Multiscale nanopore structure characterization in shales from the Longmaxi and Niutitang formations, Sichuan Basin, China

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Materials and methods

In this study, nanopore parameters of shales were obtained from N_2 and CO_2 adsorption data; the two dimensional (2D) pore networks, including organic pores, inorganic pores and micro fractures were depicted by field emission–scanning electron microscopy (FE–SEM) images; and the three dimensional (3D) reconstruction of different constituents, i.e., organic matter, organic pores, minerals and pyrite in shale, were conducted based on focused ion beam–scanning electron microscopy (FIB–SEM). These techniques were applied to shale samples from five drill-holes (Jiaoye-1, Jiaoye-4, Weiyuan-201, Wuxi-2, and Ciye-1) and various outcrops in order to assess pore volume, size, and morphology, and porosity and connectivity.

Results and discussion

The lower Silurian Longmaxi Formation shales have been successfully exploited in Sichuan Basin, and provide important insights into the evaluation of Longmaxi Formation shales in other areas and lower Cambrian Niutitang Formation shales in southern China [1]. Our analyses were aim to better understand the similarities and variations in shale pore structures from these two formations, and yielded the following results. (1) The differences in nanopore development between the Longmaxi Formation and Niutitang Formation shales mainly reflect the extent of micropore and fine mesopore development (i.e., micropore/fine mesopore volume per TOC content). (2) Semi-quantitative analysis of 2D FE–SEM images and 3D FIB–SEM reconstructed shale solids shows that OM-hosted pores of 10–40 nm in size are prevalent in the two sets of shale samples. (3) The pore connectivity in the Longmaxi Formation shale is better than that in the Niutitang Formation.

[1] Zou et al. (2010) Petroleum Exploration and Development **37**, 641-653.