A COMPARISON STUDY ON ORGANIC PORES IN PYROBITUMENS FROM SHALES AND CONVENTIONAL RESERVOIRS

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Although organic pores are quite common in shale reservoirs, not all organic grains in shales are the same porous owing to variations in their genetic nature and post-genetic alternation (Curtis et al., 2012; Tian et al., 2015; Katz and Arango, 2018). In particular, there are still debates on the relative dominance of organic pores hosted in residual kerogen and pyrobitumen grains that make up the main organic components of overmature shales originally containing oil-prone kerogens. While it has been tentatively recognized that pyrobitumens evolved from pre-oil bitumens are less porous than residual kerogens, the porosity of pyrobitumens derived from thermal cracking of retained oils in shales is still poorly understood, partly due to their difficult accurate discrimination from residual kerogens at overmature stages. In this study, pyrobitumens in shales are mainly identified according to their petrographic occurrence which are typically engulfed by quartz grains and often far away from assemblages of clay-organic matter grains. For a purpose of comparison, pyrobitumen grains were also isolated from carbonate and sandstone reservoirs.

Field Emission Scanning Electronic Microscopy (FE-SEM) examination shows that there are abundant pyrobitumen-hosted organic pores in overmature shales (EqVRo up to 4.0%) with pore diameters as large as up to 100–200 nm (Fig. 1), whereas FE-SEM visible pores are quite rare for the pyrobitumens isolated from carbonate and sandstone reservoirs whose thermal maturity levels are similar to those of investigated shales. Low-pressure N_2 adsorption results also reveal that the adsorbed gas quantities at the partial pressure of 0.995 and BET surface areas, both of which are TOC-normalized, for the isolated pyrobitumen samples are remarkably lower than those of kerogens isolated from shale samples that contain both pyrobitumen and residual kerogen. All the above results indicate that organic pores in pyrobitumens isolated from carbonate and sandstone reservoirs are not well developed or preserved as in pyrobitumens present in shales, and that the distinct variation in the abundance of organic pores in different types of pyrobitumens is not controlled by thermal maturity since they are similarly matured but is probably related to their distinct original chemical composition. The precursors of pyrobitumens in conventional reservoirs are migrated and accumulated oils, whereas pyrobitumens in shales are mainly derived from the cracking of retained oils. The migrated oils would become less enriched in asphaltene fractions than the retained oils due to geochromatography. As asphaltene fractions share similar chemical composition and structures as their parent kerogens, the pyrobitumens in shales may be chemically identical to the residual kerogens, which is probably one of the main reasons for their high abundance of organic pores and also indicates that original chemical composition of organic matters may affect their ability to develop and preserve organic pores.

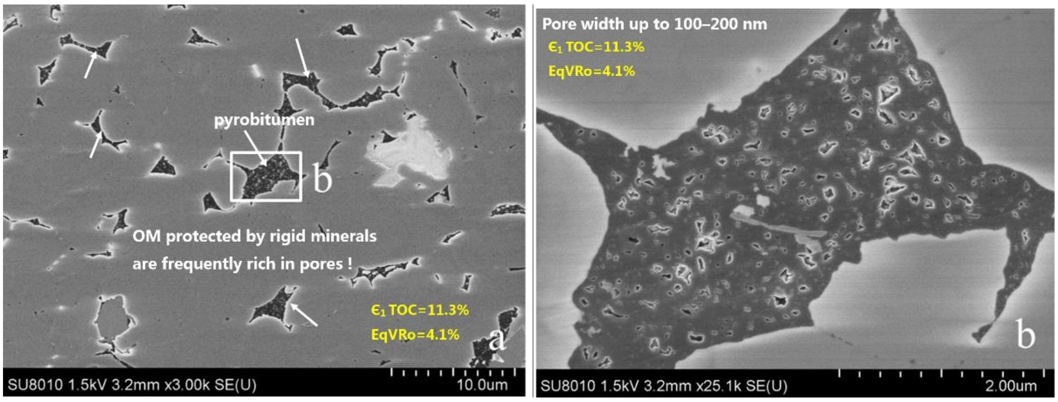

Figure 1 *FE-SEM images of organic pores hosted in pyrobitumen grains of overmature Lower Cambrian shales.*

References

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