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Using noble gases to predict the hydrocarbon-water contact

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A fundamental part of any appraisal program is locating the depth of the hydrocarbon-water contact (gas-water or oil-water). Such information is critical in determining the total volume of hydrocarbons emplaced. Until drilling, such information is estimated using calculated spill points or direct hydrocarbon indicators on seismic. A typical exploration strategy is to drill a well proving an economically viable volume of hydrocarbons. The first appraisal well is drilled to define the size of the pool of hydrocarbons in place by locating the hydrocarbon-water contact. However, such an approach has a variety of outcomes, of which only one is penetrating the contact.

Within the subsurface, the source of atmosphere-derived noble gases (^{20}Ne, ^{36}Ar, ^{84}Kr and ^{132}Xe) in hydrocarbon fluids is the groundwater or aquifer [1]. The noble gas composition of water in the subsurface is relatively well-constrained [2]. Upon interacting with hydrocarbons, these noble gases will partition from the water into the hydrocarbons [3][4]. When samples are collected within a connected reservoir at steady-state conditions, a distal effect with depth is observed [5]. Using the noble gas signature of two or more downhole fluid samples (e.g. WFT), an estimation of the contact position can be provided without penetrating the contact itself.

In this study, we present the application of this method on different contacts, predicting oil-water and gas-water depths, from a single well and multi-well studies.

An implication of this study is the possibility to constrain the hydrocarbon limit from a single well. Thus, reducing the number of appraisal wells and the cost of an appraisal programme.

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