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Depletion of near-critical oils: comparison between pore network model predictions and experimental results.

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#### **ABSTRACT**

Literature data show a wide scatter in critical gas saturation when near-critical oils are depleted. Some controls have clearly been identified, such as the depletion rate, but cannot explain such a large scatter. In fact, the influence of several other parameters is still unclear. This paper sets out to study the effects of rock characteristics, core height and presence of initial water saturation, and the influence of the corresponding capillary to gravity ratios on critical gas saturation for solution gas-drive.

The combination of three different approaches has been used to decipher the variability:

1. Firstly, pore network simulations have been performed to assess the influence of rock properties and  $S_{wi}$  and design the experiments

2. Secondly, to check the validity of the pore network model predictions, several depletion experiments were performed with the same fluid (C1/C10) at 38°C and 400 bars initial pressure. During the depletion at 4 b/d depletion rate, fluids were recovered and measured at high pressure. In-situ saturation monitoring ensured a good control of saturation gradients within the cores.

- The depletion behaviour of a 750 mD homogeneous sandstone is compared with a 4 mD rock.
- The depletion performance of a dry Berea sample is compared with a 26 % initial water saturation sample
- The depletion behaviour of a high permeability, one metre long Berea core is compared with a 10 cm tall sample

3. Thirdly, numerical simulations with both pore network and ECLIPSE simulators were carried out and compared with experimental data.

It is concluded that:

- Both the rock characteristics and the amount of initial water saturation have a very significant effect on critical gas saturation and experimental observations are in agreement with predictions of pore network models
- Whilst there appears to be little evidence of the effect of core height on critical gas saturation, in-situ saturation profiles versus time and relative permeabilities are significantly affected. These issues are well described by the ECLIPSE simulations.