Petroleum Systems of the Tertiary-Reservoired Oils in the Beaufort Mackenzie Basin: A New Perspective from the Quantitative Whole Oil GC/MS and Saturate GC/MS/MS Data

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Abstract

This preliminary study is based on a large collection of Tertiary-reservoired oils from the Beaufort Mackenzie Basin. Molecular markers are used to group genetically related oils, to correlate discovered oils with source rocks and to postulate the probable source rock depositional environments for migrated oils of uncertain origin. This approach, used with petroleum mass fraction in mind and integrated with geological data, could allow exploration geologists to constrain source rock quality, one of the key variables in petroleum systems, even in cases where the source rock has not been penetrated. Saturate GC/MS/MS results of the Tertiary-reservoired oils show a general increase in the relative proportion of C29 steranes within the total 4-desmethylsteranes from the Beaufort Sea toward Mackenzie Delta, in contrast to a general decrease in the (oleanane + bisnorlupane) to sterane ratio. Many of the oils in the offshore area display extremely low apparent maturity levels by the C29 steranes, but their C27, C28 and C30 counterparts show much higher maturity signatures. These discrepancies, together with the whole oil GC/MS data, suggest that most of the Tertiary-reservoired oils in the Beaufort Mackenzie Basin were derived from thermally mature source rocks, likely expelled at peak oil window. We propose two possible hydrocarbon fluid mixing scenarios to explain the origin of these oils, suggesting that the possibility of graben-type Mesozoic nonmarine source rocks in the southern delta (Adlartok-Taglu trend) and Upper Cretaceous-Paleogene marine source rocks in the offshore area be further investigated.