Influence of OM properties on the development of organic-associated pore system in organic-rich shales

CHAO YANG[1]*, YONGQIANG XIONG[1], JINCHUAN ZHANG[2] AND YUKE LIU[1]

[1] Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Guangzhou 510640, PR China (*correspondence: yangchao@gig.ac.cn)

[2] School of Energy Resources, China University of Geosciences (Beijing), Beijing 100083, PR China (zhangjc@cugb.edu.cn)

Abstract

Organic-rich shale samples, selected from the marine, lacustrine, and marine-continental transitional sedimentary settings, were performed to reveal the organic matter (OM) properties and further investigate their correlation with organic-associated pore system using the broad ion beam-scanning electronic microscope.

Different organic macerals have different occurrence patterns. The structured macerals inherited with bio-texture tend to be randomly scattered in shale matrix due to their poor ductility, and therefore are easier to produce the micro-cracks at the maceral periphery when there is a differential shrinkage between OM and inorganic constituents. While the amorphous macerals biodegraded or released from kerogen macerals during maturation, have a great ductile capacity, and thereby can seamlessly fill in the matrix gaps or adhere the minerals so as to have themselves preserved. Furthermore, macerals in different associations with minerals differ in thermal evolution, and the macerals adhering the minerals are earlier to be thermally matured under the participation of contact clay minerals than the macerals isolated with minerals.

OM geochemical properties strongly influence the development of the OM internal pores caused by hydrocarbon generation, which are mainly reflected in two aspects: 1. Different organic macerals have a big difference in the capacity of generating organic pores, and the sapropelic macerals are more likely to develop organic pores than the humic macerals. 2. Thermal maturation strongly influences the developmental scale of the organic pores, which shows attendant increment with the enhancement of the organic maturity within limits (generally less than 3.5%R_o).

Finally, the secondary organic-acids released from the kerogen macerals during maturation can corrode the dissolvable grains resulting in the formation of the secondary dissolution pores. Since the organic-acids prevail in the low maturity stage, these dissolution pores may constitute the majority of the organic-associated porosity in the less mature shales.