AAPG Datapages/Search and Discovery Article #90319 ©2018 GEO 2018 13th Middle East Geosciences Conference and Exhibition, Manama, Bahrain, March 5-8, 2018

Evaluation of Permeability in Tight Sandstones of Eastern Saudi Arabia Based on Digital Rock Physics

Ivan Deshenenkov[1] and Abrar Alabbad[1]

[1]Exploration Technical Services, Saudi Aramco, Dhahran, Eastern Province, Saudi Arabia.

ABSTRACT

Formation absolute permeability is the key reservoir parameter that indicates how efficient fluids flow to wellbore through the pore network. It is important to understand the controls and factors affecting the pore-scale fluid propagation through a porous medium. This study is initiated to refine permeability model and address the challenge occurring in several Saudi Arabia oilfields, where promising intervals with apparent fluid flow from conventional core analysis (CCAL) results do not produce upon testing or fluid mobility sampling. This phenomenon has resulted in increased fluid sampling, well testing and EOR treatment costs to confirm petrophysical interpretations. Rock grain sizes, pore system tortuosity and their effect on flow properties were analyzed for complex tight microporous sandstones of the Tuwaiq Mountain Formation in Rub' al-Khali Basin of Eastern Saudi Arabia. This Jurassic formation consists of north-easterly prograding fluvio-deltaic sandstones, alternating with finer grained paralic to shallow marine sandstones, dark lagoonal mudstones and sandy dolomitic limestones. Pore-scale permeability controls are studied with digital rock physics (DRP) technology as part of the pre-testing petrophysical analysis to support exploration drilling campaign and compute absolute permeability in this reservoir with wireline logs. A proper evaluation of the pore structure, types and hydraulic tortuosity led to better permeability log estimation through calibration of petrophysical algorithm using data produced from high-resolution (2-5 microns) X-ray micro computed tomography imaging. Generated DRP models from the core samples are used as an input to simulate profile of hydraulic tortuosity and grain sizes for the entire interval logged with downhole measurements. These properties together with total and effective porosities are considered as the main variables of the permeability function. Permeability calculation is supported by sorting index and cementation profile defined from borehole resistivity micro-image logs. Utilization of information on grain sizes and hydraulic tortuosity of the rock in permeability estimation significantly improves the results that show good agreement with well tests, CCAL and mercury injection capillary pressure data. This study confirms the feasibility of combining the DRP technology with well logging data to enhance the prediction of petrophysical properties, which are not directly measured from downhole tools.