Kinetics of Hydrocarbon Generation from the Marine Ordovician Goldwyer Formation Canning Basin, Western Australia

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Abstract

Pyrolysis and bulk kinetic studies were used to investigate the hydrocarbon generation potential and variability in the organofacies of marine source rocks in the Middle Ordovician Goldwyer Formation of the Canning Basin, Western Australia. Rock Eval pyrolysis results for the analysed samples imply that the Goldwyer Sequence I contains mostly Type I and type II kerogen, while the Goldwyer Sequence III is composed of mostly Type II oil-prone and Type II/III oil and gas-prone kerogen. This is supported by the Py-GC results, which show a dominance of homogeneous, aliphatic molecular signatures in the Goldwyer I shales, possibly attributed to the enrichment from the selective preservation of the lipid fraction derived from Gloeocapsomorpha prisca (G. prisca), and a more heterogeneous organofacies in the Goldwyer Sequence III, where aromatic moieties are present in similar abundance as the aliphatic compounds. Hence, the Goldwyer Sequence I have the capacity to generate paraffinic oil with low wax contents, whereas the Goldwyer Sequence III has the generative potential for paraffinic-naphthenic-aromatic (P-N-A) low wax oils to gas and condensate. Assuming a constant geological heating rate of 3°C/Ma, the temperature for hydrocarbon generation is predicted to occur at high temperatures and over a narrow interval between 145°C and 170°C for the Goldwyer Sequence I, while generation in the Goldwyer Sequence III, containing thermally less stable kerogen, is predicted to occur from 80°C to 170°C. The kinetic model from this study was tested against wells on the Broome Platform, (Canning Basin). The

outputs show a marked difference in the degree of kerogen transformation between the kinetic models generated in the present study and some of the default kinetic models provided in the PetroMod™ software, which could significantly impact the assessment of oil and gas in-place in conventional and unconventional systems. Some of the default kinetic models suggests relatively lower TR (%) values and mid-mature oil generating window for the Goldwyer III shale unit, while other kinetic models suggest late mature stage of oil generation to early stage of gas generation. On the other hand, no kerogen transformation reaction was observed for the Goldwyer Sequence I in the Broome Platform wells. This study highlights the significance of obtaining specific kinetics data on samples from a specific shales and basins rather than using “global” average kinetics.