

CARBON ISOTOPIC COMPOSITIONS OF N-ALKANES AND ISOPRENOIDS PROVIDE EVIDENCE OF SOURCE CONTRIBUTIONS FOR XIHU PETROLEUM

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The $\delta^{13}\text{C}$ of individual hydrocarbons has been commonly used in making oil-source and oil-oil correlations. But the isotope variation in different carbon number n-alkanes could complicate the interpretations. Sun et al. (2000) reported a depletion in ^{13}C in high molecular weight n-alkanes of mudstones associated with coals in Turpan Basin, and attributed this to a large amount of algal inputs due to aqueous biota resulting in ^{13}C depletion for specific molecules. However, Xiong et al. (2005) and Liu et al. (2006) studied the n-alkanes carbon isotopes of source rocks in the Turpan and Huanghua Basin and couldn't observe significant differences in $\delta^{13}\text{C}$ values between coals and interbedded mudstones. Zhou et al. (2010) studied the saw-tooth patterns of the $\delta^{13}\text{C}$ of these n-alkanes and showed that both odd and even carbon number n-alkanes could have originated from terrestrial higher plants, but via different biochemical pathways. Solely using carbon isotope of individual hydrocarbon to make correlation may neglect the different organic matter sources contribution to identical lithology.

The molecular and individual n-alkanes carbon isotope compositions from the Paleogene coals (TOC: 48.00%-60.28%), mudstones (TOC: 0.45%-2.27%, 12.73%-19.63% for carbonaceous mudstones) and oils in the Xihu depression, East China Sea were determined to discriminate the relative hydrocarbon contribution of coals and associated mudstones for petroleum generated from basin. Much abundant diterpanes (e.g., isopimarane, phyllocladane) are present. The changes in $\delta^{13}\text{C}$ values of Pr and Ph is suggestive of separate origins for the isoprenoids. A general trend of negative sloping profile across carbon chain length was observed with $\delta^{13}\text{C}$ values between -22.12‰ and -32.64‰ vs. VPDB for the individual n-alkane, which is characteristic of C3 plants isotopic compositions and is consistent with typical fluvial/lacustrine depositional settings as well. The n-alkane $\delta^{13}\text{C}$ values of Pinghu oil field samples are generally heavier (-22‰ to -30‰) relative to Huangyan oil field samples (-24‰ to -34‰), which may reflect the variability of different biota. The isotope compositions of individual n-alkanes show correlations with the relative concentration of terrigenous higherplant-derived diterpenoids, suggesting that plant phyla/classes (gymnosperm derived diterpanes vs. angiosperm derived diterpanes) may impact the carbon isotope profiles of n-alkanes. For terrigenous-dominant organic matter, long-chain n-alkanes with a large proportion of gymnospermous organic inputs are approximately 2-3‰ enriched in ^{13}C than those with angiospermous organic inputs, regardless of lithologies. Thus, this provides with evidence of differentiating specific hydrocarbon contribution to petroleum. Oils generated from coals show decreasing $\delta^{13}\text{C}$ values with chain-length within a narrow range (approx. 2-3‰), whereas oils from the mudstones are more depleted in ^{13}C with increasing carbon number (n-C₂₀₋₃₀). For Huangyan oil field, 825B oils have more mudstone-sourced hydrocarbon contribution than that of 825AD oils. The tricyclic, tetracyclic diterpanes and isotopic compositions of individual n-alkanes may be useful in estimating the relative contributions of coals and associated mudstones to petroleum.

References

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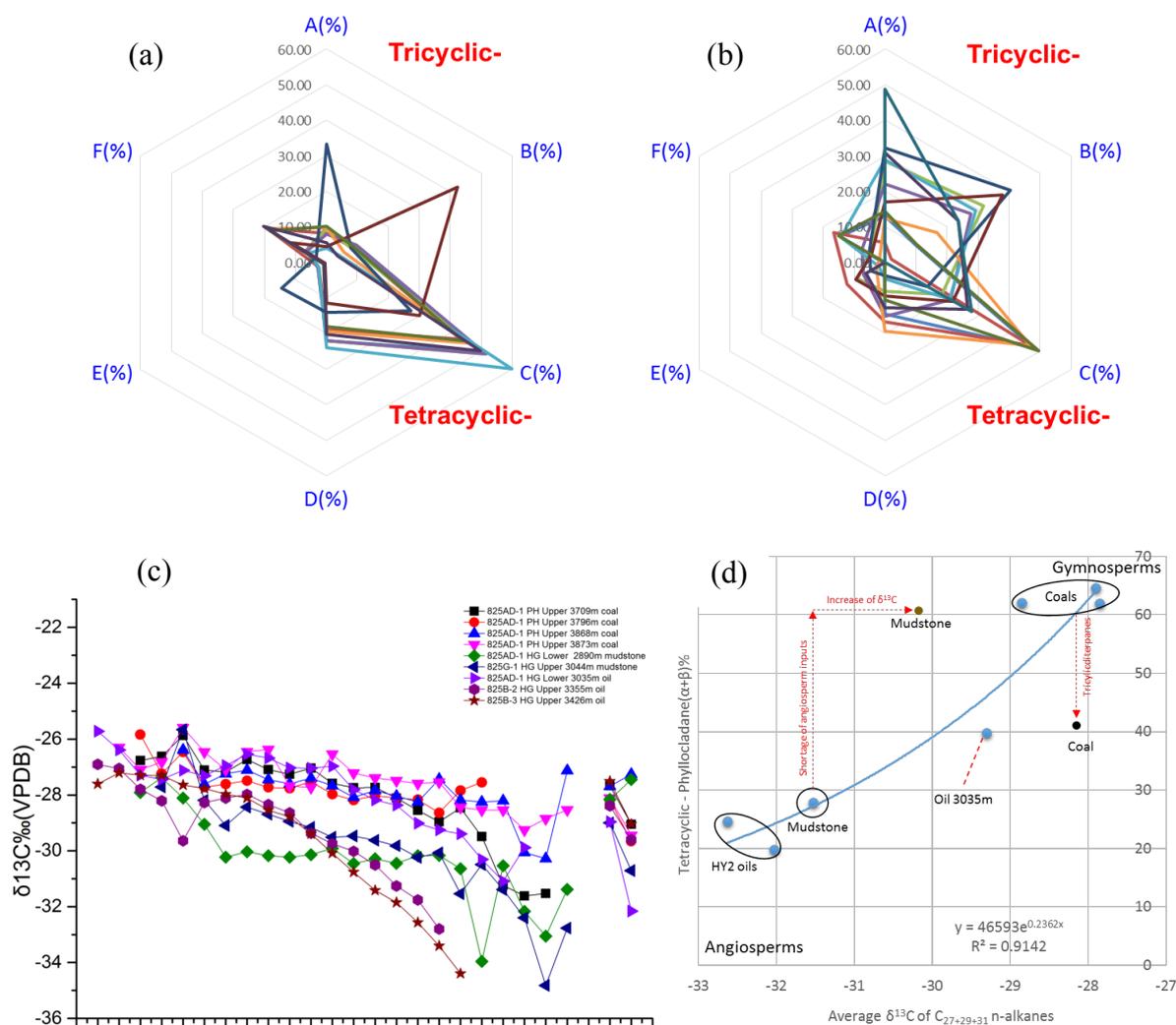


Figure 1 Spider diagrams showing the variation in higher plants related diterpenoids for (a) coal extracts, (b) mudstone extracts. The $\delta^{13}\text{C}$ values of individual n-alkanes and isoprenoids in samples from (c) HY oil field. (d) Correlations of average $\delta^{13}\text{C}$ values of n- $\text{C}_{27+29+31}$ alkanes versus relative abundance of tetracyclic diterpanes.