World Academy of Science, Engineering and Technology
International Journal of Geotechnical and Geological Engineering
Vol:13, No:10, 2019

Factors Controlling Marine Shale Porosity: A Case Study between Lower Cambrian and Lower Silurian of Upper Yangtze Area, South China

Authors : Xin Li, Zhenxue Jiang, Zhuo Li

Abstract : Generally, shale gas is trapped within shale systems with low porosity and ultralow permeability as free and adsorbing states. Its production is controlled by properties, in terms of occurrence phases, gas contents, and percolation characteristics. These properties are all influenced by porous features. In this paper, porosity differences of marine shales were explored between Lower Cambrian shale and Lower Silurian shale of Sichuan Basin, South China. Both the two shales were marine shales with abundant oil-prone kerogen and rich siliceous minerals. Whereas Lower Cambrian shale (3.56% Ro) possessed a higher thermal degree than that of Lower Silurian shale (2.31% Ro). Samples were measured by a combination of organic-chemistry geology measurement, organic matter (OM) isolation, X-ray diffraction (XRD), N2 adsorption, and focused ion beam milling and scanning electron microscopy (FIB-SEM). Lower Cambrian shale presented relatively low pore properties, with averaging 0.008ml/g pore volume (PV), averaging 7.99m²/g pore surface area (PSA) and averaging 5.94nm average pore diameter (APD). Lower Silurian shale showed as relatively high pore properties, with averaging 0.015ml/g PV, averaging 10.53m²/g PSA and averaging 18.60nm APD. Additionally, fractal analysis indicated that the two shales presented discrepant pore morphologies, mainly caused by differences in the combination of pore types between the two shales. More specifically, OM-hosted pores with pin-hole shape and dissolved pores with dead-end openings were the main types in Lower Cambrian shale, while OM-hosted pore with a cellular structure was the main type in Lower Silurian shale. Moreover, porous characteristics of isolated OM suggested that OM of Lower Silurian shale was more capable than that of Lower Cambrian shale in the aspect of pore contribution. PV of isolated OM in Lower Silurian shale was almost 6.6 times higher than that in Lower Cambrian shale, and PSA of isolated OM in Lower Silurian shale was almost 4.3 times higher than that in Lower Cambrian shale. However, no apparent differences existed among samples with various matrix compositions. At late diagenetic or metamorphic epoch, extensive diagenesis overprints the effects of minerals on pore properties and OM plays the dominant role in pore developments. Hence, differences of porous features between the two marine shales highlight the effect of diagenetic degree on OM-hosted pore development. Consequently, distinctive pore characteristics may be caused by the different degrees of diagenetic evolution, even with similar matrix basics.

Keywords : marine shale, lower Cambrian, lower Silurian, om isolation, pore properties, om-hosted pore
Conference Title : ICGESSR 2019 : International Conference on Geological Engineering, Sedimentology and Sedimentary Rocks
Conference Location : Los Angeles, United States
Conference Dates : October 30-31, 2019