

Effect of carbonate content on the porosity and pore structure of the Wufeng-Longmaxi shale in the Sichuan Basin, China

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The Wufeng–Longmaxi shale is commonly accepted to be the best shale for shale gas exploration and development in China. Changning and Fuling are the two depositional centers of the Wufeng Formation and Longmaxi Formation in the Sichuan Basin. However, there are significant differences in the gas content of the Wufeng–Longmaxi shales between these two areas. Gas content of Changning and Fuling are in the range of 2.4–5.5 m³/t and 4.7–7.2 m³/t, respectively (Zou et al., 2016). There is also significant variation in the gas production from different parts of the Wufeng-Longmaxi shales. For example, the initial test output of average single well in the Fuling shale gas field is much higher than that of the Changning shale gas field.

Two shallow wells were drilled in Changning (Well Shuanghe-1, close to Changning depositional center) and Sanquan (Well Sanquan-1, close to Fuling depositional center), respectively. The characteristics of the Wufeng-Longmaxi shales from both wells, together with Well Jiaoye4 from the Fuling shale gas field, were investigated and compared. The results indicate that organic-rich shale intervals (TOC >2.0 wt.%) in both Well Sanquan-1 and Well Jiaoye4 have high pore volume and low carbonate content, whereas those in Well Shuanghe-1 usually have lower pore volume but higher carbonate content. Basically, for Well Shuanghe-1, both total pore volume (V_{total}) and total specific surface area (S_{total}) of the organic-rich shale samples with very similar TOC content decrease by approximately 30% when the carbonate content of the shale increases by 10%, especially when the carbonate content is in the range of 10%-20%. However, carbonate content doesn't significant influence both pore volume and specific area when it is less than 5%. Therefore, high carbonate content may be one critical geological factor that is responsible for the lower gas content in the Wufeng–Longmaxi shale reservoirs in the southern Sichuan Basin.