

How to resolve the noble gas composition of an oil

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Over the last two decades, several noble gas studies reported and interpreted results on petroleum systems. Noble gas reservoir fluid composition is straightforward when the fluid is stored in sub-surface under gas phase. However, when the fluid is diphasic or monophasic liquid, the reservoir fluid noble gas signature has to be recombined, as only the gas phase can be analyzed without generating permanent damages in the analytic system [1]. To do so, phase fractionation coefficients (Ki) [2], P-T conditions and phase volume ratios (Gas Oil Ratio) have to be known.

Nowadays, only fractionation coefficients of two oils, distinguished only by their API gravity, are available in the literature [3], which is far from covering all different types of oil.

We proposed in this study, a new experimental approach to access to the initial noble gas content based on successive measurements of the gases released from the same oil at different steps of pressure. This type of experiment, called multiple steps flash experiment, is well-known and widely used in PVT (Pressure Volume Temperature) facilities, to define thermodynamic properties of hydrocarbon fluids. In this case, a synthetic fluid was created, recombining a lacustrine dead oil (equilibrated with air) with a separator gas whose noble gas composition was previously measured. The API gravity of the fluid is 25, and the GOR is about 100. The recombined fluid was then transferred monophasic liquid in a PVT unit, whose volume was pumped down to 10^{-7} mbar to minimize the air pollution and, the temperature is maintained at 70°C. The experiment consists on a step by step pressure decrease below the bubble point pressure in order to create a gas phase. At each step of pressure, the gas phase is separated from the oil phase then subsampled and analyzed. Knowing the initial fluid composition in noble gases and measuring the one in the gas fraction, it is possible to deduce the residual noble gas composition in the liquid fraction and therefore the fractionation coefficients.

This approach aims to extend the Ki database for oils in order to access to the first order parameters influencing their value.

[1] Pinti & Marty (1995). GCA, 59(16), 3389-3404

[2] Ballentine et al. (2002), Rev. Min. 47, 539-614

[3] Kharaka & Specht (1988) Appl. Geochem. 3 137-144