How are grain size and pore size related? A transformation based on electro-kinetic theory

Glover, P.W.J. **GA13-819**
Université Laval, Département de géologie et de génie géologique, Faculté des sciences et de génie, Sainte-Foy, Québec, Canada. E-mail: paglover@ggl.ulaval.ca; walker.emilie@gmail.com;

Most permeability models use effective grain size or effective pore size as an input parameter. Until now, an efficacious way of converting between the two has not been available. We propose a simple conversion method for effective grain diameter and effective pore radius using a relationship derived by comparing two independent equations for permeability, based on the electro-kinetic properties of porous media. The relationship, which we call the theta function, is not dependent upon a particular geometry and implicitly allows for the widely varying style of microstructures exhibited by porous media by using porosity, cementation exponent, formation factor, and a packing constant.

The method is validated using 22 glass bead packs, for which the effective grain diameter is known accurately, and a set of 188 samples from a sand-shale sequence in the North Sea. This validation uses measurements of effective grain size from image analysis, pore size from mercury injection capillary pressure (MICP) measurements, and effective pore radius calculated from permeability experiments, all of which are independent. Validation tests agree that the technique accurately converts an effective grain diameter into an effective pore radius. Furthermore, for the clastic data set, there exists a power law relationship in porosity between effective grain size and effective pore size. The theta function also can be used to predict the fluid permeability of a sample, based on effective pore radius. The result is extremely good predictions over seven orders of magnitude.