Improving Prediction of Fractured Basement Reservoir Performances - An Integrated History Matching Approach - Block S2, Yemen

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ABSTRACT

This work addresses the challenging task of history matching a fractured basement reservoir.

Habban field, south-western part of Yemen, produces from two different horizons: the Kuhlan sandstone overlaying the fractured basement.

The fractured basement reservoir is characterized by two types of fracturing: background fractures with very low effective permeability of less than 0.001mD and fracture corridors with an effective permeability ranging from 0.01 up to 10 mD, and a total porosity of 1.3% only. Two sets of fracture corridors, with N-S and NW-SE mean orientation, contribute to production whereas background fractures act as storage feeding in those corridors.

The large contrast in properties between Kuhlan and Basement adds-on further challenges: Kuhlan possesses good reservoir properties but moderate storage (~10m thick), whereas fractured basement has extremely poor reservoir properties but significant storage (~700m thick).

Habban field has produced since end 2006 by depletion through 30 slanted wells. To optimally assess different production strategies, a simulation model was built. Dynamic data (MDT, PLT, BHP, production rates) were used to constrain the dynamic model on well by well basis.

Due to this extremely challenging setting, a very high focus was put on a history matching process that integrates geology and reservoir simulation work to result into an enhanced understanding of field mechanisms.

One main conclusion of this integrated history matching approach is that water comes to wells from neighborhood formations through main faults, explaining then the erratic water production (no crest to flank correlation). Second highlight concerns the major contribution of N-S main fractures. Finally understanding of the communication mechanism between basement and Kuhlan was enhanced, showing that despite basement poor properties, basement oil feeds in Kuhlan, as Kuhlan is produced.

This synergized understanding of Habban mechanisms is a clear milestone for further well location planning and oil recovery optimization under uncertainty.