

Are Present-Day Stresses Inferred from Petroleum Exploration Data Consistent with Neotectonic Structures in Australia?

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Present-day stresses inferred from petroleum data (e.g. borehole breakouts and leak-off tests) are routinely used in geomechanical methodologies to predict the risk of fault reactivation and related breach of fault-bound traps. Contrary to the widely held belief that the Australian continent has an ancient, stable landscape, neotectonic structures are being progressively recognised. This paper investigates whether geomechanical predictions of fault reactivation using petroleum-based present-day stress data are consistent with observed neotectonic structures.

Present-day stress orientations are consistent with the orientation of neotectonic structures across Australia. The NE-SW striking (predominantly) normal faults of the Timor Sea and the NE-SW striking left lateral strike-slip faults of the Browse Basin are consistent with stress orientations in those basins. N-S oriented anticlines and inverted normal faults in the Carnarvon Basin are consistent with E-W maximum horizontal stress, as are the N-S reverse fault scarps onshore SW Western Australia. In SE Australia, broadly N-S reverse faults in the Flinders Ranges are consistent with the E-W oriented maximum horizontal stress. NE-SW oriented reverse faults and anticlines of the Otway and Gippsland Basins are consistent with the NW-SE maximum horizontal stress direction.

Throughout Australia, present-day stress orientations from petroleum data are consistent with the orientation of neotectonic structures. However, present-day stress data underestimate the extent of reverse faulting. Leak-off and related tests, from which the minimum horizontal stress is estimated, at best provide an estimate of the minimum principal stress. Hence petroleum data do not generally yield estimates of minimum horizontal stress in excess of vertical stress.