

A New 4-D Structural and Oil Charge Model of the Greater Wytch Farm Field Area (Wessex Basin, United Kingdom)

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ABSTRACT

The Wytch Farm Field reportedly contains an estimated 1 billion barrels of oil in place, the majority being trapped in the Triassic Sherwood sandstone. However, the oil charge is still not completely understood. The oil is proven to be generated from Liassic source rocks, which are mature for oil and gas in a half graben south of the Purbeck - Isle of Wight Disturbance, a major E-W fault system. The present day structural configuration does not present any kitchen to carrier connections across that fault system, which would allow for recent hydrocarbon migration. Using simple 2D structural restoration, previous published models have suggested up fault migration to the Sherwood in the footwall at the time of maximum burial in the Late Cretaceous. The question why the charge has been successful only for Wytch Farm and a series smaller satellite traps along a fill/spill chain to the west, and did not work elsewhere, is not addressed. This new study uses structural modeling and restoration, paleo- fault juxtaposition and fault seal analysis was carried out to recreate a pre-inversion 3D structural configuration of the greater Wytch Farm area. In this restored space, corresponding to Cretaceous times, the oil kitchen and carriers beds of the hanging wall were modeled to be locally in contact with the footwall carrier beds and reservoirs. This past zonal juxtaposition along the fault system occurred at some specific locations only, which were controlled by the presence of Triassic salt, the structural style of the fault system, the linkage of its individual fault segments, and the varying throw. Pre-inversion drainage area-based oil migration analysis and petroleum systems modeling were applied to investigate the duration of the localized “charge window”, cross-fault charge amounts and rates. With this new quantitative 4D charge model for the greater Wytch Farm area, oil and gas discoveries, shows and seeps, the absence of charge in other structures, and the successful charge of the Wytch Farm oil field can be explained, and the exploration potential in this mature basin can be re-evaluated.