

The Structural Characteristics of Nanopores in the Marine Shale of Lower Paleozoic in Southeastern Sichuan Basin, China

Nyujia Peng¹ and Sheng He¹

¹China University of Geosciences (Wuhan)

Abstract

The marine shale of the Ordovician Wufeng Formation to the Silurian Longmaxi Formation in Southeastern Sichuan Basin is shale gas exploration intervals in China. Accurate evaluation of the pore structure of shale gas reservoir has important significance for the forecast of beneficial gas bearing areas. The structural characteristics of nanopores and its main controlling factors has been analysed through adsorption tests of N₂ and CO₂ as well as scanning electron microscope in Jiaoshiba and Pengshui areas. The results are summarized to 4 points:

- (1) The total organic carbon contents of Jiaoshiba Area and Pengshui Area are respectively 0.55%-5.89% and 0.18%-4.08%. The mineral compositions are mainly quartz and clay minerals, and illite is the major part of clay minerals. The quartz content of Jiaoshiba region is between 18% and 71%, while clay minerals are inversely proportional to quartz and range from 17% to 63%; the content of the quartz in Pengshui area is from 28% to 56%, and the clay minerals and the quartz are also inversely proportional, ranging from 30% to 60%.
- (2) The specific surface areas of Wufeng Formation and Longmaxi Formation of Jiaoshiba area are 36.48-41.02 m²/g and 15.14-35.86 m²/g respectively, and their pore volumes are 0.029-0.036 cm³/g and 0.0128-0.0365 cm³/g; in comparison, the specific surface area of the nanopores in Pengshui area distributed in 4.48-28.54 m²/g and 8.63-27.78 m²/g respectively, the pore volumes are 0.0046-0.0185 cm³/g and 0.0077-0.0202 cm³/g. Through N₂ and CO₂ adsorption methods, micropores and mesopores that are less than 50nm in shales provide the main specific surface area and volume, which are the main places for the storage of shale gas.
- (3) The sample of shale in the research area has organic pores, which are more developed in the range of 5nm to 50nm. Those organic pores in Wufeng Formation mostly have irregular shapes, while those in Longmaxi Formation are more like ovals, and nanopores usually develop themselves in the organic matter, clay mineral and around the pyrite.
- (4) Correlation analysis shows that nanopores structure have interrelationship with organic carbon and mineral composition. The total volume of pores increases with the increase of TOC, which shows that TOC is the primary controlling element of pore development.