

# National Drilling Initiative - MinEx

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November 2024



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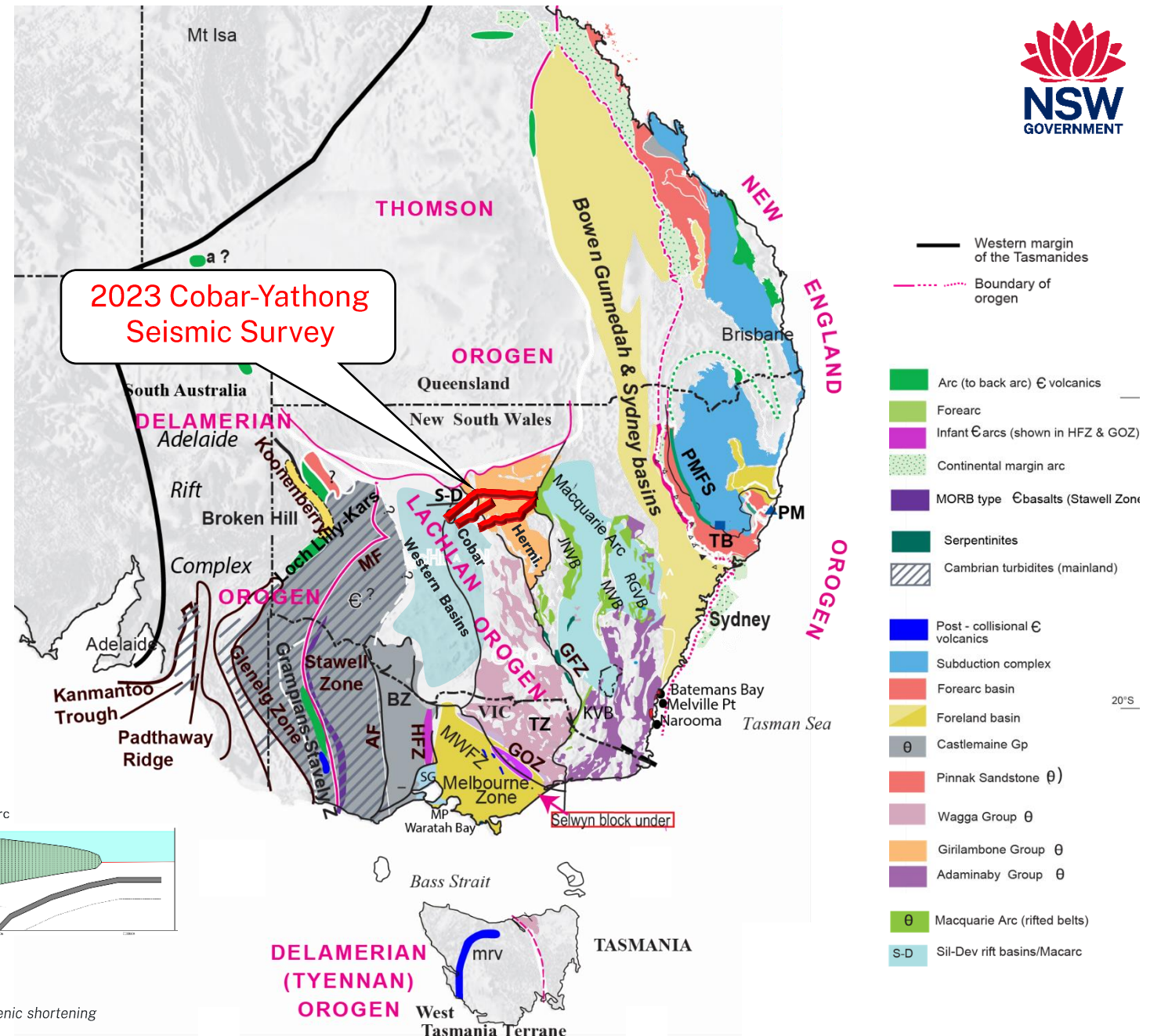
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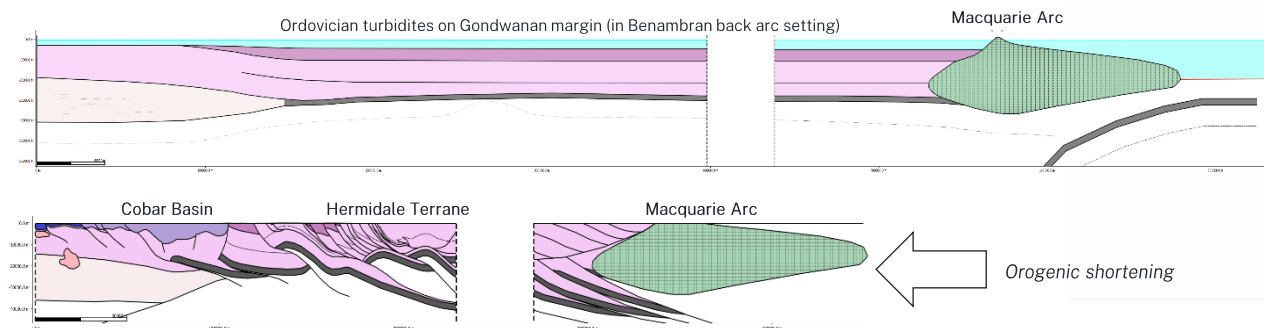


# Geological overview

- Region multiply deformed by the Benambran and Tabberabberan orogenies (and younger events)
- Region contains polymetallic mineral systems + provides context for NSW's premier mineral province, the Macquarie Arc
- Seismic transects across central-western Lachlan Orogen (mostly Ordovician to Devonian rocks)



Evolution: Pre-Benambran Orogeny (ca Late Ordovician) and present day timesteps





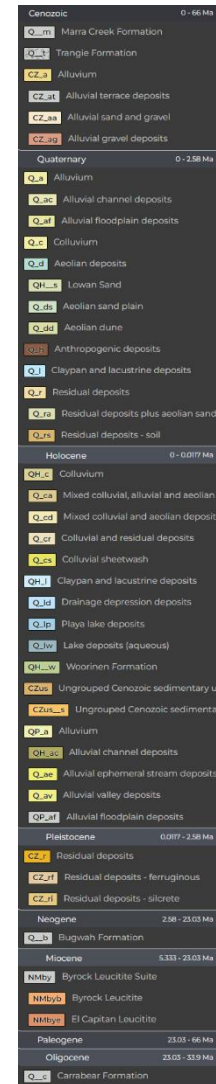
# Geological overview

## Regional Characteristics

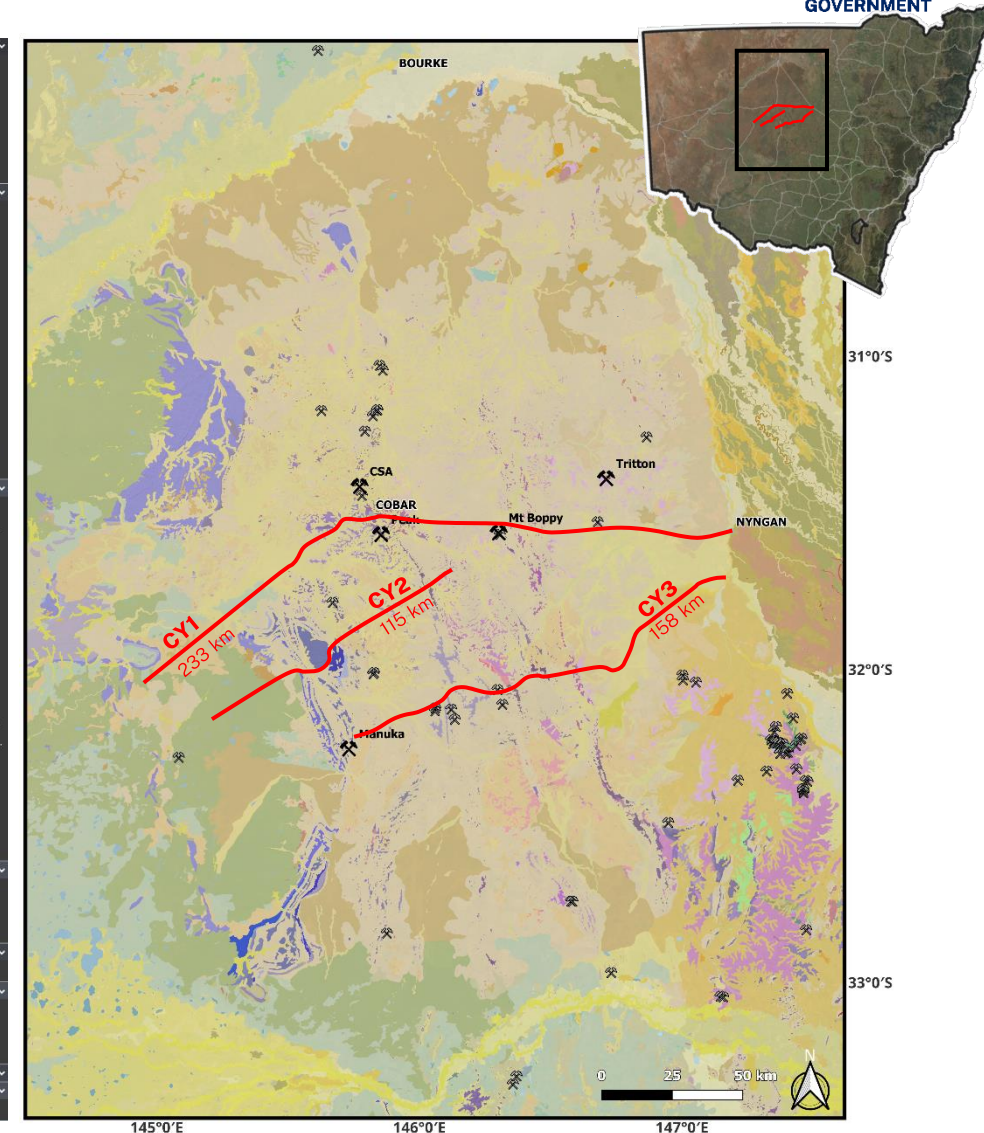
- Extensive Cenozoic sediment cover challenges our understanding of economic basement geology
- Basement outcrop is dispersed and often deeply weathered
- Seismic provides:
  - a means to see through the cover
  - subsurface context for surface observations
  - a crustal-scale tie between geological regions (Hermidale Terrane, Cobar Basin and Western Devonian Basins)



Photo credit: Liann Deyssing



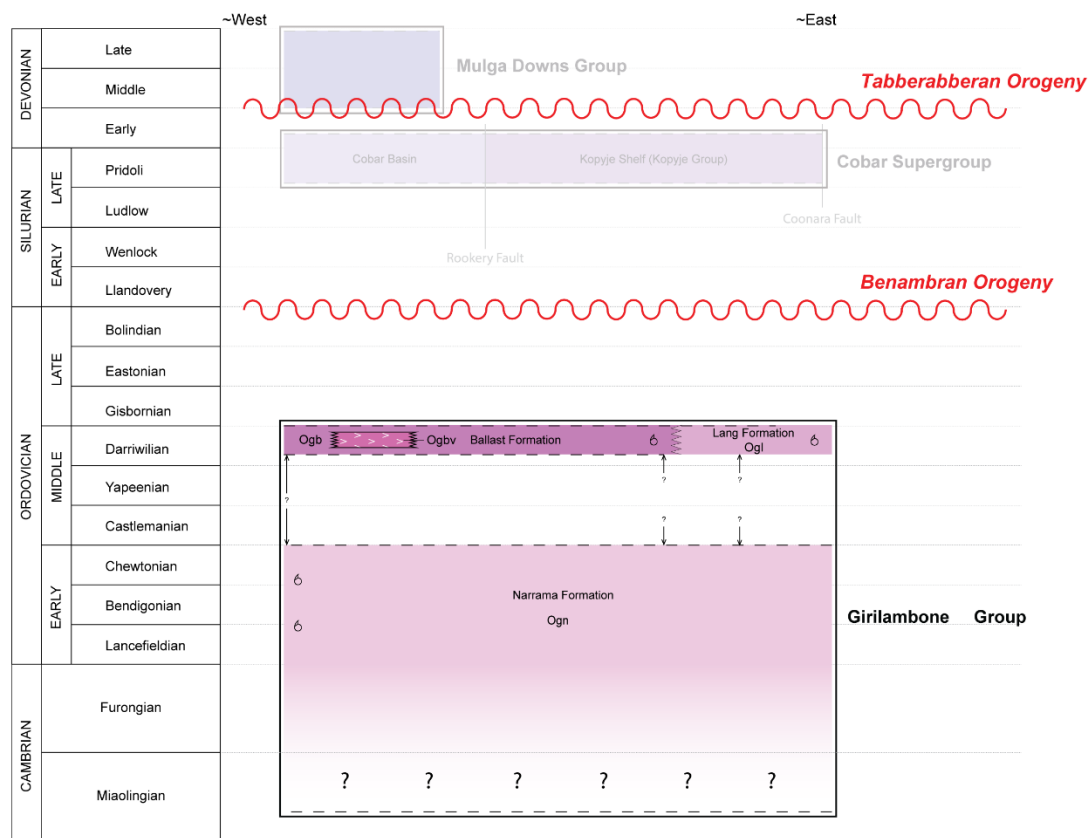
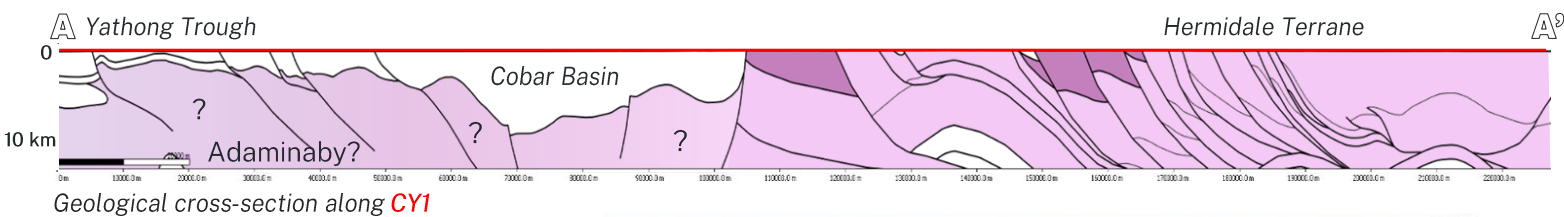
MinView



Seamless Surface Geology

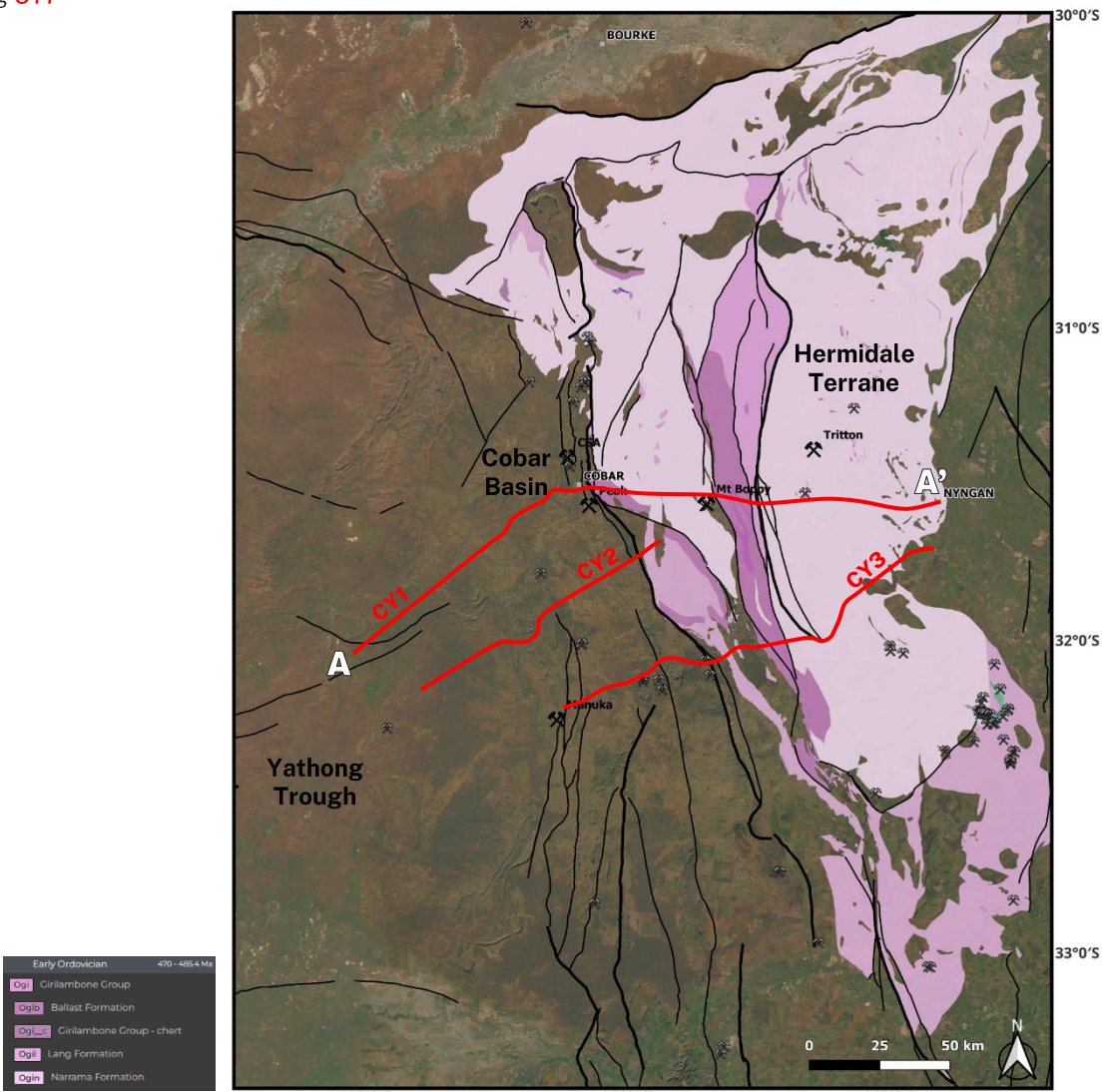


# Geological overview



Time-space plot

Courtesy of Mark Eastlake - modified from Burton et al. (2012)



MinView

Solid Geology: Girilambone Group



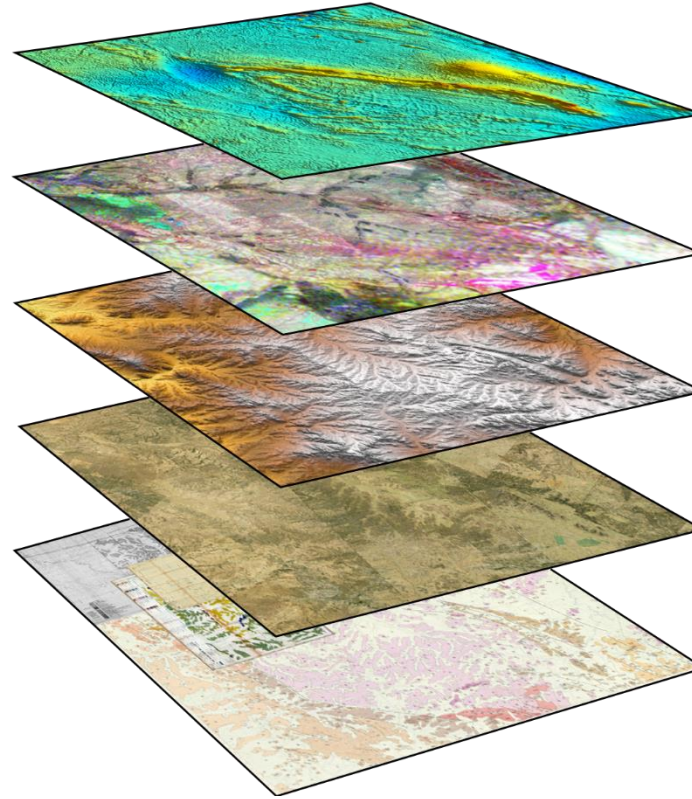
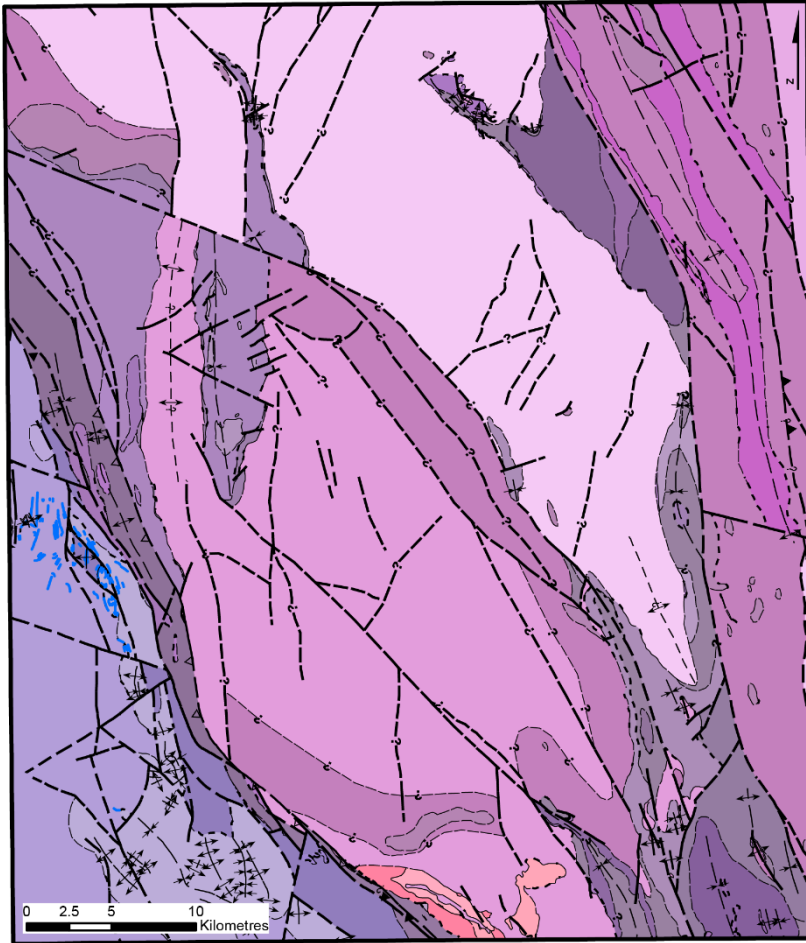
# 1

## Mapping

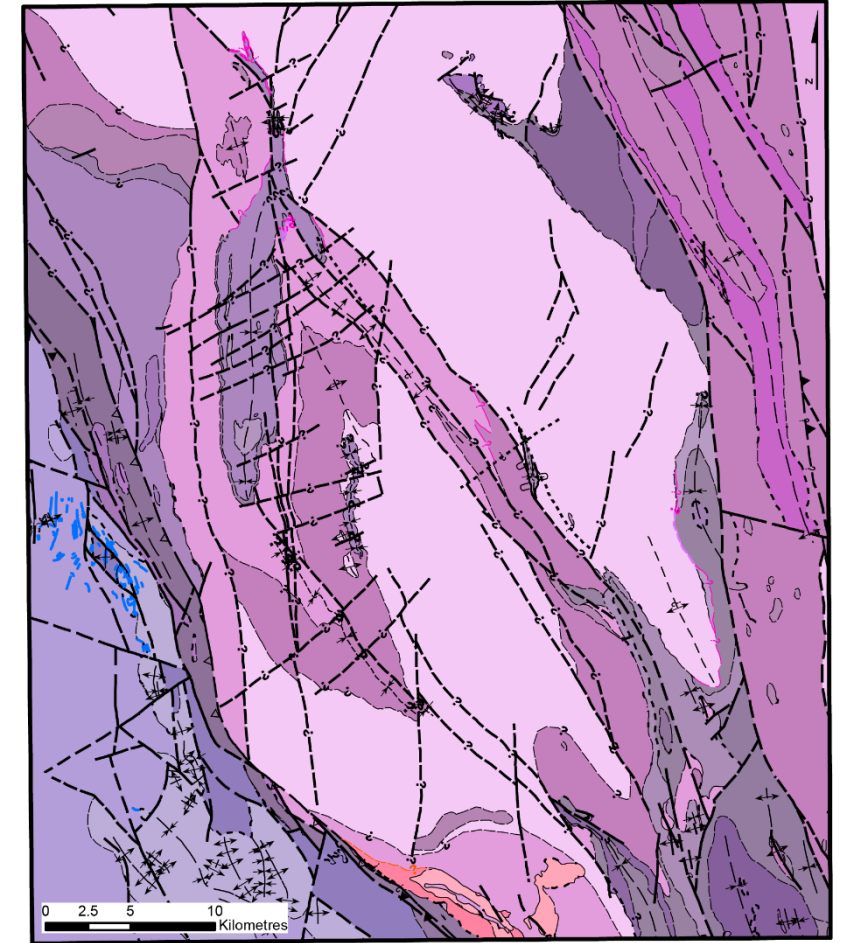


# Canbelego mapping

Existing solid geology



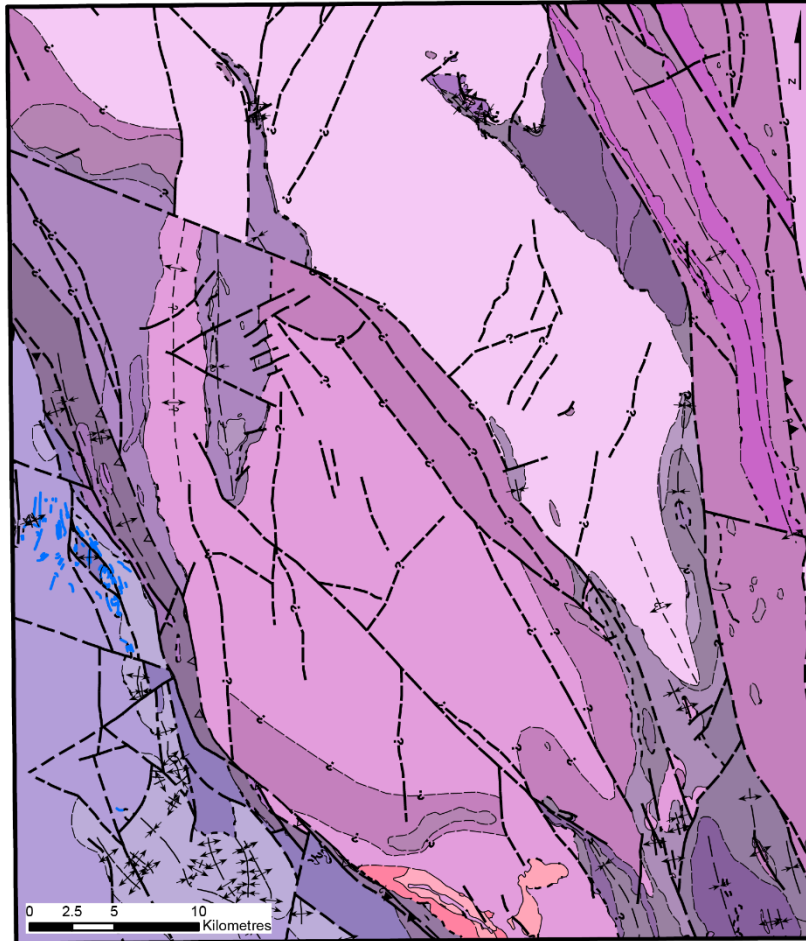
New solid geology



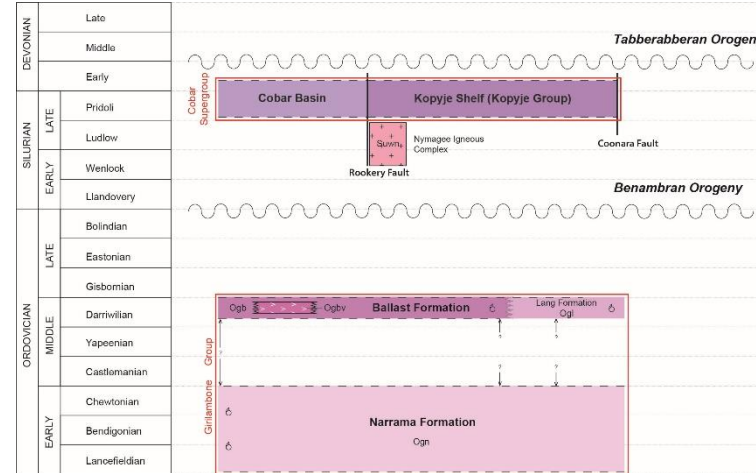
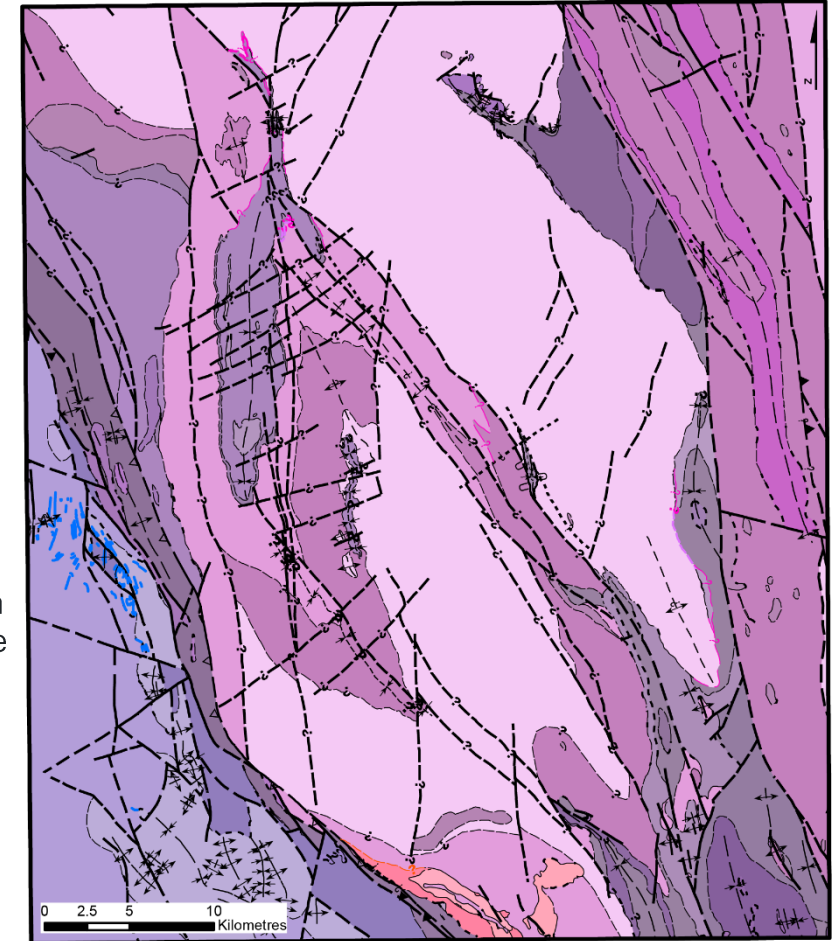


# Canbelego Outcomes

## Existing solid geology



## New solid geology



Time-space plot modified from Burton et al. (2012)

- Shows the distribution of stratigraphy is strongly influenced by two distinct fold-styles
  - Benambran: large-scale, long wavelength, high amplitude folds affecting the distribution of the Girilambone Group
  - Tabberabberan: small-scale, shorter wavelength and lower amplitude folds most influential on the Cobar Supergroup
- New apatite age of  $506.3 \pm 8.8$  Ma obtained from metagabbro in the Narrama Formation
  - suggests deposition of the Girilambone Group commenced in the Cambrian
  - supports development of a large-scale fold geometry in the Girilambone Group during the Benambran Orogeny
  - consistent with crustal architecture imaged by the Cobar–Yathong seismic survey

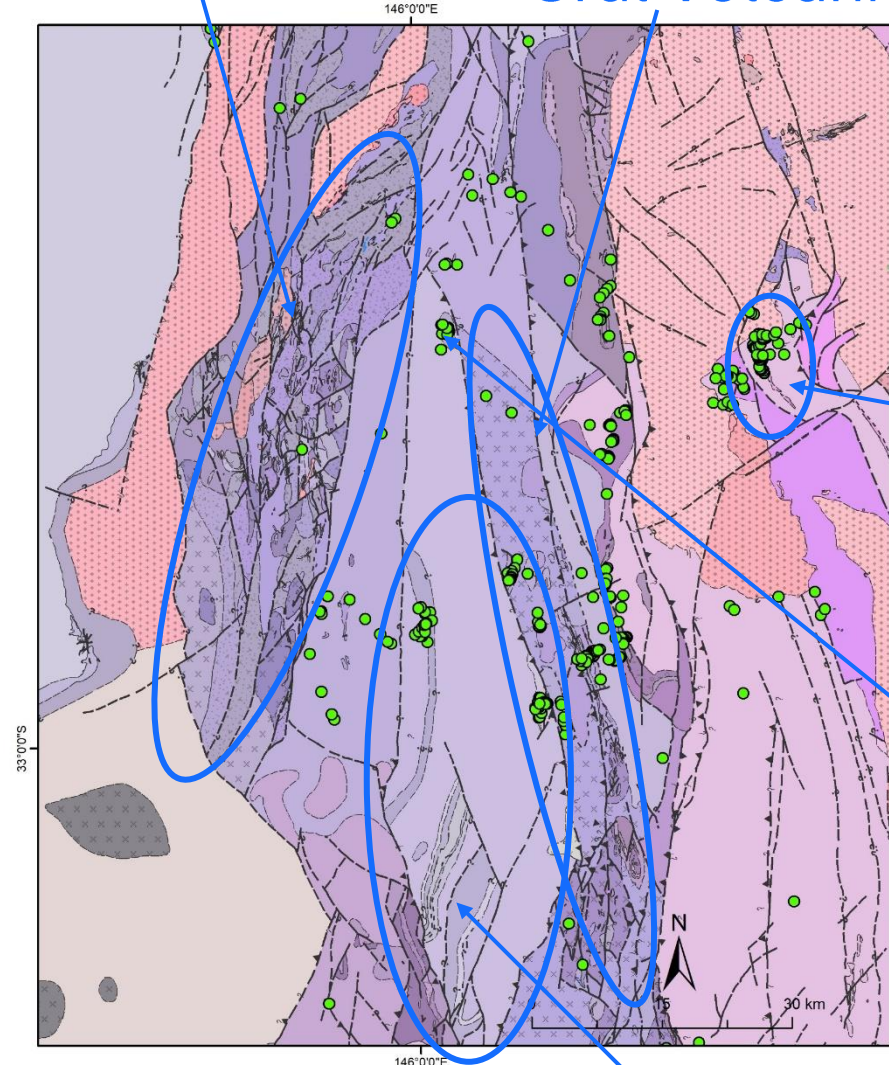


# South Cobar Outcomes

- Upgrade of data and mapping
  - (307 new field observations, NSW Seamless Geology update and report)
- The Marobee Conglomerate continues to be considered to be very probably Ordovician in age
- The Ural Volcanics were proven to be temporal equivalents (latest Silurian to earliest Devonian) of the Mount Hope Group volcanics
- An outlier at Kilparney hill provides evidence the Mulga Downs Group probably extended across the Mt Hope Trough
- The siltstone sequence below Kilparney hill while consistent with Walters Range Group could also be Amphitheatre Group. The latter would call into question the nature of the Walters Range Block.

Mount Hope Group

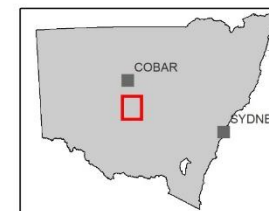
Ural Volcanics



Marobee Conglom.

Kilparney hill

Walters Range Group



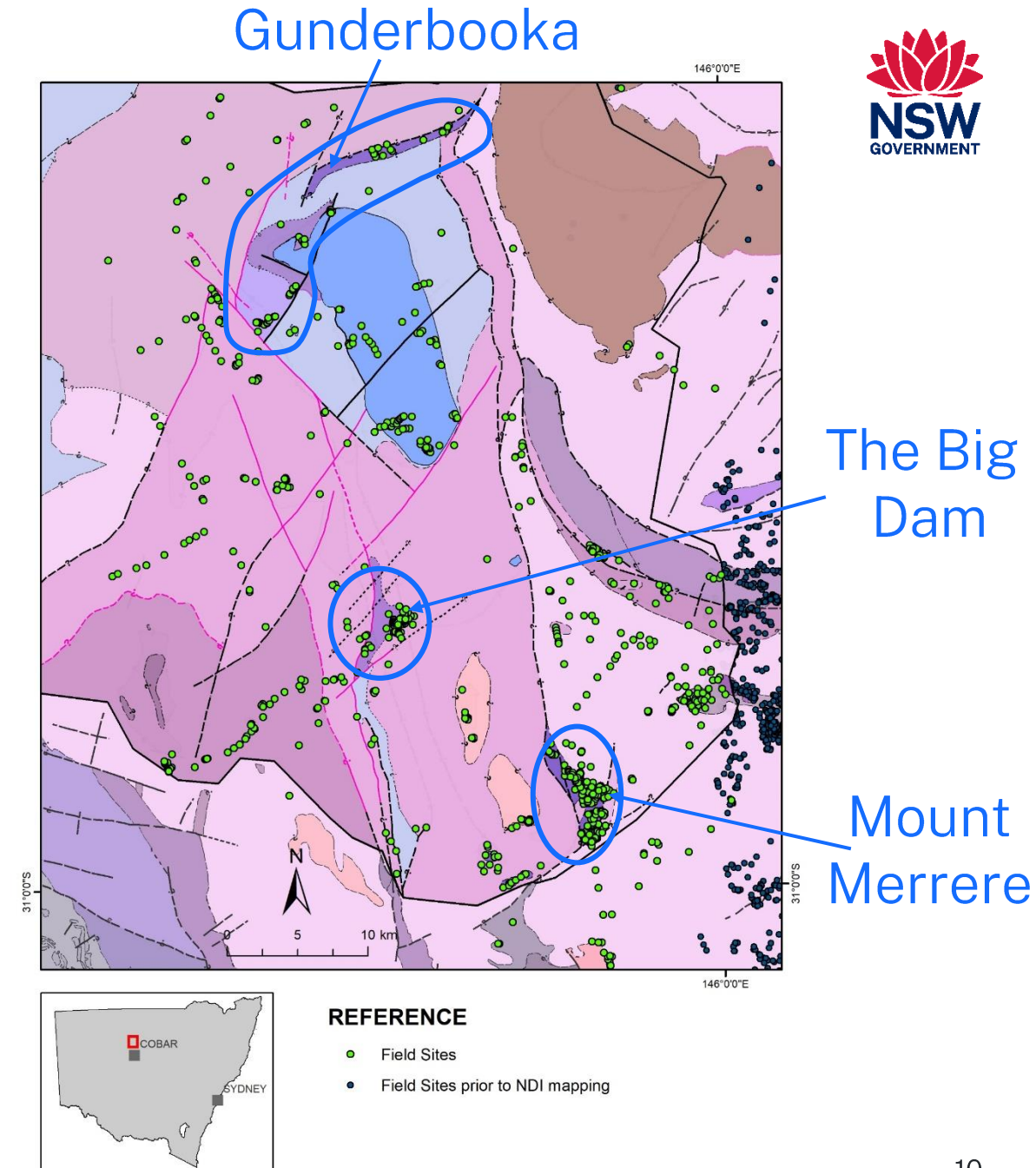
REFERENCE

● Field Sites



# Gunderbooka Outcomes

- Upgrade of data and mapping  
(776 new field observations, NSW Seamless Geology update and report)
- Discovered an area of previously unmapped Cobar Supergroup around The Big Dam
- Confirmed that the conglomerates at the Merrere hills are Cobar Supergroup (not part of the Girilambone Group)
- Possibility that the Cobar Supergroup sequence under Mount Gunderbooka extends from basal conglomerate through to the overlying Mulga Downs Group
- Potential for further unrecognised Cobar Supergroup between The Big Dam and Gunderbooka areas



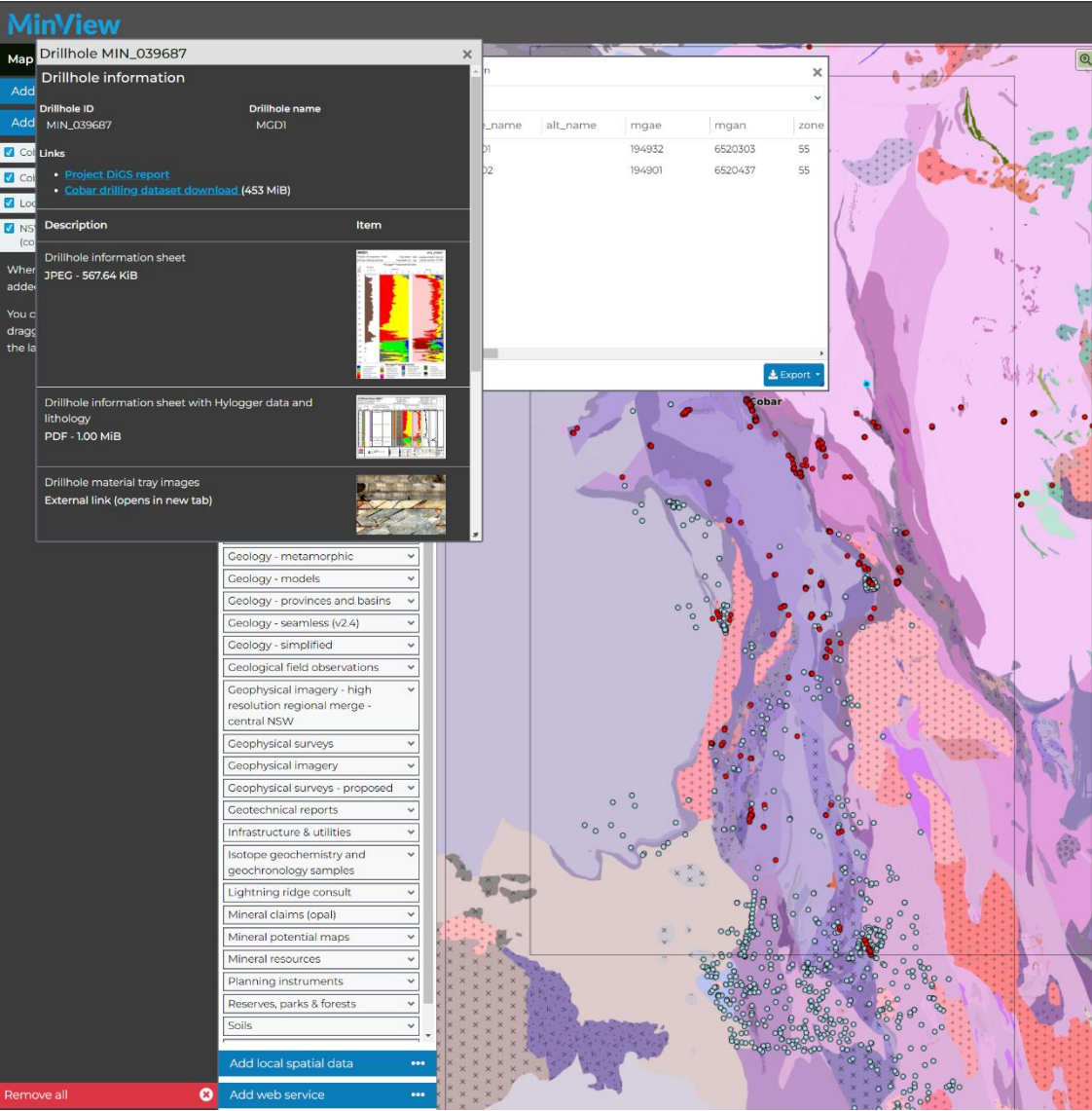
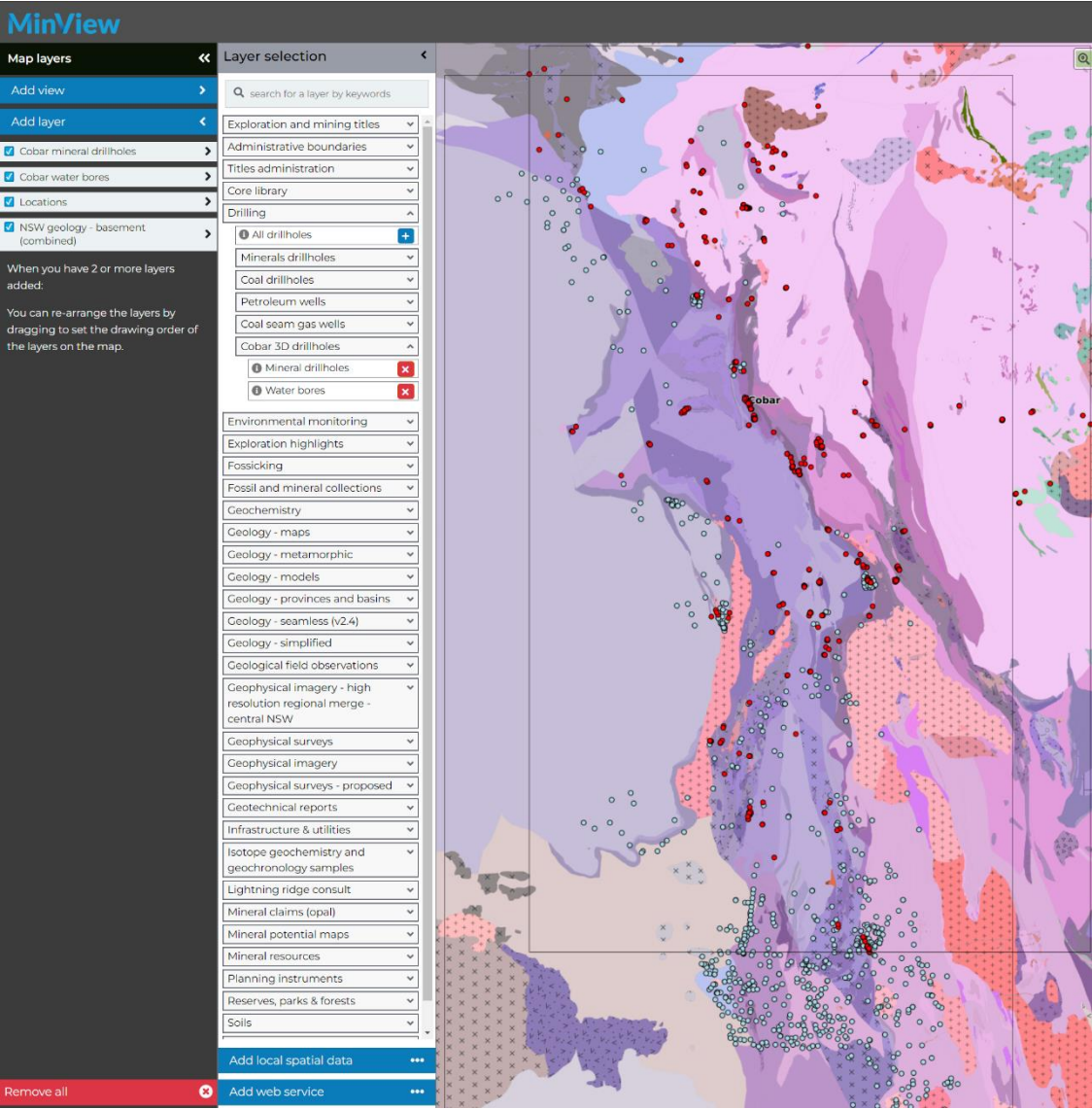


# 2

## Cobar drillhole database

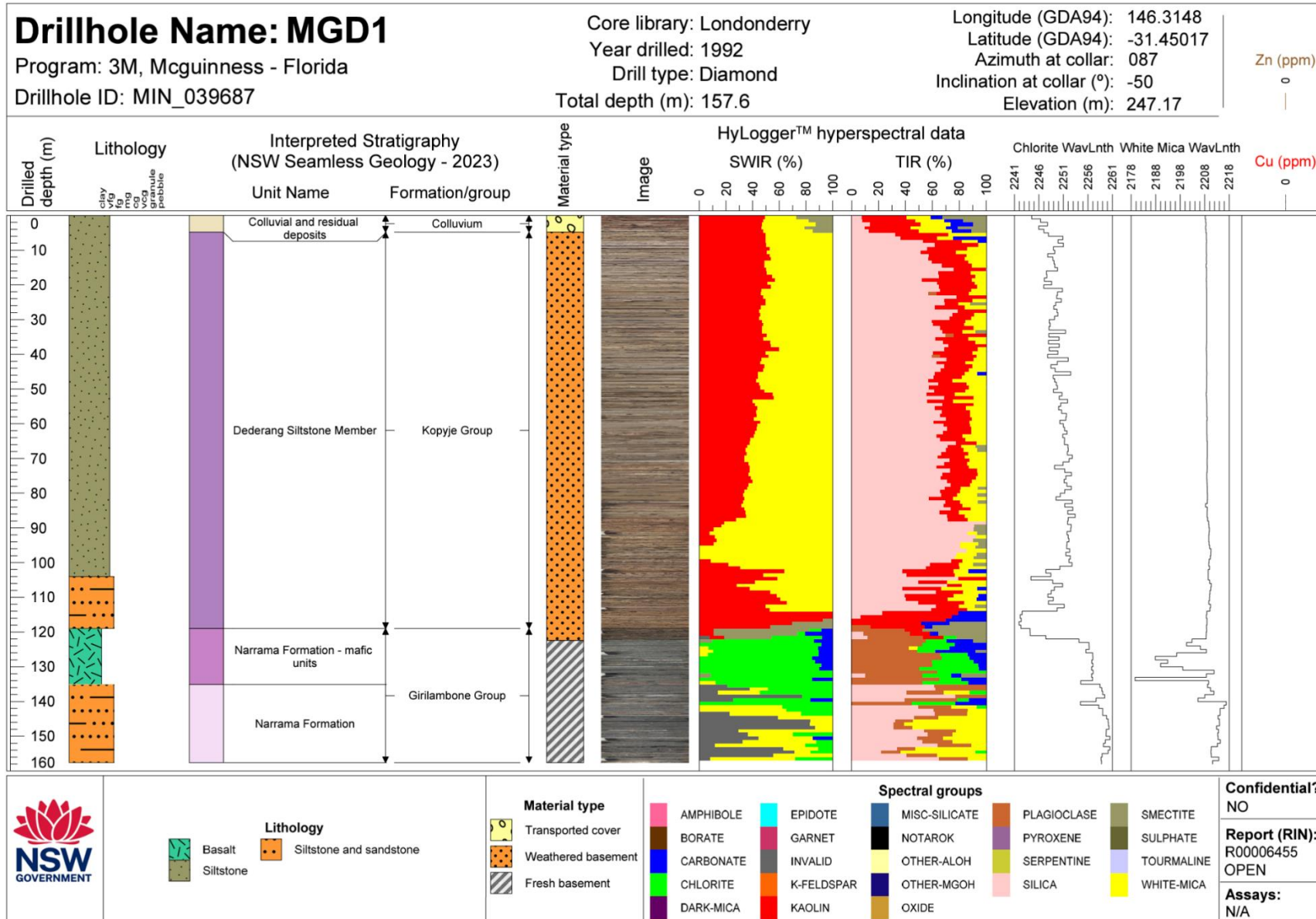


# Cobar drillhole database





# Cobar drillhole database





# 3



## Seismic

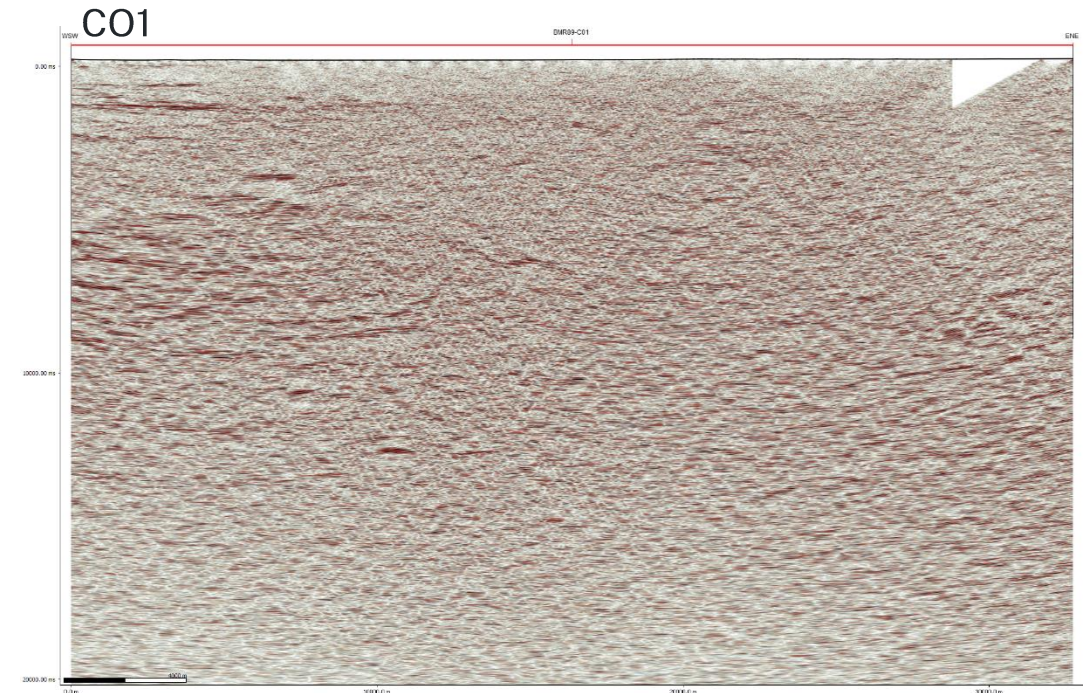
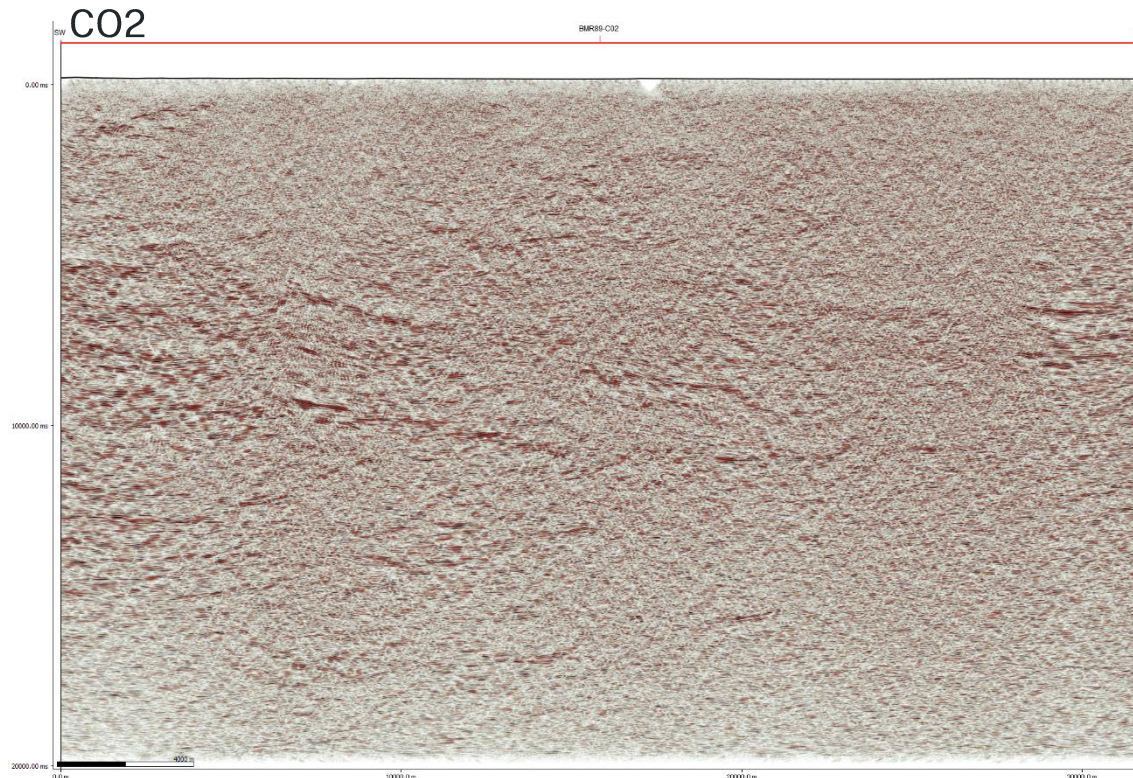
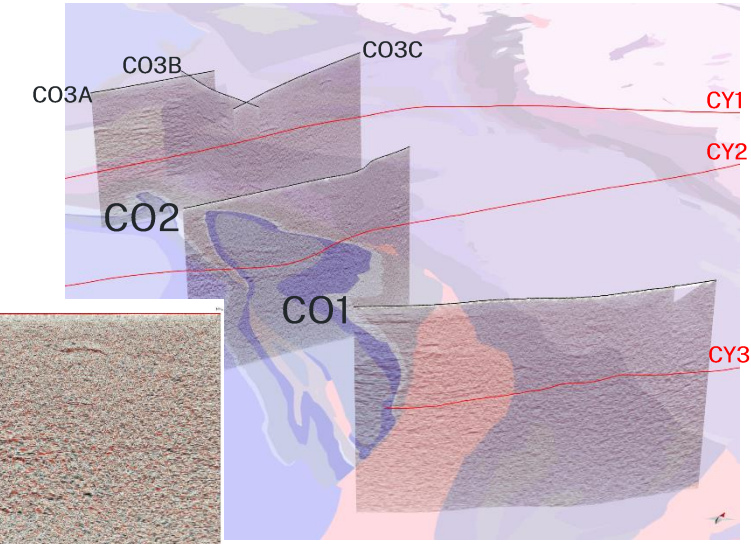
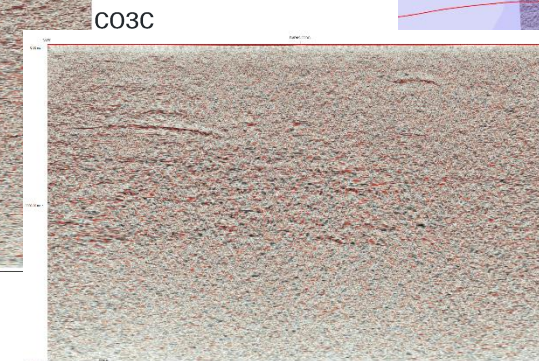
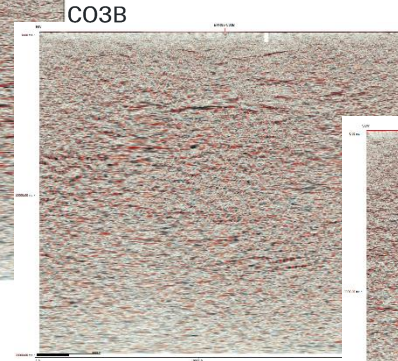
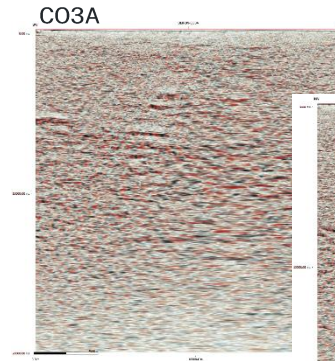




# 1989 Cobar Basin Seismic Survey

*“The major emphasis of the test survey was to assess the feasibility of acquiring shallow and deep seismic reflections in order to examine various geological models of bounding faults and basin structures”*

*Operational Report extract, AGSO (1993)*

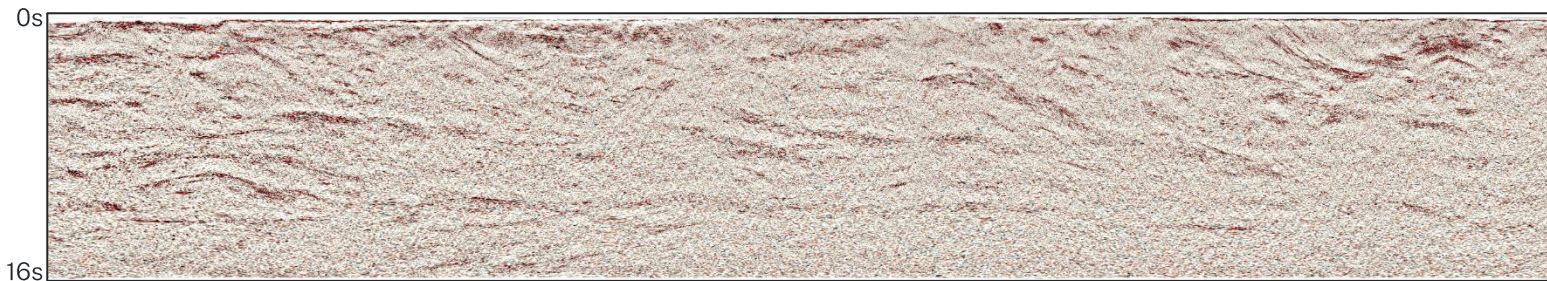




# Seismic acquisition: then and now

	1989 Cobar Basin	23NSW-Cobar-Yathong
Acquisition company	BMR	Velseis
Survey line length	184 km	506 km
Source	10 kg explosives (40 m shothole)	Vibroseis x 2
Source point interval	360 m	20 m
Receivers	String	Nodes
Receiver spacing	60 m	10 m
Receiver spread	~3 km	~12 km
Record length	20 s	16 s
CDP fold	8	600

Source: processing reports



Line CY1



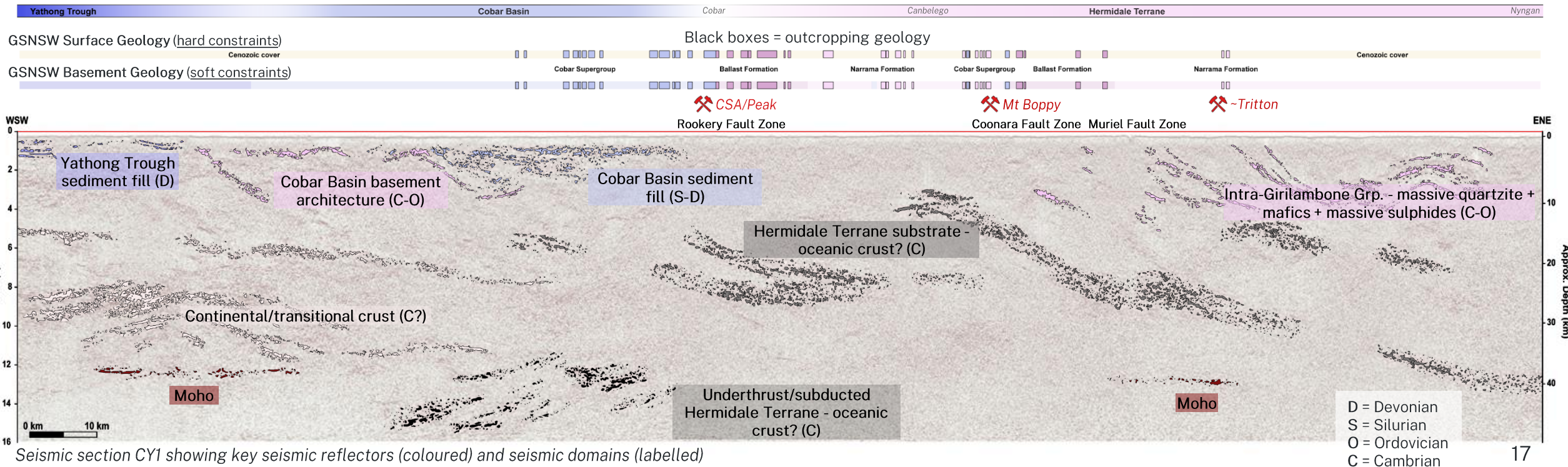
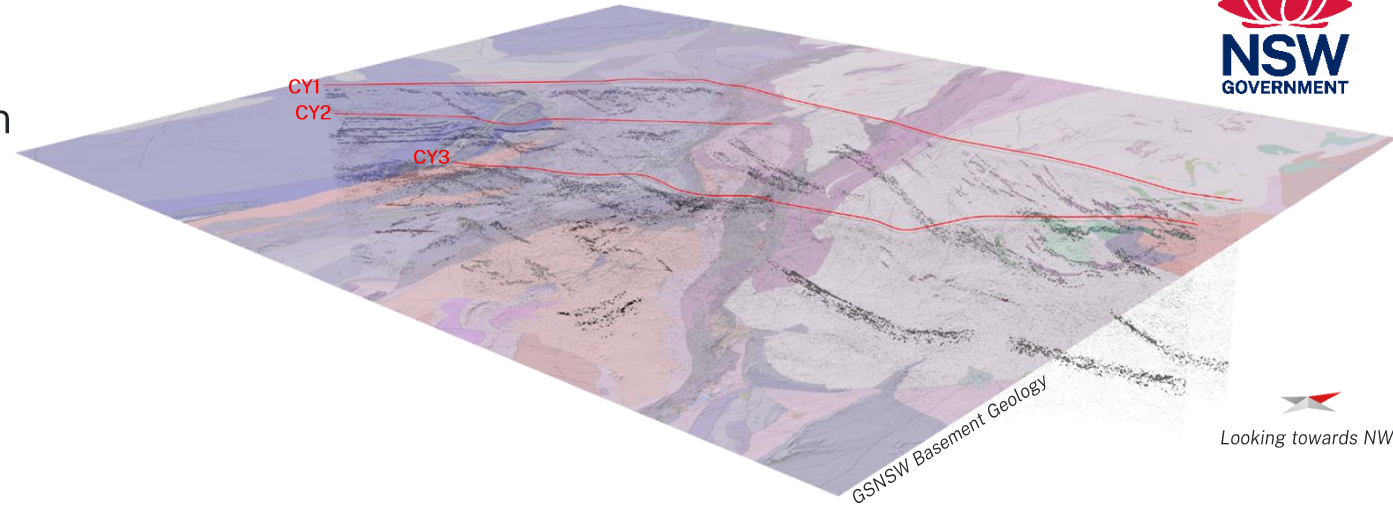
Video credit: Simone Meakin





# Interpretation

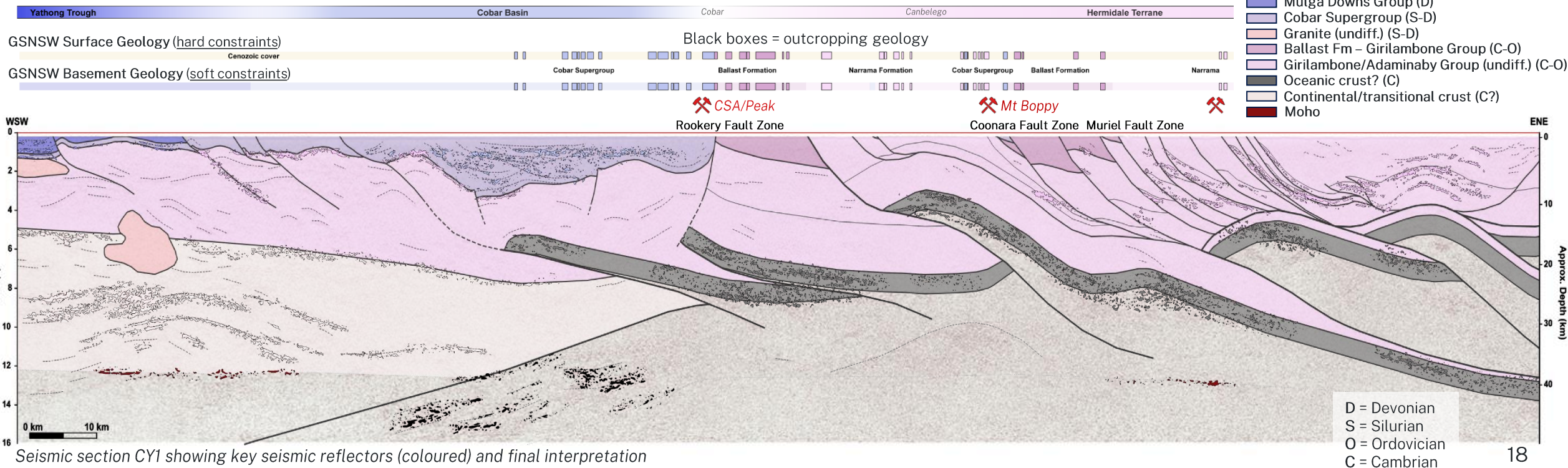
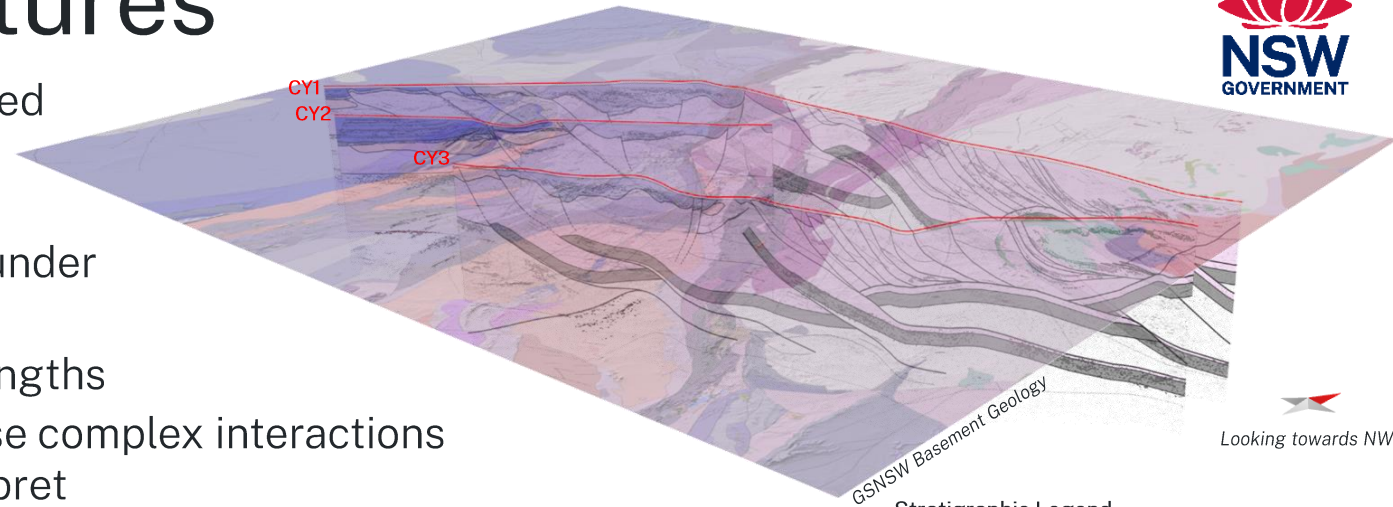
- Seismic domains characterised with consideration of legacy geological and geophysical data
- Interpretation hierarchy: hard constraints >> soft constraints
- Key seismic reflectors and characterised seismic domains form the basis for interpretation in poorly-imaged and thus higher-uncertainty areas





# Interpretation — key features

- Overall structural style: west-verging, thick-skinned orogenic wedge/fold and thrust belt
- Continental/transitional crust in west buttressing westward shortening (?) causing obduction (and under thrusting/minor subduction) of oceanic crust
- At least two distinct structural styles/fold wavelengths
- Cross-cutting relationships evident, however these complex interactions are poorly-imaged and therefore difficult to interpret





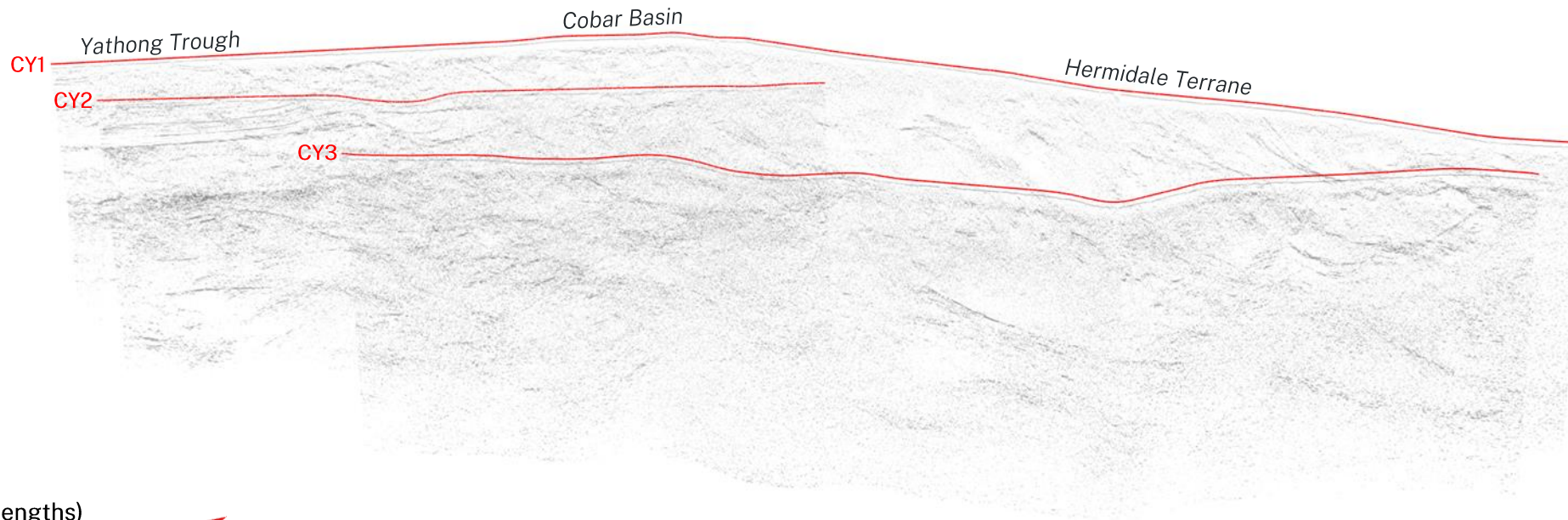
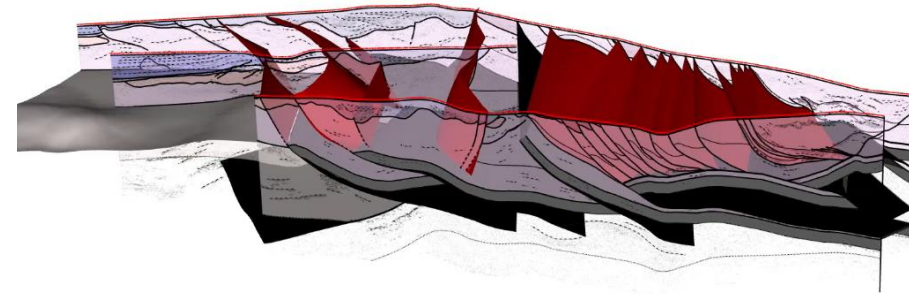
# Interpretation — 3D validity

## Stratigraphic Legend

- Mulga Downs Group (D)
- Cobar Supergroup (S-D)
- Granite (undiff.) (S-D)
- Ballast Fm – Girilambone Group (C-O)
- Girilambone/Adaminaby Group (undiff.) (C-O)
- Oceanic crust? (C)
- Continental/transitional crust (C?)

## Structural Styles

- Deeper crustal-scale faulting and longer wavelength folding
- Shallower closer-spaced faulting



## Scale (Line lengths)

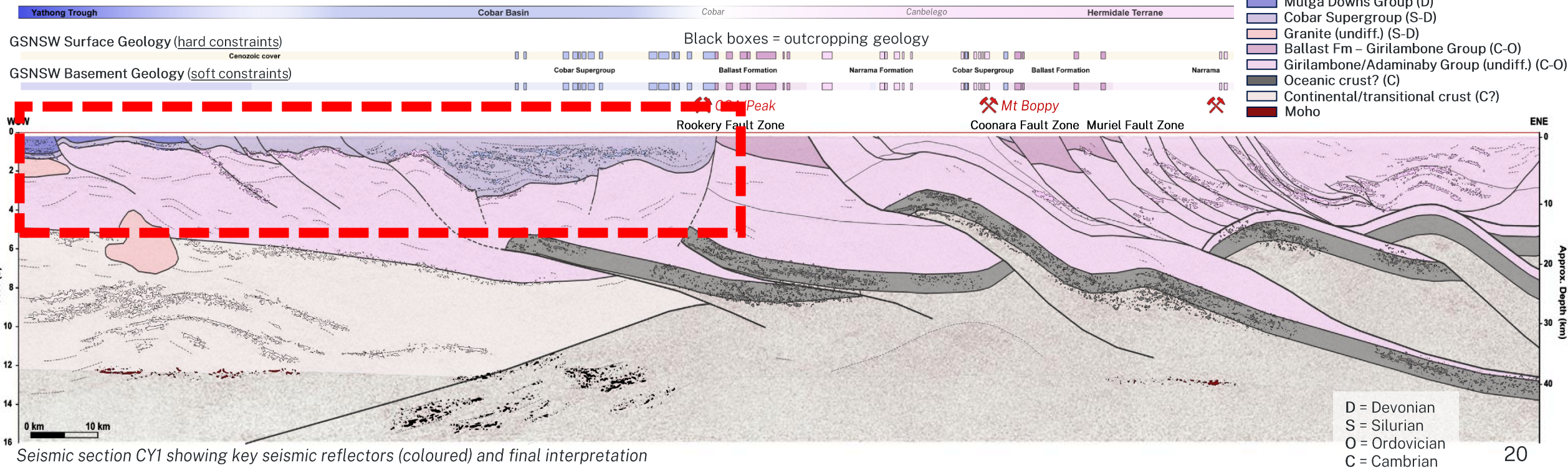
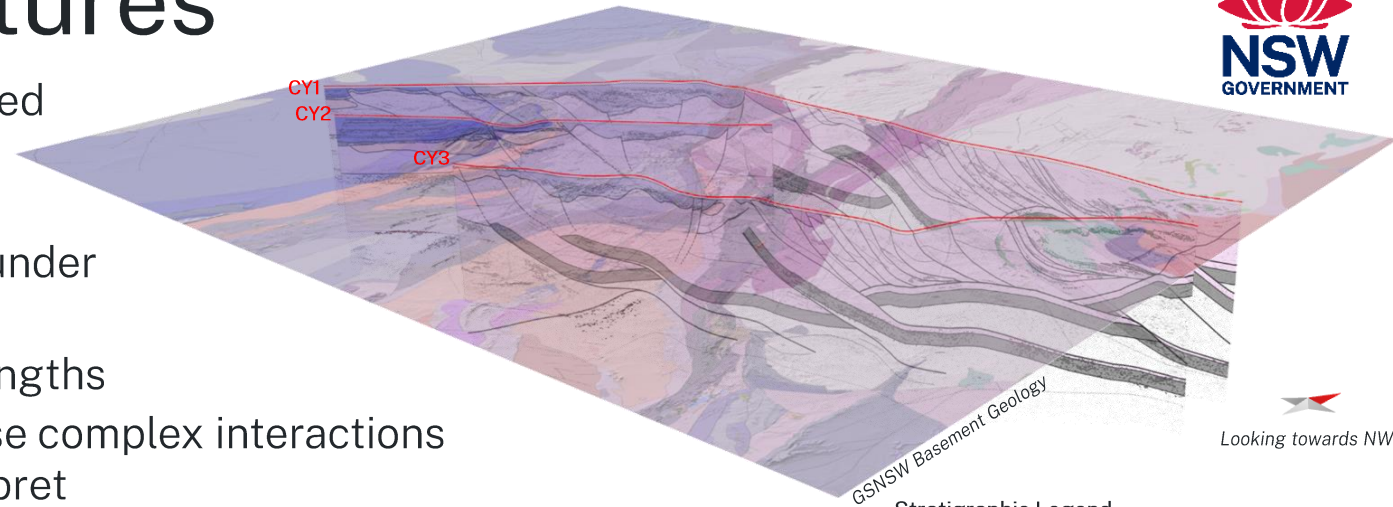
- CY1 = 233 km
- CY2 = 115 km
- CY3 = 158 km

  
Looking towards NW



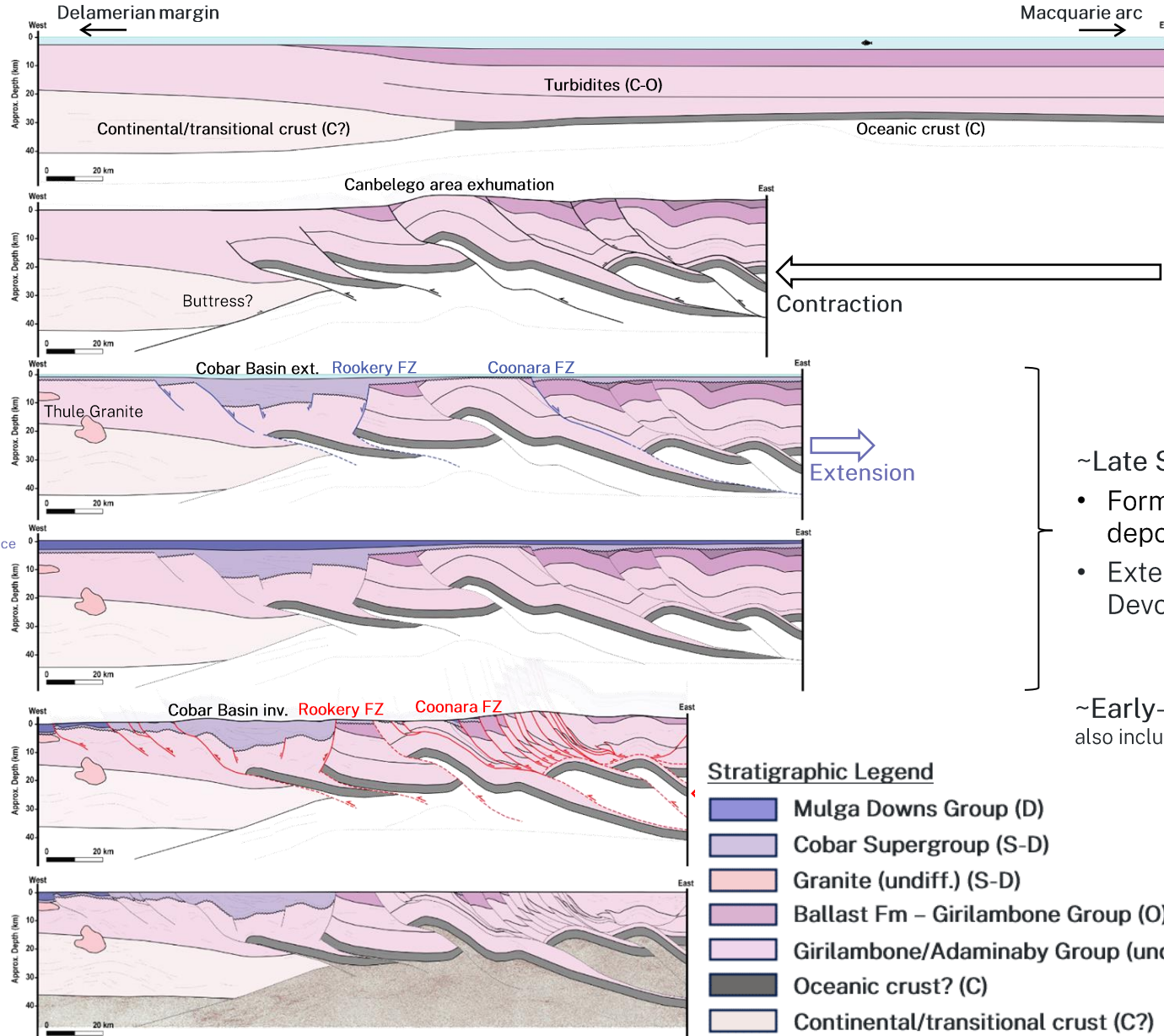
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- Cross-cutting relationships evident, however these complex interactions are poorly-imaged and therefore difficult to interpret





# Schematic geological evolution



## ~Cambrian to Middle Ordovician – Benambran Extension

- Back-arc extension and widespread turbidite deposition over attenuated Delamerian margin and Cambrian oceanic crust
- Emplacement of syngenetic mineral deposits of the Hermidale Terrane

## ~Late Ordovician to early Silurian – Benambran Collision

- ~40% shortening by thick-skinned faulting and long wavelength folding
- Significant uplift of Canbelego area

## ~Late Silurian to Late Devonian – Tabberabberan Extension

- Formation of Cobar Basin and emplacement of syngenetic mineral deposits
- Extension and/or widespread subsidence and formation of Western Devonian Basins

## ~Early-Late Devonian – Tabberabberan Collision (timestep as represented here may also include deformation attributable to Kanimblan and younger events)

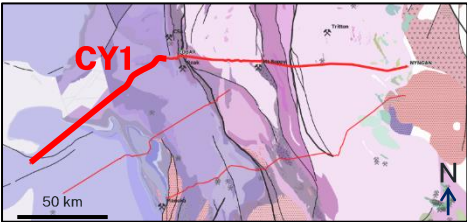
ng, reactivation of pre-existing Benambran structures and hallowly detached thrust faults and shorter wavelength

obar Basin and emplacement of epigenetic mineral deposits

d by new Cobar-Yathong seismic and legacy datasets



# Seismic Reprocessing — line CY1

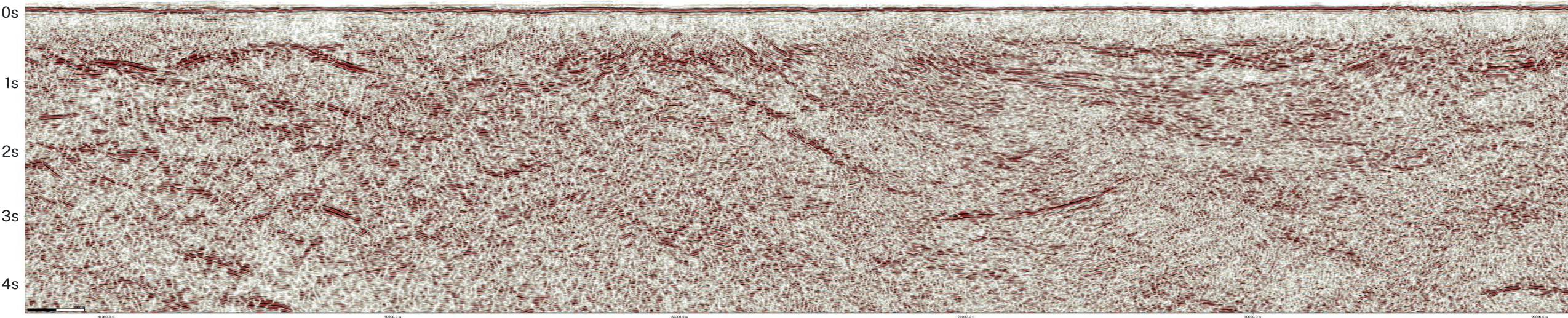




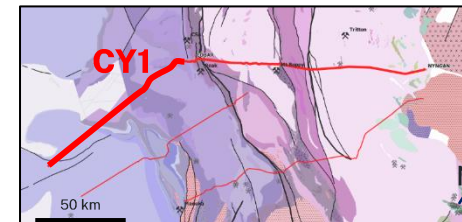
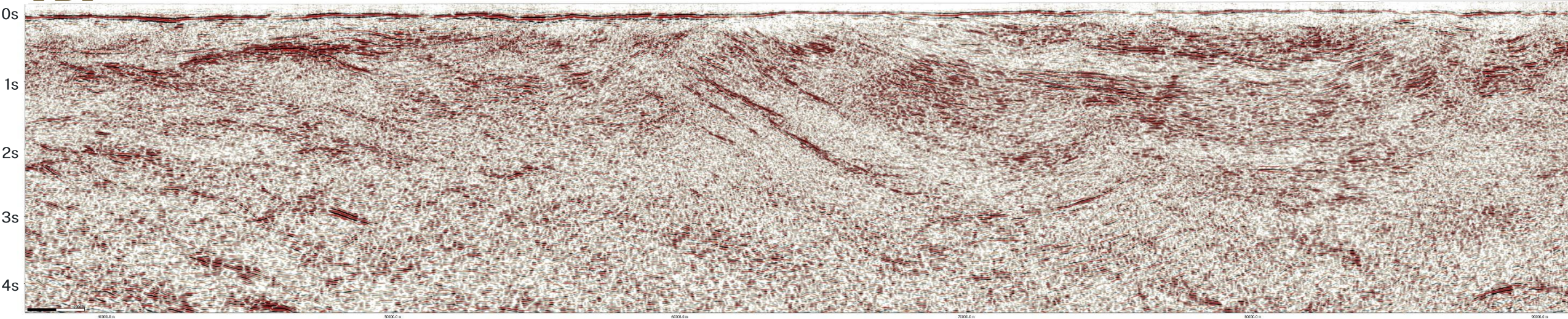
# Seismic Reprocessing — line CY1



*Original PSTM processing*

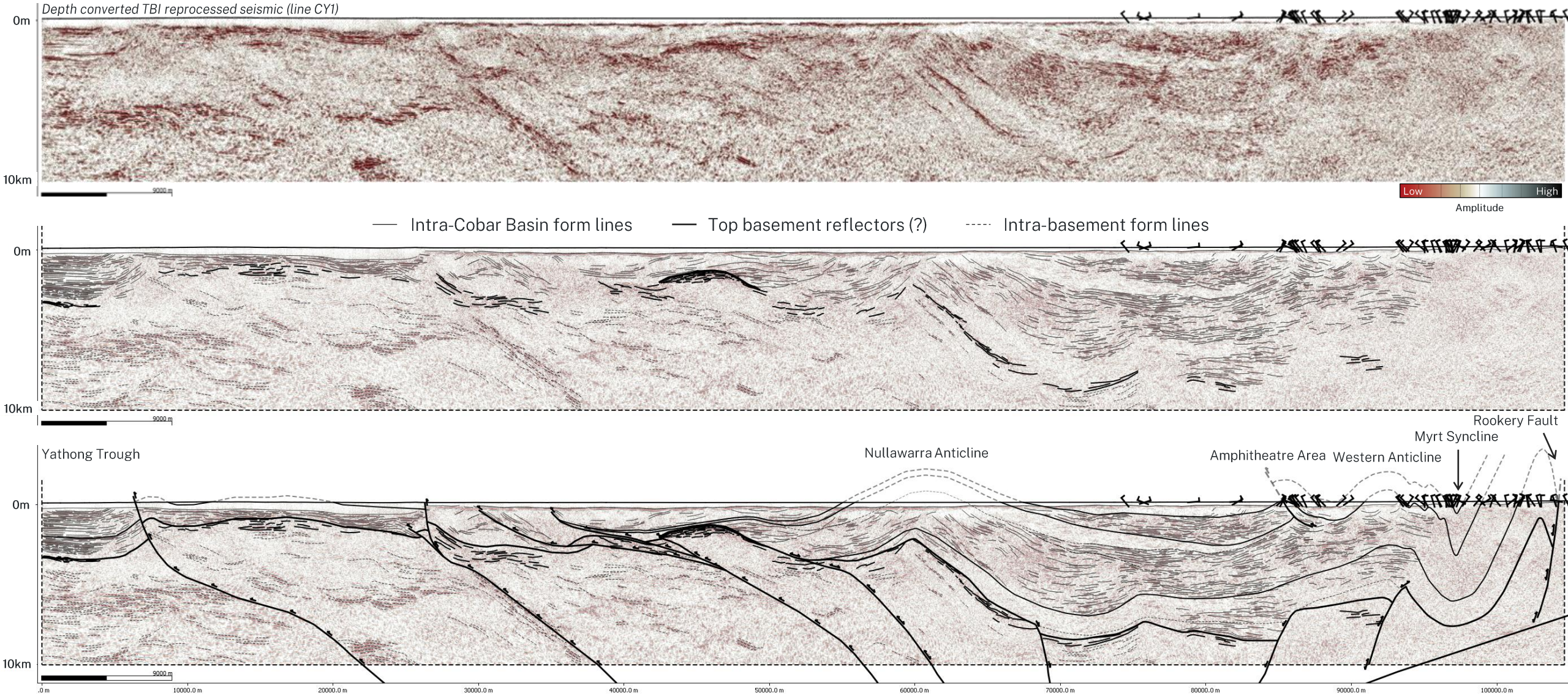
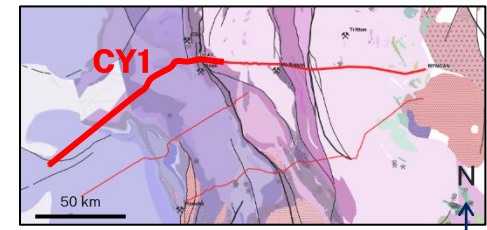


*PSTM Reprocessing*



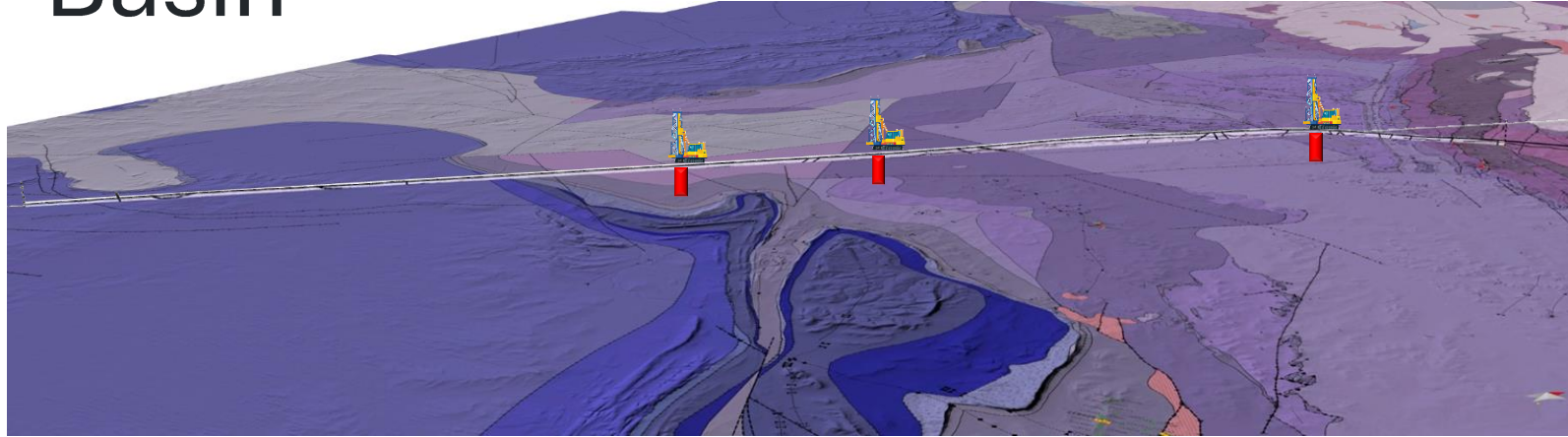


# Reprocessed seismic interpretation — Cobar Basin

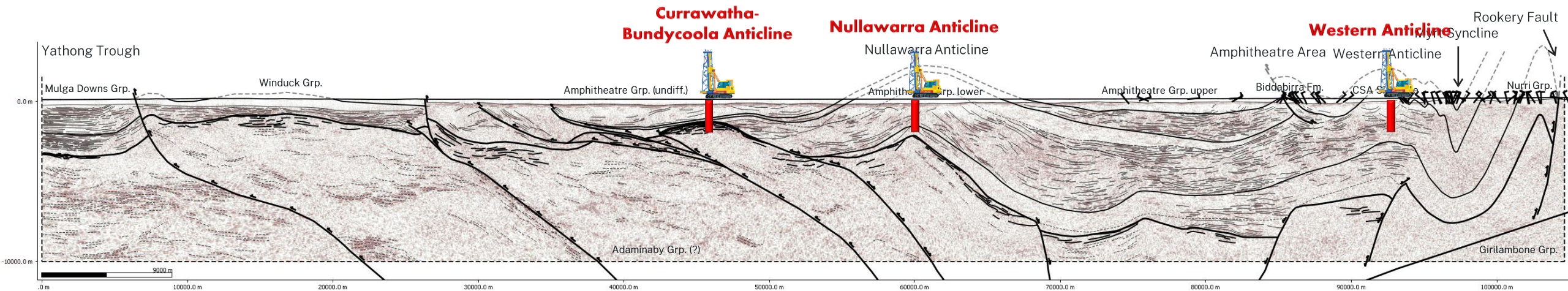




# Reprocessed seismic interpretation — Cobar Basin



Source: MinEx website





# 4

## Drillhole target selection



# NDI Cobar drillhole targets

→ Deep holes to investigate internal stratigraphy & structure ± basement of mineralised Cobar Basin and Hermidale Terrane. All along deep crustal seismic lines.

The 'Wooltrack'

## 1. Currawatha-Bundycoola Anticline

→ Deep drillhole in the western Cobar Basin targeting lower basin stratigraphy and basement rocks uplifted in the 'Currawatha-Bundycoola Anticline'

## 2. Nullawarra Anticline

→ Deep drillhole in the central-western Cobar Basin targeting lower basin stratigraphy and basement rocks uplifted in the Nullawarra Anticline

## 3. Western Anticline

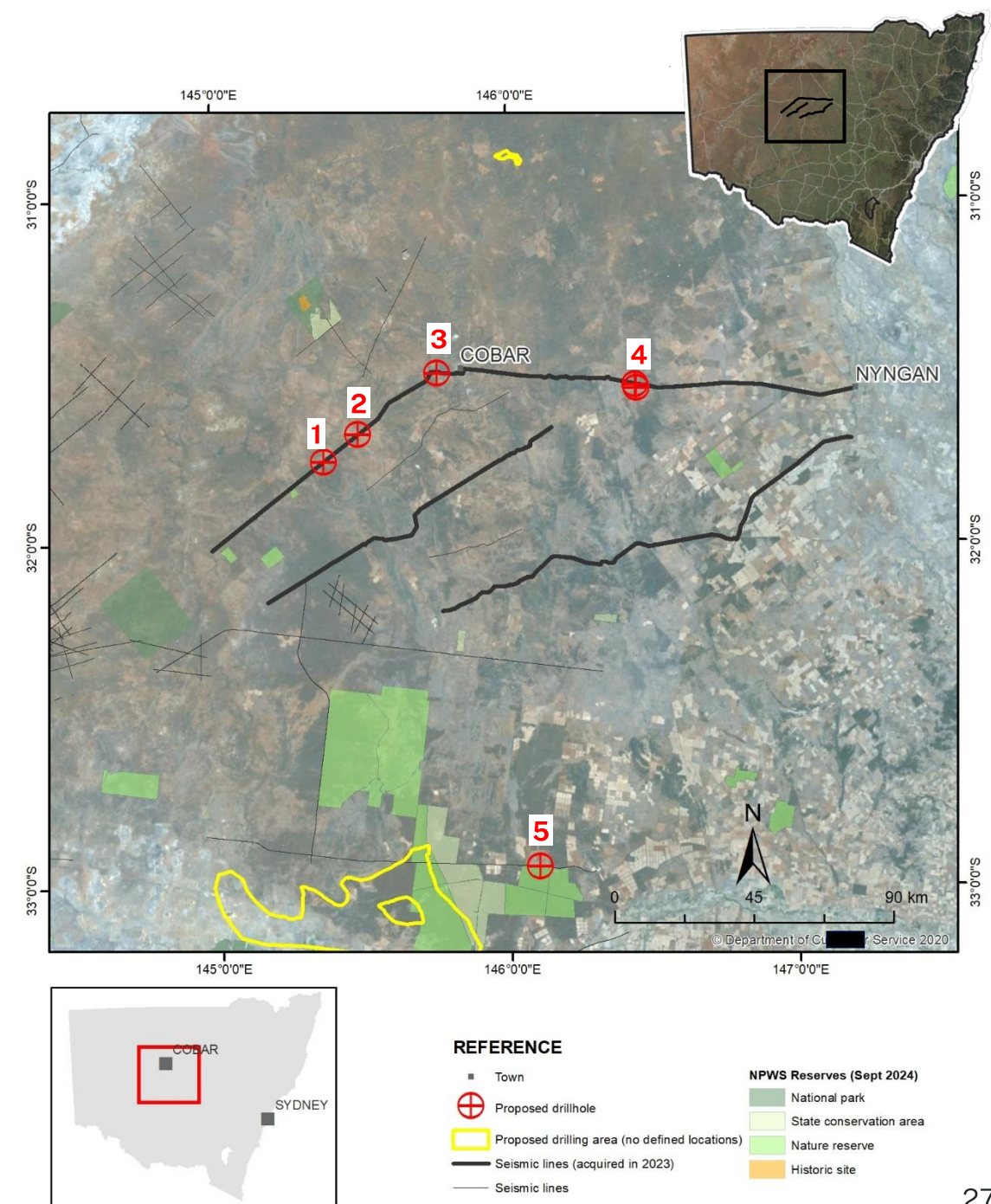
→ Deep drillhole in the eastern Cobar Basin targeting lower basin stratigraphy and basement rocks uplifted in the 'Western Anticline'

## 4. Ballast Formation

→ Deep drillhole in the Hermidale Terrane to investigate the internal stratigraphy of the Cambro-Ordovician Girilambone Formation

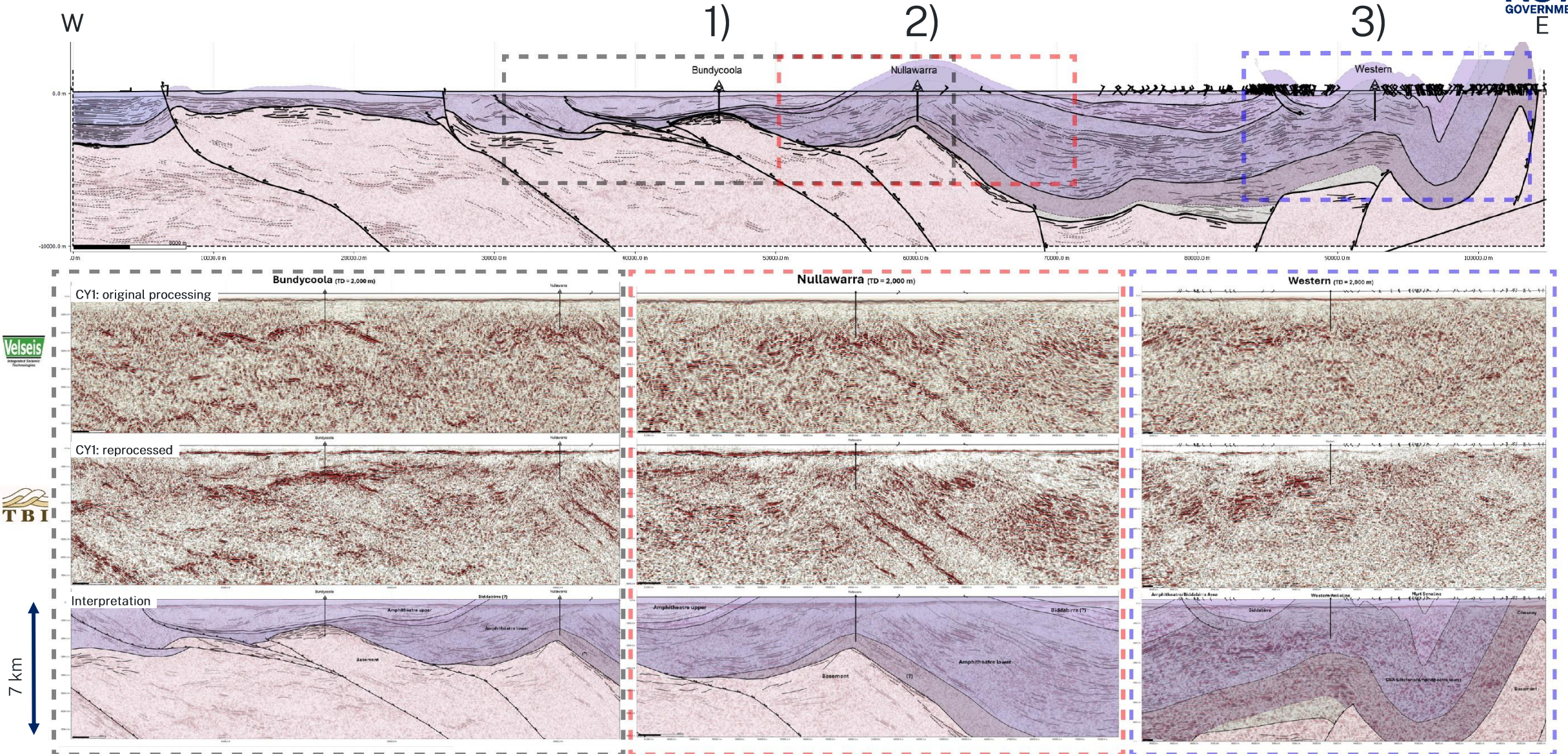
## 5. Walters Range

→ Deep drillhole in the southern Cobar Basin to characterise the nature of the Walters Range 'block'





# 'Wooltrack' drillhole targets





# NDI Cobar drillhole targets

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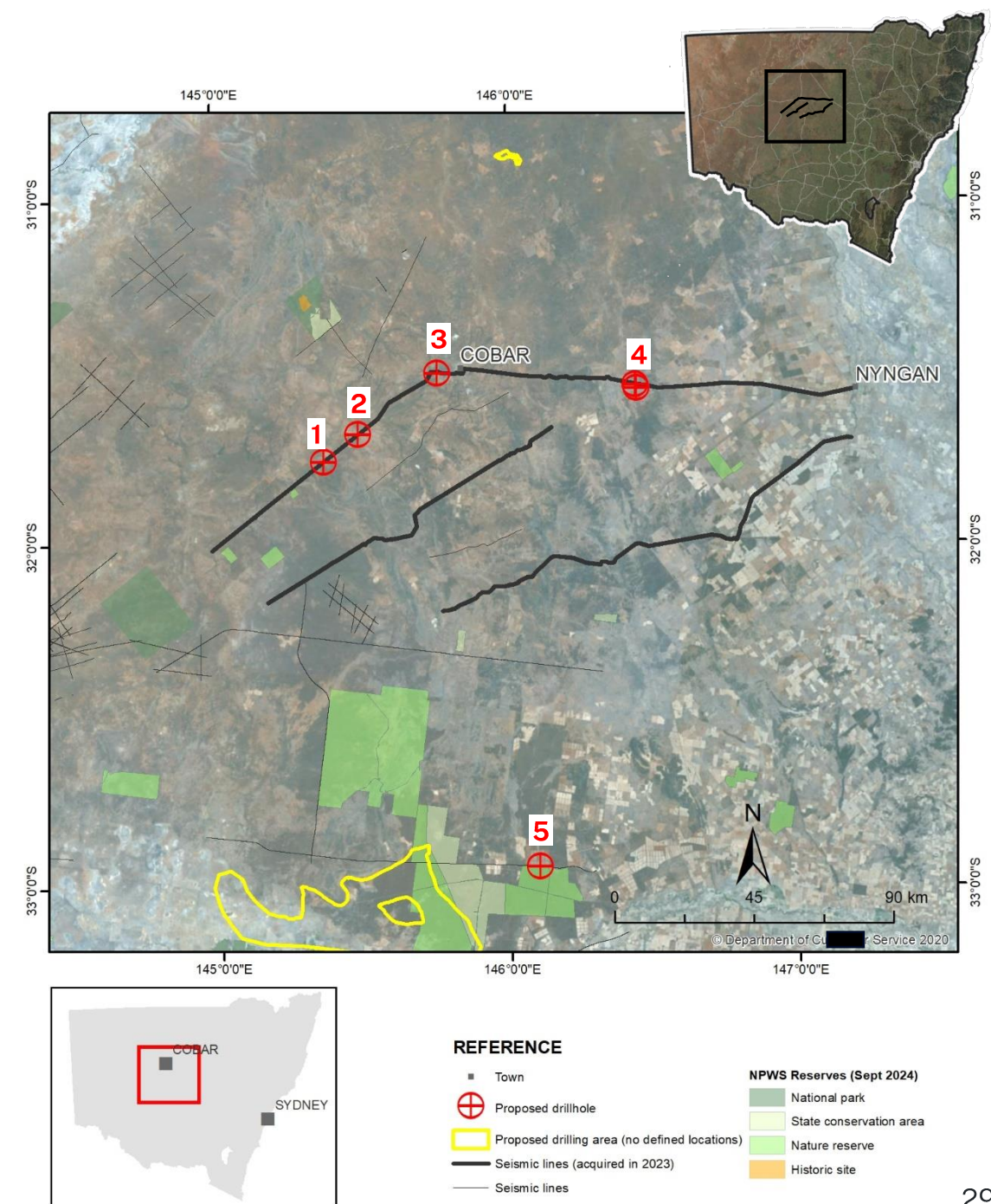
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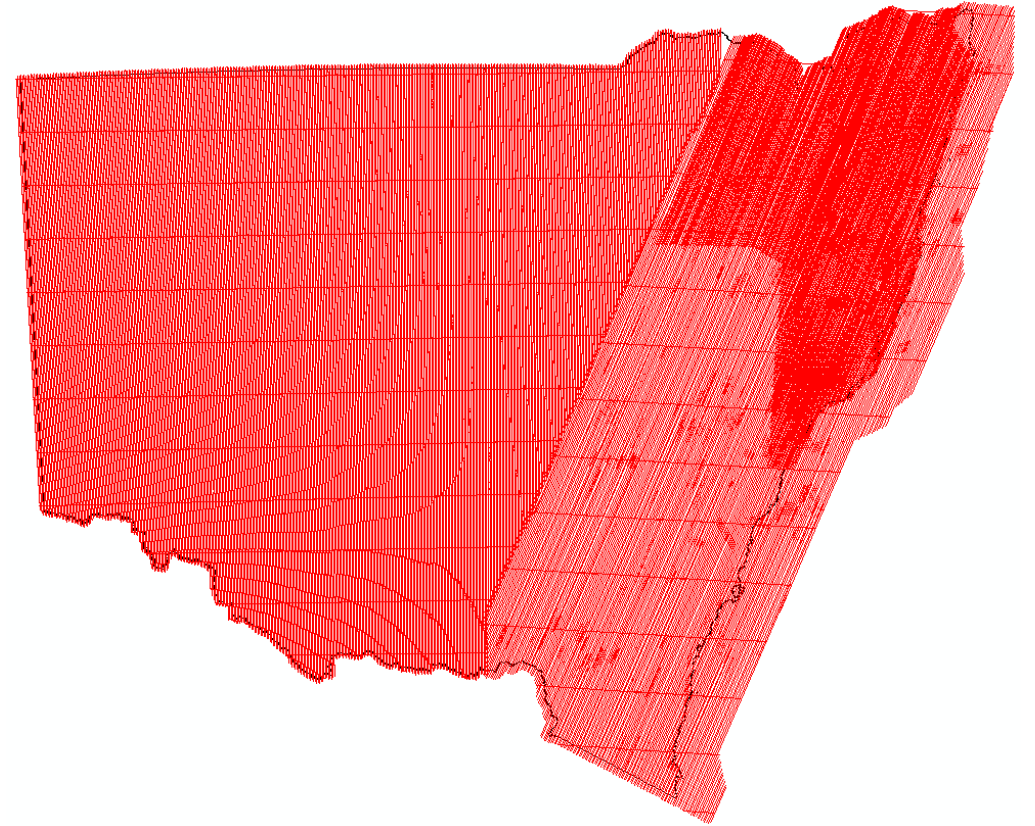
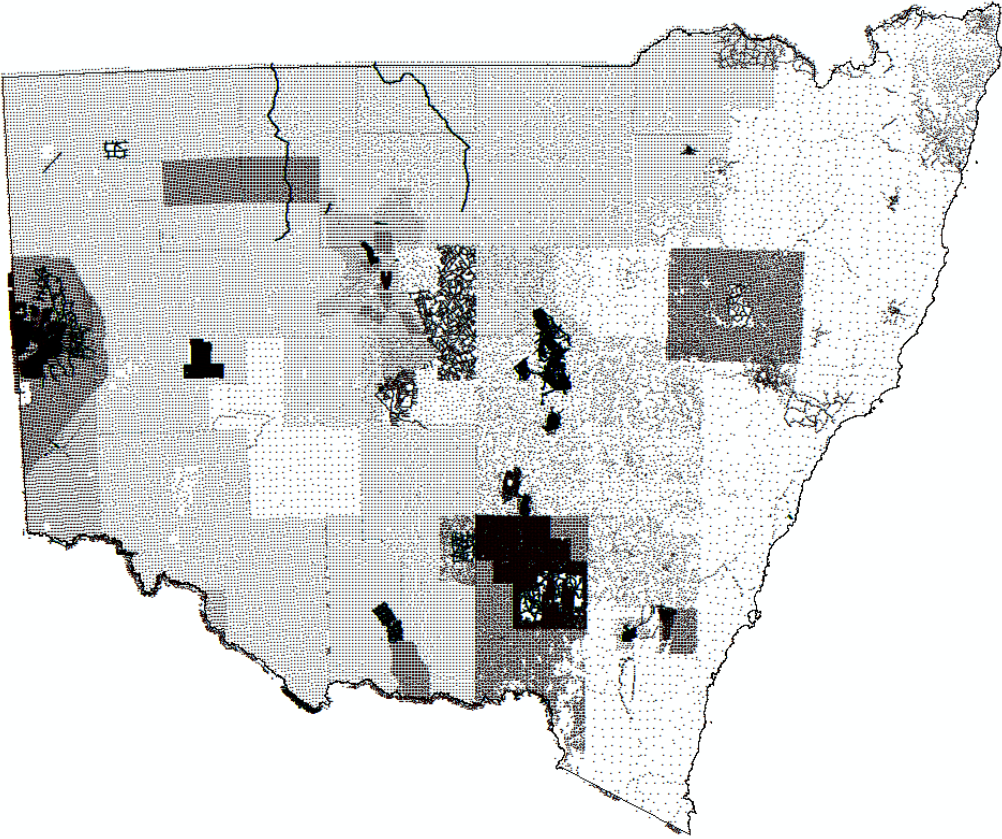


# 5

## New statewide gravity



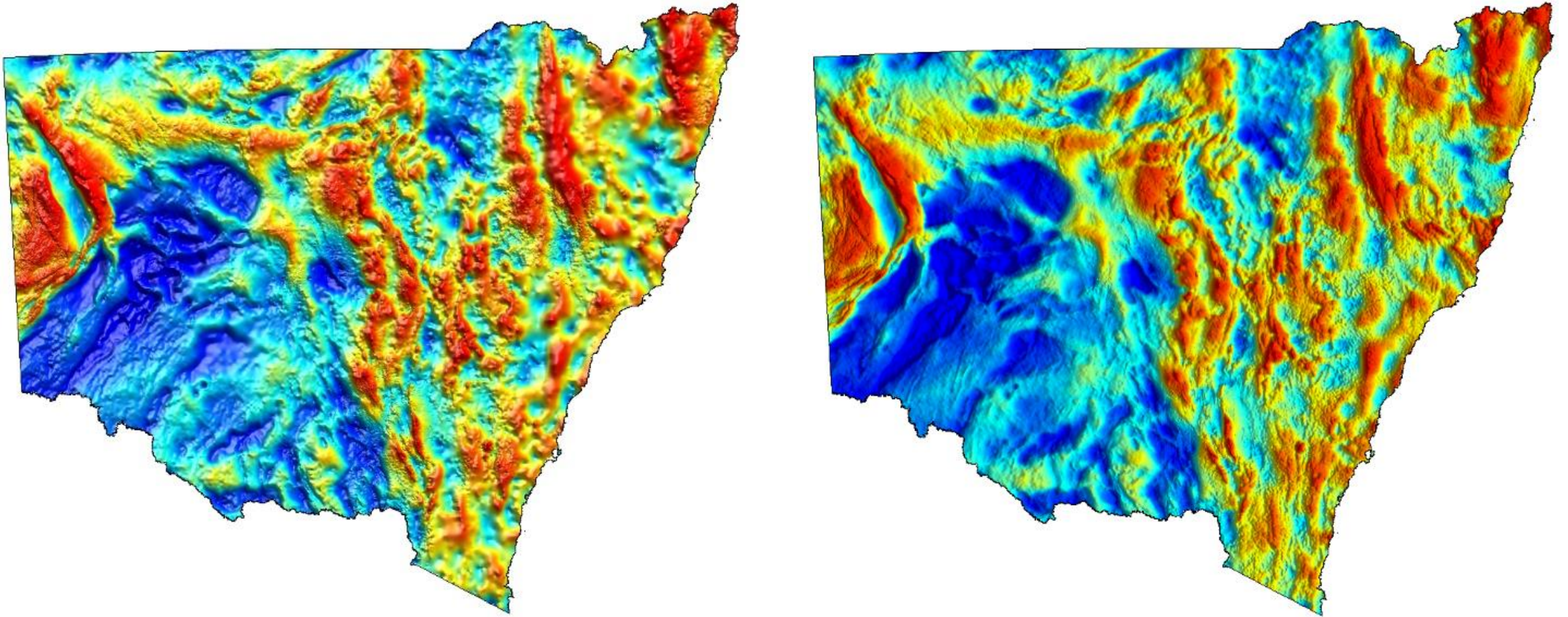
# New statewide gravity coverage



**Ground gravity station coverage (left) compared to airborne gravity coverage (right).**



# New statewide gravity images



**2020 isostatically corrected Bouguer gravity (left) compared to the 2024 composite update (right).**



