

What lies beneath the western Gawler Craton? Interpretations and implications from deep crustal seismic reflection profile 13GA-EG1

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The eastern section of deep seismic reflection profile 13GA-EG1, here referred to as 13GA-EG1E, starts at Tarcoola in the central Gawler Craton and extends west across the predominantly covered western Gawler Craton, and into the thickly covered Coompana Province. Limited control on the crystalline basement imaged by this seismic transect is available to aid seismic interpretation, as outcrop and drilling are sparse. Neoproterozoic-recent cover thickens to the western end of 13GA-EG1E, with the Neoproterozoic-Ordovician Officer Basin and Cenozoic Eucla Basin combining to provide a cover thickness of up to ~2.5 km. Hence, the seismic profile is a crucial tool for understanding the geology and crustal evolution of this area.

The upper crust of the Gawler Craton can be sub-divided into three distinct domains, corresponding to domains previously defined by aeromagnetics. The Wilgena Domain, at the eastern end of the profile, is characterised by apparent east-dipping structures, whereas the Christie and Nawa Domains predominantly contain apparent west-dipping structures. Some of these upper crustal structures can be traced to greater depths, where they either flatten out in the lower crust, or in several cases, offset the Moho. These structures are interpreted to represent multiple phases of extension and basin development as well as being multiply reactivated during compressive deformation associated with several orogenic events recognised within the Gawler Craton. These include the Sleafordian (c. 2440 Ma), Kimban (c. 1730-1690 Ma), Kararan (c. 1600-1580 Ma) and Coorabie (c. 1450 Ma) orogenies. Viewing this seismic section in conjunction with potential field data, especially aeromagnetic imagery, it is apparent that a significant component of deformation along shear zones in the western Gawler Craton is accommodated by strike-slip movement, particularly in the c. 1450 Ma Coorabie Orogeny. This adds another layer of complexity when resolving apparent offsets of seismic horizons.

Magmatism is recorded as bland zones in the upper crust in the Gawler Craton. Several Kimban-aged (i.e. c. 1730-1690 Ma) granites are recognised as thin, sheet-like bodies in the upper part of the Christie Domain. In contrast, the Mesoproterozoic Hiltaba Suite forms a series of prominent, irregular bland zones that occur throughout the upper crust of the Wilgena Domain. Similar seismically bland zones are associated with Hiltaba Suite intrusions that are known to host iron-oxide copper gold mineralisation at Olympic Dam, further east in the Gawler Craton.

The Gawler middle crust is characterised by a series of bland zones, which are separated by west-dipping reflective layers that correspond to crustal-scale shear zones. The lower crust of the Gawler Craton is characterised by sub-horizontal to shallowly west-dipping reflectors.

Seismic profile 13GA-EG1E offers the first look at the margin of the Gawler Craton with the Coompana Province. This boundary is interpreted to be a west-dipping shear zone (the Jindarnga Shear Zone), which juxtaposes Palaeo- to Mesoproterozoic granitic rocks of the Coompana Province over Archaean-Palaeoproterozoic rocks of Gawler Craton upper-middle crust.