

Evolution of Structural Traps within the Left-Lateral, Obliquely Extending Shipwreck Trough, Otway Basin, Southeast Australia

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The north-trending Shipwreck Trough contains the Thylacine, Geographe and Minerva gasfields. Although formed coevally, each exhibits a unique structural style reflecting the complex interplay between reactivation of basement structural fabrics, the syn-rift mechanical stratigraphy, and the obliquity of rifting. Late Jurassic-Barremian rifting formed north- and northeast-trending horst and graben parallel to basement structural fabrics. In contrast, Cenomanian-Late Paleocene rifting created west-northwest trending normal faults including the Tartwaup-Mussel Fault Zone (TMFZ) to the southwest. Within the central portions of the trough, normal faults are largely detached from the underlying horst and graben. A striking exception is the north-northwest trending, left-lateral oblique Shipwreck Fault Zone (SFZ) which overlies the eastern margin of an Early Cretaceous graben and bounds the Shipwreck Trough to the east. The SFZ shows both positive and negative flower structure morphology. Within this oblique structural environment, the Minerva Anticline formed by Late Cretaceous inversion of the Jurassic-Barremian Minerva Graben at a right-hand kink in the SFZ. Above the northeast-trending, Jurassic-Barremian Geographe Horst, the Geographe Anticline formed as an accommodation, or transverse fold, between faults and fault tips of the TMFZ and eastward directed folding into the Investigator Graben pull-apart basin along the SFZ to the east. Thylacine formed as a horst between the TMFZ to the southwest and the Investigator Graben to the northeast. These gas-bearing structural traps within the Shipwreck Trough all formed synchronously with reservoir and seal deposition, so each structure has a unique uplift-subsidence history and has its own local stratigraphy and complex reservoir architecture.