A priori simulation of relative permeabilities of intact subsamples of tight oil shale from a hydraulic fracturing play

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Abstract. We present novel, *a priori* estimates of the nanoDarcy oil/water relative permeabilities within tight-oil shale that are too small to be measured experimentally, with the aim of increasing the yield from existing unconventional reservoirs. Intact half-cm^3 subsamples were washed to remove the mobile tight oil, then subjected to electron microscopy, mercury porosimetry, and helium and powder pycnometry. Simulated void networks were generated that are based on the PoreXpert inverse modelling of the entire mercury intrusion curve, extended to nanometer scale using helium pycnometry, with the completely integrated percolation behaviour of around 43000 voids of sizes closely matched to the experimental input. The absolute permeability of the network is calculated as the maximum flow through the pore-throat-pore arcs, determined by parametrised Navier Stokes equations. Relative permeability is modelled as a mobile phase moving past a static phase that restricts the flow. The resulting oil relative permeabilities vary according to the wettability of the sample surfaces. The unique characteristics of our results are that quasi-static and dynamic aqueous relative permeabilities vary according to local flow conditions, and that absolute relative permeabilities are presented that vary widely between samples, in contrast to the usual normalized values.