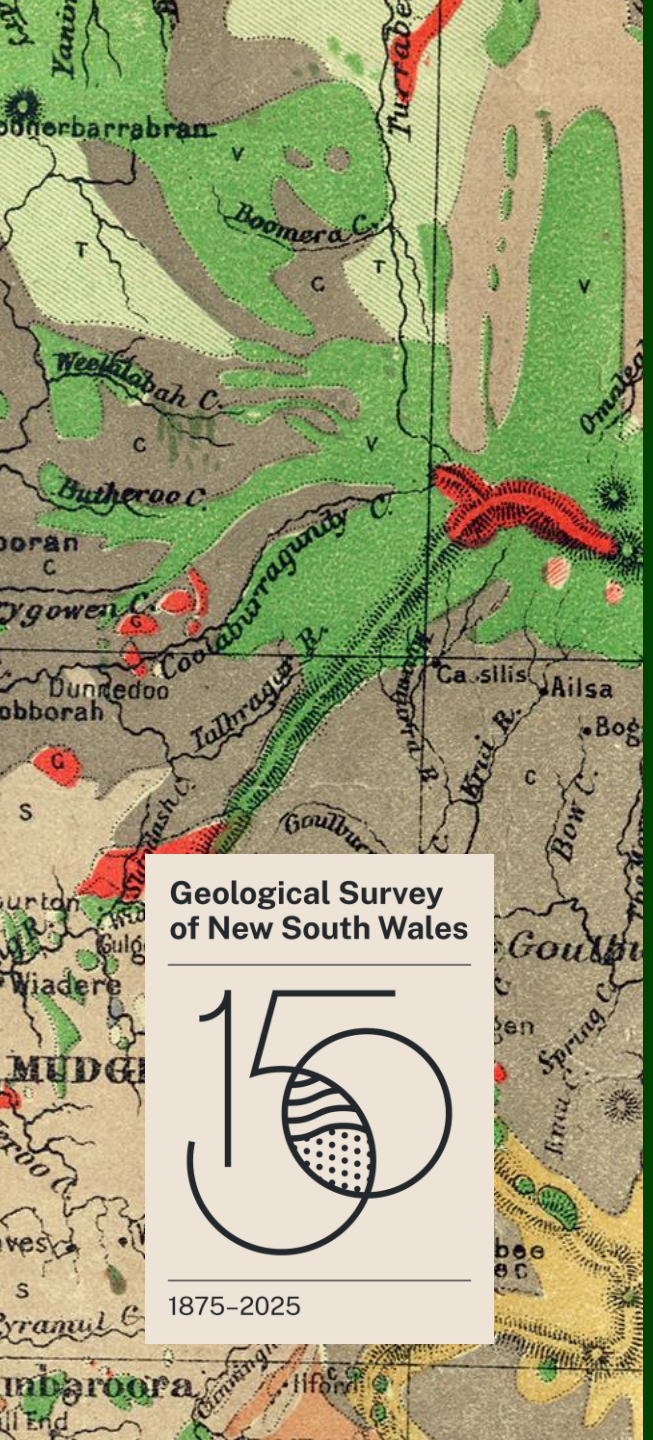


Insights into the Cobar–Hermidale–Yathong region from seismically constrained potential field modelling

Integrated interpretation of deep crustal seismic

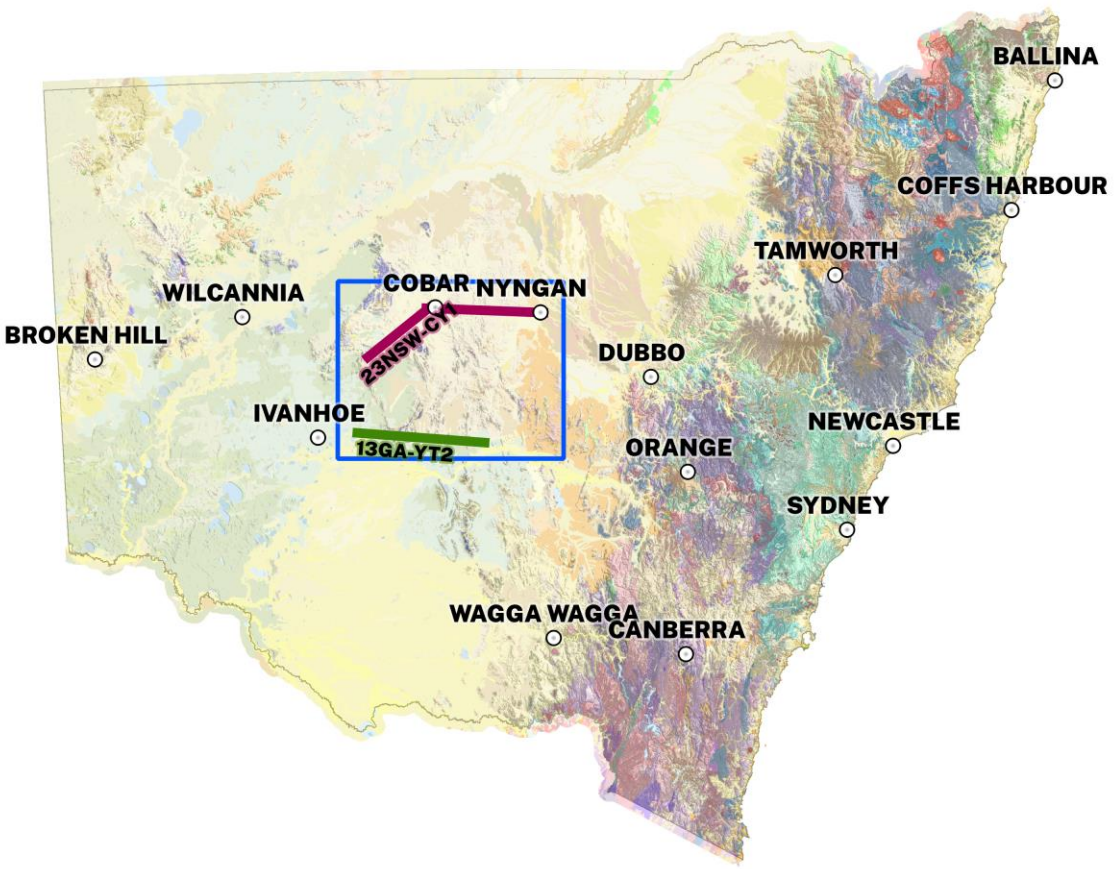
Max Milz
Geophysicist

Dr Luke Mahoney
Senior Geoscientist 3D

9 May 2025

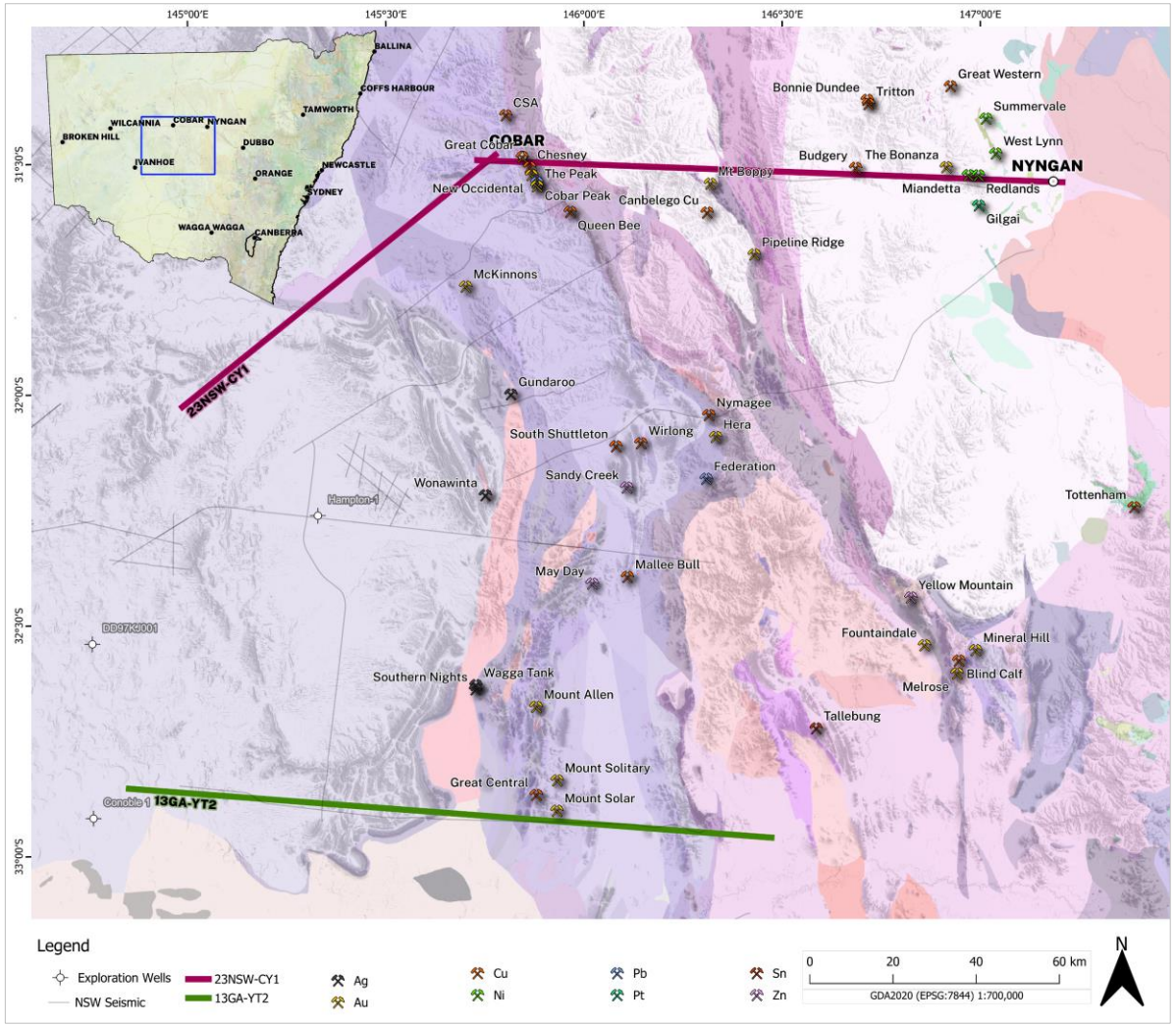
NSW GOVERNMENT

Project overview



- **Project summary**: Iterative forward modelling along 2 deep crustal seismic sections to improve subsurface geology, inform MinEx CRC drilling and better understand controls on mineral systems.
  - 23NSW-CY1: located along the Wool Track and Barrier Highway covering the Yathong Trough, Cobar Basin and Hermidale terrain.
  - 13GA-YT2: located over the Yathong, Mount Hope and Rast troughs.
- Initial seismic interpretation was mostly limited to areas with good signal.
- In problematic areas, seismic interpretation was driven by potential field modelling.

Project overview



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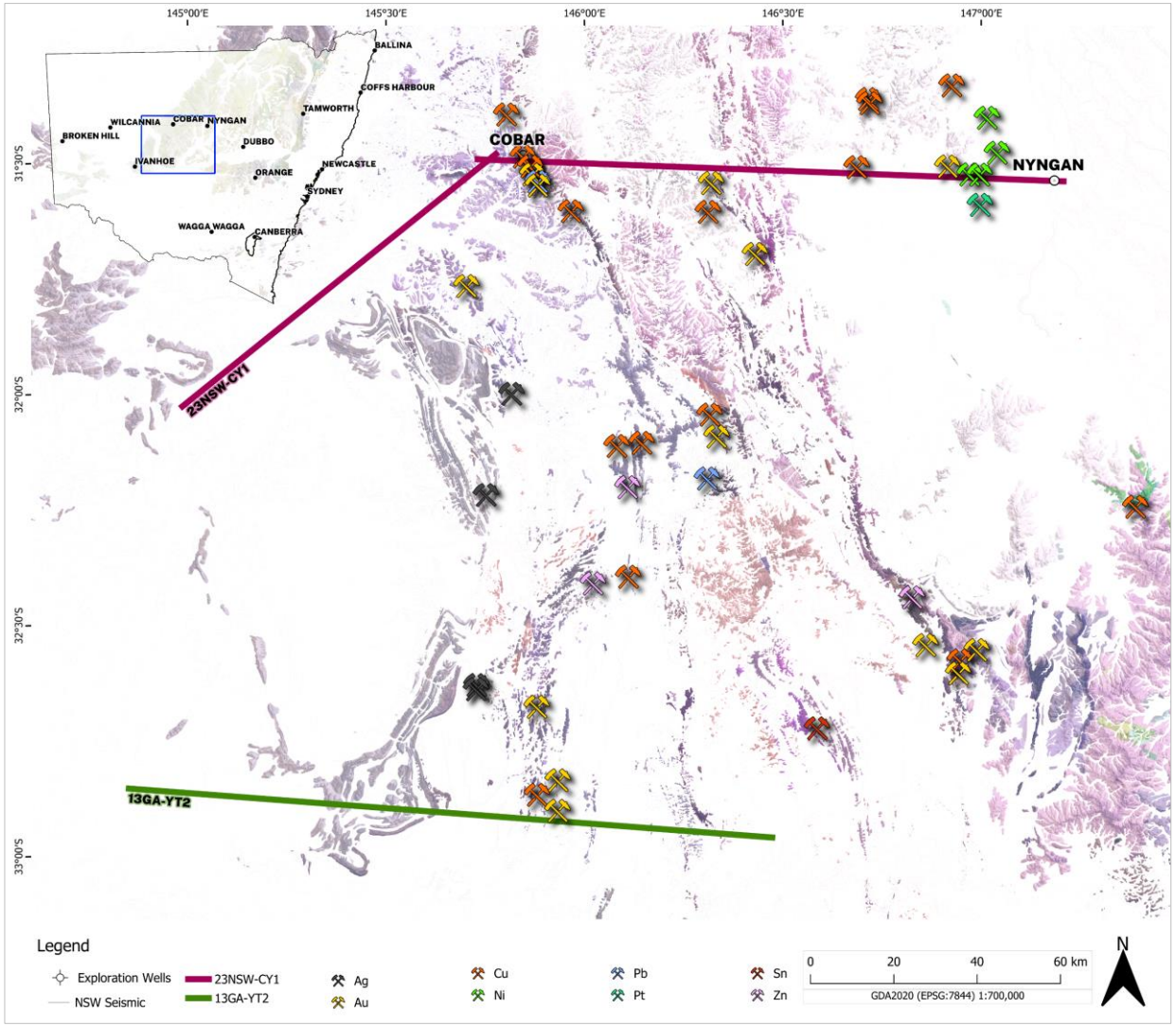
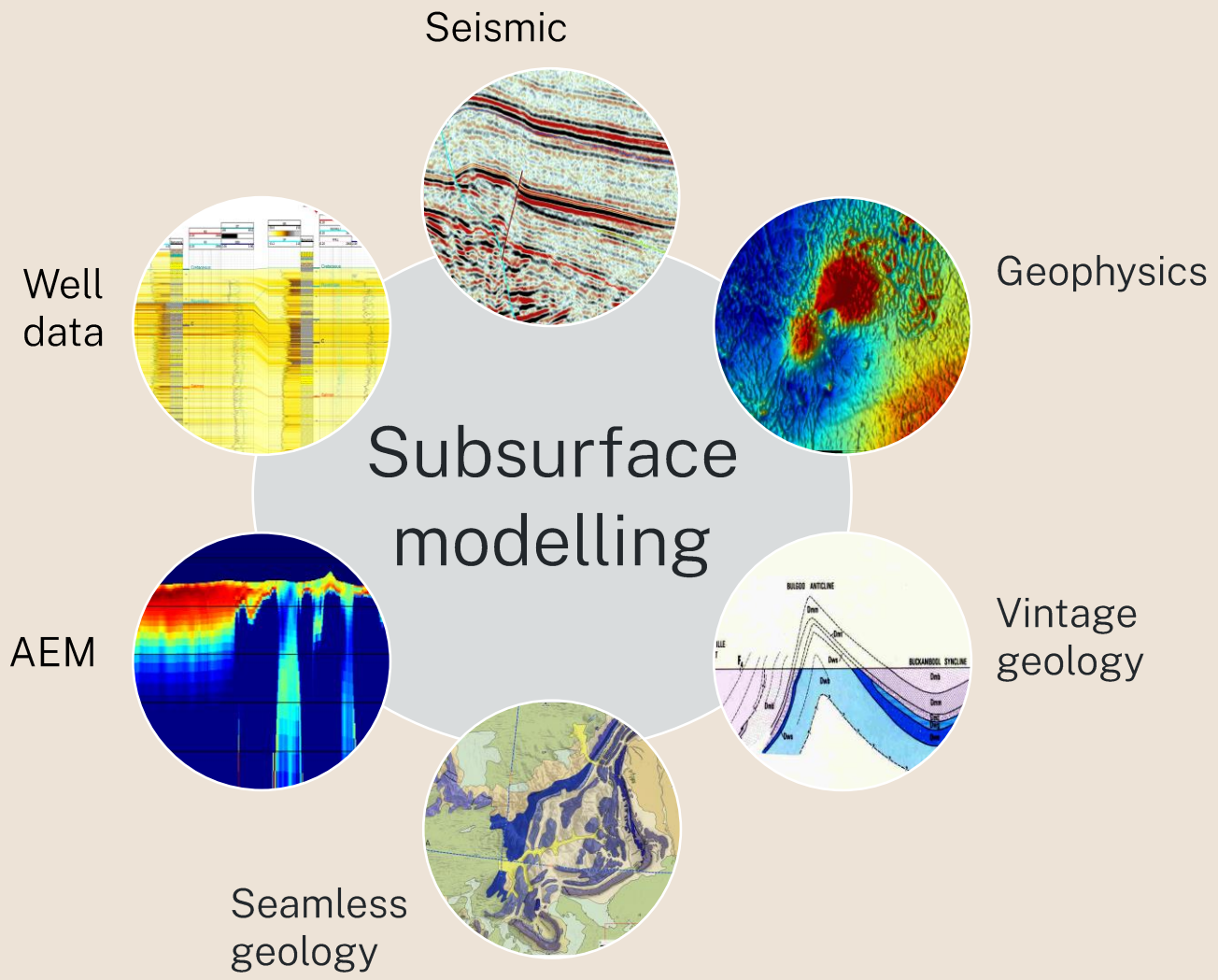
Incentive: undercover exploration



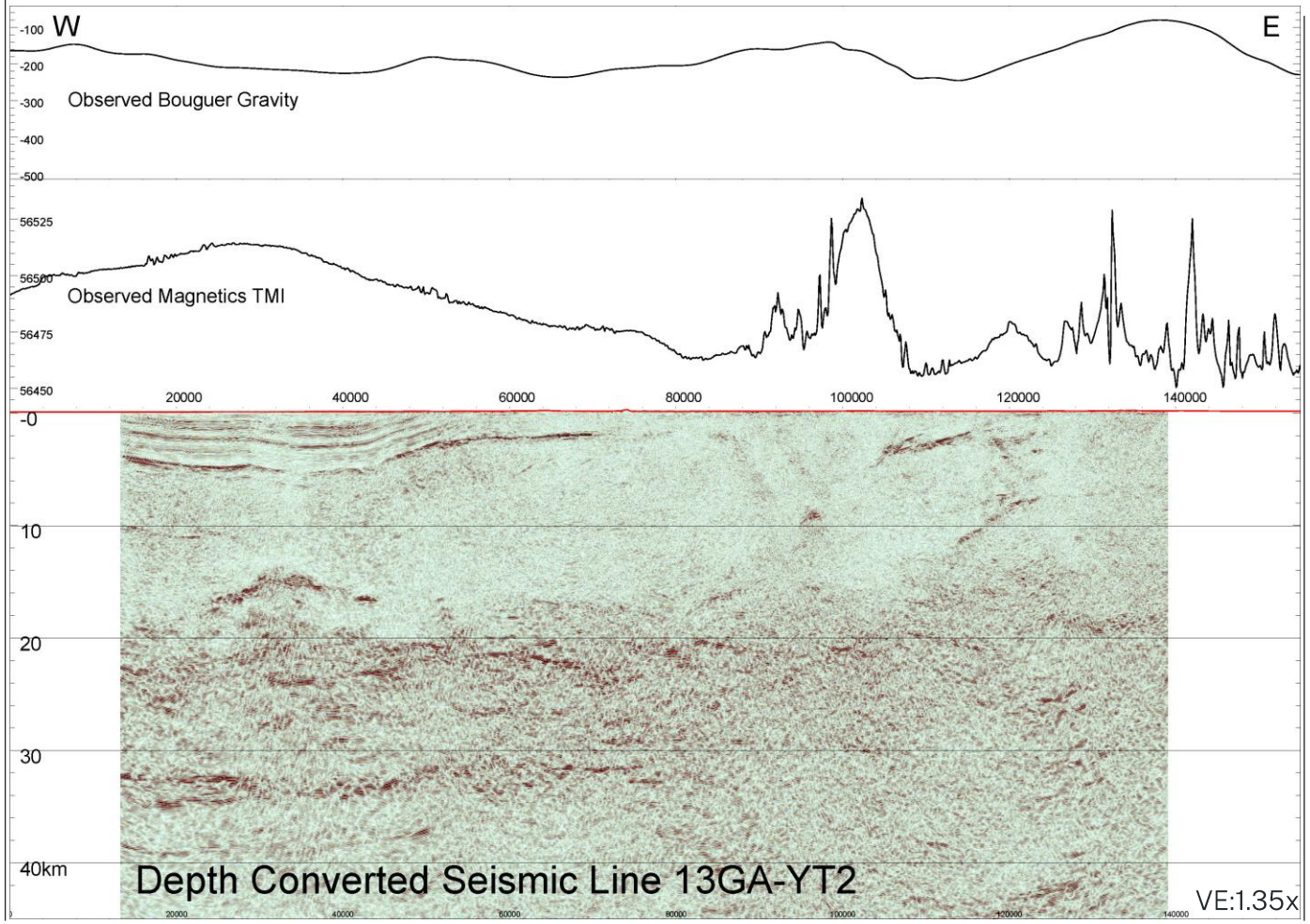
- The Cobar and Hermidale region is a historical and active mining province hosting deposits rich on Cu–Au–Pb–Zn–Ag-Ni.
- Exploration is increasingly undercover.
- World-class pre-competitive geophysical datasets - decades of value.
- Regional modelling to constrain the evolution of basin provenance, and further, its influences on mineralisation.

1

Potential field modelling methodology



Deep crustal modelling method



Similar method as described by Musgrave (2020) '*Integrating seamless geological mapping with geophysics: a profile across (and beyond) East Riverina*' was used:

1. Set regionals to constant, considering that lower crust and Moho will be modelled
2. Initially target deep magnetic sources- long wavelength
3. Shallow magnetic sources- short wavelength, run constrained inversions with reasonable parameters
4. Incorporate the gravity response
5. Synchronise a joint signal and refinement

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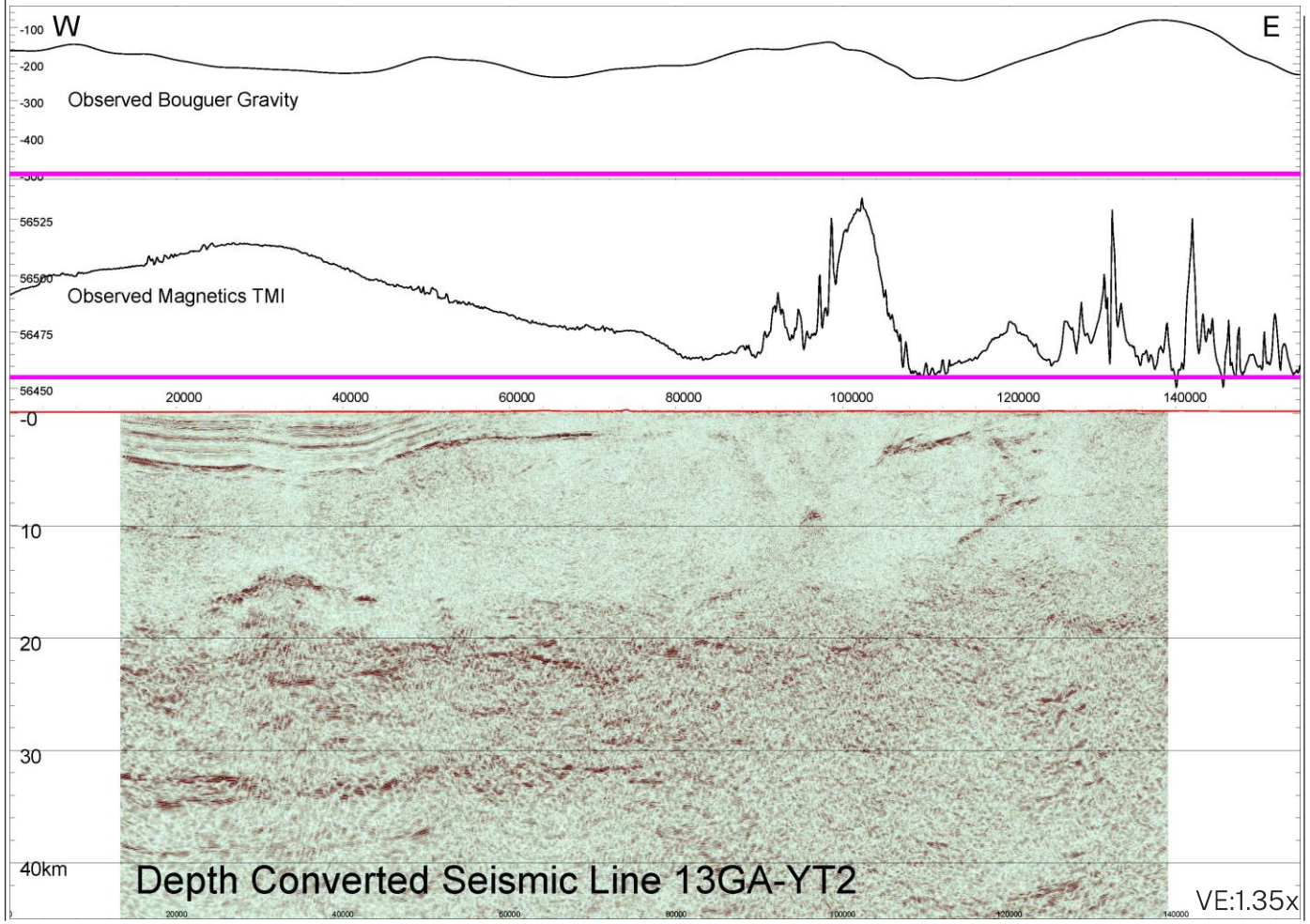

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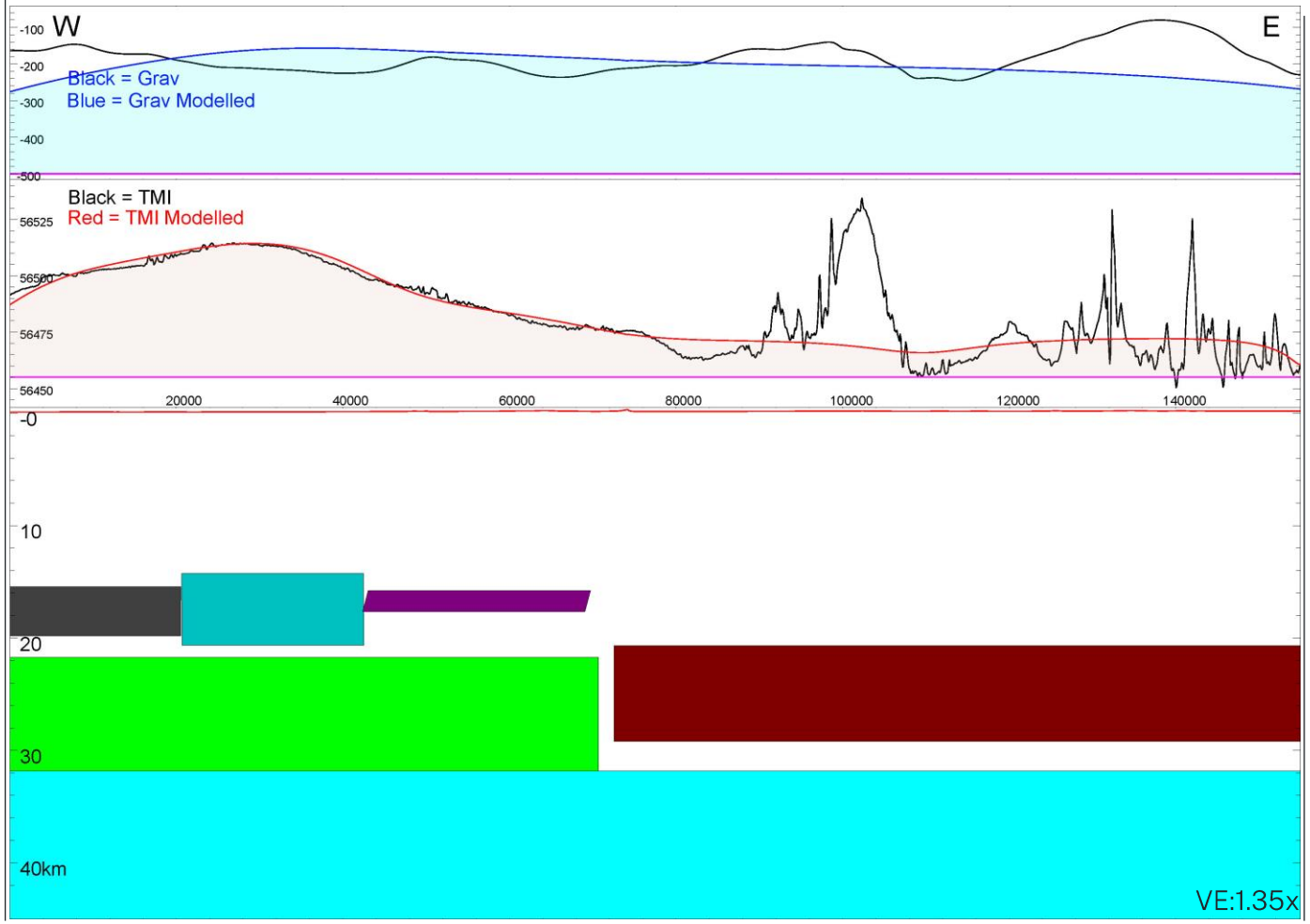

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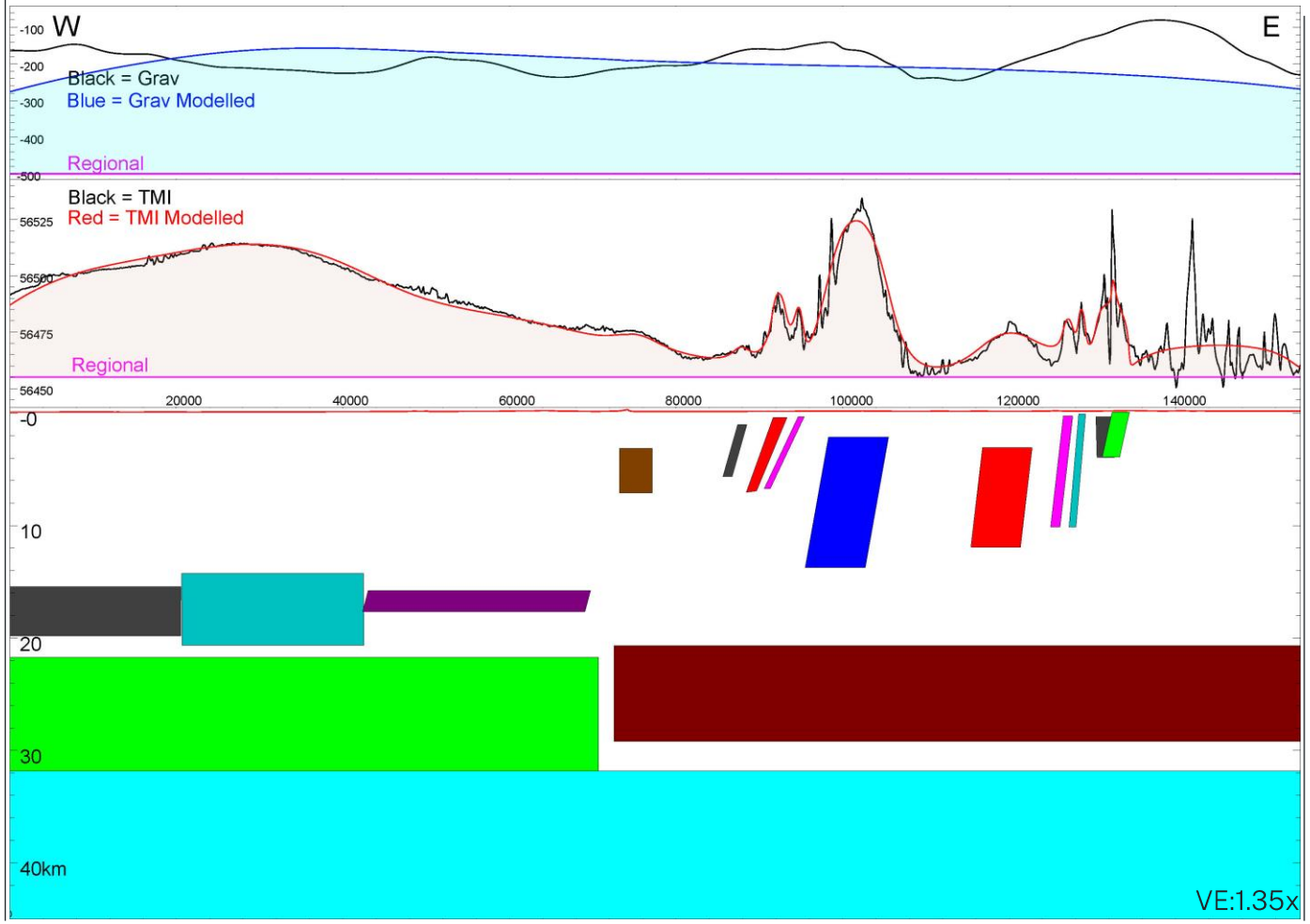

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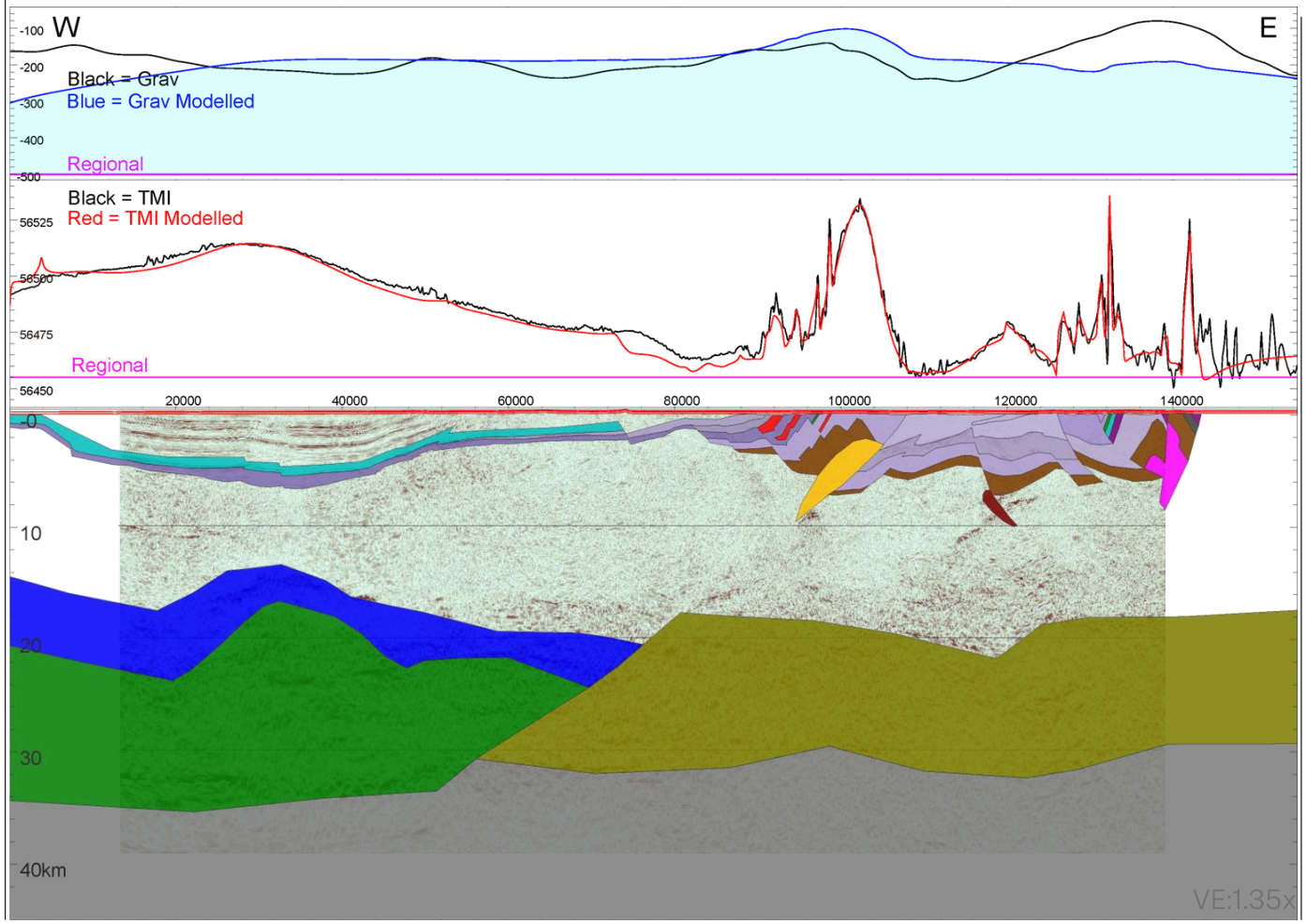

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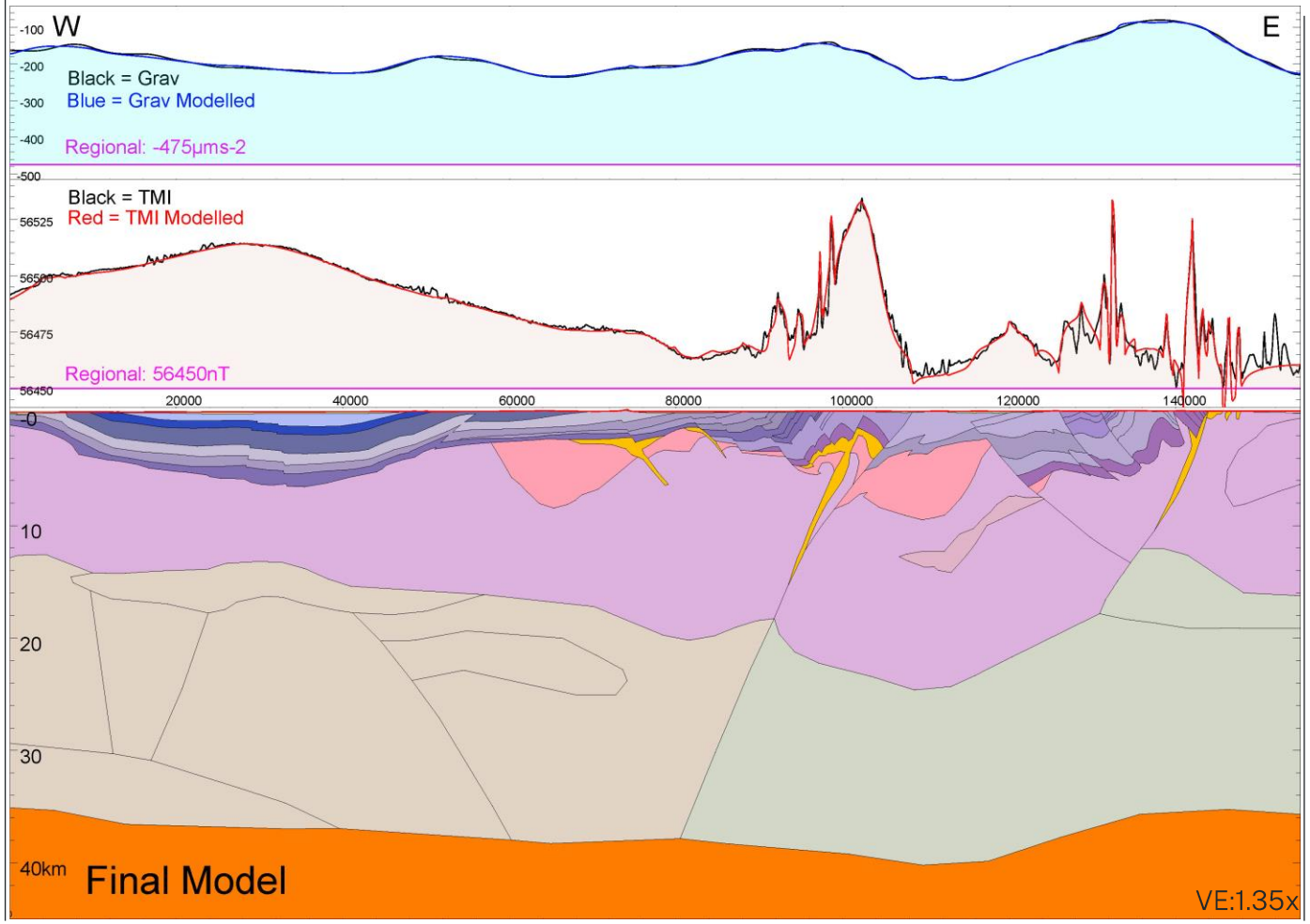

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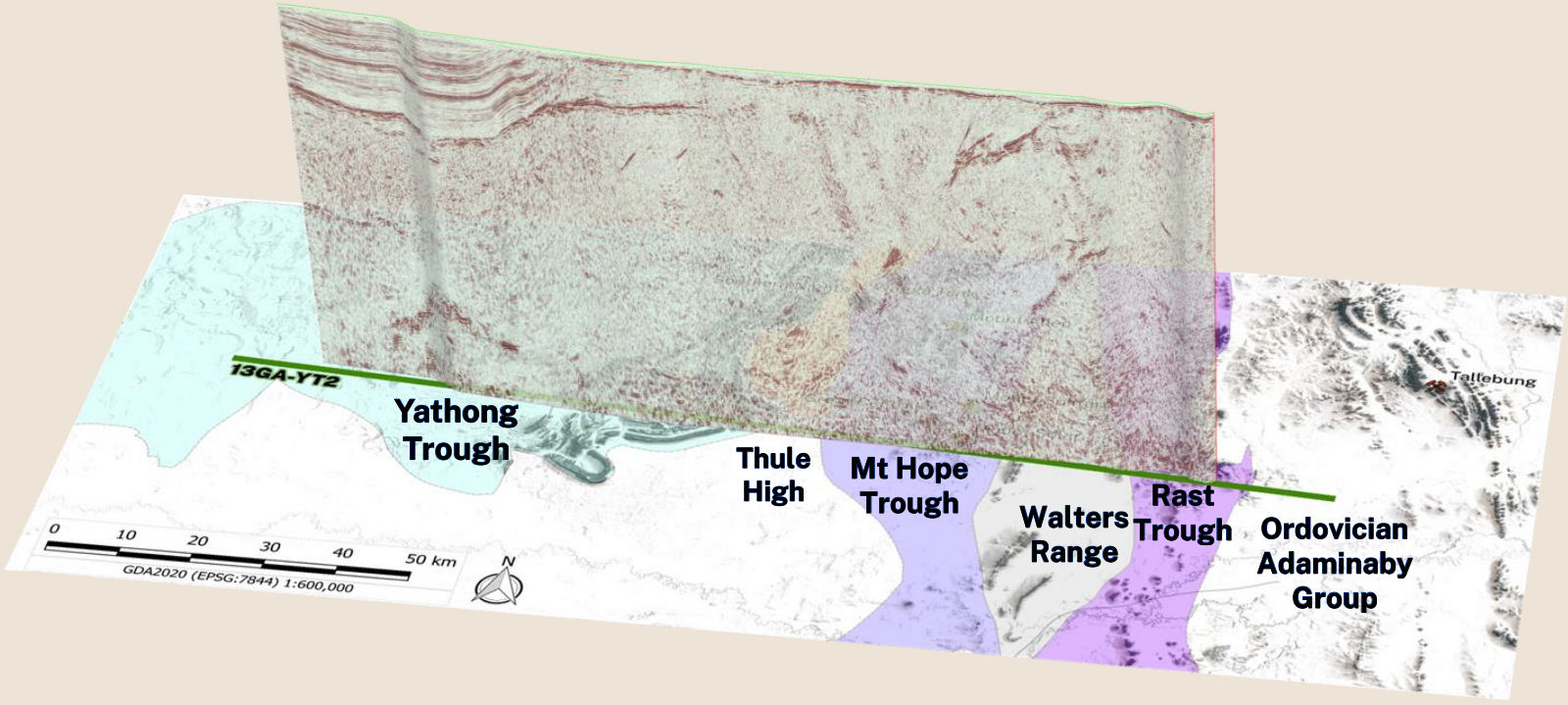
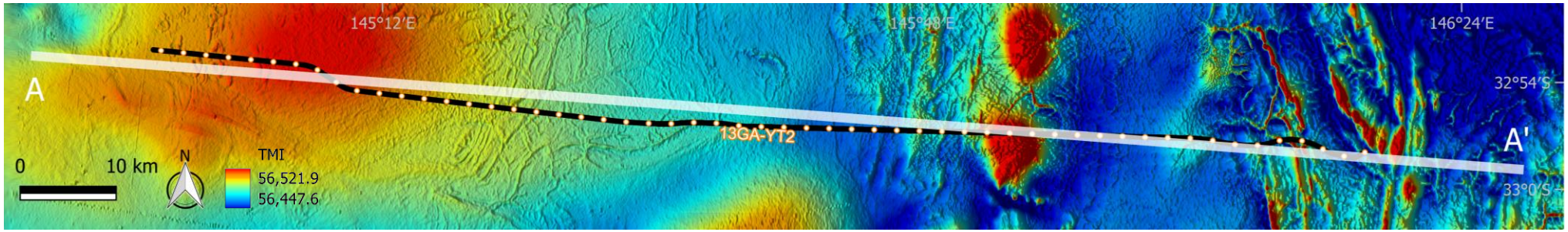
2

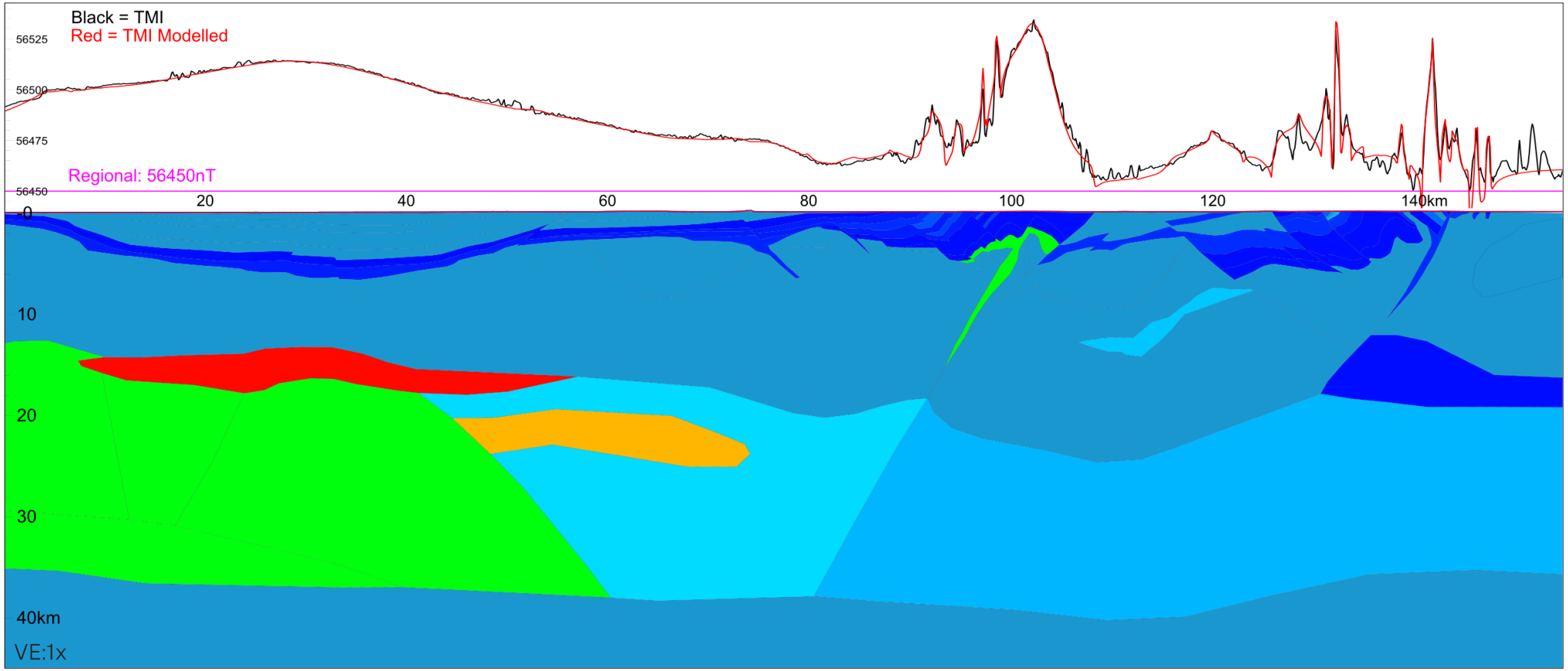
13GA-YT2

Model results



13GA-YT2 magnetics signal



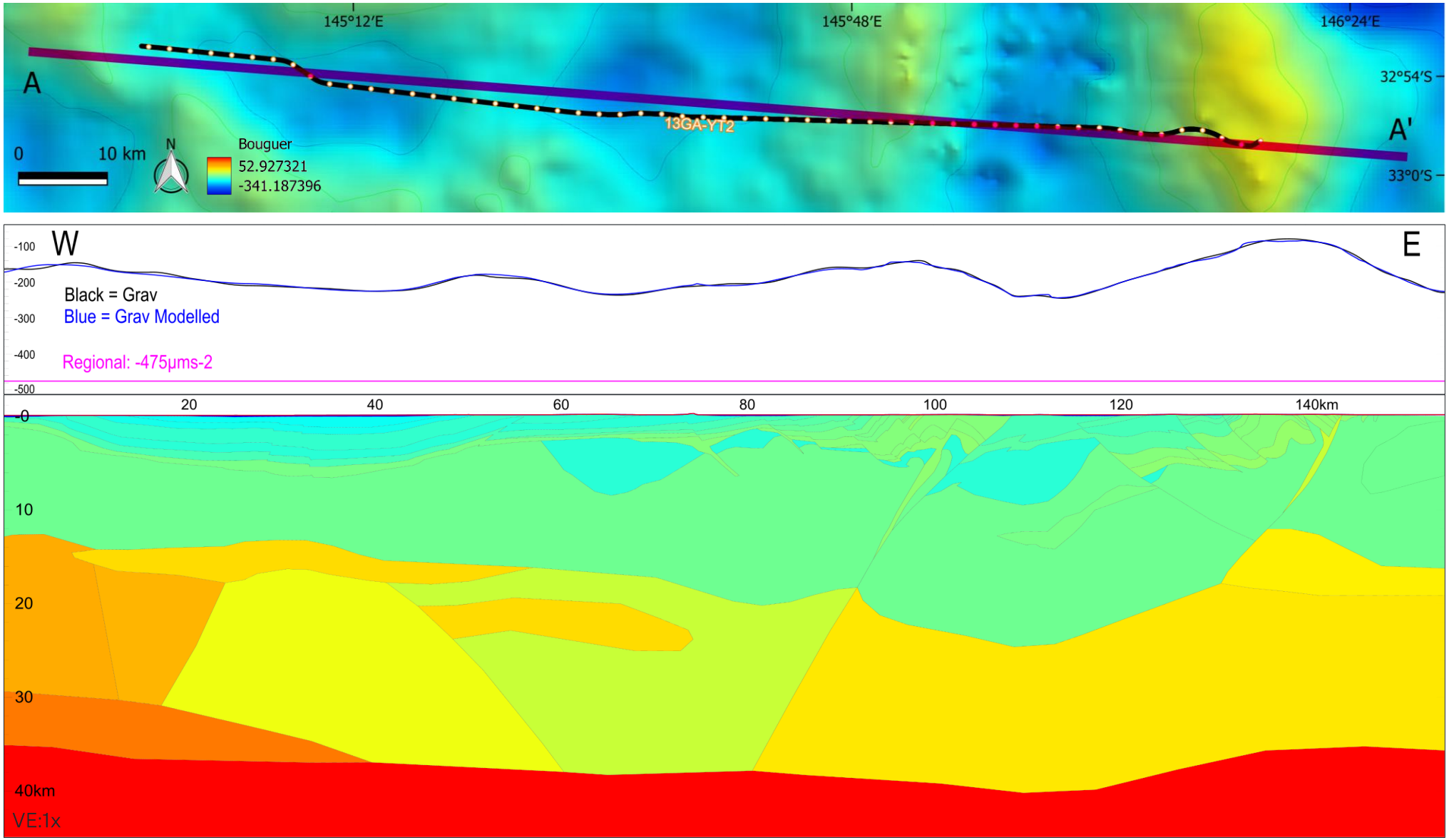


Total magnetic intensity (TMI)

- Long-wavelength anomaly over Yathong Trough – lower Delamerian crust?
- Shallow sources – Mt Hope Group and Rast Group volcanics
- Sharp anomaly under Mount Hope Trough – volcanics eruptive centre

GSNSW statewide total magnetic intensity dataset used for modelling

13GA-YT2 gravity signal

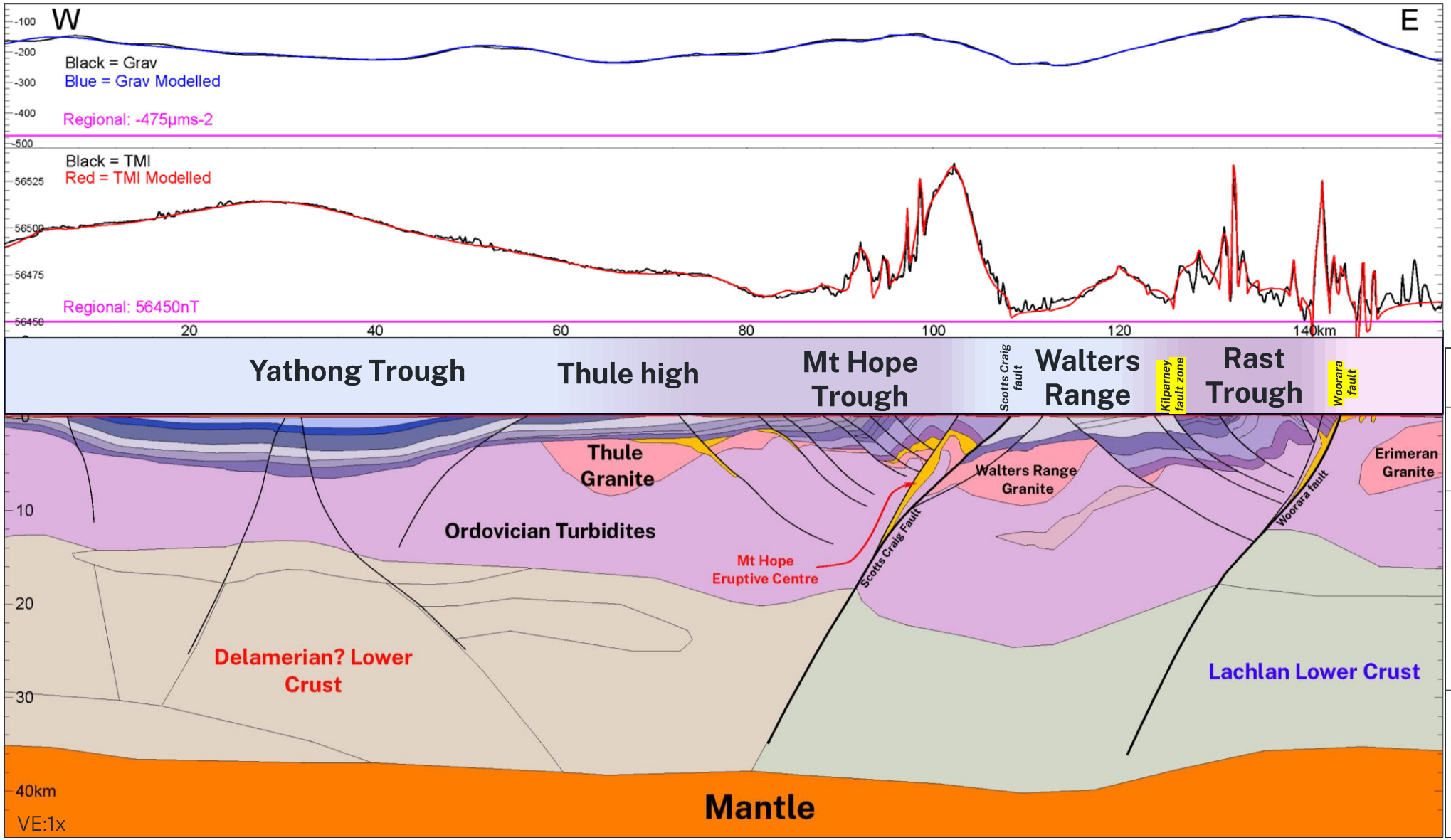


GSNSW statewide Bouguer gravity dataset used for modelling

Bouguer gravity

- Low over the Walters Range – potential granite
- Thule granite extends further south than previous mapping
- Mt Hope and Rast troughs higher density – volcanic input and mineralisation

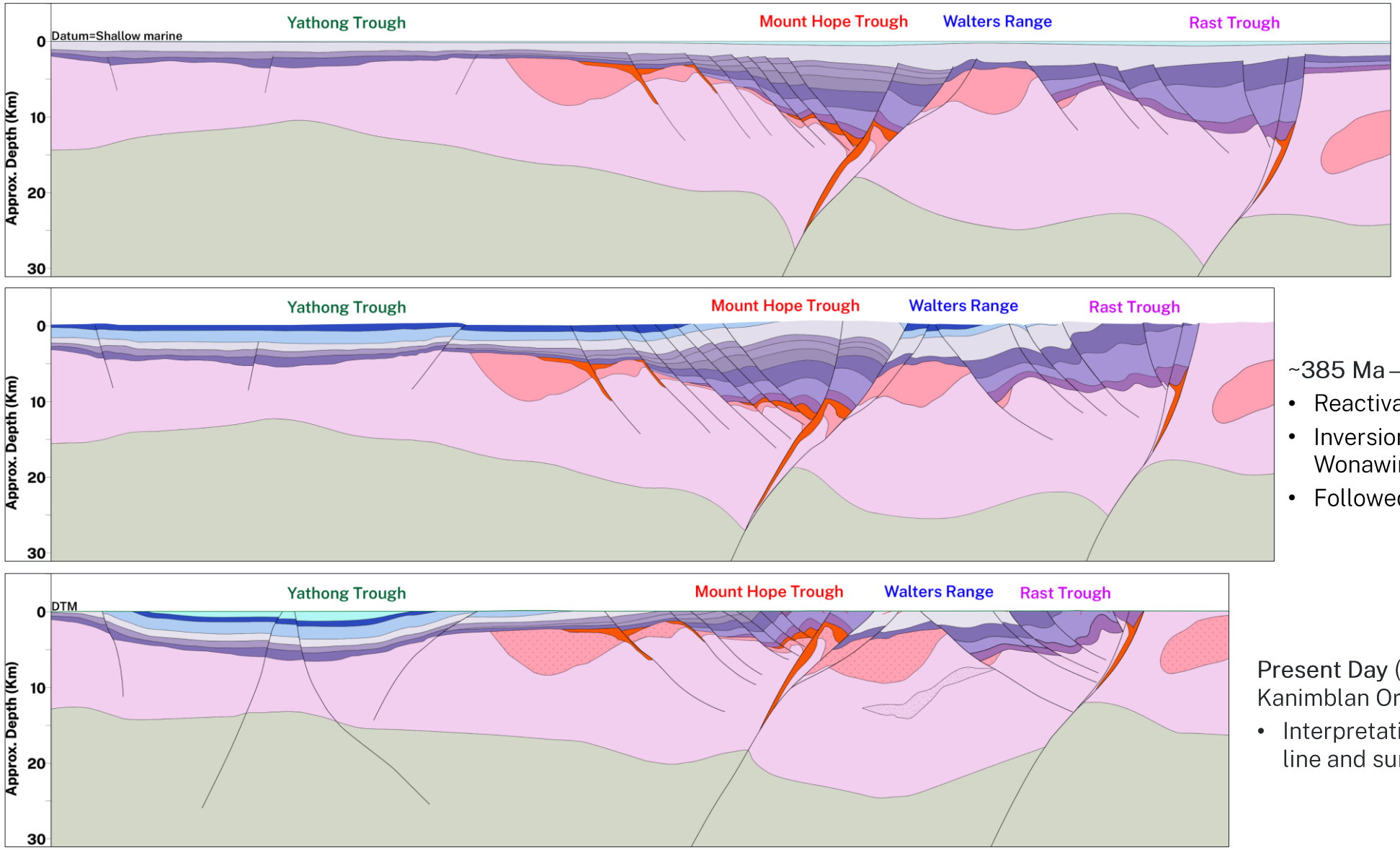
13GA-YT2 final model



- A regional approach highlights more geological continuity than originally thought
- Same rocks, different names

Seismic Intervals		Yathong Trough	Mount Hope Trough	Walters Range	Rast Trough
Mulga Downs	Ravendale Interval	Dmdr / Undiff.			
	Wana Karnu Interval	Dmdj / Dmdjk / Dmdrc			
		Dmdb / Dmdf / Dmde / Dmdy			
Cobar Supergroup	Winduck Interval	Winduck Group Dwi		Walters Range Group Dwr	
		Ambone Volcanics Dmha			
		Mount Kennan Volcanics Dmhm			
	Lower Cobar Supergroup Interval		Mount Halfway Volcanics Dmhh		
		Ambone Volcanics - lava deposit Dmha_l		Ambone Volcanics / Ural Volcanics ?	Ural Volcanics Drau
			Broken Range Group Dbk		Crossleys Tank Formation Drac
			Mouramba Equivalent ?		Mouramba Group Dmm
			Early rift volcanics		Early rift volcanics
Pre-Devonian Basement		Suw Silurian Granites (undiff.)			
		Ordovician Turbidites (undiff.)			
		Delamerian? Lower Crust		Lachlan Lower Crust	
		Mantle			

Schematic restoration for line 13GA-YT2



~407 Ma — Tabberabberan Cycle

- End of Cobar Supergroup deposition
- Sag phase mineralisation (Cu, Au, Zn)
- Gradual transition to fluvial environment driven by transpressional shortening

~385 Ma — Tabberabberan Collision

- Reactivation of pre-existing structures
- Inversion phase mineralisation (Pb-Zn-Ag) e.g. Wonawinta
- Followed by deposition of upper Mulga Downs

Present Day (deformation attributable to Kanimblan Orogeny and younger events)

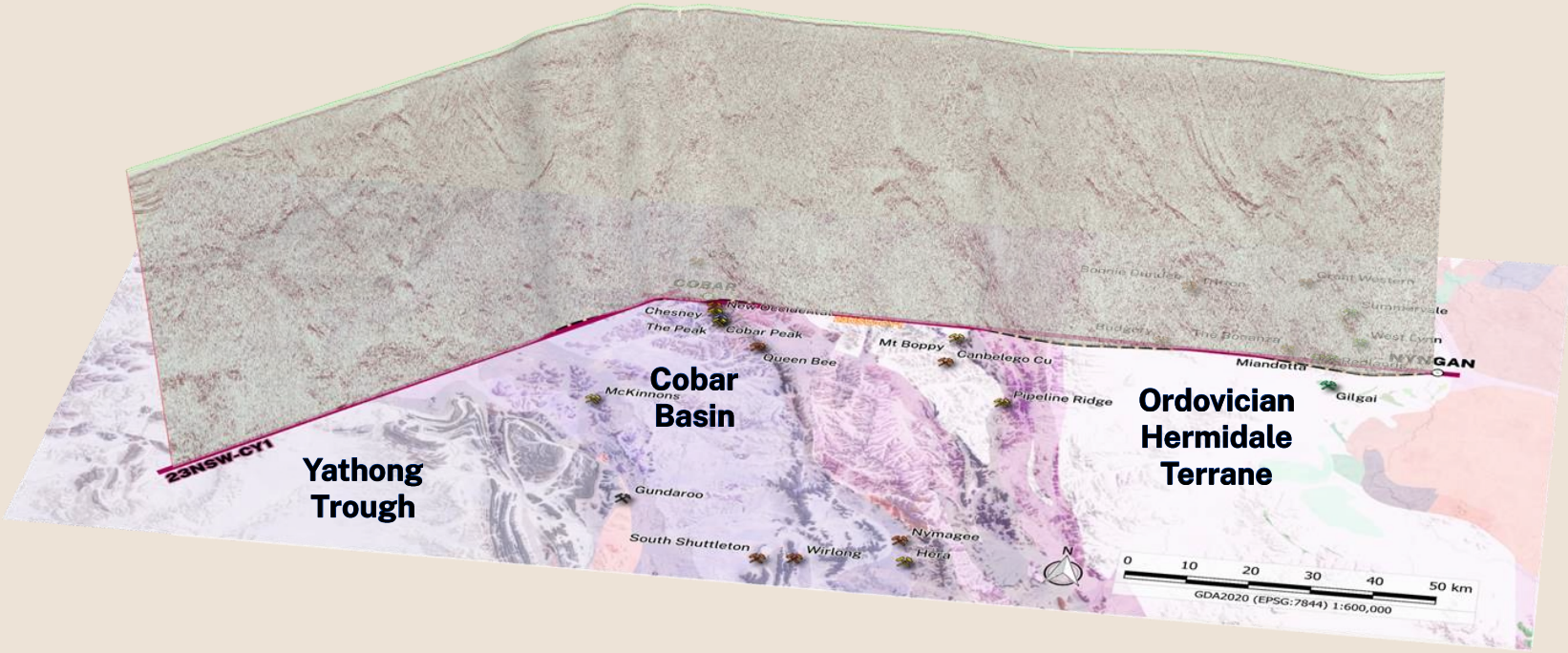
- Interpretation based on the 13GA-YT2 seismic line and surface geology

Geodynamic events modified from Folkes and Stuart 2020 and mineralisation timing based on Fitzherbert 2022

3

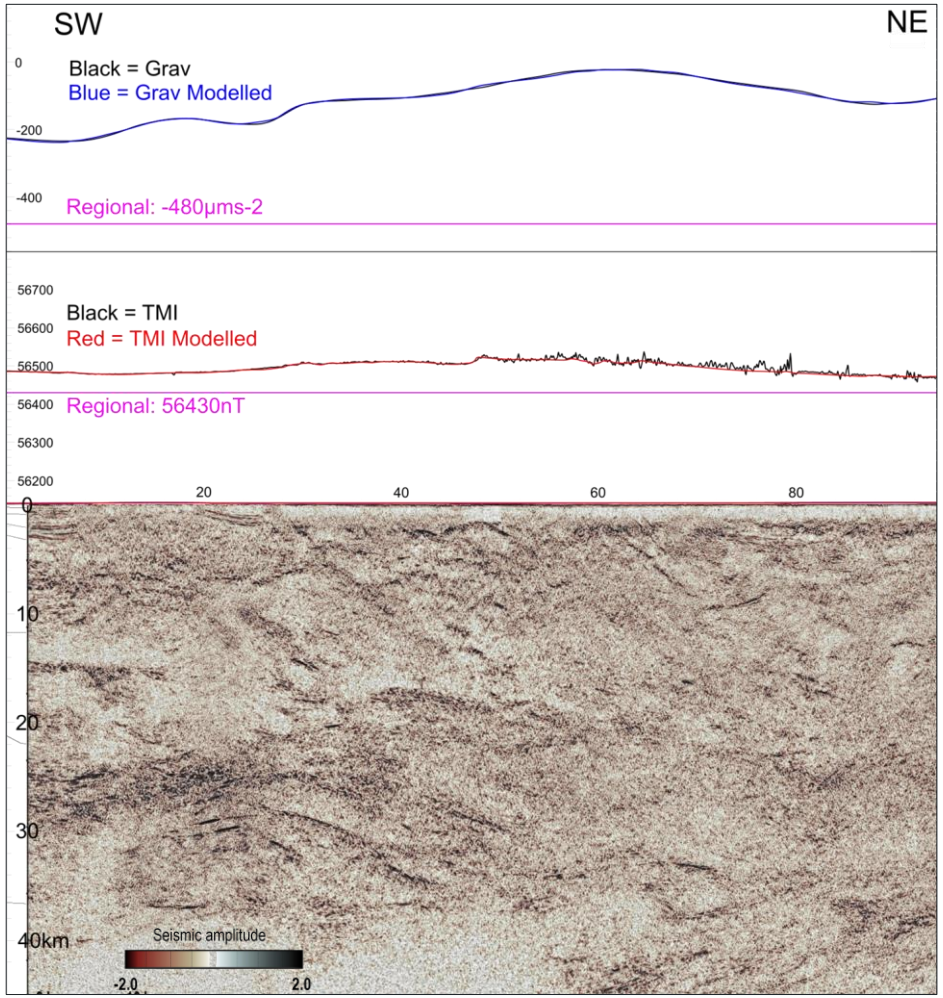
23NSW-CY1

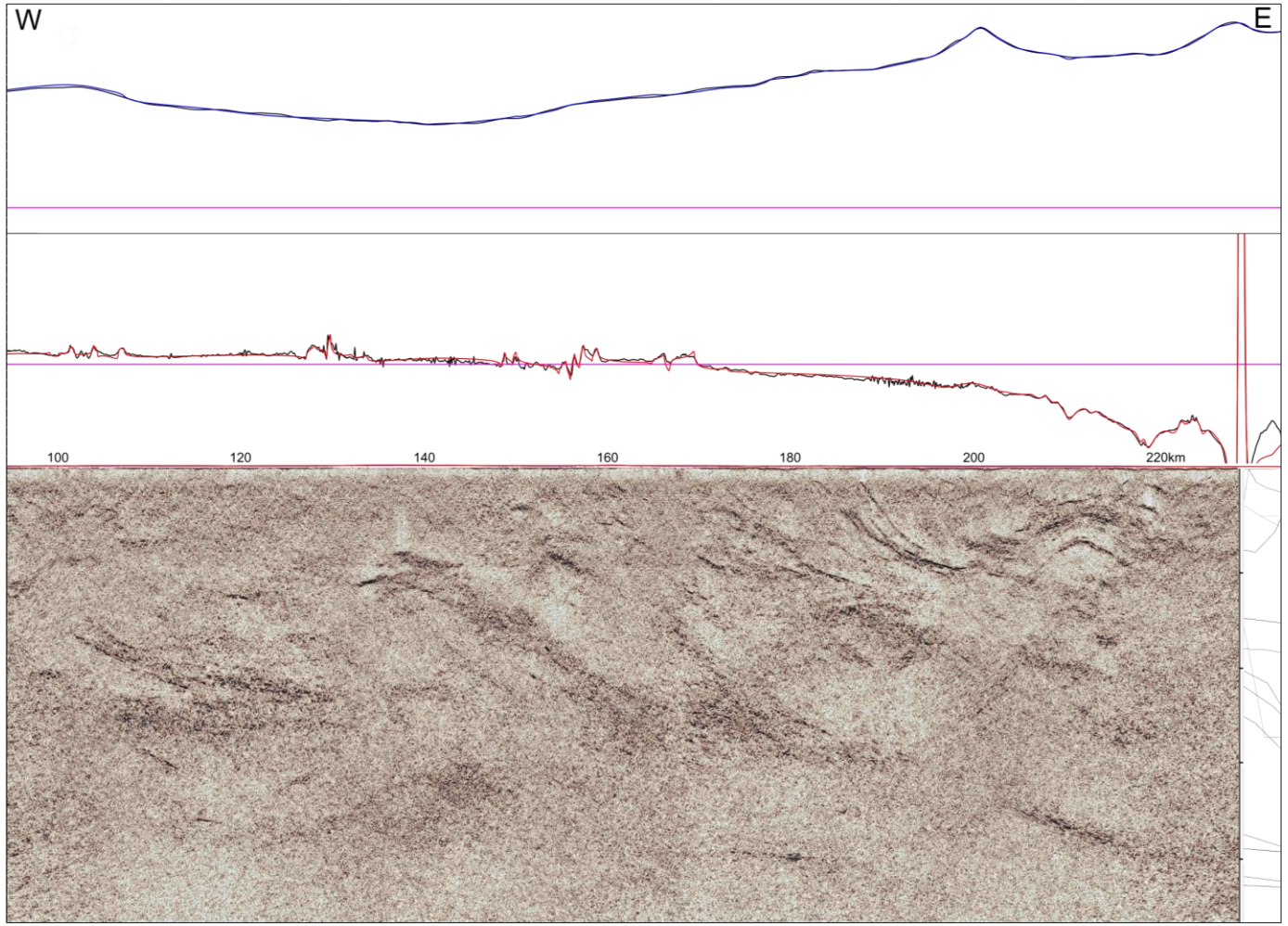
Model results



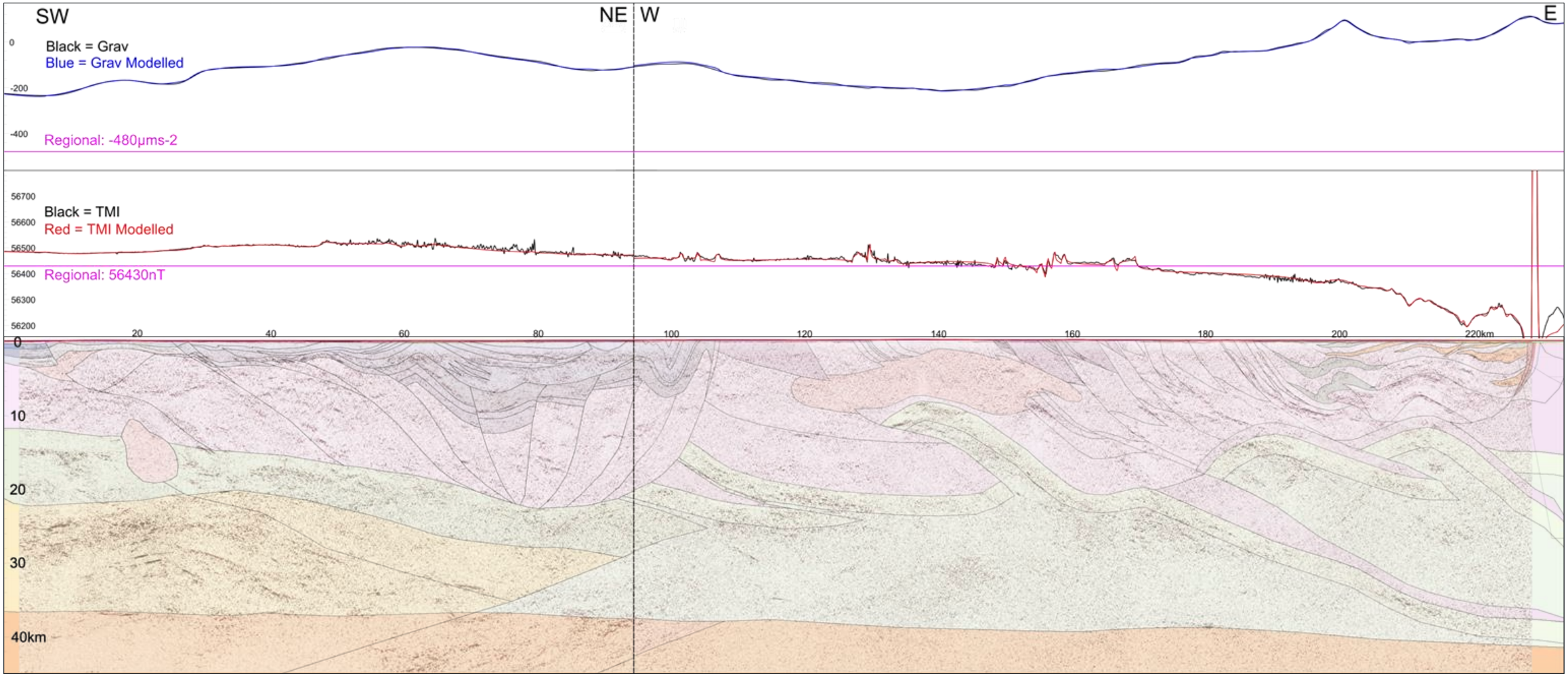
23NSW-CY1 seismic backdrop

West section | **Merge point** | **East section**

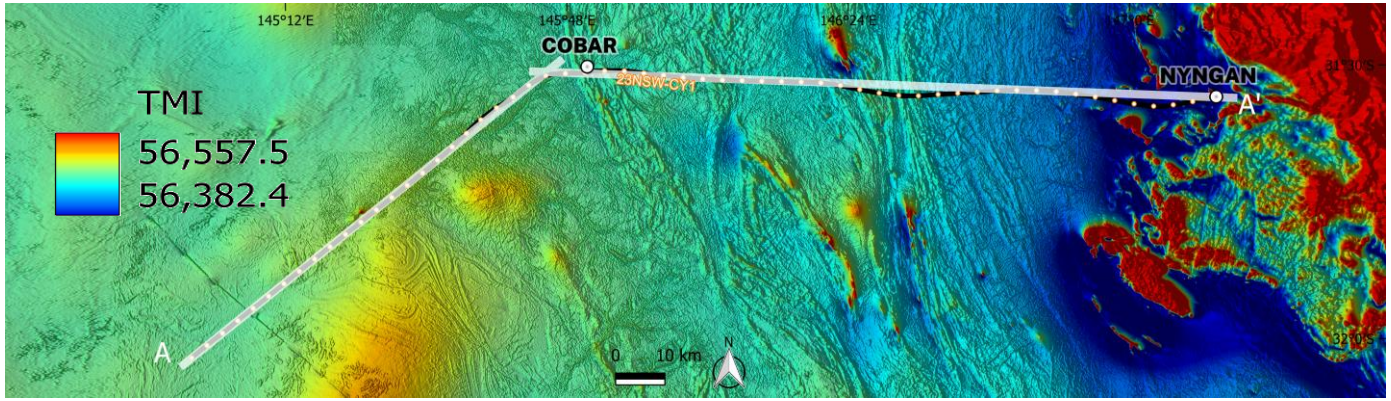




23NSW-CY1 wireframe and seismic backdrop

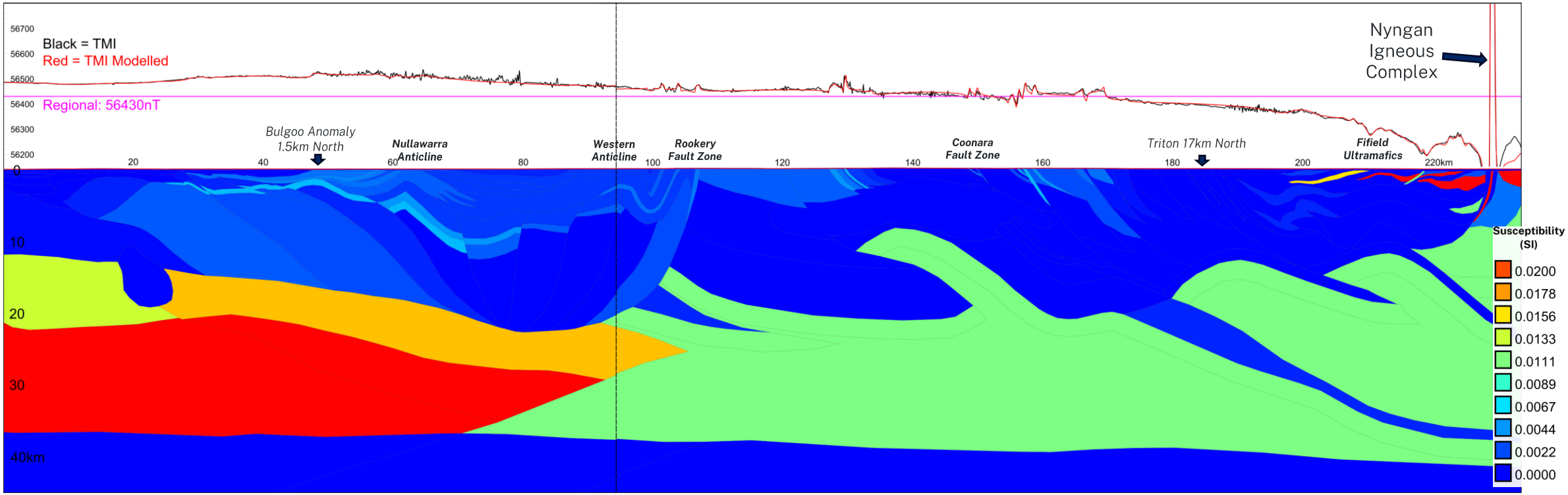


23NSW-CY1 magnetics signal



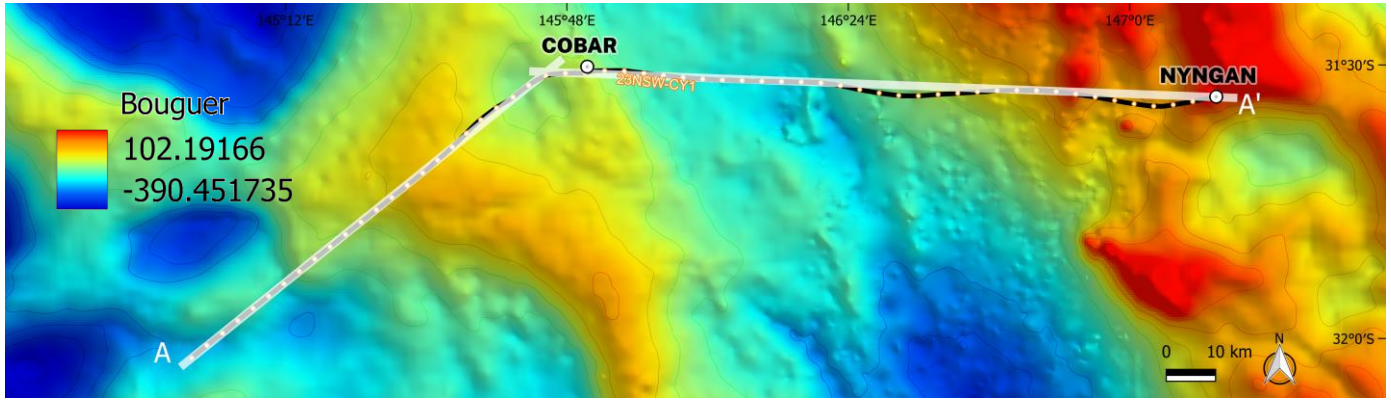
Total magnetic intensity (TMI)

- Western lower crust more magnetic – interpreted as Transitional/Delamerian crust
- Lower units of Cobar Basin more magnetic
- Eastern end of line – highly magnetic shallow bodies Fifield Suite ultramafics



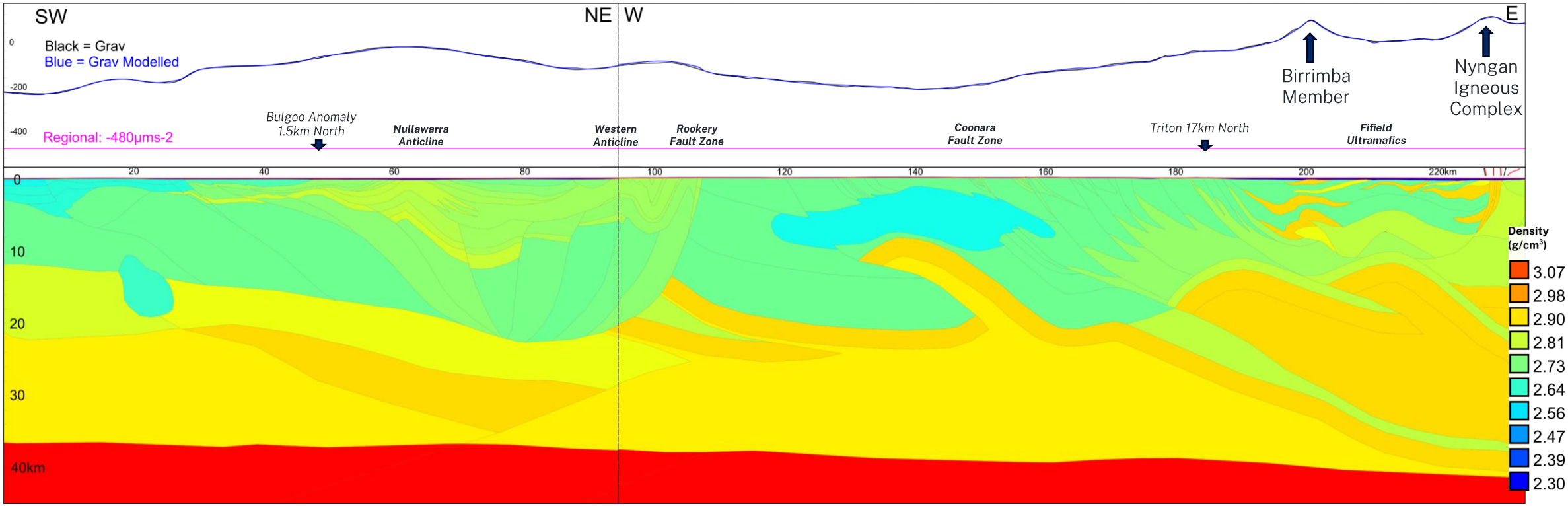
GSNSW statewide total magnetic intensity dataset used for modelling

23NSW-CY1 gravity signal



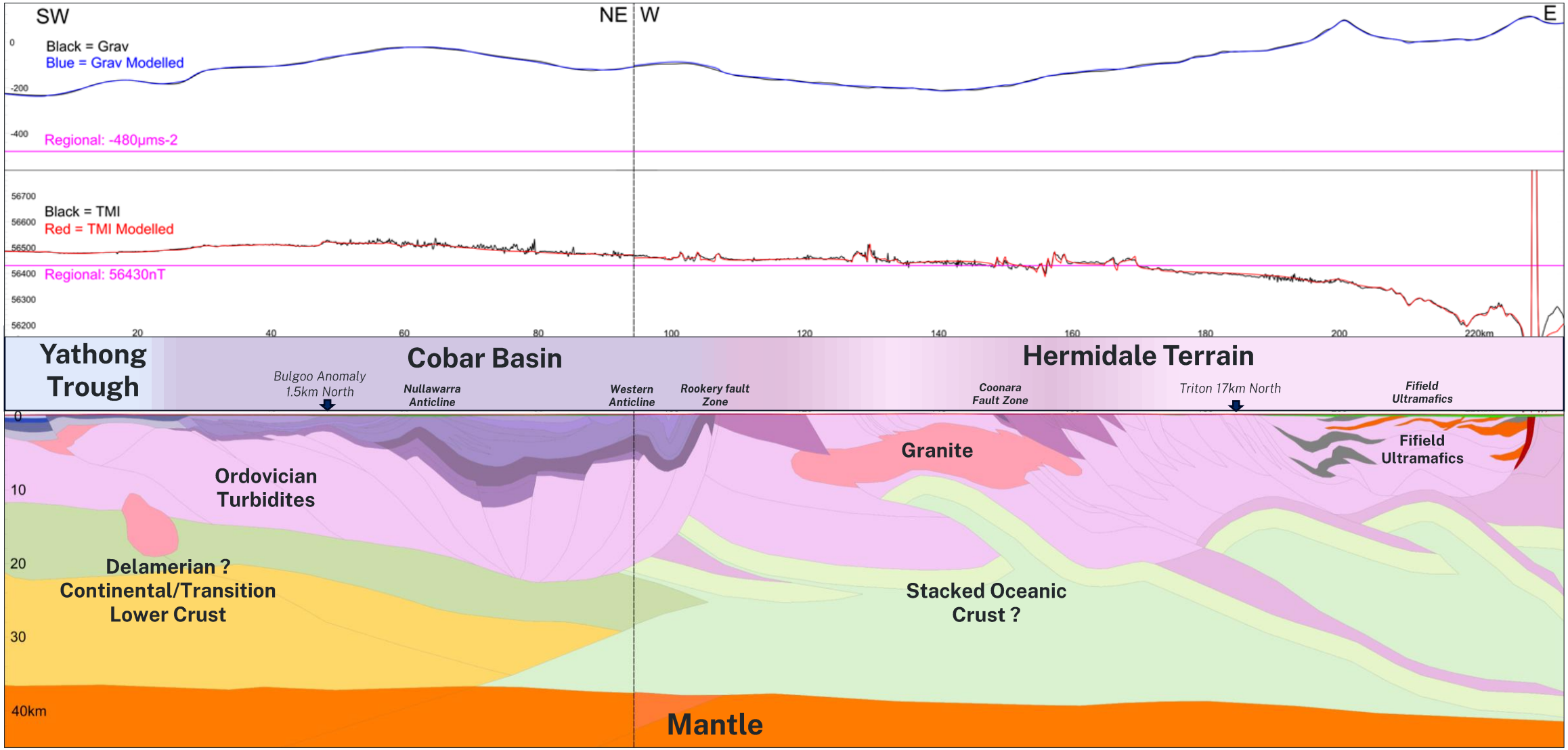
Bouguer gravity

- Central Cobar Basin higher density
- Eastern highs – Fifield Suite ultramafics and Birrimba Member
- Central low interpreted as granitic body, within Tinderra and Erimeran Granite trend

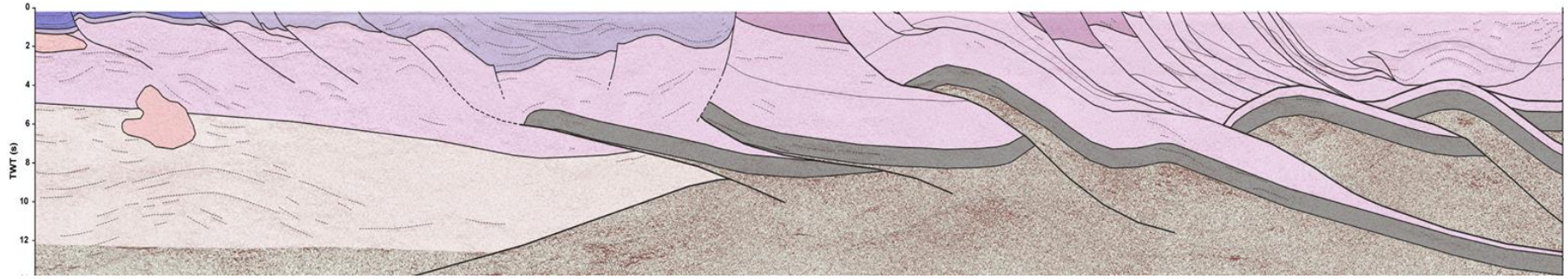


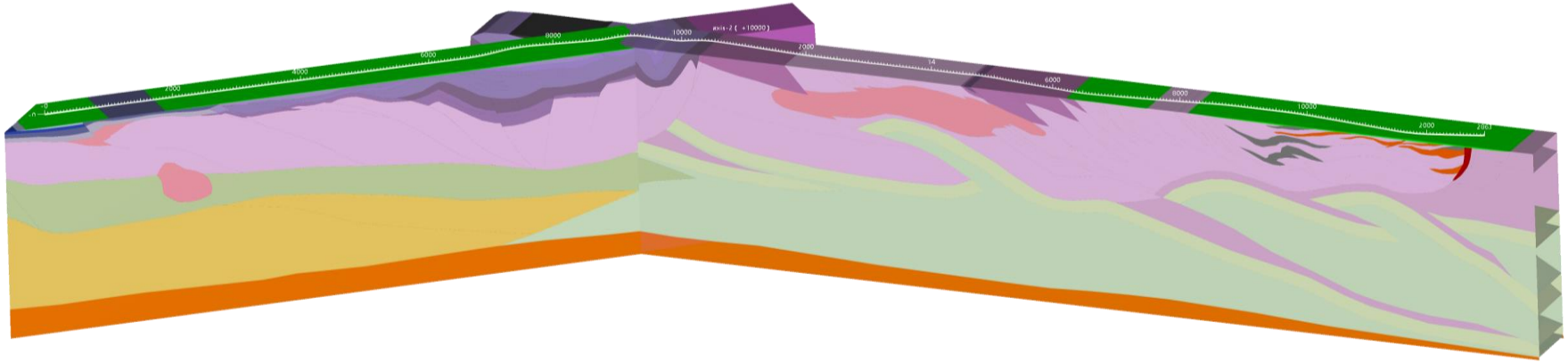
GSNSW statewide bouguer gravity dataset used for modelling

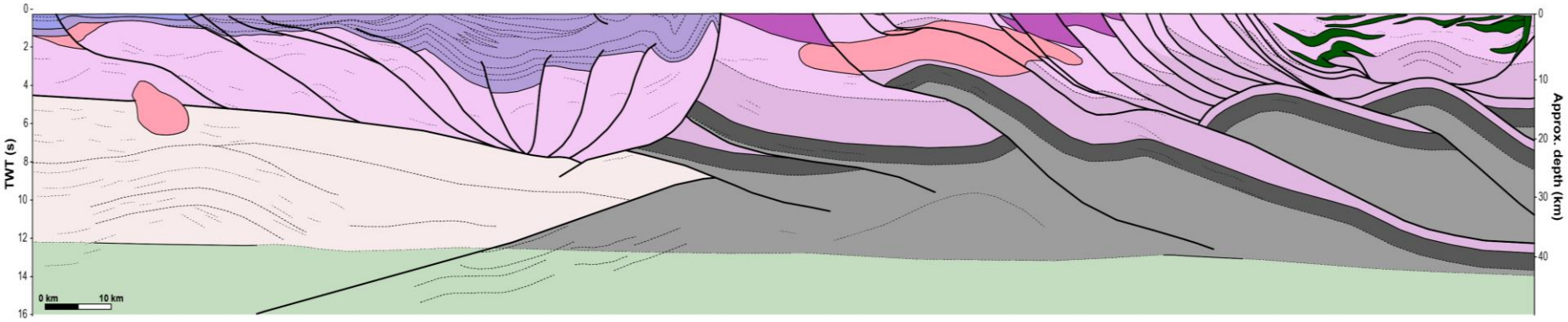
23NSW-CY1 final model

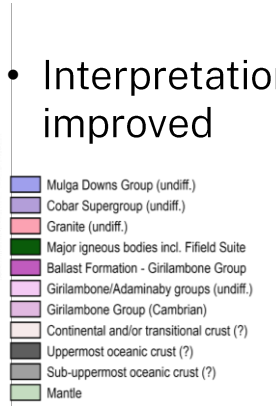


Interpretation progression









Initial interpretation

- Original seismic processing and surface geology
- Built on time domain

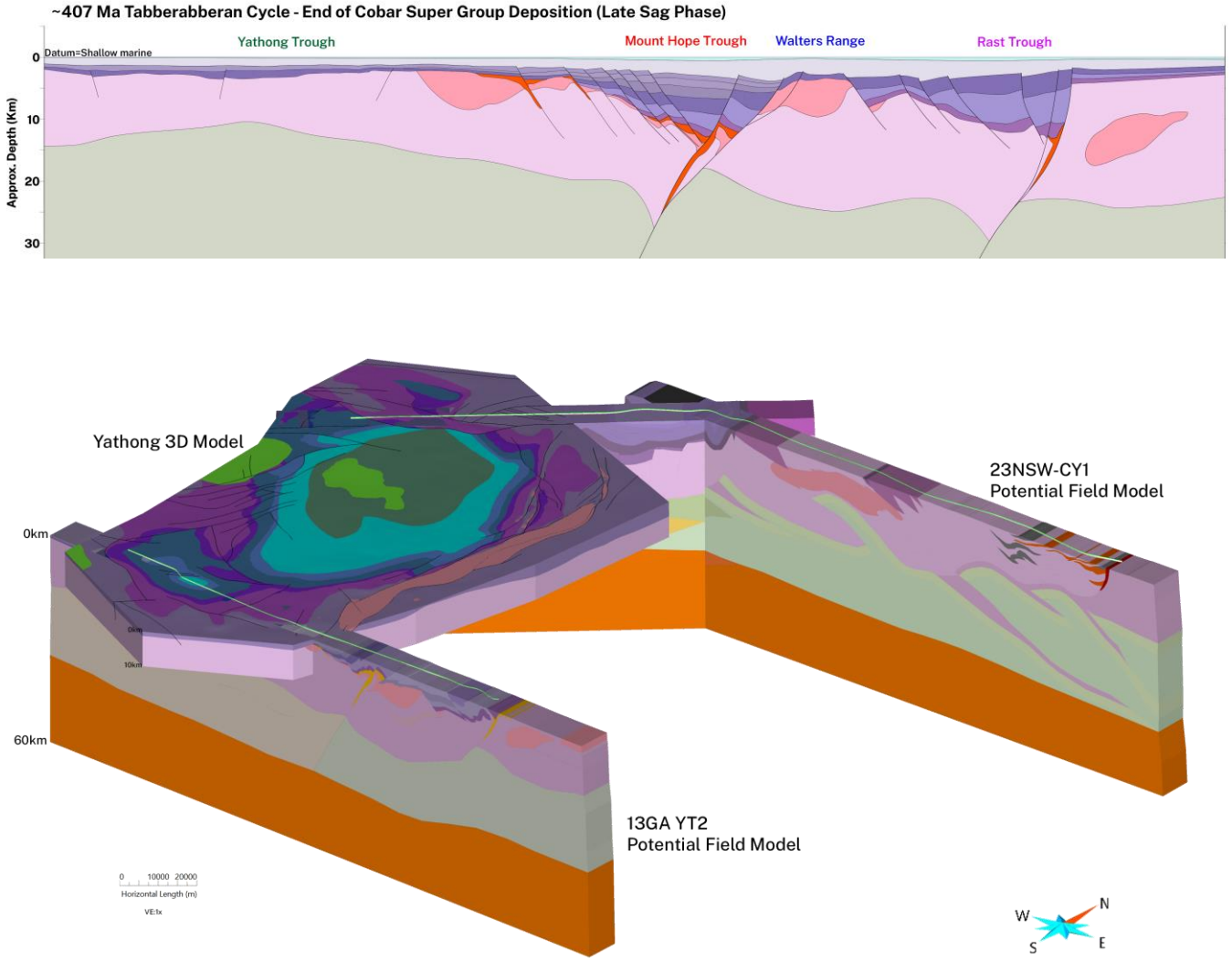
Potential field modelling

- 2.5D models built on depth domain
- Reprocessed seismic
- Integrating seismic architecture with gravity and magnetics signal

Final model

- Interpretation validated and improved
- Defined igneous bodies
- Thicker Cobar Basin

Summary



- With the aid of modern tools, we are developing methods and best practice workflows that are providing a clearer 3D image of the subsurface.
- Potential field modelling of deep crustal seismic resulted in revisions of earlier interpretations, generating new geological and tectonic models.
- This work has informed hole placement and ranking of targets for the MinEx CRC drilling program.
- The modelling and subsequent drilling will play a crucial role in a better understanding of mineral systems.

Related reports later this year:

- GS reports – 3D model Yathong Trough
- DNPP report – Yathong and Bancannia Trough
- Dr Luke Mahoney – 2023 Cobar–Yathong seismic survey paper (in prep.)

Acknowledgements

John Davidson, Liann Deyssing, Steve Trigg

Thank you

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