Investigating reservoir connectivity using nobles gases in a West of Shetland hydrocarbon reservoir

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A multitude of established tools exists to determine static connectivity and fluid organisation post-hydrocarbon emplacement. However, these tools are not applicable to all scenarios, and it is particularly difficult to assess the connectivity between fluids of different phases. We present work from Field A, which investigates the role noble gases can play in resolving vertical and lateral reservoir connectivity and post-emplacement fluid organisation.

Field A is located in the Flett sub-basin, West of Shetland, UK Atlantic Margin. To date, three wells have been completed (W1, W2 & W3); with W1 & W3 encountering gas condensate and oil in W2. The reservoir is composed of four sand intervals (A, B, C & D); the sands have a porosity of ~22% and a permeability of 30-300mD. Each reservoir interval was sampled downhole during drilling; sub-samples were then taken onshore for noble gas analysis.

Noble gases are chemically inert tracers that naturally occur in hydrocarbon reservoirs. The fractionation of noble gases between phases and the physical processes that act on them are relatively well constrained [1]. In theory, if a reservoir interval is disconnected, then the radiogenic and elemental ratios of the noble gases will be distinct, thus making them ideal tracers of hydrocarbon fluid.

Conventional connectivity studies completed on Field A have established partial vertical connectivity in wells W1 and W2, but could not resolve lateral connectivity. We firstly show that noble gases clearly confirm the previous findings of vertical connectivity.

Further, we propose a new dynamic approach to understanding hydrocarbon fluid organisation within a two-phase system, permitting improved understanding of lateral reservoir connectivity.

[1] Ballentine, Burgess & Marty. (2002) *Reviews in mineralogy and geochemistry*, **47** 539-614.