Pore Structure and Adsorption Capacity of the Lower Carboniferous Dawuba Formation Shale in Southern Guizhou Depression (China)

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Abstract

Theme 13: AAPG and SEPM Student Research Pore structure and adsorption capacity of lower Carboniferous Dawuba Formation shale in Southern Guizhou Depression (China) Based on the rich organic shale of lower Carboniferous Dawuba formation in the QZY1 well in Southern Guizhou Depression as the research object. Using multiscale testing technologies and observation methods such as low-pressure gas adsorption (N2 and CO2), high-pressure mercury injection, argon ion polishing-field emission scanning electron microscopy (FE - SEM) and organic pore statistical analysis method, and combined with methane isothermal adsorption test, studied the Dawuba formation shale pore structure characteristics such as pore types, pore morphology, pore diameter distribution and specific surface area, analyzed the adsorption capacity of shale methane, discussed the factors that affect development and pore structure of shale. Our research shows organic matter maturity (R_o) of the shale is about 2.4%, the total organic carbon (TOC) is 1.3~3.0 % (average 1.8%) and the type of organic matter (OM) is mainly type II, besides the main minerals of the shale are clay minerals (34~75%) and quartz (25~71%), containing a small amount of carbonate minerals and pyrite. The organic pores are irregular and densely distributed, the pore diameter of which is between 4~80nm (concentrated at 10~37nm), and the surface pore rate of organic matter is 6.23~7.34%. Compared with the shale of Wufeng-Longmaxi formation, the inorganic pores of Dawuba formation shale are more developed, and the pores supported by quartz

particles account for a higher proportion. The adsorption capacity of methane increase with the TOC, specific surface area and micropore volume, indicating OM may provide abundant adsorption sites and strengthen its adsorption capacity. Our research confirmed that the effect of temperature and pressure on methane adsorption capacity is to some extent opposite, suggesting that during burial or uplift period, the gas adsorption capacity of oil and gas reservoirs can be expressed as a function of burial depth. The specific surface area of Dawuba formation shale is positively correlated with TOC, but not significantly correlated with mineral composition, indicating that OM is the dominant factor controlling the specific surface area. The content of quartz is negatively correlated with TOC, indicating that the quartz in the sample may not be biogenic, and its main source is terrestrial material. The pore volume of shale is positively correlated with the content of quartz, indicating that the supporting effect of rigid terrestrial quartz particles has an important contribution to the formation of inorganic pores. The inorganic pores supported by quartz particles account for a large proportion in the pore volume of shale, which is consistent with the observation result of FE - SEM.