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Effects of source and thermal maturity on the distribution of aromatics and biomarkers in artificially generated oils

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Oils generated from isolated kerogens from a variety of source rocks, including two marine shales, two terrestrial coals, and three lacustrine oil shales were characterized for the effects of source and maturity on the distributions of hydrocarbons compounds. Experiments were conducted by confined pressure (gold-tube) pyrolysis at 320 deg. Celsius at four laboratory maturities (0.79, 0.95, 1.10, 1.34 Easy%Ro).
The results show that normal alkane distribution in oils from different kerogens exhibit distinct preference in carbon number and predominance in specific compounds. The carbon preference index (CPI) and odd-even predominance (OEP) ratios tend to approach to 1 with increasing maturity. Oils from two terrestrial kerogens show higher Pr/n-C17 ratio than lacustrine kerogens (Green-river oil shale, GR) and vice versa for Ph/n-C18 ratio. Both ratios decrease with increasing maturity but show distinct trends for different kerogens. The (Pr/n-C17) and (Ph/n-C18) ratios for the lamosite, torbanite, and two marine kerogens are very low at all studied maturities. The pristane/phytane (Pr/Ph) and [(Pr/C17)/(Ph/C18)] ratios in oils from three major kerogen types vary barely with maturity but are discernible in diverse organic types, implying good source indication.
The methylphenanthrene ratios (MPR) for most kerogens, which vary significantly only at maturities higher than 1.0 %Ro, are suitable for high maturity indication. The methylphenanthrene distribution fraction (MPDF), in general, increases slightly with increasing maturity, except in torbanite. The MPDF parameter for GR kerogen exhibits best linear correlation with maturity whereas methylphenanthrene index (MPI1 and MPI3) from GR kerogen and two marine kerogens show better correlation than terrestrial kerogens. Source dependence of these methylphenanthrene maturity parameters was observed. The low contents of methyl-dibenzothiophenes (MDBTs) in oils from lacustrine and terrestrial kerogens lead to abnormally low MDR ratio (i.e. 4-MDBT/1-MDBT), and hence the ratio may underestimate the maturity for terrestrial oils. MDRs for two marine kerogens follow oppose trends, suggesting high source-dependence of the MDR as maturity parameter. Two trimethylnaphthalene parameters, TNR-2 and TMNr, exhibit good correlation with maturity for most kerogens, but the MNR, DNR-1, and TNR-1 ratios for GR kerogen are suitable only for indicating maturity higher than 1.0 %Ro. Maturity parameters, Ts/Ts+Tm, tetracyclic terpanes/C30-hopane, and drimane/homodrimane, show conspicuously different trends with increasing maturity for all studied kerogens. The contents of bicyclic sequiterpanes in oils varies with their sources but their relative concentration changes significantly with maturity as a result of neo-formation and/or secondary cracking; the drimane/homodrimane ratio in Green-River oil increases progressively with maturity whereas the eudesmane/drimane ratio in the terrestrial oils decreases with maturity.