Carbon and hydrogen isotopic analysis of hydrocarbons from the South Oman Salt Basin

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The ^{13}C and ^{2}H contents of sedimentary hydrocarbons are controlled by multiple factors including the isotopic contents of the inorganic carbon and ambient water, the isotopic fractionations imposed by the enzymes of C and H assimilation and biosynthesis, and processes that take place during diagenesis and catagenesis. Disentangling these effects can present significant challenges for those attempting paleorecontruction using the isotopic compositions of individual organic compounds.

Oils from the South Oman Salt Basin (SOSB) have been formed from organic matter that was deposited in the Huqf Supergroup over a period of about 100 million years spanning the Neoproterozoic-Cambrian Boundary. Data on the C and H-isotopic contents of these oils might be useful for correlating petroleum deposits with their source rocks. Given appropriate geological and geochronological controls, the isotopic characteristics of these hydrocarbons might also inform us about biogeochemical events that took place during the Neoproterozoic reorganisation of biogeochemical cycles and surrounding the early radiation of the metazoa.

The ^{2}H contents of hydrocarbons in SOSB oils and their source rocks do not vary systematically with stratigraphy or biomarker-defined petroleum systems but have apparently been strongly influenced by sedimentary diagenetic and catagenetic processes. In contrast, distributions of ^{13}C show some consistent and unusual features that are useful for correlation and, possibly, biogeochemical reconstruction. The ^{13}C contents of alkanes range, overall, from about -30 to about -40‰ and vary systematically with carbon number. In any single oil they range over 2 to 5‰. With some overlaps, they correlate roughly with biomarker-defined petroleum systems. Independent of the petroleum system, C_{15}-C_{20} alkanes invariably show a strong odd-versus-even isotopic variation that, by reason of scale and sign, suggests mixing from isotopically distinct sources. These low molecular weight alkanes are isotopically ‘light’ and distinct from their high molecular weight counterparts. This is opposite to maturity-driven trends so, evidently, this also reflects mixing of different organic sources. The isotopic compositions of the acyclic isoprenoids pristane and phytane do not track those of the adjacent n-C_{17} and n-C_{18} hydrocarbons. These variations can be specific to source-rock horizons.