

SOURCE ROCK DEPOSITIONAL SETTINGS OF NORTHWEST BORNEO: FROM PEATSWAMPS TO ULTRADEEP WATER

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The continental shelf of offshore northwest Borneo represents the eastern margin of Sundaland, the southernmost extension of Eurasia. Sundaland is an amalgamation of terrains that have accreted during the Mesozoic and Tertiary and which, consequently, represents a range of tectonic and depositional settings. Borneo's northwest continental shelf has subsequently, and at different times, experienced extensional, compressional, and passive regimes with a variety of sedimentary packages deposited in response to these differing settings. This paper describes the range of source rock types that occur in the Malaysian sectors of northwest Borneo outlining their distribution, quality, and resulting oil families.

Predominantly coal and carbonaceous shale source rocks occur both onshore and offshore the Malaysian state of Sarawak. These occur in a swath orientated NW-SE, approximately perpendicular to the current coastline orientation. Oils along this trend tend to have similar characteristics and are moderately waxy, low sulphur crudes containing abundant higher plant markers such as oleanane and bicadinanes, possess a high Pr/Ph ratio, and display a strong C₂₉ sterane preference. East of this trend, and reflecting the palaeogeography, the source rocks become increasingly marine. In contrast to other classic petroleum systems around the world, marine sequences of the Tertiary of southeast Asia tend not to be highly prolific source rocks and generally an increasing marine influence is marked by a deterioration in source rock quality. This is well documented in the Balingian and Central Luconia provinces of offshore Sarawak where the hydrocarbons in the marine influenced eastern sectors tend to be gases and condensates. This oil family tends to be distinctly isotopically heavier than the coal sourced oils and, where biomarkers are present, tend to be lacking in oleanane and bicadinanes, possess low Pr/Ph ratios, a slight C₂₇ sterane preference and elevated extended (C₃₄ and C₃₅) hopanes.

Recent major oil discoveries in the deepwater acreage of offshore Sabah have confirmed the existence of an effective oil prone source rock facies beyond the continental shelf out onto the continental slope. Geochemical characterisation of these deepwater oils have shown that the source organic material is of predominantly terrigenous higher plant material. GCMSMS analysis shows a very low relative abundance of C₃₀ regular steranes

which suggests marine influence is only minor, but observed trends in the amount of C₂₇ steranes, relative to C₂₉, does suggest that marine influence increases into progressively deeper water.

Beyond the Sabah trough, into ultradeep water, attenuated Mesozoic continental crust was subjected to episodic rifting during the Tertiary. Although yet unproven, these seismically defined extensional, half grabens could contain a lacustrine source facies that could act as a source of hydrocarbon in present day ultradeep environments. Such frontier, deepwater settings are currently being explored in Malaysia's furthest offshore areas.