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Organic Matter Distribution in Bazhenov Source Rock: Insights from Sequential Extraction and Molecular Geochemistry

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Abstract : There is a high complexity in the pore structure of organic-rich rocks caused by the combination of inter-particle porosity from inorganic mineral matter and ultrafine intra-particle porosity from both organic matter and clay minerals. Fluids are retained in that pore space, but there are major uncertainties in how and where the fluids are stored and to what extent they are accessible or trapped in 'closed' pores. A large degree of tortuosity may lead to fractionation of organic matter so that the lighter and flexible compounds would diffuse to the reservoir whereas more complicated compounds may be locked in place. Additionally, parts of hydrocarbons could be bound to solid organic matter –kerogen– and mineral matrix during expulsion and migration. Larger compounds can occupy thin channels so that clogging or oil and gas entrapment will occur. Sequential extraction of applying different solvents is a powerful tool to provide more information about the characteristics of trapped organic matter distribution. The Upper Jurassic – Lower Cretaceous Bazhenov shale is one of the most petroliferous source rock extended in West Siberia, Russia. Concerning the variable mineral composition, pore space distribution and thermal maturation, there are high uncertainties in distribution and composition of organic matter in this formation. In order to address this issue geological and geochemical properties of 30 samples including mineral composition (XRD and XRF), structure and texture (thin-section microscopy), organic matter contents, type and thermal maturity (Rock-Eval) as well as molecular composition (GC-FID and GC-MS) of different extracted materials during sequential extraction were considered. Sequential extraction was performed by a Soxhlet apparatus using different solvents, i.e., n-hexane, chloroform and ethanol-benzene (1:1 v:v) first on core plugs and later on pulverized materials. The results indicate that the studied samples are mainly composed of type II kerogen with TOC contents varied from 5 to 25%. The thermal maturity ranged from immature to late oil window. Whereas clay contents decreased with increasing maturity, the amount of silica increased in the studied samples. According to molecular geochemistry, stored hydrocarbons in open and closed pore space reveal different geochemical fingerprints. The results improve our understanding of hydrocarbon expulsion and migration in the organic-rich Bazhenov shale and therefore better estimation of hydrocarbon potential for this formation.

Keywords : Bazhenov formation, bitumen, molecular geochemistry, sequential extraction
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