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Title **Critical Gas Saturation and Relative Permeability During
Depressurization in the Far Field and the Near-Wellbore Region**
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Abstract

Depressurization of a virgin or waterflooded oil reservoir results in the appearance of a solution gas saturation. Above a saturation threshold, this gas becomes mobile and can be produced. Knowledge of the critical gas saturation (S_{gc}) and the subsequent relative permeabilities (K_r) in the far field and the near-wellbore region has a tremendous impact on gas and oil production forecasts.

The present paper provides a new methodology to obtain representative K_r and S_{gc} values for a depressurization process. Specific experiments are presented in which under-saturated oil was injected upstream at a fixed rate whereas downstream the pressure was controlled in order to reproduce a drawdown. Evolution of pressure was recorded and in-situ gas saturations measured by CT-scanner. Two initial conditions were considered, fully oil saturated and at irreducible water saturation. Influence of the drawdown scheme was also explored. Transient evolution of the gas saturation profile in the core is clearly shown. K_r are deduced from history matching. They are finally compared to the K_r derived from gas injection experiments.

It is demonstrated that gas/oil K_r shape is strongly affected by the way the gas appears and is distributed in the porous medium. For solution gas drive, oil relative permeability is higher and gas relative permeability is smaller than for gas injection.

Concerning critical gas saturation, the experiments show two types of gas mobility depending on the operational conditions: mobility threshold attained from connection of bubbles or from mobilization of a population of separate bubbles. For the first type, S_{gc} can be linked to the values obtained through static experiments at fixed depletion rate.