Australian Government

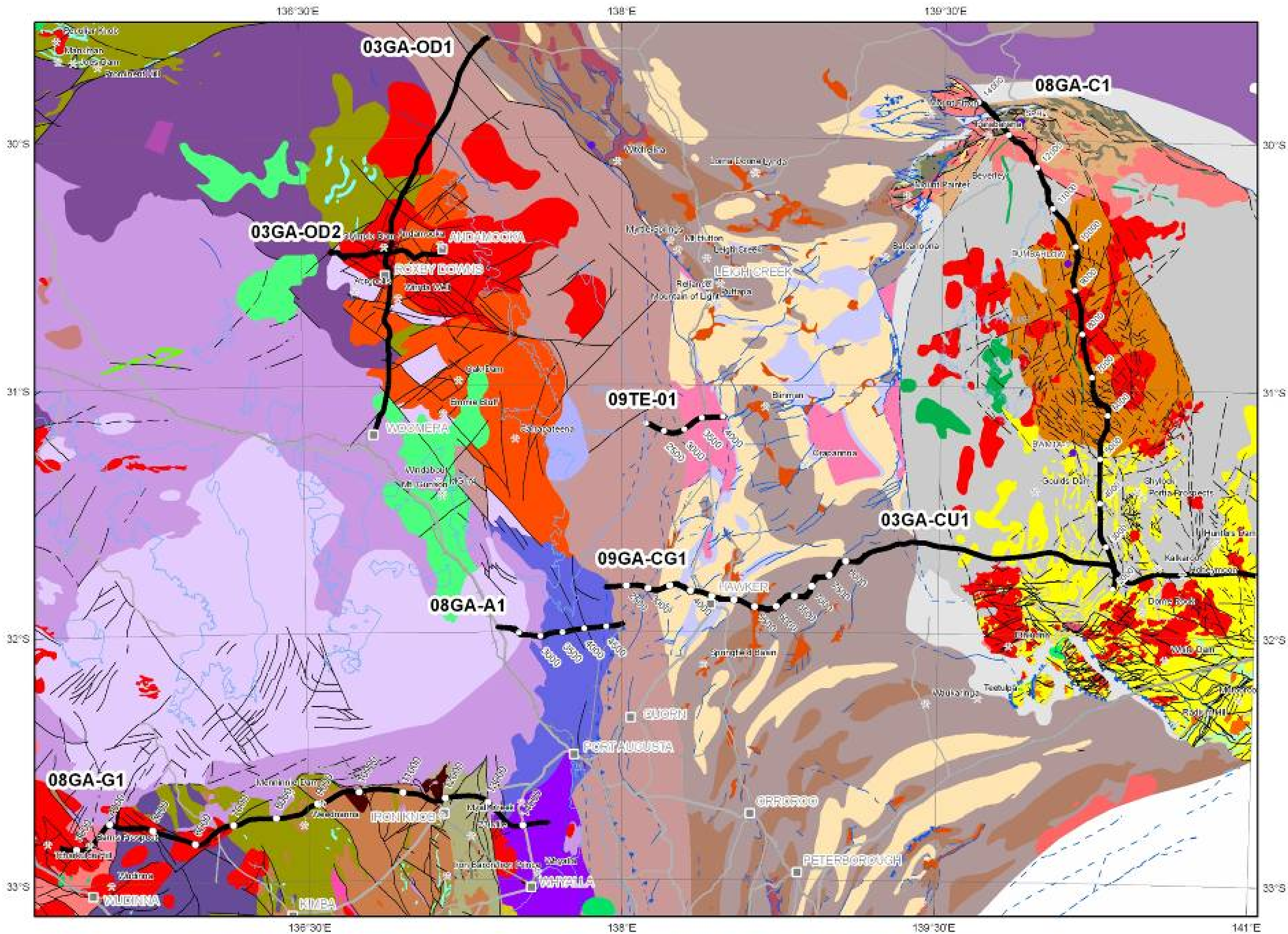
Geoscience Australia

INTERPRETATION OF THE GAWLER SEISMIC LINE; 08GA-G1

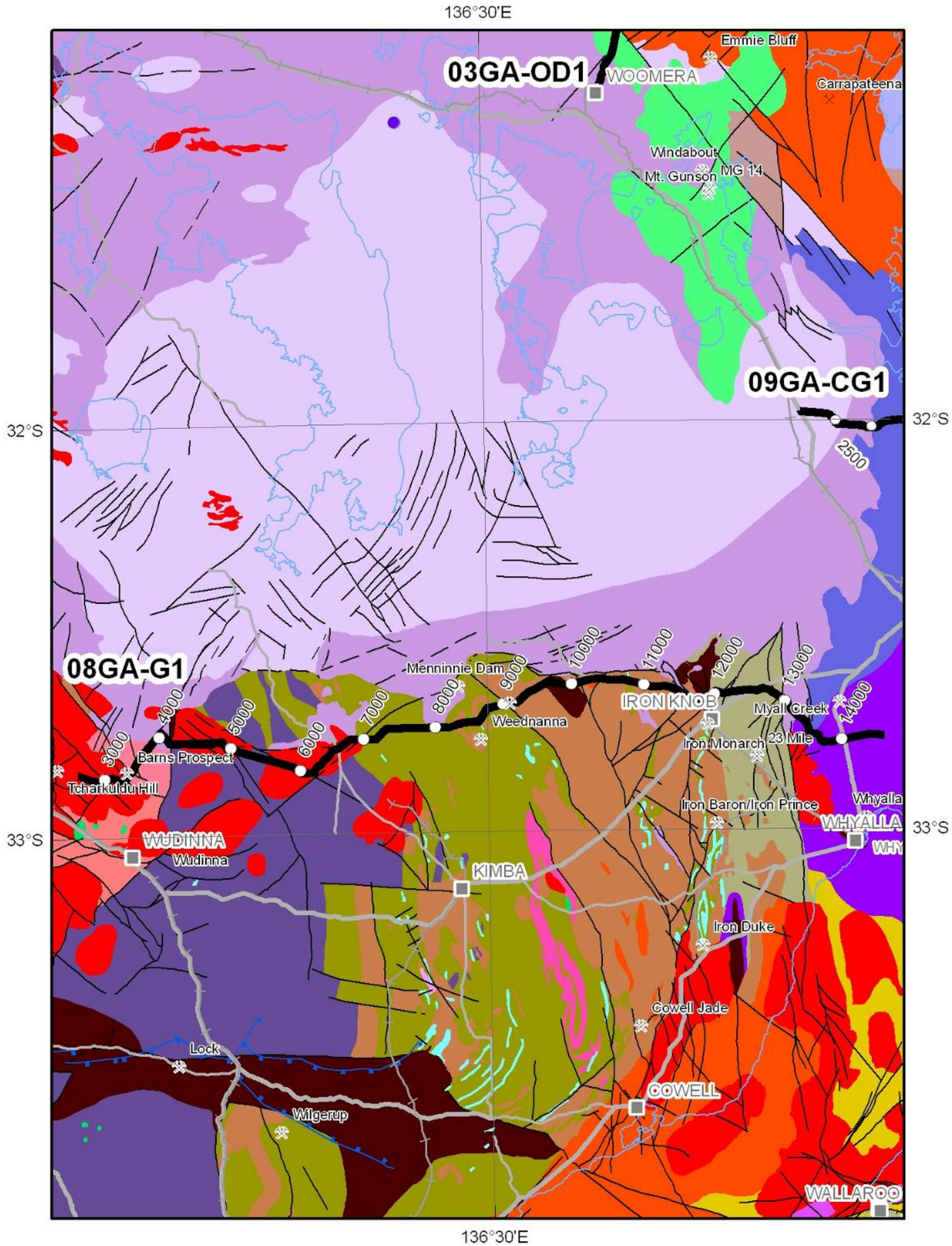
G. Fraser, R. Blewett, A. Reid, R. Korsch, R. Dutch, N. Neumann, T. Meixner, R. Skirrow, W. Cowley, M. Szpunar, W. Preiss, T. Fomin, J. Holzschuh, S. Thiel, P. Milligan, B. Bendall

Government of South Australia

Primary Industries and Resources SA



136°30'E
138°E
139°30'E
141°E
30°S
31°S
32°S
33°S
03GA-OD1
03GA-OD2
08GA-C1
09TE-01
03GA-CU1
09GA-CG1
08GA-A1
08GA-G1
ANDAMOOKA
ROXBY DOWNS
Olympic Dam
Wirrda Well
WOOMERA
Oak Dam
Emmie Bluff
Carrapateena
LEIGH CREEK
Leigh Creek
Mt Hutton
Reliance
Mountain of Light
Mount Painter
Beverley
Moolawatana
Curnamona
Blinman
Wirrealpa
HAWKER
Springfield Basin
QUORN
PORT AUGUSTA
ORROROO
PETERBOROUGH
Waukaringa
Gould's Dam
Kalkaroo
Dome Rock
Portia Prospects
IRON KNOB
WHYALLA
KIMBA
WUDINNA



Solid Geology

- Hiltaba Suite granite
- Wallaroo Group
- 'Lincoln Complex' gneisses
- Hutchison Group
- Miltalie Gneiss
- Sleaford Complex

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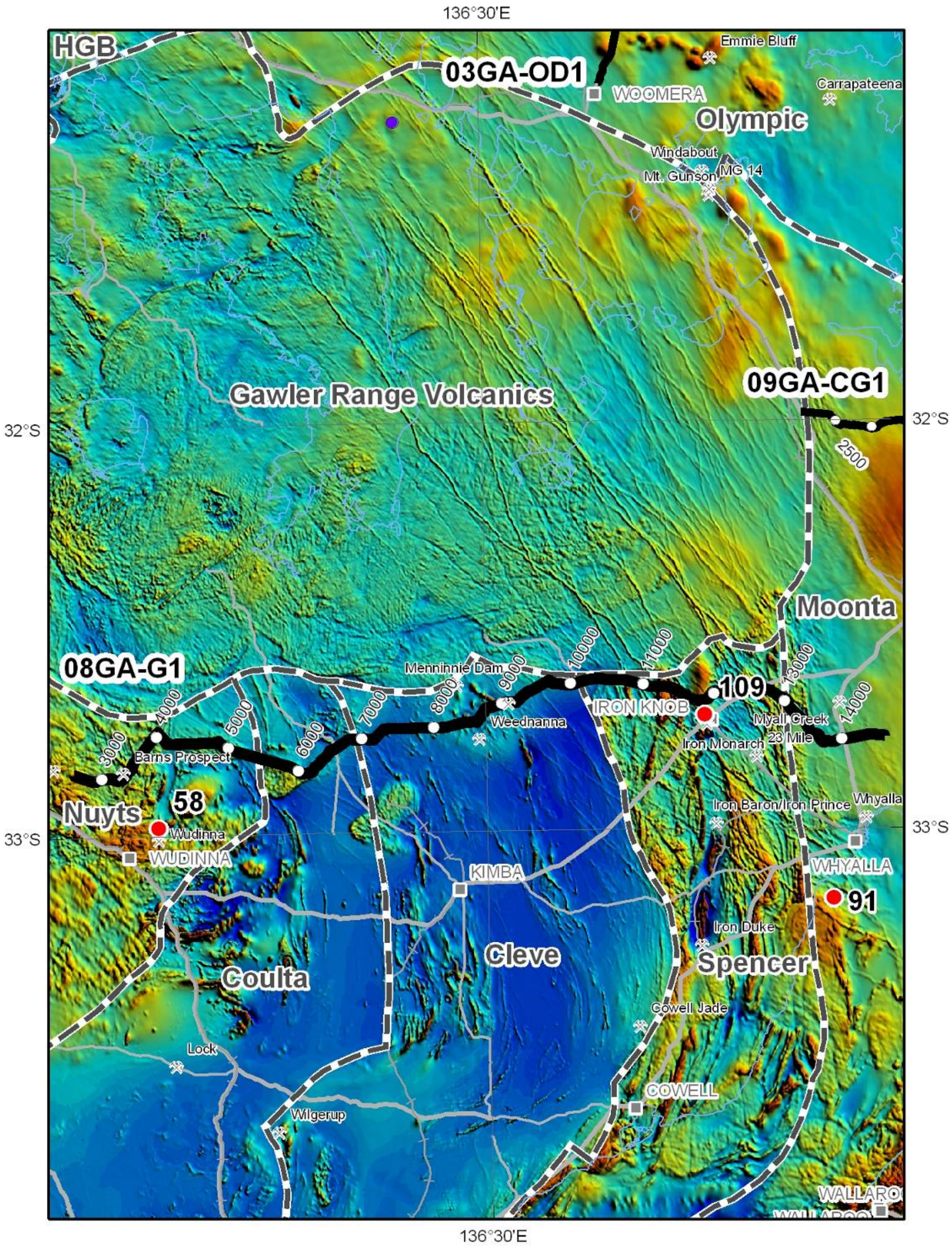
Magnetics



Domain subdivisions after Ferris et al. 2002

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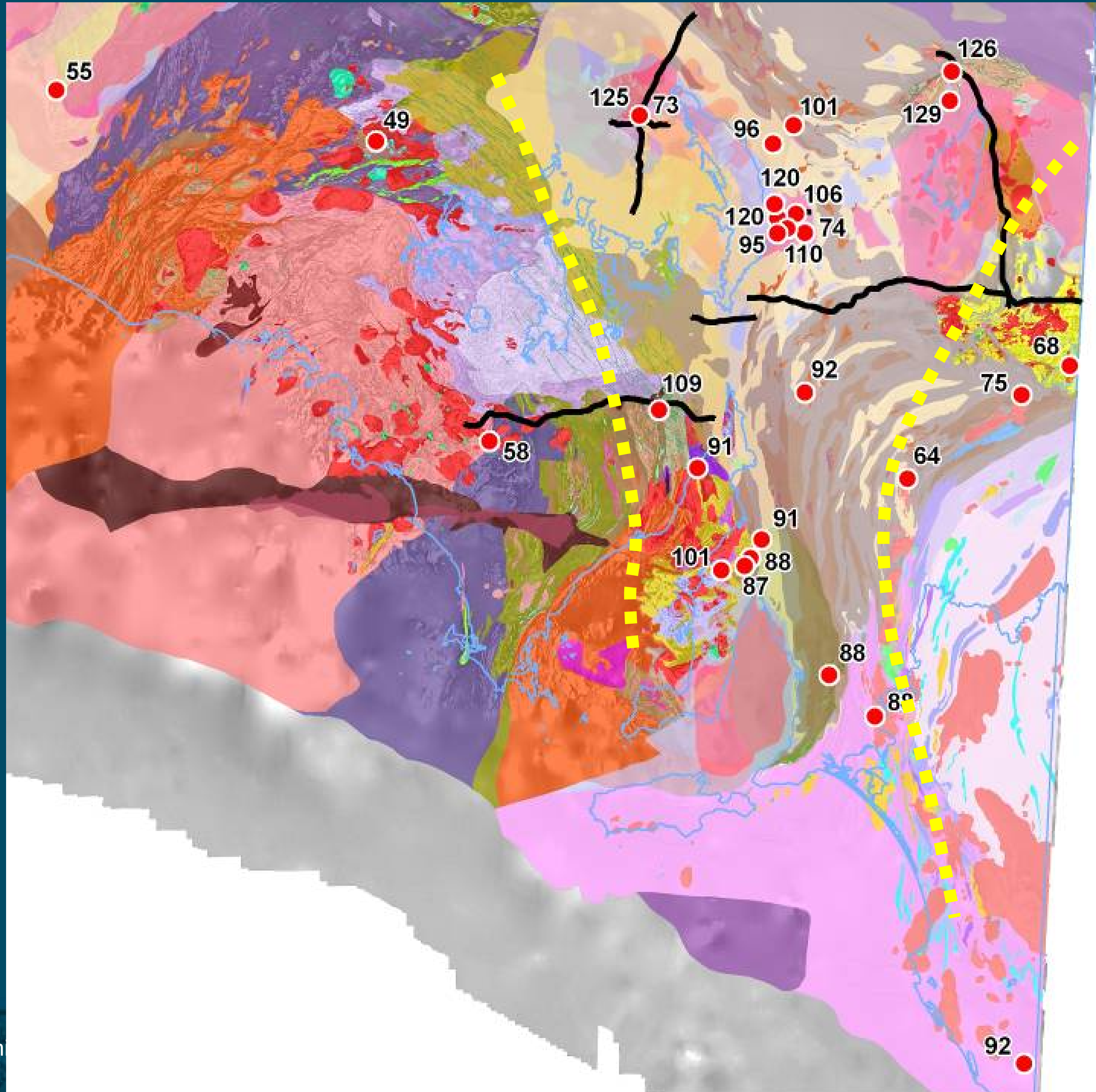
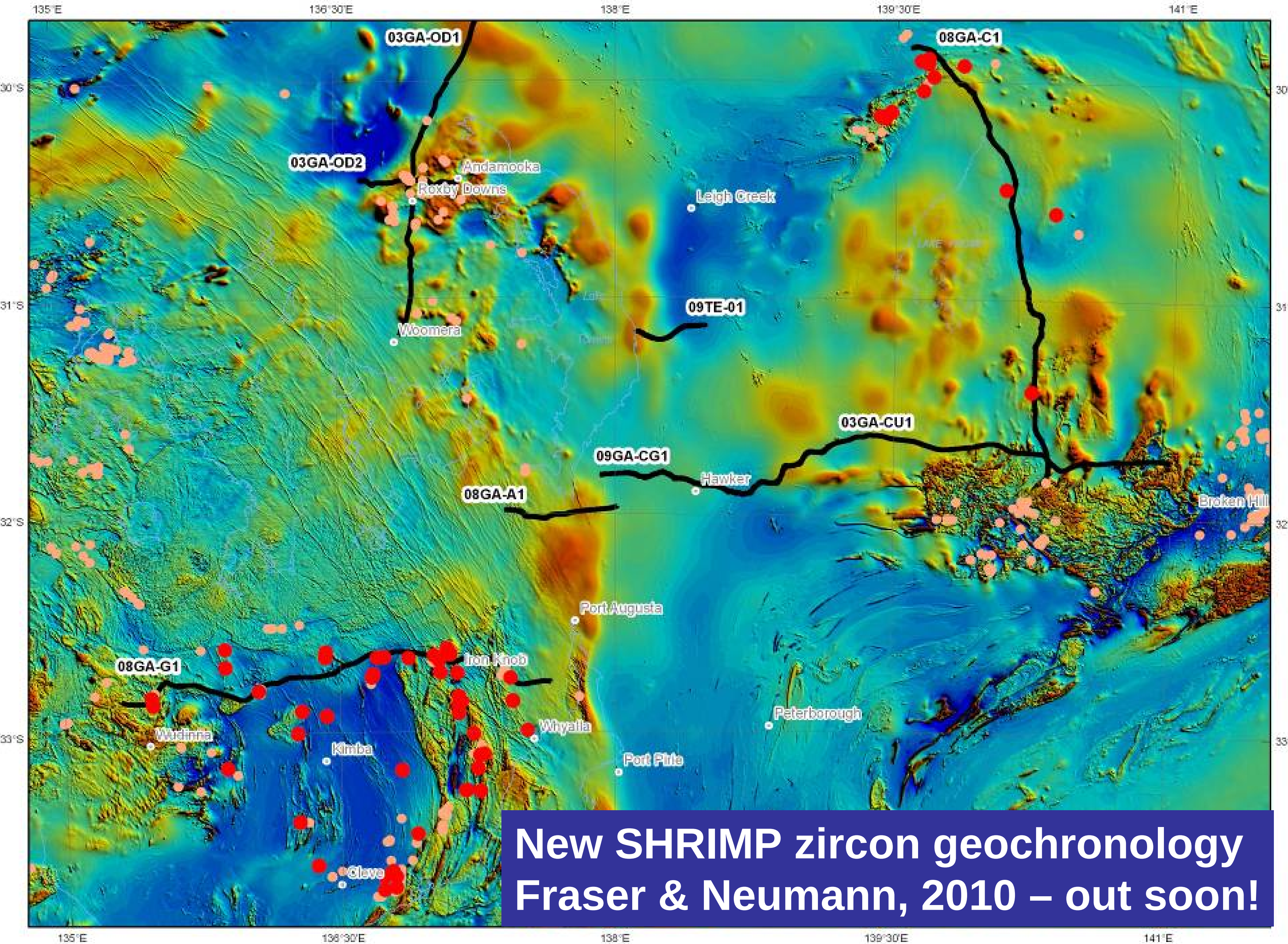


SA Seismi

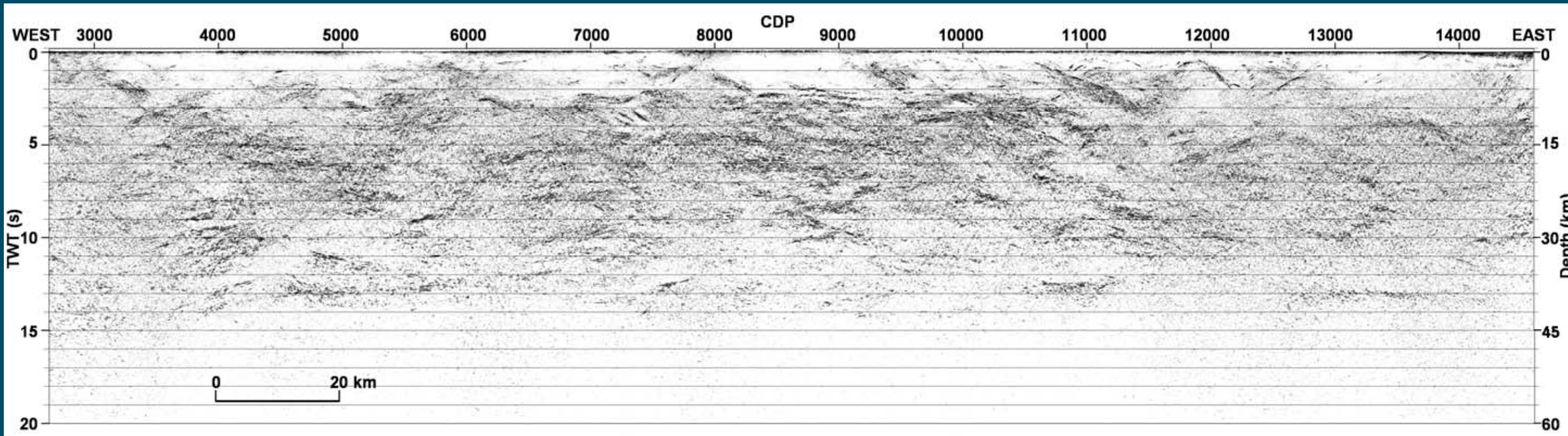
TRALIA



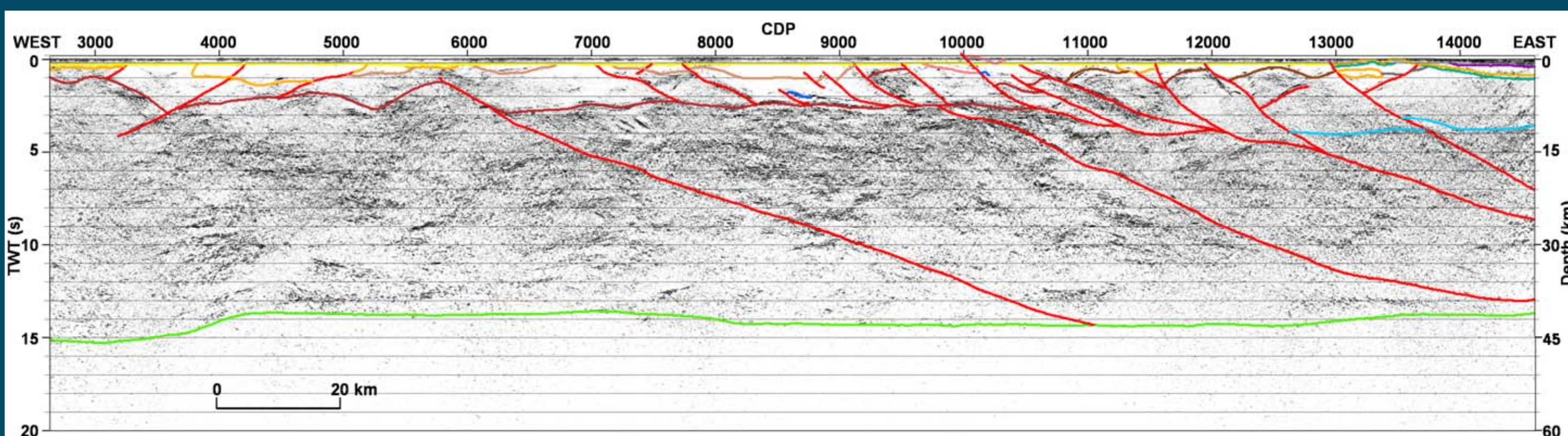
New SHRIMP zircon geochronology
Fraser & Neumann, 2010 – out soon!

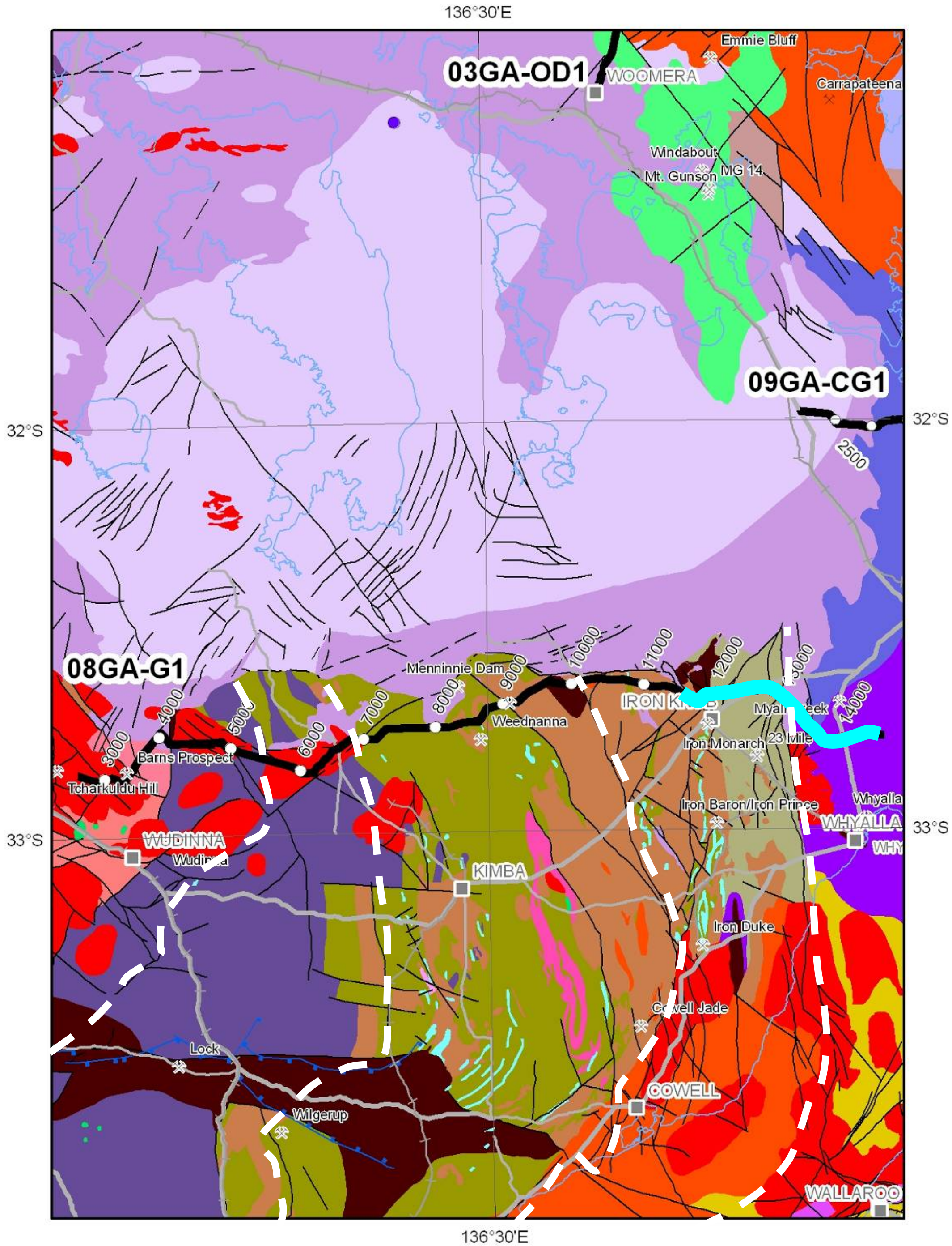
08GA-G1

253 km
V:H ~ 1:1



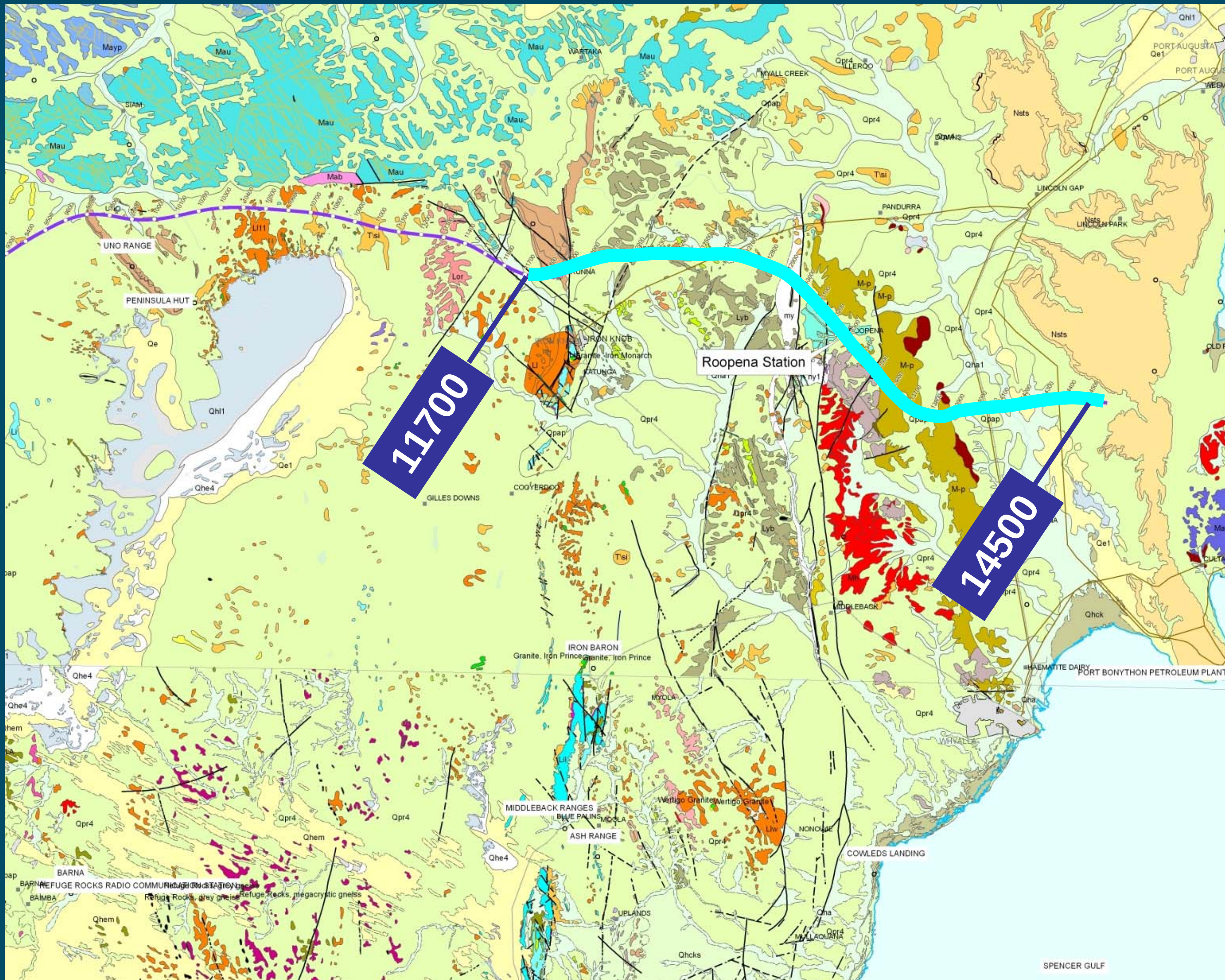
Nuyts | Coulta | Cleve | Spencer | Moonta/Olympic

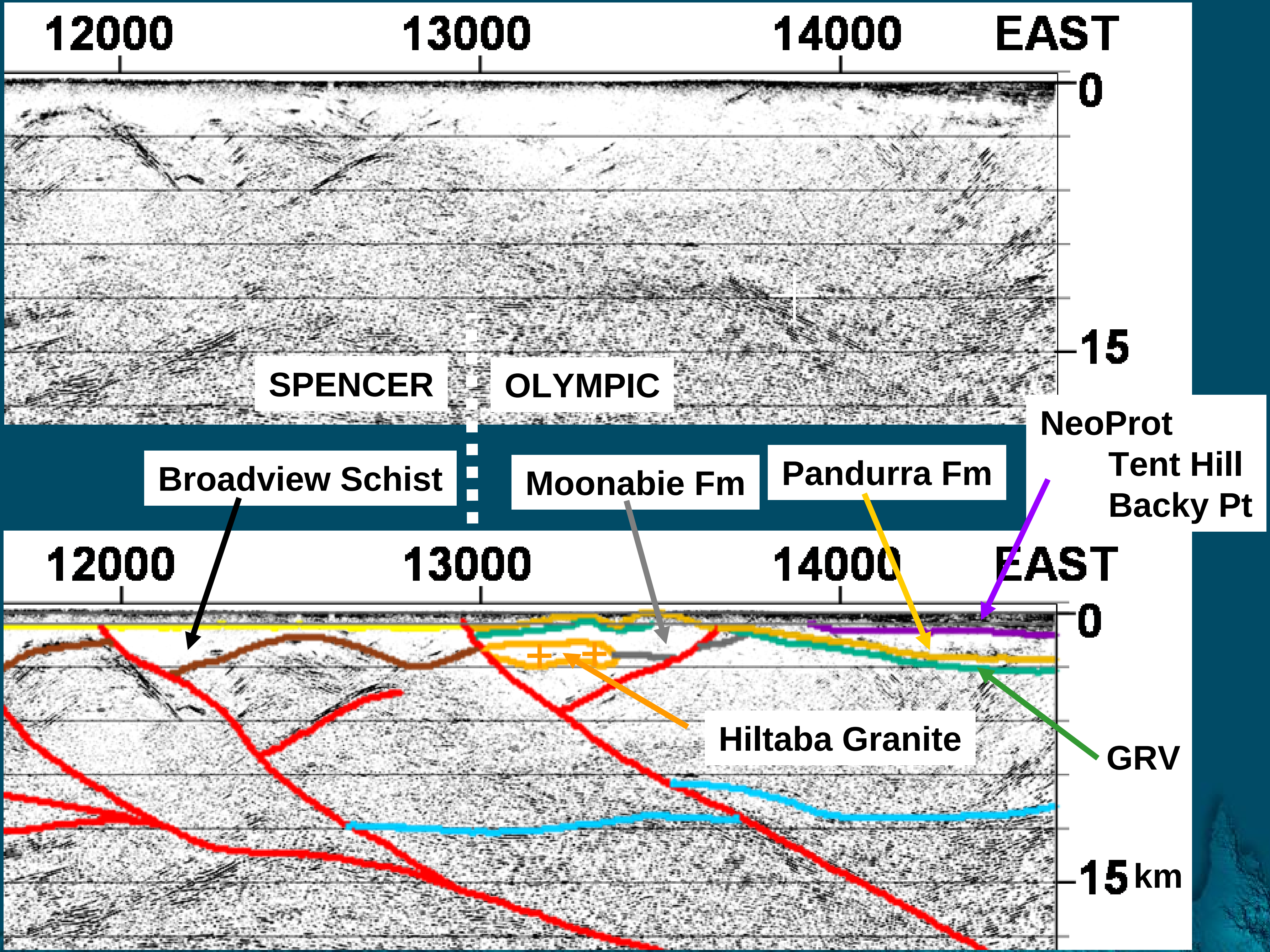


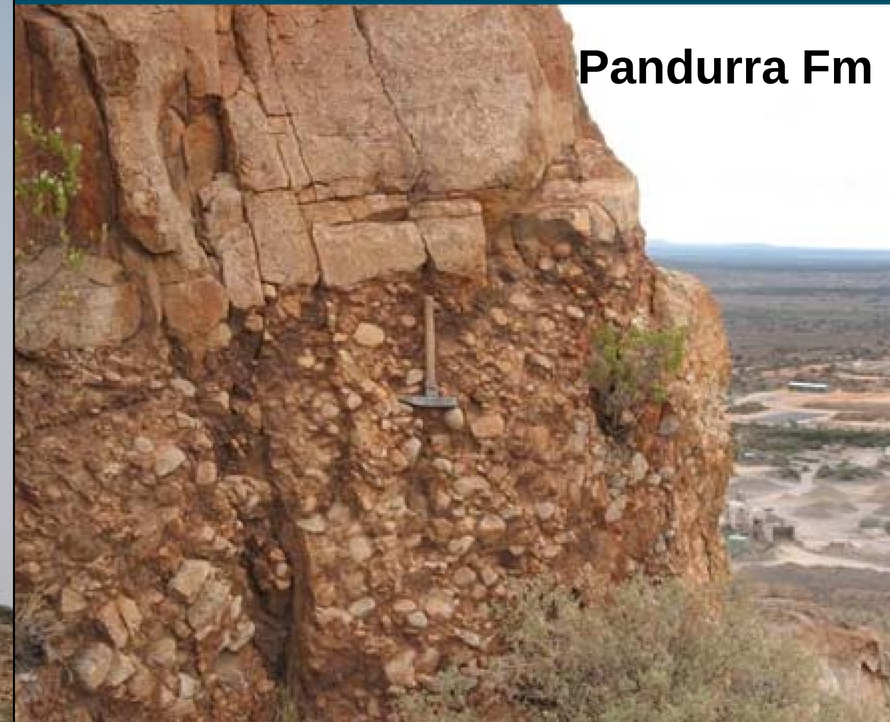


Solid Geology

GEOSCIENCE AUSTRALIA

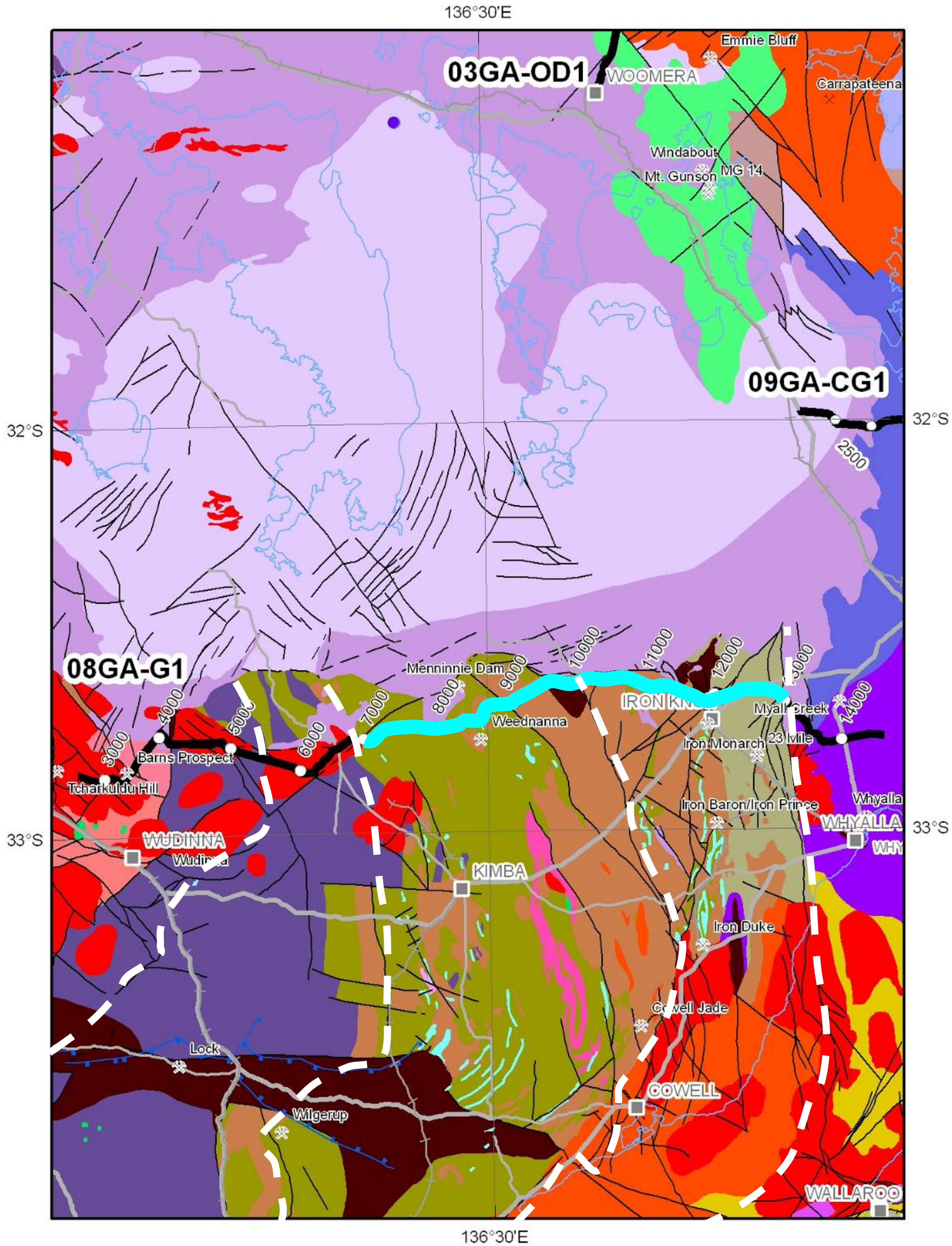

11700
14500
Roopena Station
UNO RANGE
PENINSULA HUT
IRON KNOB
KATUNGA
GILLES DOWNS
COOYERDOO
IRON BARON
MIDDLEBACK RANGES
ASH RANGE
MYALL CREEK
PANDURRA
LINCOLN GAP
LINCOLN PARK
PORT AUGUSTA
HAEMATITE DAIRY
PORT BONYTHON PETROLEUM PLANT
WHYALLA
COWLEDS LANDING
SPENCER GULF
UPLANDS
BARNA
MIDDLEBACK
Wertigo Granite


12000
13000
14000
EAST
0
15
SPENCER
OLYMPIC
Broadview Schist
Moonabie Fm
Pandurra Fm
NeoProt
Tent Hill
Backy Pt
12000
13000
14000
EAST
0
Hiltaba Granite
GRV
15 km


Pandurra Fm
unconformity
Moonabie Fm

Pandurra Fm

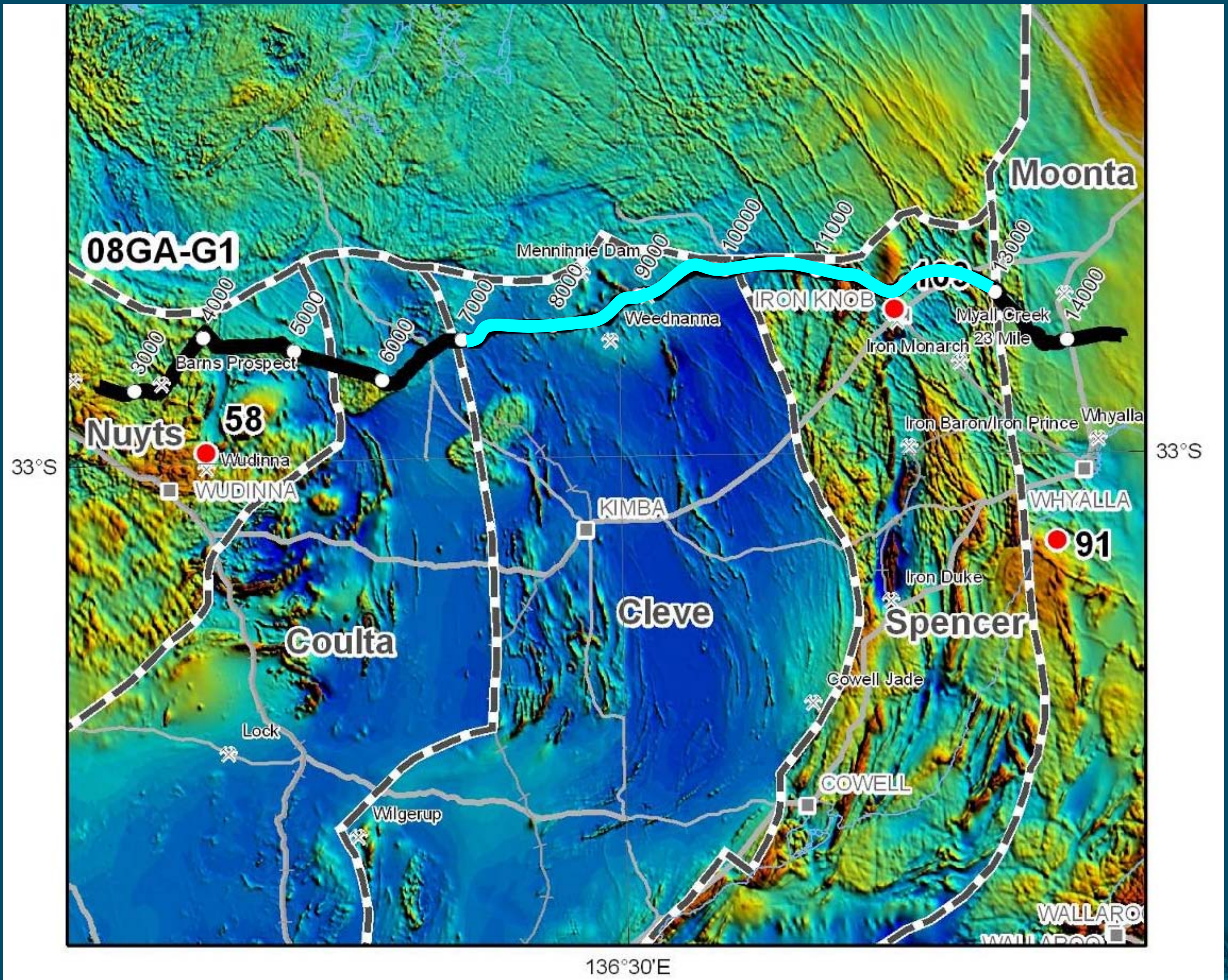
Broadview Schist

Solid Geology

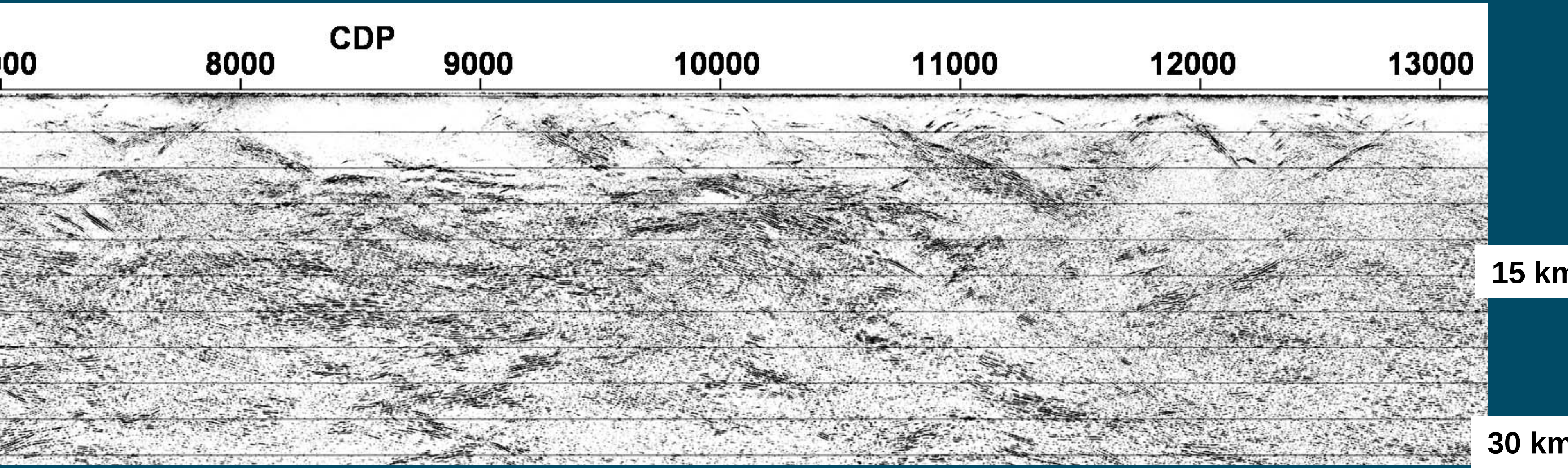


GEOSCIENCE AUSTRALIA

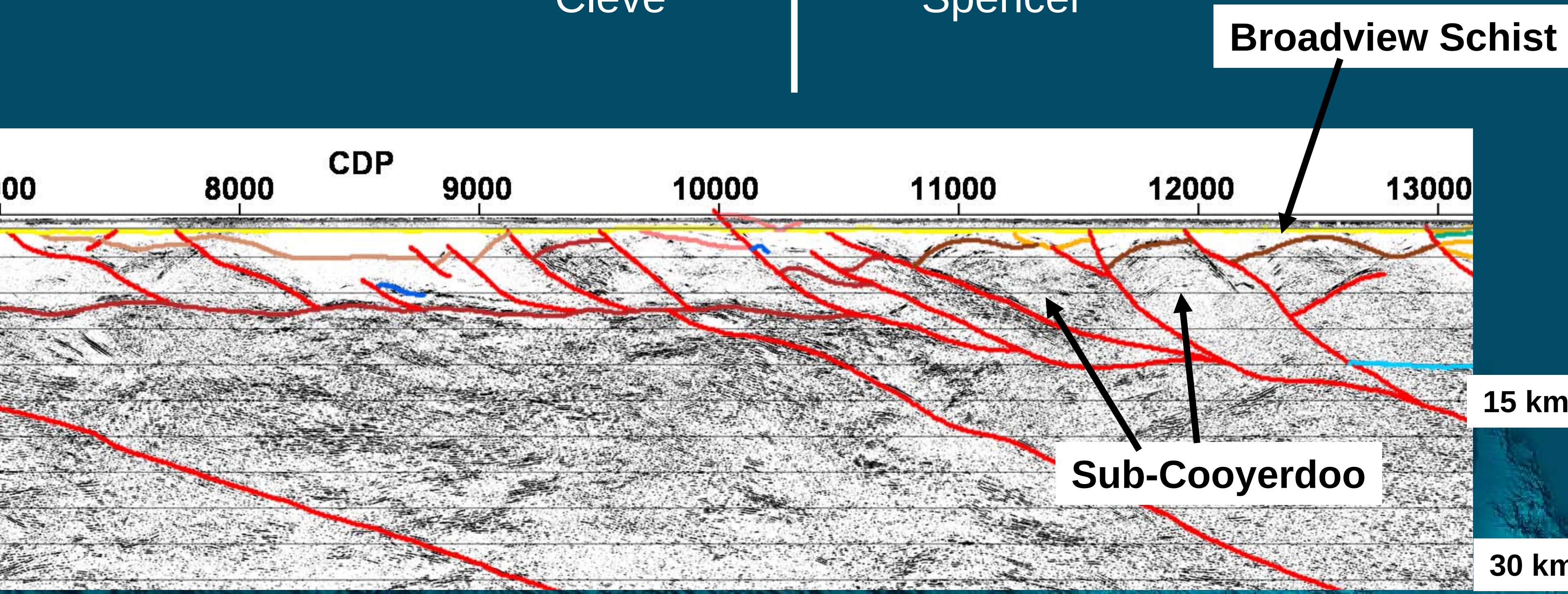
7000
13000
o Station
Roopena Station
TIN HUT
BURKS HUT
UNO RANGE
PENINSULA HUT
IRON BARON
MIDDLEBACK RANGES
ASH RANGE
COWLEDS LANDING
SPENCER GULF



08GA-G1
Moonta
Menninnie Dam
10000
11000
12000
13000
14000
9000
8000
7000
6000
5000
4000
3000
IRON KNOB
Weednanna
Iron Monarch
Myall Creek
23 Mile
Barns Prospect
Nuyts
58
Wudinna
WUDINNA
33°S
Iron Baron/Iron Prince
Whyalla
WHYALLA
91
KIMBA
Iron Duke
Cleve
Spencer
Coulta
Cowell Jade
Lock
COWELL
Wilgerup
WALLARO
136°30'E



Cleve | Spencer

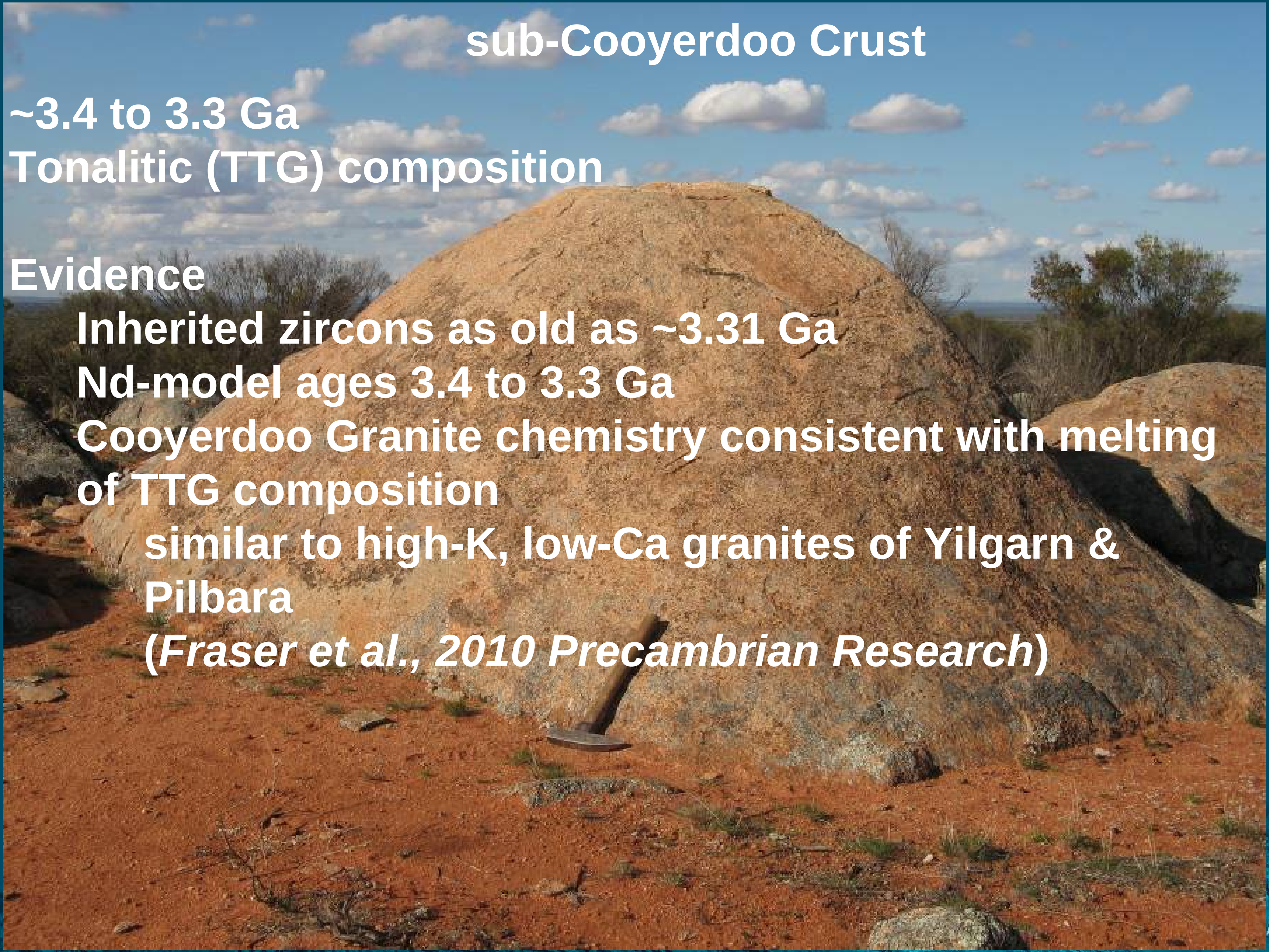


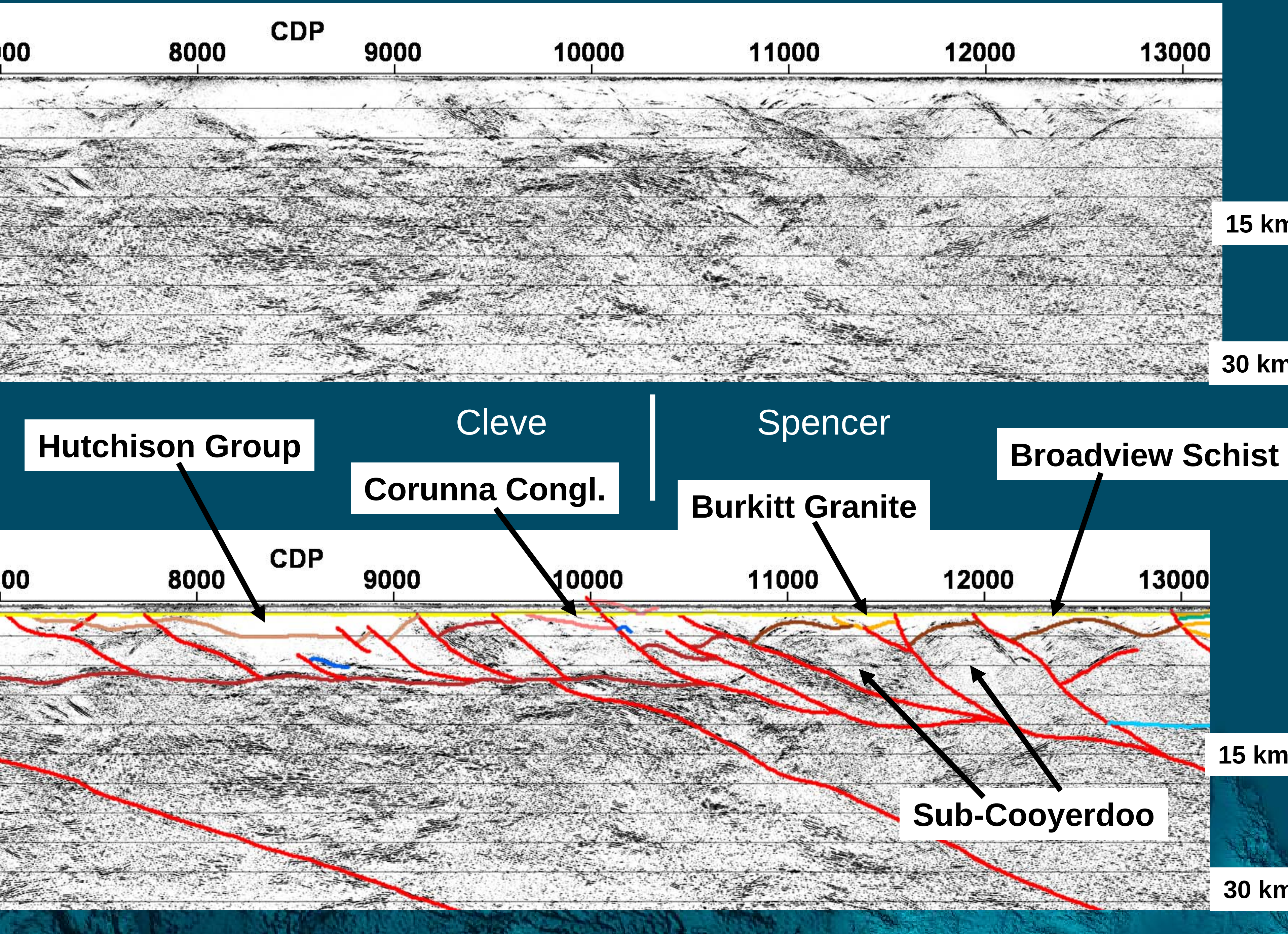
sub-Cooyerdoo Crust

~3.4 to 3.3 Ga
Tonalitic (TTG) composition

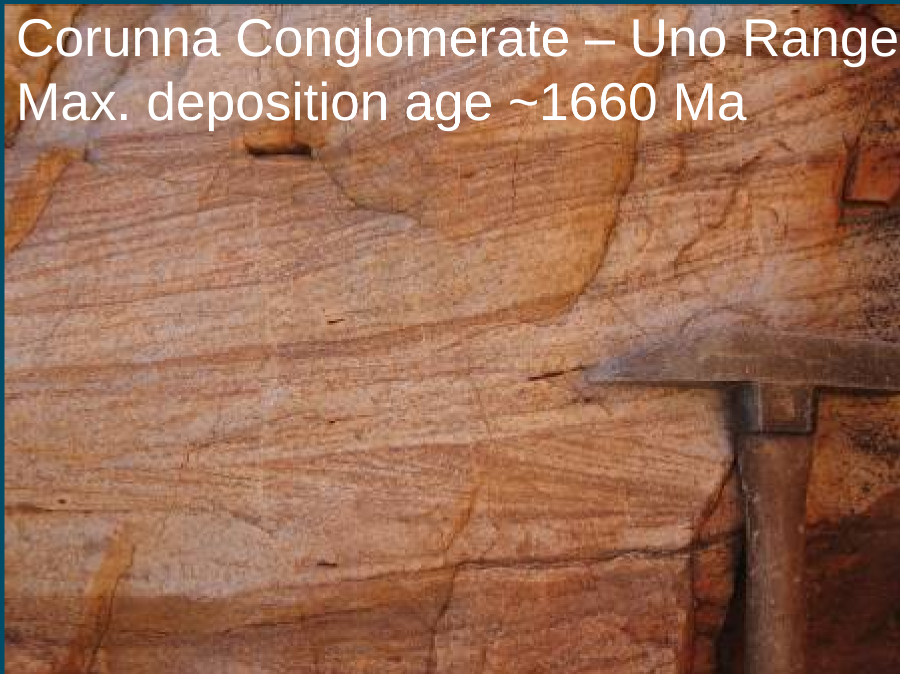
Evidence

- **Inherited zircons as old as ~3.31 Ga**
- **Nd-model ages 3.4 to 3.3 Ga**
- **Cooyerdoo Granite chemistry consistent with melting of TTG composition**
  - **similar to high-K, low-Ca granites of Yilgarn & Pilbara**
  - **(*Fraser et al., 2010 Precambrian Research*)**





CDP
00
8000
9000
10000
11000
12000
13000
15 km
30 km
Cleve
Spencer
Hutchison Group
Corunna Congl.
Burkitt Granite
Broadview Schist
CDP
00
8000
9000
10000
11000
12000
13000
15 km
Sub-Cooyerdoo
30 km



Corunna Conglomerate – Uno Range
Max. deposition age ~1660 Ma

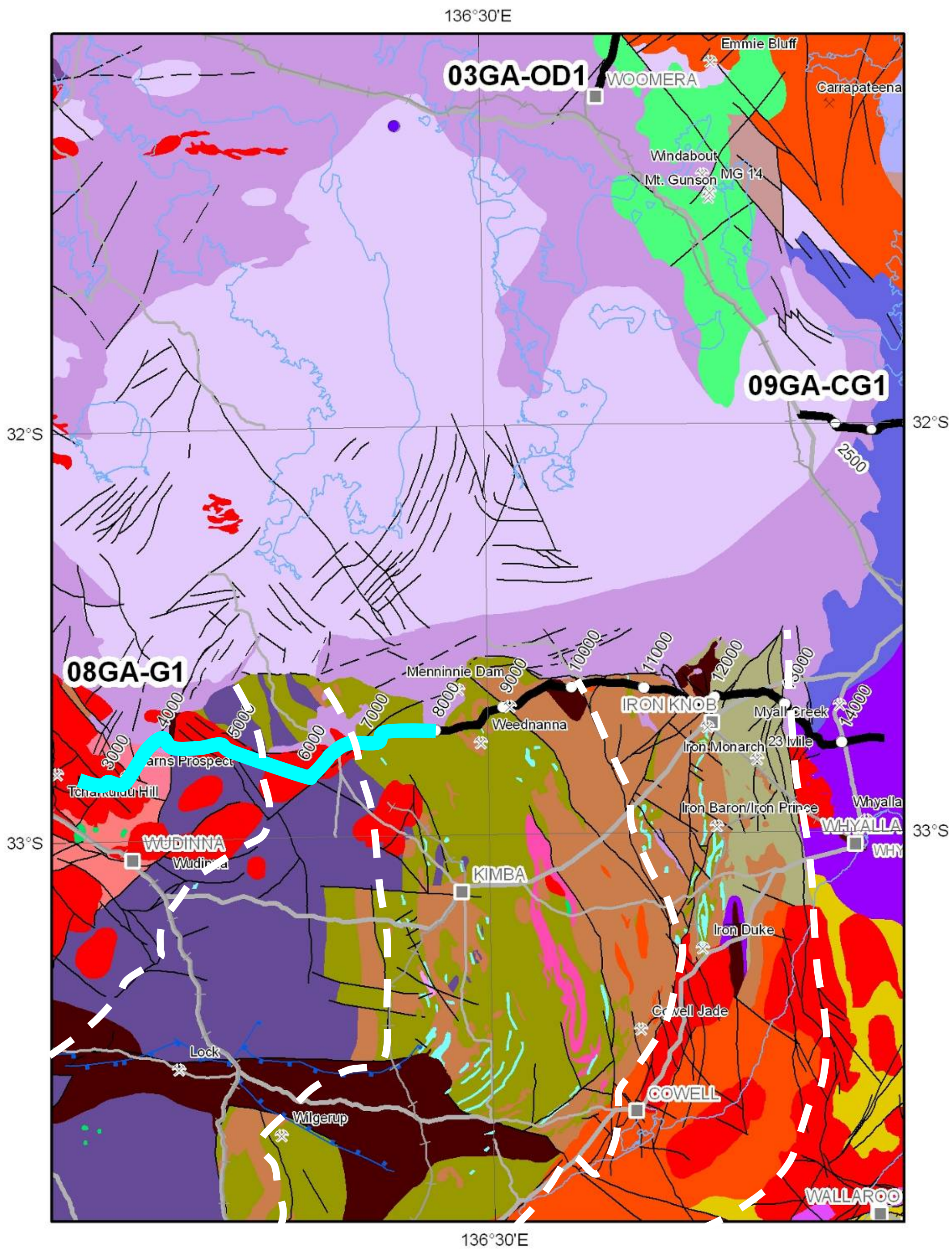
Corunna Conglomerate – Uno Range

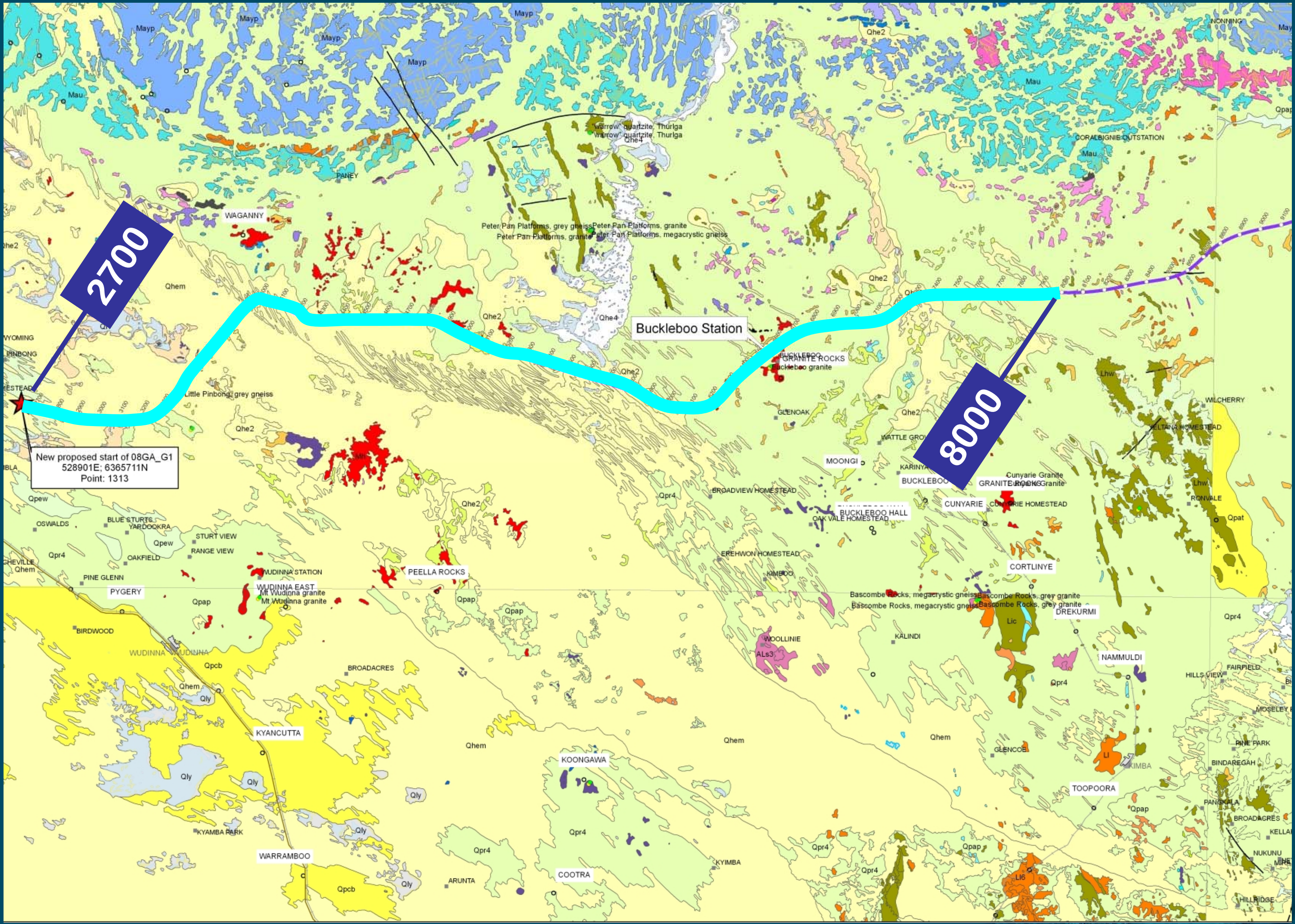
Warrow Quartzite – west L. Gilles
Max. deposition age ~2000 Ma

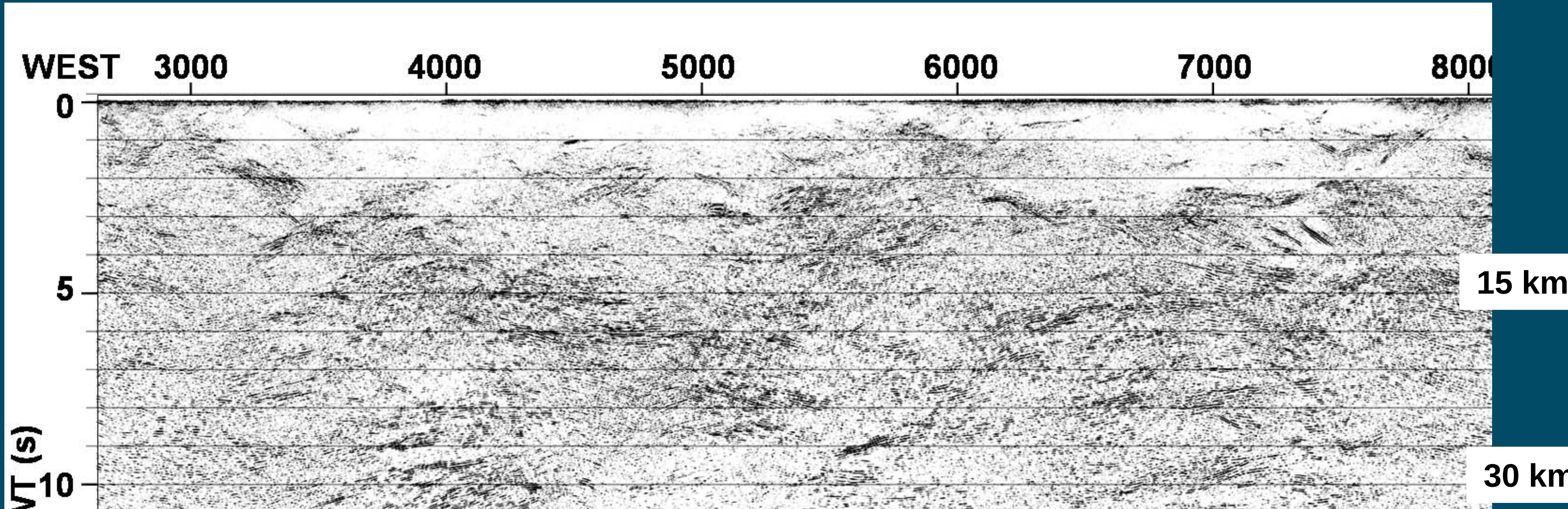
Minbrie Gneiss – Refuge Rocks

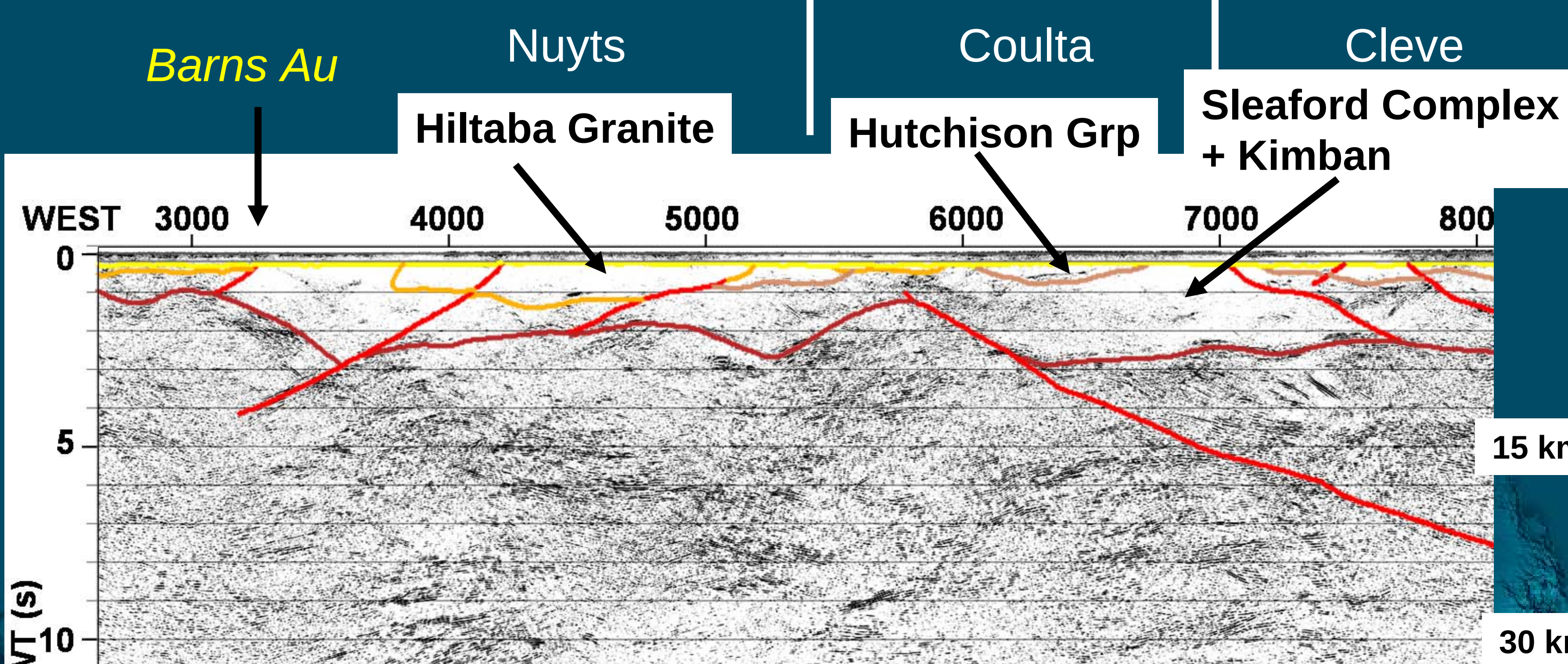
~2550 – 2500 Ma protolith zircons
~1725 Ma melting, deformation, granite intrusion

Solid Geology




2700
8000
Buckleboo Station
New proposed start of 08GA_G1
528901E; 6365711N
Point: 1313


WEST
3000
4000
5000
6000
7000
0
5
10
15 km
30 km


Barns Au
Nuyts
Coulta
Cleve
Hiltaba Granite
Hutchison Grp
Sleaford Complex
+ Kimban
WEST
3000
4000
5000
6000
7000
0
5
10
15 km

Sleaford Complex protoliths with Kimban granites and deformation

Peter Pan platforms granite
~2550 – 2500 Ma inheritance
~1725 Ma granite

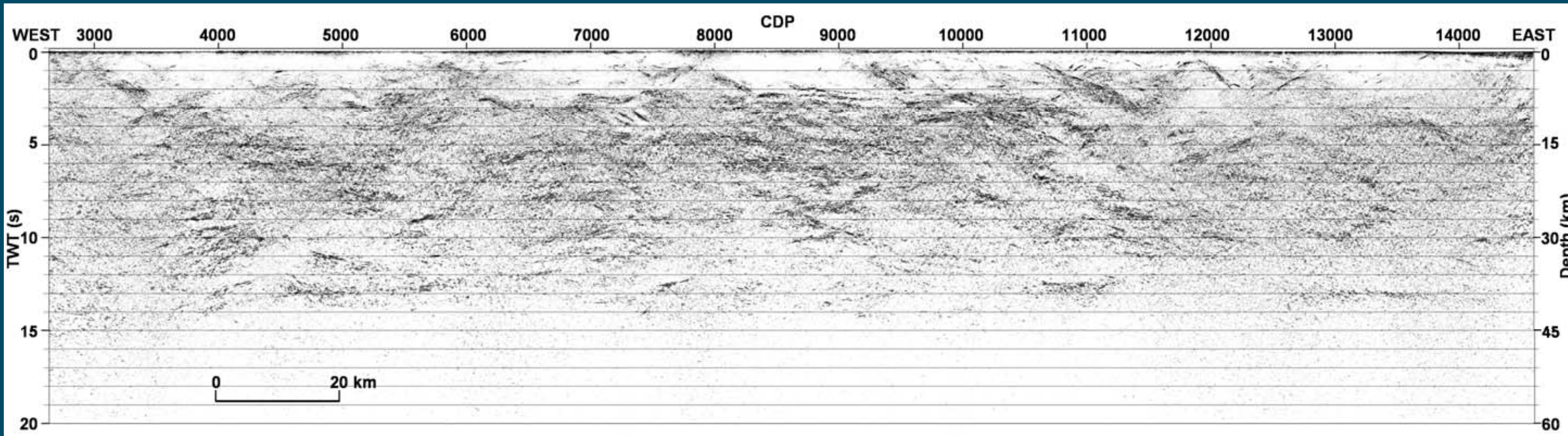
Peter Pan platforms gneiss
~2550 – 2500 Ma protolith
~1725 Ma melting

Warrow Quartzite
Max dep age ~2500 Ma

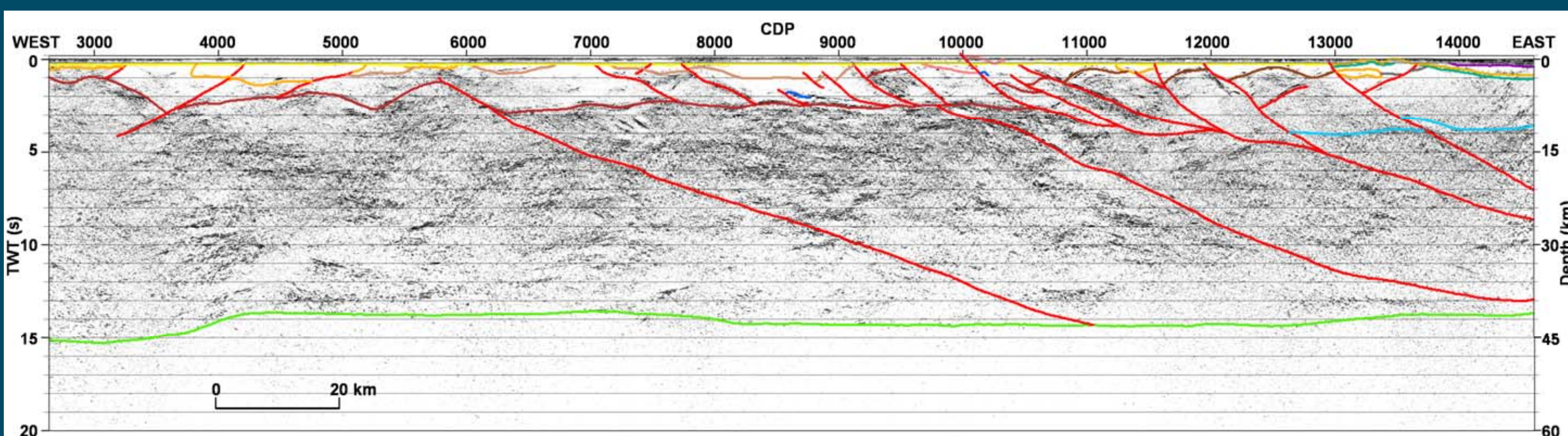
Hiltaba Granites – eg Mt Wudinna

08GA-G1

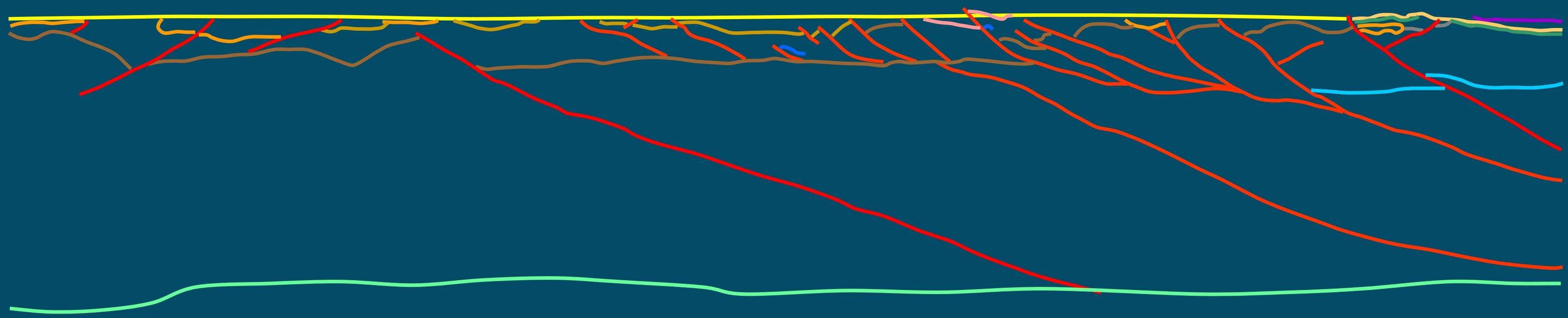
253 km
V:H ~ 1:1

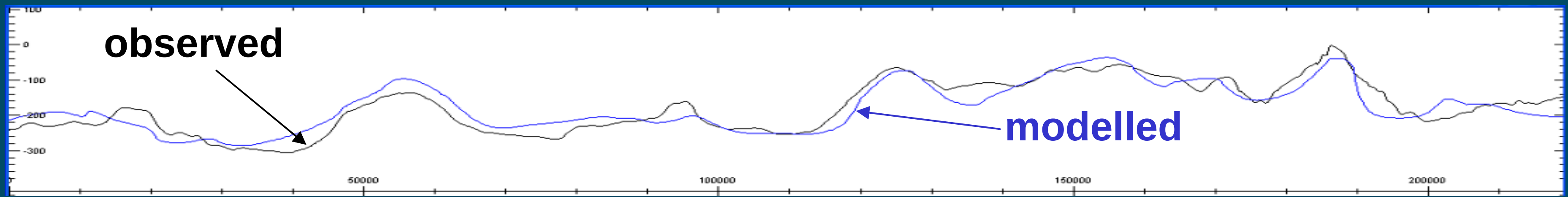


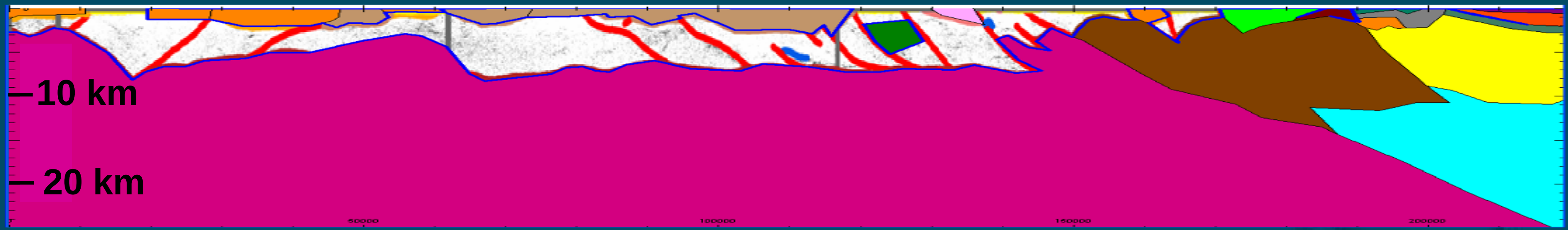
Nuyts | Coulta | Cleve | Spencer | Moonta/Olympic



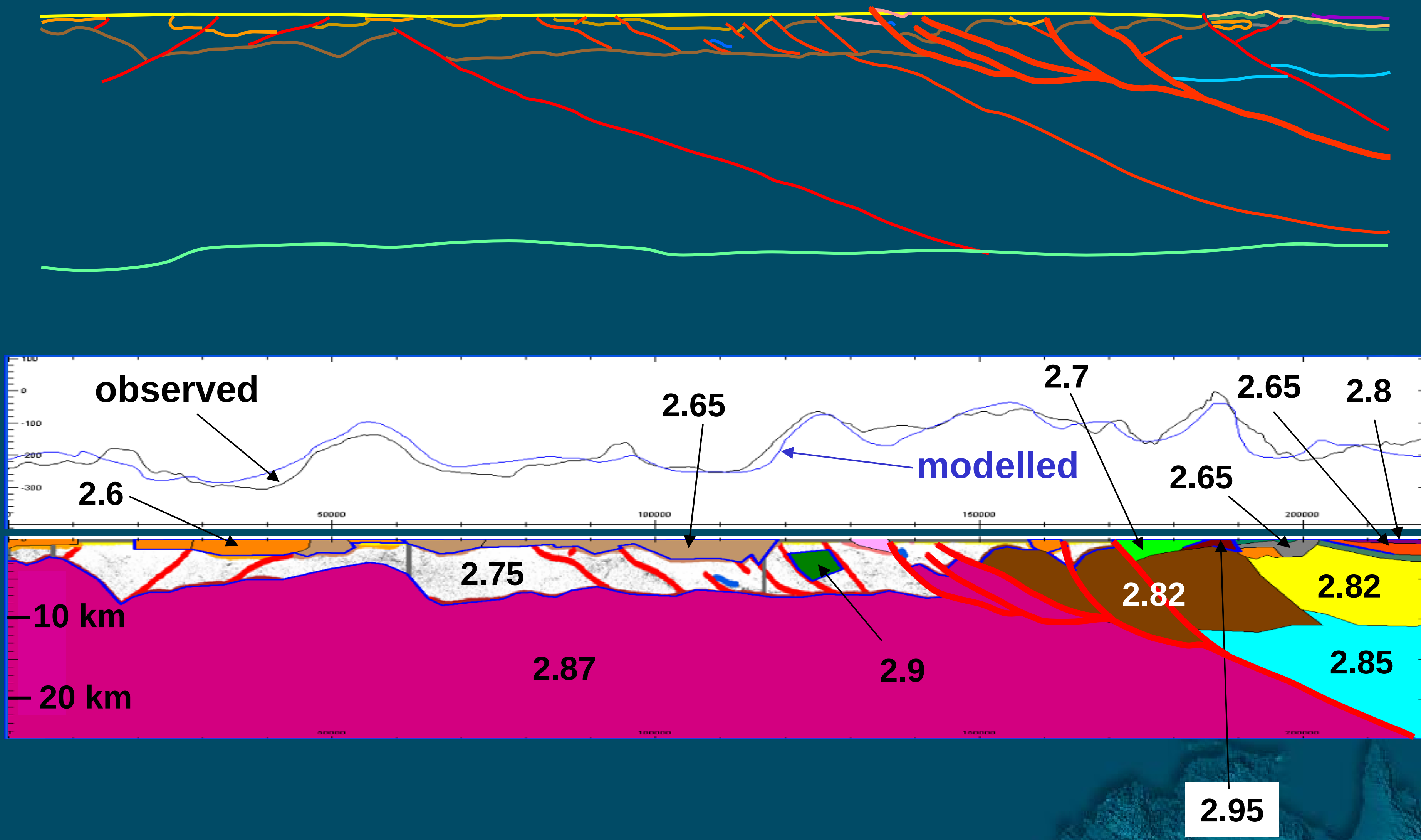
Gravity: Forward Model



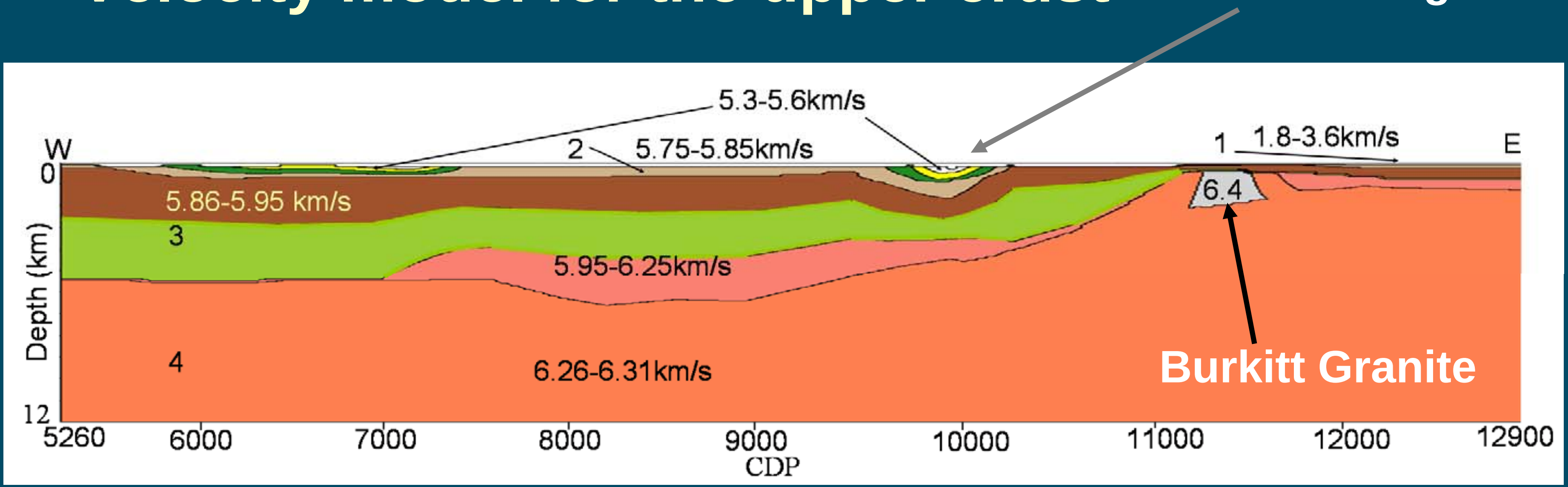




Gravity: Forward Model



Velocity model for the upper crust

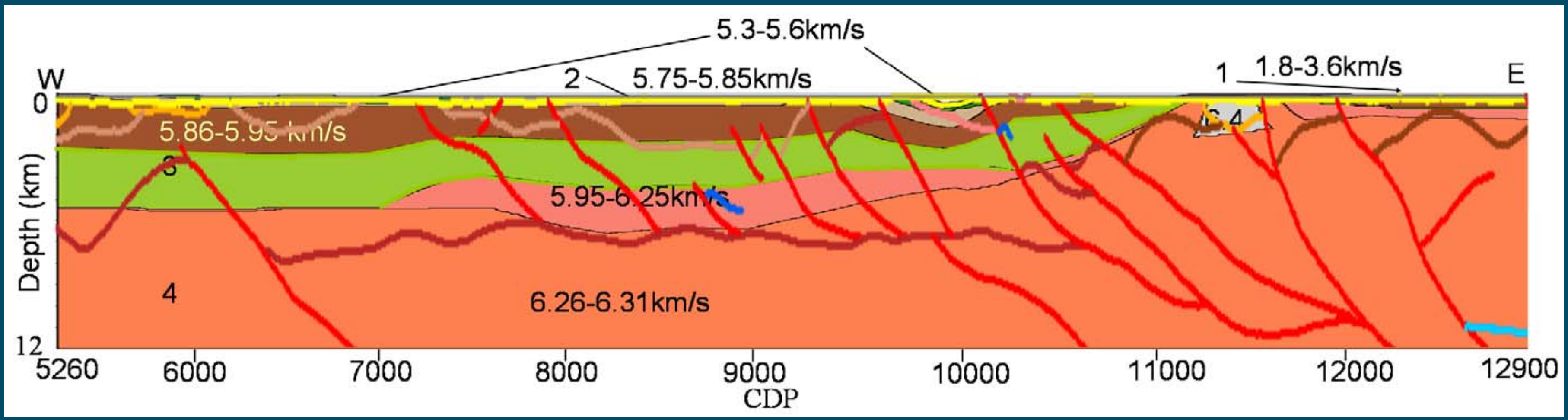


The upper crustal model consists of three layers over basement:

- **(1) thin upper layer from 4 to 200 m depth with velocity - 1.8-3.6 km/s**
- **(2) 200-900 m thin layer in general with velocity 5.75-5.85 km/s; with two local bodies relatively lower velocity 5.3-5.6 km/s**
- **(3) thick layer with velocity 5.86-6.25 km/s down to 5.5 km depth in the western part and only 1.3 km in the east**
- **(4) basement 6.26 - 6.31 km/s, 6.4 km/s high velocity body**

Velocity model for the upper crust

Interpretation (lines) of reflection seismic data, superimposed on the velocity model



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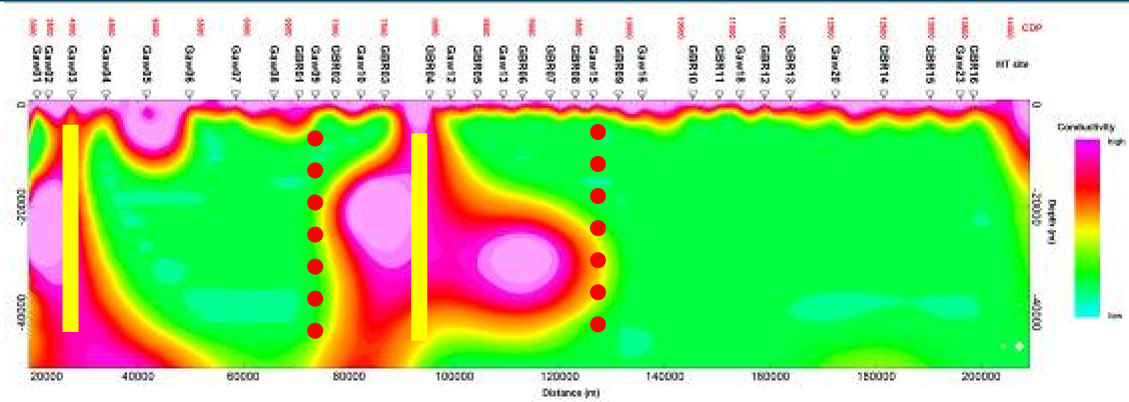
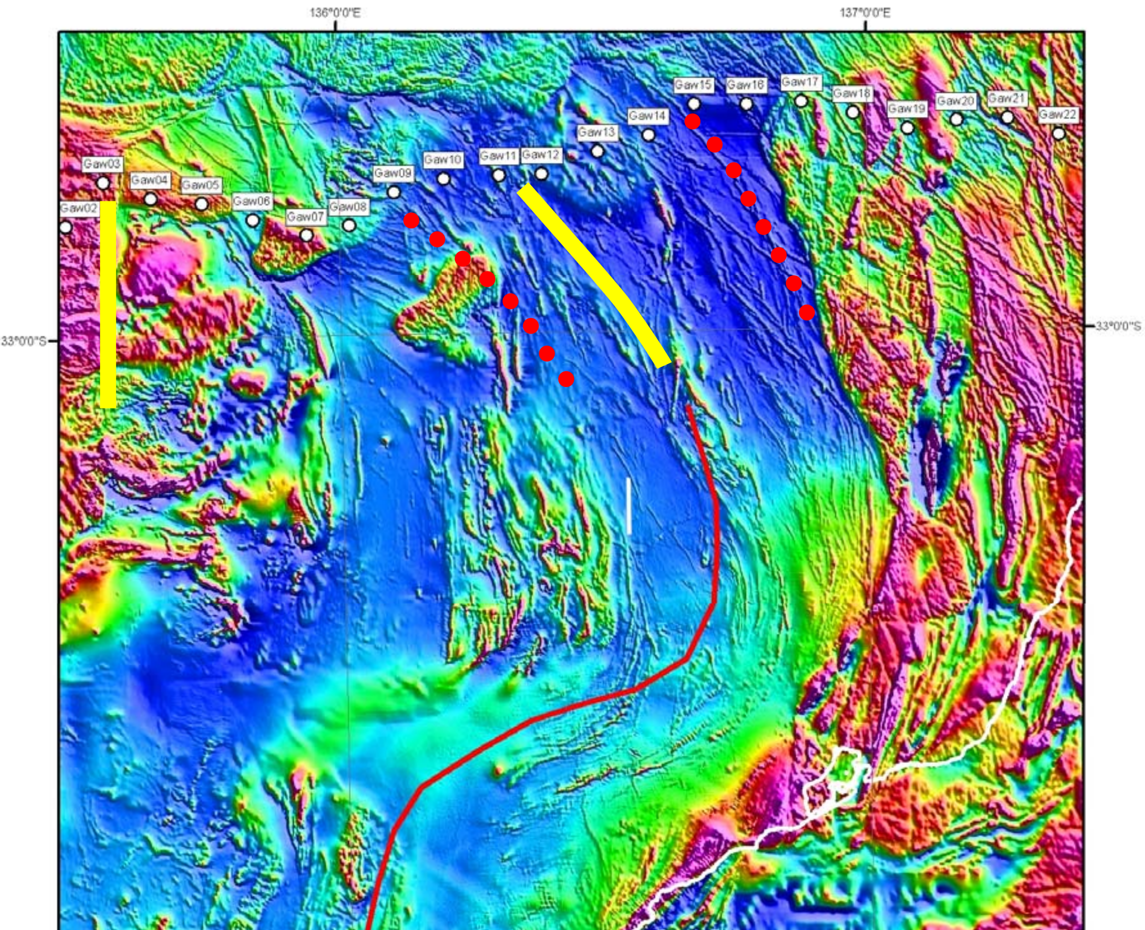
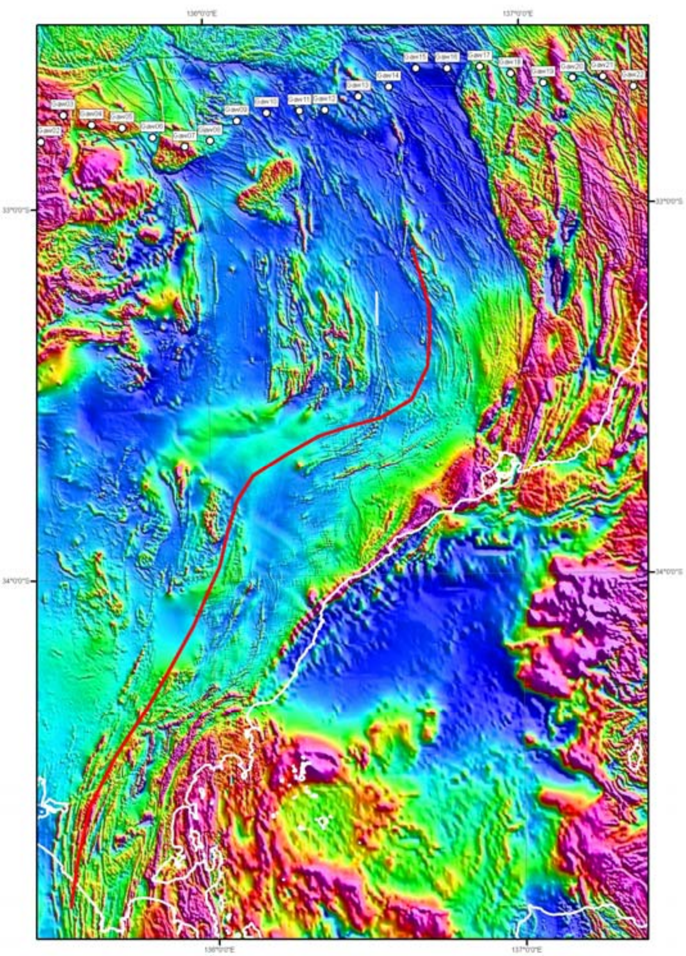
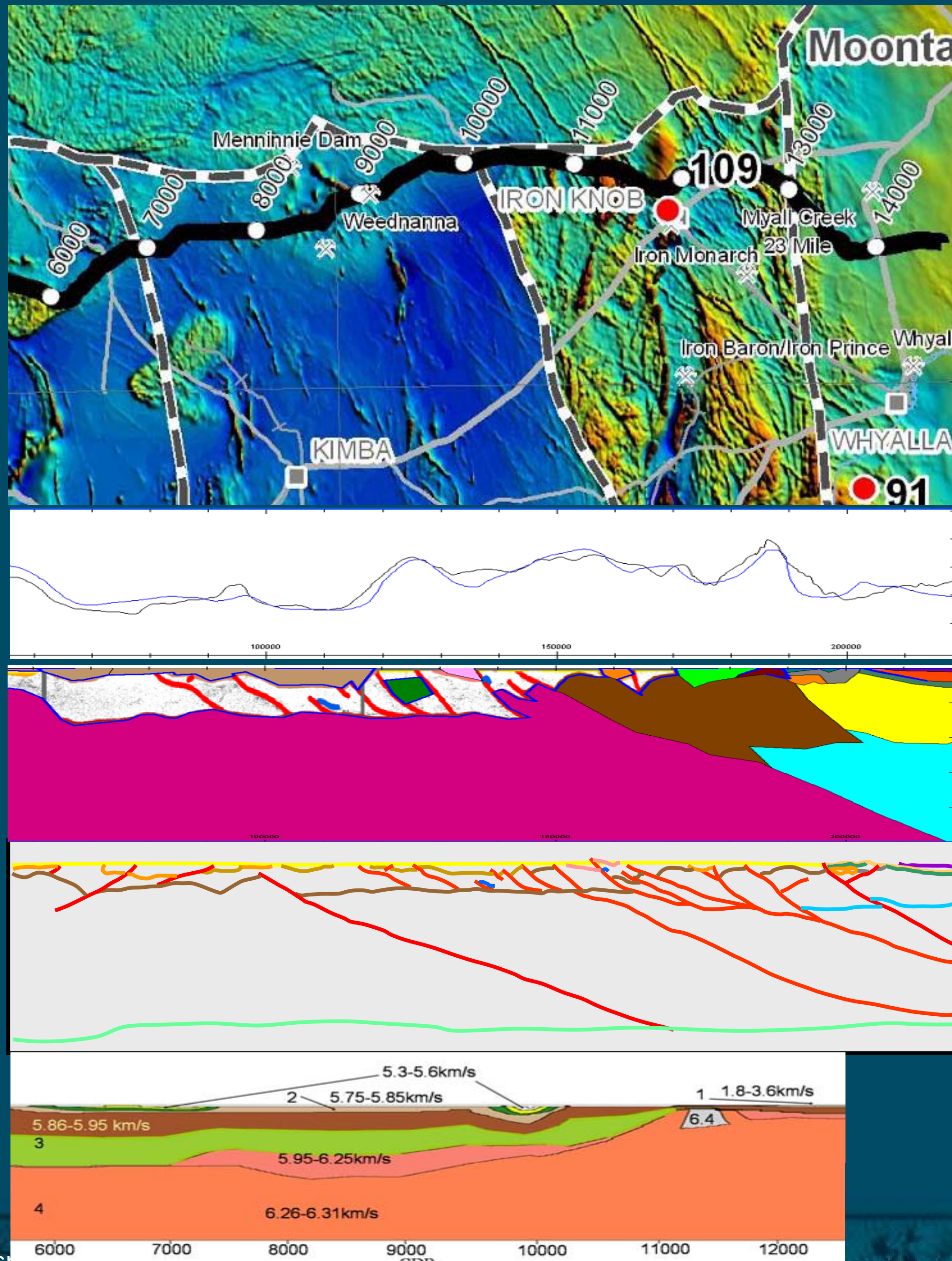
Magnetotellurics

Eyre Peninsula Conductivity Anomaly









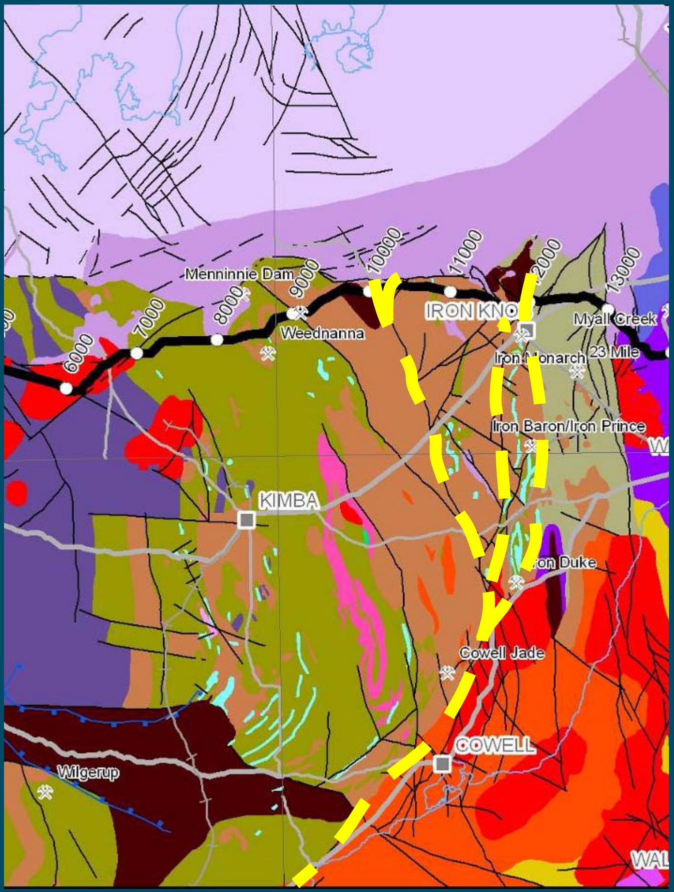
Magnetics

Gravity

Reflection Seismic

Wide-angle seismic

Geological differences across KMZ



West

Sleaford Complex
No Donington Suite
No Mesoarchean
possibly at depth?

Kimban (~1730 Ma) gneisses and granites
- Refuge Rocks
- Minbrie Gneiss
- Middlecamp Granite
- Bascombe Rocks
- Peter Pan Platforms

East

No Sleaford Complex
Mesoarchean
Donington Suite
Cornian Orogeny

No Kimban gneisses
Few Kimban granites
- only undeformed
- Burkitt Granite

~1750 – 1740 Ma volcanics and clastics
low metamorphic grade
~1790 & ~1765 Ma magmatism & metamorphism

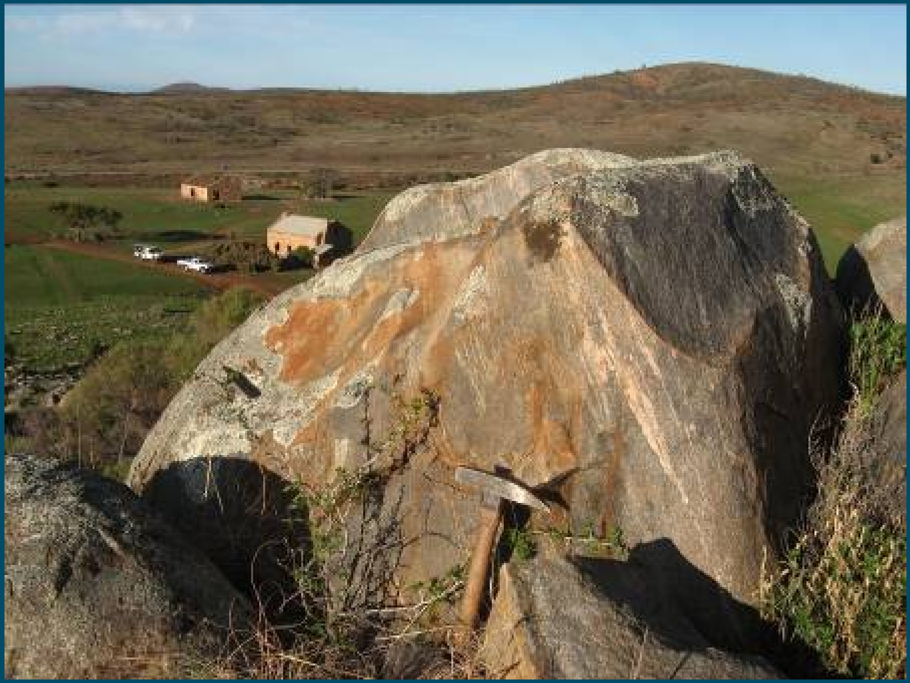
Geological commonalities across KMZ

< ~1790 Ma sedimentary rocks
- Hutchison Group

< ~1790 Ma sedimentary rocks
- Myola Volcs, Broadview Schist

Evidence for extension across KMZ: Gneisses to the west - footwall

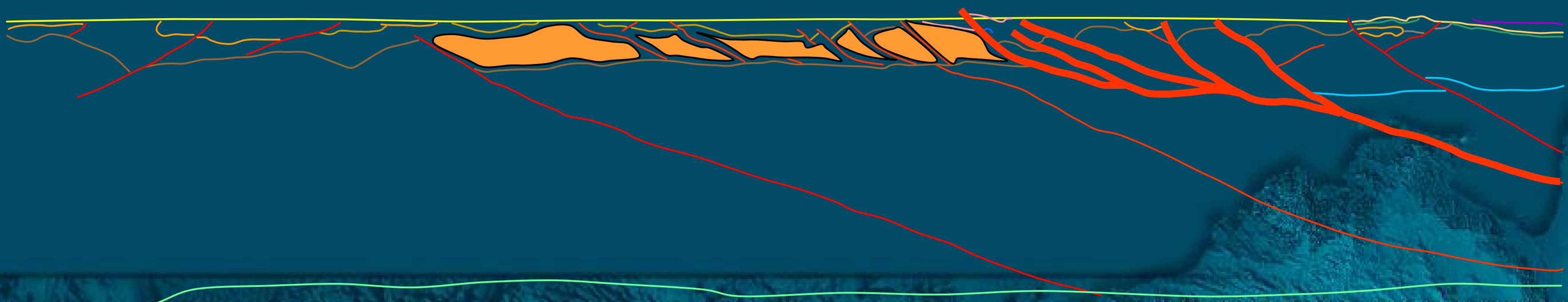
Evidence for extension across KMZ: Gneisses to the west - footwall



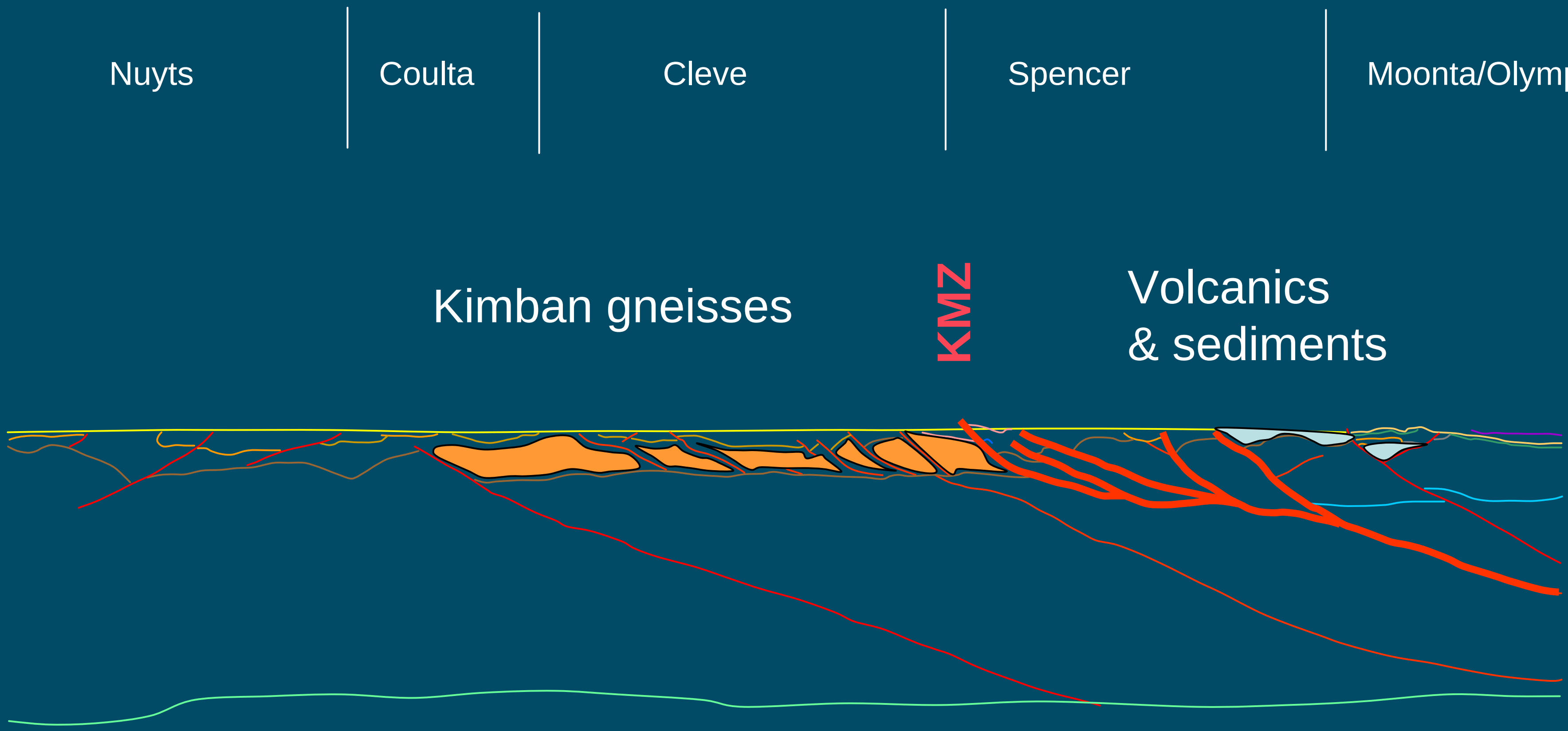
Kimban gneisses

KMZ

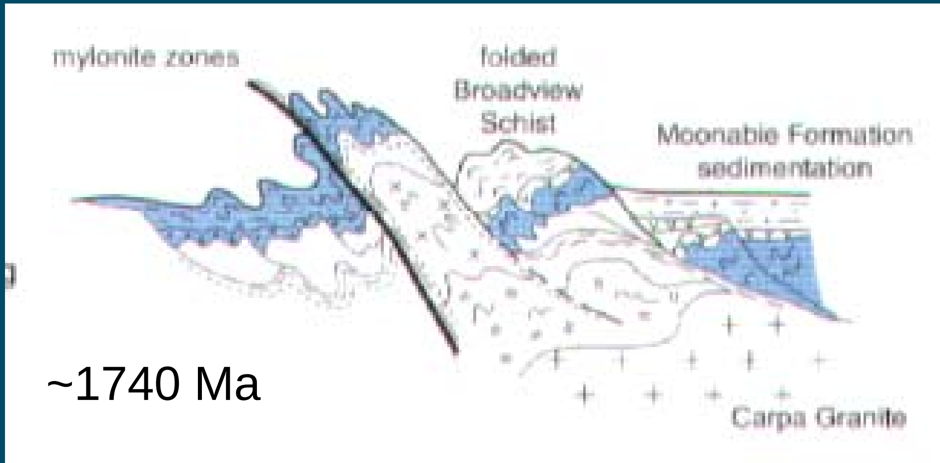
Volcanics
& sediments

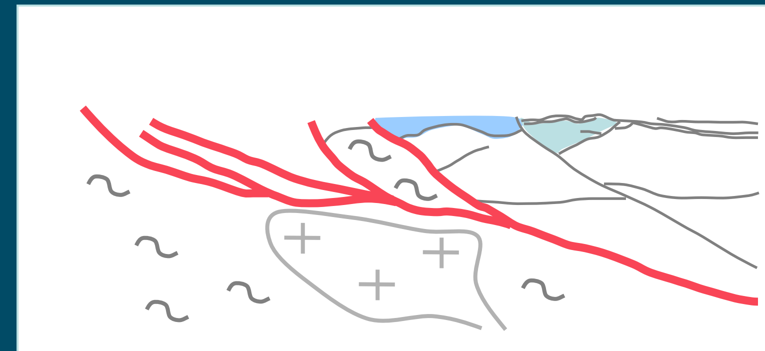


Extension across KMZ: Volcanics & Sediments to the east – hanging wall

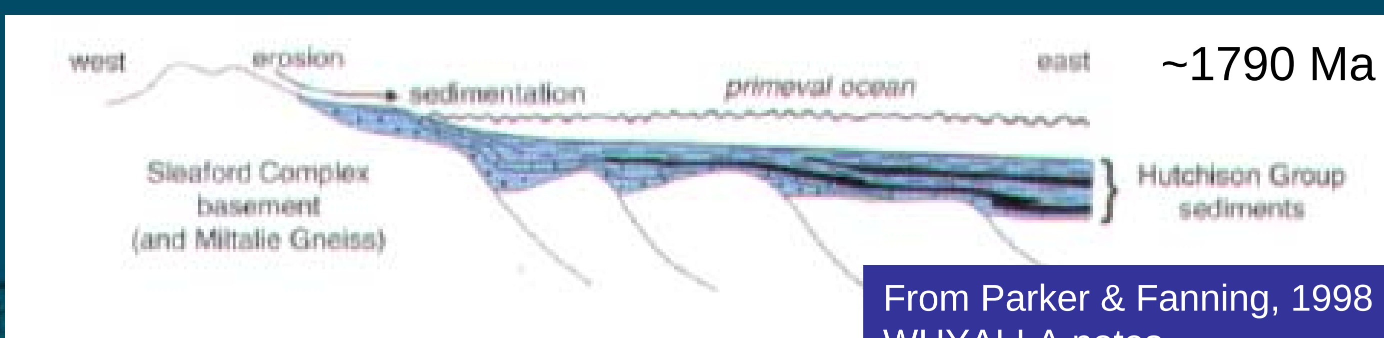

Nuyts
Coulta
Cleve
Spencer
Moonta/Olympic
Kimban gneisses
KMZ
Volcanics
& sediments

c.f. seismic geometry





TIME



From Parker & Fanning, 1998
WHYALLA notes

Some Big Questions

Is the lower crust different in age and origin across KMZ (Cleve-Spencer)?

If so, when did these crustal blocks amalgamate?

Timing and kinematics of movement on KMZ?

- multiple movement episodes:
  - pre-Kimban
  - Kimban
  - Kararan/Hiltaba
  - Neoproterozoic
  - Delamarian

Conclusions

- Crustal-Scale Geometric Constraints

- East-dipping structural grain

- Kalinjala Mylonite Zone (KMZ)
    - several fault splays rooted in single crustal-scale structure (east dipping)

- KMZ separates crust of differing seismic character
    - Coulta + Cleve Domains vs Spencer + Olympic Domains