AAPG Datapages/Search and Discovery Article #90254 ©2016, GEO-2016, 12th Middle East Geosciences Conference & Exhibition, Manama, Bahrain, March 7-10, 2016

Dual Porosity, Dual Permeability Modeling of Carbonate Reservoir with Integration of Fracture Characterization

Hugo Caetano[1], Reza Iskandar[1], Sahid Sutanto[1], Elena Niculescu[1],
Magdy Hozayen[1], Umer Farooq[1], Vincent de Groen[2], Solenne Roosz[2], Ghislain de Joussineau[2]

[1]SE, Abu Dhabi Company for Onshore Petroleum Operations, Abu Dhabi, UNITED ARAB EMIRATES
[2]Beicip-Franlab, Paris, FRANCE

ABSTRACT

Characterization of naturally fractured reservoirs is challenging due to its heterogeneous quality. An example is the complex fractured carbonate reservoir (Upper Cretaceous) in a field on-shore of Abu Dhabi. In order to control early water breakthrough problems, caused by fracture connections to aquifer and resulting in reduced oil production and bypassed oil issues, a detailed dual porosity, dual permeability (DPDP) modelling study was conducted to accurately characterize and model both matrix and fracture properties occurrence.

Initially, the workflow involved an evaluation of Electrofacies (EF) for rock-typing definition, full integration of seismic and fracture characterization, sedimentology, sequence stratigraphy and diagenesis. Based on 43 wells, 11 EF have been defined (6 limestones, 3 calcitic dolomites, 1 shale, 1 dolomitized limestone) for the reservoir using DT, NPHI, RHOB and VCL logs. Poro-perm relations and capillary pressures have been defined for each EF. The seismic mapping conversion to depth insured proper horizontal wells placement in the model. Based on Impedance distributions of facies, most porous limestone (EF05), was discriminated from the rest. Therefore, a cube of predicted EF05 with attached probabilities was used in the geomodel. Sedimentological and stratigraphical analysis assisted in defining 4th order sequences between main seismic horizons comprising of depositional, erosions and onlapping, helped to control facies distribution and created an exquisite framework.

Secondly, modeling of matrix properties with a nested approach where EF were simulated with pluri-gaussian methods provided a robust integration of seismic and diagenesis distribution. Petrophysical properties were simulated conditionally to the facies for Poro, Perm and Sw, based on the rock-types associations.

Thirdly, the dynamically calibrated fracture model built previously, using seismic facies maps, fractures density map, rock facies and dynamic reservoir data measurements, has been used to define range of length, spacing and spatial distribution of the fracture system.
Uncertainty analysis and upscaling was finally performed, where sensitivity analysis show a maximum 5% of variability from P50. Upscaling reduced 13M active cells to a dynamic case with 1.9M. The upscaled model will be dynamically modeled and historically matched in order to optimize location of new wells and trajectories for increased field production and delayed water breakthrough.