Synchrotron-Based Data-Constrained Modeling Analysis of Microscopic Mineral Distributions in Limestone

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Three dimensional (3D) microscopic distributions of dolomite and calcite in a limestone sample have been analyzed with a data-constrained modeling (DCM) technique using synchrotron radiation (SR) based multi-energy X-ray CT data as constraints. Multi-energy X-ray CT scans were performed at the Shanghai Synchrotron Radiation Facility (SSRF) at beam energies of 25 and 35keV. The high resolution distributions of mineral phases of a natural limestone have been obtained using CT slices via the DCM approach [1], as shown in **Fig. 1**. It is found that a fraction of calcite formed clusters inside dolomite, and pores was concentrated in some parts of the sample. The figures also indicate that there was a significant proportion of pores and dolomite which were smaller than the CT resolution (3.7μm), which is shown as unsaturated pixel intensity for images. The volume fractions of calcite, dolomite and pores were calculated as average voxel values in **Fig. 1** (c, d), which were 15%, 81% and 4% respectively. The results are useful for quantitative understanding of mineral, porosity, and physical property distributions in relation to oil and gas reservoirs hosted in carbonate rocks, which account for more than half of the world's conventional hydrocarbon resources [2].

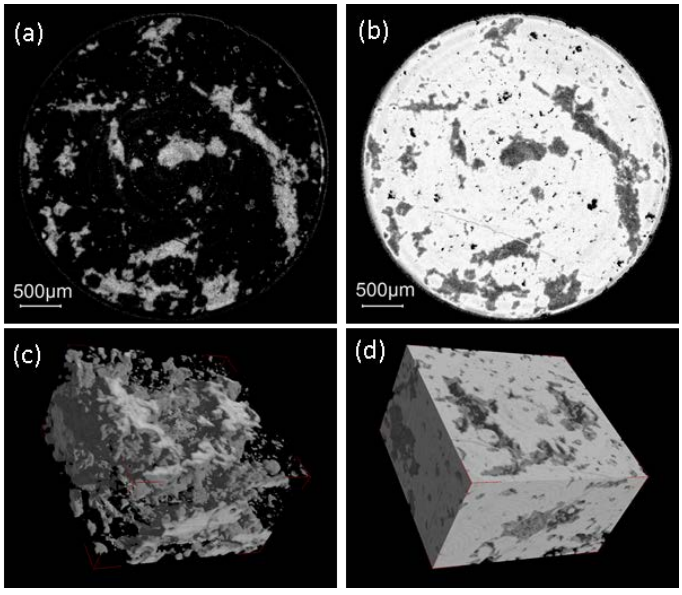

Fig. 1. Distribution of mineral phases on the X-Y plan and its 3D structures of part of sample with the size of 500×500×300 pixels. (a) and (c) are calcite, (b) and (d) are dolomite.

[1] Y. Wang, Y. Yang, I. Cole, A. Trinchi, T. Xiao, Materials and Corrosion, **63**, 180 (2013).

[2] Y.D. Wang, Y.S. Yang, T.Q. Xiao, K.Y. Liu, B. Clennell, G.Q. Zhang, H.P. Wang, International Journal of Geosciences, **4**, 344 (2013).