GENERALITY OF GEOMETRIC INFORMATION IN MICROSTRUCTURES OF ROCKS: A COMPUTATION MODELING STUDY ON MICRO-CT IMAGES AND SYNTHETIC ROCK SAMPLES

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ABSTRACT

Theoretical rock physics models predict effective elastic properties of rocks by making assumptions about the microstructure. For practicality reasons, the microstructure is typically simplified as idealized grain and pore geometries. However, geometries of real rocks are much more complex and irregular. Until now, little work has been done to explore the feasibility of extracting geometrical information from rocks to be used as input in rock physics models for predicting elastic properties. Here, we propose a study that will utilize synthetic rock models, digital rock imaging, and finite-element modeling (FEM) to develop techniques for extracting geometrical parameters from more complex geometries, as well as rock physics models that are based on the actual microstructure of rocks. We expect the results from the study to 1) demonstrate the generality of the stiffness level of the microstructure of rocks, 2) determine the effective pore shape resultant from mixing different pore shapes, and 3) quantify the effect of adding certain structures, such as fractures, on an existing microstructure. Consequently, this allows us to make recommendations on the suitability of using the existing theoretical rock physics models in certain reservoir scenarios and for certain rock types, and develop workflows for predicting reservoir parameters. Potential applications include identification of pore types, quantifying the intensity of fracturing, as well as performing fluid substitution with fewer input parameters. In addition, we will analyze the connection between microstructures and macroscale properties in porous materials, which has potential impact in multiple fields such as continuum mechanics, civil engineering, and material science.