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DERIVATION OF RELATIVE PERMEABILITY & FRACTIONAL FLOW BEHAVIOUR FROM THE INVERSION OF SATURATION LOGS IN HORIZONTAL WELLS WITH APPLICATION TO WATER SHUT-OFF AND PREDICTING VOLUMETRIC SWEEP EFFICIENCY

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DESCRIPTION

An inversion method is presented that uses saturation log profiles recorded in horizontal wells to derive relative permeability and fractional flow properties for a waterflooded carbonate reservoir. Observed water saturation profiles decreasing horizontally away from hydraulically conductive faults suggest a line-drive type encroachment of water into the fault-bound matrix blocks. The waterfronts have produced saturation profiles analogous to that predicted by Buckley-Leverett displacement theory, including the characteristic shock front. These profiles record parameters such as irreducible water saturation, the shock-front saturation, average saturation behind the front, and the residual oil saturation. These parameters are used to define boundary conditions on a fractional flow plot using Welges method. A fractional flow curve which meets the boundary conditions is then derived by changing the shape of the controlling relative permeability curves. The observed saturation profiles also show a correlation with porosity, allowing a suite of scanning curves to be derived for each porosity class. The reliability of the method is demonstrated by plotting the average pulsed-neutron-capture log saturations at the perforations against the producing watercut at the time of logging on the fractional flow graph.

APPLICATION

The fractional flow curves are used to discriminate between wells that produce at the correct watercut from wells that could benefit from water shut-off. The curves are also utilised for forecasting waterflood performance.

RESULTS

Identification of additional perforation and water shut-off activities amounting to significant oil gains over the past three years from very mature well stock. Provided new insight into the oil displacement process inferring higher mobility to water than previously suggested from core-plug data. Improved modelling of well & reservoir performance.

SIGNIFICANCE

First time that nonsynthetic saturation-front profiles are presented in the literature and used to derive dynamic properties.