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DIAMONDOIDS AND BIOMARKERS IMPROVE UNDERSTANDING OF OIL CRACKING, MIXING, AND GEOCHEMICAL CORRELATION ON THE NORTH SLOPE, ALASKA

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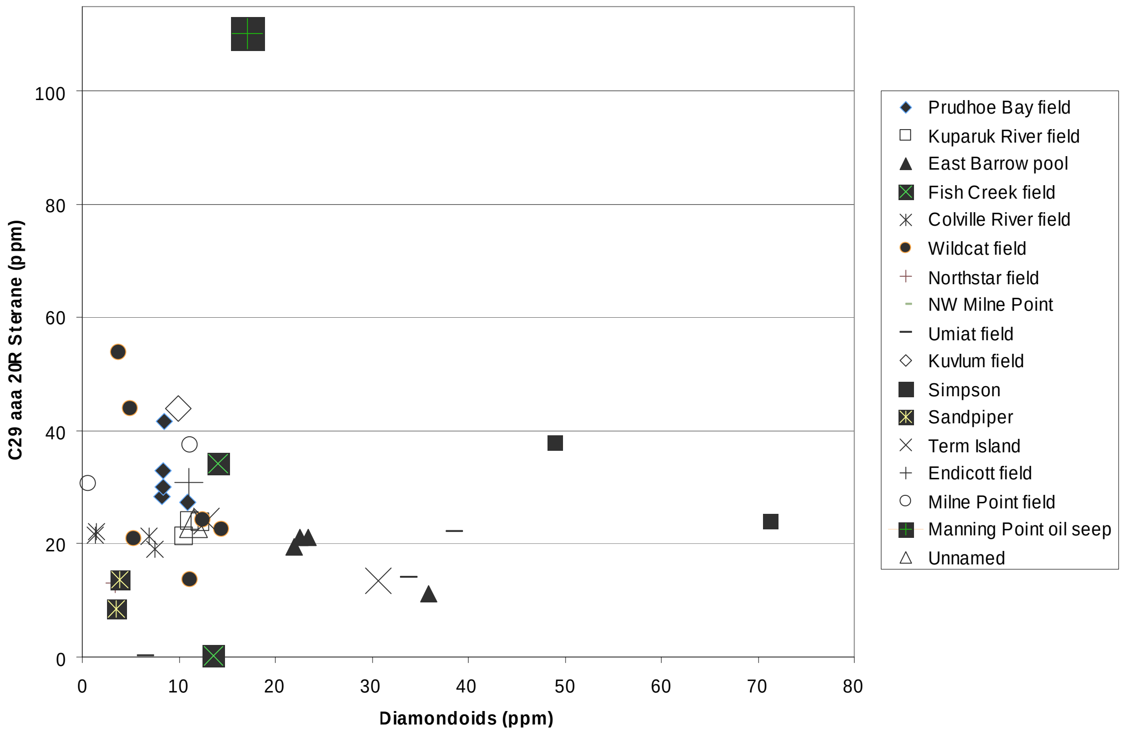
Due to high thermal stability, diamondoids resist oil cracking and become more concentrated, while biomarkers crack and decrease in concentration. Therefore, the extent of oil cracking can be investigated by plotting both diamondoid and biomarker concentrations. Furthermore, mixtures of high- and low-maturity oil can be identified when concentrations of both biomarkers and diamondoids are high.

Forty-one crude oil samples from the North Slope of Alaska have variable diamondoid and biomarker concentrations, which indicate different extents of oil cracking (Figure 1). Some of the samples are mixtures of high- and low-maturity components because they contain high concentrations of both diamondoids and biomarkers. Components of these mixtures were identified using compound-specific isotope analysis of diamondoids (CSIAD) and light hydrocarbons and by age-related biomarker analysis. The CSIA analyses were used to correlate the high-maturity components, while biomarkers, especially those providing information on the age of the source rock, were used to correlate the lower-maturity components.

Five source-rock intervals for the oil samples can be identified by their biomarker characteristics and the CSIA analyses: Carboniferous-Permian Lisburne Formation, Triassic Shublik Formation, Jurassic Kingak Shale, Lower Cretaceous Hue/GRZ/pebble shale complex, and Tertiary Canning Shale. Effective age-related and taxon-specific biomarker parameters include: (1) the NDR ratio [24-nordiacholestane/(24- and 27-nordiacholestane)], which distinguishes oil samples that originated from Hue/GRZ Shale from those that originated from older source rocks, such as the Shublik and Kingak source rocks, (2) TA-DMD ratio (triaromatic 23,24-dimethylcholesteroids/triaromatic stigmasteroids), which distinguishes Lisburne oil samples from Shublik, and other units, (3) the presence of oleanane, which is characteristic only of the Canning samples, (4) the extended tricyclic terpane ratio (ETR), which distinguishes Triassic Shublik from Jurassic Kingak formation, and (5) sharp differences in bicadinane index that occur among the Hue/GRZ/pebble shale sourced oil samples, which may distinguish between contributions or facies of the members of that source complex (i.e., pebble shale vs. Hue/GRZ?).

CSIAD can distinguish oil samples from Lisburne/Shublik ($\delta^{13}C$: ~-25.0 ‰), Kingak ($\delta^{13}C$: -27.5 ‰), and Hue/GRZ/pebble shale ($\delta^{13}C$: -23.5 ‰). The possible contribution of Lisburne gas and condensates to mixed-oil accumulations will be further investigated using the CSIA methods.



3- and 4-methyldiamantanes

Figure 1. Schematic relationship between concentrations of methyldiamantanes and stigmastane (5α,14α,17α(H)-24-ethylcholestane 20R) for oil and condensate samples from the Alaskan North Slope.