Pore characterization of organic-rich Late Permian Da-long Formation shale in the Sichuan Basin, southwestern China

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The Late Permian Da-long Formation shale in southern China is regarded as a shale gas reservoir target. However, the lack of fundamental data for shale gas reservoirs increases the difficulty of gas exploration. To understand the pore structure characteristics of these shales, a series of experiments was conducted on Da-long Formation samples collected from the Shangsi Section in the Guangyuan area in the Northwest Sichuan Basin, southwestern China, including total organic carbon (TOC) content, X-ray diffraction (XRD), field emission scanning electron microscope (FE-SEM) and low-pressure N_2 adsorption-desorption analyses. The results show that the major components of the mineral matrix are carbonate and quartz minerals. A weakly positive trend between the TOC content of organic-rich shales and the quartz content was observed, indicating that the quartz in these Da-long shale samples is at least partially of biogenic origin. Both mineral matrix and organic matter pores are developed in Da-long black shales, as observed by FE-SEM, along with a few interP and intraP pores and fracture pores. Additionally, with increasing TOC content, the pore size distribution (PSD) curves of organic-rich shale gradually decrease as a result of OM ductility. Bimodal PSD versus surface area and unimodal PSD versus pore volume were measured in the shale samples, indicating that surface area is mainly associated with micropores and fine mesopores (< 10 nm) and larger pores are the dominate contributor to pore volume. Therefore, the pore network in this gas shale reservoir is predominantly associated with organic matter, especially small pores, and the mineral compositions are expected to be responsible for larger pores.