Bondino, I. 2006.
Pore-scale modelling of pressure depletion in porous media.
Gordon Research Conference, Andover, USA. 30 July-4 August.

ABSTRACT
Solution gas drive is the mechanism by which bubbles nucleate and grow from dissolved gas present in oil when reservoir pressure is lowered below the bubble point — gasphase expansion subsequently drives oil to the wellbore. A 3-phase pore network simulator has been developed to account for the fundamental steps of such a depressurisation process, where the nucleation of bubbles is modelled as a function of the petrophysical parameters and the physico-chemical properties of the oil. Each bubble grows by solute diffusion and expansion, until it coalesces with other bubbles creating a continuous gas phase that can eventually migrate and be produced. The predictive capability of such a tool, in terms of oil recovery profiles, critical gas saturations and relative permeabilities, is enhanced by the fact that each network can be anchored to real core samples (using mercury injection capillary data). Here, the complex dynamics specific to heavy, light and critical oil depletion are explored. The bubble nucleation process, the impact of different fluid properties upon bubble nucleation and growth and the dynamics of depletion at different rates are also studied in great detail. The simulations show that bubble densities, supersaturation histories and gas evolution strongly depend upon the particular fluid under investigation, as a result of the complex interplay between different interfacial tensions, gas/oil diffusivities and dissolved gas-oil-ratios characterising the fluid. Interfacial tensions were found to play the most dominant role in determining bubble nucleation density and subsequent gas evolution. Sensitivities at different depletion rates finally confirm the relationship between nucleation behaviour and supersaturation that motivates higher bubble densities as depletion rates increase.