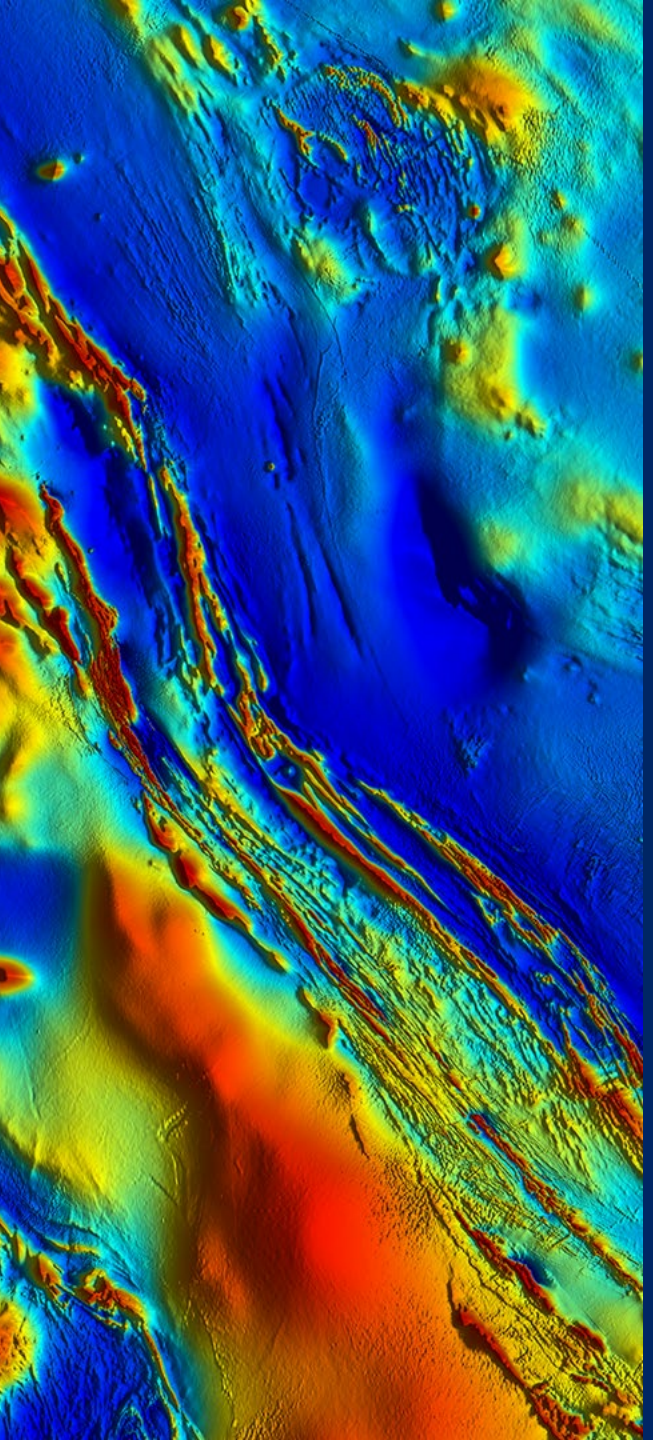

New constraints on the subsurface structure and geological evolution of the Cobar Basin and Hermidale Terrane

Interpretation of the 2023 Cobar–Yathong Seismic Survey

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Consulting Geophysicist

10 May 2024

NSW GOVERNMENT

Contents

Motivation

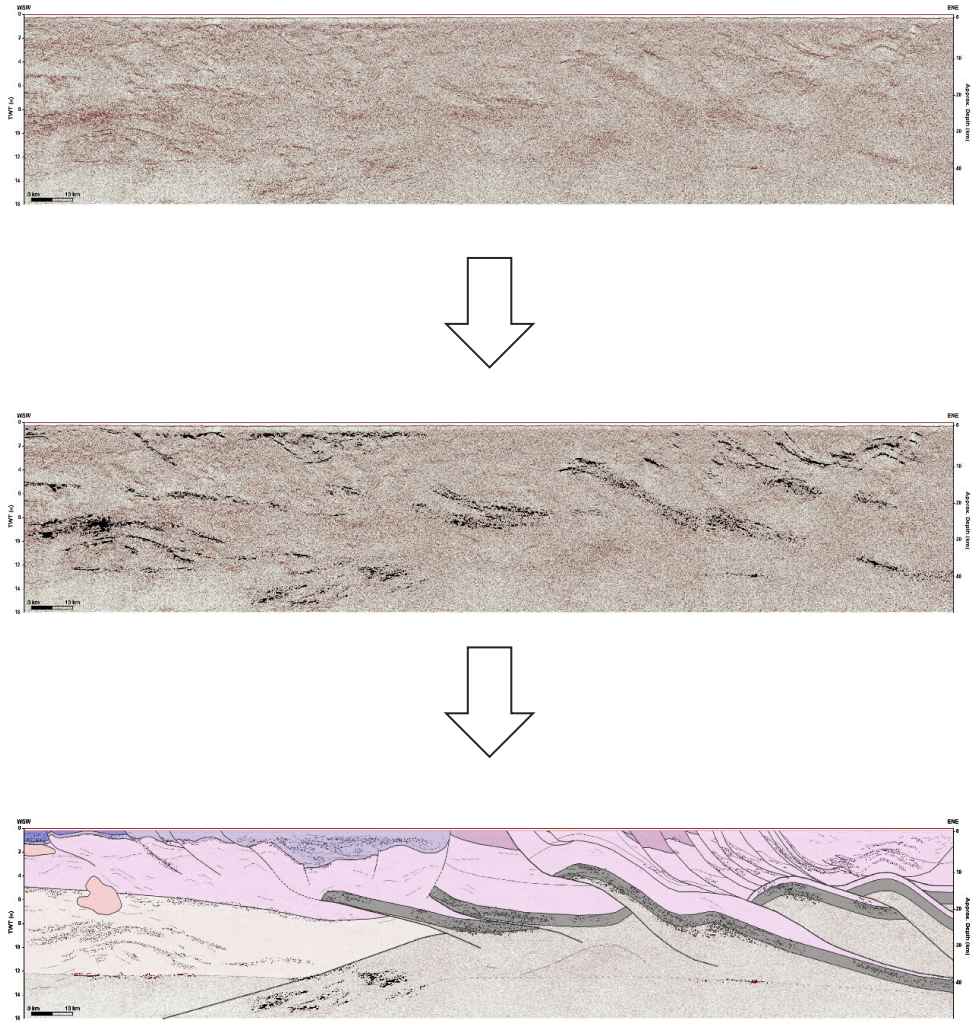
Geological overview

Seismic domains

Interpretation

Geological evolution

Summary

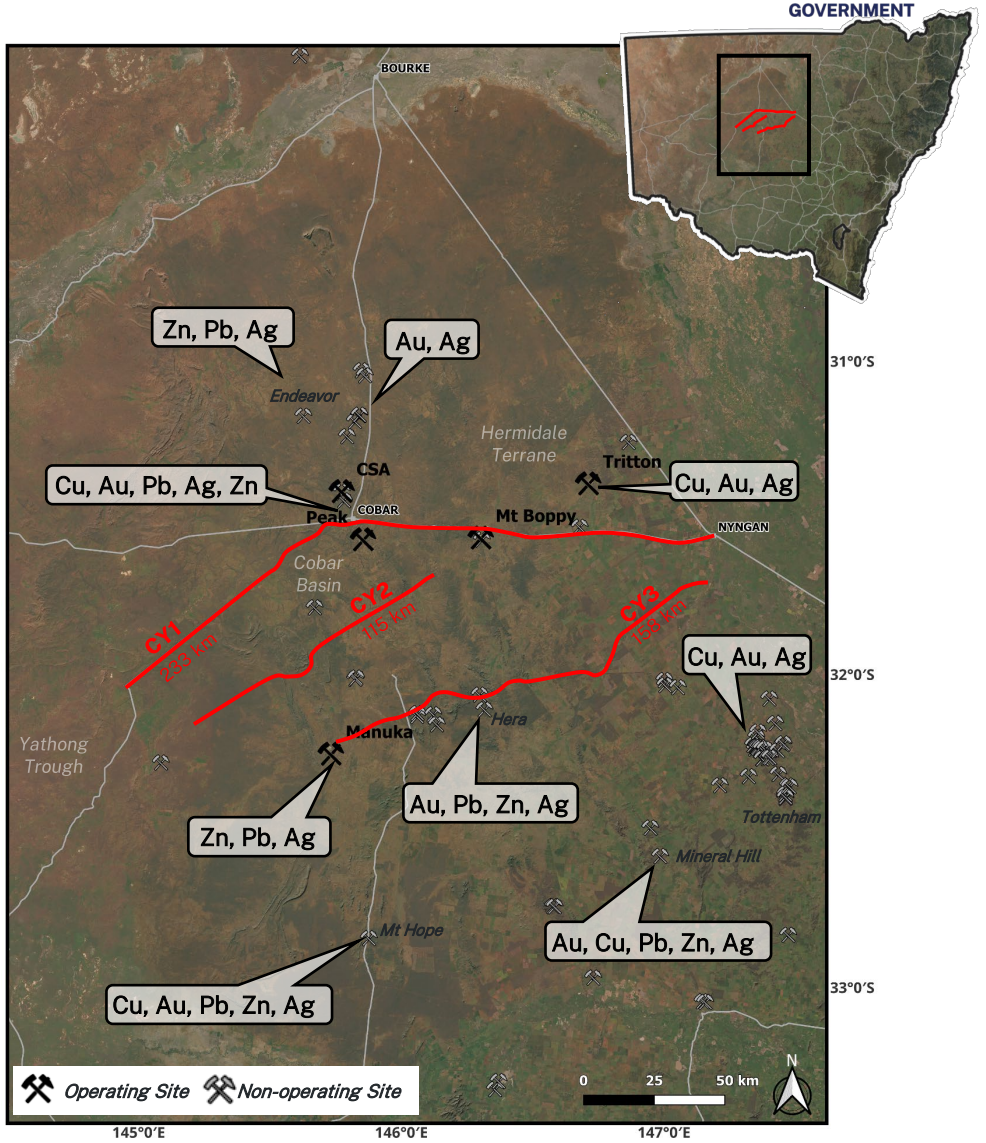


Motivation

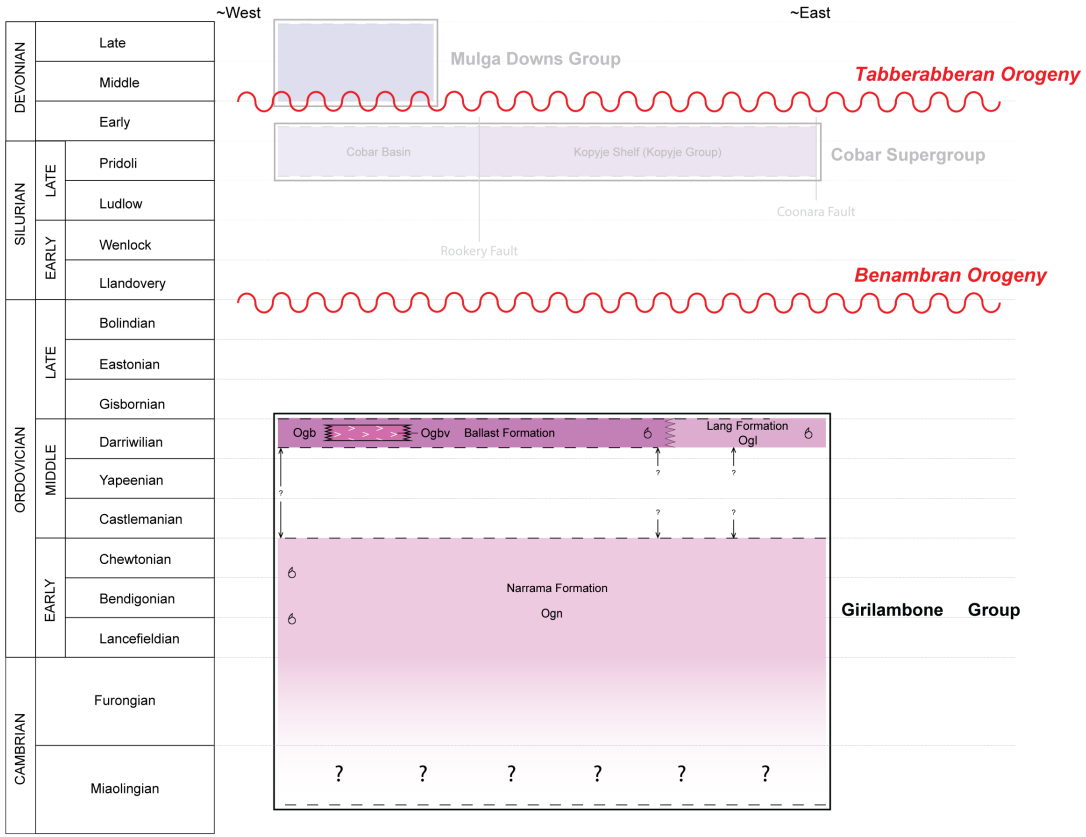
Cobar Basin and Hermidale Terrane are polymetallic provinces:

- Cobar Basin: Cu-Au, and Zn-Ag-Pb
- Hermidale Terrane: Cu-Au-Ag
- Region of active exploration — brownfield + greenfield
- Unresolved questions related to the structural and geological evolution of the region and their controls on the genesis and distribution of metal accumulations

MinEx CRC focus area

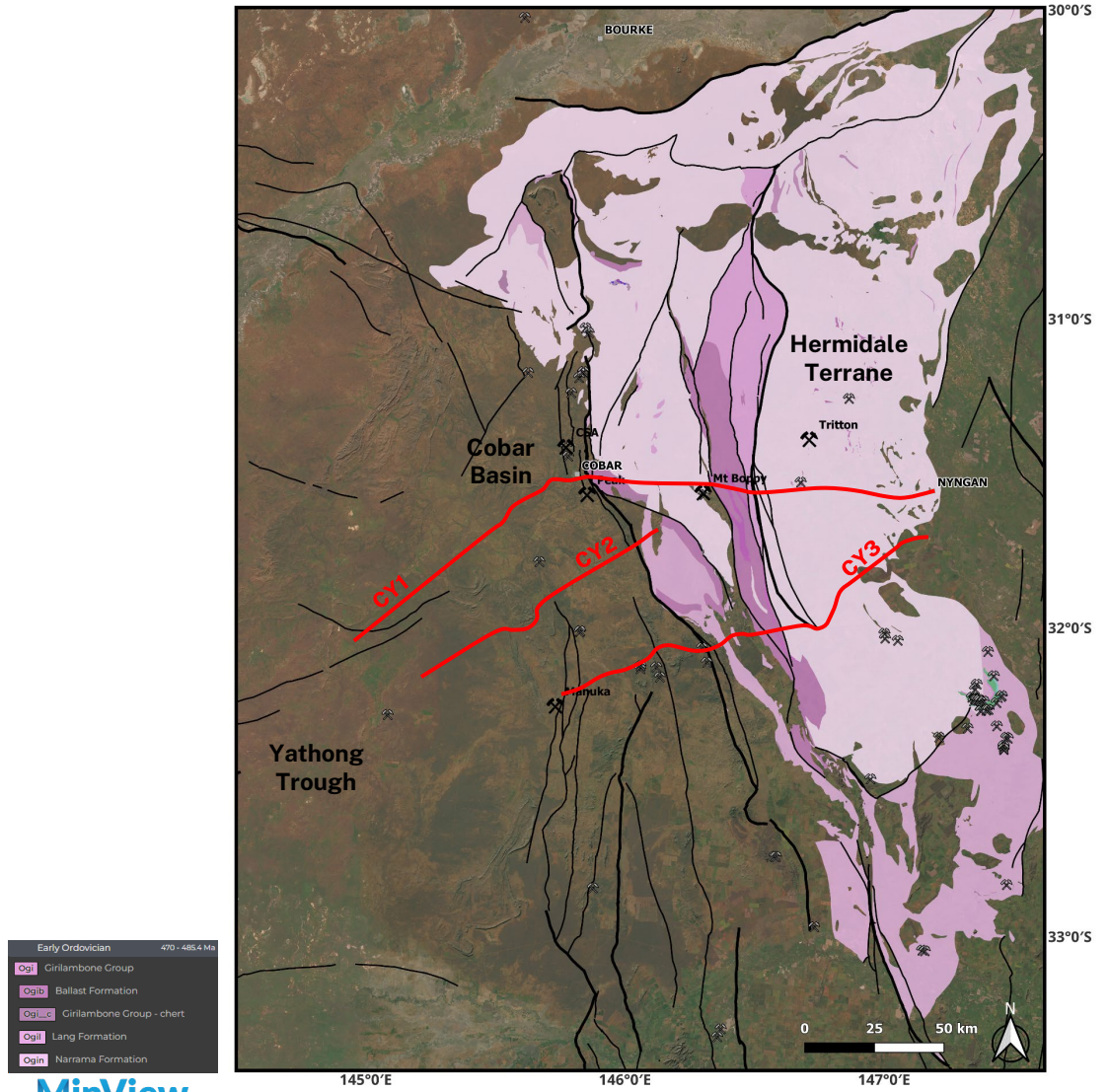


Geological overview



Time-space plot

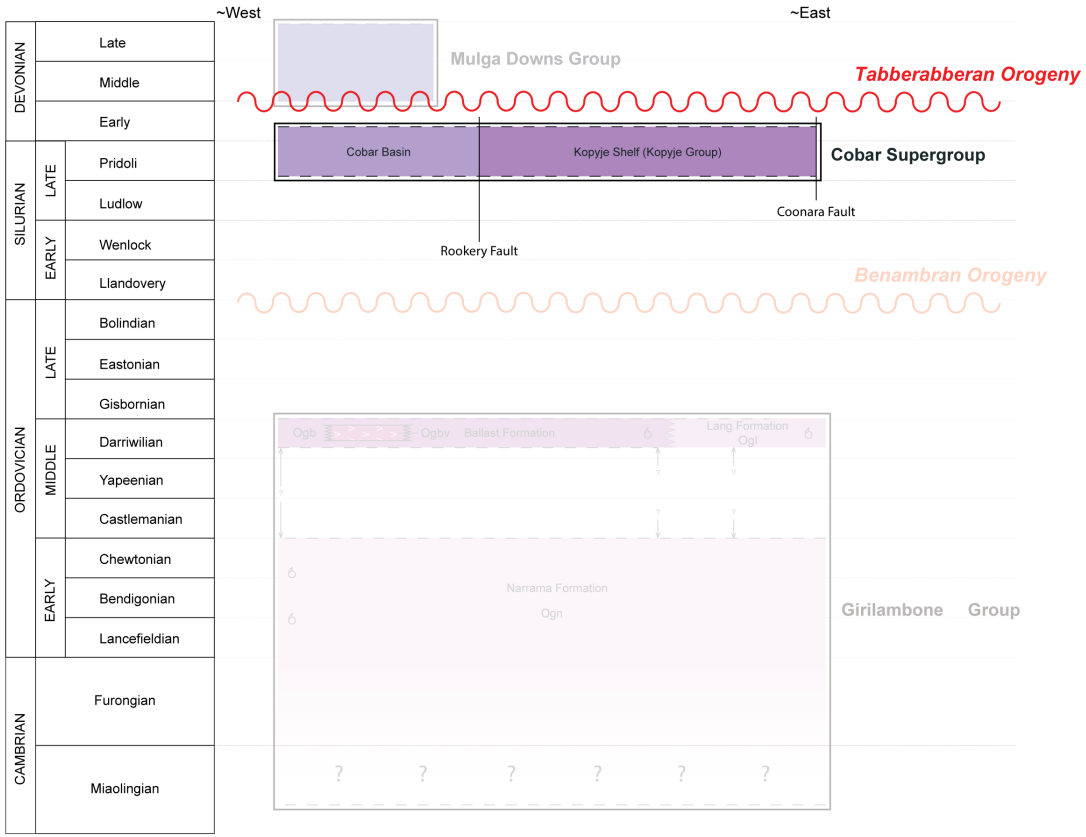
Courtesy of Mark Eastlake - modified from Burton et al. (2012)



MinView

Solid Geology: Girilambone Group

Geological overview



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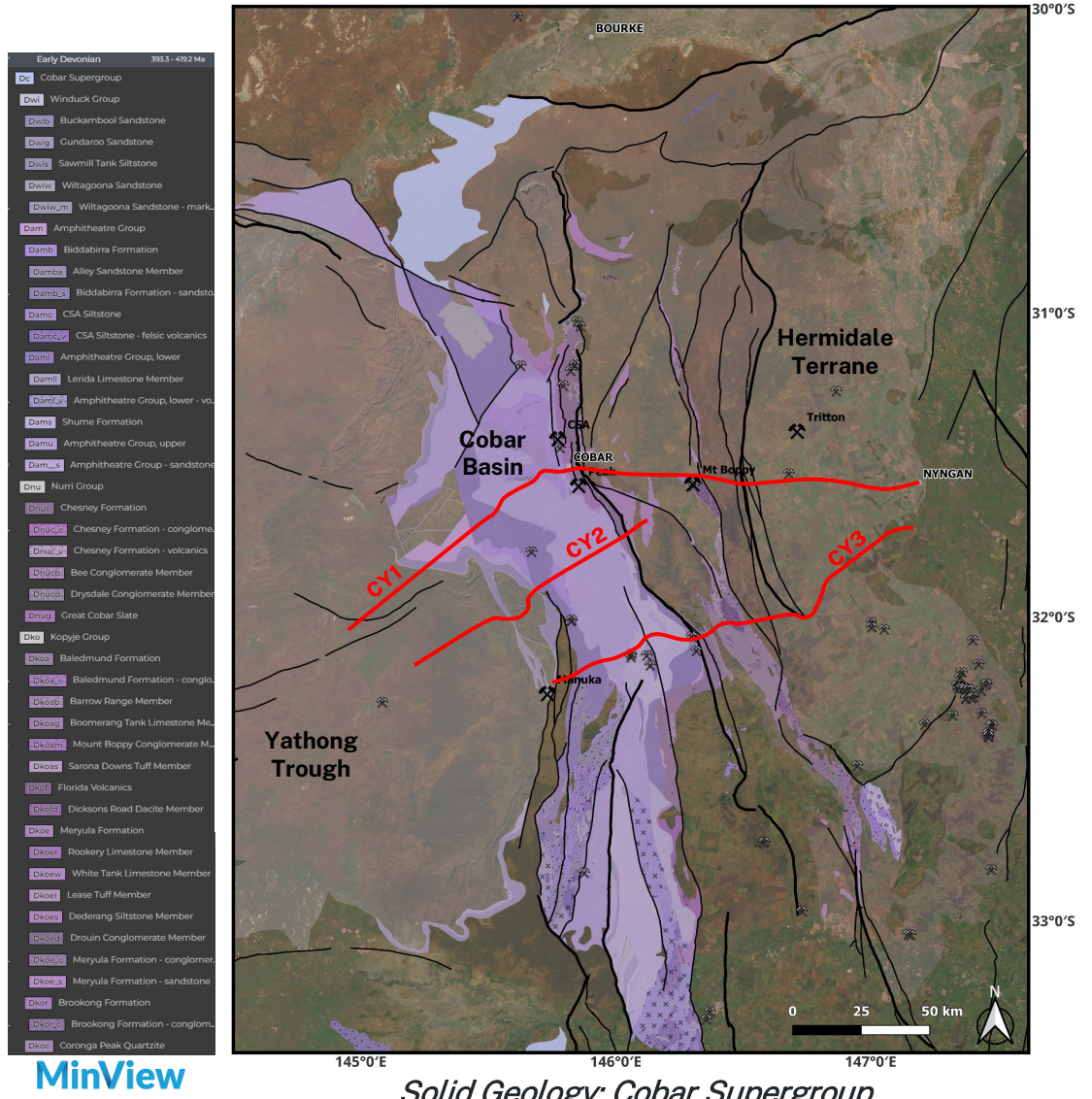

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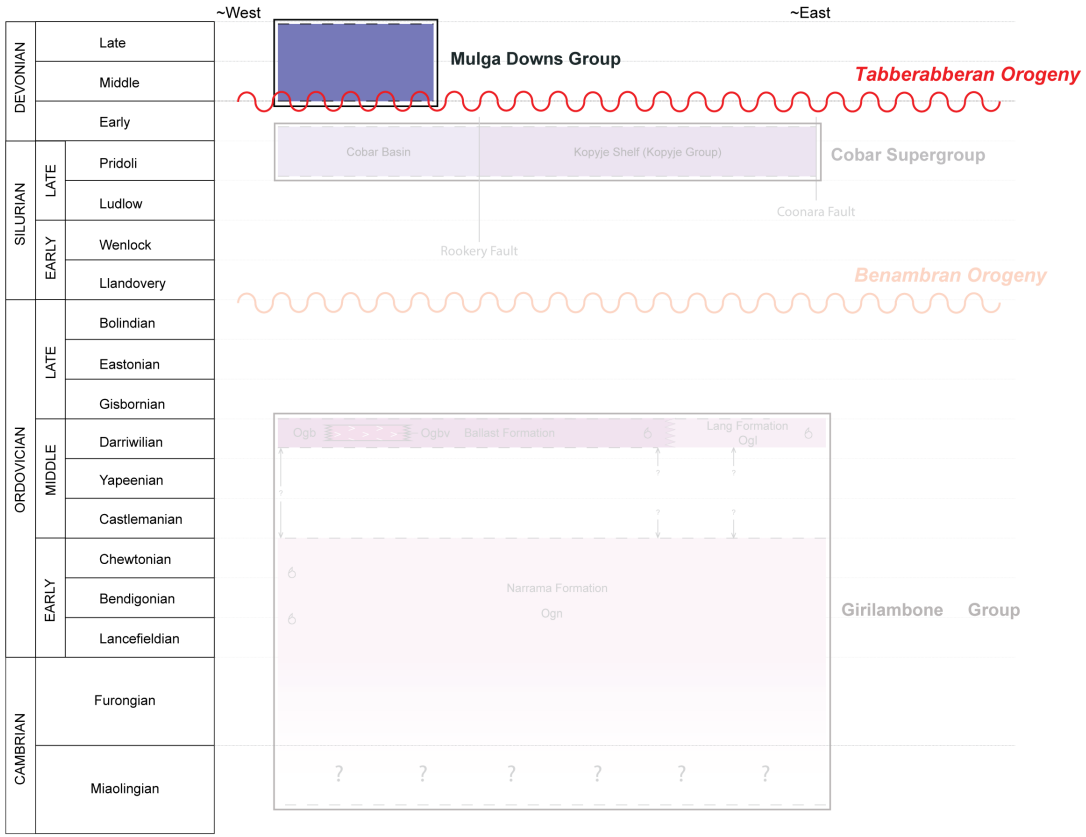
Solid Geology: Cobar Supergroup

Geological overview



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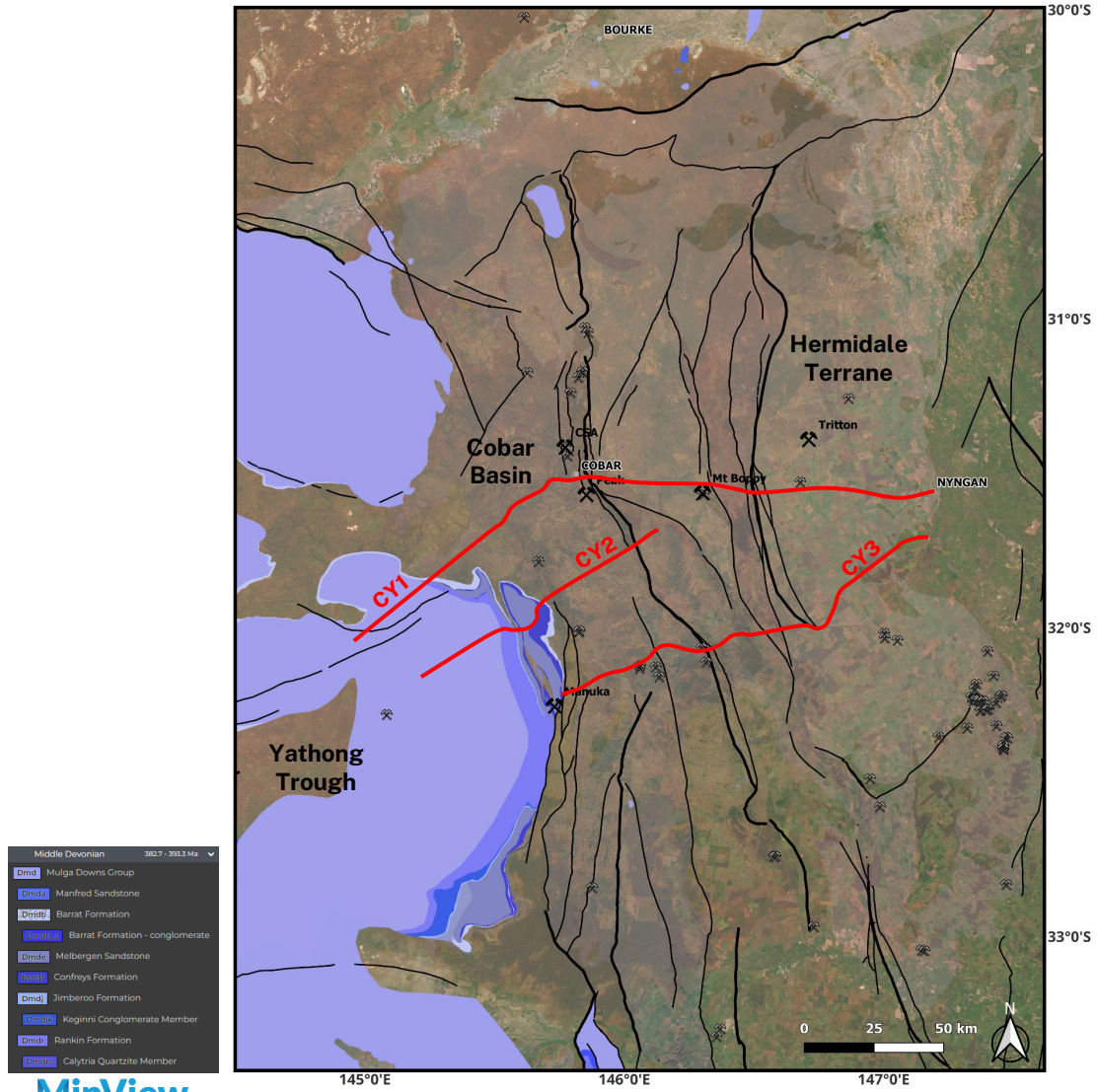
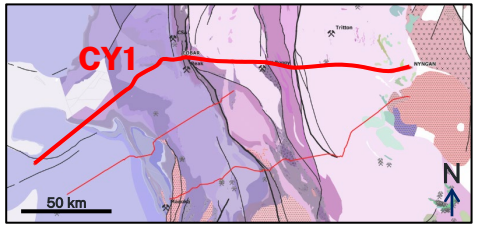
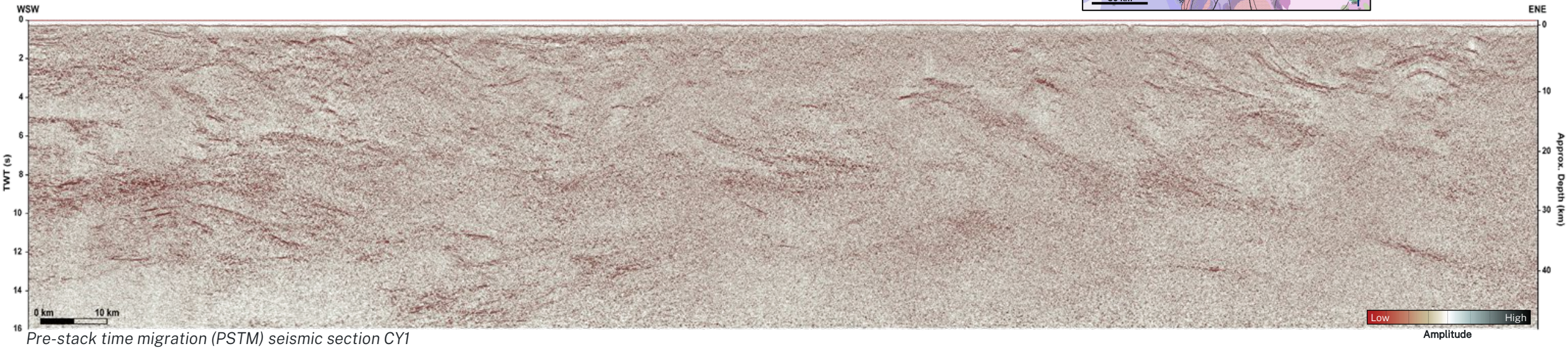


MinView

Solid Geology: Western Devonian Basins

Seismic domains — line CY1





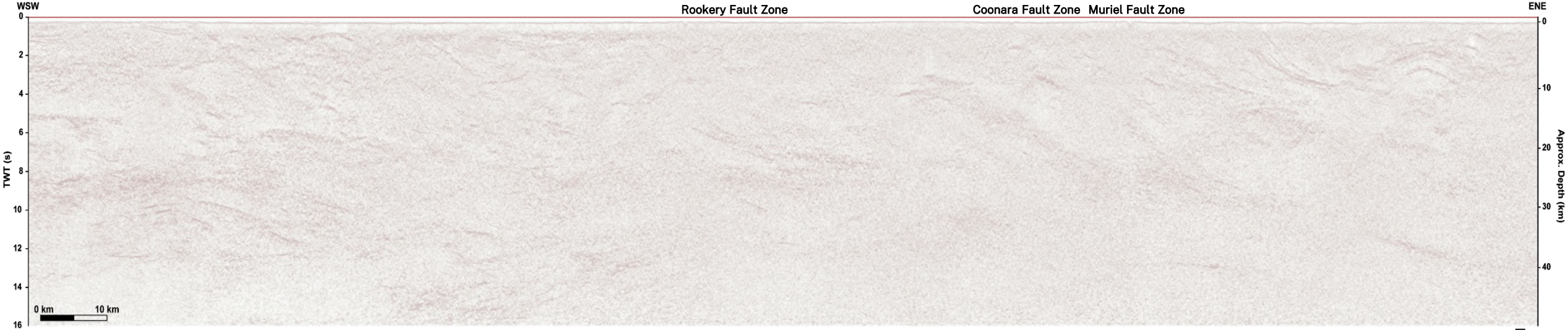
Pre-stack time migration (PSTM) seismic section CY1

Yathong Trough | Cobar Basin | Hermidale Terrane

CSA/Peak — Rookery Fault Zone

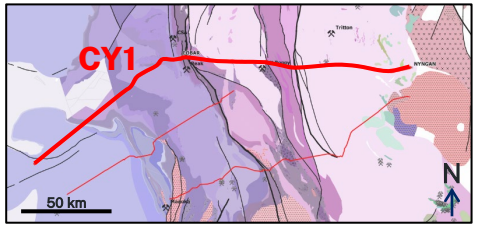
Mt Boppy — Coonara Fault Zone

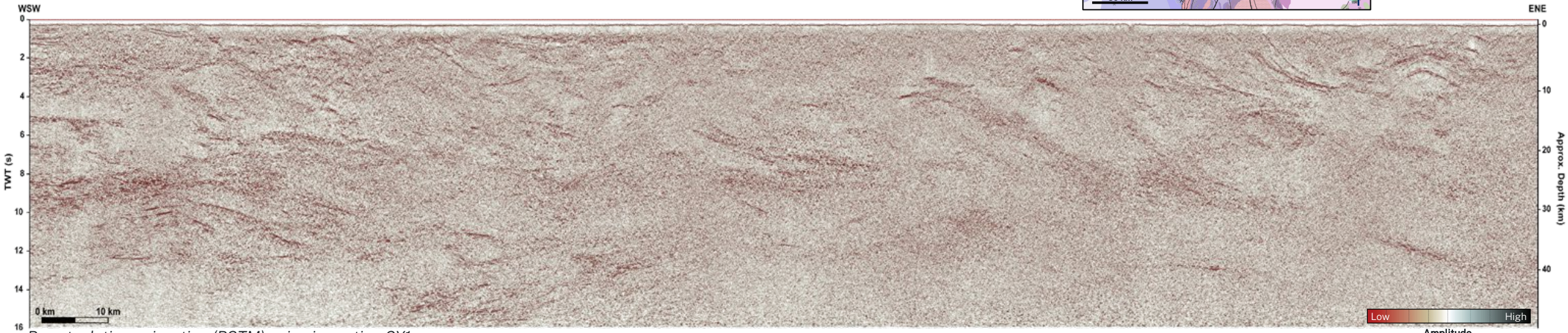
~Tritton — Muriel Fault Zone



PSTM seismic section CY1

Seismic domains — line CY1





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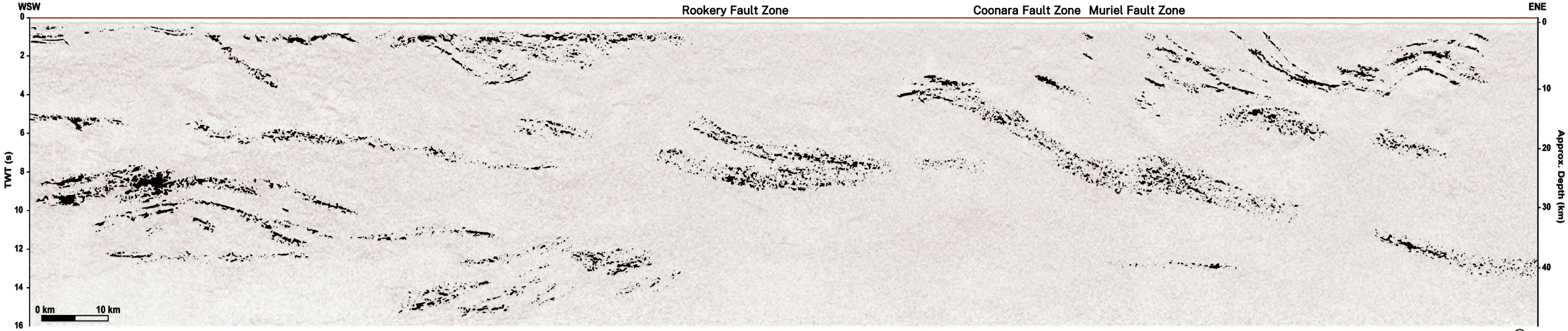
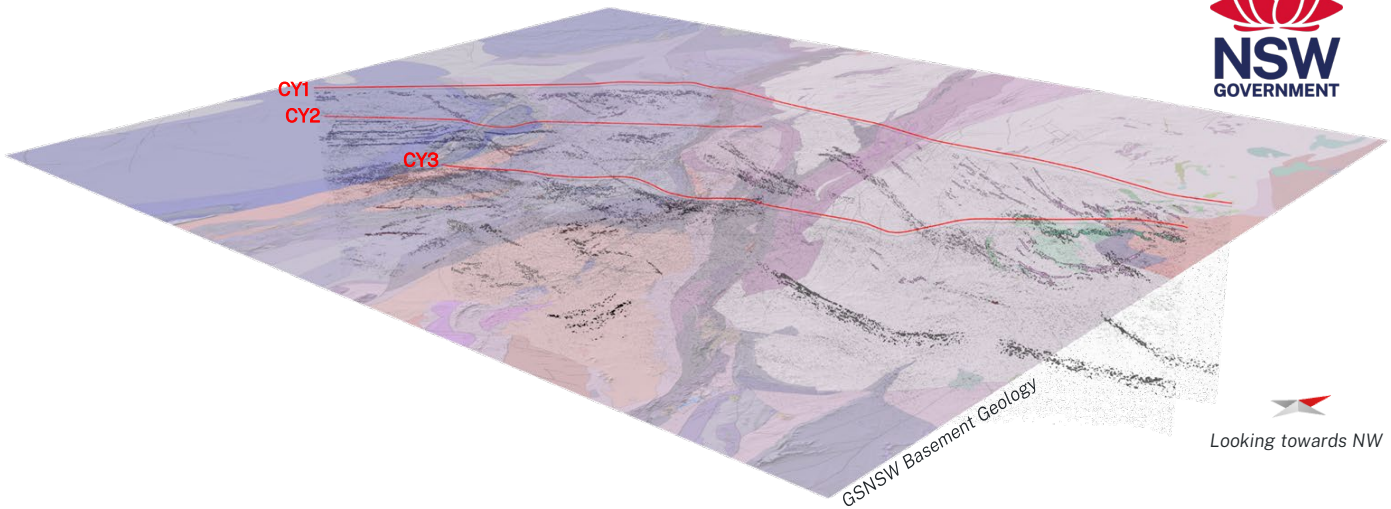
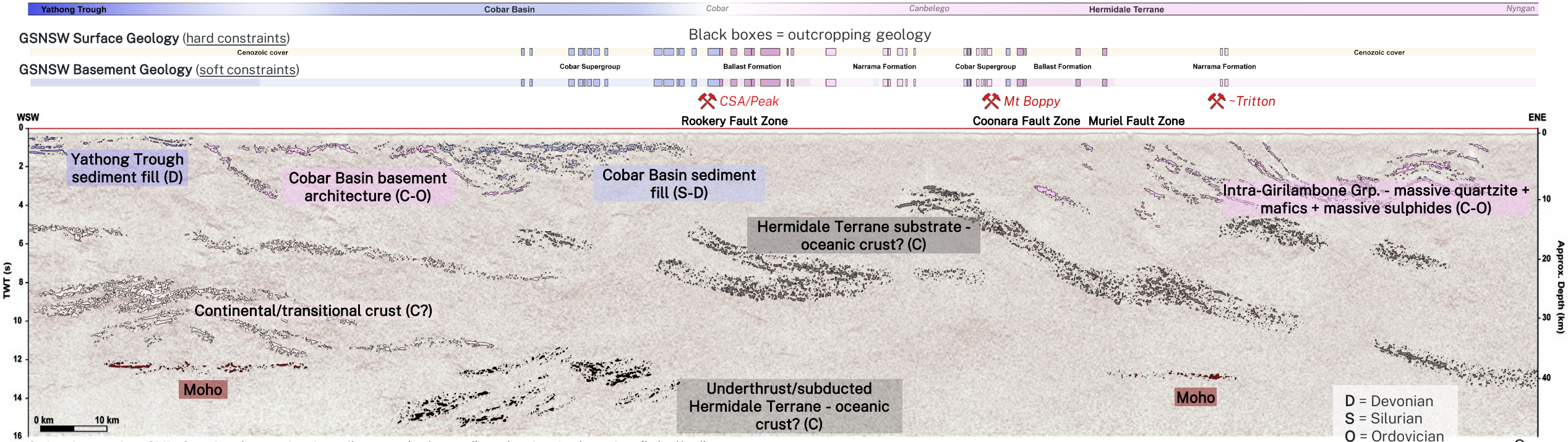


PSTM seismic section CY1

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

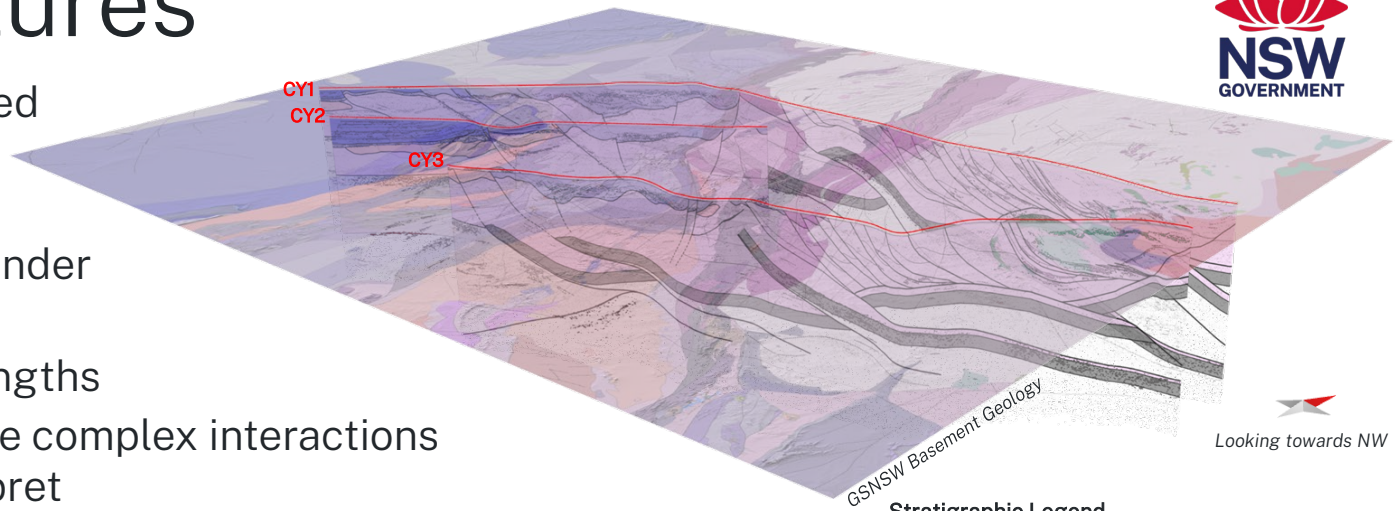


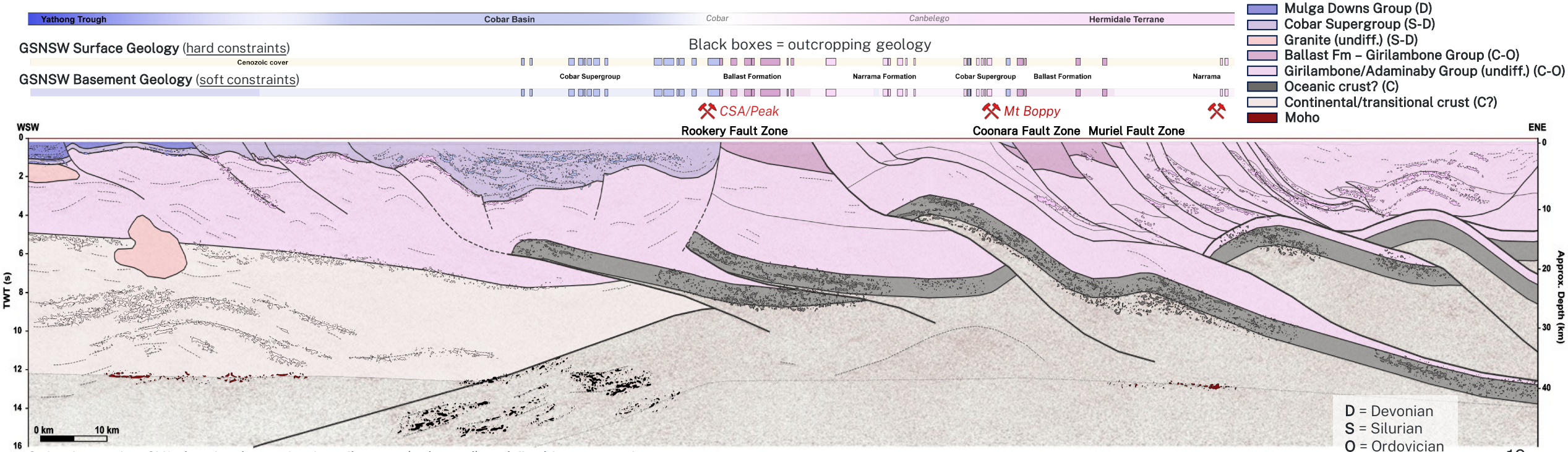


Seismic section CY1 showing key seismic reflectors (coloured) and seismic domains (labelled)

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





Seismic section CY1 showing key seismic reflectors (coloured) and final interpretation

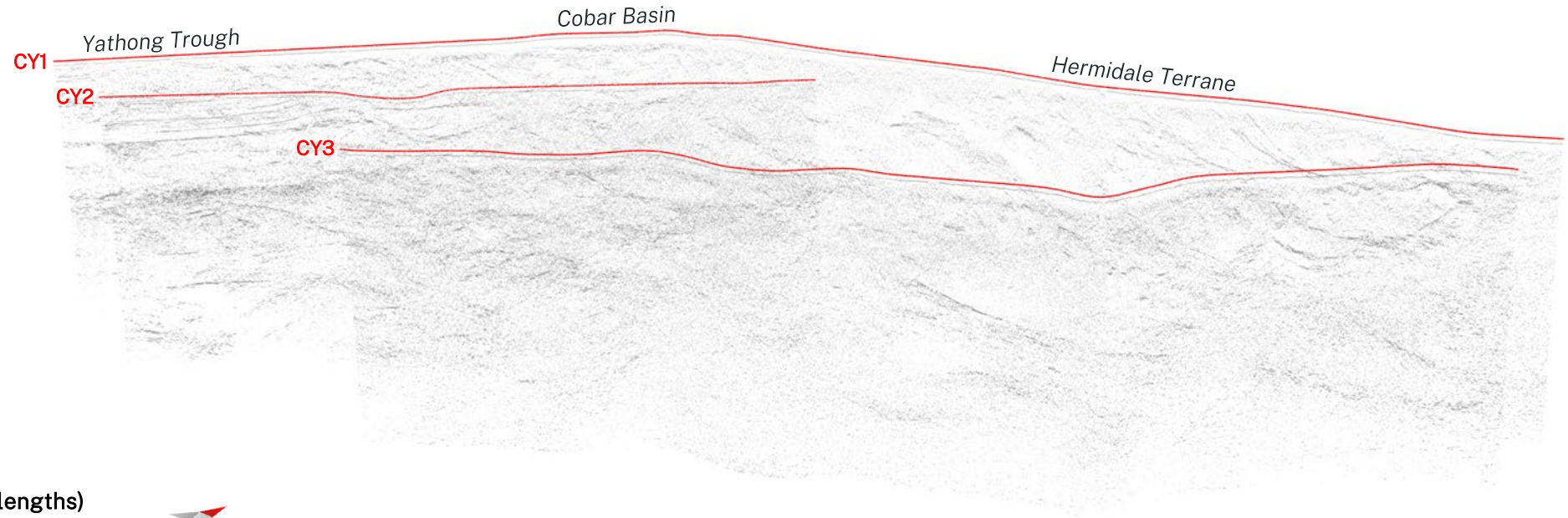
Interpretation — 3D validity

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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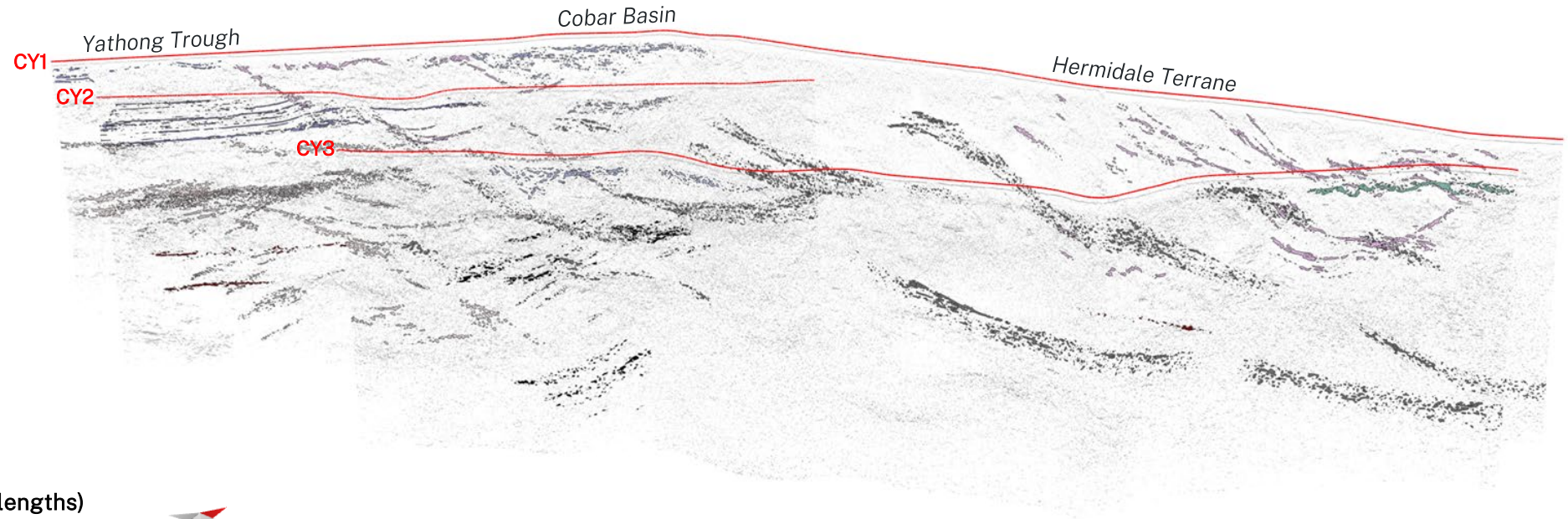

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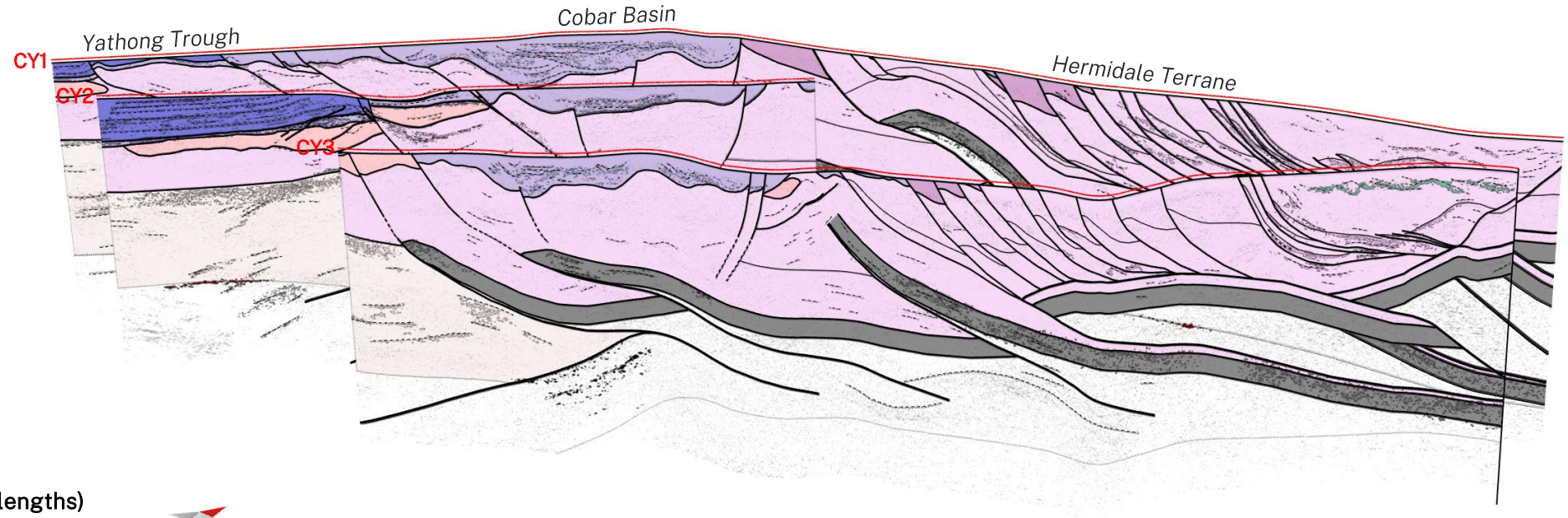

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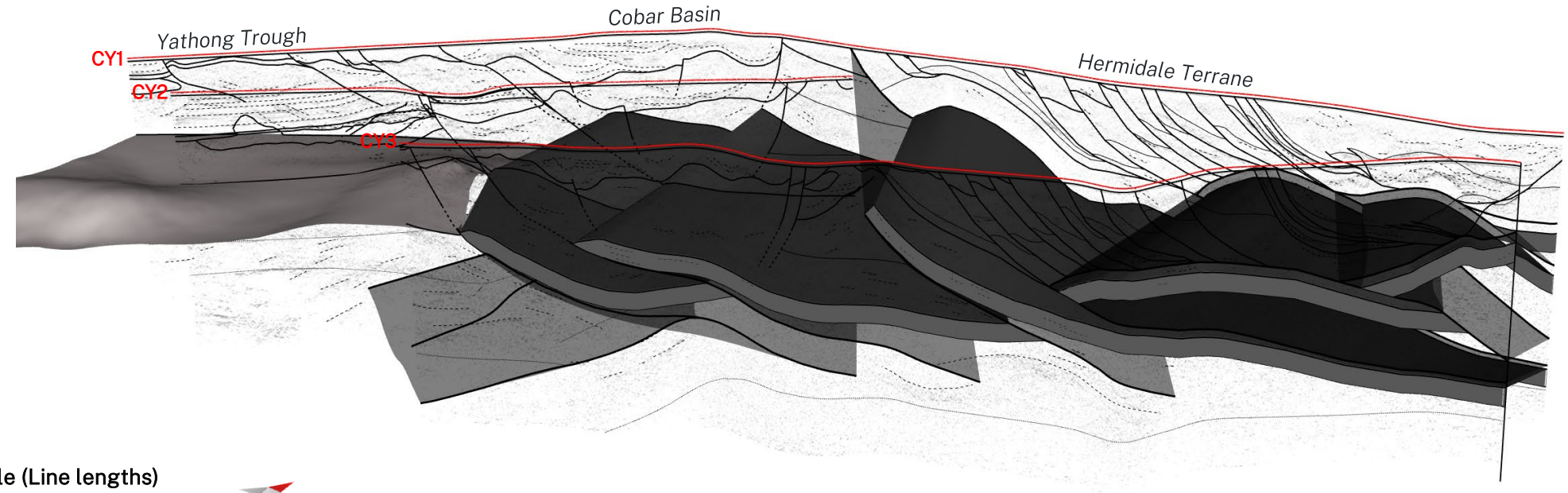

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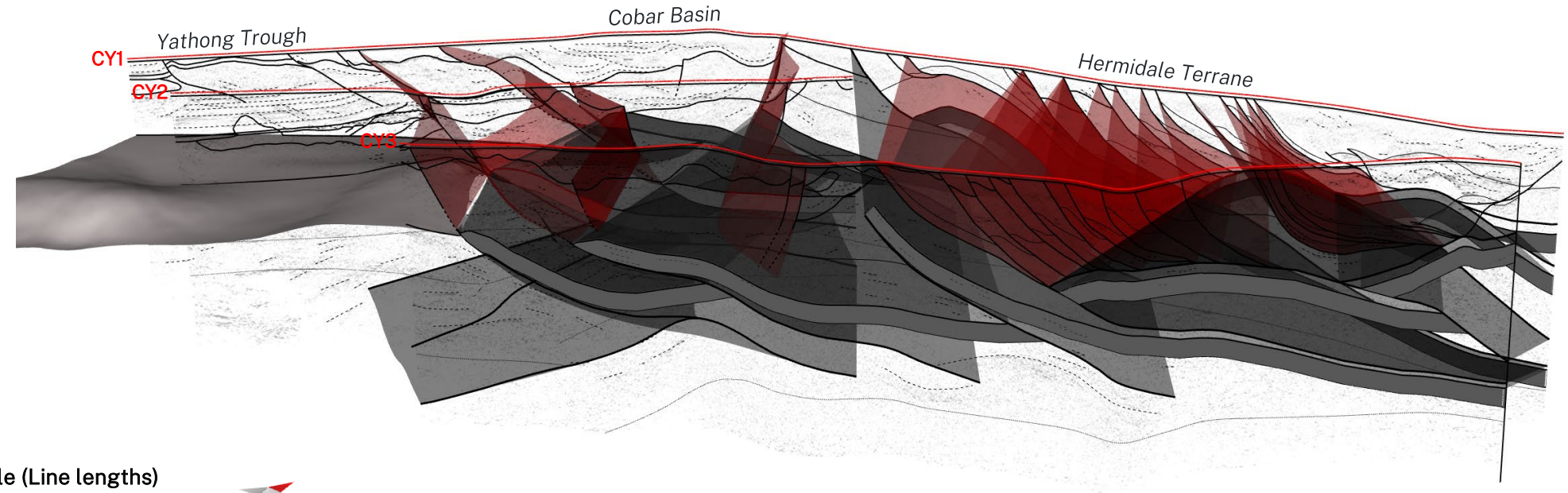

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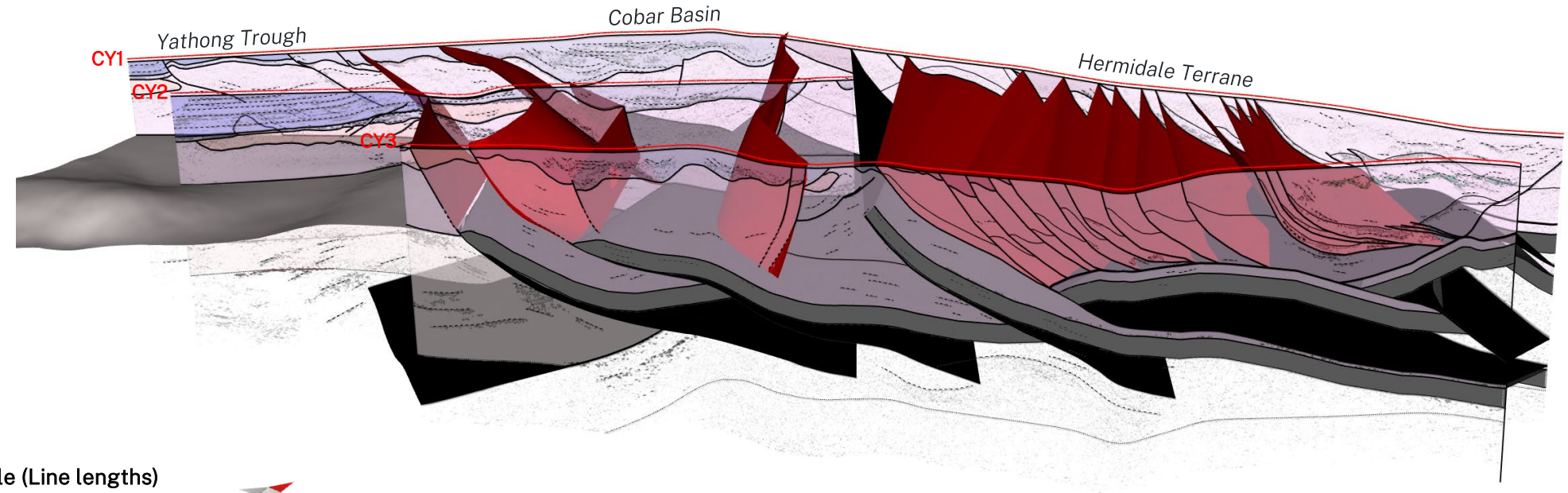

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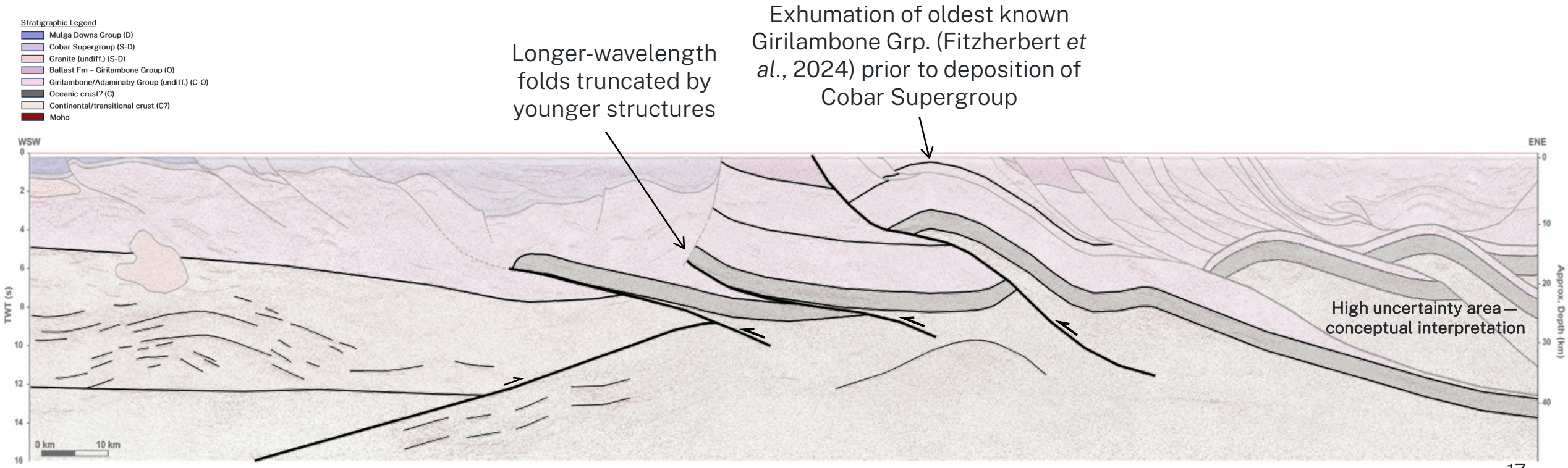
Looking towards NW

Geological evolution — temporal constraints

Two phases of orogenesis identifiable from geological observations, cross-cutting relationships and fold wavelengths:

1. Longer wavelength folding (> 30 km) and crustal-scale thick-skinned faulting affecting only the Hermidale Terrane (incl. under the Cobar Basin) and continental/transitional crust. Relationship with Cobar Basin extensional structures suggest this deformation is older, likely related to the **Benambran Orogeny**



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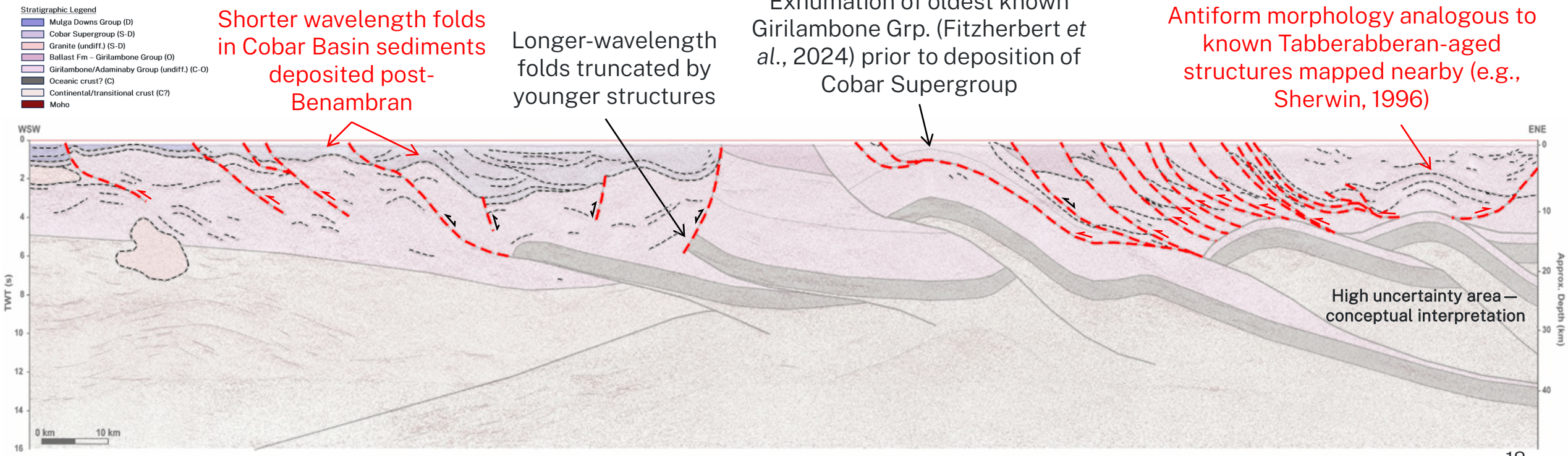
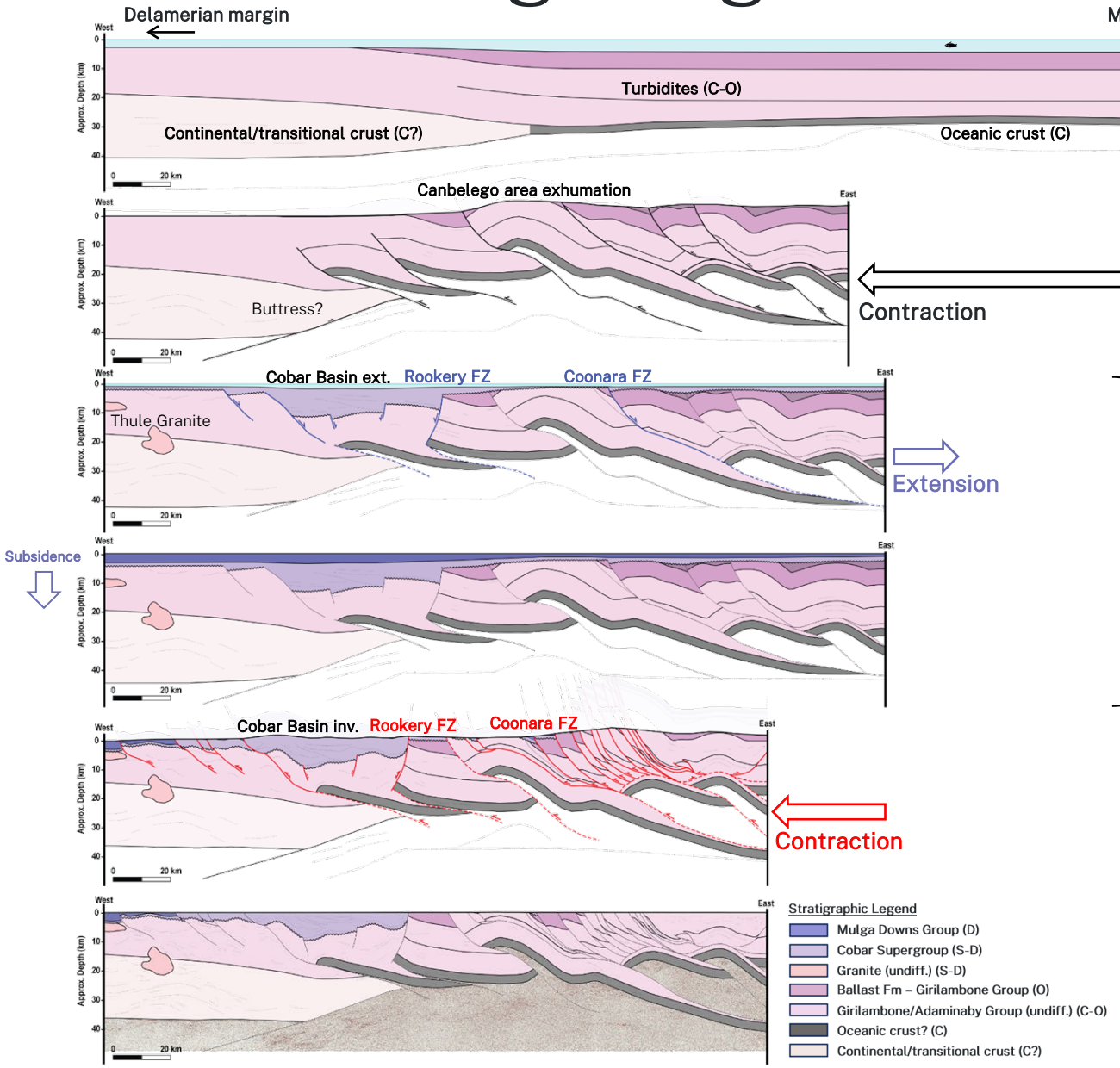
2. Shorter wavelength folding (< 15 km) and closer-spaced faulting affecting both the Hermidale Terrane (imbrication) and the younger Cobar Basin and Yathong Trough (inversion and thrusting). Likely related to the **Tabberabberan Orogeny** (and/or younger events)



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)

- ~15% shortening of the Hermidale Terrane, reactivation of pre-existing Benambran structures and formation of shallowly detached thrust faults and shorter wavelength folds
- Inversion of Cobar Basin and emplacement of epigenetic mineral deposits

Present Day

- As constrained by new Cobar-Yathong seismic and legacy datasets

Tectonic cycles modified from Glen 2005

Summary

- Good quality seismic imaging for a complexly structured onshore environment
- Seismic domains identifiable and robustly correlatable between overlapping seismic lines
- Improved subsurface characterisation of the nature of, and the relationship between, the Hermidale Terrane, Cobar Basin and Yathong Trough
- Constraints from seismic images coupled with new (and legacy) data are offering new insights into the complex multi-phased geological evolution of the region