Sequence Stratigraphy, Facies Architecture, and Petroleum Potential of the Roseneath-Epsilon-Murteree Gas Plays in the Cooper Basin, Australia

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Abstract

The Permian Roseneath Shale, Epsilon Formation, and Murteree Shale (informally known as the REM strata) comprise a ~ 140 m thick succession within the Cooper Basin, Australia. This succession hosts important conventional and unconventional gas plays. An integrated study of the sedimentology, facies architecture, sequence stratigraphy, and related geochemical data allows a better understanding of the regional paleogeographic evolution of the basins that provides a perspective on the petroleum potential of the strata. Cores from nine wells with a total length of in excess of 1400 m were logged. Twelve lithofacies were identified and were further categorised into eight facies associations. The strata are interpreted as a fluvial-deltaic-lacustrine system with glacial influences. The Roseneath and Murteree Shales were deposited in a widespread lake with dominant rhythmites and claystones whereas the Epsilon Formation formed in a transitional environment with a mixture of fluvial, deltaic, shoreface and mire environments. Sequence stratigraphic analysis indicates that the REM strata were deposited within two 1st-order Transgressive-Regressive (T-R) sequences that can be further separated into four sequence units: SU1, SU2, SU3, and SU4. 2nd-order transgressive and regressive cycles are present within each stratigraphic unit. The depositional history of the strata is divided into four phases: I, II, III, and IV, which were mostly controlled by basin subsidence, lake level, and paleo-climate. The distribution of siderites and pyrites within the REM strata suggests

that the Patchawarra Trough was likely a closed or restricted lake while the lake in the Nappamerri Trough may have had occasional connections with the marine realm to the east. Petroleum plays with the strata are arguably part of a continuous gas accumulation and additional evidence is needed to confirm this hypothesis. The southern flank of the GMI Trend, east Nappamerri Trough, and some major basin highs are prospective areas for conventional structural, stratigraphic, and combination traps. Unconventional petroleum potential (shale gas, deep coal seam gas, and tight gas) is relatively limited in terms of current extraction techniques. Compared to North American shale gas plays, the Roseneath and Murteree Shales appear to be not as favourable for gas production due to the low organic content and high ductility. The potential of coal seam gas in the REM strata is limited by its ultra-deep burial and thin nature of the coal seams.