

A new stratigraphic/structural interpretation helps focus exploration in the Poolowanna Trough, Eromanga Basin, South Australia

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The Poolowanna Trough is a Jurassic to Late Cretaceous trending intra-cratonic depocentre which straddles the border between South Australia and the Northern Territory. It overlies the Permo-Triassic Pedirka and Simpson basins and is characterised by the presence of a well-developed Early Jurassic fluvio-lacustrine Poolowanna Formation. Only a few wells have been drilled and the area has seen very little exploration activity. In contrast, the neighbouring and similar aged Cooper Basin has seen exploration mature over the last two decades. The last well drilled in the South Australian sector of the Poolowanna Trough was Poolowanna-3 in 1989. This well was a follow up to Poolowanna-1 which recovered significant oil and condensate on test from both the lower Poolowanna Formation and sands in the Triassic Simpson Basin succession.

The Poolowanna Formation is divided into two depositional cycles: a lower 'Cycle 1' is overlain by the upper 'Cycle 2'. The majority of hydrocarbon shows and recoveries have been from sediments of Cycle 1 or below, and are rare in Cycle 2. Calcite is commonly recorded in Cycle 2 sediments but rare in Cycle 1 sediments. This is analogous to the Hutton/Birkhead reservoir-seal couplet (Boul¹ et al., 1997, 1998) that occurs stratigraphically just above the Poolowanna Formation. At this level in the Cooper Basin region, an effective seal has trapped significant quantities of oil in the underlying craton-derived quartz-rich sands. The seal is formed by two processes: a) an influx of labile, volcanogenic material derived from the east, and, b) subsequent diagenesis of the volcanogenic layer which has resulted in the formation of pore-blocking kaolinite and calcite through the reaction of calcium cations with CO₂ anions associated with dewatering of the underlying Cooper Basin (Schulz-Rojahn 1993). Although mappable across the eastern half of the Poolowanna Trough, the Birkhead Formation is not well developed over basin's centre, where vitrinite reflectance data indicates that the generation of hydrocarbons has occurred within the Poolowanna Formation and below. In this scenario, any migrated oil would either be trapped within these lower formations or be dispersed by migration into the Algebuckina Sandstone that lack good intraformational seals.

A new structural interpretation has revealed that while most wells were drilled on structural crests, those wells which show appear to be associated with Tertiary reactivation of pre-existing faults that may have compromised hydrocarbon preservation. Faulting across the area has a predominant N-S to NNW-SSE trend. Faults generally have very long strike lengths compared to displacement and are thus attributed to significant early strike-slip motion. Several faults appear to have an expression in the total magnetic field image. Fault displacement is much greater on the northern side of an E-W lineament that is observable in the TMI data and passes close to Walkandi-1, Poolowanna-1, -2 and -3 and Kuncherina-1 – all wells which recorded hydrocarbon shows.

The entire area is now under licence for petroleum exploration, except for the Simpson Conservation Park whose southern margin happens to coincide with the E-W lineament observable in the TMI. The main depocentre of the Poolowanna Trough occurs to the south of the park. Recommendations for future exploration include focussing on early structures that have not been reactivated and lie close to the trough depocentre where both Cycle 1 and Cycle 2 are developed in the Poolowanna Formation. Here, significant source rocks in either in the Poolowanna Formation or the Permo-Triassic succession may also be present.

References

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