



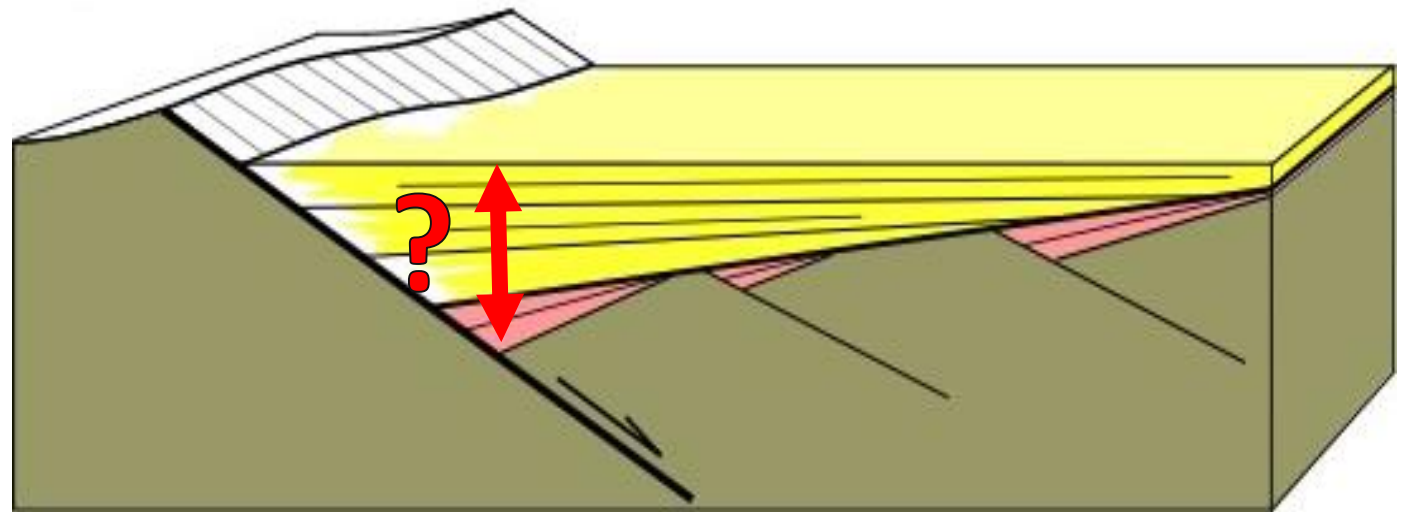
# Carnarvon Basin SEEBASE

*How deep is the basin?*

**Charmaine Thomas**

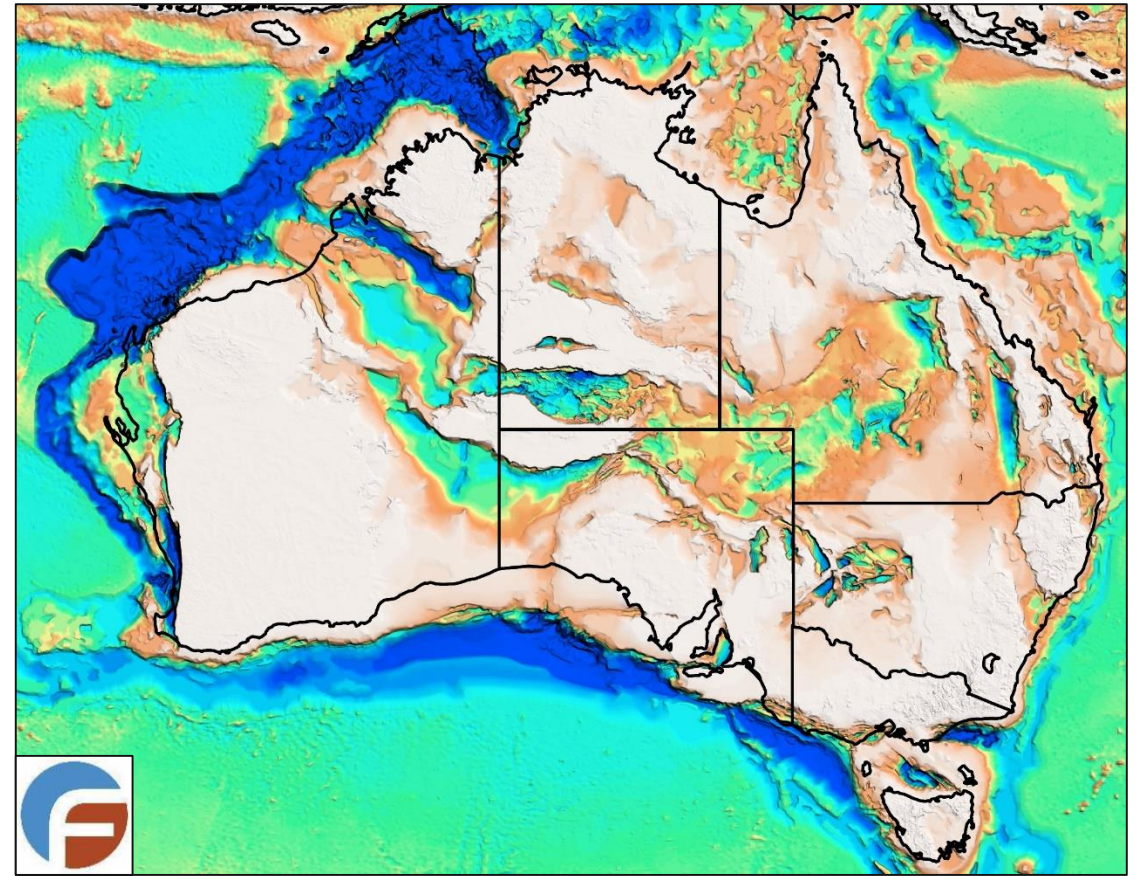
**Energy Geoscience and Carbon  
Strategy Branch**

Presented by  
**Deidre Brooks**



# What is SEEBASE?

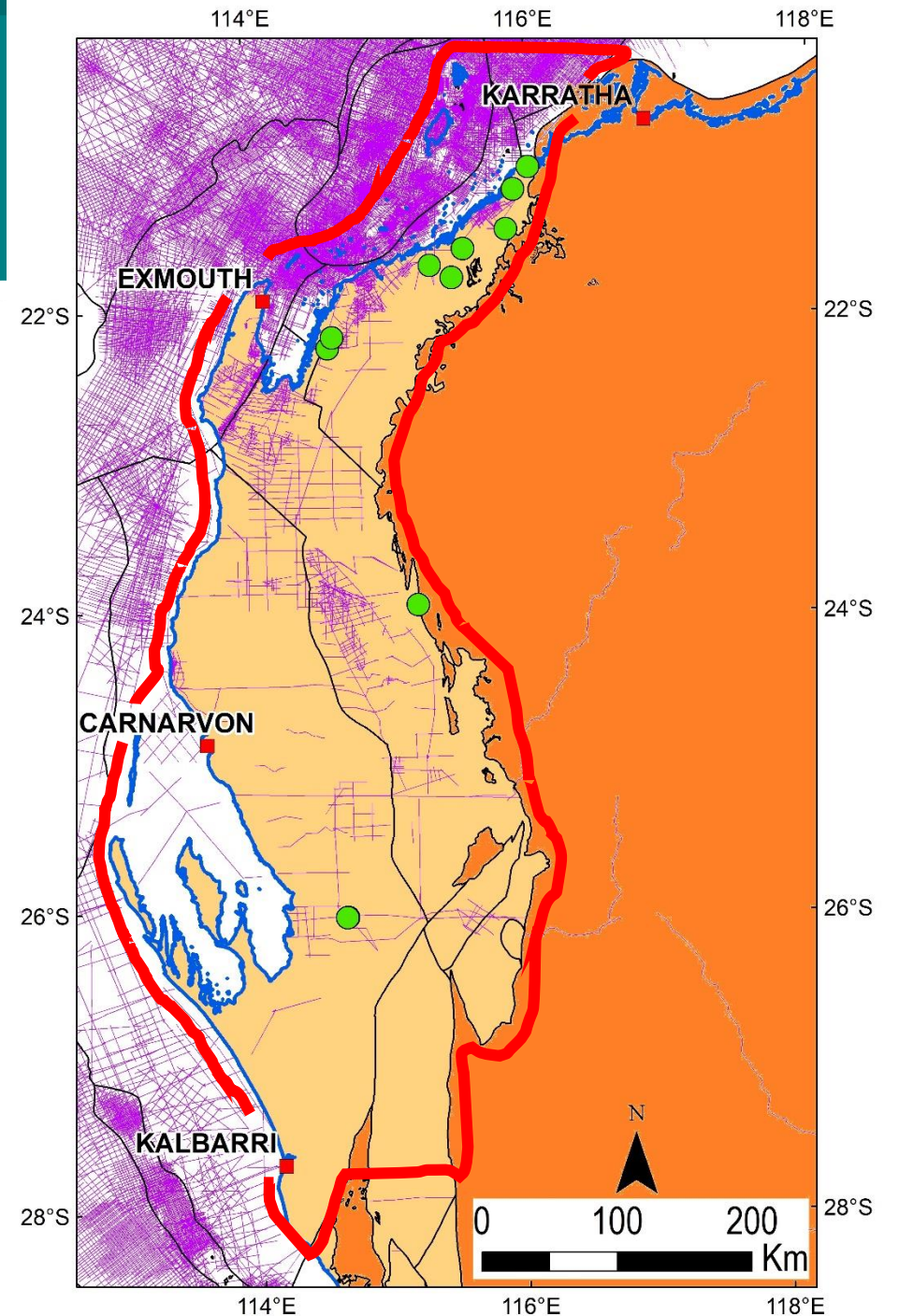
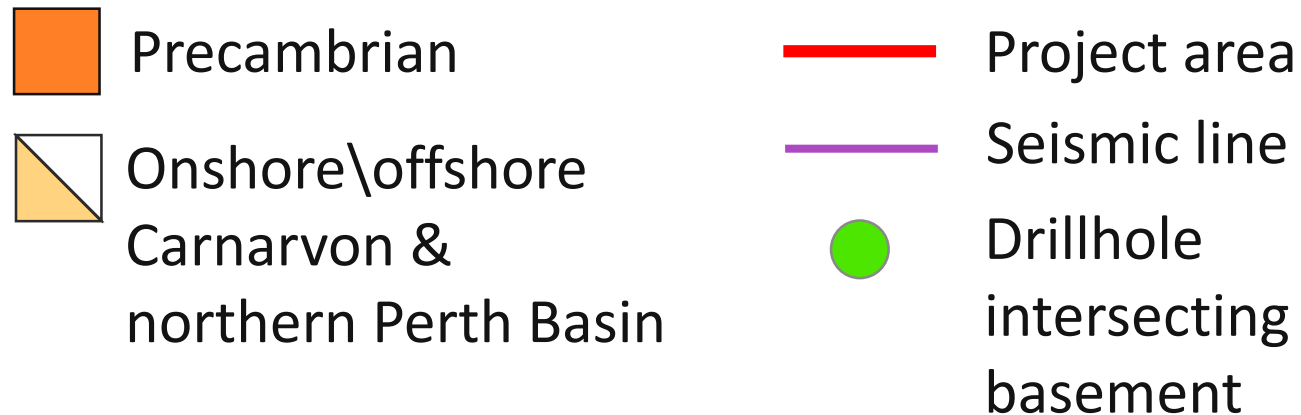
- **Structurally Enhanced** view of **Economic BASEment**
- Australia-wide 2005 Oz SEEBASE
- Depth to basement uncertain in most basins
- Magnetic & gravity data can help fill the gaps



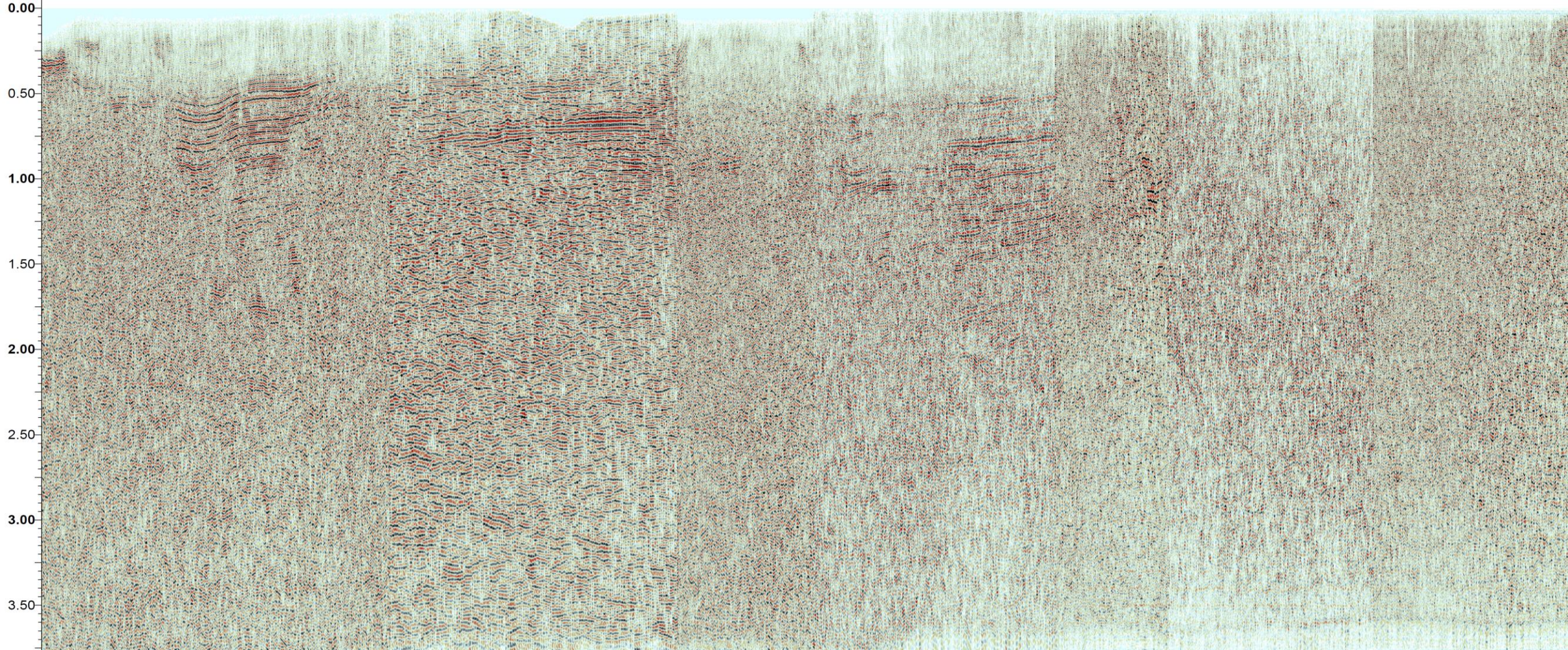
Oz SEEBASE2005

# Why the Carnarvon Basin?

- Onshore - Very sparse and poor quality seismic
- Few drill holes intersect basement
- Offshore - basement too deep to image on seismic



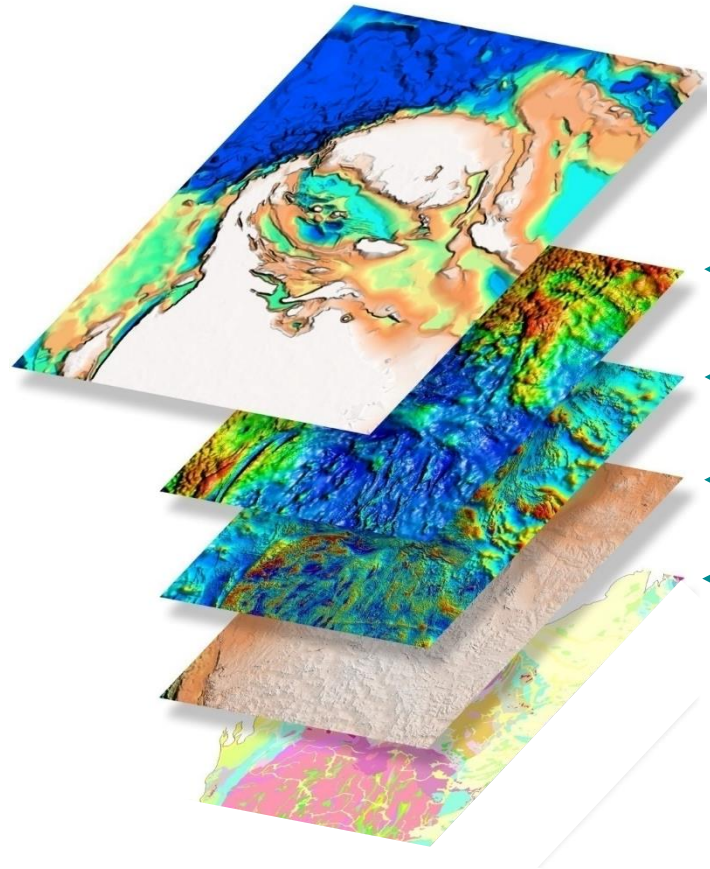




- Existing onshore seismic mostly dynamite source, low fold data
- Basement is very difficult to pick



# SEEBASE construction overview



## Core datasets

← Gravity

← Magnetics

← Digital Elevation Model

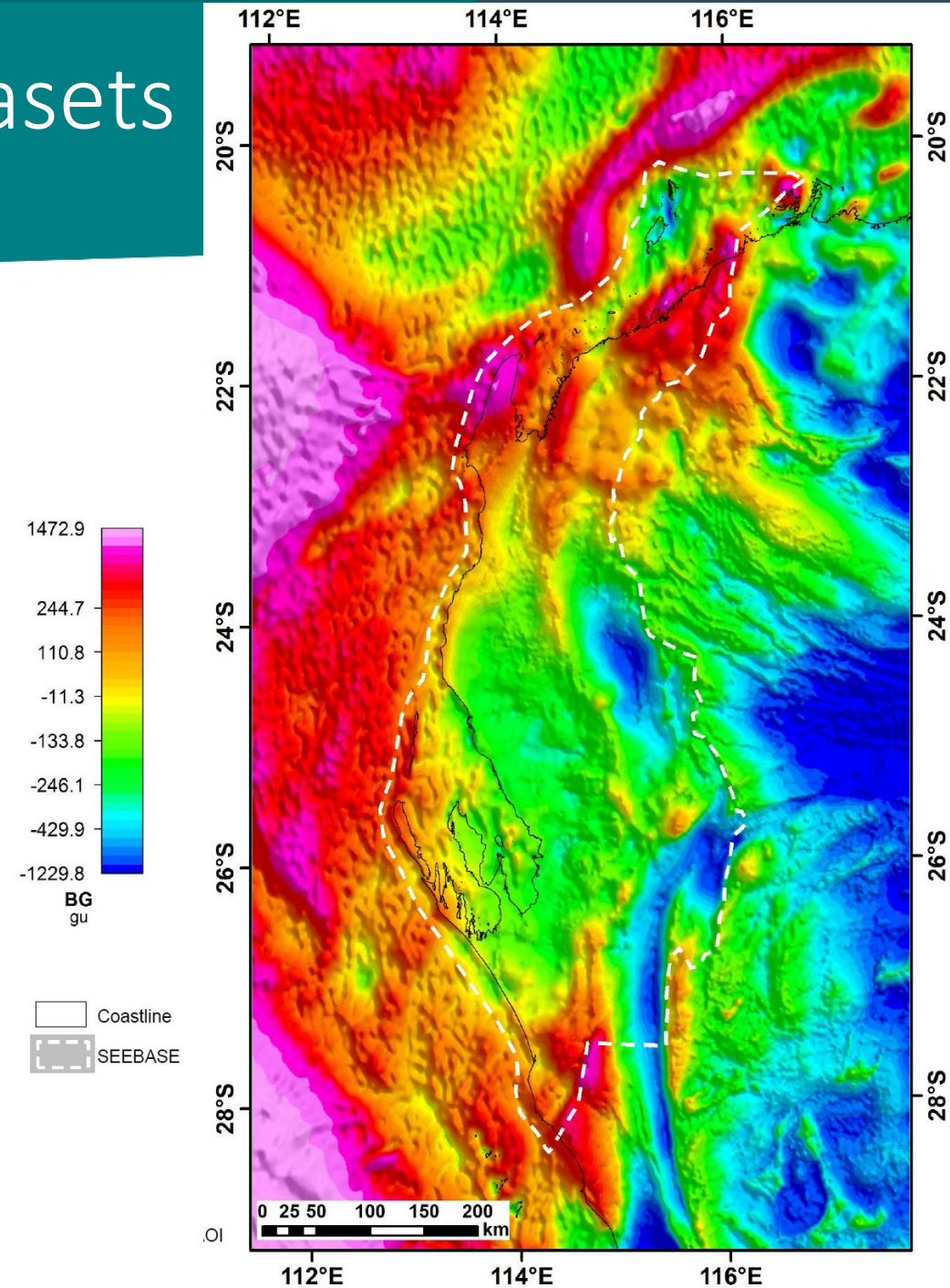
← 'Calibration' datasets

Surface geology / wells / seismic

# SEEBASE grid construction datasets

## Gravity

- Measures changes in the Earth's gravitational field caused by variations in density of rocks
- Sources of data:
  - Onshore - airborne and ground gravity data
  - Offshore - satellite gravity data
- Assuming a density contrast between basement and sediments, gravity data can be used to model depth-to-basement

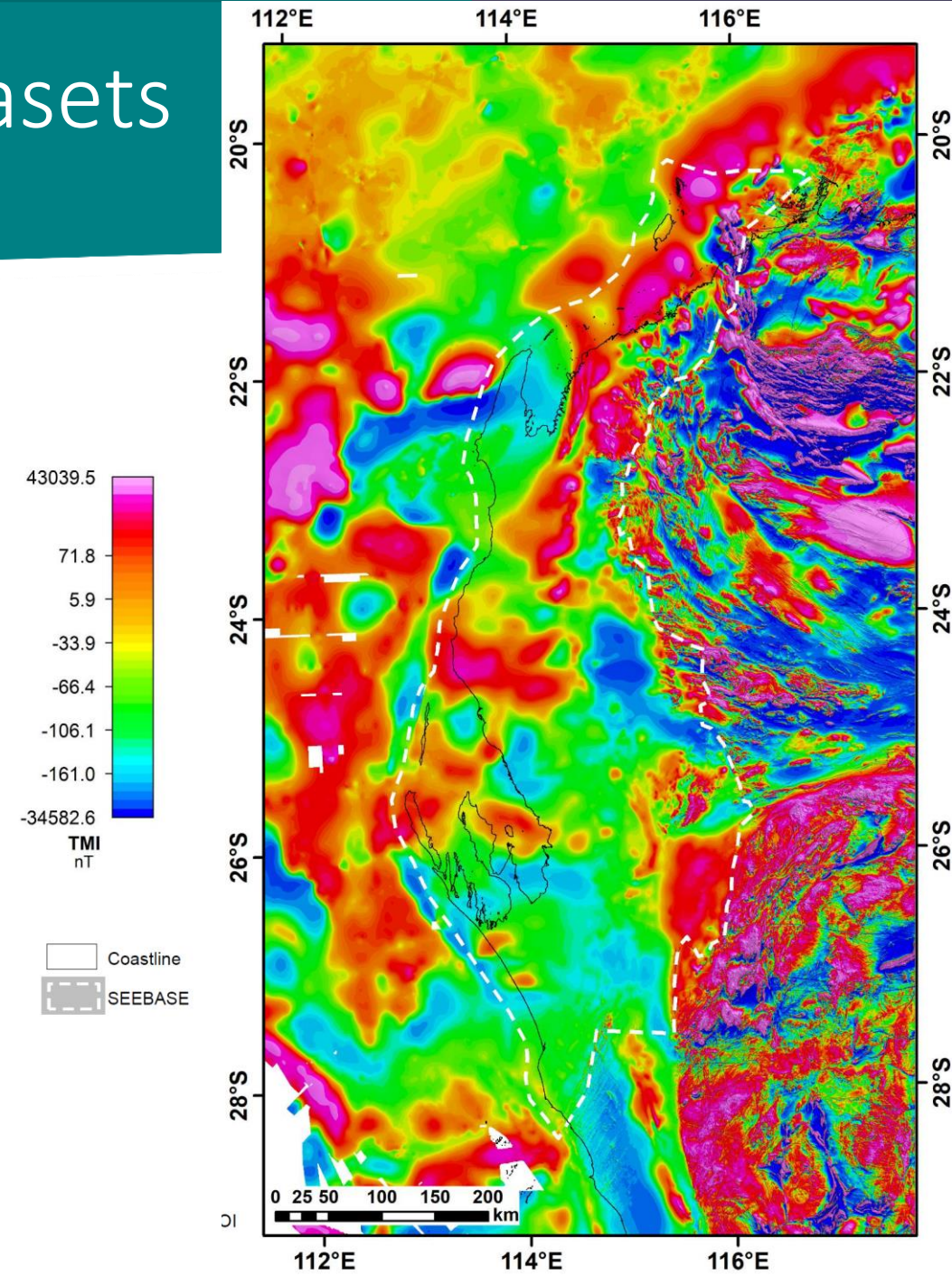




# SEEBASE grid construction datasets

## Magnetics

- Measures variations in Earth's magnetic field caused by differences in magnetic susceptibility of rocks
- Sources of data:
  - Onshore - company-submitted and State Government aeromagnetic data
  - Offshore – shiptrack data and company aeromagnetic data
- Basement lithologies generally have stronger magnetic signatures than basin sediments, therefore magnetic data can be used to model depth-to-basement

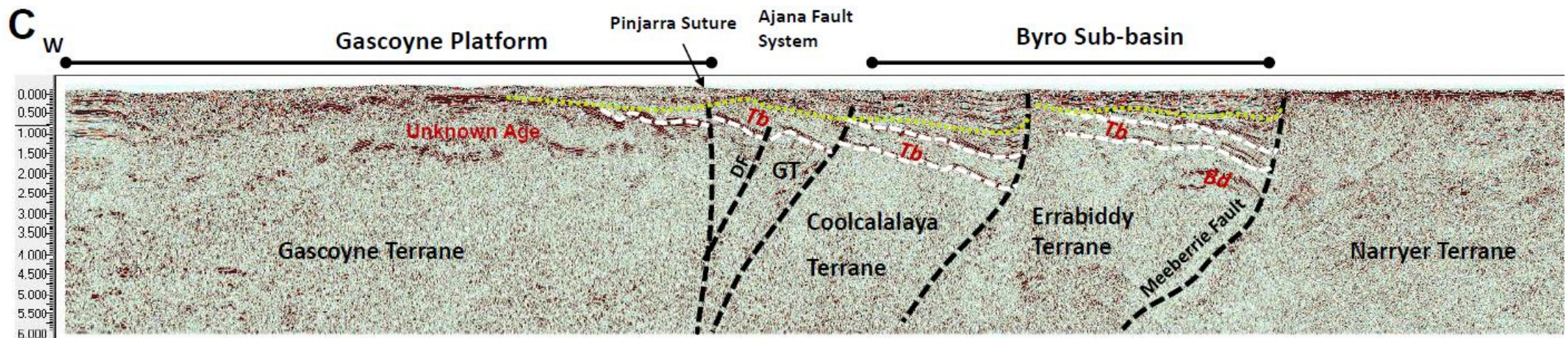




# SEEBASE grid construction datasets

## Seismic & wells

- Wells & seismic provide calibration for depths to basement determined from gravity & magnetic data
- Well basement intersections = hard constraints on depth to basement
- Seismic = soft to hard constraint depending on data quality & interpretation confidence

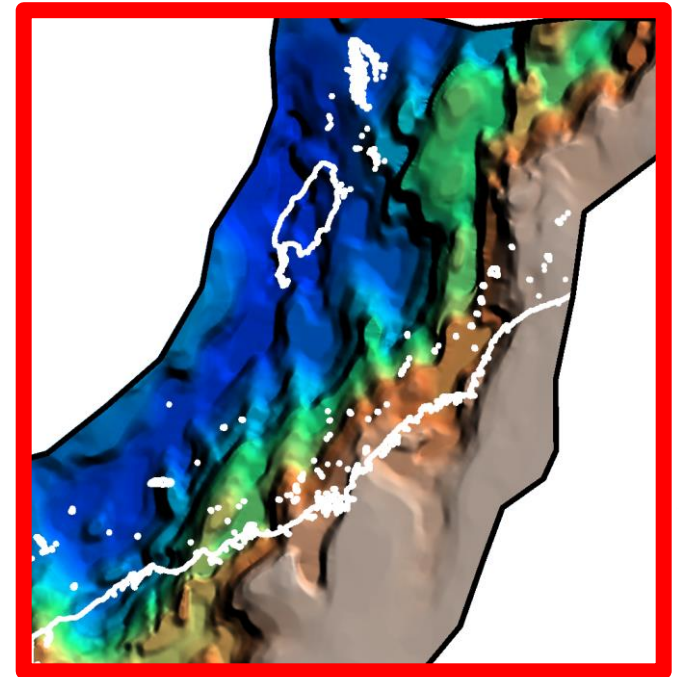
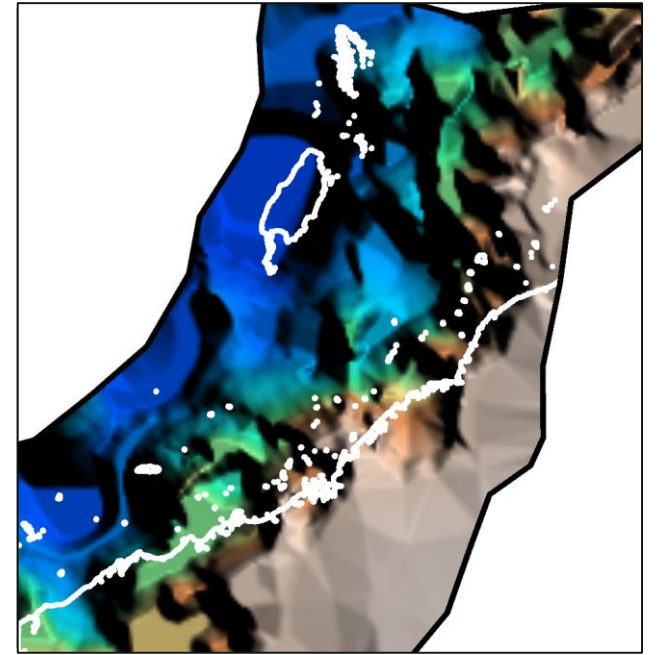
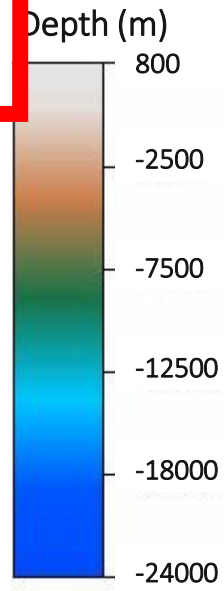
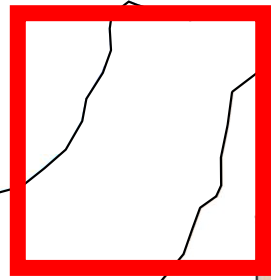
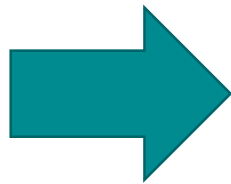




2005



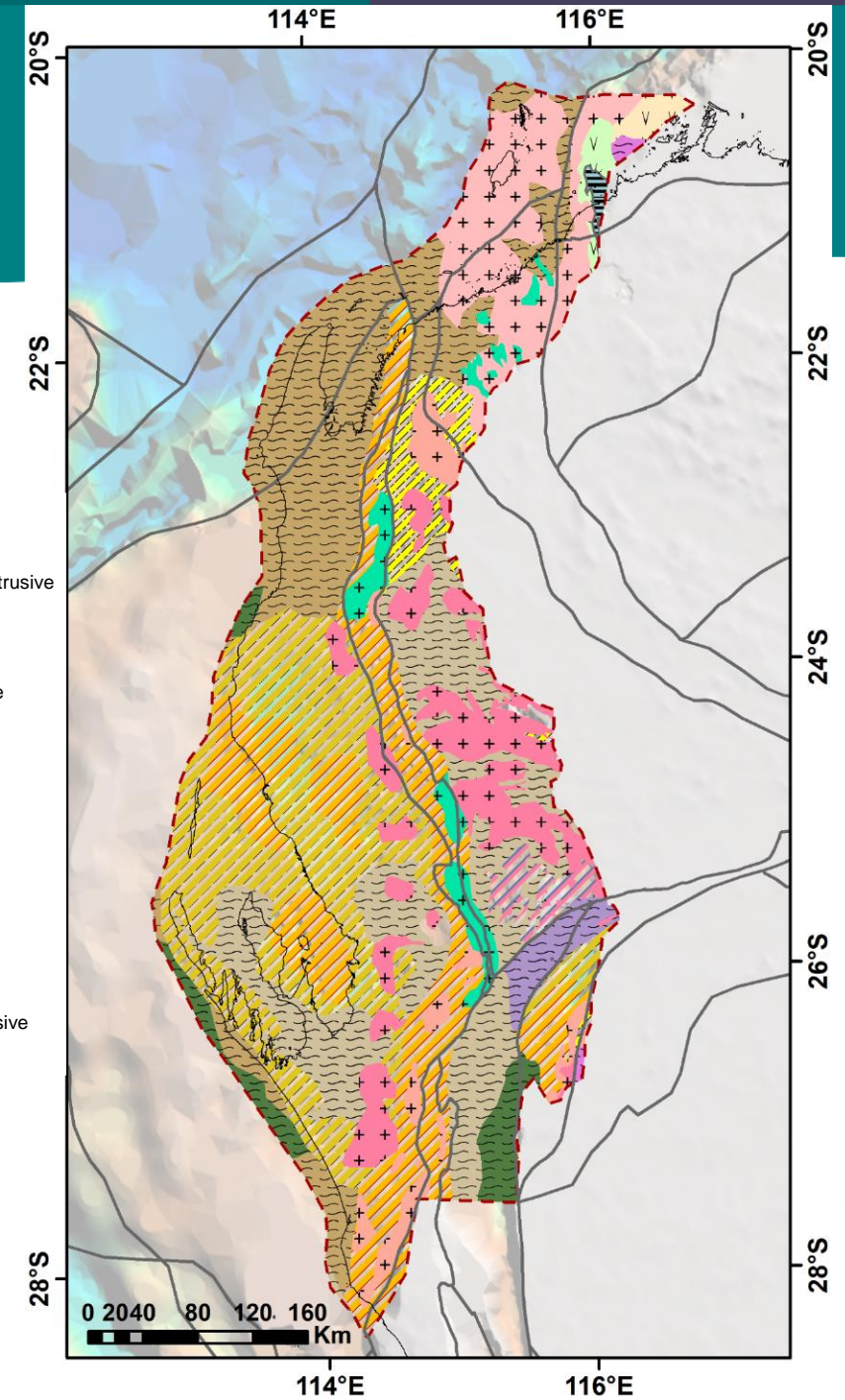
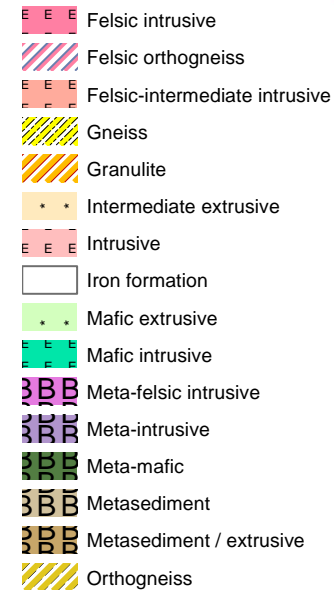
2018





# Basement lithology

- Map of predicted basement lithology
- Basement lithology has implications for heat flow





# How can I get it?

## DMIRS eBookshop

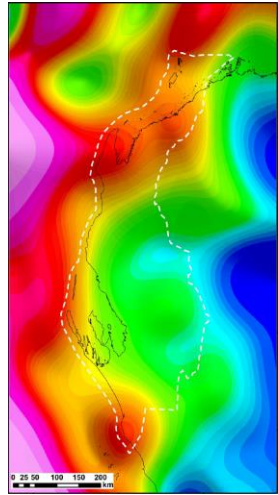
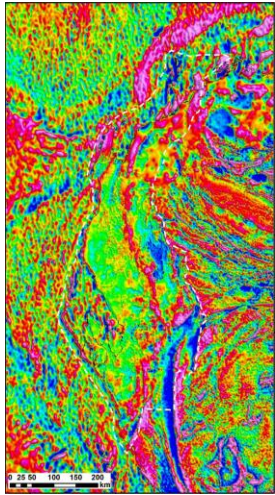
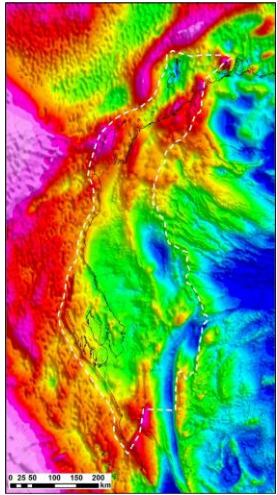
- Report and ASCII grids free download
- ArcGIS USB package order form

The screenshot shows the DMIRS eBookshop website. At the top, there is a navigation bar with the Government of Western Australia logo and the text "Government of Western Australia Department of Mines, Industry Regulation and Safety eBookshop". A search bar is located on the left, and a shopping cart icon is on the right. Below the navigation bar, there is a search bar with the text "Search keyword, title, author, locality" and a "Go" button. A "Categories" menu is on the left, listing various book types such as "Book series", "Explanatory notes", "Non-series books and articles", "Geological map series", "Regolith geochemical maps", "Geophysical maps", "Other maps and atlases", "Data packages", "3D geology", "Virtual tours", and "Posters and flyers". The main content area features a "Featured Books" section with the text "All books available as free PDFs". Five book covers are displayed, each with a title and a "Downloadable file" link. The books are: "Regional seismic interpretation and structure of the southern Perth Basin", "Petroleum geochemistry and petroleum systems of the Perth Basin", "Gemstones of Western Australia second edition", "The Cryogenian Aralka Formation, Amadeus Basin: a basinwide biostratigraphic correlation", and "Metamorphic history of the Mougoderra Formation, Yilgarn Craton, Western Australia".

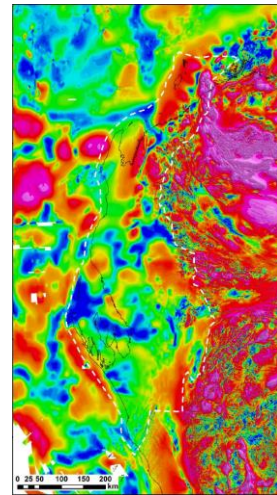
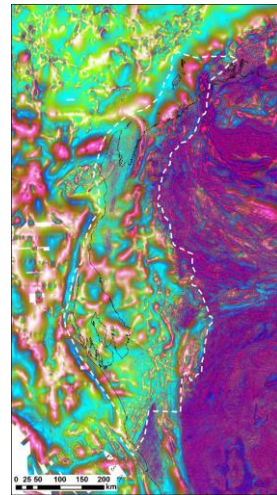
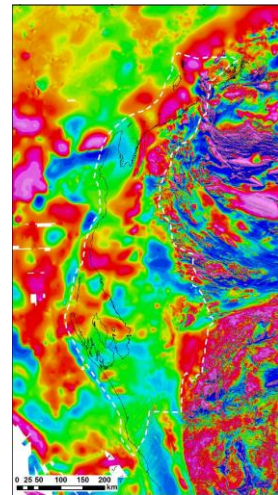
<http://www.dmp.wa.gov.au/ebookshop/>



# Other included datasets – ArcGIS package



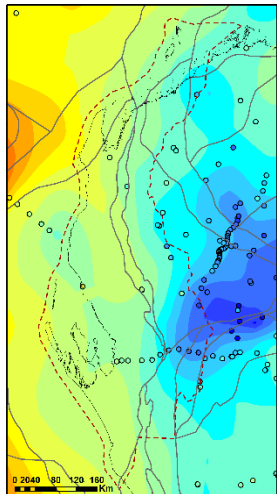
Processed gravity datasets



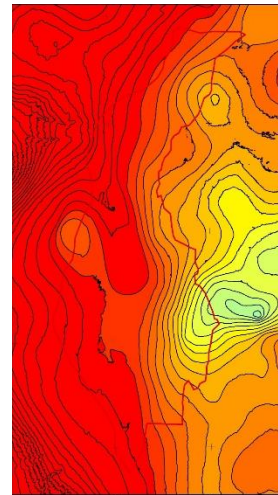
Processed magnetic datasets



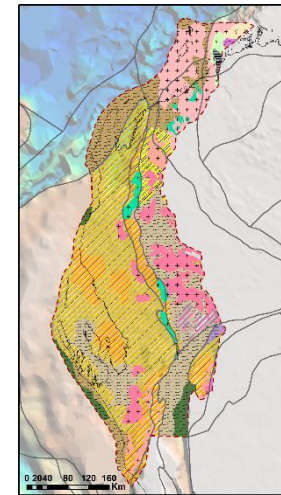
Digital Elevation Model



Crustal thickness



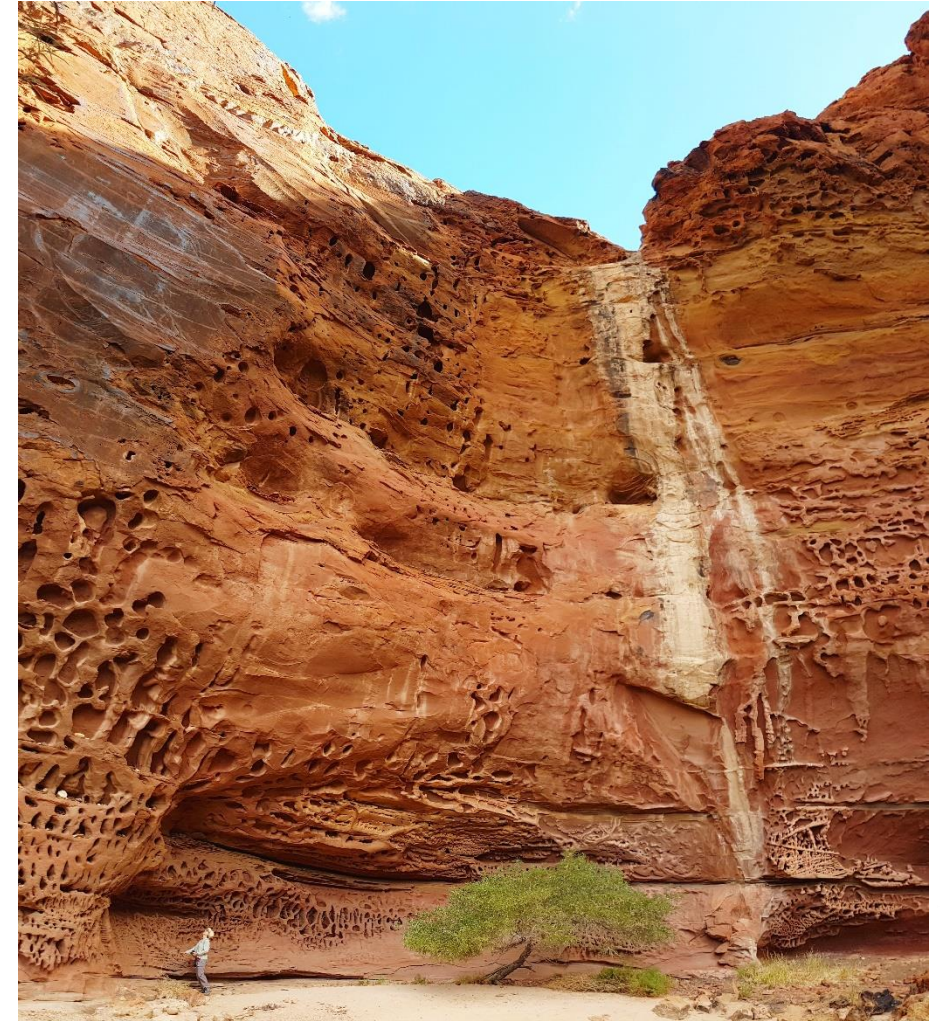
Depth to Moho



Interpreted basement lithology



# Other Carnarvon Basin projects





# Lower Permian Byro Group stratigraphic reassessment, Southern Carnarvon Basin

- Up to 1500 m thick; about 50% consists of carbonaceous mudstone
- Biostratigraphic control indicates a general Artinskian–Kungurian age, but is poorly constrained
- Seismic interpretation and more detailed fossil studies are needed & underway



# Lower Permian Byro Group stratigraphic reassessment, Southern Carnarvon Basin



- GSWA has a rich collection of marine Permian macrofossils from the Carnarvon Basin, held in the Paleontology collection at the Carlisle Core Library
- Macrofossils could provide additional support to age determinations
- Useful in correlating outcrop and subsurface successions



# Permian source rocks

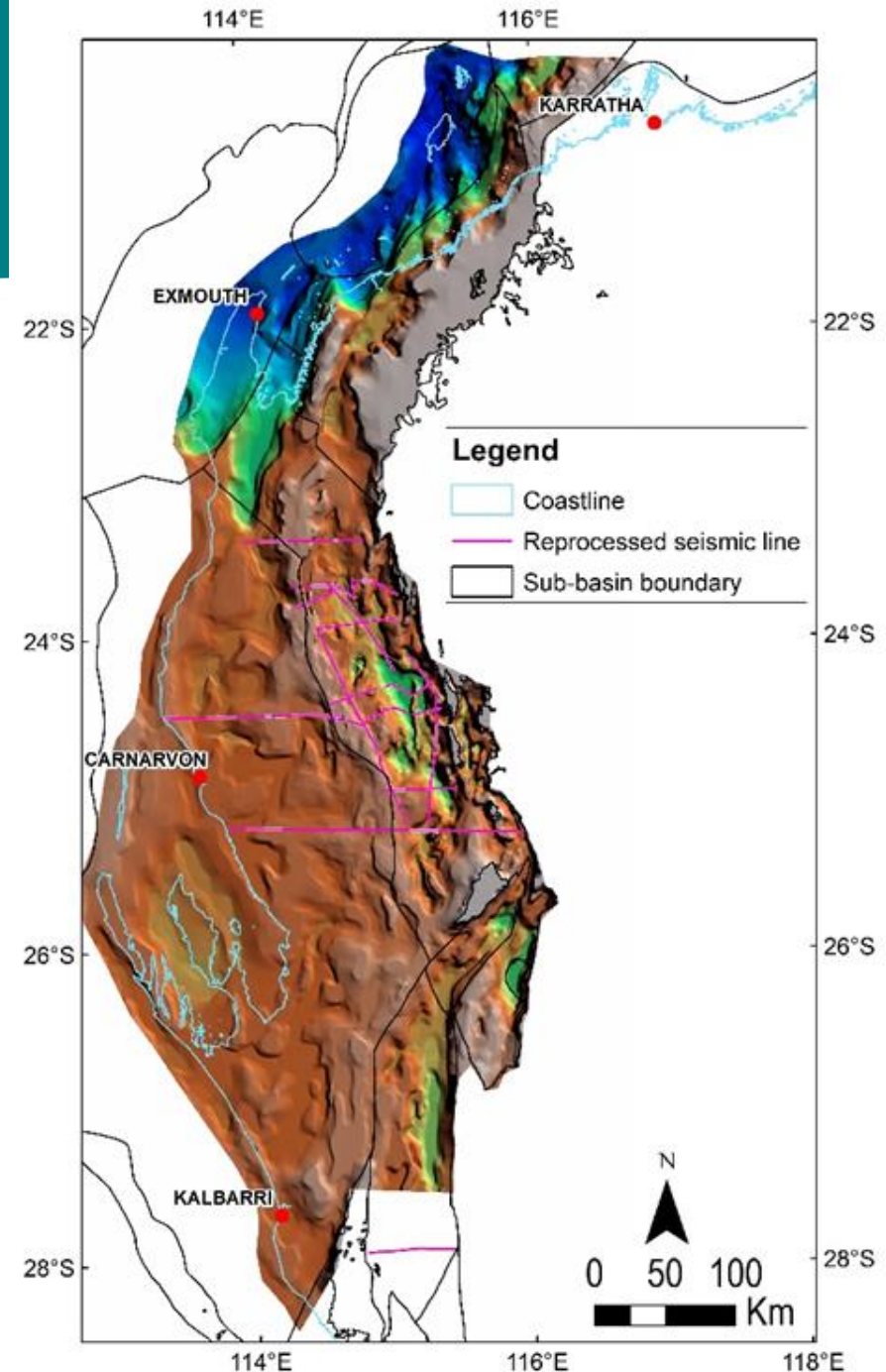
- New sampling of coal exploration drillcores & outcrop for source rock characterisation
- Rock-eval & TOC results confirm that Lower Permian source rocks in the Southern Carnarvon Basin have good gas-generating potential



TOC: 5.96 %  
S2: 5.96 mg HC/g

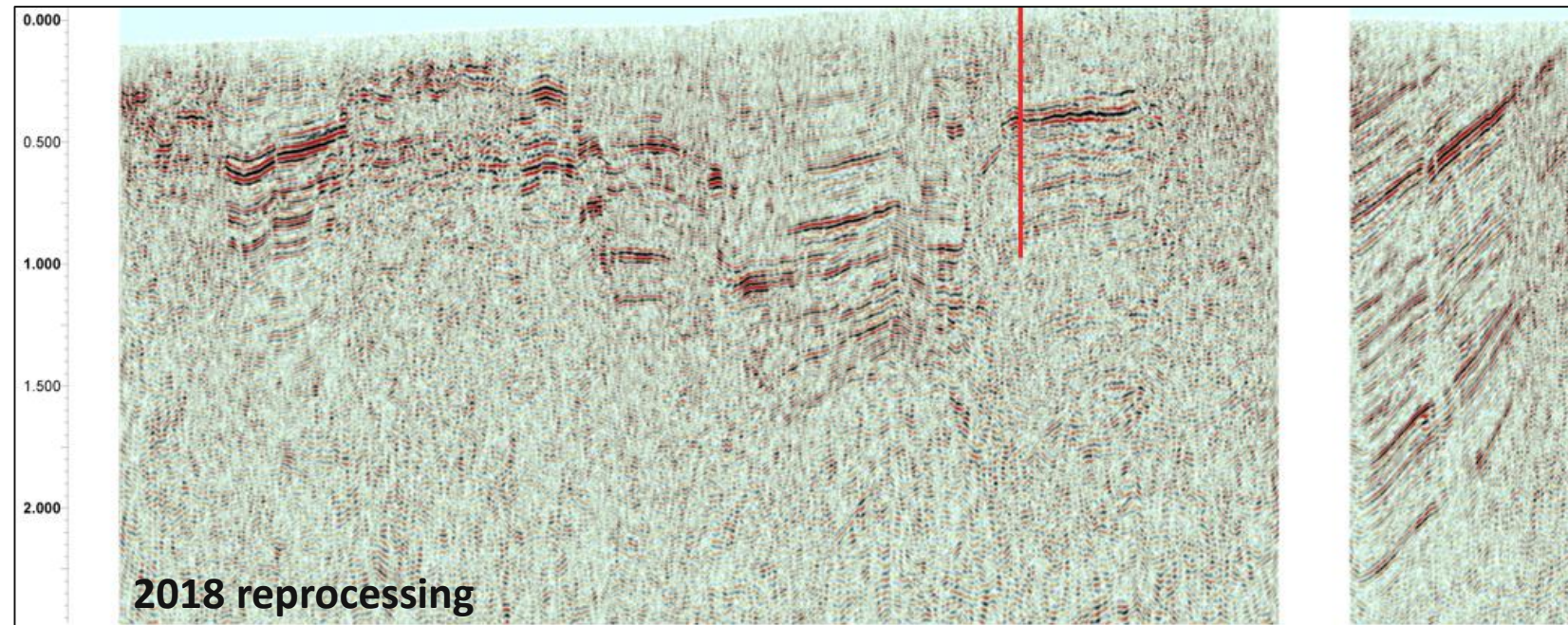
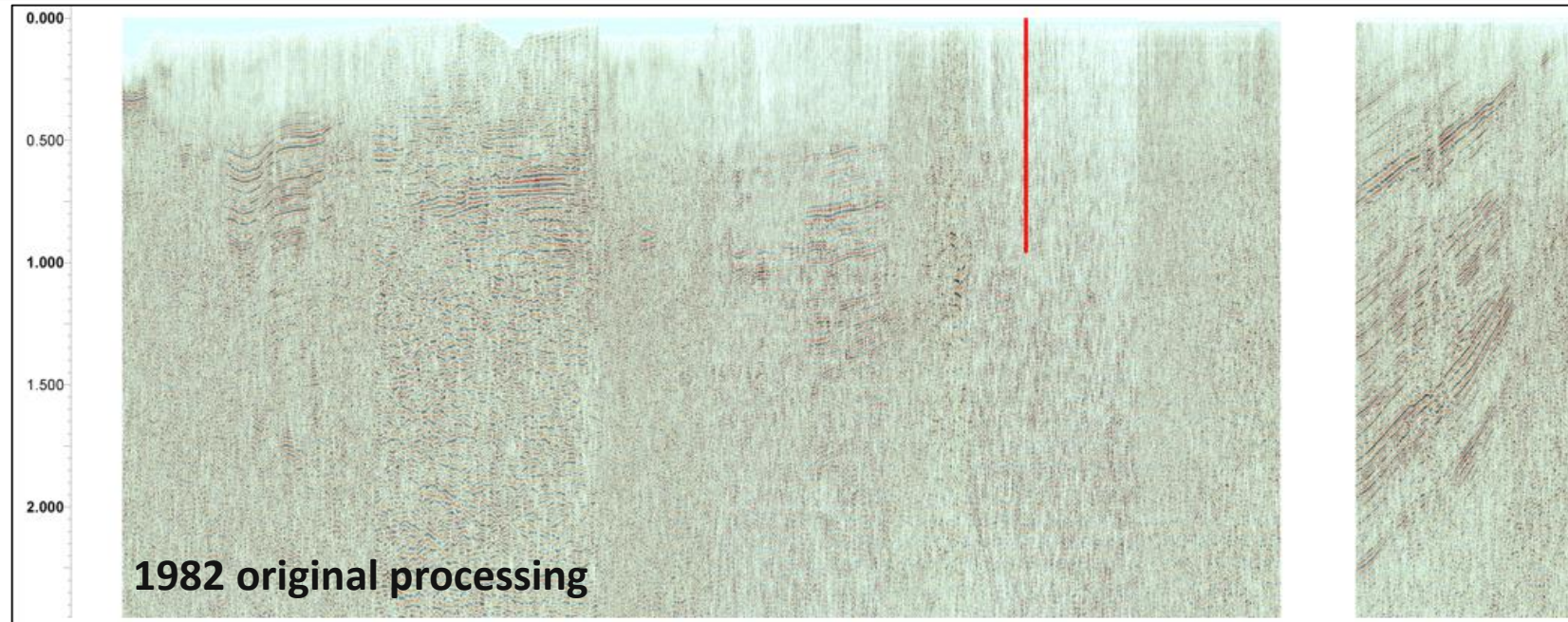
# Seismic reprocessing

- Southern Carnarvon Basin underexplored
- ~ 1400 km of 2D seismic were reprocessed in the Southern Carnarvon Basin
- Seismic lines chosen:
  - over the deepest parts of the basin (Merlinleigh Sub-basin)
  - traversed deep/important petroleum wells
  - long regional lines

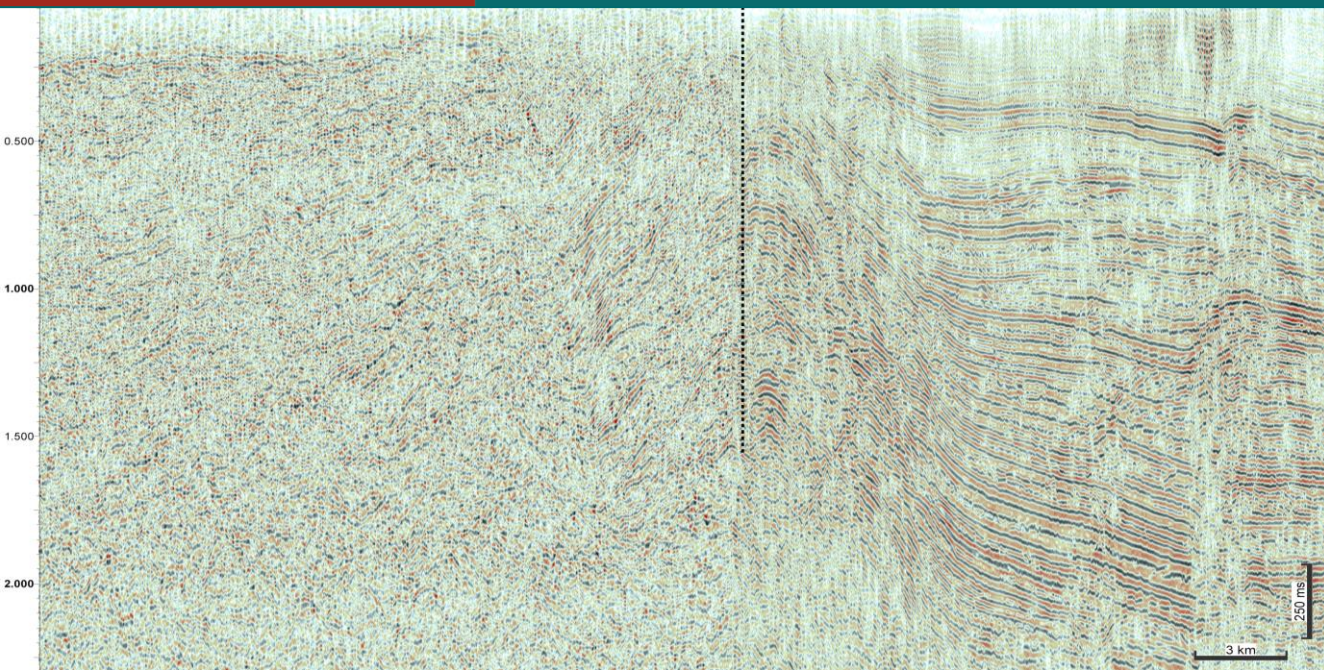




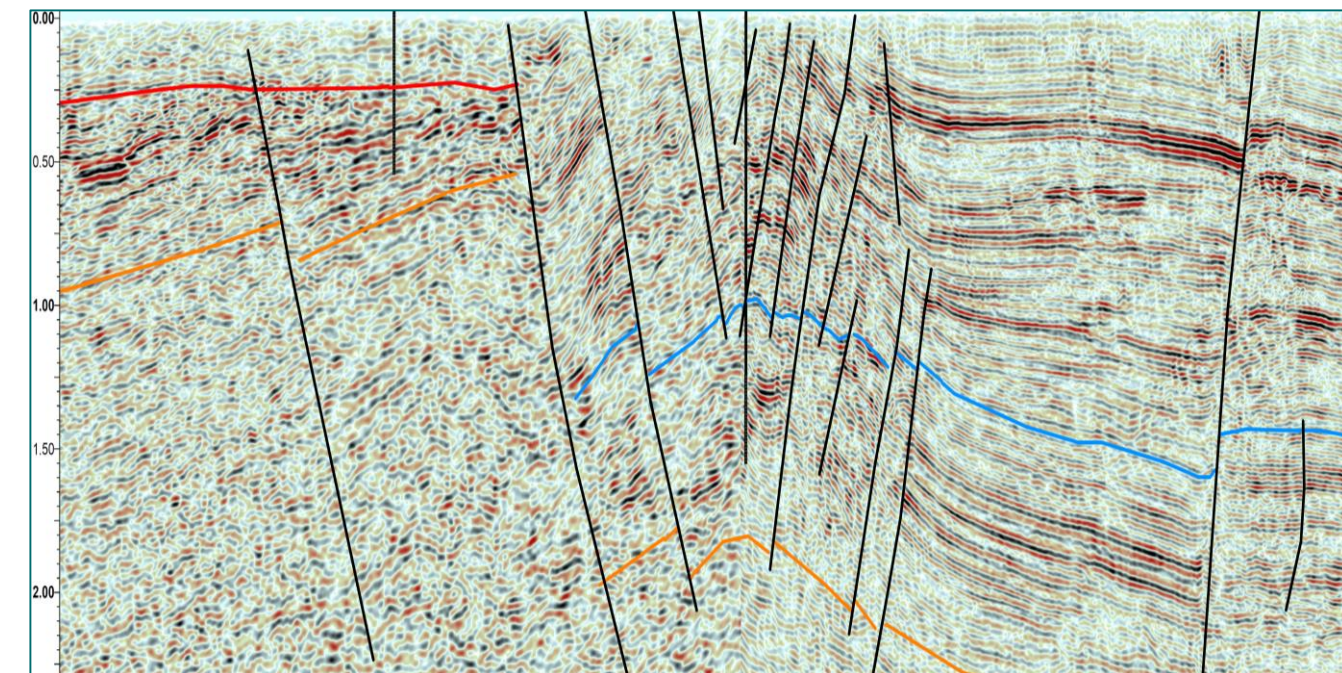
- W-E composite seismic section through Kennedy Range 1 well
  - only well in Merlinleigh Sub-basin to have intersected hydrocarbon shows







- W-E composite seismic section through Quail 1 well
  - Deepest well in Merlinleigh Sub-basin
  - Sharper imaging of faults





# Conclusions

- EIS-funded Carnarvon Basin SEEBASE project has seen significant refinement in predicted basement depth compared to 2005 version
- EIS-funded seismic reprocessing has provided better data for future interpretation projects
- More detailed work and new analysis/technology is required to unlock the potential of the Permian of the Northern and Southern Carnarvon Basins