Chemometric Classification of Terrestrial Oil Families in Taranaki Basin, New Zealand:
Higher Plant Trends and Migration Contamination Effects*

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Abstract

Chemometric analysis of biomarker parameters for more than 200 terrestrial (coal-sourced) oil and gas condensate samples from almost all fields and reservoir zones in Taranaki Basin (New Zealand) has led to an improved classification of genetic oil families but has also identified biomarker contamination effects from entrainment of bitumen during migration. Mid-Cretaceous to Eocene coaly source rocks in Taranaki Basin display broad stratigraphic trends in di- and triterpane distributions that reflect the evolutionary development of higher plants on the Zealandia continent (Killops et al. 1995, 2003). Woody gymnosperm biomass input to coal-forming mires is indicated primarily by the diterpane isopimarane, whereas woody angiosperm input is indicated by the triterpanes oleanane and the ring-A degraded counterparts of oleanane, lupane, and ursane. Stratigraphic changes in the relative abundances of these biomarkers indicate a coal-forming flora relatively poor in total higher plants (i.e., woody gymnosperms and angiosperms) in the mid-Cretaceous to Early Haumurian (Late Cretaceous; c. 100–79 Ma), changing to one dominated by gymnosperms in the Late Haumurian (latest Cretaceous; c. 79–66 Ma), then transitioning to a dominance of angiosperms by the Eocene. In this study, these changing terpane distributions have been utilised in hierarchical cluster and principal component analysis of source-related biomarkers to identify four tribes and seven families of terrestrial oils and gas condensates in Taranaki Basin: one tribe and family derived from the Early Haumurian; one tribe and family from the Late Haumurian; one tribe of two families from the Paleocene–Eocene; and one tribe of three families from the Eocene. Through an iterative process, parameters were selected to minimise non-source-related variations caused by, for example, differences in fluid volatility (i.e., oils vs condensates), maturity, and biodegradation. The resulting oil (and condensate) families model displays strong geographic coherency and provides first-order oil-oil and oil-source rock correlations. However, clear reservoir unit and facies-related trends indicate second-order entrainment of triterpanes and tricyclic terpanes (cheilanthanes) during migration and entrapment, highlighting the need for caution when using such models for correlation at a more detailed level; e.g., for charge analysis.
References Cited


HIGHER PLANT BIOMARKER TRENDS AND MIGRATION

...indicate a coal-forming flora relatively poor in total higher plants (i.e., major sources of oil and gas-condensate accumulations in Taranaki Basin (Late Eocene (Mangahewa Formation) coaly source rock formations in green (Strogen et al. 2017). Mid-Cretaceous to Paleocene coal measures were...