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Please fill in your abstract title.	Cross Well Electromagnetics: Reservoir Surveillance and Monitoring Technology	
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Abstract

Objectives/Scope:

This is a joint field project between Saudi aramco and Schlumberger. The project was designed to understand the remaining fluid saturation in a naturally fractured carbonate reservoir and find by-passed oil.

Methods, Procedures, Process:

The formation electrical resistivity is a basic petrophysical parameter used to evaluate subsurface reservoirs, particularly in petroleum fields. As reservoirs become more mature it has become imperative to extend this knowledge deeper into the reservoir to better characterize the rocks and fluids distribution away from the wells, and thereby improve field management. This can be accomplished by applying tools that are sensitive to the reservoir scale. One of these tools is inductive crosswell electromagnetics (EM).

Crosswell EM involves applying inductive physics and 2D/3D inversion to interrogate the interwall resistivity distribution. The method has developed into a mature technology in the oil and gas community, especially for EOR and time lapse studies. A crosswell EM system consists of a transmitter in one well that broadcasts a time varying magnetic field in the 3D region surrounding the boreholes, and multiple receivers that detect the magnetic field in another well some distance away. The collected data are used to image the interwall conductivity structures providing insights to fluid distribution and saturation mapping.

Results, Observations, Conclusions:

The results of the 3D inversions and saturation mapping of a crosswell EM survey conducted between two horizontal wells are presented. The data was acquired between a 1-km-long horizontal water injector and an equally long horizontal producer, spaced 1.3 km apart. The final 3D inversion yielded a resistivity model with clearly defined low- and high-resistivity areas. Aided by reservoir simulations, the resistivity model was converted to a 3D water saturation distribution, which connects the low-resistivity volumes with fracture zones filled with water, and high-resistivity volumes with possibly unswept rock matrix. A well was drilled to test an indicated high-resistivity area for by-passed oil. The well penetrated an oil column and is currently on production.

Novel/Additive Information:

This was the world's first crosswell EM survey between two horizontal wells. The achievements were identifying un-conformance in the water injection sweep, by locating potentially bypassed hydrocarbons.