Thermogravitational segregation in a North Sea petroleum reservoir

Baghooee, Hadise; Montel, François; Galliero, Guillaume; Lassen, Charlotte; Yan, Wei; Shapiro, Alexander

Publication date:
2020

Document Version
Peer reviewed version

Thermogravitational segregation in a North Sea petroleum reservoir

Hadise Baghooee[1, 2], *François Montel*[3], *Guillaume Galliero*[3], *Charlotte Lassen*[1], *Wei Yan*[4], *Alexander Shapiro*[2]

[1]*Danish Hydrocarbon Research and Technology Centre*
[2]*Technical University of Denmark, Department of Chemical and Biochemical Engineering, CERE*
[3]*University of Pau, LFCR*
[4]*Technical University of Denmark, Department of Chemistry, CERE*

In many petroleum reservoirs, the fluid properties are not the same through the reservoir thickness. Variation of the composition, i.e. compositional grading, can affect reserve estimation, production and EOR strategies. Apart from gravity, the geothermal gradient may also contribute to the fluid distribution. Thermodiffusion is the governing phenomenon determining contribution of the geothermal gradient.

Compositional grading in reservoirs at initial state can be obtained from data analysis, but in many cases, the quality of the data is poor and the number of representative samples from a given reservoir is scarce. Therefore, non-equilibrium thermodynamic models are used for the calculation of the compositional gradients. This computation provides valuable information on the connectivity between the different sampling points [1].

In order to determine the variations in pressure and composition with depth and to be able to indicate if/where a gas-oil contact exists, we have developed a model based on the principles of irreversible thermodynamics, within the approach to thermodiffusion in porous media proposed by Montel et al. [2]. Based on the relationships where pressure, chemical potentials, and thermal gradient are linked, the distribution of hydrocarbons in a petroleum reservoir is described. A computational algorithm accounting for non-ideality of the mixture, characterization and phase transitions has been developed. We validate our model and calculation procedure for the compositional grading by comparison with the case studies reported in the literature for a North Sea reservoir, and with sample component distributions produced by application of the molecular dynamics.

Acknowledgement

This research has received funding from the Danish Hydrocarbon Research and Technology Centre (DHRTC) under the TRD programme.

References

[1] R. O. Espósito, P. H. R. Alijó, J. A. Scilipoti, and F. W. Tavares, *Compositional Grading in Oil and Gas Reservoirs*. 2017.
[2] F. Montel, H. Hoang, and G. Galliero, “Linking up pressure, chemical potential and thermal gradients,” *Eur. Phys. J. E*, vol. 42, no. 5, p. 65, 2019.