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Controlling Factors of Pore Types in Shale Reservoirs from the Lower Silurian Longmaxi Formation in Eastern Sichuan Basin, China

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To define the vertical distribution characteristics of pore types in various lithofacies of shale from the Lower Silurian Longmaxi Formation in Eastern Sichuan Basin, Ar-ion beam scanning electron microscope (SEM) imaging and quantitative analysis of the pore types were performed on 8 shale samples. 5 regions were selected in each sample considering the heterogeneity of shales, each region (10x10 μ m) was composed of 100 SEM photographs which were amplified 14000 times. 2000 point-count method was employed to count plane porosity of various pores on each SEM photograph, and then the average percentage of various pores in each sample was obtained. The results show that content of various pore types is different in various lithofacies. The main pore type of the lower segment of Longmaxi Formation, mainly composed of siliceous shale and characterized by high total organic content (TOC) (4.23%) and low clay content (22.9%), is organic matter (OM) pores with the content more than 70%, even up to 81.97%. The main composition in the middle segment of Longmaxi Formation is silty shale with TOC and clay content to be 2.11% and 40%, respectively. The content of OM pores in this section is in the range of 48.54%-65.38% and that of intraparticle (intraP) pores, mainly composed of pores within clay, is ranged from 9.46%-20.51%. The upper segment of Longmaxi Formation lithology is mainly composed of argillaceous shale and characterized by extremely low TOC (0.52%) and high clay content (78.9%). The content of OM pores reduced to 8.7%-17.74% and the content of intraP pores (mainly pores within clay) increased to 69.49%-77.08% due to variation of components. Small fluctuation of the content of interparticle (interP) pores was observed in Longmaxi Formation, although the content of quartz is increased from top to bottom. This is because of biogenic origin of quartz in the lower segment of Longmaxi Formation which can provide a large amount of spaces for OM. The main pore type of shales is changed from intraP pores to OM pores with increase of TOC and decrease of clay content from top to bottom in Longmaxi Formation. Therefore, we can conclude that TOC is the main controlling factor of pore types in shale reservoirs.

