A new approach of Petrophysical Characterization for Fractured Basement Reservoirs

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ABSTRACT

Fracture identification can be easily detected using well log and mud log data. However, quantitatively analysing porosity and permeability in basement fractured reservoirs has been a big challenge for the oil and gas industry. There are currently no standard workflows for the evaluation and resource assessment of unconventional basement reservoirs. Further, most conventional logs are designed for clastic and carbonate environments and the mineralogical composition of basement rocks are complicated, with large scale variability in their volumes and components. Therefore, the determination of petrophysical parameters by conventional methods has been known to cause errors. In order to reduce these uncertainties, our software provides a comprehensive workflow for fractured reservoir petrophysics (FRP), with a more robust determination of porosity and permeability. Based on petrography and mineralogical data, utilizing our multi-mineral solver, the FRP module applies a special algorithm to solve a system of multi-equations, to determine volumes of different minerals and total porosity of fractured basement reservoirs. Furthermore, macro, micro, fracture, and vuggy porosity can also be classified. Fracture porosity is estimated by the Maxwell formula, with looping techniques for the exclusion of the influence of vugs, which could be significantly affected by the resistivity values of invaded zones. Empirical formulas of the relationship between porosity, residual water saturation and attenuation of the Stoneley wave have been used to calculate permeability. These reservoir parameters have then been integrated with the results from core analysis, production logs and borehole images, in order to verify the petrophysical parameters and to better understand the complex behavior of fractured basement reservoir in other wells.