Enhanced Dynamic Simulation through Continuous Fracture Modelling of Carbonate Reservoir, Oman

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[1]Daleel
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ABSTRACT

The studied block is the largest and most faulted within the carbonate field which is currently under water-flood FDP. The study kicked off with extensive borehole image interpretation review of existing and new fracture picks. In parallel, several high resolution seismic inversions and spectral imaging attributes were generated as drivers to geological and fracture modelling. High resolution seismic was used to highlight subtle faults. Facies changes were also visible from seismic as seen in cored wells. Sequential geological modelling of GR, density, porosity and SW was constrained by seismic attributes.

The derived fracture frequency logs were compared against geological, structural and seismic drivers in a process called driver ranking. The results confirmed the role of faults as well as facies being primary causes of fracturing. Subsequently, the screened and cross-correlated potential drivers were carried forward to constrain the fracture models. Multiple stochastic realizations were derived through NNT training and testing and an average model was kept. Final models were validated against hidden BHI data. New BHI was used to confirm model prediction. Different types of dynamic data in non-BHI wells were also used to validate the fracture models as specific production/injection related issues could be directly linked to presence of fractures. These data include PLT, PTA and tracer tests from which injectivity issues and short circuiting were explained by higher fracture densities and corridors.

Through dynamic calibration, the fracture model was converted to fracture permeability. The fracture permeability is the product of fracture density and a scaling factor derived from history matching. Subsequently, the addition of matrix permeability and fracture permeability will determine the effective permeability. This $K_{effective}$ was directly used in Daleel's simulator without upscaling since it was part of the same grid hosting the fracture models. The results were encouraging as the simulation was smooth and error-free.