Chemical analysis of source rocks

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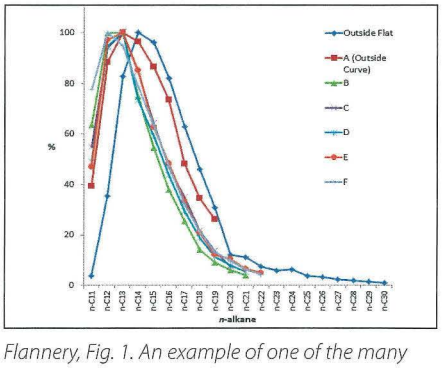
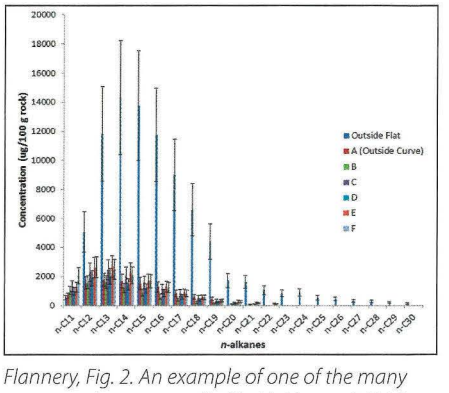
The chemical analysis of source rocks and oils provides invaluable information on thermal maturity, source characteristics, oil-oil or oil-source correlations and palaeobiology. The use of chemical analysis in the understanding of the palaeobiology is particularly important in Precambrian rocks, due to the relative scarcity of body fossils. Many applications involving the analysis of hydrocarbons in petroleum systems rely upon the assumption that there has been no contamination of the sample. Due to both age and typically low total organic carbon content however, Precambrian basins are susceptible to hydrocarbon overprinting due to contamination. In my honours study three cores from the 1.4 billion year old Velkerri Formation, McArthur Basin, were subjected to slice experiments and molecular geochemical analyses using gas chromatography-mass spectrometry (GC-MS). Internal slices were found to have consistent hydrocarbon signals, providing strong evidence that the organic matter in the inner slices is indigenous (Figure 1). In all three cores, both the aliphatic and aromatic hydrocarbon signatures indicate that the outside of the core had been exposed to contamination from both the drilling and sawing processes (Figure 2). This contamination has the potential to overprint the indigenous hydrocarbon signal and highlights the importance of the removal of the outside portion of the drill core prior to analysis, even in organic rich rocks.

Biomarkers are molecular fossils that allow us to infer the past presence of life. In my study, biomarker analysis of Velkerri Formation rock extracts allowed for the reconstruction of the palaeobiology at time of deposition. High bacterial input into the organic matter was evidenced by hopanes, bicyclic sesquiterpanes and monomethylalkanes. This is not unusual as Precambrian source rocks are thought to result almost entirely from microbial mat growth. Steranes, or eukaryotic biomarkers, have previously reported in Velkerri Formation oils and rock extracts. However, in this study steranes were found to be absent or below the limit of detection, indicating a low input from eukaryotes in the deep marine environment of the Velkerri Formation. This suggests that previous studies on the chemical composition of Velkerri Formation rock extracts, particularly that use whole rock extraction, may have analysed non-indigenous steranes. ■



Flannery, Fig. 1. An example of one of the many compound groups studied in McManus-1 1216 m: n-Alkanes normalised to the n-alkane with the highest concentration in each slice, showing inconsistent hydrocarbon distributions in both the outside flat slice and outside curve slice A. Slices B to F show a consistent hydrocarbon distribution, attributable to the indigenous hydrocarbon signal.



Flannery, Fig. 2. An example of one of the many compound groups studied in McManus-1 1216 m: Concentration of n-alkanes with % error estimate in McManus-1 slices. The outside flat slice shows an increase in concentration in n-alkanes compared to slices A–F.