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Identification of Potential Reservoir Intervals in Oil-shale Formations based on Geochemical Data

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In oil and gas regions of Russia the formations of “shale” with high bitumen content are represented mainly by the Kuonamsk and (its analogue) Inikansk suite (Lower-Middle Cambrian deposits of the Siberian Platform), Domanik suite (Middle-Upper Frasnian-Tournaisian of the East European platform), Bazhenov suite and (its analogue) Lower Tutleimsk sub-suite (Upper Jurassic-Neocomian of the West Siberian Platform) and Kumsk and Khadumsk suites (Eocene and Oligocene-Miocene in the Pre-Caucasus foredeep).

These suites are known as both important oil source and oil reservoir series. The distribution of oil in such deposits has similar nature. Hydrocarbon (HC) accumulations in these suites are believed to associate with laterally persistent widely distributed reservoirs.

Because of the specific structure of such strata it is not always possible to identify and delineate the existing oil-saturated reservoirs based on the traditional methods only. This problem can be successfully solved by integrating organic geochemistry methods into the methodology applied.

These methods permit to study specific features of distribution of various forms of organic matter (OM), including oil, in these strata.

The Rock-Eval method is most effective for identification of oil-saturated intervals in sections of such suites. It permits to confidently identify oil intervals based on high values of peak S_1 relative the TOC (Total Organic Carbon) background.

Study of the Bazhenov and Domanik deposits shows that in zones where OM maturity attains the "oil window" peak the oil-saturated intervals are identified in the form of single small-thickness layers predominantly made of relatively organic-lean non-clay rocks.

In zones of OM late maturity the presence of mobile oil is noted almost all over the suite section. Besides, free high-molecular oil components are present in these rocks. This is indicated by reduced values of peak S_2 obtained by repeated Rock-Eval analysis of the extracted rocks.

For suites drilled with sufficient core recovery it is possible to evaluate thickness of the identified oil-saturated intervals.

One of the reservoir geochemistry methods based on results of GC analysis and comparison of oils and bitumen [1] can be used to identify productive intervals and to determine the extent of vertical and lateral oil reservoirs continuity.

These geochemical studies permits to obtain more accurate data on thickness and lateral distribution of the oil-saturated bodies and amount of oil contained therein, which results in obtaining more accurate (compared to currently used) parameters needed for assessment of resources (calculation of reserves) of HC in oil-shale formations.

References:

[1] Kaufman R.L. et al. (1987) In Proc. of the Sixteenth Annual Convention of the Indonesian Petroleum Association: Indonesian Petroleum Association, Jakarta, 247-268

