INVESTIGATING THE ORGANIC PORE STRUCTURE OF OHIO SHALES

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ABSTRACT

The recoverable resource of shale gas is 25 trillion cubic meter, 33% of which is stored in transitional shales in China. We investigate the effects of organic and inorganic compositions on the development of Upper Paleozoic transitional shale pore structures through a combination of petrophysical and geochemical measurements. 42 shale samples were collected from marsh-lagoon and coastal delta settings in the Ordos Basin, NW China. The samples include the Upper Permian Shanxi shale (average total organic carbon (TOC) of 1.58 wt.%, Type III kerogen, average Ro 2.6%), and the Upper Carboniferous Benxi shale (average TOC of 1.91 wt.%, Type III kerogen, average Ro 2.74%) at the over-mature stage or dry gas window. An important characteristic of these shales is the large proportion of clay minerals (~69% in Benxi shale and 54% in Shanxi shale). The quartz content is ~17% and 40% for Benxi and Shanxi shales, respectively. The pore structure of three samples and one isolated kerogen sample is analyzed via both low-pressure nitrogen and carbon dioxide adsorption methods. Low pressure nitrogen adsorption experiments show that Benxi and Shanxi shales characterized by ultra-low porosity and permeability develop mainly silt-shaped pores and potentially ink-bottle-shaped pores. We find that increasing fractions of OM result in a decrease in both total pore volume and specific surface area (SSA). Low pressure carbon dioxide adsorption experiments show that micropore volumes nonlinearly increase with increasing OM, although the contribution of organic micropore volume is limited. The mesopore and macropore volumes of inorganic compositions contribute mostly to the total pore volume. The OM in transitional shales in Yanchang mainly develop mesopores (with < 5 nm diameters), which significantly contribute to the SSA, while micropores are the main contributor to SSA in the inorganic matter. For thermally over-mature transitional shales, clay minerals contribute the most to SSA and pore volume as well as the storage capacity of absorbed and free gas.

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