

# The plate tectonic and stratigraphic evolution of SE Australia, New Zealand and Antarctica: implications for petroleum systems

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## **Abstract**

Southern Australian and New Zealand breakup history is divisible into three phases. The first phase began with Callovian extension in the western Bight Basin. During the Tithonian, rifting extended eastwards into the Duntroon, Otway and Gippsland Basins. By the Valanginian, ocean crust formed between India and western Australia. Structural style in the western Bight changed to thermal subsidence. However, fluvio-lacustrine rift sedimentation continued in Duntroon, Otway and Gippsland until the Barremian when these basins also changed to thermal subsidence. During the early Barremian, massive amounts of dacitic volcanoclastic debris began to flood the Bass Strait basins and indeed much of eastern Australia from volcanic centres in the Lord Howe Rise region. This style of volcanogenic fluvial sedimentation continued through the Aptian and Albian.

The second phase began during the Cenomanian with uplift in eastern Australia, stress reorganisation and divergence of basin development. The Otway, Sorell and Great South Basins, and possibly also other basins under the Ross Sea, deepwater Taranaki and Lord Howe Rise, formed in a transtensional regime, arranged in an X-shaped complex of rifts. During the Santonian, oceanic spreading began in the southern Tasman Sea (c.83 Ma), and between the Campbell Plateau and Antarctica. Slow extension caused thinning of continental crust in the Bight and Otway Basins and subsidence into deeper water. Ocean crust formed south of the Bight Basin in the Early Campanian (c. 80 Ma) and also started extending up the eastern Australian coast.

The third stage in development was caused by end-Paleocene (55 Ma) cessation of Tasman Sea spreading, Middle Eocene (43 Ma) changes to fast Southern Ocean spreading, and end-Eocene (35 Ma) final separation between the South Tasman Rise and Antarctica. These events caused collapse of continental margins and widespread marine transgression. Breakthrough of ocean crust between Australia and Antarctica was followed by propagation of spreading into the Emerald Basin and ultimately by development of the transpressional margin through New Zealand.

Plate tectonic reconstructions of the 16 or more continental pieces making up SE Australasia allow us to predict stratigraphy and petroleum systems in deepwater areas where there has been little exploration. The gas-bearing Otway-Gippsland Lower Cretaceous rift complex appears to extend to the Lord Howe Rise but not as far as New Zealand. Mid-Cretaceous rift basins, similar to the Emperor Group in Gippsland and Shipwreck Group in Otway, occur on the Campbell Plateau and deep beneath the shallow water Taranaki and East Coast North Island Basins. So far, the only member of this group with a proven source system is the Great South Basin, but other possible Mid-Cretaceous rift-related petroleum systems may be present on the Lord Howe Rise and deepwater Taranaki. The prolific Late Cretaceous-Palaeogene petroleum source systems in Gippsland and shallow water Taranaki were deposited on separate continents and are therefore only related climatically.

## Author



Martin Norvick is a graduate of Imperial College, London, with a PhD in micropalaeontology. He joined BMR (the predecessor of Geoscience Australia) in 1969, where he worked as a palynologist and on regional geological mapping projects in PNG. In 1975 he moved to the international petroleum industry, initially with BP (1975-82) and then with BHP (1982-98), where he was involved with exploration projects in many basins around the world. He is currently a consult and is also an Honorary Fellow at University of Melbourne, following up research interests in plate margin evolution and the linkage to stratigraphy, and teaching courses in basin analysis and petroleum systems.