# The importance of igneous intrusions and basement composition on the timing of petroleum generation

The Faroe-Shetland Basin (FSB) is a prolific deep-water hydrocarbon province with world-class oil, gas and condensate discoveries within reservoirs ranging in age from Neoarchean fractured basement to Devonian, Carboniferous, Triassic, Jurassic, Cretaceous and Paleogene clastics, including the Clair Field with an estimated 10 x $10^9$ barrels of in-place oil.

Several geological features of the FSB make this a relatively unique province within the UK Continental Shelf (UKCS), including:

1. Prolific Paleogene flood basalts and igneous intrusions which are thought to be thickest in the basin (up to 1,500 m cumulative thickness) (Mark *et al.,* 2018)
2. Sampling shows basement rock in the FSB (e.g. Cambo-1, 204/10-1) to be composed of Neoarchean orthogneisses which are significantly older, and consequently colder, than the North Sea basement, where average upper crustal radiogenic heat production (RHP) averages 2.8 – 3.2 μW/$m^3$. Our calculations suggest the RHP may be 50 – 60% lower than in other petroleum basins on the UKCS (e.g. Central Graben), averaging just 1.6 μW/$m^3$ on the Corona Ridge.
3. Wide-angle seismic, gravity and magnetic evidence suggests that continental rifting may be of a much greater magnitude in the centre of the Flett Sub-Basin, with a cumulative stretching (β) factor of 3.0. This implies the present-day crystalline crust may be as thin as 7km.

Recent work by IGI in collaboration with Siccar Point Energy, Chemostrat, APT & The University of Aberdeen has created an updated geological and petroleum systems model which includes igneous intrusions and basement composition, in order to investigate their effects on the timing and magnitude of petroleum generation from Kimmeridgian source rocks. The results suggest the geological characteristics of the basin may, once properly included in our 3-D model, bring the predicted timing of oil generation closer to the present day by up to 40 m.y.

The study is to be published in *Geology* in October 2019, with an open access early publication edition available online now:

https://pubs.geoscienceworld.org/gsa/geology/article/573069/modeling-petroleum-expulsion-in-sedimentary-basins

References:

MARK, N., SCHOFIELD, N., GARDINER, D., HOLT, L., GROVE, C., WATSON, D., ALEXANDER, A., & POORE, H., 2018, Overthickening of sedimentary sequences by igneous intrusions. Journal of the Geological Society, v.176, p.46–60. https://doi.org/10.1144/jgs2018-112