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Pressure Seal and Modelling of the Jurassic Overpressure in the Barrow Sub-basin, North West Shelf of Australia

The Jurassic rift-related thick sequence is highly overpressured with the excess pressure between 20-35 MPa at 3100-4500 m in the overpressured compartments as indicated by repeat formation tests (RFTs), drill stem tests (DSTs) and mud weights in the Barrow Sub-basin. The overpressure is also confirmed from well log responses associated with higher sonic transit time and lower resistivity within the fine-grained rocks of the Jurassic organic-rich shaley sequence.

The top pressure seal of the overpressured compartments consists of a rock layer of claystone, siltstone, sandstone with thin limestone in the upper part of the Upper Jurassic strata with the pressure transition zone from three wells. The top of the layer ranges from 2650 m to 2750 m with temperature about 110 8C. The thickness of the layer varies between about 300-400 m. The porosities in the claystone are 1-5 % with the calculated permeabilities in range 10^{-20}-10^{-24} m^2 using the modified Kozeny-Carman method. The rock layer appears to be compacted, and cemented by quartz overgrowth, calcite and siderite cementation. Therefore, the layer is comprised of diagenetically-cemented rocks with very low-permeability and acts as a top pressure seal.

Two-dimensional modelling within the sub-basin was performed to reconstruct the histories of the overpressure and fluid flow using the BasinMod 2D software. The model takes contributions of compaction, quartz cementation, temperature and hydrocarbon generation into consideration. The modelled results indicate that compaction disequilibrium and the formation of highly effective seals associated with compaction, quartz cementation and fault sealing are the dominant controls on generation and maintenance of the overpressure, and fluid thermal expansion and hydrocarbon generation have minor contributions to the overpressure in this case.