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Please fill in your abstract title.	Synthetic Digital Rock Methods for Exploring the Properties Associated with Complex Rock Textures

Please fill in your author name(s) and company affiliation.

Given Name	Surname	Company
Zeyun	Jiang	Heriot-Watt University
Helen	Lewis	Heriot-Watt University
Gary	Couples	Heriot-Watt University
Jim	Buckman	Heriot-Watt University

Abstract

Objectives/Scope:

We develop methods to convert observed rock textures into historical or future predictions of flow properties.

Methods, Procedures, Process:

Digital rock methods provide a way to link the texture of a rock with its calculated properties (eg permeability). Many commercial digital rock approaches are based on acquisition of a 3D rock image via X-ray tomography. Those methods are limited to use with actual (existing) rock samples, and to the sample size and resolution that can be obtained by XRT. Other digital rock tools can construct 3D models from 2D images at arbitrary scale, deriving pore system models at that scale, for that component of the rock. These methods allow us to create 3D models within which we can add or subtract cements or other texture-altering processes that can be observed in thin sections. By combining the pore networks from multiple components, perhaps arising from different length-scales, it is possible to calculate flow responses for materials that cannot be imaged via XRT, which we cannot sample, or which have been overprinted by later geological events. Carbonates often prove to be difficult materials in the digital rock world, due to the need to capture pore components associated with different length-scales and which may relate only to specific parts of the rock. Carbonates also often possess fractures, possibly of multiple sizes, and the tendency of these rocks to change via diagenesis can mean that we want to determine properties for samples that are not in our possession - due to being located at another physical position of the subsurface, or perhaps being located somewhere else in time.

Results, Observations, Conclusions:

Here, we illustrate digital rock solutions that address all of these issues. We describe our approach that enables fractures (as imaged, or arbitrary) to be included within pore-networks. We also describe our second-generation method (Multi-Component Architecture Method - MCAM) that addresses rocks that can be partitioned into distinct regions. We illustrate MCAM in an application that involves estimating property evolution in a bio-clastic wackestone, where the fossil elements and the matrix both experienced the effects of dolomitisation. By employing MCAM, and existing methods for calculating flow properties, we are able to derive max-min limits on the bulk permeabilities of the rock before and after the main diagenesis event, including variations related to the spatial density and orientations of the fossil elements. These property bounds inform numerical simulations of the basin history that seek to explain the cause of diagenesis and its relationship to hydrocarbon charge.

Novel/Additive Information:
Our approach is able to calculate the flow properties of heterogeneous rocks as a function of geological time (and thus the history of the rock).