Nanoporosity of Macerals in Gas-Bearing Shale by Scanning Electronic Microscopy and Reflected Light Petrography

Xin Li, Zhenxue Jiang
China university of petroleum (Beijing)

9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

Organic matter (OM) hosted pore is considered to be important to the gas-bearing shale reservoir with low porosity and ultra-low permeability. However, owing to heterogeneity of OM itself, characteristics of OM-host pores (OMP) vary dramatically with different macerals, in terms of pore distribution, pore diameter and morphology, even at the similar thermal maturity stage. In this study, pore features within different types of kerogens at over-maturity stage from Lower Paleozoic, South China, were investigated via a combination of the X-ray diffraction, organic geochemistry analysis, soxhlet extraction, gas adsorption analysis and combined scanning electron microscopy and reflected light petrography. Results showed that pore volumes of isolated OM of marine shale were approximately three times greater than the corresponding bulk samples. While pore volumes of isolated OM of either terrestrial shale or transitional shale presented no differences with or even lower values than the corresponding bulk samples. In addition, through the combination of SEM and reflected light petrography, maceral groups were recognized and the corresponding pore properties were searched. Pre-depositional OMP was observed within inertinite macerals (fusinite and semifusinite) occurring as a limited amount of isolated pores with inherited features (>450nm). Also, trace amounts of pre-depositional OMP was observed in other macerals such as vitrinite (telovitrinite and detrovitrinite) and liptinite (alginite, sporinite and cutinite). Whereas, abundant thermally generated OMP developed in post-oil solid bitumen with authigenic characteristics that circular pores (20~200nm) nested in larger pores enhancing connectivity within the OM particle. It is

suggested that the type of kerogen may control the development of OM-hosted pores besides thermal maturity, which means that nanoporosity varies within different macerals. Moreover, at the stage of over-maturity, secondary nano-porous network within the solid bitumen plays a dominant role in the contribution of OM-hosted pores, which is of great significance to hydrocarbon storage and migration of gas-bearing shale.

Keywords: Shale; Organic Matter; Macerals; Solid Bitumen; Nano-porosity; South China

AAPG Datapages/Search and Discovery Article # 91200 © 2020 AAPG Annual Convention & Exhibition Online, Sept. 29- Oct. 1.