Characterization of Nanometer- to Micron-Scale Pore Structure of Tight Gas Reservoir Using a Combination of Nitrogen Gas Adsorption and Mercury Intrusion Capillary Pressure

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Abstract

The biggest challenge in estimating transport and storage properties of tight gas reservoir is a lack of understanding of their nanometer- to micron-scale pore structure. Tight gas reservoir has predominantly meso- (2nm<diameter<50nm) and macro-pores (diameter>50nm) according to the definition probides by the International Union of Pure and Applied Chemistry (IUPAC). The pore structure of tight gas reservoir is difficult to characterize because of a wide range of pores, often associated with extensive compaction and cementation, making the use of a single technique inappropriate. A hybrid of techniques is typically required to characterize the complete pore size distribution, including a combination of radiation and fluid invasion methods. Mercury intrusion capillary pressure (MICP) technique is generally used for pore structure analysis of conventional reservoir. However, for tight gas reservoirs, more than 400MPa would be required for mercury to access the complete pore size distribution, which has potential pitfalls. Nitrogen gas adsorption (N2GA) technique is mainly used to characterize porous materials dominated by micro- and meso-pores. One weakness of this technique is that it fails to analyze large pores (diameter＞300-400nm) by the reason of experimental principles. Therefore, the combination of MICP and N2GA techniques is required to characterize nanometer- to micron-scale pore structure of tight gas reservoir.

Tight gas sandstone samples originating from Shahezi formation of Xujiaweizi fault depression in the Songliao Basin were analyzed. N2GA experiment can efficiently analyze the pore structure of micro- and meso-pores while for macropores MICP experiment can give its pore structure information accurately. Thus, we recommend that using a combination of N2GA and MICP techniques to characterize the complete pore size distribution of tight gas reservoir.