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Evolution of a Neotectonic, Intraplate Reverse Fault Zone: The Paralana Fault Zone, Northern Flinders Ranges, South Australia

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ABSTRACT

The Flinders Ranges and Mount Lofty Ranges in South Australia are a tectonically active intraplate zone in an otherwise quiet Indo-Australian plate. Ongoing tectonism, responsible for producing some of the most impressive neotectonic landscapes in the Australian continent, is attributed to high intraplate stresses and abnormally high heat flow. The Paralana Fault Zone is situated on the eastern flank of the northern Flinders Ranges and separates the Mesoproterozoic Mount Painter Domain to the west and the Mesozoic-Cenozoic Lake Frome Embayment to the east. West-over-east neotectonic faults within the fault zone have been identified previously; the main ones having been described in literature but to date there have been no regional structural studies focusing on the geometry and kinematics of the Paralana Fault Zone. The vast majority of research into fault growth has focused on normal fault regimes; the well-exposed Paralana Fault Zone provides an opportunity to studying meso-scale fault propagation within in a compressive setting. We have identified three individual thrust fault sets from a total of 56 catalogued faults, within an area of 150km2. Fault Set 1 strikes approximately NW-SE with moderate dip in both directions and a NE-SW principal stress direction ($\sigma 1$). Fault Set 2 strikes N-S and has shallow dip and E-W $\sigma 1$. Fault Set 3 has an overall NE-SW strike, moderate dip, and is representative of the current stress regime with a $\sigma 1$of NW-SE. Fault Set 3 features spectacular examples of neotectonic faulting, with Mesoproterozoic marbles and granites of the Mount Painter Inlier overlying Quaternary sandstones and conglomerates of the Frome Embayment. Observed fault displacements since the end of the Miocene range from 10 cm up to an estimated maximum of 800 m. We have sampled fault rocks from 34 measured faults and characterized micro textures ranging from unconsolidated fault gouge and breccia to heavily silicified fault gouge, indicating a range of fluid-flow conditions. The spatial relationship of these textures coupled with the geometries of the faults will lead to a deeper understanding of fault evolution and segment linkage, and their implications for fault-controlled fluid flow in a compressive tectonic regime.