

The First Reoccurrence of a Jurassic Seep Onshore Jamaica

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Abstract

The first occurrence of Jurassic oil in Jamaica was documented in the Windsor-1 well, drilled in 1982 in the north of the island. However, more recently (2018), an active Oxfordian aged oil seep has been identified in the northeast of Jamaica (named the Hopewell seep after its location in Hopewell, St. Mary). This area is dominated by strike-slip and normal faulting. Recent field studies have identified the presence of several hydrocarbon seeps of Paleogene and Late Cretaceous origins, both on and offshore Jamaica. The Hopewell oil seep is classified as a live oil seep with the presence of migrant hydrocarbons. Gas chromatography and gas chromatography-mass spectrometry (GC-MS) data show the presence of n-alkanes extending up to n-C₄₀ and the presence of well-resolved biomarkers (triterpanes and steranes), respectively. The n-alkane and biomarker distributions indicate that the oil seep was derived from a marine carbonate source rock, deposited under highly reducing/anoxic conditions. Further investigations of the Hopewell oil seep using gas chromatography-mass spectrometry-mass spectrometry (GC-MS-MS) technique allowed identification of the C₂₆ steranes (24-Nordiacholestanes and the 24-Norcholestanes) series, which are specifically used as geological age indicators of crude oils. The calculated 24-Nordiacholestane (NDR) and the 24-Norcholestanes (NCR) ratios suggest that the Hopewell oil seep was likely derived from a Jurassic source rock. Moreover, the distribution of the triterpanes (tricyclic terpanes and hopanes) in the Hopewell oil seep is almost identical to those seen in the well-established Jurassic Smackover Formation source rock. The repeatable and consistent geochemical data from this oil seep sample (sampled and analysed on separate occasions) reveal the existence of an additional, distinct oil group that potentially challenges existing models of the tectonic evolution and

petroleum potential of Jamaica, with follow-on implications for the wider Caribbean region. It is widely accepted that Jamaica originated as an active Early Cretaceous (Valanginian-Hauterivian) island arc system, and that the oldest known sediments deposited in Jamaica are Early Cretaceous island-arc volcanoclastic and carbonate deposits exposed in the Benbow Inlier. The recent evidence for Jurassic-sourced oils in Jamaica suggests that these are either migrant hydrocarbons that have originated elsewhere as Jamaica migrated through the Caribbean, or are hydrocarbons sourced from hitherto unknown, locally present strata that are either not exposed at the surface or have not been penetrated by exploration wells. The recognition of an additional oil family added to the established Cretaceous and Tertiary petroleum systems further evolves the prospectivity of petroleum exploration in Jamaica.