OIL SOURCE DEPOSITS IN THE BAZHENOV FORMATION OF WESTERN SIBERIA

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Introduction

The relevance of the study and the increased interest in the sediments of the Bazhenov formation (Volga layer of the Upper Jurassic and Berrias of the Lower Cretaceous) is quite natural and is associated with its well-known uniqueness (oil resources) and the need to clarify the prospects for the oil and gas potential of the formation in most of the basin. The deposits of the Bazhenov formation, which are widely developed within Western Siberia, have been fairly well studied and described. However, a relatively high degree of study of the formation did not lead to unambiguous judgments about the origin of the hydrocarbon (HC) series in it and the regularities of their spatial location. Some researchers believe that the oil of the Bazhenov formation is syngenetic with the organic matter (OM) of its rocks. Other authors consider the oil in the formation to be epigenetic due to their secondary arrival from the underlying deposits in areas of high fracturing. The existence of different views on the source of oil has further increased the scientific and practical interest in the problem of the oil and gas potential of the Bazhenov formation, in particular, the geochemical aspects of the origin of HC in them (Kontorovich et all., 2014).

Results

This report reviews the features of the diagnostics of oil source sequences of the Bazhenov deposits, using the trace element (TE) criteria for the genetic relationships “oil – scattered OM”. The TE composition of bitumoids over the area of distribution of the Bazhenov formation (by atomic adsorption) and the content of metal porphyrin complexes (MPC) were studied. A search in the section of the sedimentary strata of the oil source formations and their diagnostics is a necessary stage in assessing the prospects of the petroleum potential of sedimentary basins. The similarity of oils and syngenetic bitumoid rocks to the distribution of TE can be indicative of the participation of these strata in the processes of oil formation. Undoubtedly, the biogenic nature of most TE of oils provides a complete basis for such a correlation. For a more reasonable judgment on the presence in the sedimentary section of the oil deposits, it is necessary to clearly separate the bituminous components into syngenetic and epigenetic components. The syngenetic bitumoid from rocks with high organic carbon (Corg) and low bituminous content (β) is usually characterized by a high content of V, Ni, Co, Mo and other TEs associated with asphalt-resinous components. The concentrations of these TE can be two orders of magnitude higher than in oils or epibitumoids. The concentration of so-called “mobile” TE, associated with oil HC components – Fe, Au, Pb, Cu, etc., in these bitumoids is lower than the concentration in epibitumoids. The distribution of TE in epigenetic bitumoids reflects their migratory nature, sometimes contaminated, they are more mobile, and they have relatively lower concentrations of “heavy” TEs (in the same order as in oils) as compared to syngenetic bitumoids (Punanova, 2017; Punanova and Shuster, 2018). Table 1 provides a clear example of such a dramatic difference.

The features of the formation, its shale nature and the frequent alternation of denser and less dense rocks – reservoirs and HC producers, lead to difficulties in deciphering the actual oil-material interlayers in its structure. This uncertainty is caused by the fact that the methods of studying conventional HC accumulations are not applicable to non-conventional objects, which are both oil source and oil-containing objects. Any movement of fluids within such strata...
results in a change in their composition, in particular, enrichment with more mobile components and depletion with resin-asphaltene components, to which TE and MPC are associated.

**Table 1. Comparison of TE composition of syn- and epigenetic bitumoids of rocks of the Bazhenov formation (Salym field) in the contour and behind the contour of the oil field.**

<table>
<thead>
<tr>
<th>Binding of sample</th>
<th>Type of bitumoid</th>
<th>TE content in bitumoid, ppm</th>
<th>Concentration rows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behind</td>
<td>Syn</td>
<td>1040 120 40 10 170 30 30</td>
<td>V&gt;Zn&gt;Ni&gt;Fe&gt;Pb&gt;Cu&gt;Co</td>
</tr>
<tr>
<td>In contour</td>
<td>Epi</td>
<td>3.6 0.6 3.0 1.7 8.5 2.0</td>
<td>Zn&gt;V&gt;Fe&gt;Pb&gt;Cu&gt;Ni&gt;Co</td>
</tr>
<tr>
<td>Oil</td>
<td></td>
<td>1.3 0.16 0.4 0.2 1.6 0.6</td>
<td>&lt;0.01 Zn&gt;V&gt;Pb&gt;Fe&gt;Cu&gt;Ni&gt;Co</td>
</tr>
</tbody>
</table>

A detailed study at the regional level of the OM composition of the formation showed significant heterogeneity and made it possible to distinguish two of its genetic varieties. The first one, slightly transformed, is characterized by low values (not more than 7-8%) of β and relatively high values of the metamorphism coefficient $k_i = (Pr+Ph)/(n-C_{17} + n-C_{18})$ to 0.8, and also a relatively high concentration and diversity of different oxygen-containing structures with increased total aroma (Chakhmakhchev and Punanova, 1992). This type of bitumoid is developed in the deposits of the Shirotnov Priobya. The second type of bitumoid is characterized by increased β (up to 30%), low values of $k_i$ (0.1-0.3), low relative concentration of oxygen-containing compounds and total aromaticity of bitumoids with respect to CH$_2$ groups of n-alkanes. In the OM of this type, practically no MPK are found and V concentrations are negligible. Such indicators, as noted earlier, are characteristic of high conversion stage of OM. This geochemical zone coincides with the zone of industrial oil content, and in the regional plan it was reflected in the form of a wide strip having a northeastern strike. It covers part of the Yugansky depression, the Koltogorsky trough, the Salym uplift and extends further to the northwest (Punanova, 2017).

**Conclusions**

Summarizing the rather extensive material by the features of the OM distribution in the sediments of the Bazhenov formation in Western Siberia, it can be stated that the zones of introduction of highly transformed epigenetic bitumoids are catagenically altered by deep processes. In our opinion, this improves the prospects of the oil and gas potential of the region under study at the expense of the additional source of HC, besides the OM of the Bazhenov formation itself. These sources can be associated with oil-producing Jurassic (Vasyugan and Tyumen formations) and deep-buried pre-Jurassic sedimentary deposits – Triassic and Paleozoic.

**References**