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Assessment of the Areal and Vertical Sweep Efficiency in Cyclic Carbonate Reservoirs of the Middle East - A Case Study from a Mature Field

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ABSTRACT

In this paper the authors analyze and discuss the implications of carbonate cyclicity (thin geological layers), with various degrees of heterogeneity, on the areal and vertical sweep efficiency of waterflood projects. An example from an Onshore Abu Dhabi reservoir is presented.

With the assistance of high resolution mechanistic static and dynamic models, the authors investigated the impact of various reservoir descriptions and multiple well completions with borehole segmentations, involving vertical and horizontal wells, on the overall sweep efficiency and recovery factor.

Detailed geostatistical models of porosity, permeability and water saturation were built, capturing the small scale sedimentary and diagenetic cycles, including the more dense stylolitic intervals. The mechanistic model, based on real field data, comprised of a crestal oil producer and a downflank water injector, with different completion strategies.

Applications:
Optimization of horizontal well placement, design and completion. Improved full field development plans for immiscible floods.
Improved volumetric sweep efficiency in heterogeneous cyclic reservoirs. Optimization of intelligent wells for improved recovery factors.

Results and Conclusions
In order to achieve more than 60% recovery factor in Middle East carbonates, it is not enough to change the injection fluid or the displacement efficiency mechanism. It is the judicious integration of improved displacement efficiency coupled with proper well spacing and completion design, including smart completions, that more than 60% recovery factors can be achieved.

Technical Contributions
Assessment of the areal and vertical sweep efficiency for heterogeneous cyclic carbonates of the Middle East. Guidelines for a well completion strategy for improved oil recovery in carbonate reservoirs.
Subsurface analog for waterflood projects in heterogeneous carbonates using horizontal wells with intelligent completions.