

## The Petroleum Geochemistry of Oils And Source Rocks From The Northern Bonaparte Basin, Offshore Northern Australia

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The discovery of hydrocarbons at Elang-1 by BHP Petroleum and its joint venture participants in 1993 established the Northern Bonaparte Basin of offshore northern Australia as a commercial hydrocarbon province (Figure 1). Since that time, geochemical data from exploration wildcat wells, and those drilled to appraise and develop commercial discoveries (such as the Corallina, Laminaria, Buffalo, Elang, Kakatua, Kakatua North and Bayu-Undan-Trulek fields), have been used to delineate the active petroleum systems of the Northern Bonaparte Basin. The study area comprises the northeastern portion of the Territory of Ashmore and Cartier Islands, and the western part of the Zone of Cooperation Area A, and is specifically concerned with the wells located on and between the Laminaria and Flamingo Highs.

The oils and condensates from this region can be divided into two distinct chemical groups with corresponding reservoir types, namely, a smaller group recovered from fracture porosity within the Early Cretaceous Darwin Formation, and a larger group reservoir in

sandstones of the Mid-to-Late Jurassic Plover and Elang Formations. The oils recovered from the Darwin Formation have a marine source affinity and correlate with sediment extracts from the underlying Early Cretaceous Echuca Shoals Formation. The Elang/Plover-reservoired oils, which include all the commercial accumulations, were divided into two end-member families: the first includes the relatively land-plant-influenced oils from the northwestern part of the area (i.e. Laminaria, Corallina, Buffalo fields), the second includes the relatively marine-influenced oils to the southeast (i.e. Bayu-Undan fields). A third, intermediate oil family, comprises the geographically and geochemically intermediate oils of the Elang and Kakatua fields.

While none of these oils can be uniquely correlated with a single source unit, they show geochemical similarities with Mid-to-Late Jurassic source rock extracts. Organic-rich rocks within the Plover and Elang Formations are the major source of hydrocarbons for this area. The range in geochemistry of the Elang/Plover-reservoired

oils may arise due to facies variation within these sediments, but is more probably due to the localised additional input of hydrocarbons generated from thermally mature organic-rich seals that overlie top-porosity in catchment areas and traps (the Frigate Formation in the northwestern oil family and from the Flamingo Group for the southeastern oil family). The short-range migration patterns dictated by the structural complexity of the basin are reflected in the closeness with which variations in the geochemical character of the accumulated liquids correspond to variations in the character of source-seal lithologies. The length of migration pathways can therefore be inferred from the similarity or otherwise of source-seal characters with those of the hydrocarbon accumulations themselves. The resulting observations may challenge existing ideas concerning migration patterns, hydrocarbon prospectivity and prospect risk within the Northern Bonaparte Basin.

### Biography

James Preston received a BSc (Honours) degree in geology from the University of Birmingham, England, in 1972, and an MSc from the University of Leicester, England, in 1977. He came to Australia in 1981 to work as a coal geologist for CRA Exploration, and in 1982 graduated to the company's resurrected petroleum division, later badged as Pacific Oil and Gas. He joined BHP Petroleum in 1988 as a Senior Petroleum Geologist, and has worked as a specialist in petroleum geochemistry since 1991. In this role, he has provided geochemical expertise to a series of exploration projects in Australia (notably, the offshore Northern Bonaparte, Browse and Carnarvon Basins) and overseas (including the Gulf of Mexico, Trinidad, Bolivia, Malaysia and the UK).

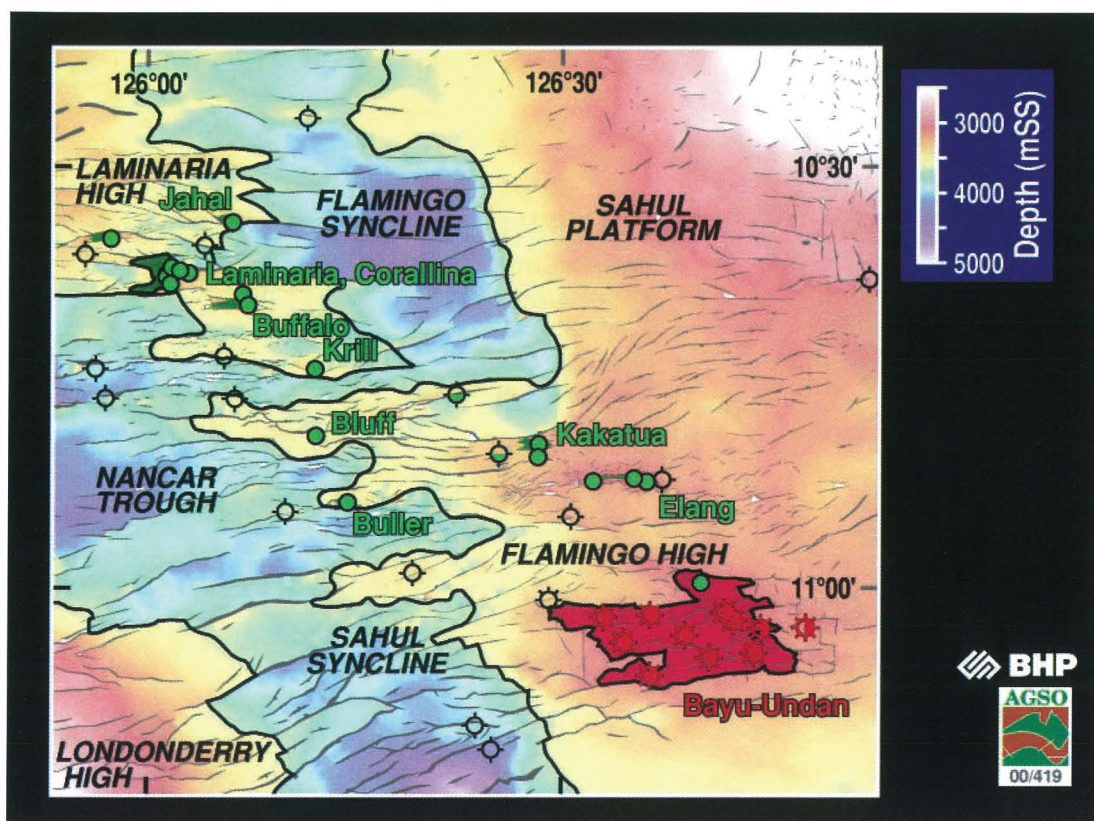


Fig. 1.