Bondino, I, Hamon, G., Long, J. & McDougall, S.R. 2007.
Investigation of gravitational effects in solution gas drive via pore network modelling: results from novel core-scale simulations.
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ABSTRACT
In this work a mature pore scale network model for oil depressurisation has been used for the first time to simulate typical core scales, initiating a new phase in the use of such techniques for core analysis. Important results clearly demonstrate the fact that it is now possible to reproduce the physical scale and pressure dependent balance of forces acting along the entire height of a vertically-mounted laboratory core during a solution gas drive experiment — without the need for upscaling pore-to-core methodologies. Now it has become possible to reproduce the complexity of an evolving gravity/capillarity force balance and investigate its nonlinear impact upon bubble break-up and coalescence phenomena throughout the course of an experiment. Using the macroscale approach explained above, we investigate the effect of varying the underlying Bond number of a simulation and examine sensitivities to the rate of depletion (bubble densities), the fluid properties, system scale, and the petrophysical characteristics of the sample. We show that relative permeabilities can be predicted according to the particular flow regimes exhibited by gas (dispersed and/or continuous) and demonstrate how flow is largely determined by the size and density of gas clusters, whether originating from nucleation or from break-up of larger structures during migration. In conclusion we show the different ways in which gas saturation gradients can develop along the height of a core sample. The results are compared against available experimental data — specifically, in situ gas saturation profiles and production histories — from equivalent sized samples (10 centimetres in height). These comparisons are utilised to provide a physical description of the mechanisms taking place during the experiments.