

OIL GENERATIVE POTENTIAL OF JURASSIC ROCKS IN THE NADYM-TAZ INTERFLUVE AREA (BASED ON THE KEROGEN STUDIES)

A.E. Kontorovich, L.S. Borisova, V.N. Melenevsky, A.N. Fomin

Institute of Petroleum Geology and Geophysics SB RAS, Russia

The issues of organic geochemistry of the northern West Siberian Basin (WSB) have been the focus of many studies conducted under the guidance of A.E. Kontorovich, Academician RAS at the Institute of Petroleum Geology and Geophysics SB RAS since the late 20th century [1-4]. Several deep and ultra-deep wells drilled in the northern areas of WSB allowed studying the organic matter (OM) in the entire section of the Mesozoic sedimentary cover.

The purpose of this work is to determine geochemical characteristics of the kerogen and to evaluate oil generative potential of deep-buried Jurassic deposits in the Nadym-Taz interfluvial area confined to northern parts of WSB and comprising the Shirotnye Priobie (Latitudinal Ob) region. We analyzed the OM of Jurassic deposits sampled from Yen-Yakhinskaya, Urengoiyskaya, Yevo-Yakhinskaya, Tyumenskaya, Zapadno-Tarkosalinskaya, Tarkosalinskaya, Geologicheskaya, Medvezhiya, Vostochno-Tarkosalinskaya, Stakhanovskaya, Gubkinskaya, Chernichnaya, Yubileinaya, Novogodnyaya and Yutymalskaya areas. Kerogen is the part of the organic matter of rocks, which is insoluble in common organic solvents and alkaline aqueous solutions (IOM) subsequent to the removal of bitumen component from OM and after dissolving mineral residue in hydrofluoric and hydrochloric acids, and the removal of elemental sulfur [5].

According to the elemental analysis, kerogen of organic matter from Upper Jurassic deposits represented by the Bazhenov and Georgievka Formation is generally attributed to the marine OM (Type II kerogen) [6], which is characterized by high hydrogen contents ($H=7.4\%$) and hydrogen to carbon ratio (H / C_{at}) (up to 1.05), with the oxygen to carbon ratio (O / C_{at}) being low (<0.05). The samples from the Bazhenov Formation are also characterized by high content of pyrite sulfur in the kerogen of OM (13.9-36.1%). Kerogen from the Vasyugan horizon is characterized by low hydrogen content (on average, $H=5.0$) and contains mostly terrestrial and mixed OM type. Kerogen of Lower-Middle Jurassic source rocks with the H / C_{at} values less than 0.66 but higher O / C_{at} values (on average 0.09), than for type II OM ratio, can be assigned to type III OM.

Based on Rock-Eval pyrolysis, the investigation of the Jurassic kerogen samples from the study area provided first insights into the genetic type of OM, the degree of its maturity, and their residual hydrocarbon-generation potential (HI). While passing the oil window (T_{max} 440-450 °C), kerogens of the Bazhenov Formation are characterized by high HI (330 mg HC / g $C_{kerogen}$). The Upper Jurassic kerogen from the Vasyugan Formation is also in the oil window, however, it is characterized by relatively low HI (51-96 mg HC / g $C_{kerogen}$), which is explained by the terrestrial origin of their OM. In general, IOM samples from Lower-Middle Jurassic deposits of the study area have predominantly low HI (25-56 mg HC / g $C_{kerogen}$ and 93-152 mg HC / g $C_{kerogen}$, respectively) and are attributed to the gas kitchen zone (T_{max} 470-520° C). The exceptions are some Middle Jurassic kerogen samples (from Malyshevka, Leontievskiy, Vymskoye horizons) in northwestern and southern regions of the study area, characterized by relatively high values of hydrogen index (up to 170 mg HC / g $C_{kerogen}$). The authors compared the obtained results with the vitrinite reflectance measurements for Jurassic rocks of WSB [7].

In the Upper Jurassic interval (Bazhenov Formation and its equivalents), the level of maturity of the organic matter ranges from low mature to mature OM (oil window). The OM is least modified within the oil window in marginal parts of the megabasin and the study area. Approaching the WSB middle part, OM maturity gradually increases (from low mature to mature) and reaches maximum (oil window) in the north. The HI values for the Bazhenov Formation totally agree with the level of maturity of OM derived from vitrinite reflectance, showing the lowest values for residual hydrocarbon potential in the north of central part of the territory. Maturity level of the organic matter in the samples from Middle Jurassic sequences is moderate within individual horizons (Malyshevka, Vymsk); kerogen sampled in a number of wells in the west and south of the study area is characterized by relatively high values of residual hydrocarbon potential (up to 175 mg HC / g of C_{kerogen}). The Lower Jurassic OM has changed significantly and become over-mature (apocatagenesis stage) in the study area. HI values for Lower Jurassic sediments in the north of central part of the study area also indicate a high level of maturity and low HI values <20 mg HC / g of C_{kerogen}. The exceptions are some of the western and north-western regions of the study area, where OM of the source rocks of Kiterbyut and Sharapovo are associated with moderate maturity and have relatively high HI values (residual hydrocarbon potential), up to 90 mg HC / g C_{kerogen}).

Thus, the study of insoluble organic matter of Jurassic deposits of the study area confirmed the high hydrocarbon potential of the Bazhenov Formation. Given that Upper Jurassic deposits have not yet passed the oil window, the generation of light liquid and gaseous hydrocarbons may be taking place thereat. Lower Jurassic reservoirs are generally characterized by terrestrial OM type; they are attributed to the active gas generation zone. Middle Jurassic reservoirs have moderate hydrocarbon potential; however, relatively high HI characterizes some parts of the study area. The results and findings of this study allow to identify zones of high hydrocarbon (oil and gas) potential within the study area.

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