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Geomechanical modelling and consequences for fluid-flow in complex rifted settings: A case study in the Otway Basin, Australia

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Geomechanical modelling of dilation tendency has been completed on more than 900 faults from nine three dimensional seismic surveys within the Otway Basin, Australia. As the in-situ stress regime within the basin is currently debated, scenarios of normal, strike-slip and reverse regimes of in-situ stress have been modelled. Additionally, the stability of natural fractures from seven wellbore image logs has been modelled under the same scenarios, with the consequences for each explored. ∼NW-SE striking faults that define the basin's major structural fabric are at critical risk of dilation irrespective of the regime of in-situ stress, while similarly striking fractures require very low (<5MPa under a strike-slip scenario) increases in pore pressure in order to be reactivated. ∼N-S striking and ∼W-E striking faults show lower risks for reactivation although their propensity to dilate is still significant. Our results in part explain why fault seal within the Otway Basin has been historically so poor, and suggest that while natural fracture networks may be optimally oriented for reactivation in order to increase secondary permeability – promising for unconventional prospectively - there is a high associated risk with respect to up-dip contamination along regional faults. This case study also provides insight into possible fluid flow pathways within other more frontier passive margin settings.