

What lies beneath the Nullarbor Plain? Insights into the geology of the Coompana Province from deep crustal seismic reflection profile 13GA-EG1

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The Coompana Province, lying between the Gawler Craton to the east and the Madura Province to the west and straddling the border between Western and South Australia, is one of the last unknowns in Proterozoic Australia. This region is entirely covered by Neoproterozoic to Cenozoic sediments of the Officer, Denman, Bight and Eucla basins. Until recently, very little was known about the structure and lithostratigraphy, with only a few basement intersecting drill holes and limited, poor resolution geophysical imagery. New data acquisition by the GSWA and the GSSA including diamond drill holes, gravity, magnetic and radiometric data, magnetotellurics and deep crustal reflection seismic is providing new insights into the geology and geodynamics of this important region. Here we present the interpretations and implications derived from the new data.

The Jindarnga Shear zone, a west dipping crustal structure, is the boundary between the Gawler Craton to the east and the Coompana Province to the west. In the hanging wall the eastern Coompana crust is three layered, consisting of; (i) a reflective lower crust with reflectors that parallel the Moho, (ii) a reflective mid-crust with west dipping reflectors and anastomosing shear zones, and (iii) a seismically bland upper crust interpreted to be dominated by intrusives. At ~18600 cdp (common depth point) there is a rise in the Moho from ~ 44 to 39 km and the strongly reflective lower and mid-crustal layers terminate at a crustal-scale west-dipping structure, corresponding to a domain of strongly magnetic, c. 1200–1120 Ma Moodini Supersuite (interpreted) intrusions.

This structure marks a transition from a three-layered crust to a two-layered crust, with a mid to lower crustal section characterised by strong, flat-lying reflectors, and a seismically bland, intrusion-dominated upper crust. At the state border (~16200 cdp) a west-dipping structure, the Border Shear Zone, soles onto the reflective mid-crust, separating predominantly Moodini Supersuite in the footwall and c. 1610 Ma Toolgana Supersuite in the hanging wall. From the Border Shear Zone west to ~ 10100 cdp, the upper-crust is characterised by shallowly dipping, often sigmoidal reflectors separated by predominantly west dipping structures that sole onto a reflective mid-crust. This upper-crust is dominated by intrusives of the Toolgana and c. 1490 Ma Undawidgi Supersuites. At ~12020 cdp (at Forrest) is a distinct, antiformal feature that coincides with a gravity and magnetic anomaly that occurs along strike from shoshonitic Moodini Supersuite intrusions to the northeast. At ~12000 cdp there is an increase in Moho depth back to ~44 km, coinciding with the narrow end of a wedge-shaped bland region in the lower crust. The reflective mid-crust thins to the west above this wedge and both are truncated by the subvertical, crustal-scale, Mundrabilla Shear Zone, which marks the boundary between the Coompana and Madura Province to the west. The mid-crustal reflective package has complex reflectors with variably shallow dipping and anastomosing fabrics.