

Molecular and Isotopic Evidence for the Origin of Tertiary-Reservoired Oils in the Offshore Beaufort-Mackenzie Basin, Canada

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Over 170 Tertiary-reservoired oils of the Beaufort-Mackenzie Basin, NW Canada have been examined molecularly and isotopically for the purpose of determining sourced-defined families and estimating the depositional and compositional characteristics of their source rocks. The oil set covers almost every major oil discovery in the Mackenzie Delta, Beaufort Sea and Tuktoyaktuk Peninsula. Stable carbon and hydrogen isotopic data discriminate three end-member oil families in the on shore and southern Delta (Parsons-Siku-Kamik, Atkinson-Mayogiak-Kugpik, and Adlortok-Niglintgak), while many of the oils in the Delta and offshore region showing evidence for mixed source inputs.

Many of the Tertiary-reservoired oils were previously proposed to have derived from resinite-rich Tertiary source rocks (e.g. coals) of usually low thermal maturity. However, this is not supported by the results of gasoline-range hydrocarbons and GC/MS/MS results of C15+ saturated and aromatic hydrocarbon fractions. The absolute concentrations of a number of molecular markers determined from the studied oils and the results of laboratory artificial mixing experiments suggest that, although the chemical distinction between the end-member oil families is likely source-defined, migration and in-reservoir contamination also appear to play a role. Molecular maturity ratios are inversely proportional to the relative concentrations of angiosperm biomarkers in the oils, suggesting that petroleum fluid mixing has compromised maturity and source assessment of many of these oils. Thus, more oil-prone marine source rocks are present in the currently unpenetrated distal deltaic portions in the Tertiary and/or Cretaceous. The relative timing of hydrocarbon generation and trap formation, not poor source rock quality, may have contributed to the under-filled traps in the offshore region.