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The Impact of a Changing Stress Field on Hydrocarbon Retention in the Northern Bonaparte Basin, Australia

A variable contemporary stress field across the Northern Bonaparte Basin, Timor Sea, Australia has acted as a key control on trap integrity. Despite receiving significant and widespread oil charge many traps have leaked during fault reactivation associated with Neogene plate collision. An integration of data covering the oil charge history and contemporary stress field allow a sub-division of the well results into two distinct categories of seal potential. Traps located on the northern Londonderry High and in the Nancarrow Trough have experienced high oil charge rates but are currently water wet. Traps located further to the northeast on the Laminaria High show similar oil charge rates but exhibit much higher retention rates. Analysis of the contemporary stress field suggests that trap integrity is strongly controlled by the orientation of the major trap bounding faults relative to the direction of the maximum horizontal stress (S_{Hmax}). Traps where the bounding faults trend northeast-southwest and are parallel to S_{Hmax} show a much greater propensity to fail during fault reactivation. Much higher retention rates are observed where the bounding faults trend east-west and S_{Hmax} is perpendicular. Significantly, the application of conventional fault seal algorithms fails to recognise a seal failure risk in this area because these methods do not consider the impact of fault reactivation. In areas with significant post charge faulting the hydrocarbon retention risk needs to consider not only the fault seal and juxtaposition elements but also the impact of regional variations in the geographic and temporal distribution of the stress field.