The Tectono-stratigraphic history of the northern margins of the Australian Plate from the Carnarvon Basin to Papua New Guinea

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Abstract

A set stratigraphic diagrams is used to describe the tectono-stratigraphy of the northern margins of the Australian Plate. The package comprises selected chronostratigraphic transects for the Barrow Sub-basin, Dampier Sub-basin, northern Bonaparte-Timor island area, Bird's Head-Seram region, the Papuan Fold Belt and a stratigraphic comparison for these basins.

Basement is Proterozoic in south-central Irian Jaya, the Arafura Sea and Western Australia, but is part of the Tasman Fold Belt in the Papuan Fold Belt, the Bird's Head, eastern Sulawesi and the Sula Spur. This clearly has implications for continuation of the Tasman Line around the north of the Australian plate.

On Timor Island, Seram and the Papuan Foldbelt, facies patterns become progressively more marine and deeper water as we move from the obvious autochthonous Australian platform into the higher thrusted terrains. These 'internal' zones appear to preserve the original lower continental margins, some of which were subsequently stretched during Jurassic seafloor spreading and then collapsed during Late Neogene thrusting. In any case, there is no evidence for another substantial continent opposite Mesozoic northern Australia. Argoland was most likely the West Burma Terrain.

Upper Triassic deltas formed thick clastic depocentres around much of the margin. However, on the outer edges of the deltas, there are shallow to deepwater carbonate facies belts, which are recognisable from the Wombat Plateau, through

Timor and Seram, to the Kubor Inlier of PNG.

The Lower to Middle Jurassic also contains various deltaic units. However, these deltas were affected by rifting events in the Early Jurassic in some basins (up to c.192 Ma, Pliensbachian). Rifting events are particularly well developed in the offshore Carnarvon Basin, especially on the Exmouth Plateau and Rankin Trend, but also occur in both the Browse and northern Bonaparte Basins and possibly in the Bird's Head. Carbonates are only common in this interval in the Bird's Head region.

A region-wide flooding surface and cessation of delta building occurs in the Callovian, probably caused by the initiation of ocean crust in the Argo Abyssal Plain (c.162 Ma). This flooding event was followed by intermittent normal faulting in marine environments during the Oxfordian, Kimmeridgian, Tithonian and Valanginian. The reason why rifting followed Callovian breakup is still under debate. However, an explanation may be that the Upper Jurassic-Lower Cretaceous normal faulting was a precursor to the Valanginian breakup in the Perth and Cuvier Abyssal Plains (c. 133 Ma), when Greater India separated from Australia-Antarctica. Rifting failed in northwestern Australia without the outer strip of continental crust detaching into a new microcontinent. However, the general cessation of faulting and rapid thermal subsidence into deep water is recorded in all basins in the Mid-Valanginian, and is followed by condensed sedimentation until the Aptian.

Passive sedimentation from the Aptian to the Late Miocene was modified by eustatic flooding surfaces, for instance in the Turonian and Santonian. There are also widespread disconformities near the Cretaceous-Paleocene boundary, which are sometimes explained by the onset of spreading in the Coral Sea and perhaps north of Irian Jaya. Carbonates became dominant after the Paleocene.

Thrusting and flexuring began in Timor, Seram and New Guinea in the Late Miocene, but mainly occurred in Pliocene to Recent times. Tectonism led to thick syn-orogenic turbidite and molasse sedimentation in the foredeeps adjacent to the still-moving thrust fronts. For example, the Timor Trench is considered to be an immature, partly empty foreland basin, with a modern foreland bulge along its southern side over the Sahul and Ashmore Platforms.

Prolific and proven petroleum source systems associated with this tectono-stratigraphic history include wet gas-prone deltaic source rocks in the Upper Triassic (North West Shelf) and Lower Jurassic (Bird's Head), and oil-prone source rocks in

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the Upper Callovian-Oxfordian marine rifts (Barrow, Dampier, offshore Bonaparte, Papua). However, among the other possible source systems is an Upper Triassic marine carbonate source rock, which is only now beginning to be recognised. This system appears to be responsible for high sulphur oils in Seram and may be represented in other areas of the former outer continental margin from the Wombat Plateau to PNG. In this way, tectono-stratigraphy may provide a predictive tool for helping to map petroleum system distribution.