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Boitnott, G. N., Bussod, G. Y., Hagin, P. N., Brown, S. R., and Jones, A. R. (2004) "Laboratory Equipment and Methodology for Physically-Based Upscaling of Heterogeneous Porous Media" Trans. Amer. Geophys. Union Fall Meeting 2004, H22B-01.

Abstract

The accurate characterization of flow and transport in near-surface aquifers and hydrocarbon reservoirs requires the detailed knowledge of subsurface structures and flow paths. Enormous resources are invested in exploration and characterization using 3-D geophysical surveys, well tests, geophysical logging, core measurements, etc. Unfortunately, much of the information acquired is lost to compromises and simplifications made in constructing numerical grids for the simulators used to predict field performance and economic viability.

In the interest of computational efficiency, recognized heterogeneities are simplified, averaged out, or entirely ignored in spite of recent studies that recognize that (1) structural and lithologic heterogeneities exist at all scales in rocks and, (2) small heterogeneities influence and can control the physical properties of rocks. In this work we demonstrate the use of laboratory equipment designed to measure fine scale heterogeneity of rocks and soils. We then discuss the development of a methodology that uses these measurements to develop reservoir and aquifer models.

These models are calibrated to the measured heterogeneous data and can be upscaled in a way that is consistent with the transport physics and the efficient use of environmental and hydrocarbon geophysics. This methodology provides more accurate interpretation and representation of the subsurface for both environmental engineering and oil and gas applications.

We show through examples, (i) the important influence of even subtle heterogeneity in the interpreting of petrophysical data, and (ii) how physically based upscaling can lead to a different and more accurate description of a heterogeneous system, when compared to a more traditional upscaling approach that combines averaging and the application of core-based models.

Contact NER for more information.