Unconventional Approach to Estimate Permeability of Thin Beds in a Carbonate Reservoir with Vertical Interference Testing

Christophe Bassem Maalouf [1], Salem Al Jaberi [1], Irina Baca Espinoza[1], F. Elarouci [2], S. Smith[2], and H. Khairy[2]

[1]ADMA-OPCO
[2]Baker Hughes

Abstract

The evaluation of permeability across heterogeneous layer-cake reservoirs is challenging. For such cases, pressure-transient-analysis interpretation from well testing is usually not very reliable, because it can derive only average permeability. The vertical interference tests (VITs) conducted by wireline formation testing (WFT) can be one of the best solutions to evaluate the reservoir communication, anisotropy ratio and zonal horizontal permeability. However, the standard method of homogeneous single-layer interpretations might not work well for zones with thin beds in between.

This paper describes an unconventional approach for how VIT data was managed to interpret a multilayer zone in a carbonate green field offshore Abu Dhabi. Three tests were performed to measure the permeability within the layered reservoir and across a thin stylolite in between two layers. The initial pressure derivative modelling with standard assumptions did not give a good match, so additional methods were evaluated. The new approach is based on integrated analysis including core data analysis using a modified Lorenz Plot, associated hydraulic flow units and reservoir quality index, an analytic permeability log from nuclear magnetic resonance (NMR) and WFT pretest mobility. The result of the tight-zone analysis was improved using the VIT data across all layers with higher complexity and enables matching pressure derivatives with a more realistic interpretation.

The revised pressure-transient analysis gave a better match that was not possible using the homogeneous model. Additional data from vertical flow units and analytic permeability logs were used to fine-tune the multilayer models. The permeability findings matched the core data from offset wells. The results showed improved accuracy for horizontal and vertical permeability, thus providing improved understanding of zonal productivity which was crucial for the field development strategy.

The successful approach of using wireline open-hole logs and conventional core analysis from offset wells enables the generation of finely tuned multilayer models for VIT interpretation.