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OILS SOURCED FROM PERMIAN COALS - GEOCHEMICAL EVIDENCE FROM SYDNEY BASIN OIL SEEPS AND SHOWS

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Oil from coal is still the subject of considerable debate, with unambiguous examples of commercial petroleum accumulations due to coal source rocks largely limited to Late Mesozoic and Cenozoic southern hemisphere examples (Wilkins and George, 2002). Petersen and Nytoft (2006) suggested that this may be due to floral control on oil generation potential, linked to the evolution of land plants. These authors also reported on some Permian coals from the Australian Cooper and Sydney Basins that may have marginal oil generation potential. In the coal-rich Sydney Basin (Australia), the presence of a petroleum system has been known for decades from the occurrences of numerous oil seeps and oil shows encountered during coal mining and the drilling of coal exploration wells (e.g. Philp and Gilbert, 1986). Nevertheless, whether these oils were sourced from coals or from other shaly source-rocks interbedded within the Coal Measures is not yet clearly established. This study assesses the organic geochemical and petrological characteristics of selected coal samples from the Late Permian Illawarra Coal Measures, fine-grained sediment samples from above and within the Coal Measures, and oil samples from the Early Triassic sandstones overlying the Coal Measures, in order to investigate if these oils are related to the coals.

Organic geochemical and petrological data demonstrate that the Sydney Basin coals (vitrinite reflectance values from 1.0 to 1.4 %) have higher hydrogen indices, higher liptinite contents and much higher organic matter extractabilities than the fine-grained sediments in the section. Biomarker evidence such as the high relative abundances of pristane, C_{19} and C_{20} tricyclic terpanes, C_{24} tetracyclic terpane and C_{29} steranes and diasteranes indicates that the oil shows and seeps were sourced from higher plant dominated organic matter deposited in an oxic environment. This is corroborated by the low abundances of dibenzothiophenes, and the absence of extended tricyclic terpanes and gammacerane in these samples. The source and maturity-specific biomarkers and aromatic hydrocarbon distributions of the oils exhibit notable affinities to those of the coals (Fig. 1). The affinity of the oils to the coals is also demonstrated by the similarities in bulk carbon isotopic compositions of the total oils and the coal extracts ($\delta^{13}C_{Oil}$ = -24.7 to -23.1 ‰ and $\delta^{13}C_{Extract}$ = -26.3 to -25.3 ‰) and carbon

isotopic compositions of their individual *n*-alkanes ($\delta^{13}C_{n\text{-Alkanes of oil}}$ = -25.7 to -23.4 ‰ and $\delta^{13}C_{n\text{-Alkanes of Extract}}$ = -25.6 to -24.6 ‰), with the exception of the heavier bulk isotopic composition of Metropolitan oil seep and the compound specific isotopic composition of Metropolitan coal extract. Permo-Triassic fine-grained sediments have relatively higher abundances of C_{14} and C_{15} bicyclic sesquiterpanes, C_{23} tricyclics terpane, C_{29} αβ hopane, 2α-methylhopanes, C_{30} 30-norhopane, 29,30-bisnorhopane, C_{27} steranes, C_{27} diasteranes and dibenzothiophenes. These distributions suggest a mixed terrestrial and calcareous organic matter input to the fine-grained sediments, which is significantly different from both the oils and the coals (Fig 1).

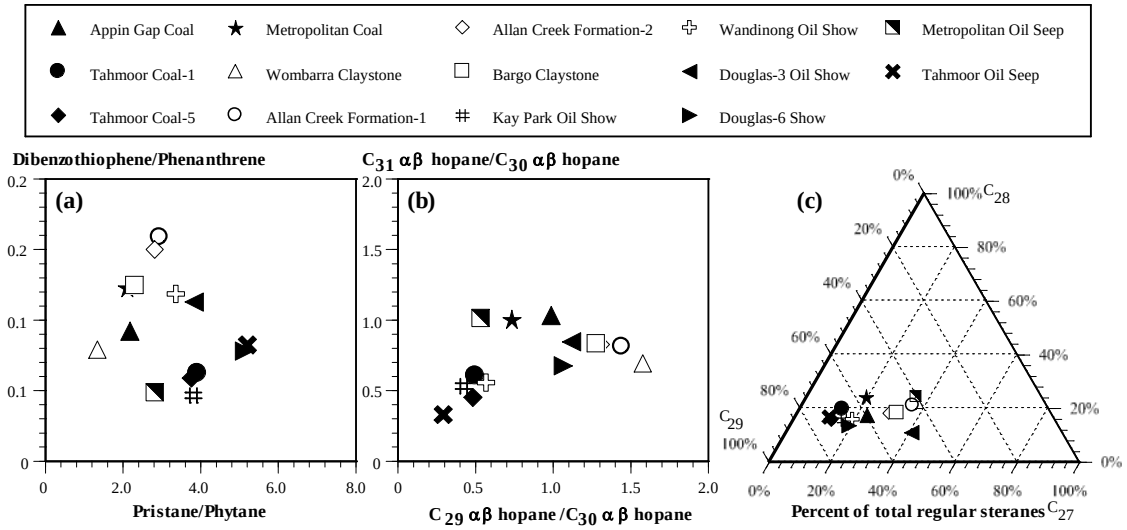

Figure 1. Cross plots of (a) Pristane/Phytane versus Dibenzothiophene/Phenanthrene, (b) C_{29} αβ hopane/C_{30} αβ hopane versus C_{31} αβ hopane/C_{30} αβ hopane and ternary diagram of (c) C_{27}, C_{28} and C_{29} regular steranes showing the genetic relationship of the oils and coals.

The similar biomarker features, bulk/compound specific carbon isotopic compositions and molecular maturities of the oils and the coals indicate that they are genetically related. This new evidence for generation and expulsion of oil from Permian Coals in the Sydney Basin indicates that this basin may have the potential for commercial oil accumulations in Permian or Early Triassic sandstones.

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