

Hydrocarbon Fill-History of the Cliff Head Oil Field, Offshore Perth Basin, Using Integrated Fluid Inclusion, Geochemical and Geological Data

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The hydrocarbon fill-history of the Cliff Head oil field (offshore Perth Basin) and adjacent areas has been investigated by integrating petroleum fluid inclusion, petrographic, geochemical and geological data. Palaeo-oil water contacts above the current OWC in the Cliff Head-3 (CH-3) and CH-4 wells suggest that the Permian siliciclastic reservoir experienced structural growth after oil inclusions were formed. The reservoir was further filled by redistribution of oil within the trap or by additional oil charge. The conformance of both palaeo and current OWC's at CH-1 confirms that the low relief, relatively unfaulted area to the south of the main horst was filled close to spill when oil inclusions were formed.

In CH-3 and CH-4 abundant oil inclusions with yellow fluorescence colours are hosted in quartz overgrowths, and, in the adjacent Mentelle structure, yellow fluorescing inclusions also occur in late-stage dolomite cement. CH-3 and CH-4 reservoir sandstones also contain blue fluorescing oil inclusions pre-dating quartz overgrowth. Whereas the yellow fluorescence suggests the late inclusion oil has a lower API gravity, consistent with 31° API produced oil at Cliff Head, early blue-fluorescing oil inclusions may contain oils of higher API gravity.

Fluid inclusion oil from the Permian in Leander Reef-1 is probably derived from the Early Permian Irwin River Coal Measures, and trace biomarkers typical for Kockatea Shale source are interpreted to be leached from this cap rock into the palaeo-oils. At Cliff Head, the blue and yellow fluorescing inclusion oils may reflect oils from different source rocks. Therefore, prospects in the Cliff Head–Leander Reef region may have received oil from more than one petroleum system.