



Australian Government
Geoscience Australia

Recent deep seismic reflection surveys in the Gawler Craton & Curnamona Province: Implications for regional energy systems



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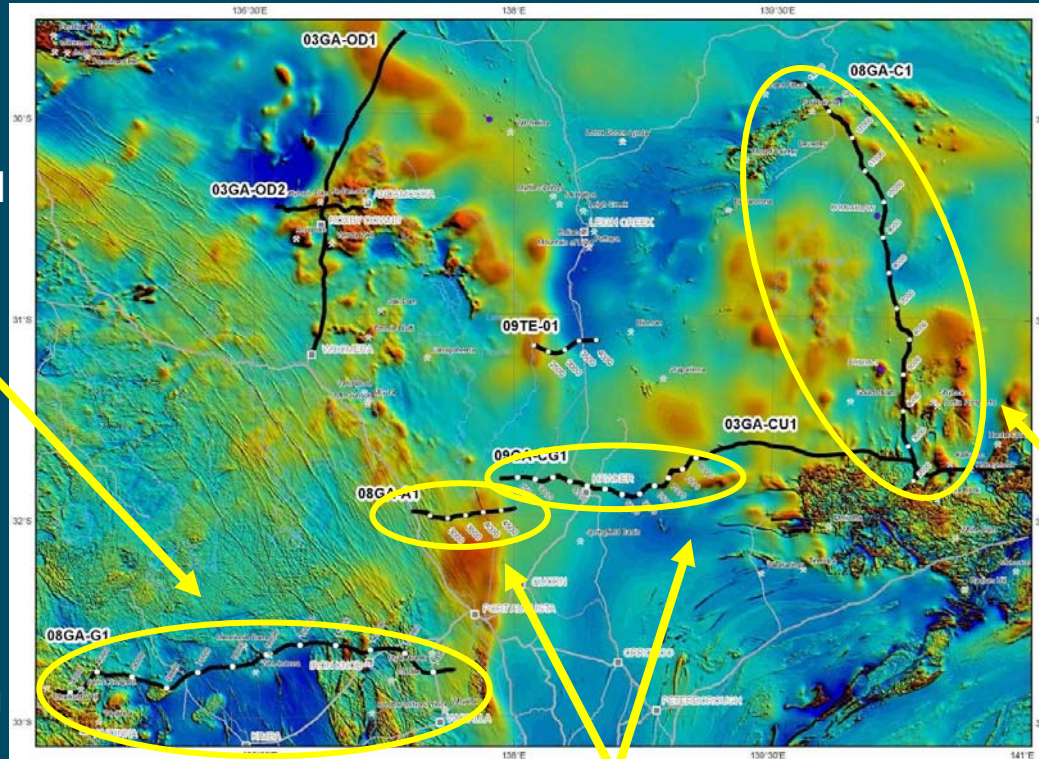
Government of South Australia
Primary Industries and Resources SA

GEOSCIENCE AUSTRALIA

Energy drivers for the new Seismic & MT data in SA

Gawler Line

- Crosses western margin of SAHFA.
- Images the crustal architecture of IOCG±U and Au-dominated provinces.
- Crosses southern outcrop of Pandurra Formation & Corunna Conglomerate → unconformity-U potential.



Curnamona Line

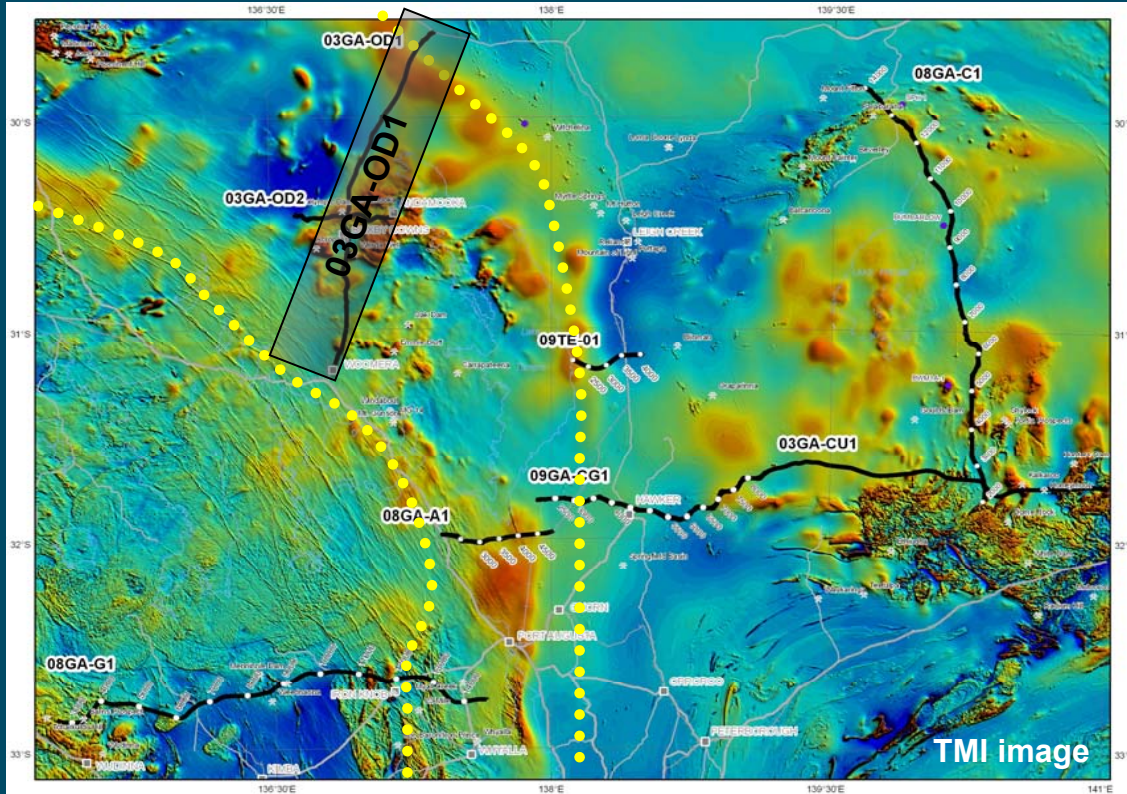
- Explores the IOCG±U potential of the Curnamona Province.
- Images regions with known sandstone-hosted U deposits (Beverley, Honeymoon).
- Traverses eastern margin of SAHFA.

Arrowie and Curnamona-Gawler Link Line

- Images the IOCG±U architecture of the eastern Gawler Craton.
- Defines the crustal architecture of the Arrowie Basin → petroleum potential
- Images crustal architecture within the SAHFA.

IOCG±U systems & the Olympic Domain

IOCG±U province



IOCG±U province

- OD: World's largest uranium deposit
 - 4th largest remaining copper deposit,
 - 5th largest gold deposit
 - Significant silver
- In a domain on the edge of a craton, which extends to the south
- 2 of the new seismic lines cross the IOCG±U domain boundaries
- 2003 seismic lines in the centre of IOCG±U domain

Crustal architecture - Olympic Dam (OD)

S

N

Olympic Dam (OD)

50 km V:H=1

twf, secs

0

5

10

15

Seismic and magnetotellurics

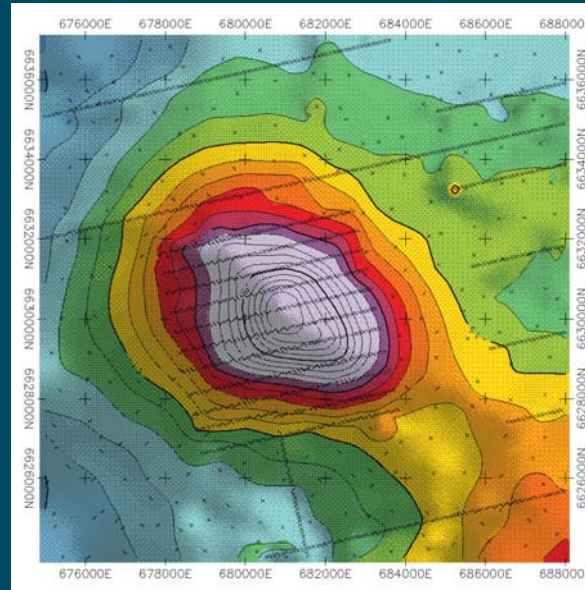
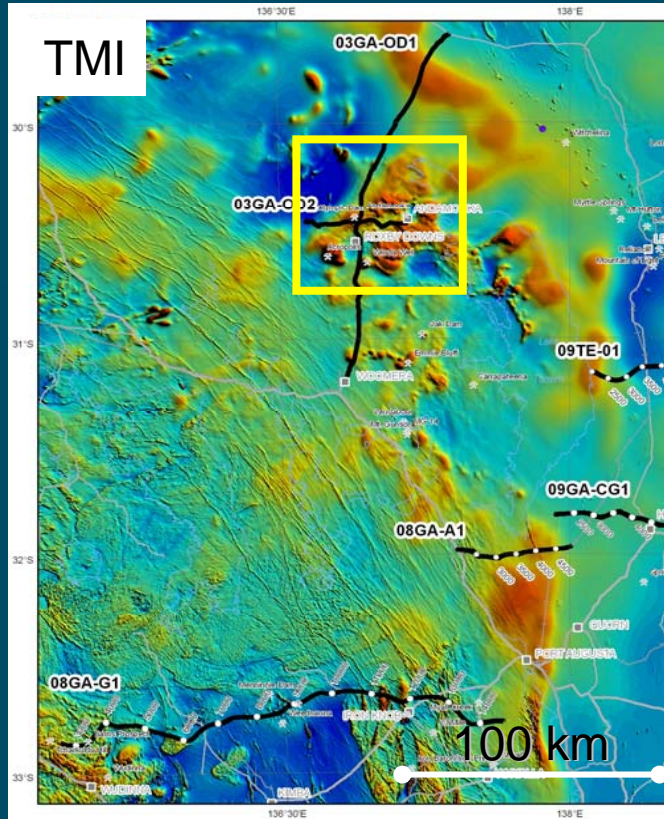
(Lyons and Goleby, 2005; Heinson et al., 2006)

Major crustal architectural ingredients, OD sits above:

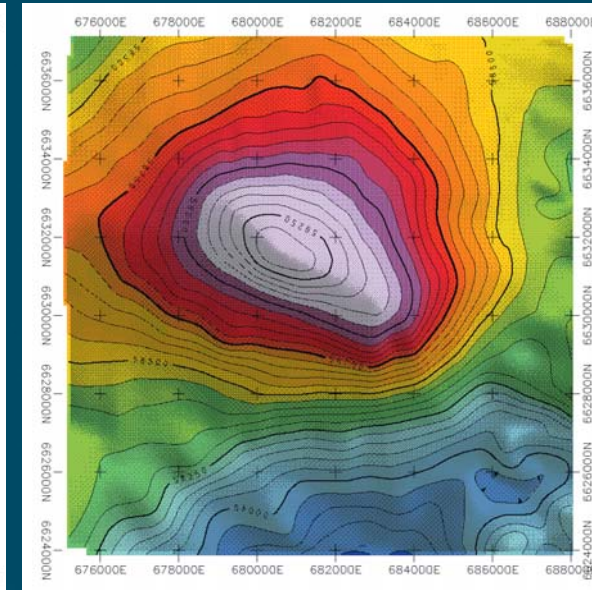
- Seismically non-reflective crustal ('bland zone')
- Crustal-scale structure (Elizabeth Creek Fault) – extension implied, OD in hangingwall
- Two different crustal blocks (seismic character)
- Magnetotellurics (MT) = conductive zone → deep alteration system?

Potential field characteristics - Olympic Dam

Hanneson (2003)



Bouguer Gravity

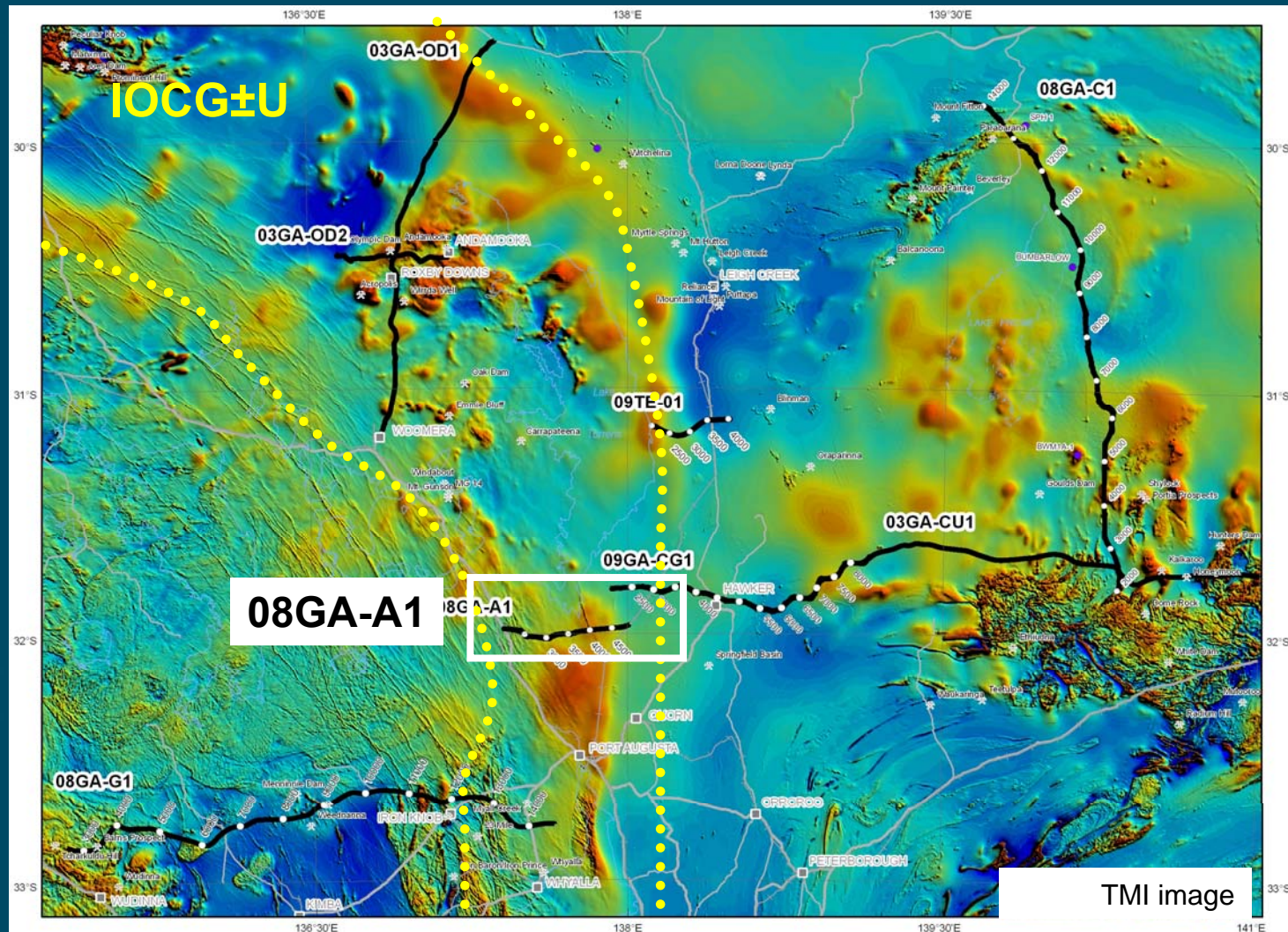


Aeromagnetics data

Geophysical characteristics:

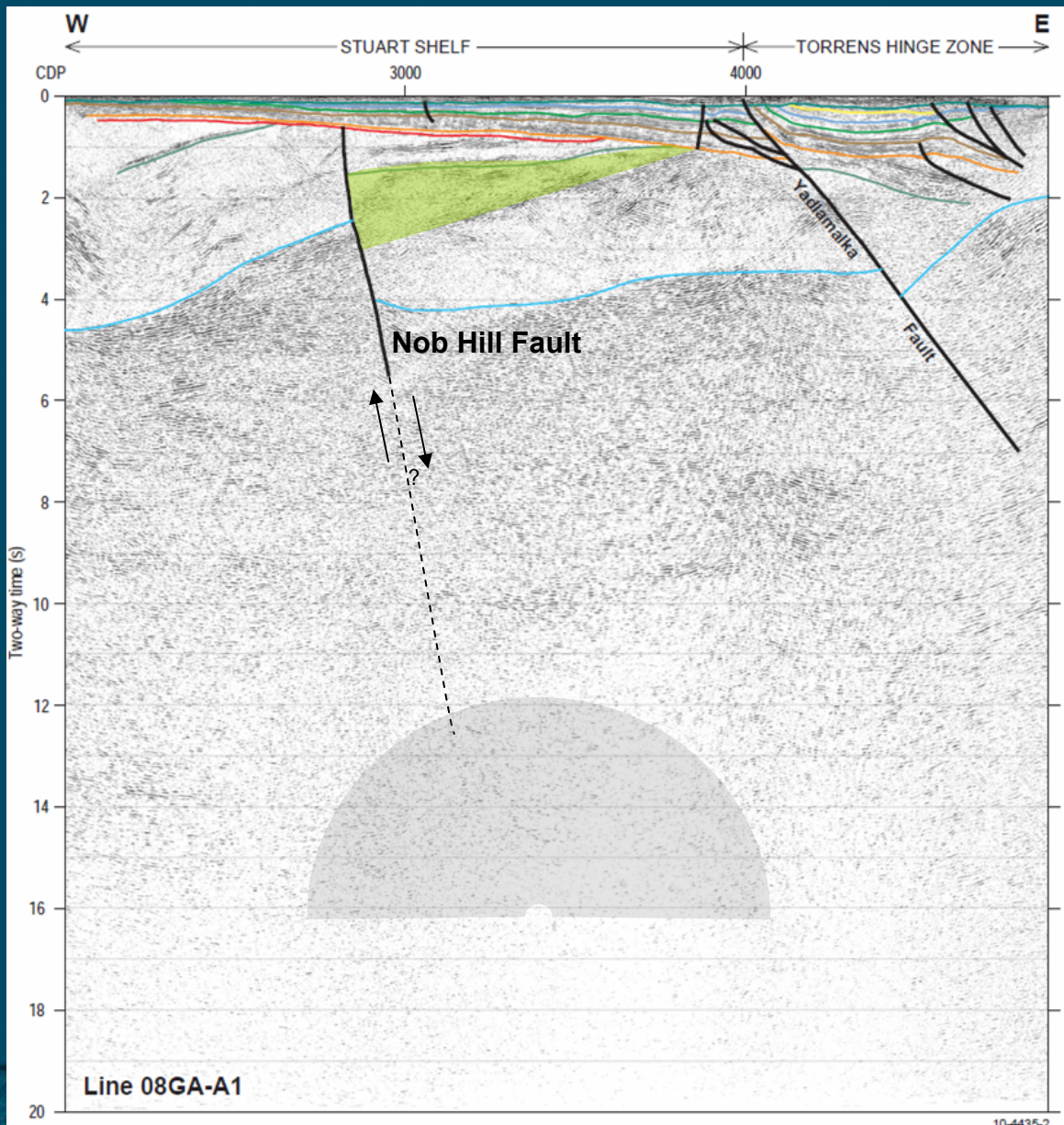
- Huge magnetic and gravity anomaly
- In detail off-set between magnetic and gravity high

IOCG±U systems across the Olympic Domain



08GA-A1 Arrowie seismic line

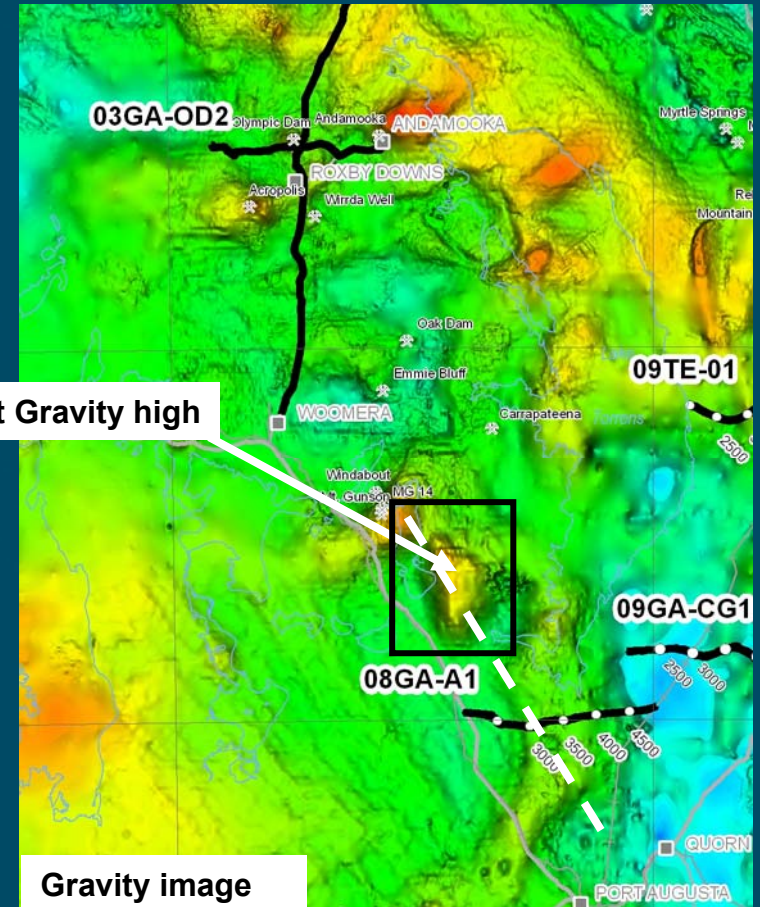
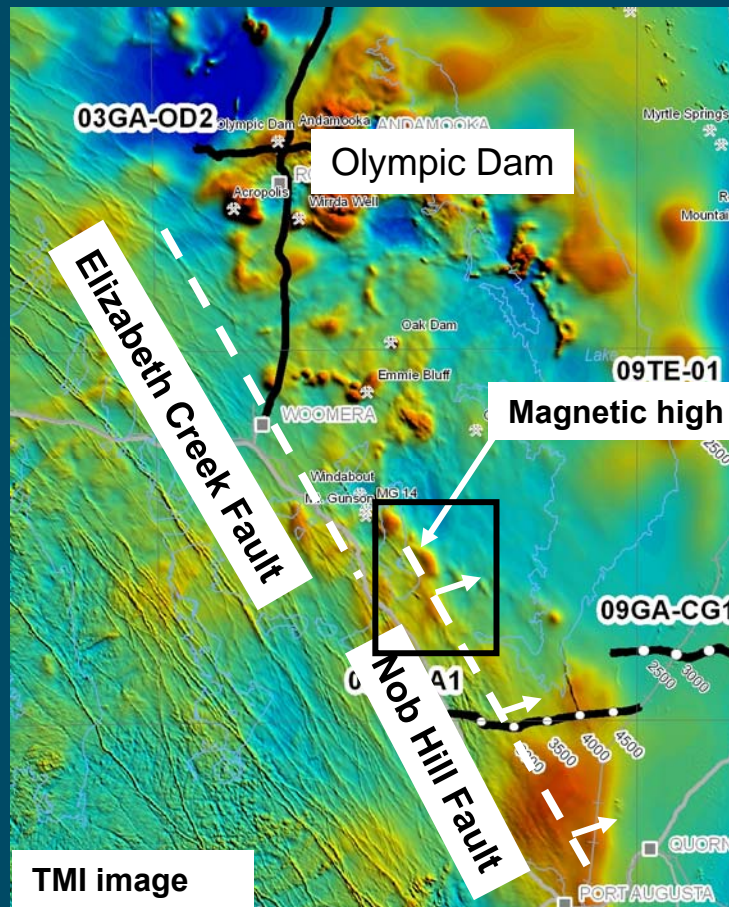
Southeast of Olympic Dam- Arrowie Basin line (1)



Major crustal architectural ingredients:

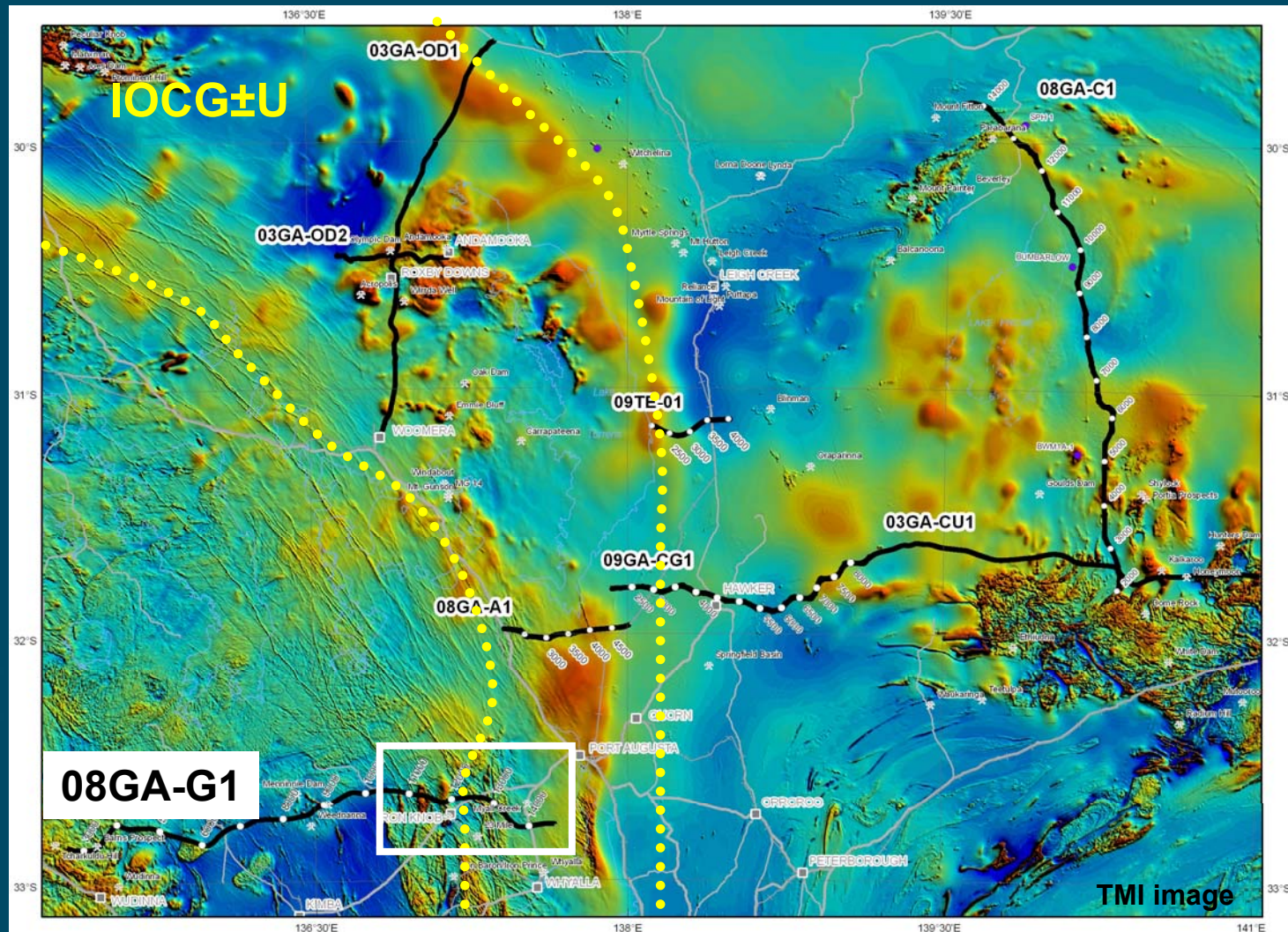
- Seismically non-reflective crustal ('bland zone')
- Crustal-scale structure (Nob Hill Fault)
- Two different crustal blocks?
- Syn-Gawler Range Volcs extension (q's about OD)
- ~6 km normal offset
- Pandurra u/c ~1 km depth
- Part of an array of major E to NE dipping normal faults
- Where to look?
- Along strike in hangingwall, prefer shallower cover

Southeast of Olympic Dam- Arrowie Basin line (2)



- Nob Hill Fault (steep dip) is NOT Elizabeth Creek Fault (gentle dip)
- Poor control on these fault strikes – a linked fault system?
- In hangingwall of Nob Hill F, off-set between magnetic and gravity highs
- Depth to basement modelling = region of shallow Stuart Shelf cover
- No MT data to compare w/ OD

IOCG±U systems across the Olympic Domain



South of Olympic Dam - Gawler line (1)



Geophysical characteristics:

- Located on western edge of Olympic IOCG±U domain
- Gravity anomaly within a generally dense region
- Anomaly strikes oblique (NW) to N-S regional strike in gravity
- Dense intrusive body eg gabbro?

South of Olympic Dam - Gawler line (2)



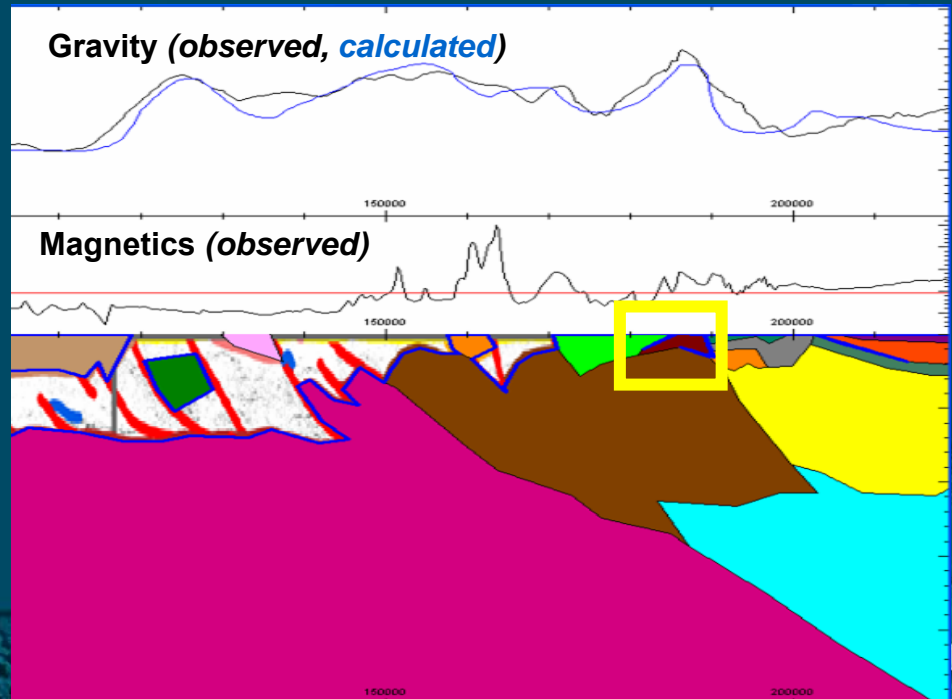
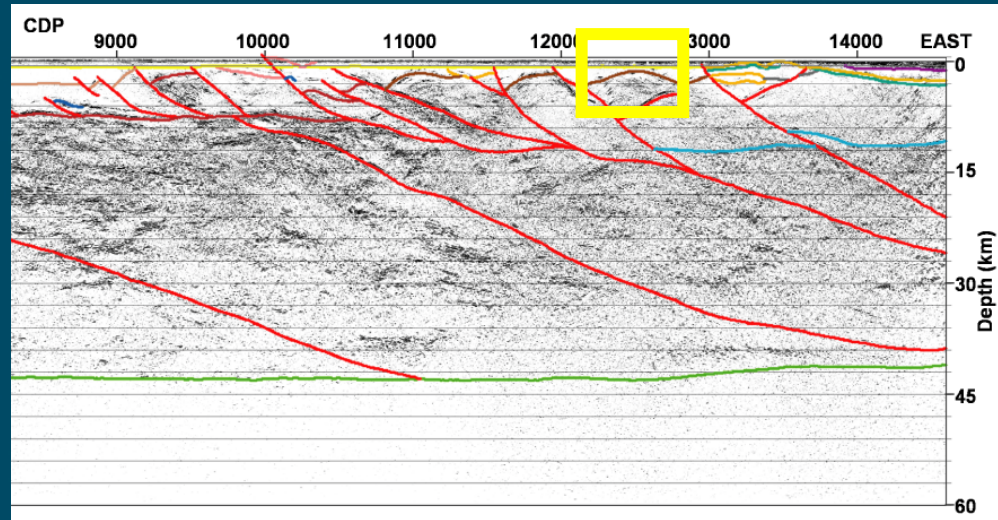
Geophysical characteristics:

- Relatively non magnetic body, or magnetic features not coincident with gravity
- If gabbro, then highly altered (demagnetised)
- Or altered felsic intrusive (granite), with non-magnetic mass added (hematite?)

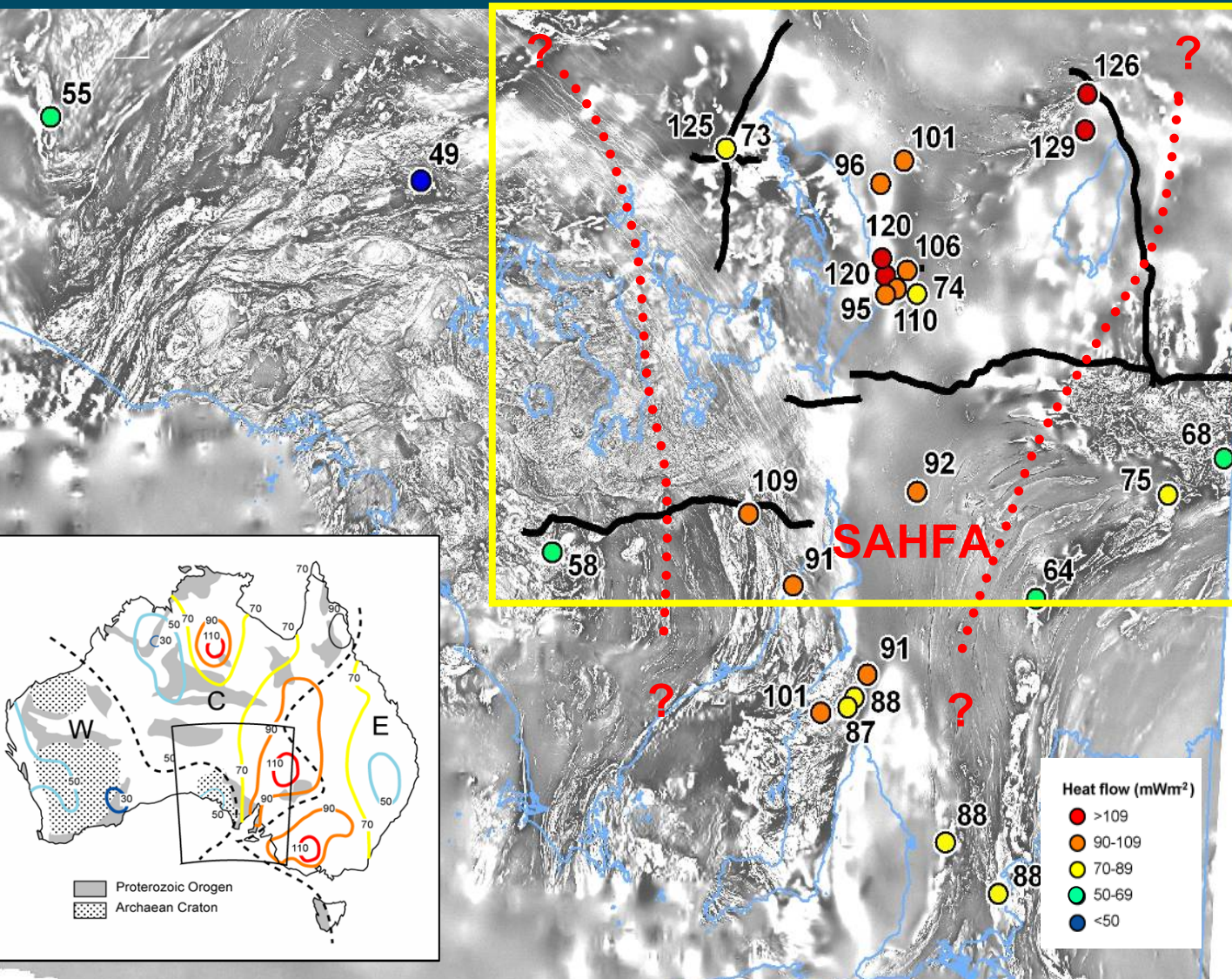
South of Olympic Dam - Gawler line (3)

Geophysical characteristics:

- Anomaly located in hangingwall of crustal structure
- Close to seismic province boundary
- Potential Field modelling requires
 - very dense (2.95 g/cm³)
 - non-magnetic body
- Unlike OD, no obvious bland zone, MT is generally resistive



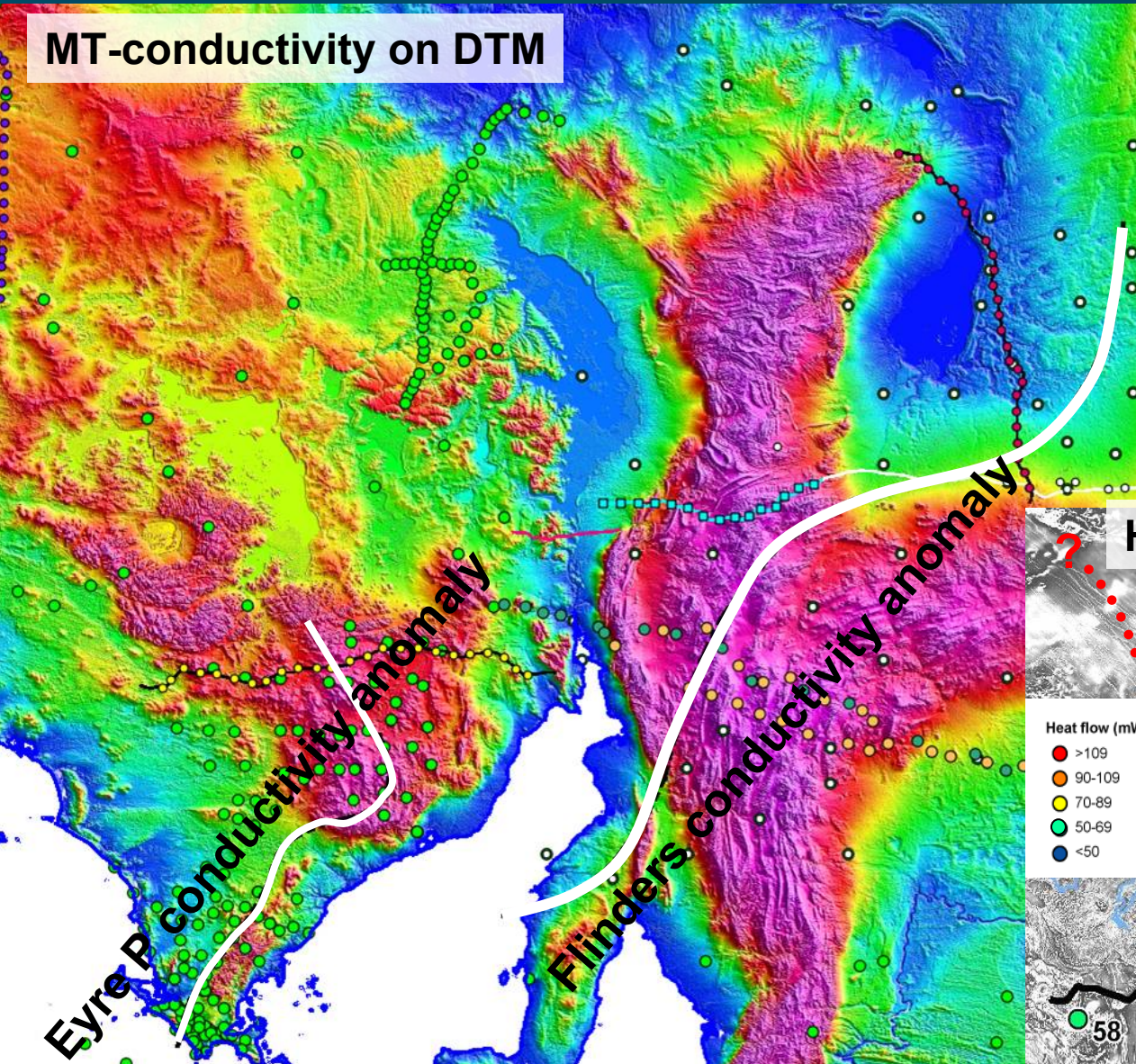
South Australian Heat Flow Anomaly (SAHFA) & Geothermal systems



- Proterozoic Australia has high surface heat flow
- SAHFA = high heat flow due to high heat-producing granites
- Can we use seismic and MT data to better map its extent?

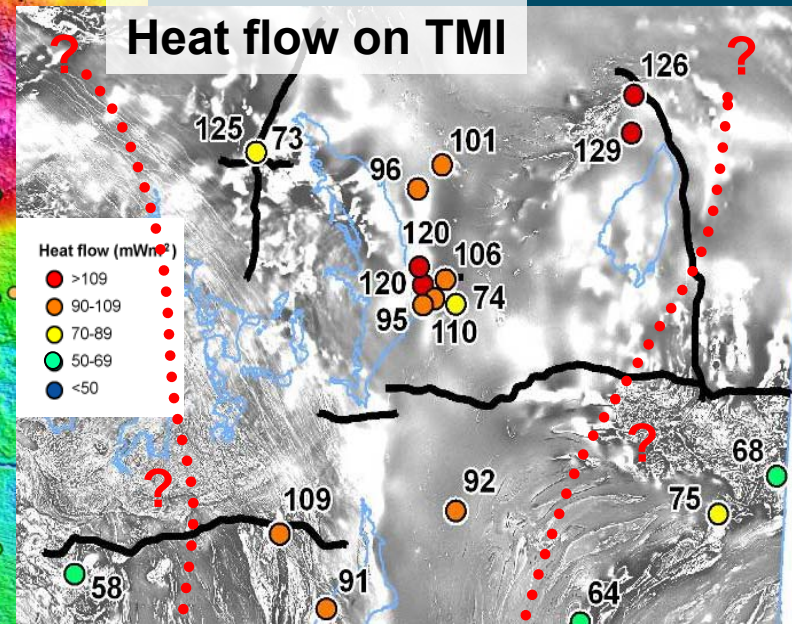
South Australian Heat Flow Anomaly & conductivity (MT)

MT-conductivity on DTM



- As, conductivity & temperature are positively correlated,
- is there a relationship between the MT boundaries and the SAHFA boundaries?

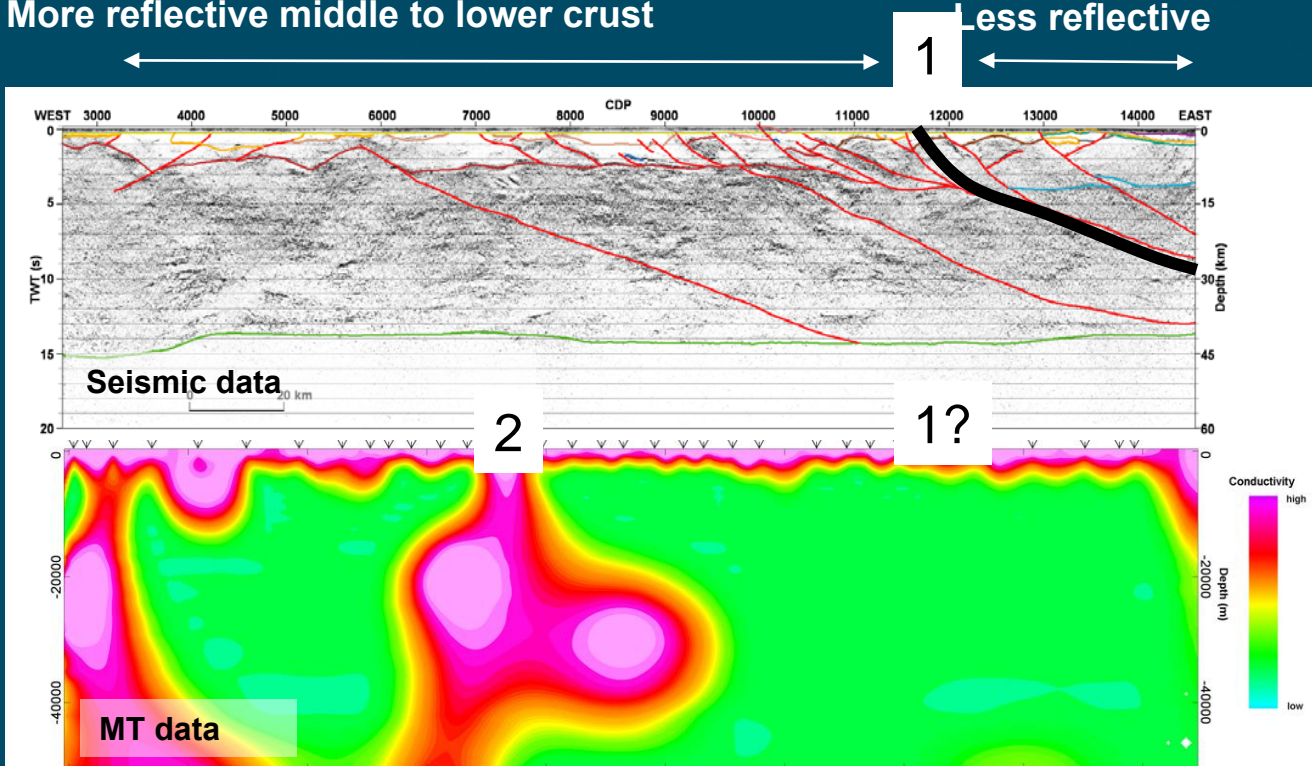
Heat flow on TMI



Western boundary of the SAHFA

More reflective middle to lower crust

Less reflective

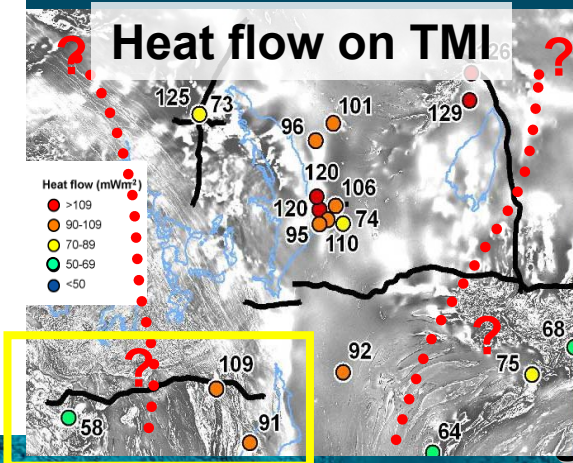
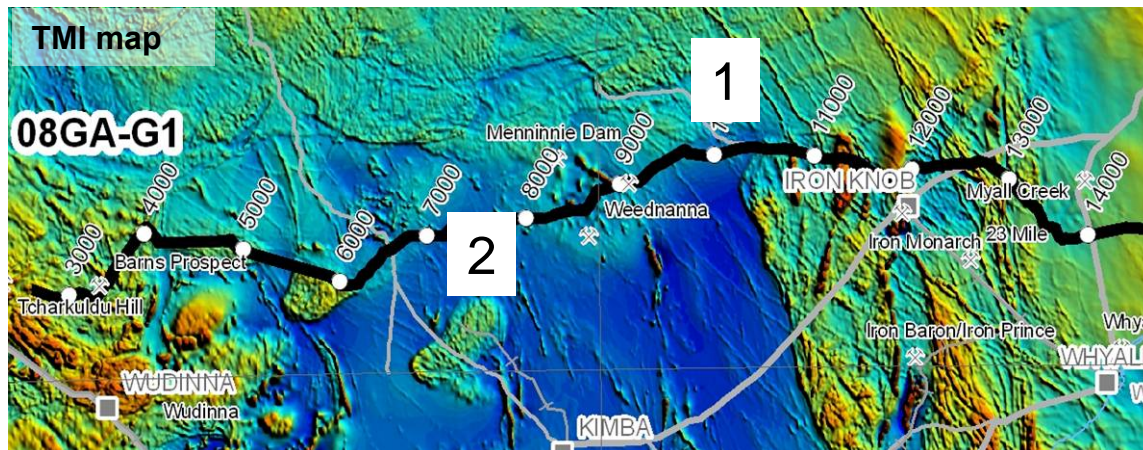


1) Mapped by the seismic boundary & crustal reflectivity?

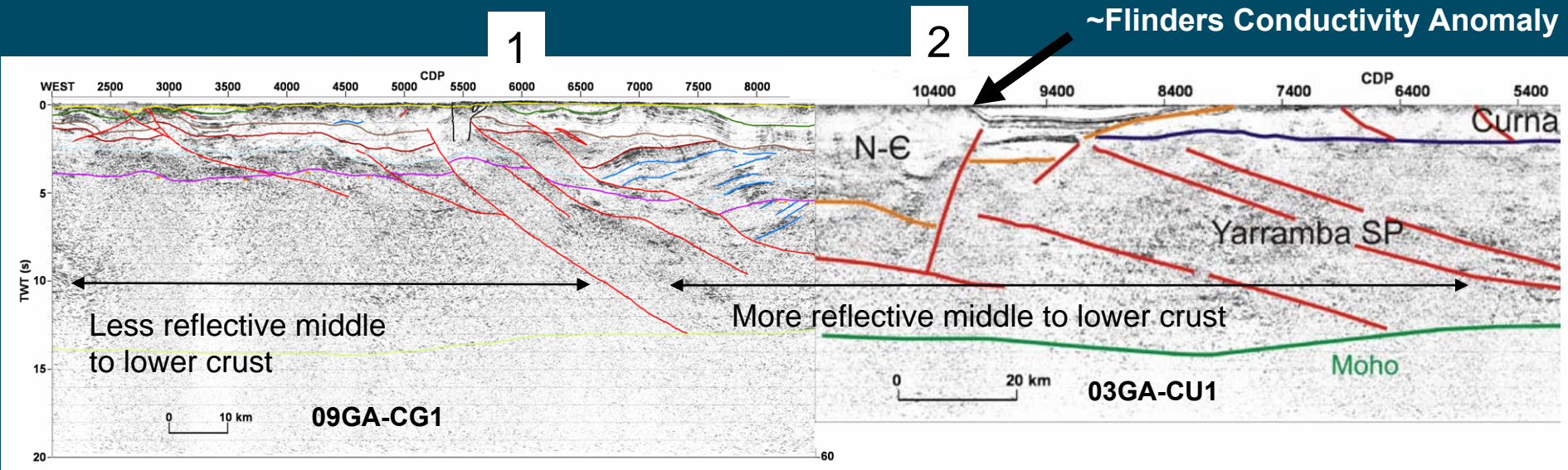
OR

2) Mapped by the MT boundary?

Although these data alone can not define the boundary, they focus the search space



Eastern boundary of the SAHFA

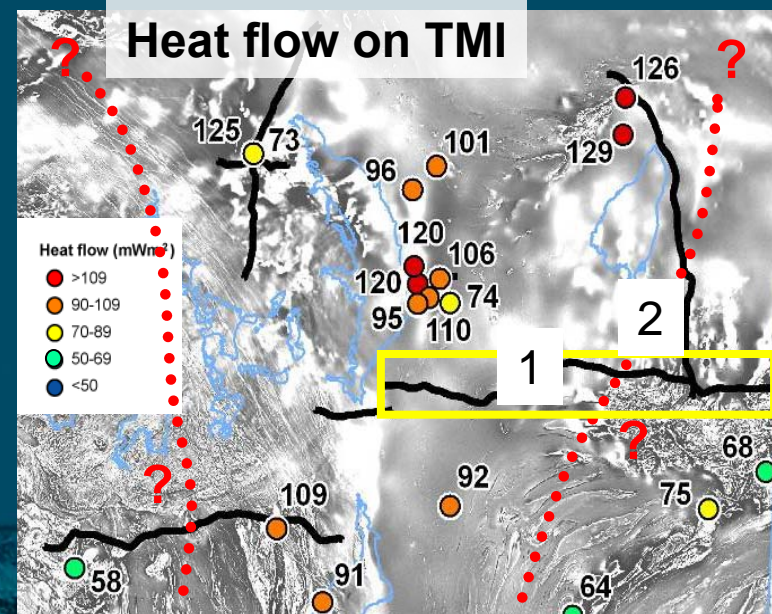


1) Mapped by the seismic boundary & change in crustal reflectivity?

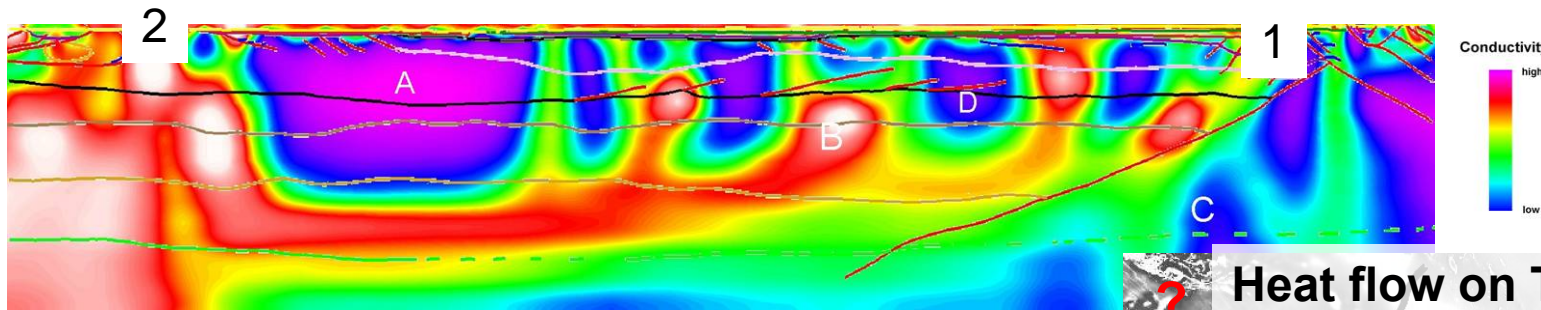
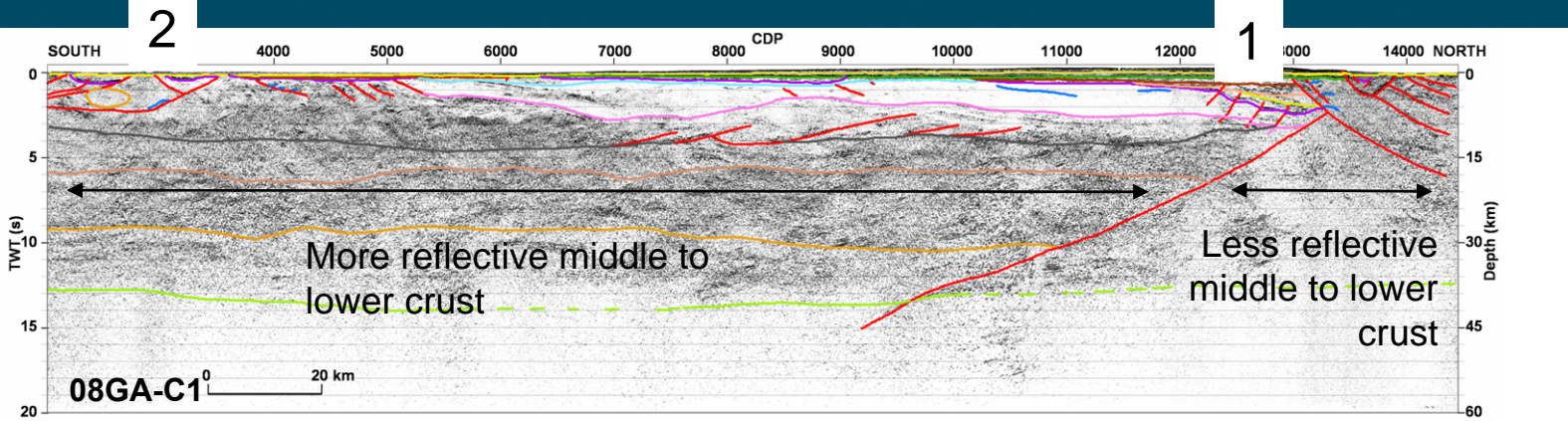
OR

2) Mapped by the MT (Flinders Conductivity Anomaly) boundary &/or eastern boundary of deep Adelaidean basin_?

Although these data alone can not define the boundary, they focus the search space



Northeastern boundary of the SAHFA

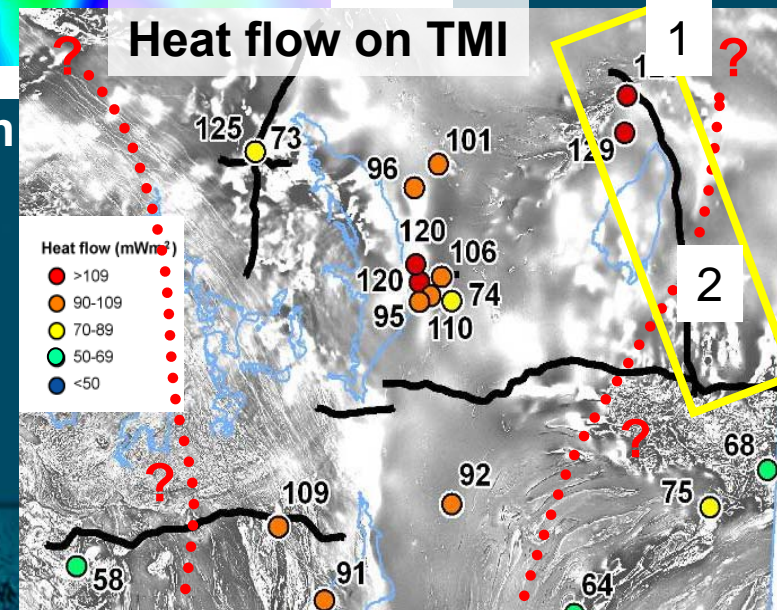


1) Mapped by the seismic boundary & change in crustal reflectivity?

OR

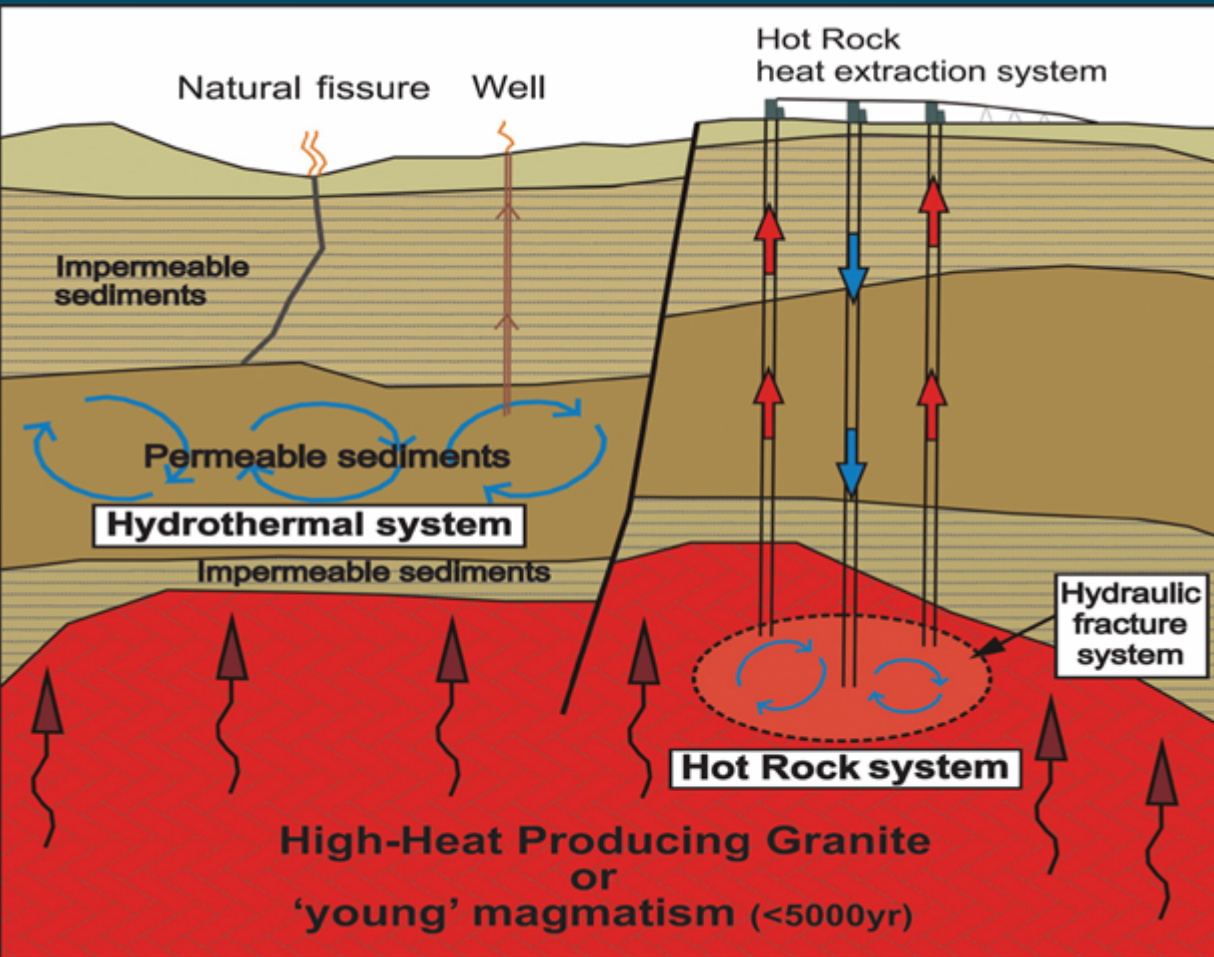
2) Mapped by the southern MT boundary?

Although these data alone can not define the boundary, they focus the search space



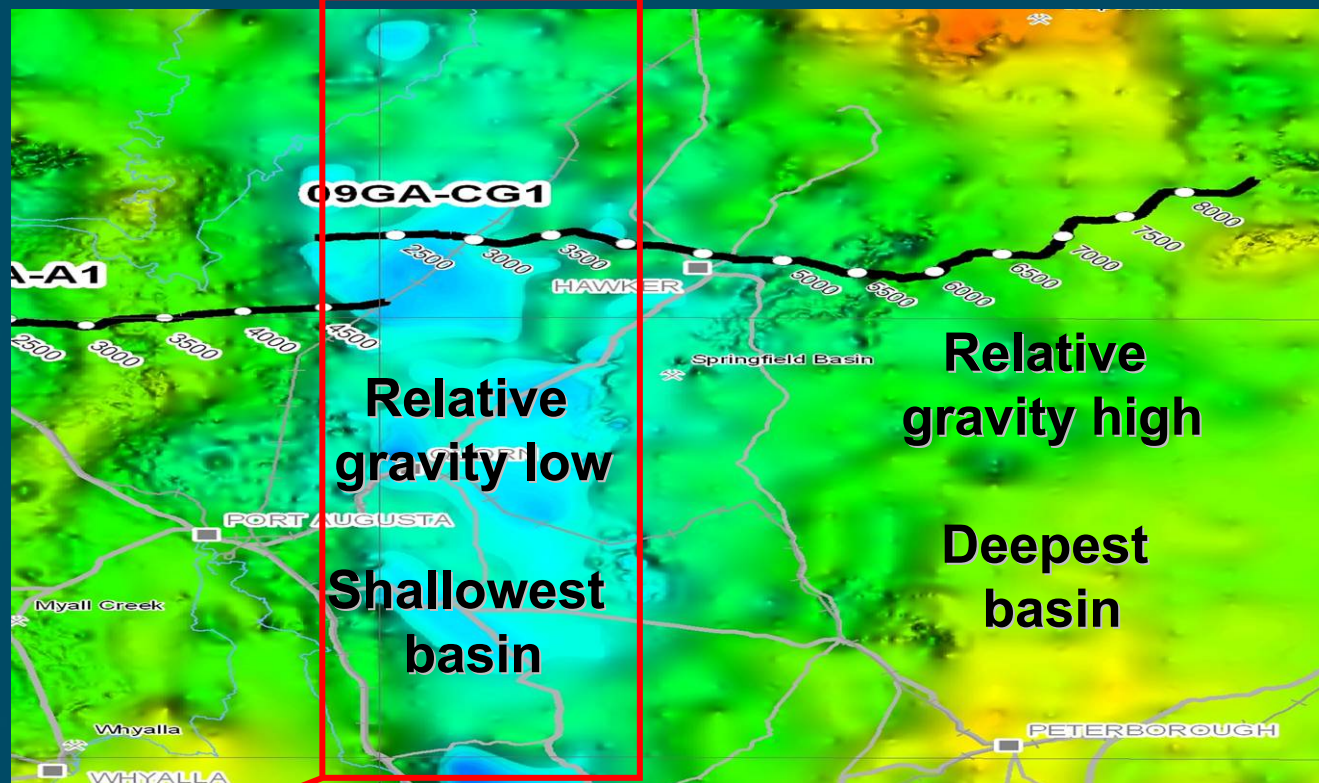
Geothermal energy plays

HOT ROCK Geothermal play



Need:

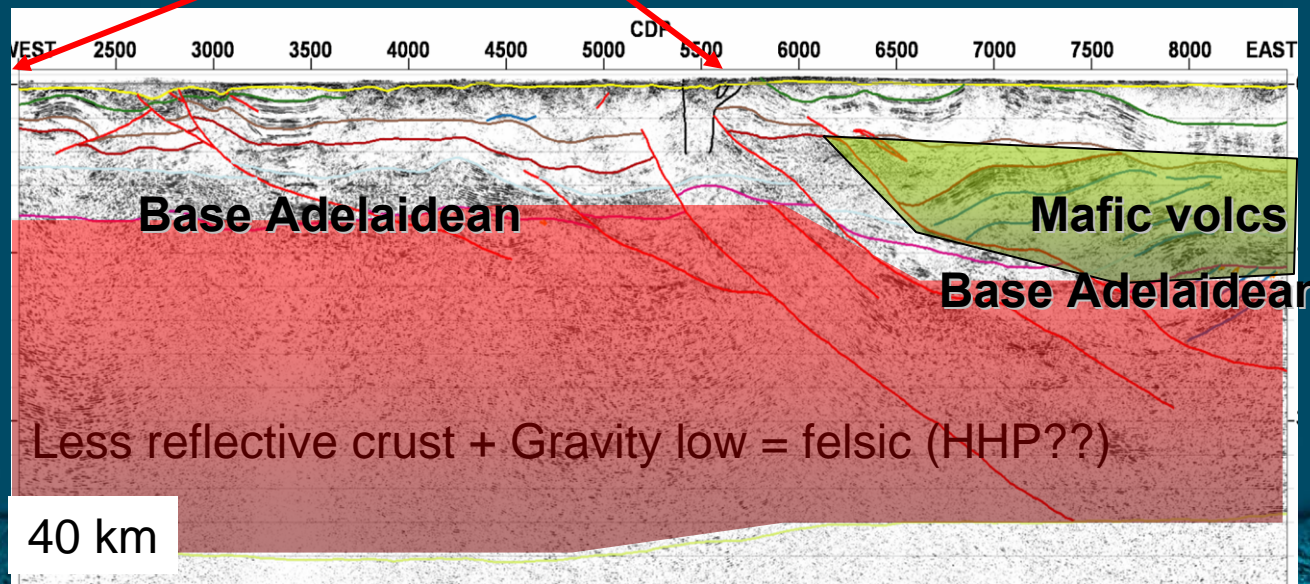
- 1) Heat source
 - 2) Normally associated with radiogenic granites
 - 3) Thermal blanket
- Can we say anything about heat-producing basement?
 - Seismic & gravity – depth and composition



- Gravity and depth to pre-Adelaidean basement = counter intuitive

- Gravity high = thick mafics in deepest depocentres

- Gravity low = basement high → extensive region of felsic crust



- Heat source confirmed by high heat flow in region

- New insights from seismic & gravity

Conclusions

- OESP seismic and allied geophysical acquisition improved understanding of the architecture of the Gawler-Curnamona
- Improved mapping of boundaries
 - Olympic IOCG±U Domain
 - South Australian Heat Flow Anomaly
- For U resources:
 - see favourable regions along strike from Olympic Dam, sharing some of the key architectural ingredients
- For geothermal resources:
 - high heat flow and areas of thickened ?HHP crust

