Identifying and Quantifying Pre-Production Imbibition: An Example from a Carbonate Field in the North of the Sultanate of Oman

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Abstract

Objective: Understanding fluid fill and charging history is one of the key building blocks for Field Development, since it is essential when estimating the initial hydrocarbon volume in place and describing the relative movements of the fluids in the reservoir. This paper demonstrates from a carbonate field in the North of Oman how the impact from a complex pre-production imbibition event can be quantified and the criticality of this in understanding well performance. **Observation and Methods**: The field was discovered in 1975, came to production in 1994 after drilling several wells which were showing water production from day one. By comparison of formation pressure data, log derived saturation data, and primary drainage capillary pressure curves from core it is shown that the free water level (FWL) in the field has risen by more than 45m between initial charge and present day (pre-production). This is consistent with a post-charge structural change (tilting) of the reservoir and seal breach with associated imbibition. The pre-production imbibition has a significant impact on the relative fluid movements, even tens of meters above the present-day FWL. Hence, it is critical for understanding well performance and selecting the optimal development strategy. The paper demonstrates how the magnitude of the imbibition can be quantified through careful comparison of primary drainage capillary pressure curves and log derived saturations, thus enabling calibration of an imbibition capillary pressure model. The model is validated through prediction of initial well test watercut and the saturation profile below the present-day FWL. The imbibition capillary pressure model as described above is established by applying a novel methodology by combining drainage and imbibition saturations to define two points on each imbibition scanning capillary pressure curve and match the imbibition capillary pressure model parameters to these points. **Novel/ Additive information**: This approach enables creation of a physically sensible model for imbibition capillary pressure even when no or only very limited core measured data are available.