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## Multi-scale pore imaging techniques to characterise heterogeneity effects on flow and transport in complex carbonate rock

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Digital rock analysis and pore scale studies have become an essential tool in the oil and gas industry to understand and predict the petrophysical and multiphase flow properties for the assessment and exploitation of hydrocarbon reserves [1]. The fundamental problem in pore-scale imaging and modelling is how to represent and model the different range of scales encountered in porous media, from the pore scale to macroscopic petrophysical and multiphase flow properties. Carbonate rocks are characteristically heterogenous. It remains very challenging to describe flow and transport in carbonates because of complex pore structure and connectivity, comprising length scales from tens of nanometers to several centimeters [2].

In this study we investigate the effect of pore structure and connectivity on the flow properties for a Ketton carbonate by integrating different 3D imaging techniques. These include 3D micro-CT imaging at four different (4  $\mu\text{m}$ , 6  $\mu\text{m}$ , 8  $\mu\text{m}$  and 10  $\mu\text{m}$ ) voxel resolutions; FIB imaging with voxel resolution of 12 nm; and 3D high resolution wide field of view CLSM images [3,4]. Pore Network and Lattice-Boltzmann [5] simulation methods are then used to predict the single and multi-phase flow properties in comparison with experimental data.

We also shed new light on the existence and size of the Representative Element of Volume (REV) for 8 different types of porous material specifically rocks ranging from beadpacks, sandpacks to sandstone to carbonate rock capturing the different scales of heterogeneity from the pore-scale imaging.

### References

- [1] Blunt, M.J., Branko, B., Dong, H., Gharbi, O., Iglauer, S., Mostaghimi, P., Paluszny, A., Pentland, C. (2013). *Advances in Water Resources*, 51, 197- 216.
- [2] Knackstedt, et al. (2006) 3D Imaging and flow characterization of the pore space of carbonate rock samples. SCA2006-23, International Symposium of the society of Core Analysts. Norway.
- [3] S. M. Shah, J. P. Crawshaw and E. S. Boek, "Preparation of microporous rock samples for confocal laser scanning microscopy", *Petroleum Geoscience* (2014).
- [4] SMK Shah, JP Crawshaw, O Gharbi, ES Boek, J Yang, SPE-166252-MS, SPE Annual Technical Conference and Exhibition, 30 September-2 October 2013, New Orleans, Louisiana, USA.
- [5] J.Yang, J.P. Crawshaw and E.S.Boek, *Water Resources Research* 49, 8531-8538 (2013).

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**Primary author:** Dr SHAH, Saurabh (Imperial College London)

**Co-authors:** Dr BOEK, Edo (Queen Mary University of London); GRAY, Farrel (Imperial College London); Dr CRAWSHAW, John (Imperial College London)

**Presenter:** Dr SHAH, Saurabh (Imperial College London)

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