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3D Structural Analysis of Inversion During Rift Evolution: Eastern Otway Basin, Australia

The Shipwreck Trough, in the Otway Basin, is the location of the recent gas discoveries at Thylacine/Geographe (800 BCF recoverable), Minerva (300 BCF), and Casino (140 BCF). Each trap exhibits a structural history of subsidence and normal faulting punctuated by episodic regional uplift and local compressional fold growth, highlighting the complex interplay between regional extension and local compression during rift evolution. The Otway Basin formed during Late Jurassic-Palaeocene rifting of the Australian and Antarctic continental plates.

Structural analysis of three 3D seismic surveys (~1200 km²) shows that early rifting (Late Jurassic-Early Cretaceous) in the Shipwreck Trough was characterized by horst-graben and half-graben formation. Although the central Otway Basin continued to subside through the Late Cretaceous, during the Cenomanian (~95-90 Ma), rifting failed in the eastern Otway Basin and the Bass Strait. In these areas, immediately east of the Shipwreck Trough, extension was replaced by compression and minor inversion creating the Otway Ranges and King Island High. Cenomanian-Santonian anticlines formed in the Shipwreck Trough at the Port Campbell, Minerva, Geographe, and Thylacine Fields, inverting Early Cretaceous grabens. These inversion anticlines show positive structural relief with adjacent ponding of upper deltaic to outer shelf growth sequences forming nascent hydrocarbon traps. Structural growth did not exceed accommodation volume, such that there are no significant breaks in sedimentation indicating that these structures were growing locally under net regional subsidence. Maturation and migration of hydrocarbons derived from Aptian-Albian sequences, commenced as early as the Maastrichtian but varied significantly due to local structural evolution.