Petroleum Systems Characterization Based on Organic Geochemistry Interpretation in Oman Basins

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Abstract

Regional geochemical synthesis study was launched in TotalEnergies with the main idea to develop petroleum systems understanding across Oman basins and to address some specific hydrocarbon systems-related questions about source rock facies, distribution, ages, and quality. Hydrocarbon compositions from more than 300 reservoired oils, source rock extracts and stains have been interpreted which helped to constrain source-rock characteristics such as organic-matter type, depositional environment, level of maturation and, to some extent, age. Oil families have been identified based on the molecular parameters and fluid bulk properties. Age indicating biomarkers helped to constrain and to infer the source rock ages for the oil families where no source rock extracts were available. Huqf oils originated from Precambrian-Cambrian source rocks are of algal and bacterial origins and deposited in low oxygen condition. They show strong molecular signatures (mid-chain mono-methyl alkanes, dominant C29 steranes, light isotopes). Oils sourced by the Cambrian marine clastic marly source rock have high C27 steranes (probably due to the increased life diversity) and lower mono-methyl alkanes. Mixed Precambrian-Cambrian fluids with terrestrial contribution of Mesozoic age (possibly Triassic?) are found in the north-west. Lower Cretaceous Natih lacustrine carbonate and marl fluids occur in the North of Oman basin. Fluid properties are highly dependent on source facies, maturity, charge history and reservoir conditions.

Regional trends in fluids distribution have been observed providing some insights about hydrocarbon commodity type in Oman basin. In the south, fluids are originated from Huqf source rock of Type IIS kerogen with lower activation energy generating hydrocarbons early and mostly sulphur-rich oil. Such source rock presence along with lower maturity level compared to the North resulted in dominantly “oil only” fields in this part of the basin (even though gas accumulations do exist). In the North, source rocks of Type IIS kerogen are also present (Natih, Huqf), but marine Type II (associated with so-called Q signature) source rock is contributing as well. Presence of such mixed source rocks in terms of kinetics and higher maturity level have resulted in mixed oil and gas accumulations. These observations could be critical in fluid properties prediction and could be investigated further along with other factors such as trap size, column heights, pressure regimes, seal capacity.

Improved understanding of Oman petroleum systems has resulted from this study and will contribute to generating new play concepts, hence new exploration opportunities.