



Petrographic interpretation of geophysical anomalies in the metamorphic rock complex of the Volga-Ural petroleum province

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The crystalline basement of the Volga-Ural petroleum province is currently considered a promising potential area of new hydrocarbon deposits. This concept is based on the presence of numerous loosely aggregated zones (or so called destruction zones) with high permeability and porosity. During production drilling, these zones can be detected by downhole geophysical surveys including gamma-ray (GR) logging and neutron gamma-ray (NGR) logging. Diagraphic data on crystalline basement rocks from a number of deep wells of the region have identified some anomalous zones. However, interpretation of anomalous data for the crystalline basement requires a detailed petrographic basis.

The authors have performed point sidewall core sampling during downhole logging to obtain petrographic data on the GR and NGR anomalies. Petrographic analysis of the core samples correlated with the geophysical anomalies permits the identification of false and real anomalies. False GR and NGR anomalies are caused by elevated concentrations of radioactive minerals, such as zircon and monazite, produced by metamorphic processes. Real anomalies of these parameters are caused by clay minerals prevailing in the metamorphic substratum of the destruction zones and formed by the alteration of the high-grade metamorphic material of the basement by low-temperature hydrothermal solutions. These anomalies are characterised by a high degree of correlation of gamma activity and neutron absorption, which can be explained by the geochemistry of clay minerals of the destruction zones that are considered potential reservoirs of hydrocarbon fluids.