Linking Static and Dynamic Data for Distributed Permeability Estimation along Horizontal Open Hole Drains in a Carbonate Reservoir: Case Study from the Middle East

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Abstract

Carbonate rocks by nature exhibit vast petrophysical variations both laterally and vertically due to their depositional environments and diagenetic overprints. Conventional core analysis (CCA) and dynamic reservoir testing are the powerful methods used for reservoir characterization. However, in this case study wells, cores are not available, therefore the permeability estimation becomes challenging. This paper demonstrates a novel and integrated approach of measuring and calculating permeability based on static and dynamic data. This method can be considered as a good integration practice to improve reservoir flow characterization and eventually reservoir modeling.

In this paper, several appraisal wells and highly deviated development wells were evaluated. The dataset consists of CCA, open-hole logs, well testing analysis, formation testers and production logging (PL). The porosity and permeability data acquired from the existing core was analyzed for multiple wells and compared to porosity and permeability index obtained from nuclear magnetic resonance (NMR) for validity and quality control. Pressure transient analysis (PTA) was also used to calibrate the average NMR permeability index across production interval.

In this field the development wells are dual oil producers (DOP) consisting of two horizontal drains. Due to well architecture the upper drain is not accessible. The main objective of this study is to estimate the permeability of reservoir zones targeted by upper drains which are completed in the upper drains in order to evaluate their production potential. The only data available for the upper drains are logging while drilling (LWD) and pressure while drilling (PWD). In order to assess the validity of the proposed method, the approach was applied to a single drain, accessible for PL. The permeability obtained using normalized NMR data calibrated to PTA was in agreement with PL results.

The used methodology helped improve the understanding of productivity in inaccessible wells without running PL. Nevertheless this method will be tested for upcoming wells in different reservoirs to confirm its validity.