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Probe imaging studies of magnetic susceptibility and permeability for sensitive characterisation of carbonate reservoir rocks

Aleksandr Ivakhnenko (1,2), Akmaral Bigaliyeva (1), and Vladislav Dubinin (1)

(1) Kazakh-British Technical University, Department of Geology & Physics of the Earth; Department of Petroleum Engineering, Almaty, Kazakhstan (energy.petroleum@gmail.com), (2) IPEC, Edinburgh, United Kingdom

In this study were disclosed the main principals of identifying petrophysical properties of carbonate reservoirs such as porosity, permeability and magnetic susceptibility. While exploring and developing reservoir there are significant diversity of tasks that can be solved by appropriate knowledge of properties which are listed above. Behavior of fluid flow, distribution of hydrocarbons and other various industrial applications can be solved by measuring areal distribution of these petrophysical parameters.

The results demonstrate how magnetic probe and hysteresis measurements correlate with petrophysical parameters in carbonate reservoirs. We made experimental measurements and theoretical calculations of how much magnetic susceptibility depends on the porosity of the rocks and analyzed data with graphics. In theoretical model of the carbonate rocks we considered calcite, dolomite, quartz and combinations of calcite and dolomite, calcite and Fe-dolomite, calcite and quartz, calcite and aragonite with increasing concentrations of the dolomite, Fe-dolomite, quartz and aragonite up to 50% with step of 5%. Here we defined dependence of magnetic susceptibility from the porosity: the higher porosity measurements, the less slope of magnetic susceptibility, consequently mass magnetization is higher for diamagnetic and lower for paramagnetic carbonate rocks, but in the both cases magnetic susceptibility tries to reach zero with increasing of the total porosity. Rock measurements demonstrate that reservoir zones of the low diamagnetic magnetic susceptibility are generally correlated with higher permeability and also porosity distribution. However for different carbonate reservoirs we establish different relationships depending on the complexity of their mineralogy and texture. Application of integral understanding in distribution of permeability, porosity and mineral content in heterogeneous carbonates represented by this approach can be useful tool for carbonate reservoir characterisation.