength of geomaterials.