What lies beneath the western Gawler Craton? Interpretations and implications from deep crustal seismic reflection profile 13GA-EG1E

T.W. Wise, M.P. Doublier, R.A. Dutch, D. Clark, M.J. Pawley, G.L. Fraser, B.L.N. Kennett, A.J. Reid, C.V. Spaggiari, A.J. Calvert, S. van der Wielen, H. Dulfer, B.R. Bendall, S. Thiel, and J. Holzschuh

Australian Earth Sciences Convention
Adelaide, June 2016

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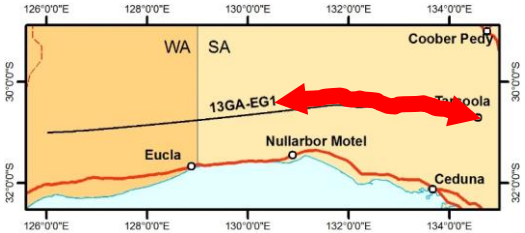
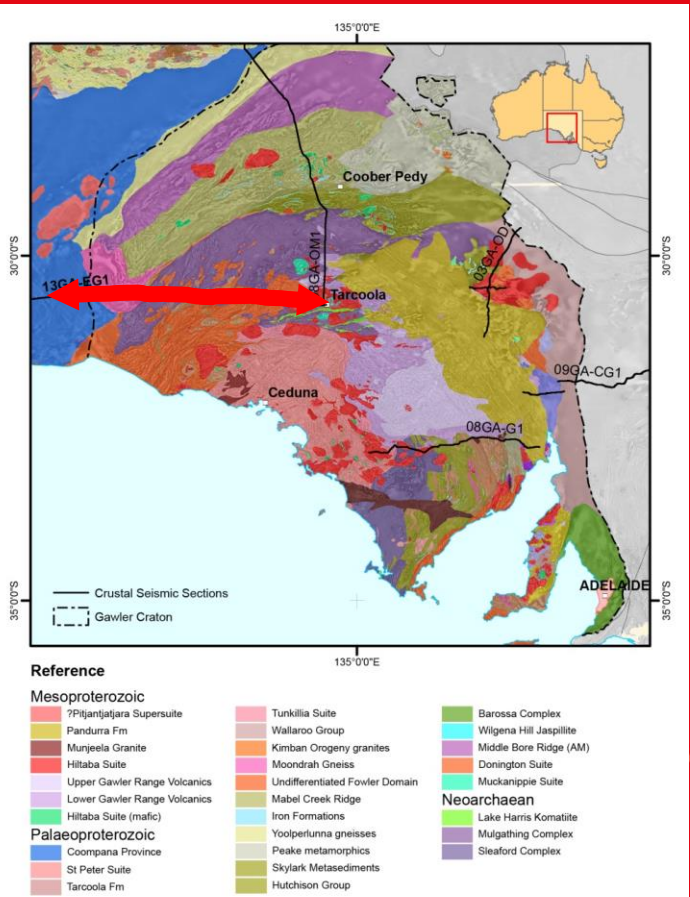
13GA-EG1E

- **Aims;**
- ➢ **define province boundaries**
- ➢ **investigate contact relationships between provinces, and internal crustal architecture**
- ➢ **image faults/shear zones**

- Results based on collaborative interpretations by;

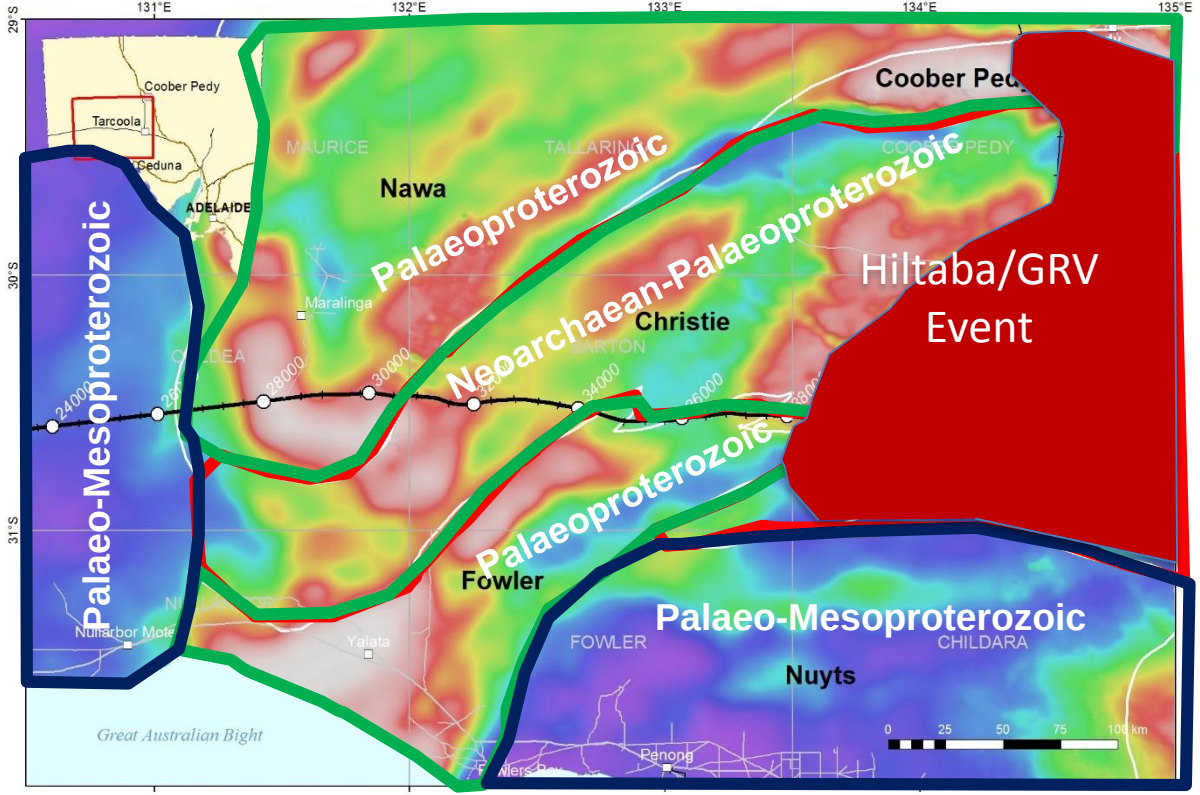
M.P. Doublier, R.A. Dutch, D. Clark, M.J. Pawley, G.L. Fraser, T.W. Wise, B.L.N. Kennett, A.J. Reid, C.V. Spaggiari, A.J. Calvert, S. van der Wielen, H. Dulfer, B.R. Bendall, S. Thiel, and J. Holzschuh





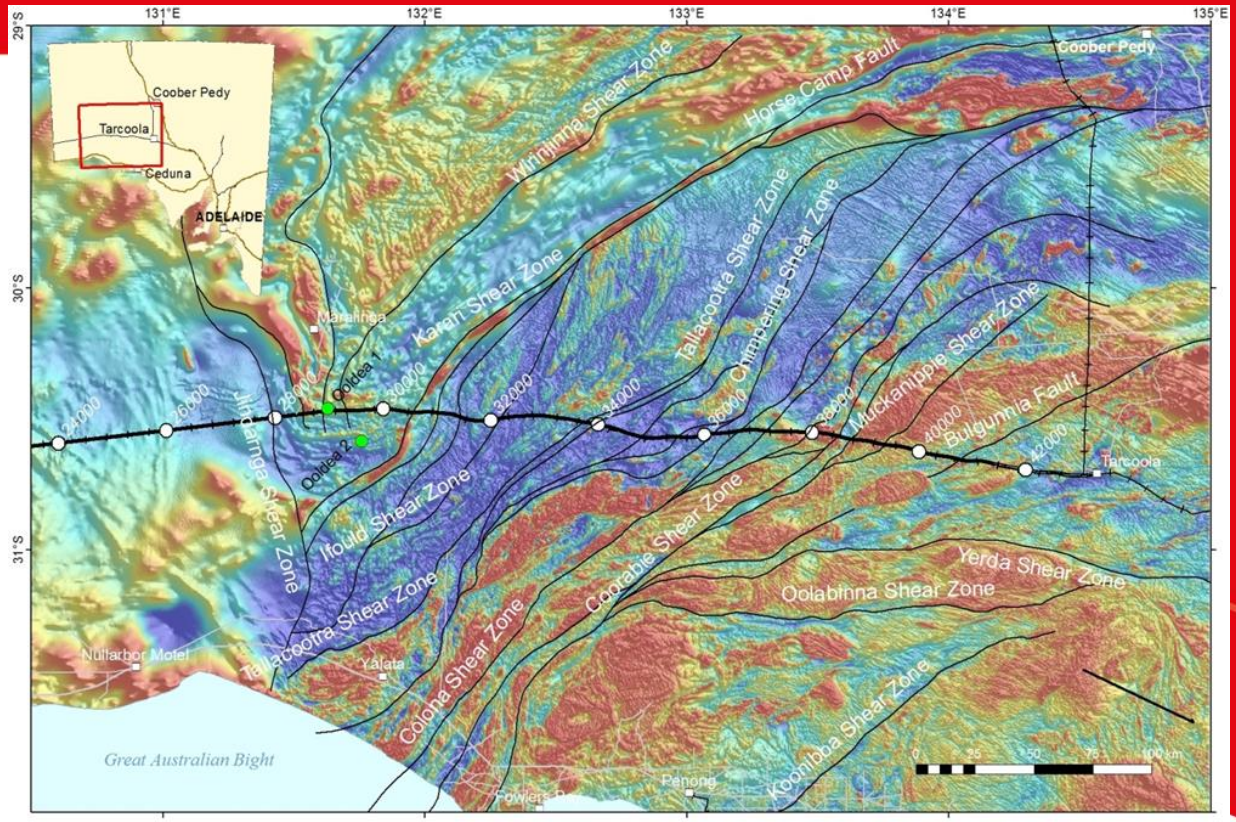
Gawler geology overview

- Western Gawler built on a Neoarchaean-Palaeoproterozoic core.
- Palaeoproterozoic basins (1750 -1700 Ma) developed on the proto-cratonic margins
- Palaeo-mesoproterzoic arc-like rocks juxtaposed
- Intrusion/extrusion of Hiltaba Suite and GRV



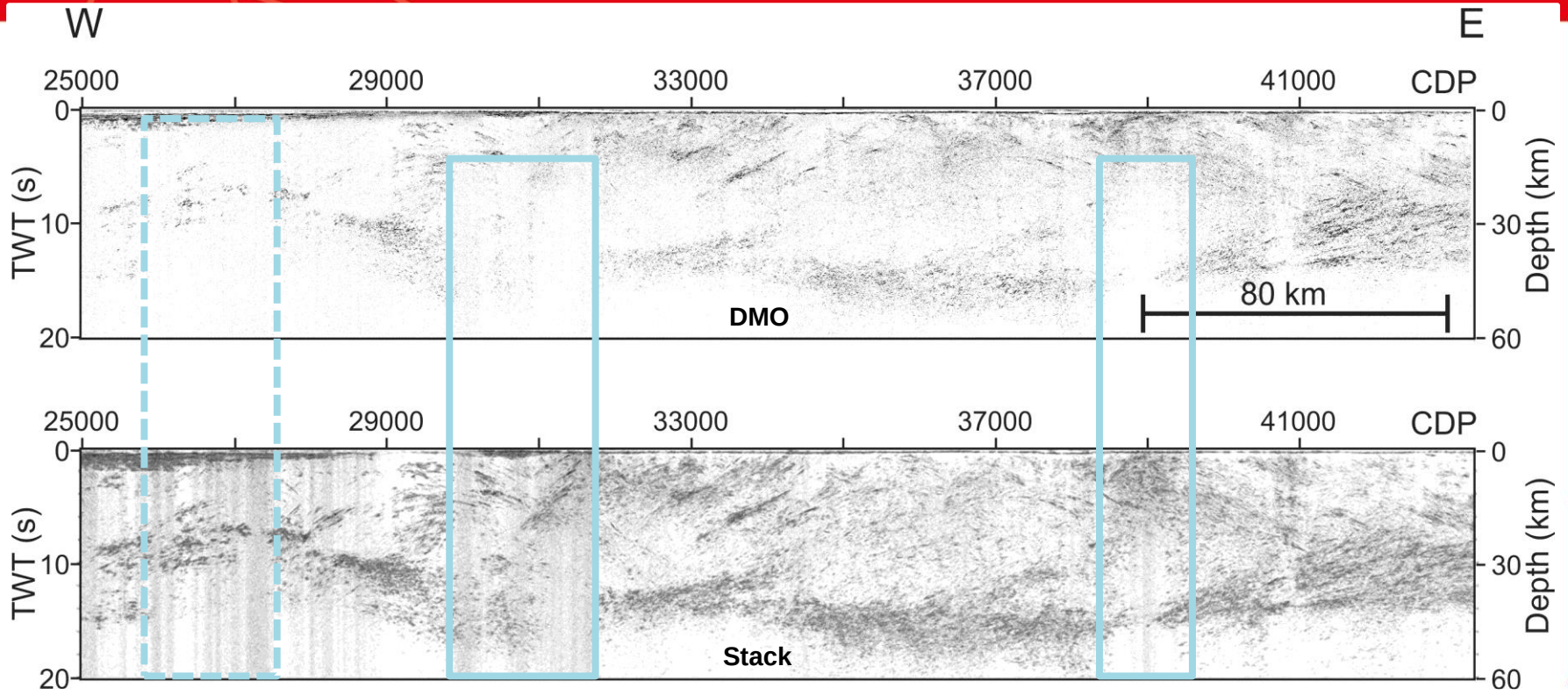
Major Structures

- Structurally complex
- Multiple re-activations
- Many structures oblique to the seismic line
- Little control on sense of movement due to limited outcrop



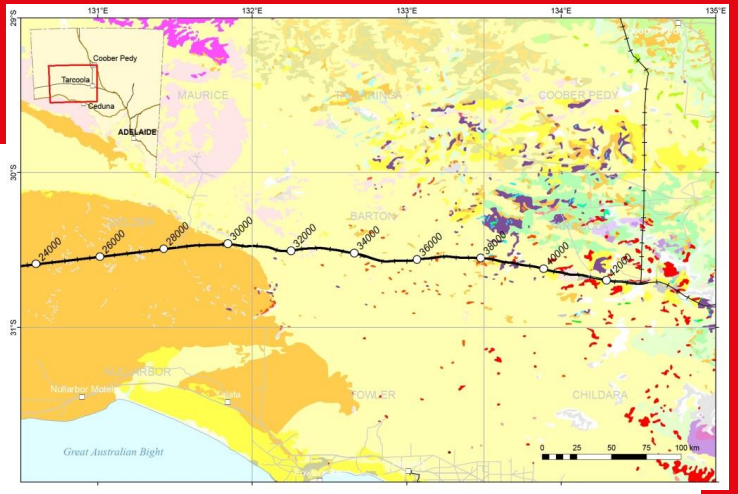
Processed data

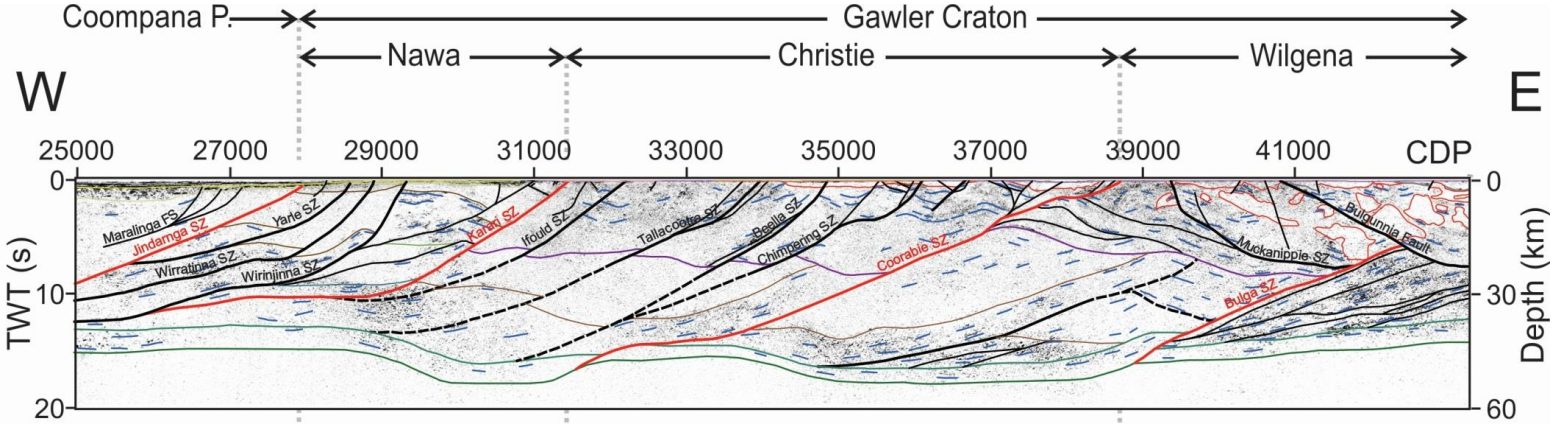
Migrated image used for interpretation. Contrast enhancements also particularly useful



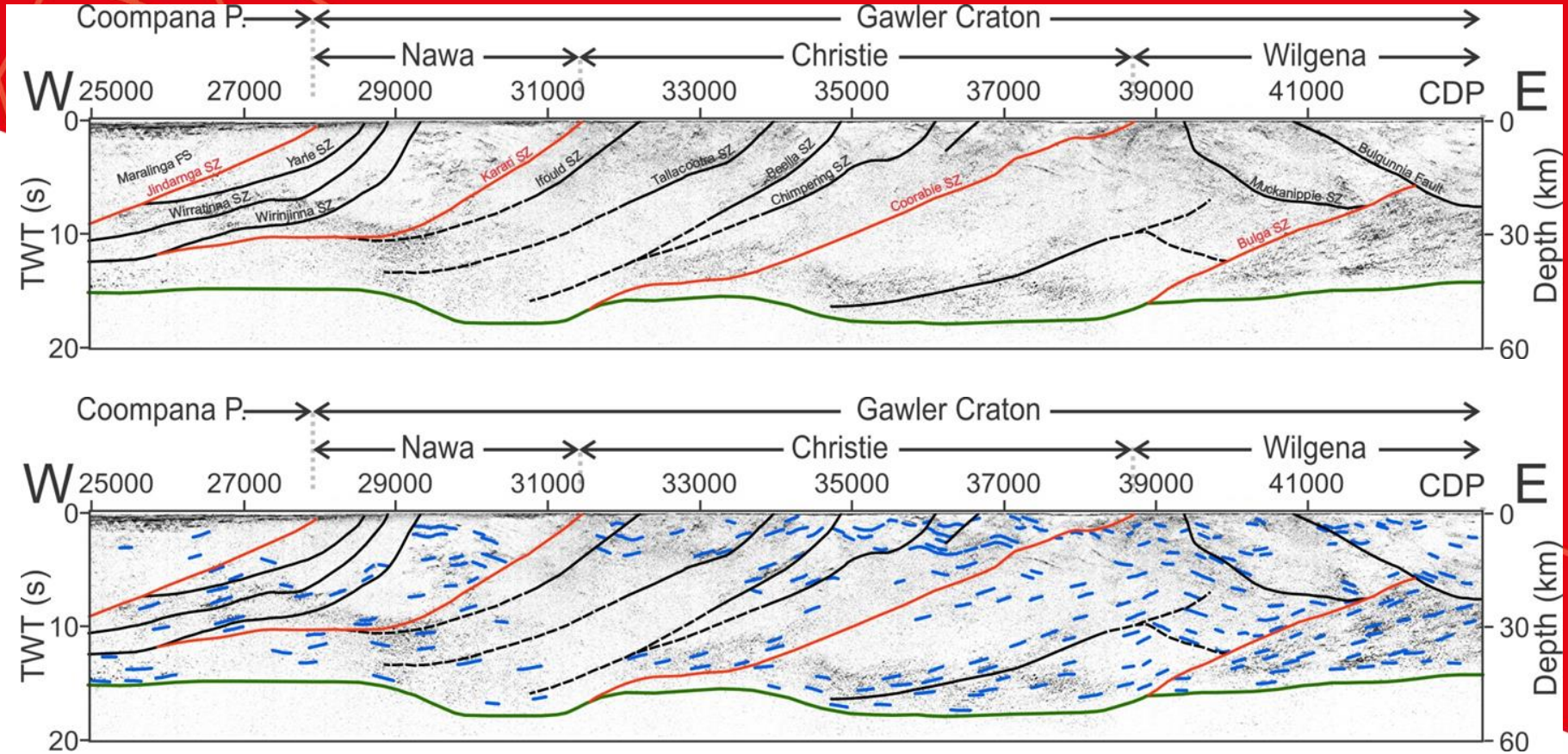
Challenges

- Poor data, often in places of greatest complexity
- Challenge of interpreting data with multiple overprinting events
- Many events strike-slip dominated, so significant out of plane movement. Potential for apparent offsets not reflecting in-plane movements
- Lack of existing geological data to constrain interpretations
- Because of uncertainties, often present more than one interpretation





Interpreted section

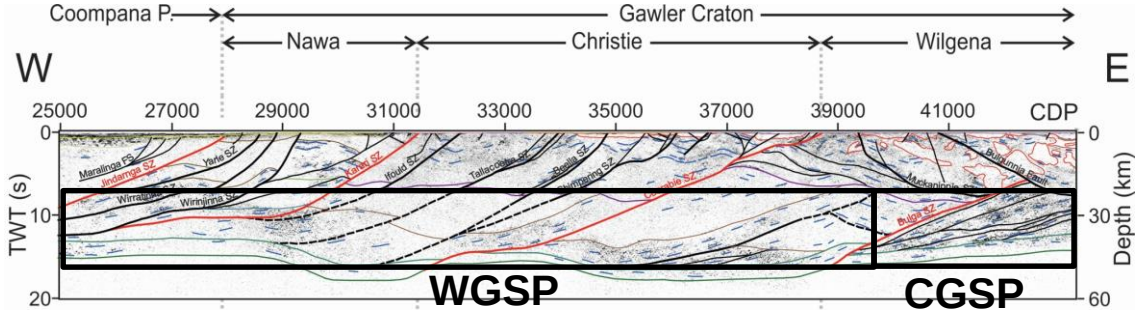


E1-Pre Mulgathing Complex

2 different lower crustal seismic provinces; Central Gawler Seismic Province (CGSP) and Western Gawler Seismic Province (WGSP)

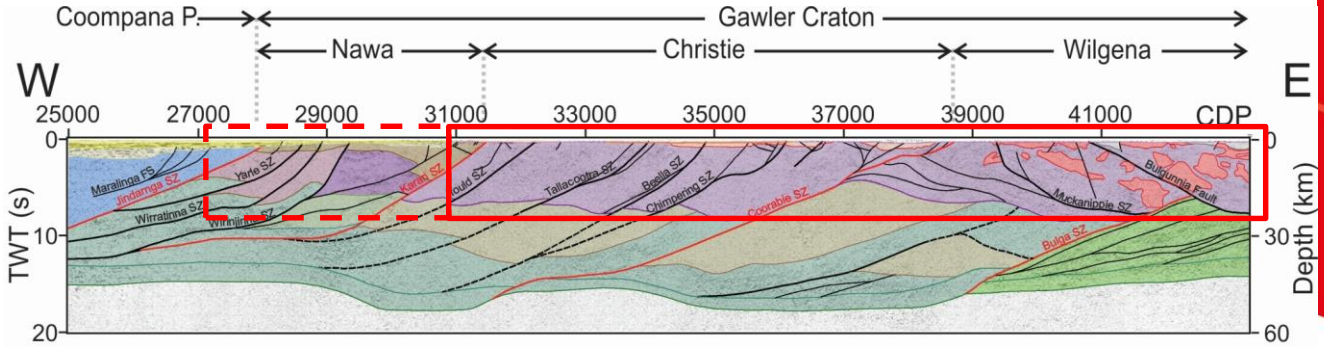
- Occurs beneath the western Wilgena, Christie, Nawa and Coompana domains
- Cross-cut by listric, west dipping structures, many of which continue through the upper-crustal Mulgathing Complex to the surface
- This province contains two layers of different seismic character; a strongly reflective lower-crust, and domains of relatively unreflective middle-crust
- Thickened in places as a product of later orogenic processes

- Reflective middle to lower-crust located at the eastern end of the line beneath the Wilgena Domain
- Continuation of WGSP?
- Modified?



E2-Mulgathing Complex

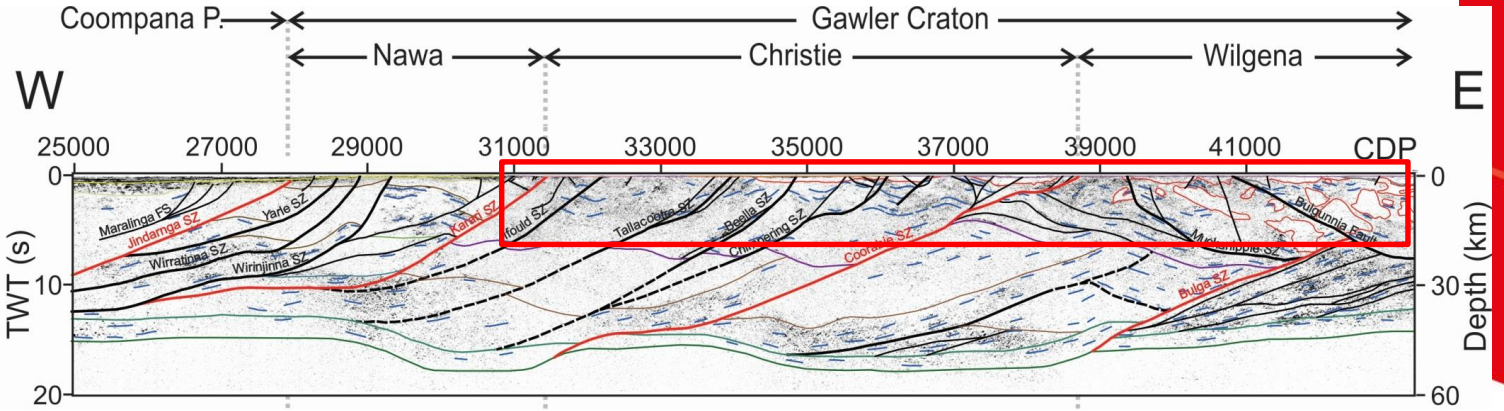
- The oldest event that can be confidently recognised is extension associated with the deposition of the Mulgathing Complex protoliths.
- Extension was accommodated along a series of east and west dipping crustal scale faults and shear zones
- Volcano-sedimentary basins; clastic and chemical sediments, volcanics
- May extend west and north as basement to the Palaeoproterozoic Nawa domain metasedimentary rocks



E3-Sleafordian Orogeny

Mafic and felsic magmatism in the Mulgathing ‘rift basin’ was accompanied by HT-LP high geothermal gradient metamorphism during the *c.* 2465 – 2410 Ma Sleafordian Orogeny

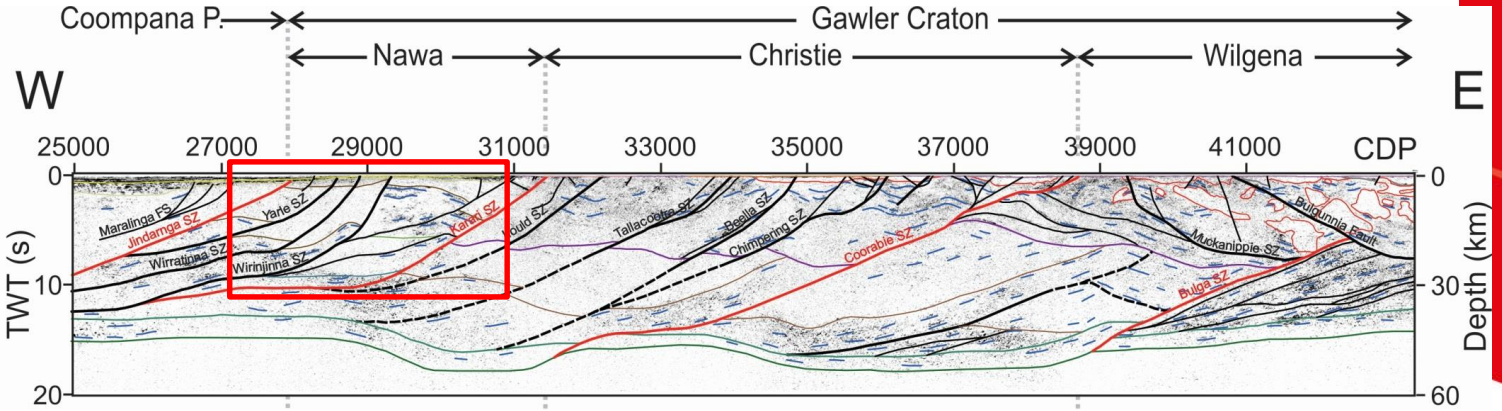
- Affected Christie and Wilgena domains
- Long lived and hot metamorphic event
- Punctuated shortening events
- Long-wavelength folding in seismic



E4-Nawa & Fowler Deposition

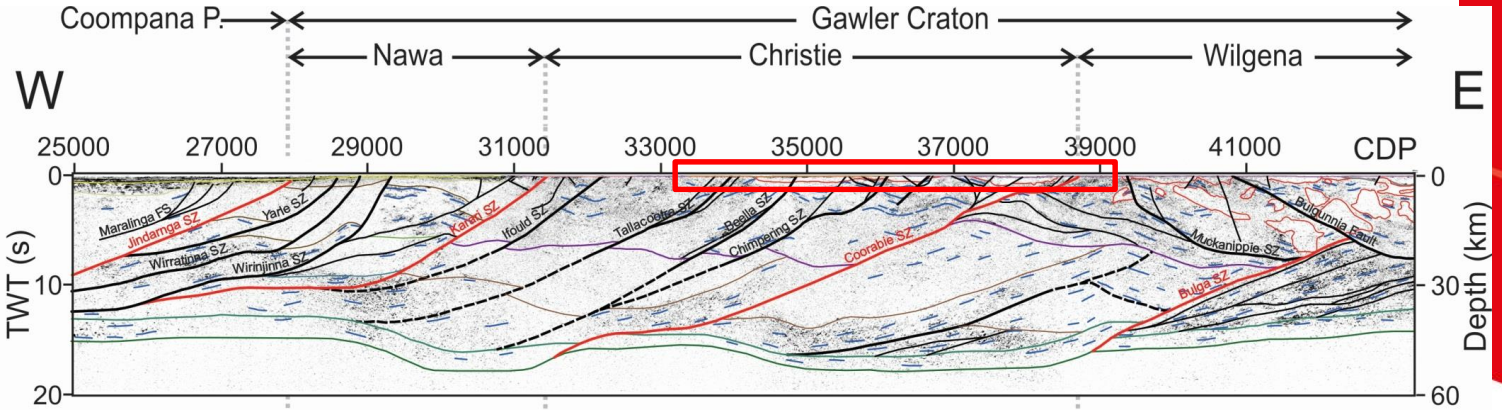
Extension along the margins of the proto-Gawler Craton (Mulgathing Complex) led to the deposition of the Paleoproterozoic metasediments of the Nawa and Fowler domains between *c.*1750 and 1720 Ma.

- Fowler Domain not imaged in section
- Nawa Domain metasedimentary rocks inc. Moondrah Gneiss
- Deposition of these sediments was predominantly accommodated by the crustal scale structures, including the Karari Shear Zone and the Wirinijinna Shear Zone



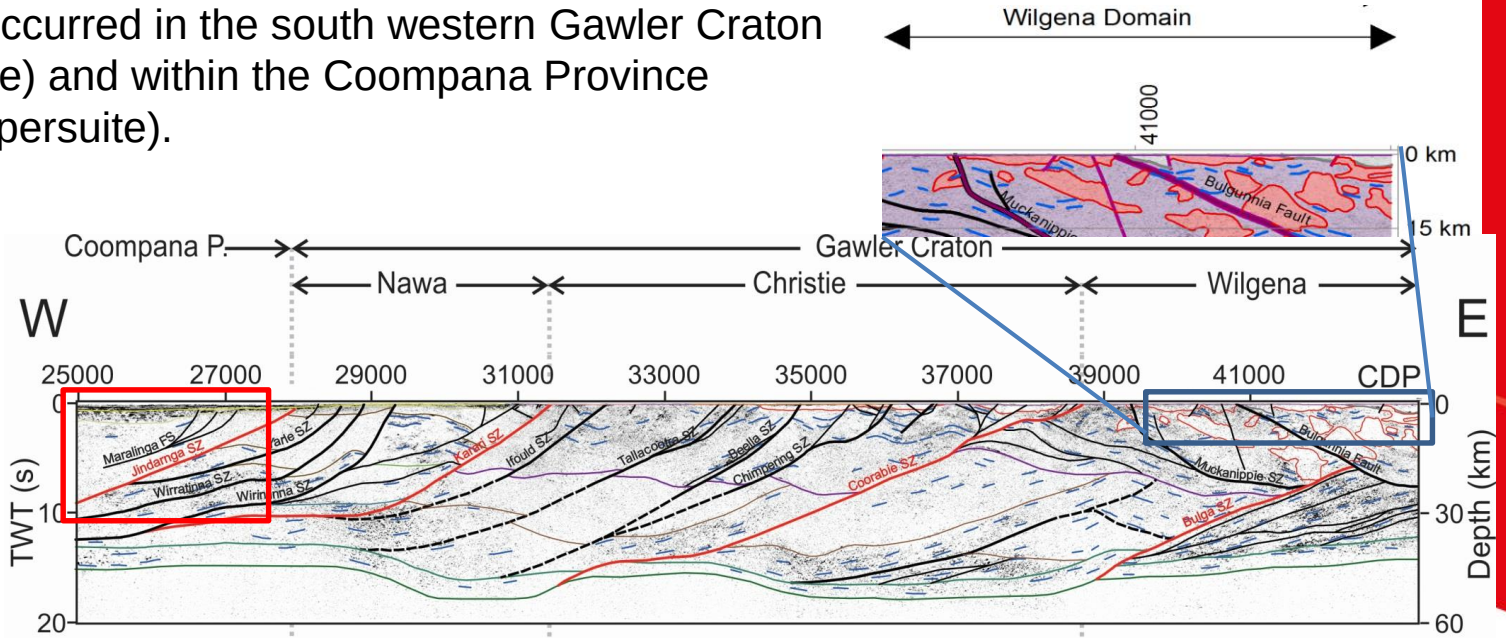
E5-Kimban Orogeny

- Sedimentary deposition in the Nawa and Fowler domains was terminated by deformation associated with the near craton-wide 1730 – 1690 Ma Kimban Orogeny
- Syn- to post Kimban Orogeny magmatism in the Christie Domain by magnetic and non-magnetic intrusions of the syn- to post-Kimban granitoids and Tunkillia Suite. These intrusions manifest as seismically-bland regions in the EG1 line.
- Syn-Kimban sedimentation of Labyrinth and Eba Formations proximal to the eastern end of the line.



E6-Tarcoola Fm/Coompana Magmatism

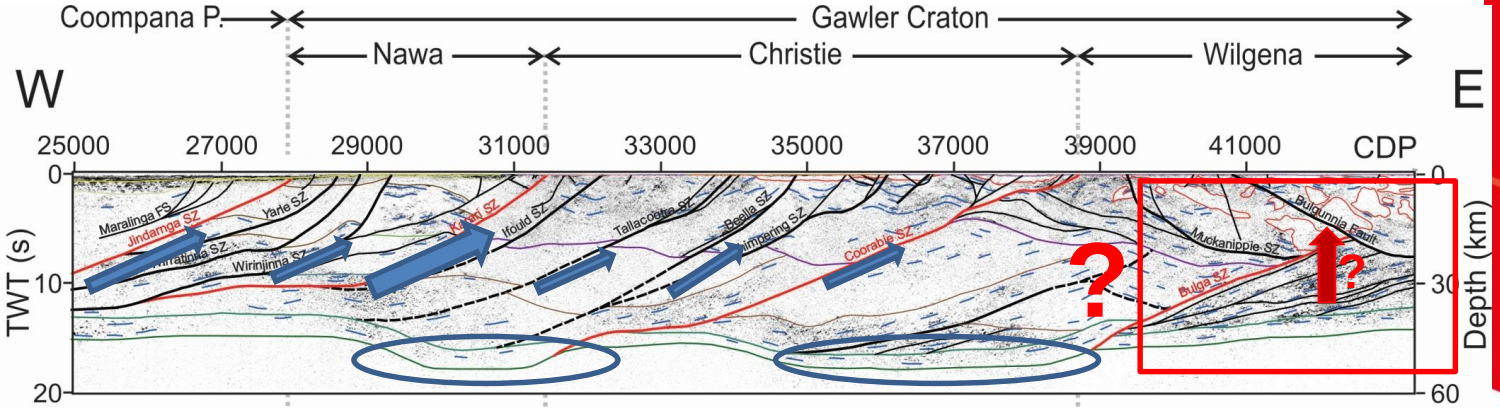
- The Tarcoola Formation was deposited into localised basins within the Wilgena Domain between c.1650 – 1600 Ma.
- Between c.1640 – 1607 Ma significant calc-alkaline magmatism occurred in the south western Gawler Craton (St Peter Suite) and within the Coompana Province (Toolgana Supersuite).



E7-Kararan Orogeny/Hiltaba Event

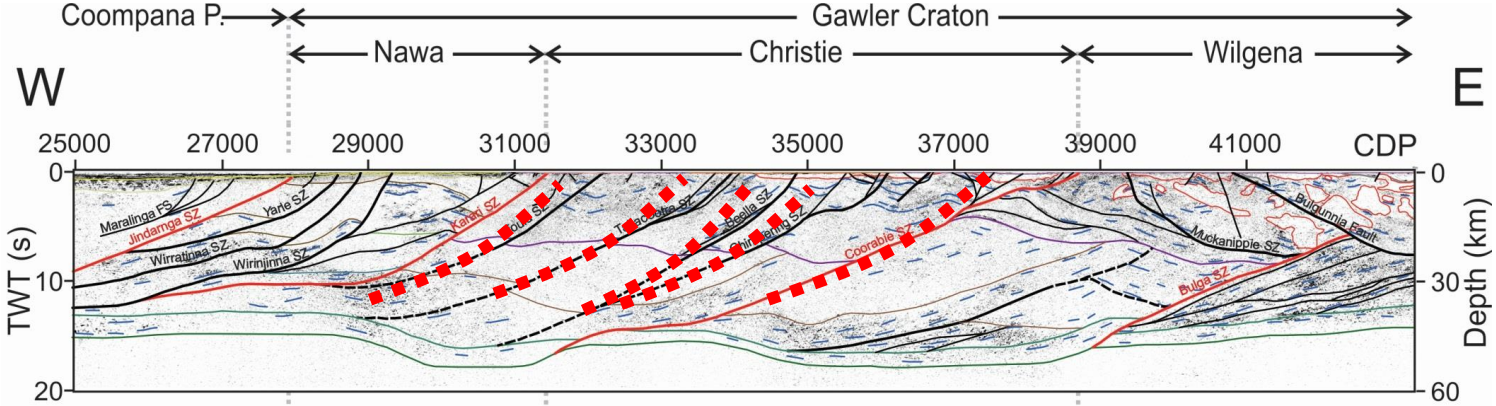
Between *c.* 1600 – 1560 Ma the western Gawler Craton underwent a major phase of deformation (Kararan Orogeny) and significant magmatism associated with the Gawler Range Volcanics and Hiltaba Suite granites.

- Re-activation of major structures
- Eastward vergent thrust stacking
- Hiltaba Suite Plutonism (and lower crustal modification?)
- Internal thickening of mid crust east of Coorabie SZ?
- Crustal thickening in/out of plane resulting in Moho bulges



E8-Coorabie Orogeny

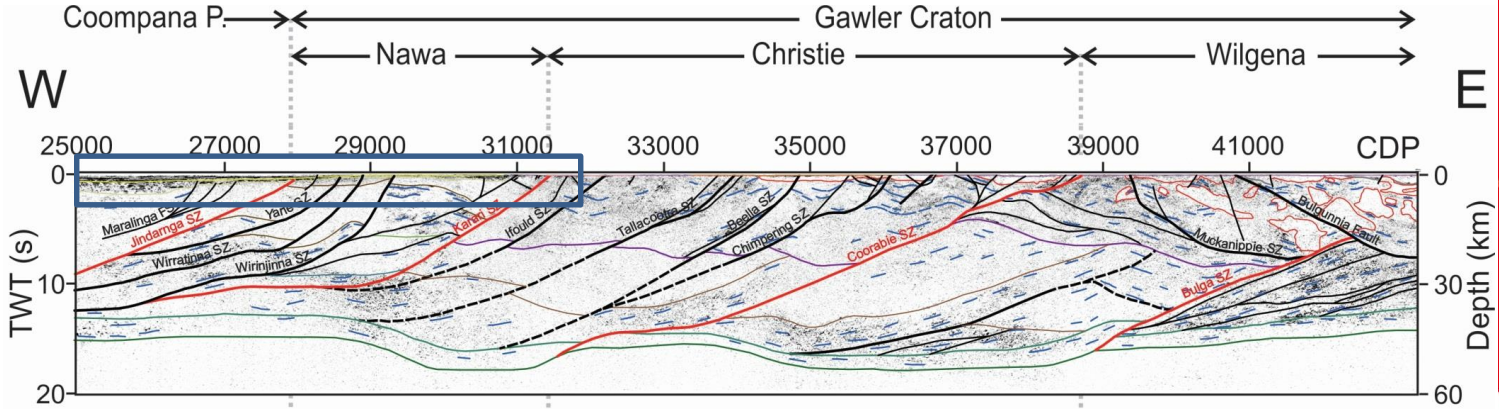
At *c.*1450 Ma, the major structures in the western Gawler Craton underwent low-temperature reactivation during the Coorabie Orogeny, in a predominantly strike-slip regime.



E9-Officer Basin

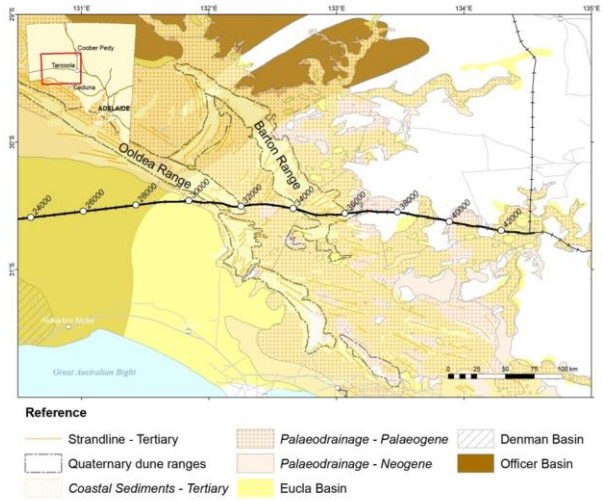
Renewed extension during the Neoproterozoic to Cambrian associated with the development of the Centralian Superbasin and the Adelaide Geosyncline reactivated existing basement structures in the Nawa and Coompana domains to accommodate the deposition of sediments of the Officer Basin.

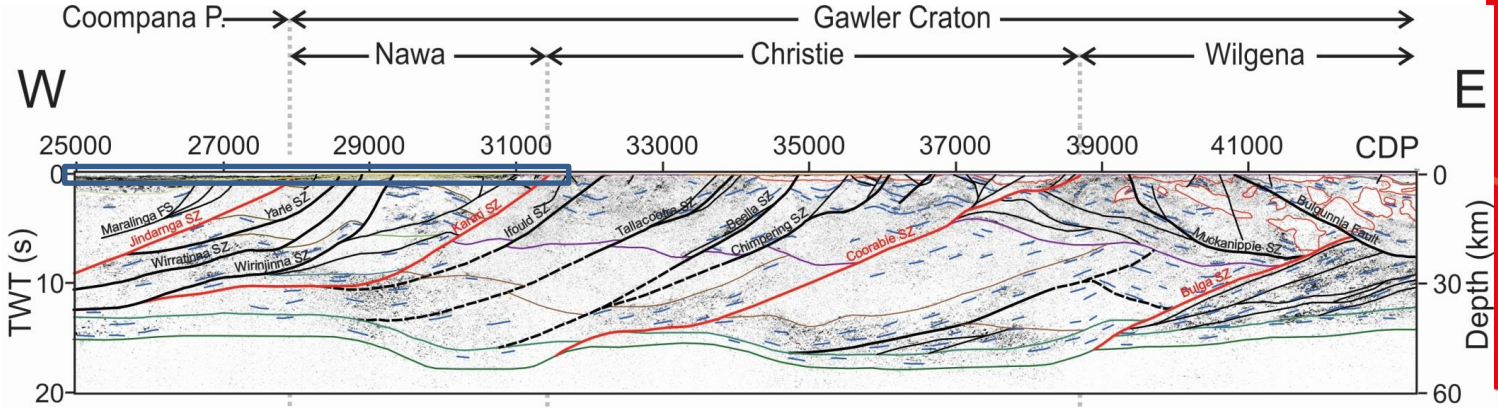
- Underlying mafic volcanics are c. 860 Ma, synchronous with Gairdner Dolerite and Amata Dolerite



E10-Eucla Basin

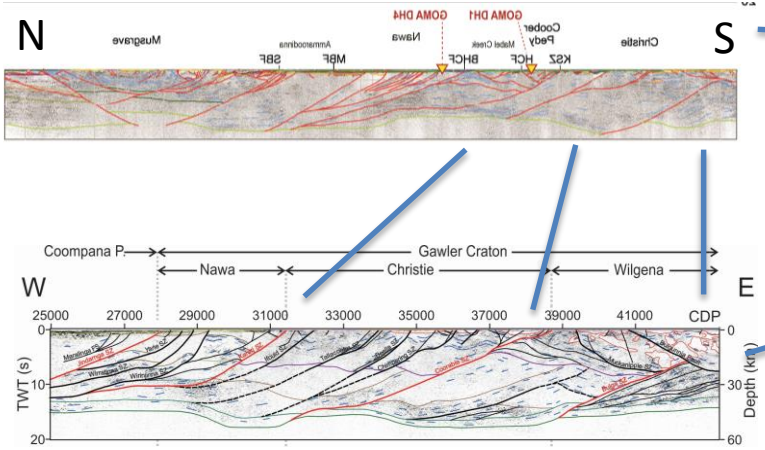
- Regional down warping and marine transgression during the Cenozoic led to the deposition of the sediments of the Eucla Basin and the paleostrandlines of the Ooldea and Barton ranges.

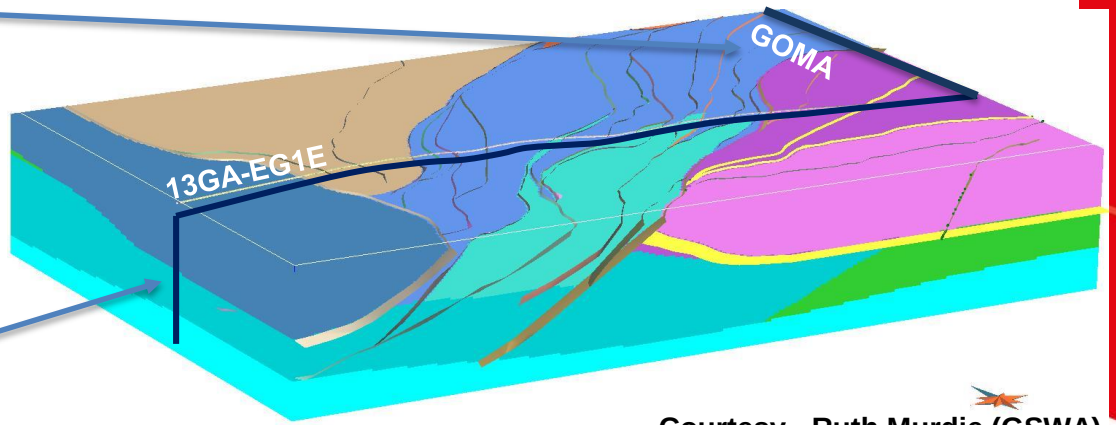




Conclusions

- Complex history
- Major crustal structures reactivated multiple times
- Similar structures imaged in GOMA line – tying together the Northern and Western Margins
- Significant in/out of plane movement makes reconstructions difficult
- Coompana Province interpreted to have been back-thrust over the Gawler Craton during the Kararan Orogeny





Courtesy - Ruth Murdie (GSWA)

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Government of South Australia

Department of State Development

Contact

Tom Wise
Geological Survey of South Australia
E: tom.wise@sa.gov.au

Department of State Development
Level 7, 101 Grenfell St
Adelaide, South Australia 5000
GPO Box 320
Adelaide, South Australia 5001
T: +61 8 8226 3821
E: dsdreception@sa.gov.au

www.minerals.statedevelopment.sa.gov.au

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