Quantitative petrophysical analysis of 2nd Wall Creek reservoir system, in NPR-3 field: an approach with academic accessible tools

Bruno Fonseca Passos*[1], Estanislau Luczynski[1], [1]Universidade Federal do Pará (UFPA)

Abstract

Commonly used by professionals working in the oil & gas industry, commercial packages, software and tools necessary to carry out basic petrophysical analysis are often far from being part of the portfolio offered by educational institutions to its staff, researchers and students, especially in underdeveloped countries, due to high prices, even when taking into account bulk sales and educational discounts. The same remain true for softwares employed in further geological and geophysical scopes. To that end, this paper uses publicly available well log data from the Naval Petroleum Reserve No. 3 (NPR-3) field in Wyoming, USA, in order to experiment with program scripts developed in-house and assess how accurate a simple academic tool can estimate a given reservoir's porosity, permeability, water saturation and shaliness. Aforesaid petrophysical properties may be subjected to interpretation and geological review in order to notice similarities with known data from previous research and put to test the approach used to process well log data and the theoretical foundation to petrophysical quantitative analysis.

After careful quality control in regard to all 1200, deep and shallow, well log files publicly available, 4 wells were chosen across 4 sections on the NPR-3 oilfield, based on how adequately all 4 well logs could reflect, as much as possible, a single reservoir system. The well logs are composed of records such as Caliper (CALD), Gama Ray (GR), Bulk Density (RHOB), Resistivity Deep (RILD), Delta Time (DT) and Neutron Porosity (NPHI), data sets which were then loaded in MATLAB® scripts and routines implemented for petrophysical quantitative estimates, to result in the following petrophysical properties: Shaliness (V_{SH}), Sonic Porosity (Φ_S), Effective Porosity (Φ_E), Water Saturation (S_W) and Permeability (κ). Lithologic and stratigraphic studies for the NPR-3 oilfield indicate up to 9 productive hydrocarbon systems however, for this endeavor, the 2nd Wall Creek reservoir system was opted due to well log data limitations related to the lack of appropriate logs after reaching a certain depth.

The results were then confronted with petrophysical property values acquired from technical data sheets kept by the Rocky Mountain Oilfield Testing Center (RMOTC), energy testing facility managing the field. Values given by the RMOTC for porosity and permeability of the 2nd Wall Creek reservoir system were 15% and 100 *mD*, respectively. The values resulting from the approach with an academic tool applied to obtain the system average porosity and average permeability were 15.41% and 82.7 *mD*, respectively. Although permeability values were similar instead of accurately close and, perhaps, Wyllie and Rose II equation is not the most adequate for permeability estimates in this geological setting, both property values are considered in line with previous research and data kept by RMOTC acquired through commercial petrophysical solutions. Therefore, results show that the approach applied and the theoretical foundation were adequate and accurate when used to estimate petrophysical data from well logs in order to expand knowledge on oil-bearing formations.