“Multifluid flow in oil and gas reservoirs: from invasion percolation to shale gas”

Roland Lenormand

CYDAREX, France

ABSTRACT

The talk will present some improvements in modeling multifluid flow in porous media during the last decades, a research area to which Alkis Payatakes and his collaborators had a significant contribution.

The first part of the talk will describe results obtained by using visualization experiments in micromodels coupled with flow simulations in pore networks. On the one hand, these studies enable the identification of the structure of flow patterns under the interaction of viscous and capillary forces: invasion percolation, viscous fingering, stable flow, and the transitions between these regimes. On the other hand, pore network modeling could replace the very expensive laboratory experiments of special core analysis (SCAL) that are commonly used to determine multiphase flow properties of reservoir rocks, such as the oil/water relative permeability curves. The microscopic structure of the rock (e.g. 3-D pore space morphology) can be quantified by using either thin sections or more recently x-ray micro-Computed Tomography scanner. Then, the multiphase flow in porous rocks may be simulated by various methods to calculate corresponding properties of reservoir rocks. Such bottom-up approaches are now commercialized by some companies.

The last part of the talk will focus on the single or multiphase flow in very low permeability rocks with application to shale gas (hydrocarbon production) or the storage of nuclear waste in clay formations (environmental protection). Some theoretical results and recent laboratory methods developed for measuring permeabilities below one nanoDarcy will be presented