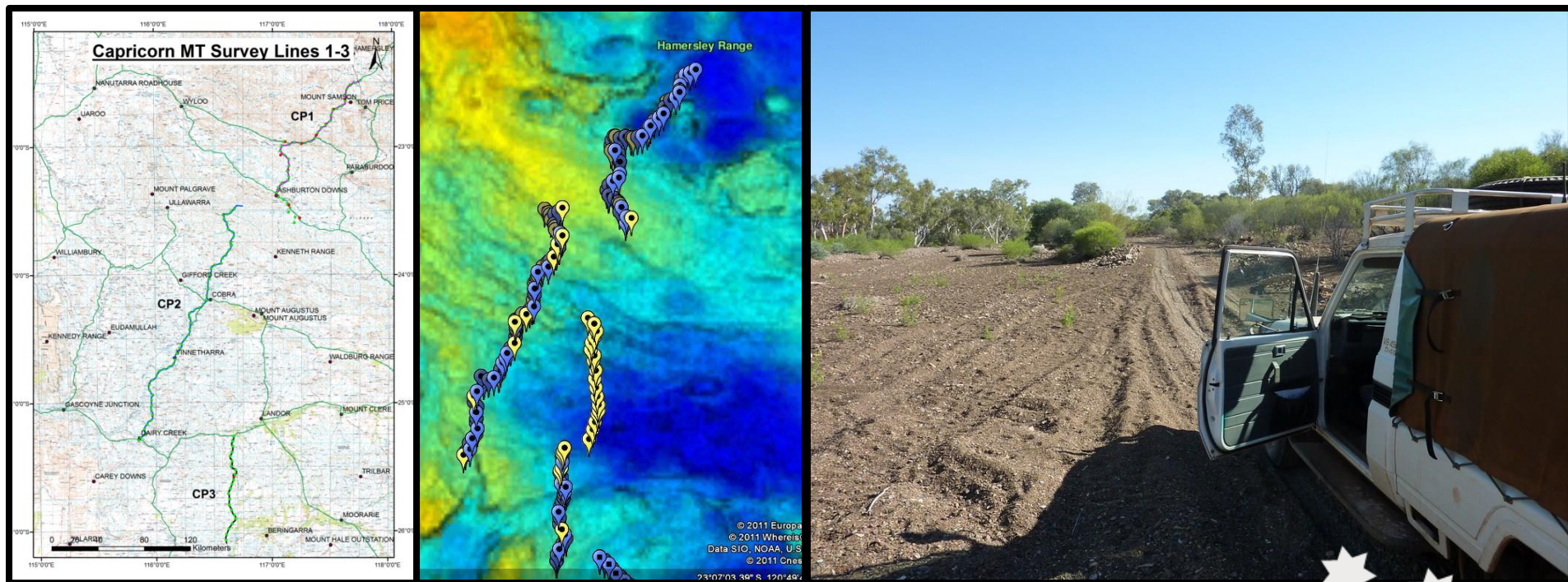


# The Capricorn Orogen Magnetotelluric (MT) Transect



Graham Heinson, Goran Boren, Jonathan Ross, Joan Campanya,  
Stephen Thiel and Katherine Selway

University of Adelaide, Adelaide SA 5005

CAPRICORN SEISMIC and MT WORKSHOP 2011

Wednesday 23<sup>rd</sup> November 2011

Mineral House, 100 Plain Street East Perth



Government of Western Australia  
Department of Mines and Petroleum

# Capricorn MT Survey

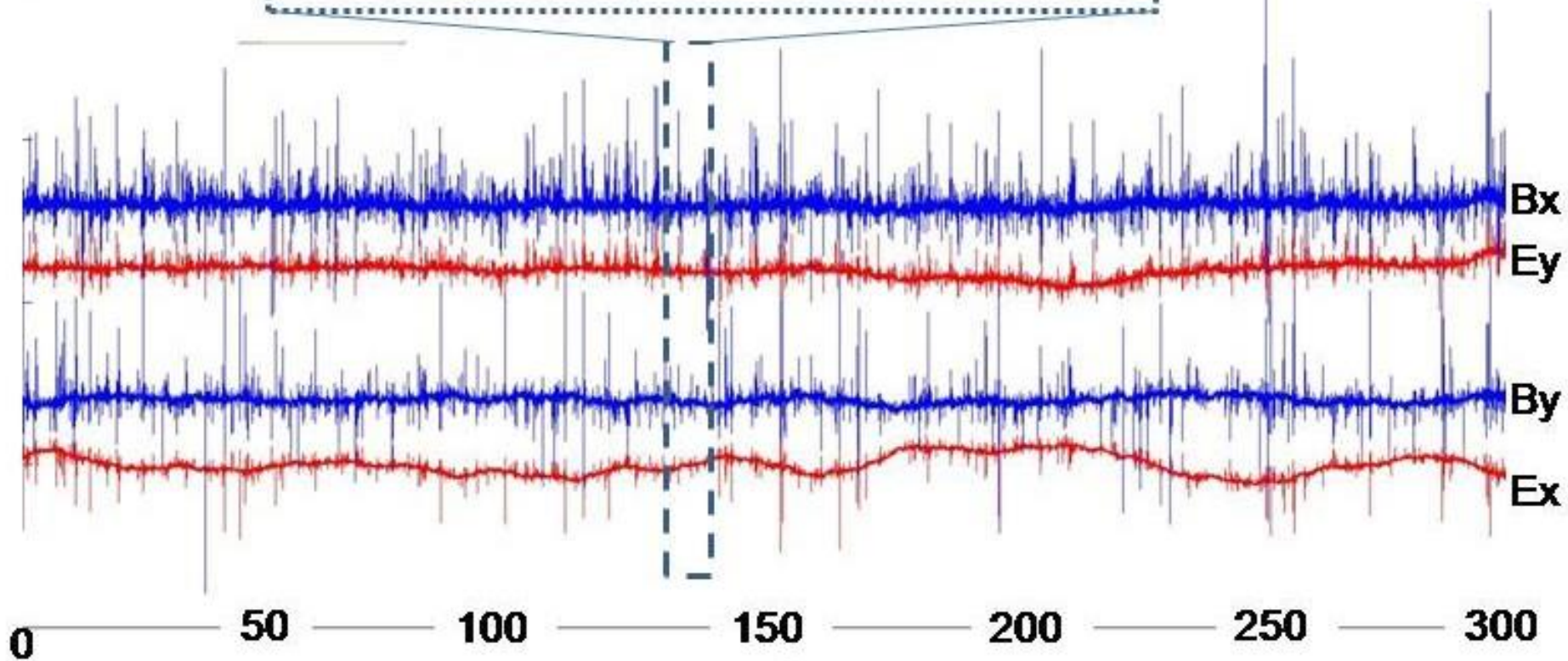
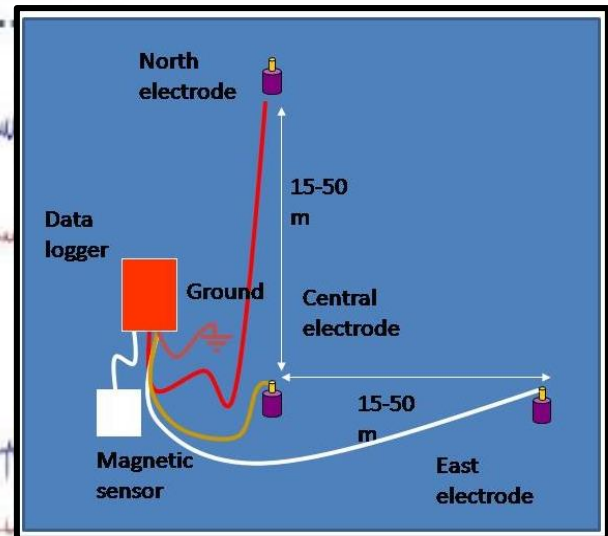
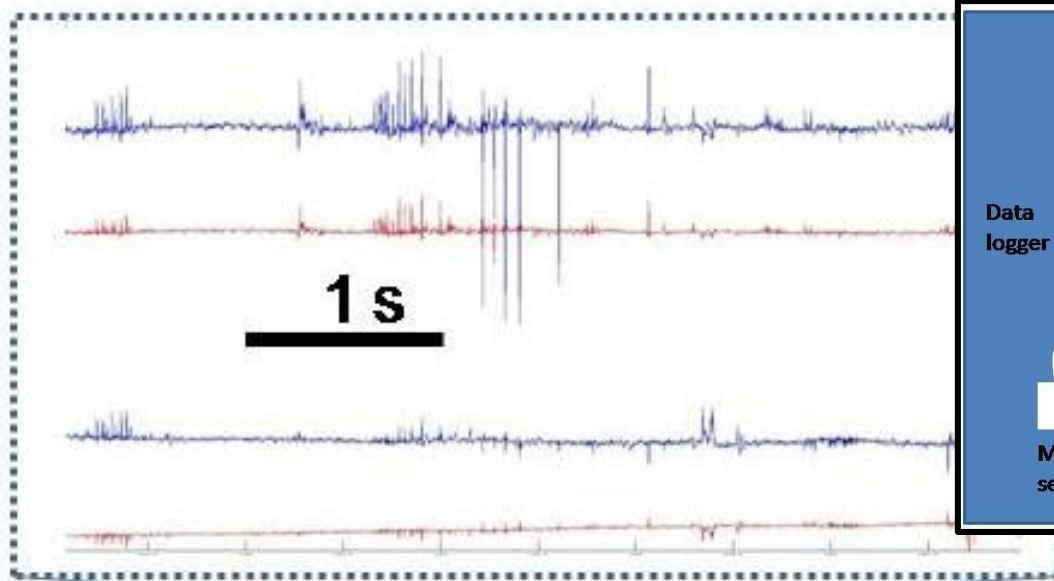
- 3 survey lines
- 156 sites in total
- CP1: 13 Long Period, 39 Broad Band
- CP2: 19 Long Period, 55 Broad Band
- CP3: 8 Long Period, 22 Broad Band

## **Long period**

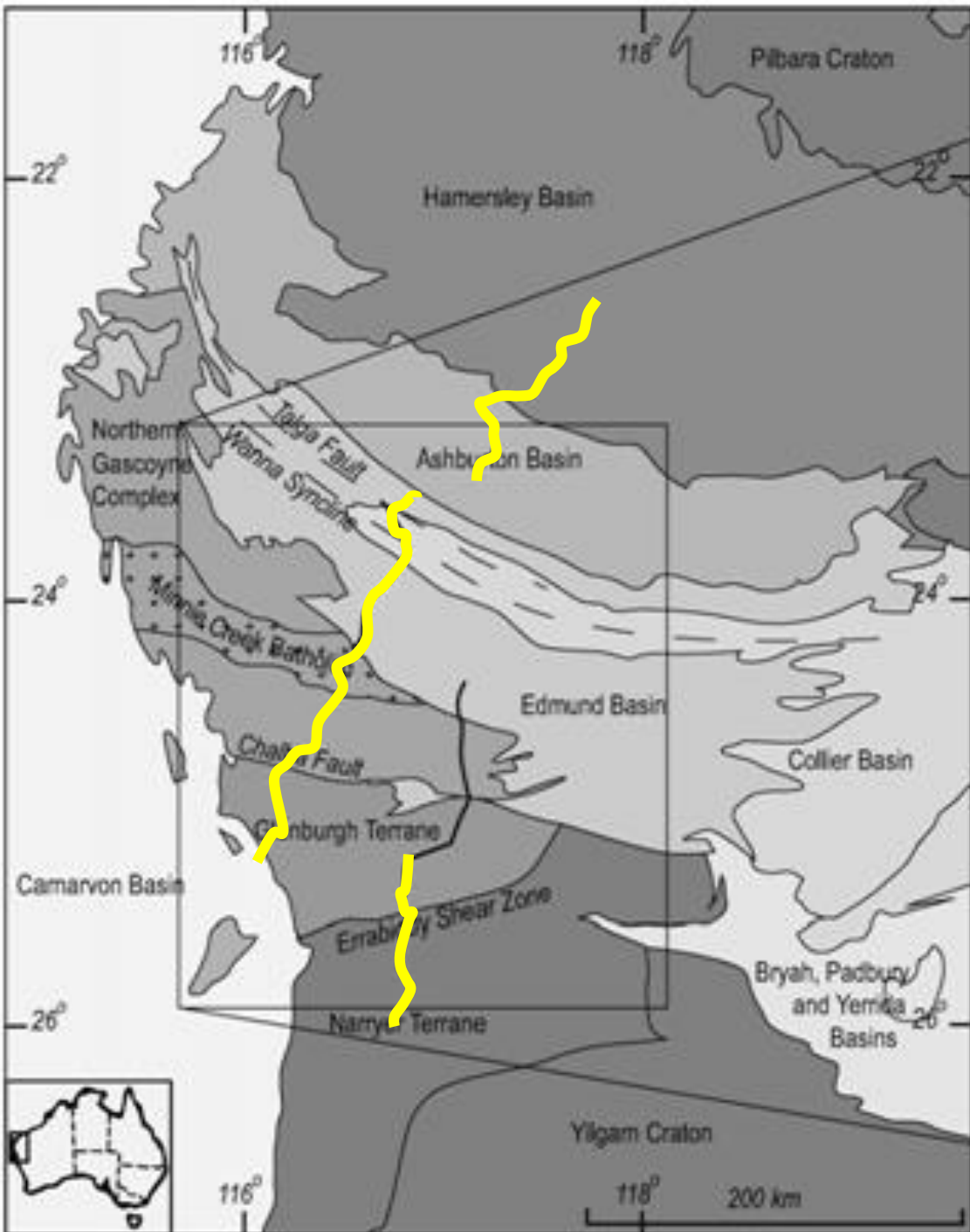
- Sampling rate: 10 Hz
- Deployment time: 5 Days
- Spacing: 15km

## **Broad Band**

- Sampling rate: 1000 Hz
- Deployment time 2-4 Days
- Spacing: 5km

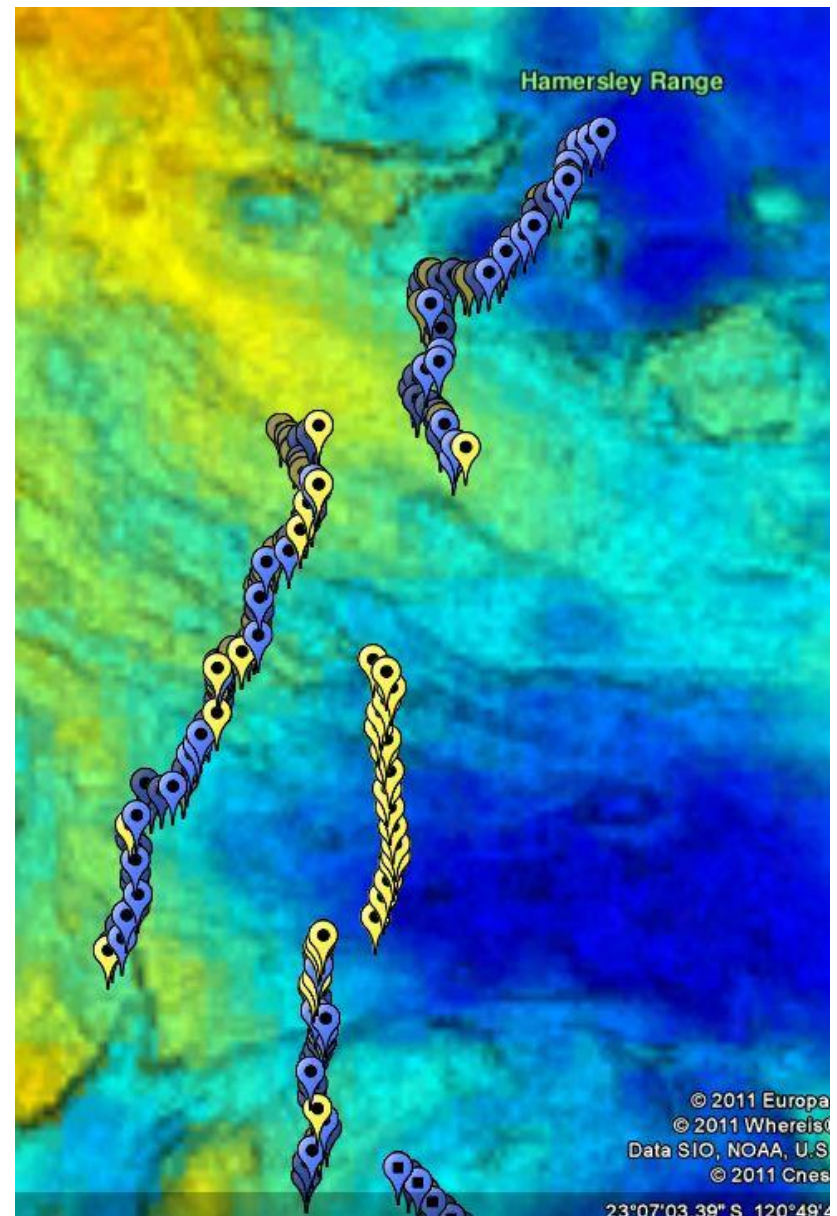
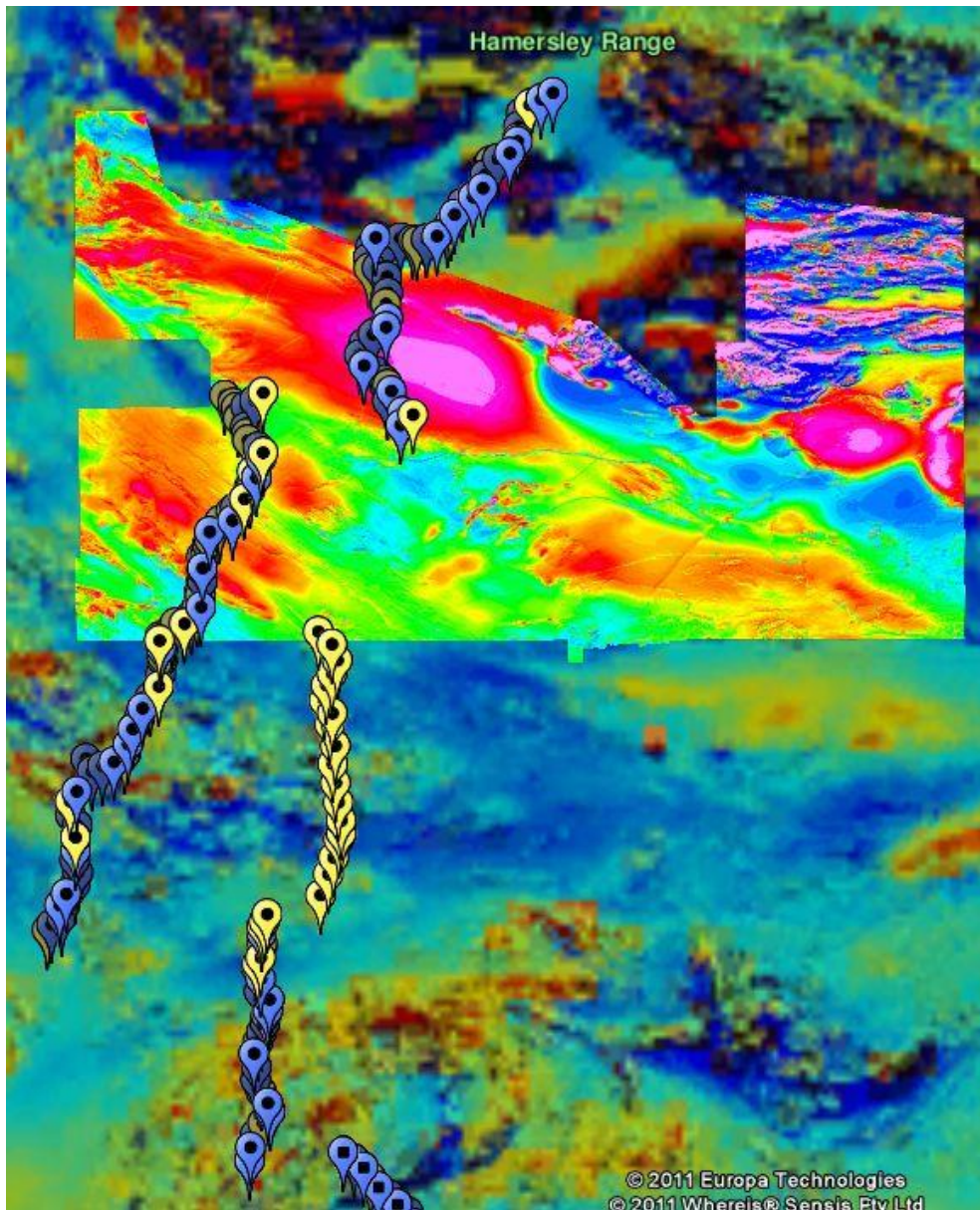






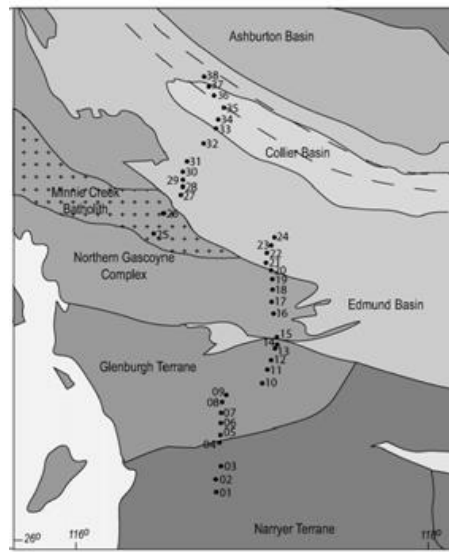
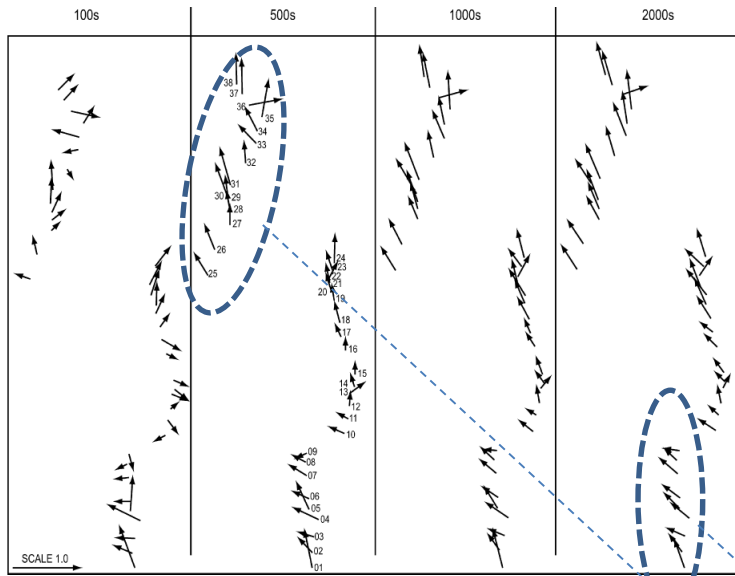
Selway et al. (2009) published long-period MT results from two lines

This survey adds to the extent of the lines and also includes broad-band data at smaller sampling intervals.

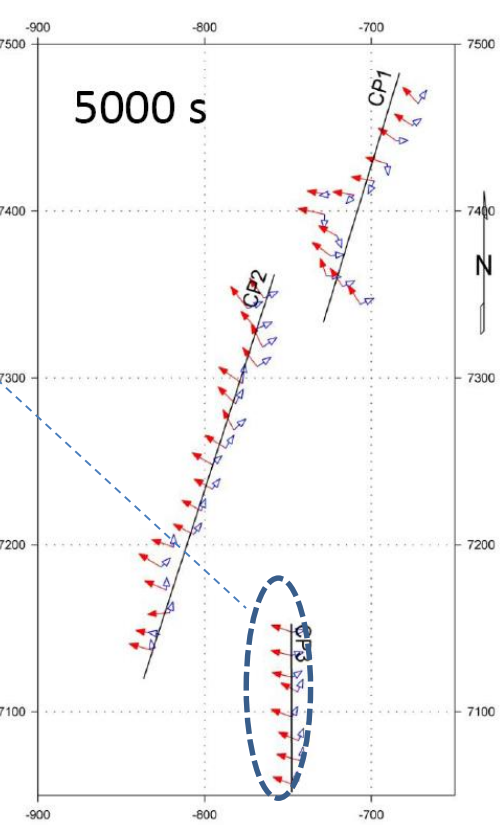
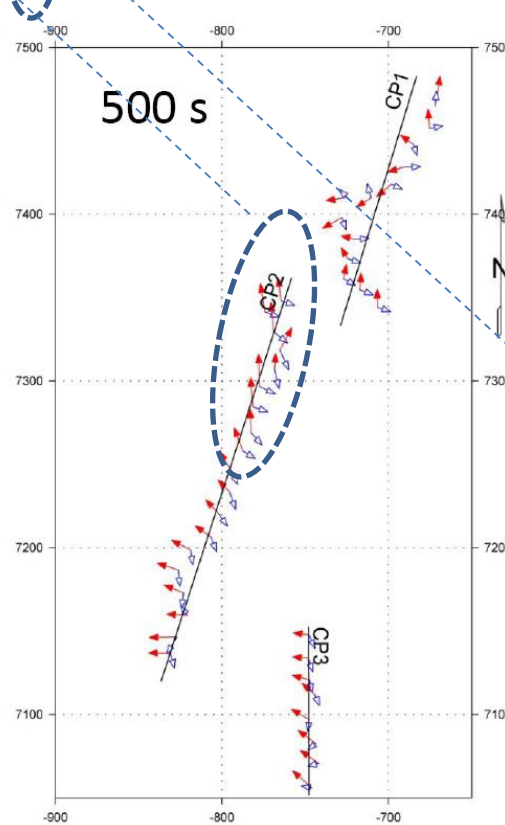
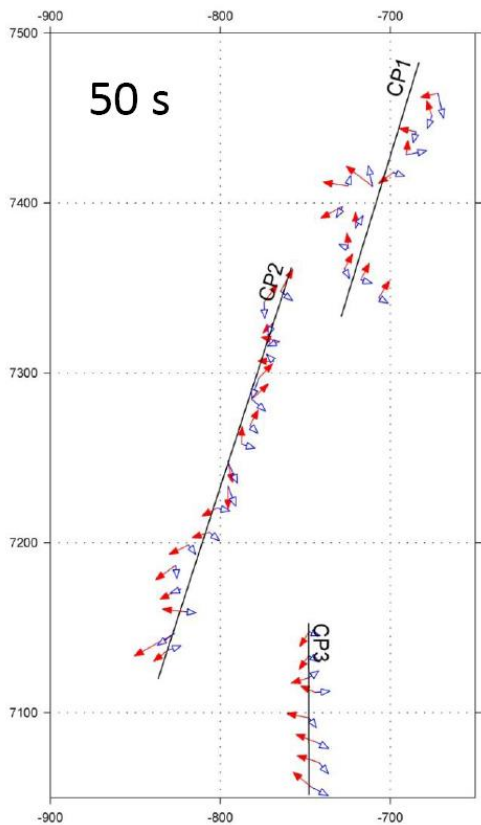


TMI (left) and Gravity (right) profiles. Yellow circles: long-period MT; Blue circles: broad-band MT





Induction arrows:  
left from Selway  
et al. (2009).  
Below: from this  
survey

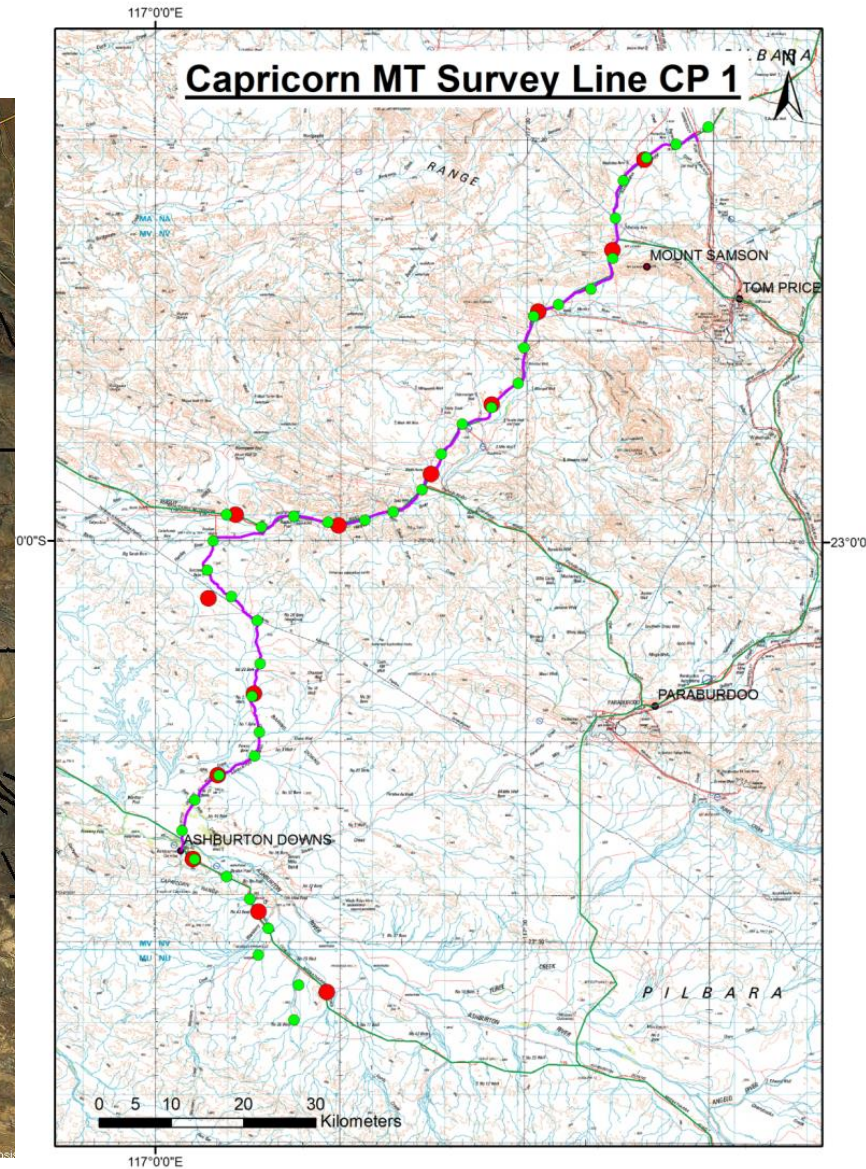




# Line CP1

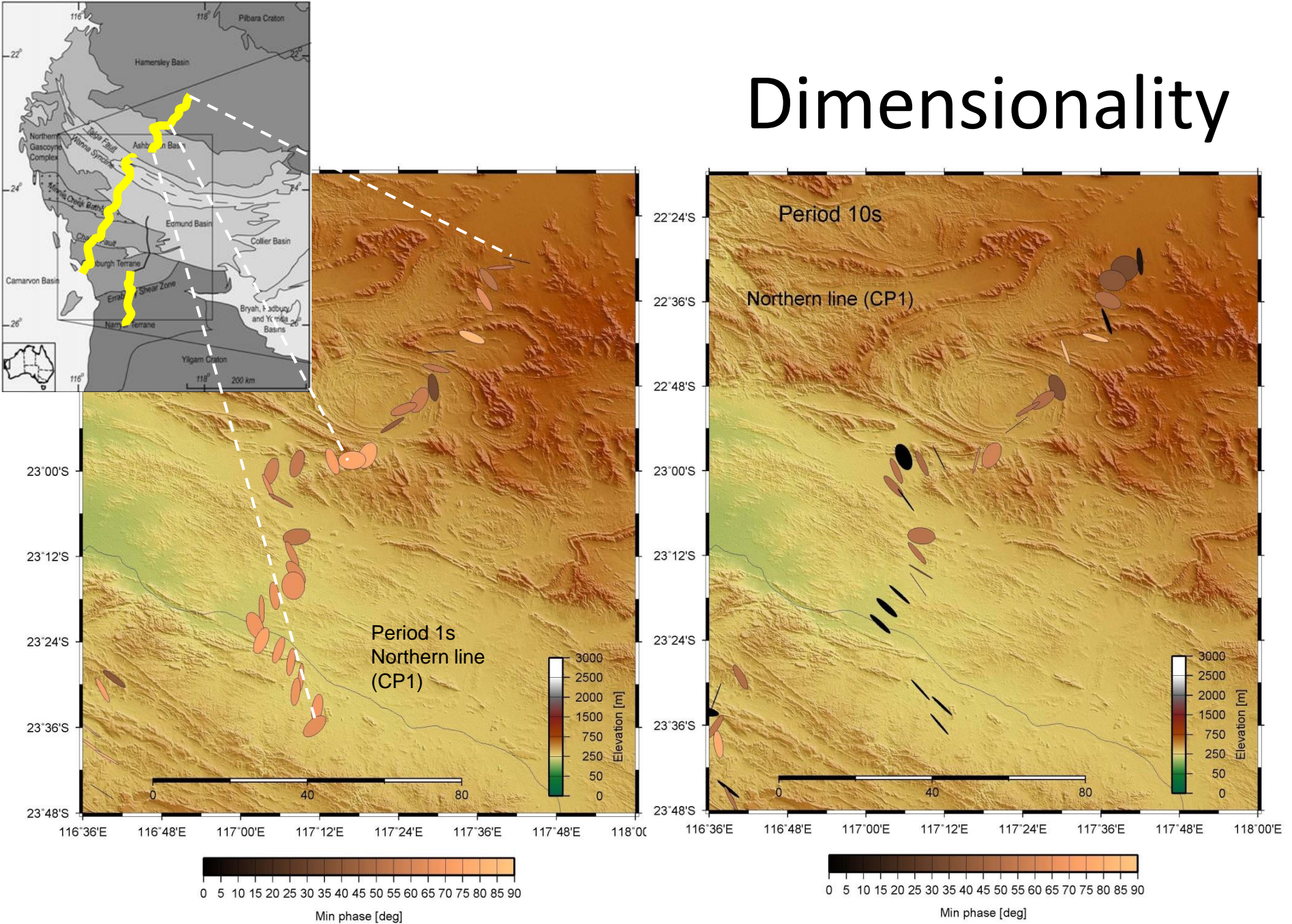
Red symbols: long-period MT

Green symbols: Broadband MT

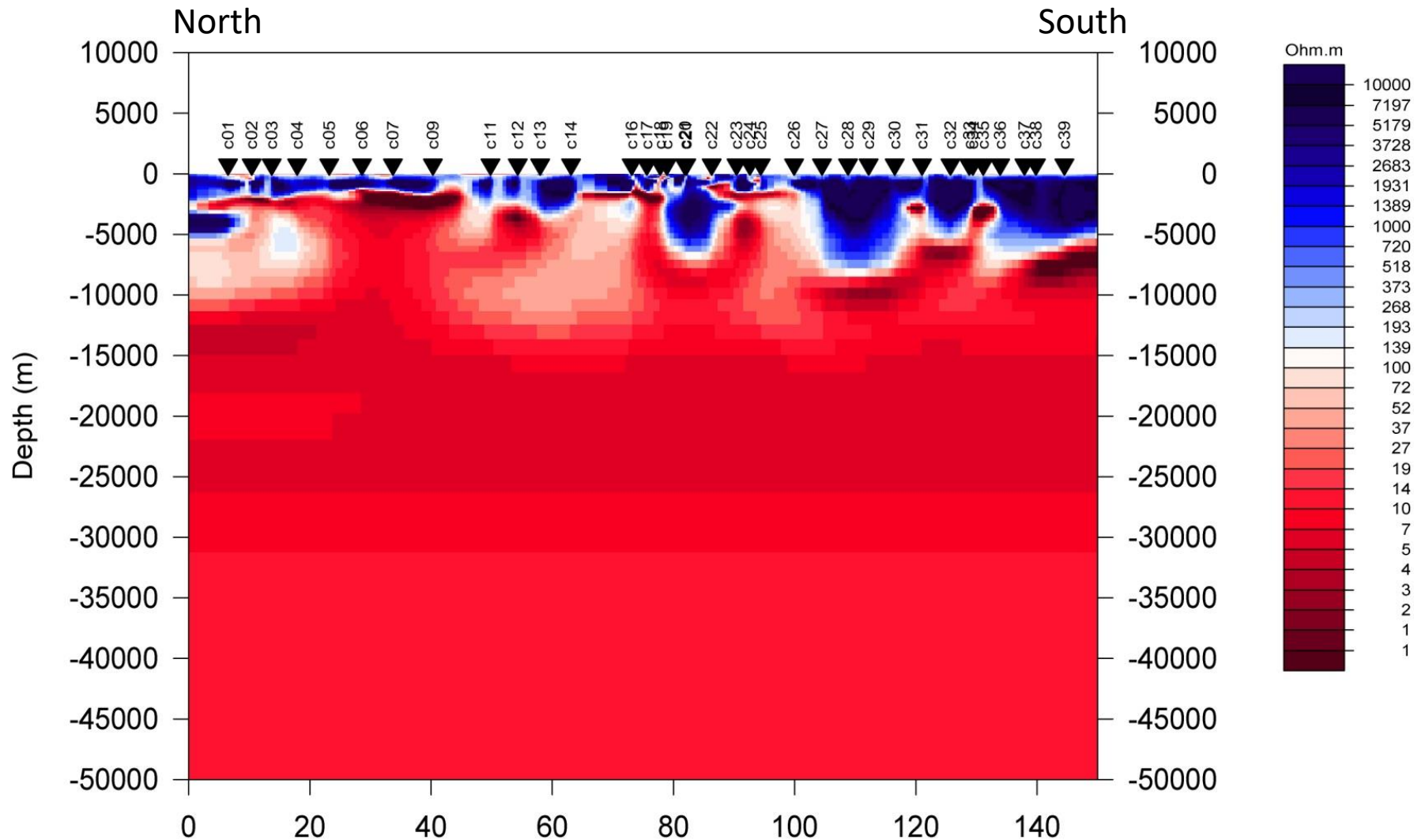




# Dimensionality







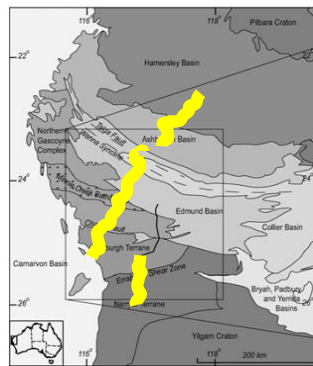
Northern Line  
 Strike 30 East of North  
 Bandwidth 200 - 0.1 Hz

Distance (Km)

Vertical Exaggeration = 2

Horizontal Scale 1 : 1000000

Vertical Scale 1 : 500000



**Western Australia**  
 Capricorn MT  
 CP1

# CP1 Comments

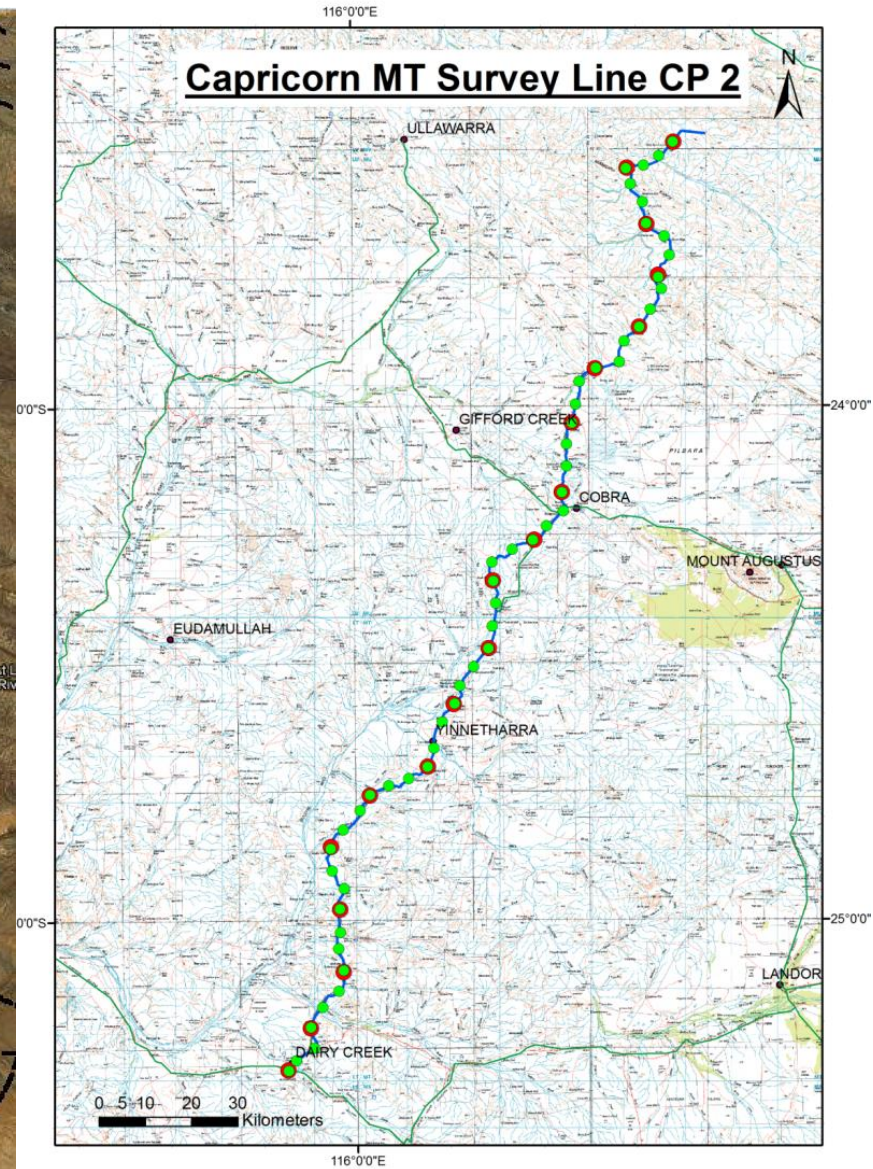


- MT Data are quite distorted (not 2D, very 3D)
- Top 200 m conductive
- Then resistive layer ( $10^3 \Omega.m$ )
- Very conductive below 2 km ( $10 \Omega.m$  – we'd normally expect  $10^4 \Omega.m$ )
- Appears to underlay all CP1 and northern CP2



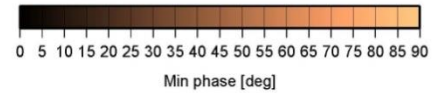
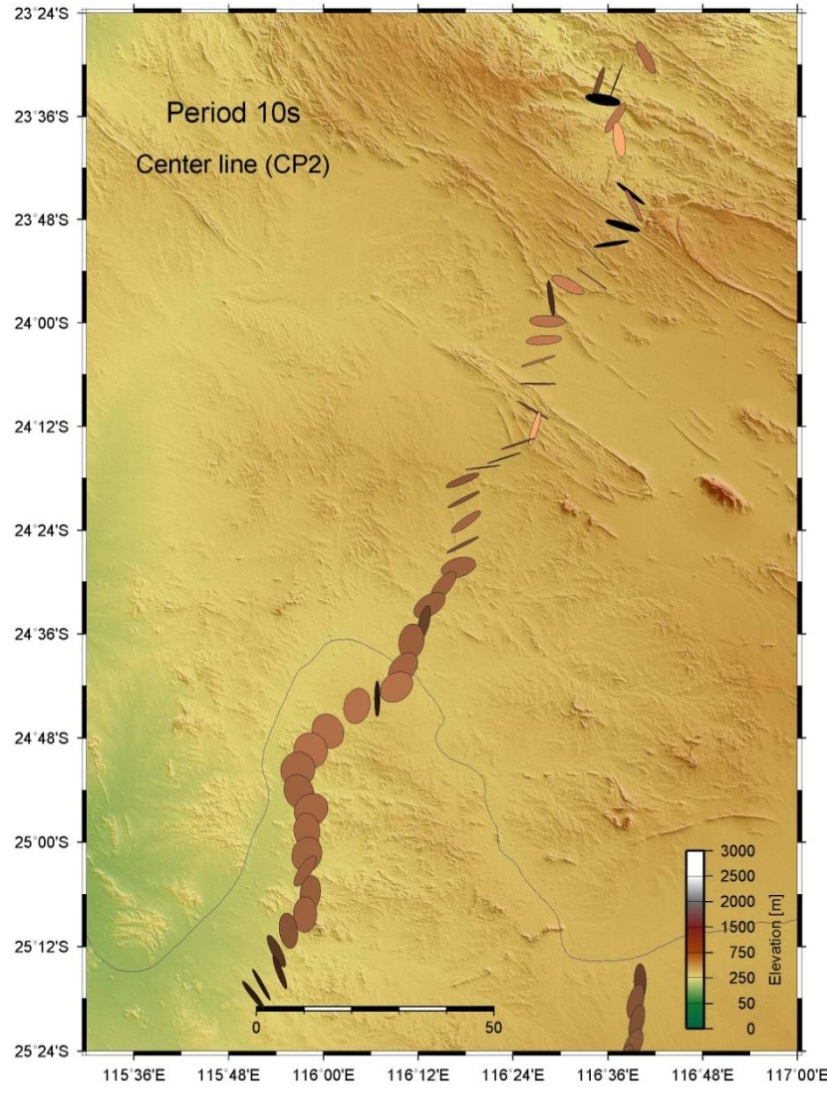
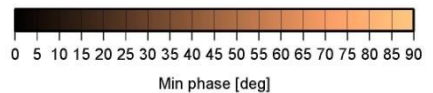
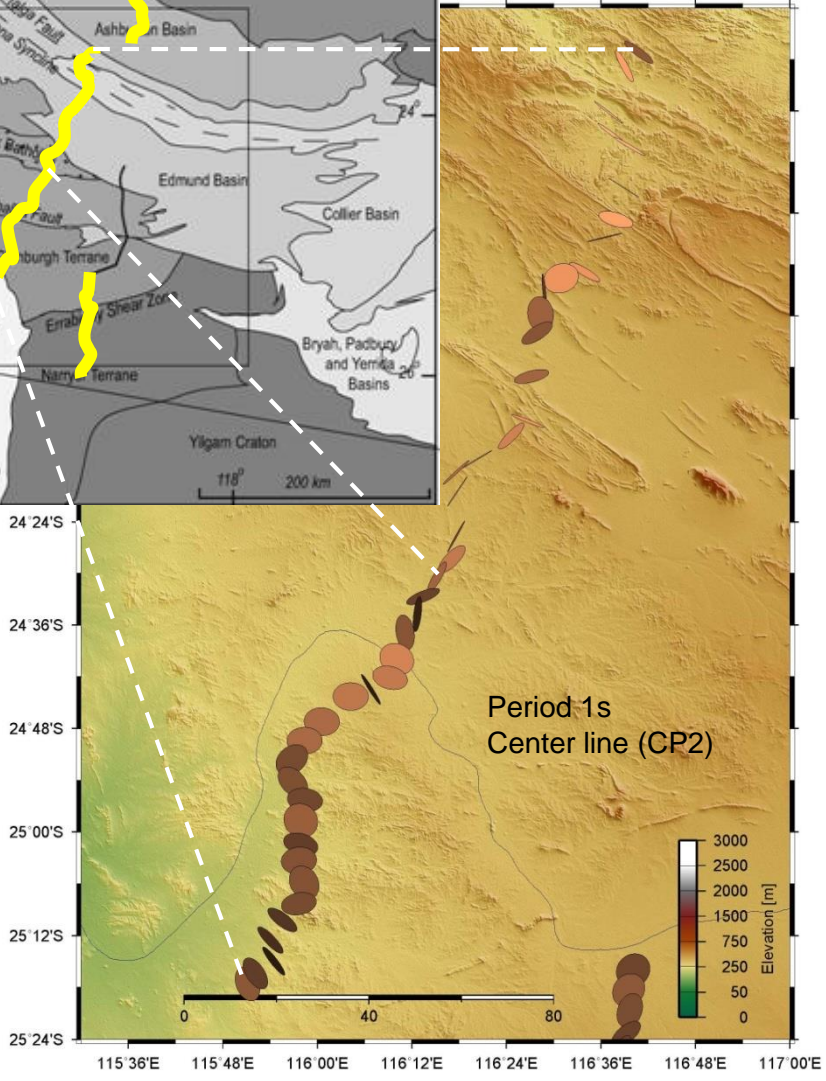
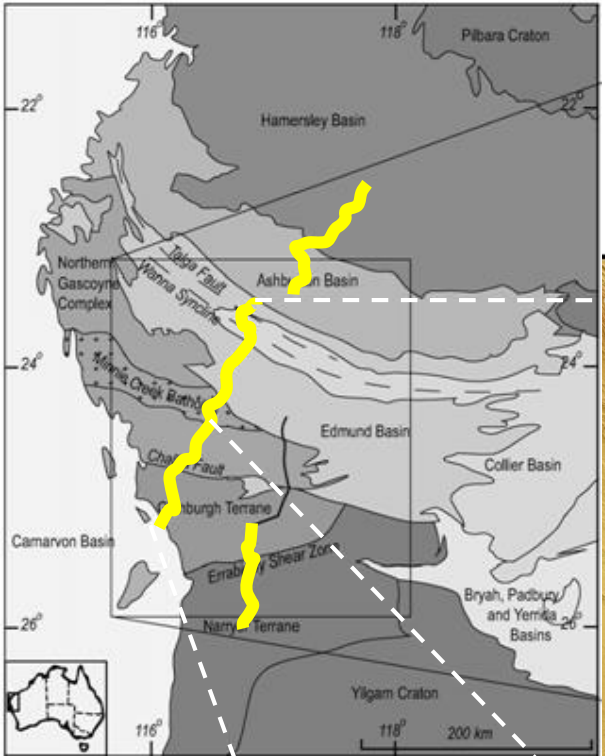
# Line CP2

Red symbols: long-period MT  
Green symbols: Broadband MT





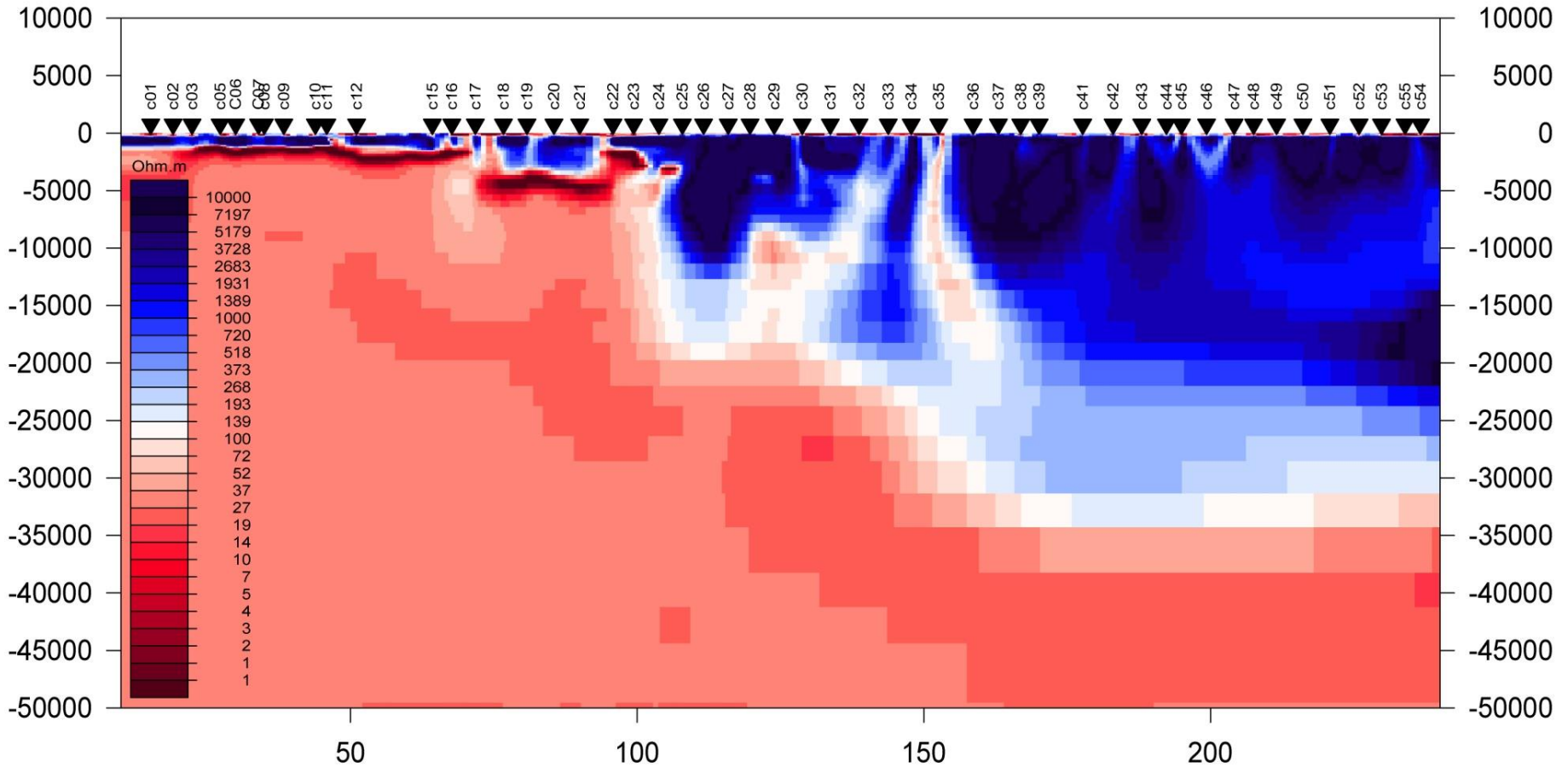
# Dimensionality





North

South



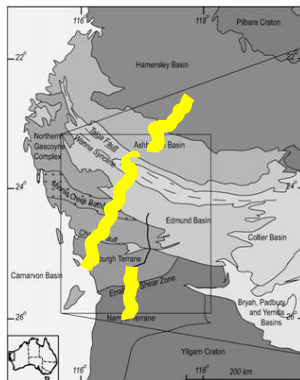
Strike 30 degrees west  
 Broadband data 200 -

Horizontal Scale 1 : 1000000

Vertical Scale 1 : 500000

Vertical Exaggeration = 2

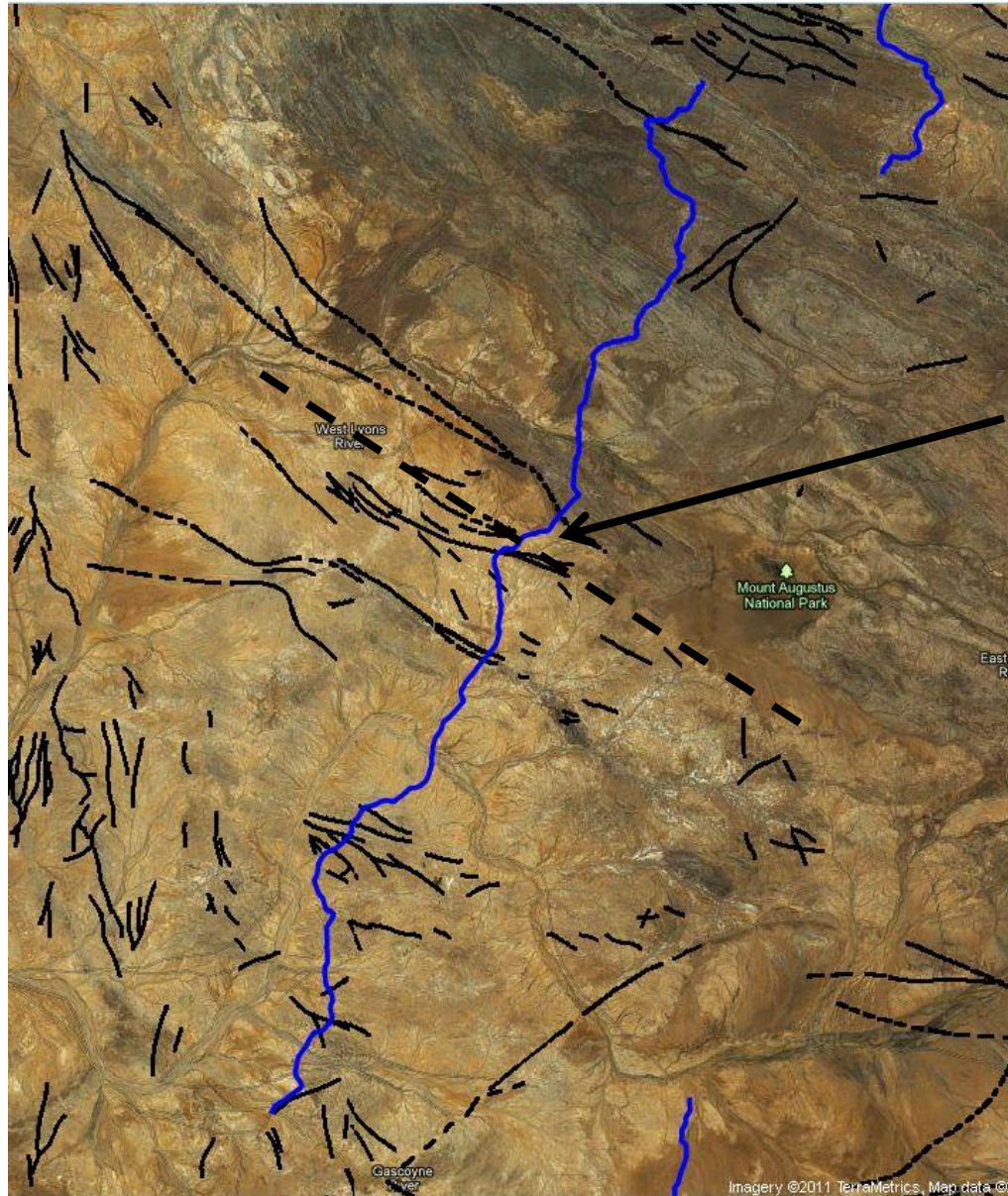
▼ MT Sounding



Distance (Km)

**Western Australia**  
 Capricorn MT  
 CP2

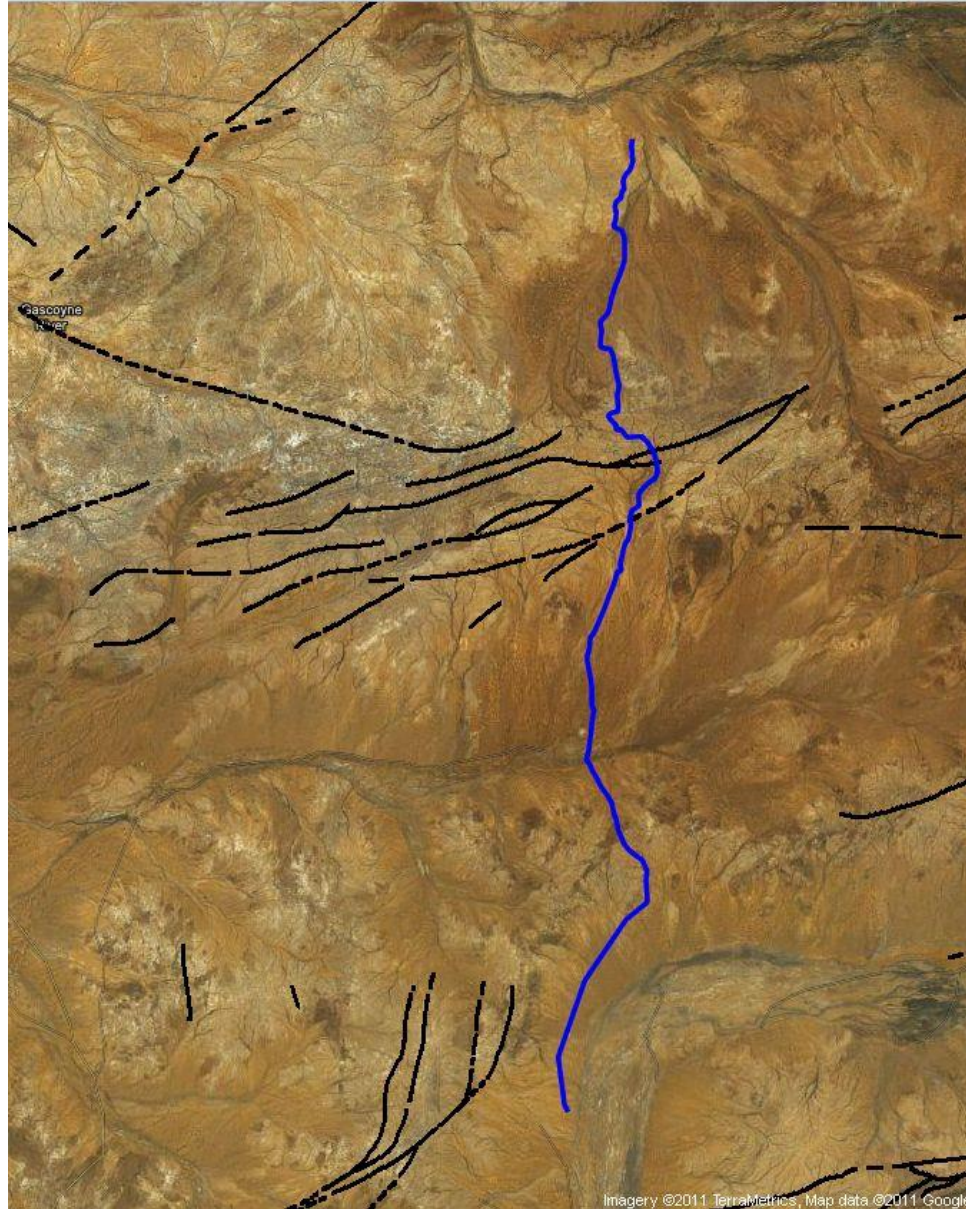
# CP2 Comments



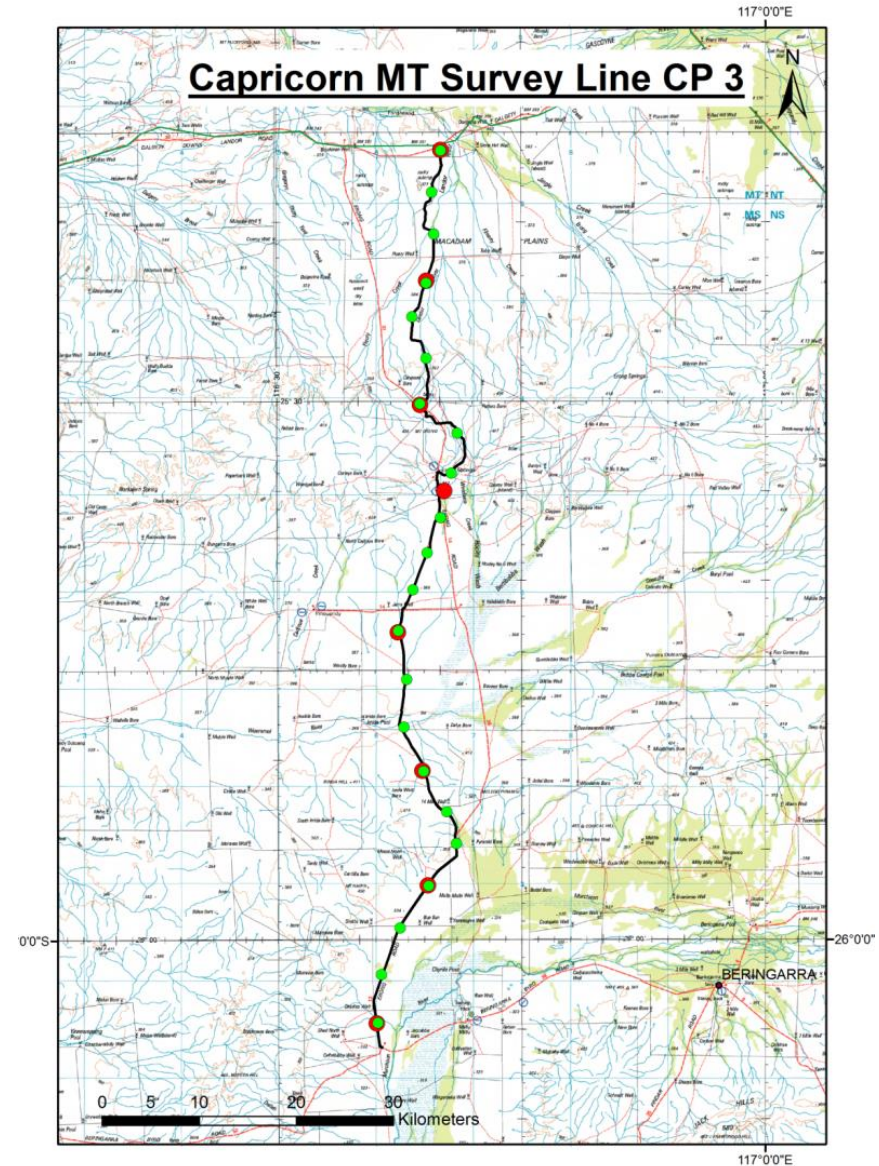
- MT Data are distorted (not 2D, very 3D)
- Very different crustal signature
  - North of dashed line upper crust is very conductive
  - South of dashed line, upper crust is much more resistive
- Some evidence of conductive shear zones through crust



# Line CP3

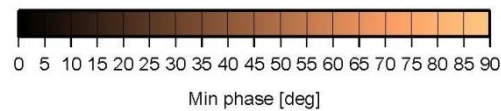
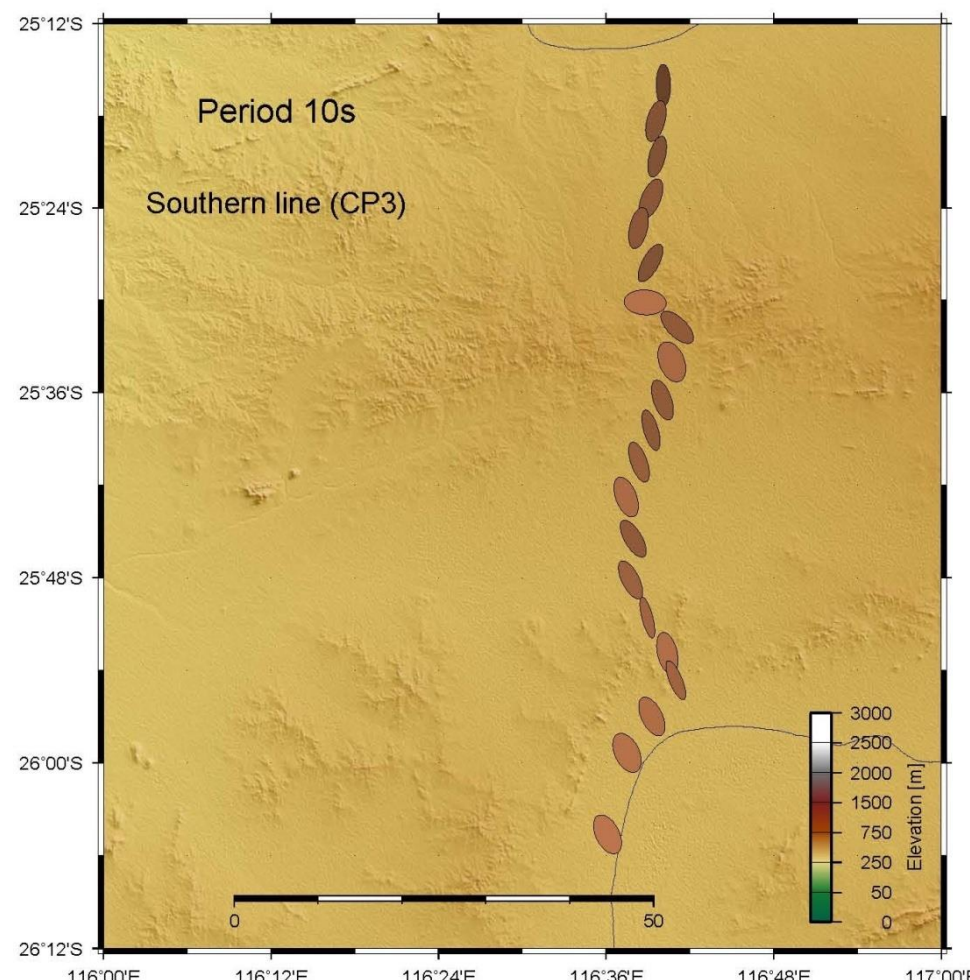
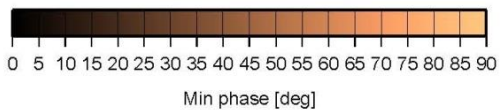
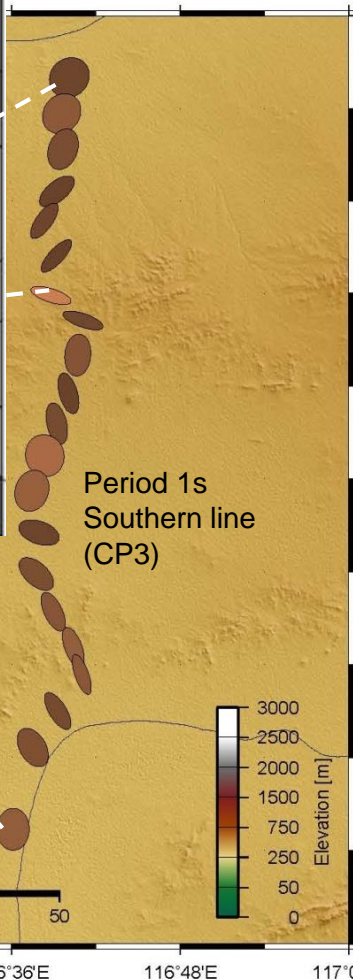
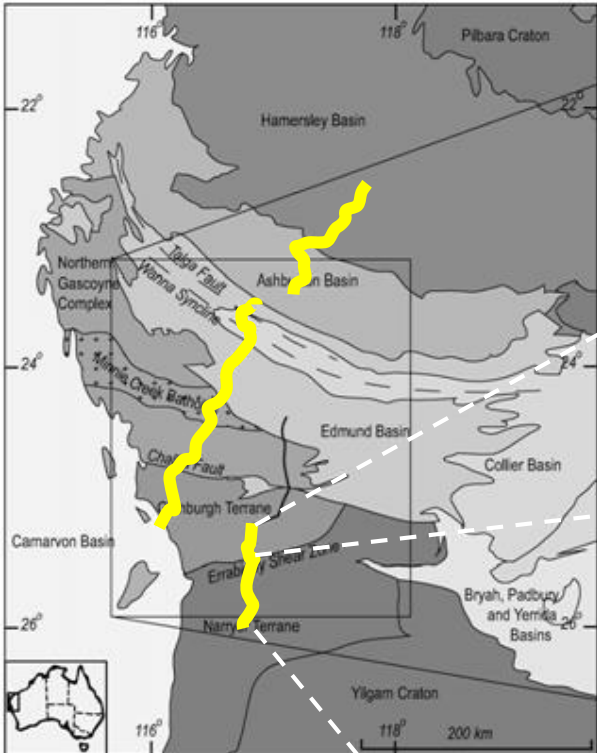


Red symbols: long-period MT  
Green symbols: Broadband MT

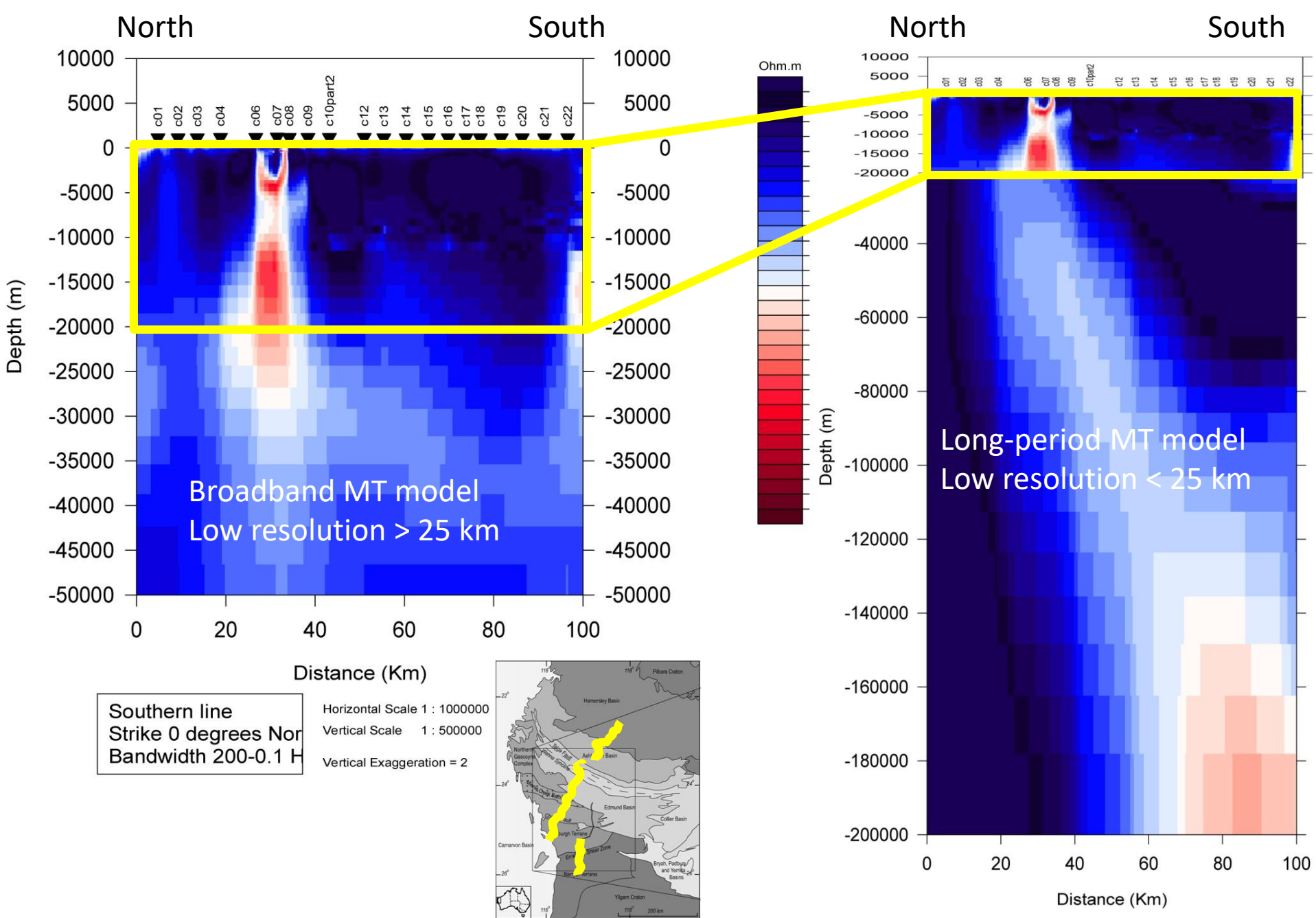




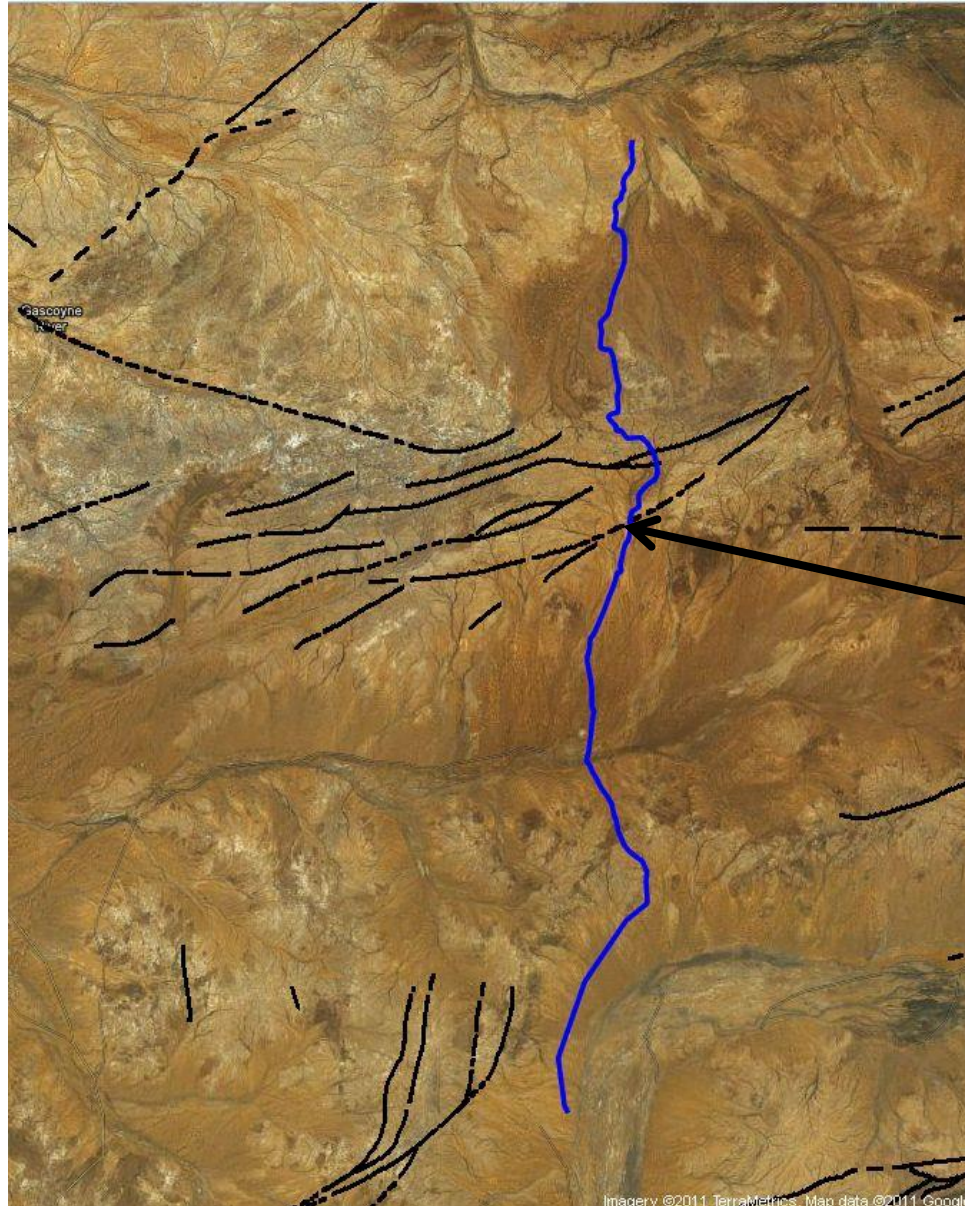
# Dimensionality





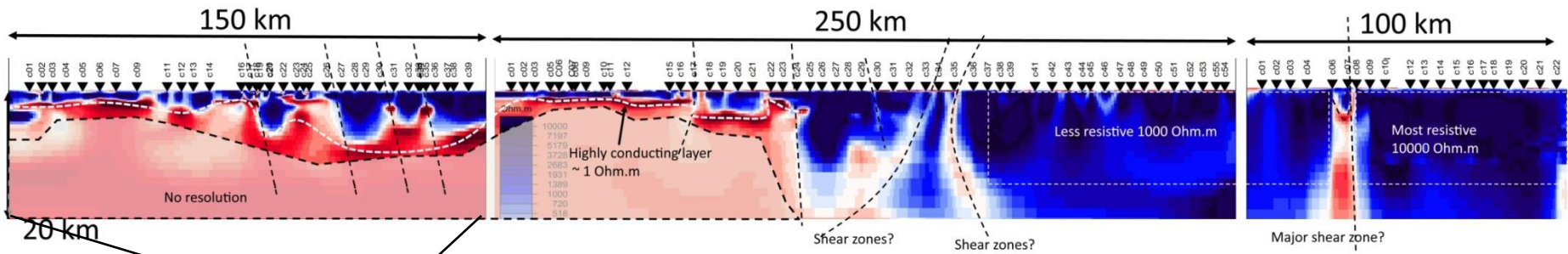


# CP3 Comments



- Much simpler data set, less distortion
  - Upper crust is much more “normal”
  - Conductive  $10 \Omega.m$  sediments to 200 m
- Very conductive shear zone here
  - North of dashed line, crust is slightly more conductive
  - South of line, quite uniform





**PILBARA CRATON**

**ASHBURTON BASIN**

**FORTESCUE, HAMERSLEY AND TUREE CREEK BASINS**

Blair Fault

Bearing Downs Fault

Nanjigardy Fault

Soda Fault

Karra Well Fault

Moona Fault

Hardey Syncline

Rocklea Dome

Turner Syncline

LWG

HaG

FG

LWG

HaG

FG

PC

LWG

HaG

FG

PC

FG

PC

FG

PC

FG

PC

**Bandeie Seismic Province**

Base Middle Crust

Base Middle Crust

Base Middle Crust

**Carlathunda Seismic Province**

Base Middle Crust

**Moho**

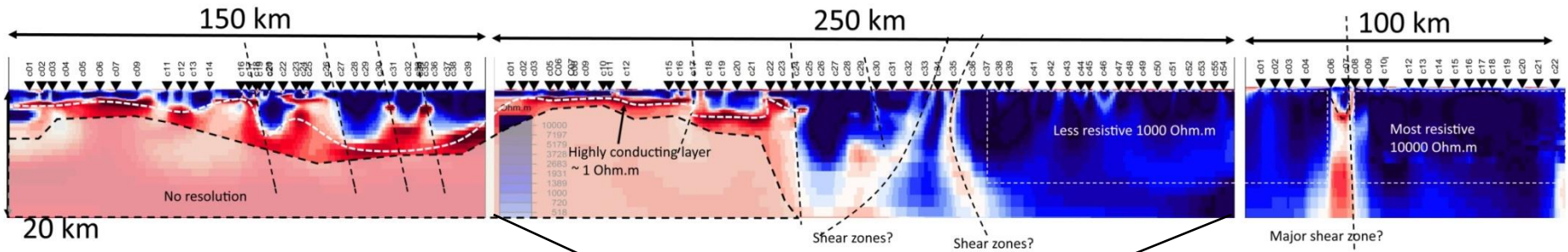
**10GA-CP1**

0

20

km

40



**GASCOYNE PROVINCE**

MOOLOO ZONE

MUTHERBUKIN ZONE

LIMEJUICE ZONE

MANGAROOON ZONE

BOORA BOORA ZONE

**EDMUND AND COLLIER BASINS**

Cardilya Fault

Chalba Shear Zone

Ti Tree Shear Zone

Edmund Fault

Lyons River Fault

Godfrey Fault

Talga Fault

Cobra Syncline

Wanna Syncline

Pingand Shell

Glenburgh Terrane

Bandee Seismic Province

Base Middle Crust

Mombo Fault

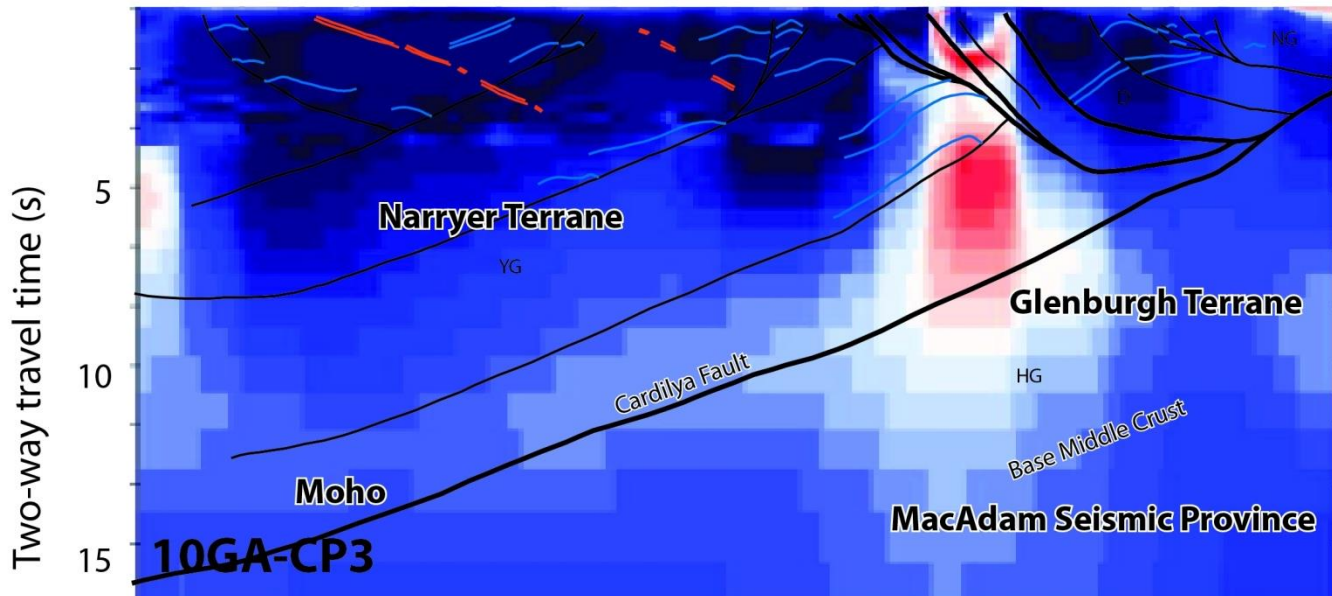
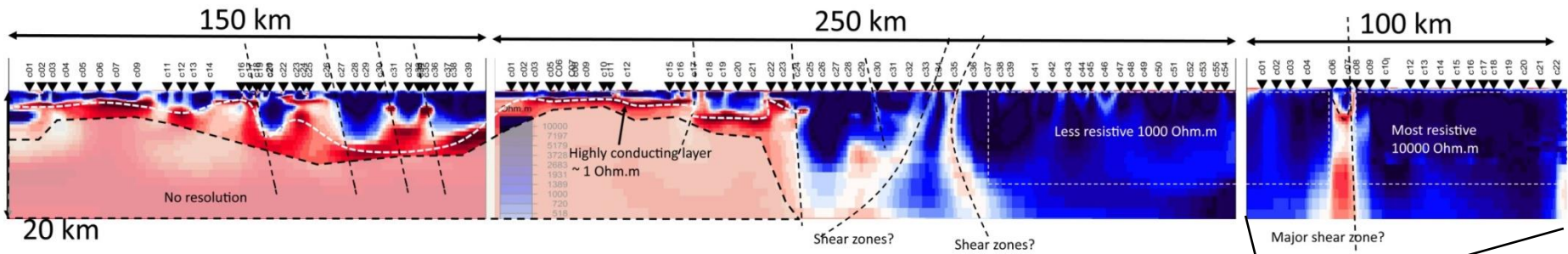
Base Middle Crust

MacAdam Seismic Province

Moho

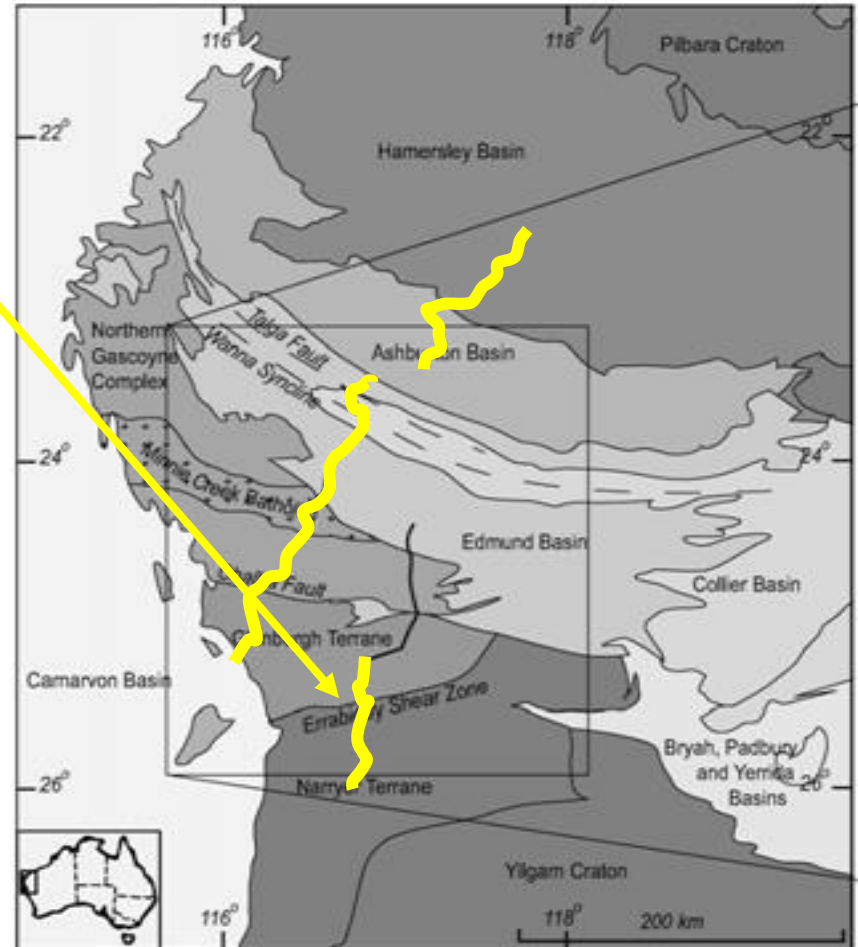
10GA-CP2





# Conclusions

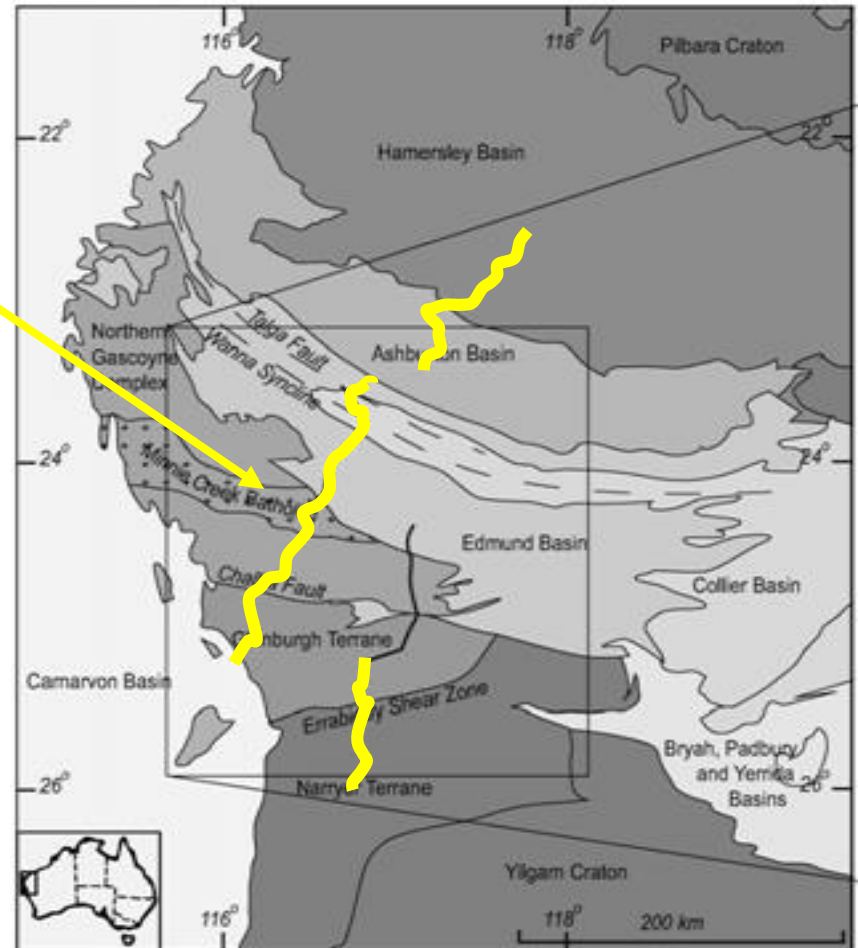
1. Errabiddy Shear Zone is clearly indentified in CP3. Zone of low resistivity
  - 10 km wide, and extends to at least 25 km
  - South-dipping, in both the low-resistivity shear zone, and also in the more resistive structures to the south





# Conclusions

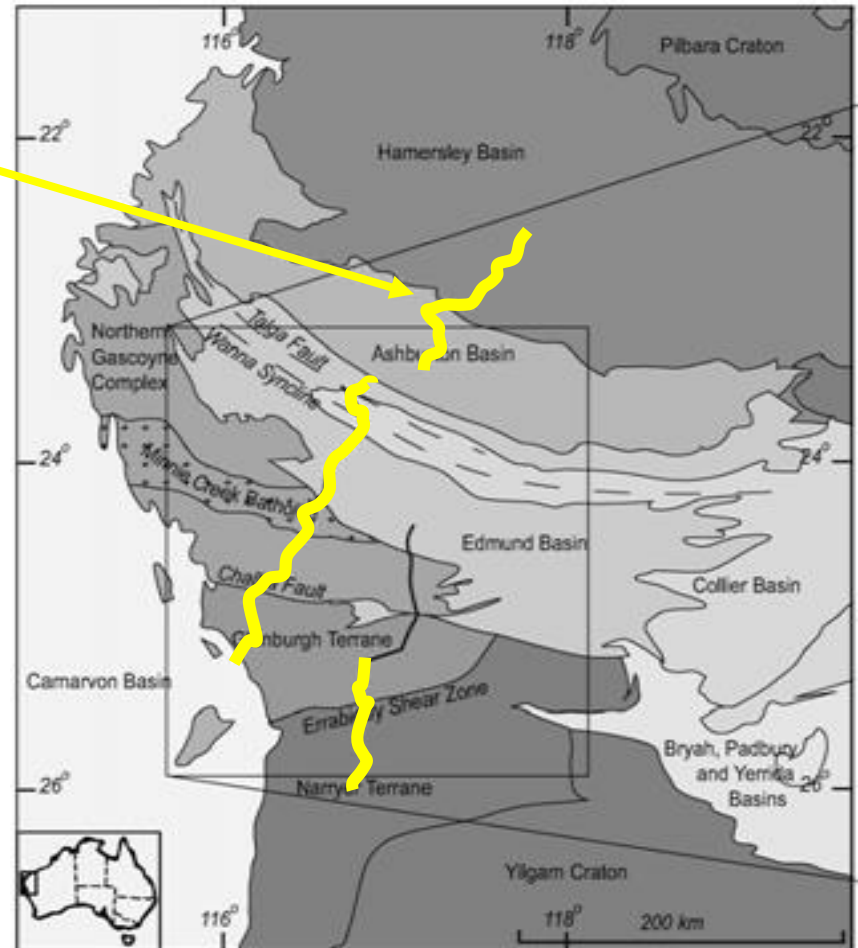
2. We do not resolve the depth and geometry of the Minnie Creek Batholith, but note that this is coincident with a profound change in the crustal resistivity along line CP2, which appears to be coincident with the Lyons River Fault.





# Conclusions

- Little in terms of basin structure and faults in the Pilbara-Hamersley-Ashburton Basin-Edmund Basin (CP1-CP2)
  - Low-resistivity structures observed at depths of 2-10 km
  - Simple interpretation of the low-resistivity due to highly-connected magnetite
  - Higher resistivity layers above have lower magnetite content, either due to the depth of weathering front, or due to intrusive bodies in the south



# Acknowledgements

- The Western Australian Government's Royalties for Regions Exploration Incentive Scheme (EIS)
- Australia Federal Government's National Earth Science Infrastructure Program (AuScope)
- GSWA and Geoscience Australia are thanked for significant logistical support for the MT fieldwork
- The authors gratefully acknowledge pastoralists and Aboriginal communities for allowing us access to the land.
- We are indebted to the many station owners along this profile that provided accommodation for the field crews and made the survey achievable in October and November.

