# REPRESENTATION OF PORE-SCALE HETEROGENEITY AND PREDICTION OF MULTI-PHASE FLOW FUNCTIONS IN CARBONATE ROCKS

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The determination of petrophysical properties in carbonate rocks is strongly affected by heterogeneity at the pore-scale, due to their complex deposition and diagenetic environments. State-of-art X-ray CT imaging technique, used at different resolutions, only enables us to reveal local structures of pores with a limited range of sizes, but it lacks the ability to capture the global structural information of complex material such as carbonates. However, determination of representative flow properties such as permeability, relative permeability and capillary pressure do require models of the pore space that include the full range of pore sizes and their connectivity. In this paper, we explore two methods to integrate multiscale pore system from different scales.

An explicit way to integrate a set of digital pore space images of different resolutions is to superpose these images into one single large image by refining the coarser image to match the finer resolution images. A pore-network model is then extracted from the superposed image to allow multi-phase flow calculations. A lternatively, a more efficient method is to obtain statistical information of different scale pore systems (probability distributions of the relevant pore geometrical and topological (GT) properties and their correlations) from pore-networks that are extracted from the images at different resolutions. A multi-scale pore-network is then statistically generated by integrating the GT characteristics from the different scales. We compare the above two methods (i.e. superposition and integration) in terms of the GT characteristics and the resulting flow properties for both natural rock samples and synthetic samples. The advantages and disadvantages of the two approaches are presented. Moreover, the integration method is validated, since it accurately reproduces both the combined GT characteristics and the flow functions generated from the superposition approach. It is also found that the microporosities often play very important roles in the multiphase flow properties in carbonates.