

Chemical and Mineral Speciation Using XRF, SEM-EDS and Synchrotron-based CT Imaging

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Following a huge success in North America, unconventional hydrocarbon resources, such as tight and shale oil and gas, are now being actively explored world-wide. Recent studies have shown that unconventional reservoirs are primarily dominated by fine-grained sediments with multiscale, complex compositional and structural heterogeneities down to micro-nano scales, which control the storage and flowing capability of hydrocarbons in the reservoirs. This poses considerable challenges for the characterisation of unconventional reservoirs using the traditional visual and optical petrographic methods.

As part of reservoir characterization of the shale oil reservoir in the Jurassic Lucaogou Formation, Junger Basin, northwest China, we employed a suite of chemical and mineralogical speciation techniques including Micro X-ray fluorescence spectrometry (Micro-XRF), Field-Emission Scanning Electron Microscopy (SEM) with Energy Dispersion Spectroscopy (EDS), and synchrotron-based multi-energy micro-CT imaging coupled with Data Constrained Modelling (DCM). The integration of these techniques allows us to systematically map the reservoir mineral compositions and pore structures from cm to nm scales in both two-dimensions and three-dimensions. It enables us to effectively identify the mineral species, pores and fractures, and effectively predict the reservoir wettability and frackability for shale oil development purposes.