Nano-pore preservation and gas storage capacity in overmature shales

HUI TIAN*, TENGFEI LI, QIN ZHOU,XING WANG

State Key Laboratory of Organic Geochemistry, Guangzhou Institute of Geochemistry, CAS, Guangzhou 510640, China (*Correspondence: tianhui@gig.ac.cn)

Nano-pores, either organic or inorganic, are dominant storage space for shale gas. Organic pores may be formed as a response to the thermal maturation of orgmic matter and subsequent matter transfer (Milliken et al., 2013 and references therein); for the inorganic pores, they would be progressively compressed with increasing thermal maturation and beocme to be minimal at very high maturation stage. However, it is still not clear if the organic pores would also be compacted at overmature stages when hydrocarbon generation is exhausted. The Lower Silurian and Lower Cambrian marine shales in China are both overmature with %Ro values generally greater than 2.0 and as high as 4.0, and therefore invesigating their pore characteristics and gas storage capacity would provide some new insights into the nano-pore preservation at overmature stage. Our results show that both inorganic and organic nano-pores are present in these overmature shales but the Lower Cambrian shales of higher maturity levels host less inorganic pores due to severe compaction. FE-SEM images illustrate that the inorganic pores beween clay garins could be well preserved when they are supported by pyrite crystals; otherwise the caly-related inorganic pores are less preserved. The organic pores are more common in pyrobitumen that is engulfed or protected by rigid grains than in residual kerogens that are ususlly associated with soft grains such as clay minerals. The measured BET surface area of these shales are positively correlated with TOC content and somehow controlled by thermal maurity because the BET surface area of organic matter in Lower Cambrian shales of higher maturity levels seem to be reduced. However, measured methane adsorption capacity of these shales is positively correlated with TOC in the range of 1.8 to 11.3 wt.% and less affected by thermal maturity, suggesting the methane adsorption capacity is not or only trivally affected by thermal maturity at overmature stage. These results also indicate that the nature of pore surface for the two sets of shales is likely different and the same surface area does not mean the same methane adsorption capacity.

Milliken, K.L., Rudnicki, M., Awwiller, D.N., Zhang, T., 2013. AAPG Bulletin 97, 177–200.

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