ORGANIC MATTER CHARACTERISTICS VARIATION IN SOURCE ROCKS AS ONE OF THE MOST IMPORTANT FACTORS FOR GEOLOGICAL PROCESSES INVESTIGATION

M.S. Topchiiy[1], N.V. Pronina[1], A.G. Kalmykov[1], G.A. Kalmykov[1]

[1] Lomonosov Moscow State University, Russia

Source rocks are one of the main objects for geological processes study and modeling. Received data may allow assuming sediments with good reservoir properties and high perspectives for oil and gas production. Ultimate investigations showed that source rocks can also be unconventional reservoirs for generated hydrocarbons storage. Therefore, more accurate and fundamental analysis of source rocks properties and characteristics is necessary for deeper understanding of geological principles of these rocks formation and reconversion. Special attention is focused on kerogen and organic matter as both a source of oil and part of rock matrix. The target of this study is investigation of organic matter characteristics variation through the source rocks of different maturity.

Bazhenov Formation (West Siberia, Russia) was chosen as the object for development. These source rocks are distinguished by a high content of organic matter (up to 30%), which is a consequence of uncondensed accumulation of deposits in a relatively deep-water (200–400 m) basin enriched with fauna. Amount of organic matter and mineral content varies with the sea level and sedimentation conditions. Secondary processes, e.g. hydrothermal treatment, affect not only composition, but also kerogen maturity and hydrocarbons formation. Set of rock samples from four different areas with different organic matter maturity varied from immature (before oil window) to late oil window stage allocated through the depth was chosen for the investigations. Collection of more than 30 samples covers main diversity of lithological and geochemical changes in source rocks to investigate organic matter characteristics and changes in accordance with different facies and thermal maturity processes.

For a comprehensive study of the organic matter a complex laboratory work was performed, including rock-eval pyrolysis, luminescent microscopy, scanning electron microscopy as well as porosity and permeability and lithological composition measurements. To obtain information on maturity of organic matter rock-eval measurements were performed on both samples before and after extraction with polar solvents. This allows to remove adsorbed hydrocarbons from kerogen and minerals and measure Tmax and hydrogen index (HI) more precisely. For microscopic investigation polished sections were prepared. Luminescence microscopy shows distribution of newly formed macerals in rocks and allows estimating maturity by spectrum measurements. Luminescence microscopy enable to distinguish macerals that retain initial organism's structure units (alginites) and structureless macerals called bituminites. Scanning electron microscopy of the same sample shows with what elements these different macerals are associated and investigate kerogen structure and distribution in rocks. Additionally, secondary processes indicators can be determined by x-ray elemental composition of exact minerals. This method provides integrated data on organic matter characteristics.

Rock-eval measurements have shown that maturity of organic matter may vary through the depth by HI parameter in the range of 200 mg HC/ g TOC. Even the total maturity of rocks is the same in the formation, organic matter transformation is affected not only general geological process of deposits formation, but also by local sedimentation and secondary processes and lithological composition of the rocks. The higher content of carbonates and organic matter in the top layers of formation leads to lower transformation of kerogen (Fig. 1). Hydrocarbons are mostly adsorbed on kerogen. In the bottom layers with higher amount of clay and silica minerals organic matter are distributed over the rocks, while kerogen do not retain any compounds. Changes in sedimentary conditions may cause

deposition of kerogen of another type, which leads to different results in measured organic matter characteristics. Measuring this sample only by one method leads to incorrect results interpreting.

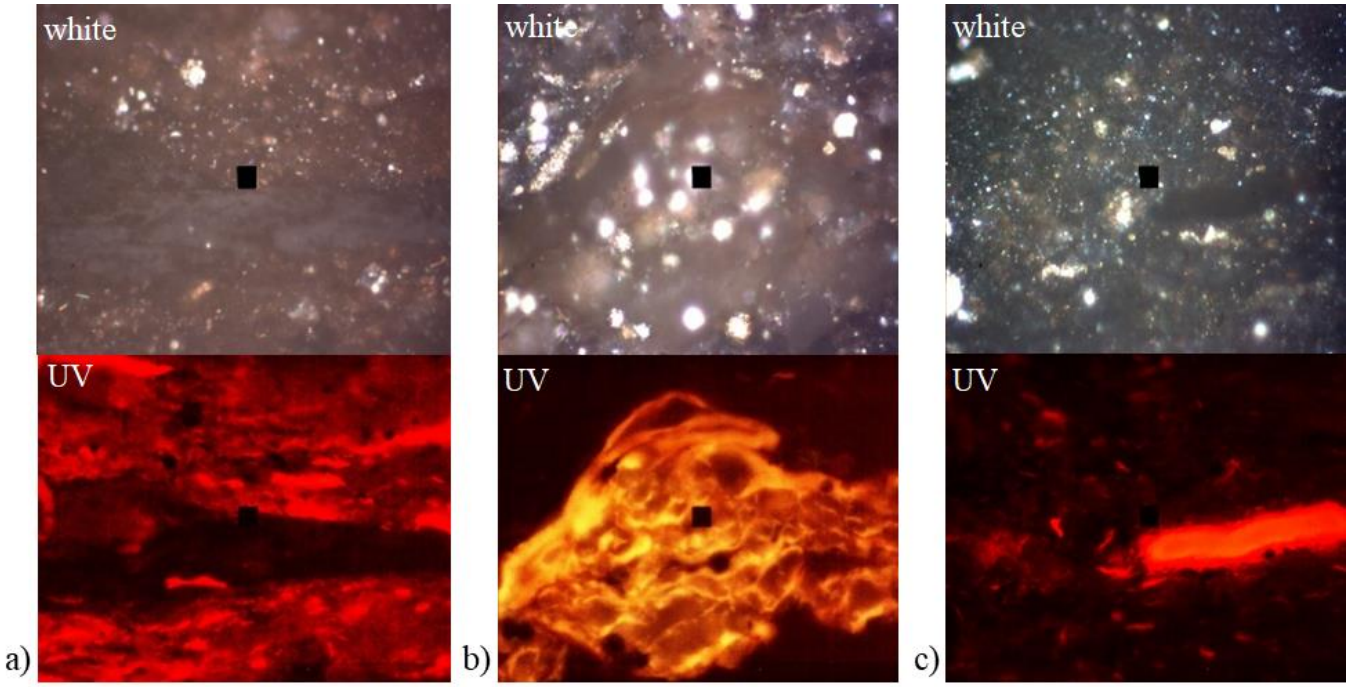

Figure 1 *Luminescence microscopy measurements of three different Bazhenov Formation rocks from one well with different types of kerogen and different macerals distribution under white light and ultraviolet: a) bottom layer; b) middle part; c) top layer (the size of black square is 5x5 micron).*

Presence of kerogen with different origin was shown by scanning electronic and luminescence microscopy investigations. It was found that in one rock organic matter may change variously. There might be both kerogen with adsorbed organic matter and fully mature kerogen. Also it was shown that different types of pores may form in kerogen with different origin, having fractures in one kerogen particle and kerogen porosity in another inside the same sample. The higher the thermal maturity of formation is, the lower difference in macerals distribution and the higher difference in types of pores and fractions in kerogen. Such structure may cause unconventional reservoir formation in Bazhenov sediments.

The results of the investigation show, that Bazhenov Formation rocks have a complex component structure, organic matter has different characteristics through depth and depends on geological history and the nature of kerogen. Organic matter differently reacts to catagenetic effects due to lithology of rocks and its origin. To obtain correct parameters for geological processes investigation and modeling complex study should be undertaken and results should be interpreted carefully.