Hydrocarbon Families of the Australian Northwest Shelf: A Regional Synthesis of the Bulk, Molecular and Isotopic Composition of Oils and Gases

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Petroleum accumulations have been discovered in the Bonaparte, Browse and Carnarvon basins over the last fifty years. However, a regional synthesis of the geochemistry of these North West Shelf hydrocarbons has not been published. To address this, we document the biomarker and isotopic analyses of ~300 North West Shelf oils/condensate samples that have been statistically characterised into genetically related families. Additionally, carbon and hydrogen isotopic signatures of ~50 gas samples, together with existing molecular data for ~1000 gas samples, show regional trends in wetness and abundance of non-combustible gases.

These petroleum accumulations can be attributed to source rocks of Early Carboniferous, Permian, Triassic, Jurassic and Early Cretaceous age; however, most economic oil and gas accumulations are sourced from Mesozoic (Triassic–Jurassic) sediments. The oils produced from the Bonaparte (Vulcan Sub-basin, northern Bonaparte) and Carnarvon (Dampier, Barrow and Exmouth sub-basins) basins are geochemically similar, being sourced from Late Jurassic marine rift-fill sediments (lower Vulcan Formation/Dingo Claystone) that contain variable amounts of terrigenous (particularly gymnosperm-derived) organic matter. Variations in their biomarker signatures can be explained by maturity differences, multiple charging and secondary alteration processes. Gas produced from the northern Rankin Platform is predominantly sourced from Triassic–Jurassic fluvio-deltaic sediments. Proven and potential supergiant and giant gas accumulations occur in the deepwater areas of the North West Shelf. Case studies focussing on the geochemistry of the outer Browse (Scott Reef trend) and Carnarvon (deepwater Exmouth Plateau and Rankin Platform) gas accumulations will be presented with emphasis on their ‰13C and ‰2H isotopic signatures.