Thomson-Lachlan seismic project Results and implications

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Collaborative high resolution seismic reflection survey

Between the DPI, pmd*CRC and GA

Full description of the project
in Mines and Wines 2006

Main objectives:

1) To investigate the nature and location of the east-west boundary between the Thomson and the Lachlan orogens

2) To assess mineral potential north and south of this boundary

3) To establish the crustal architecture of the Thomson and Lachlan orogens

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Tools

Combination of:

Interpretation of geophysical images (gravity and magnetics)

Lithology from drill holes

Some field mapping

U-Pb dating of zircons

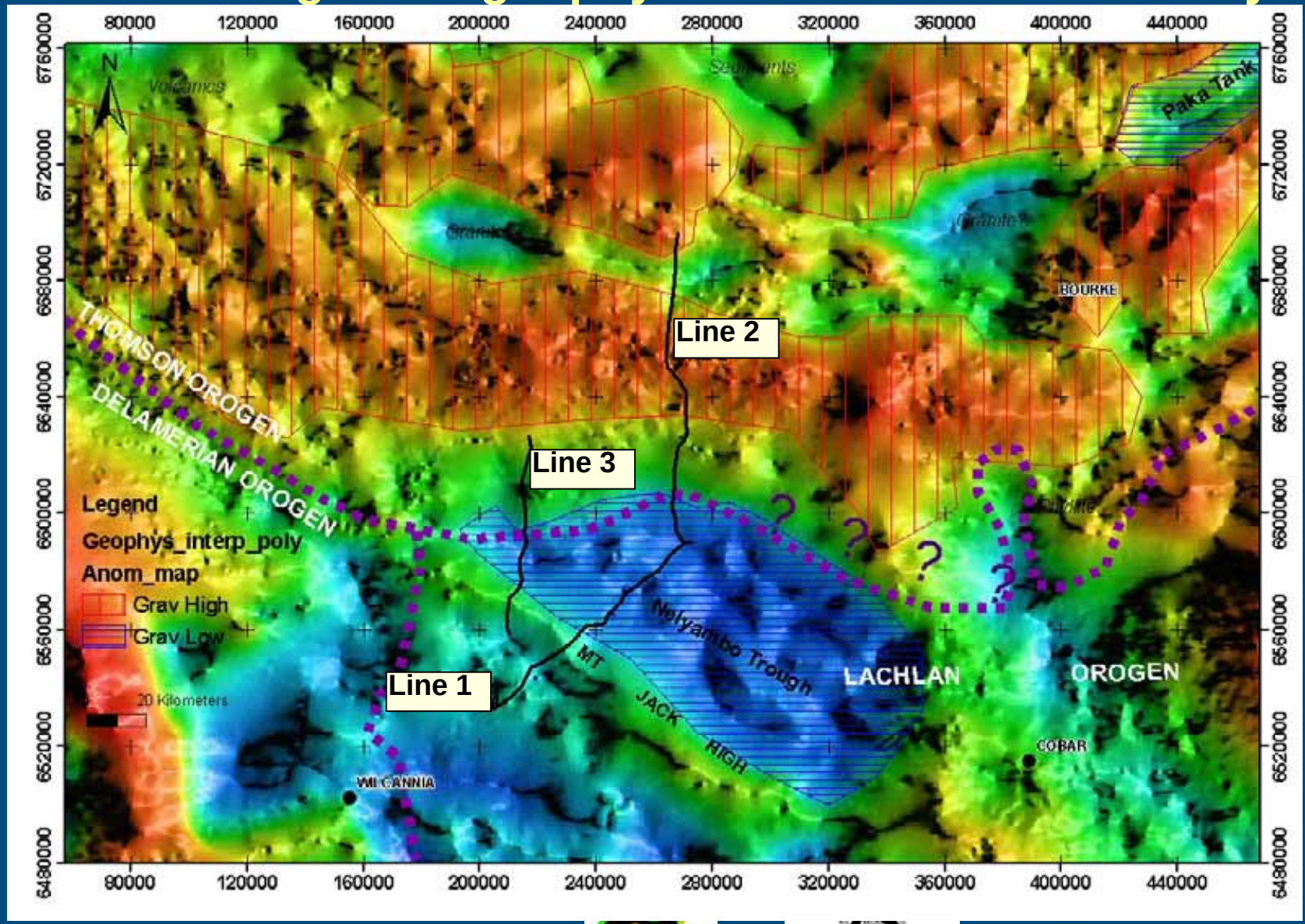
Geochemical analysis of rock samples

Interpretation of deep seismic lines

2D gravity modelling

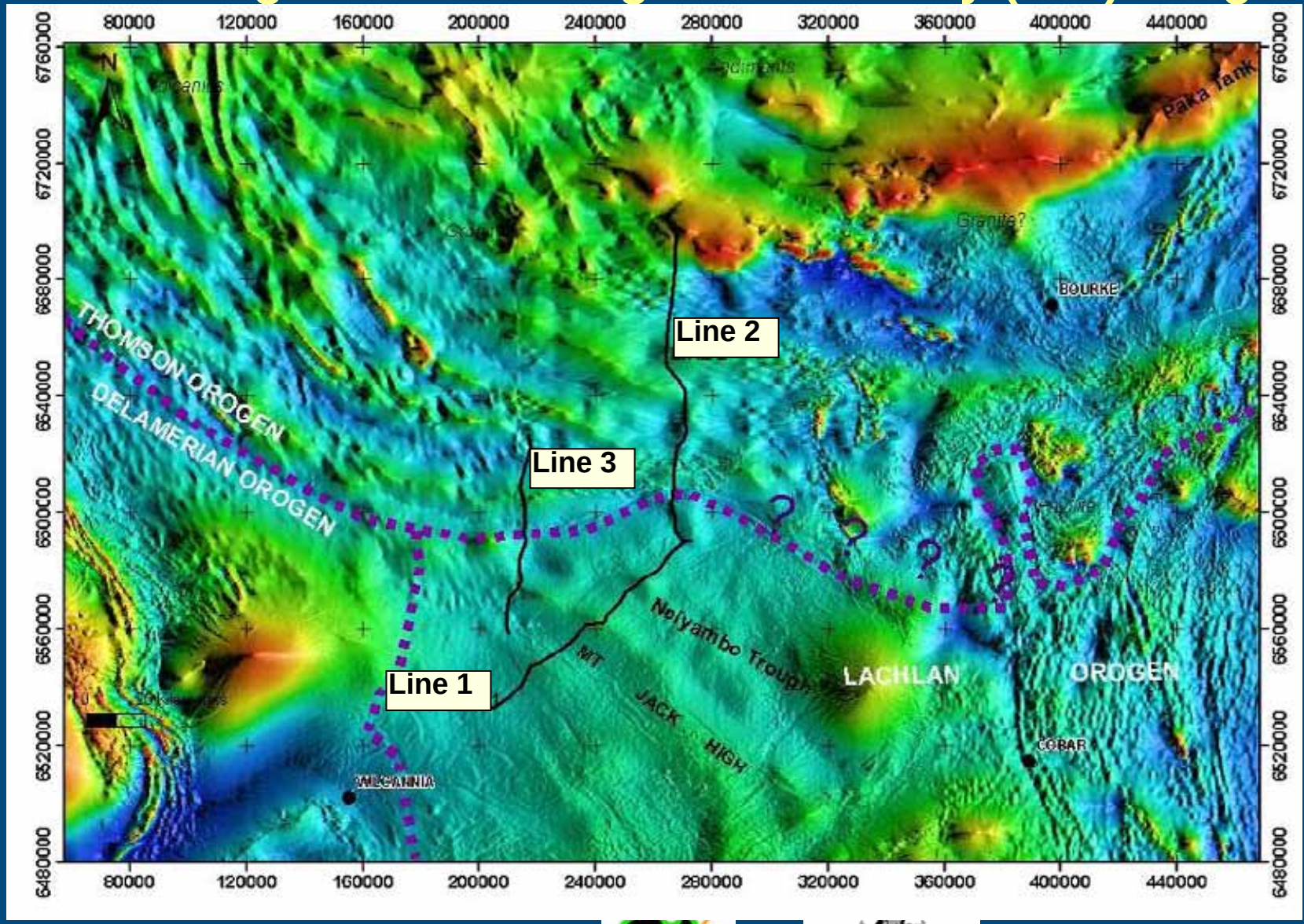
3D models with GoCad – gravity and magnetic edge analysis, and structures

Background geophysical information - Gravity



? ? ? ?

Regional Total Magnetic Intensity (TMI) image



Drilling program

Background geology

Lachlan – 3 fold stratigraphy from mapping in the Cobar region:

- Basement = Ordovician turbidites and Silurian granites

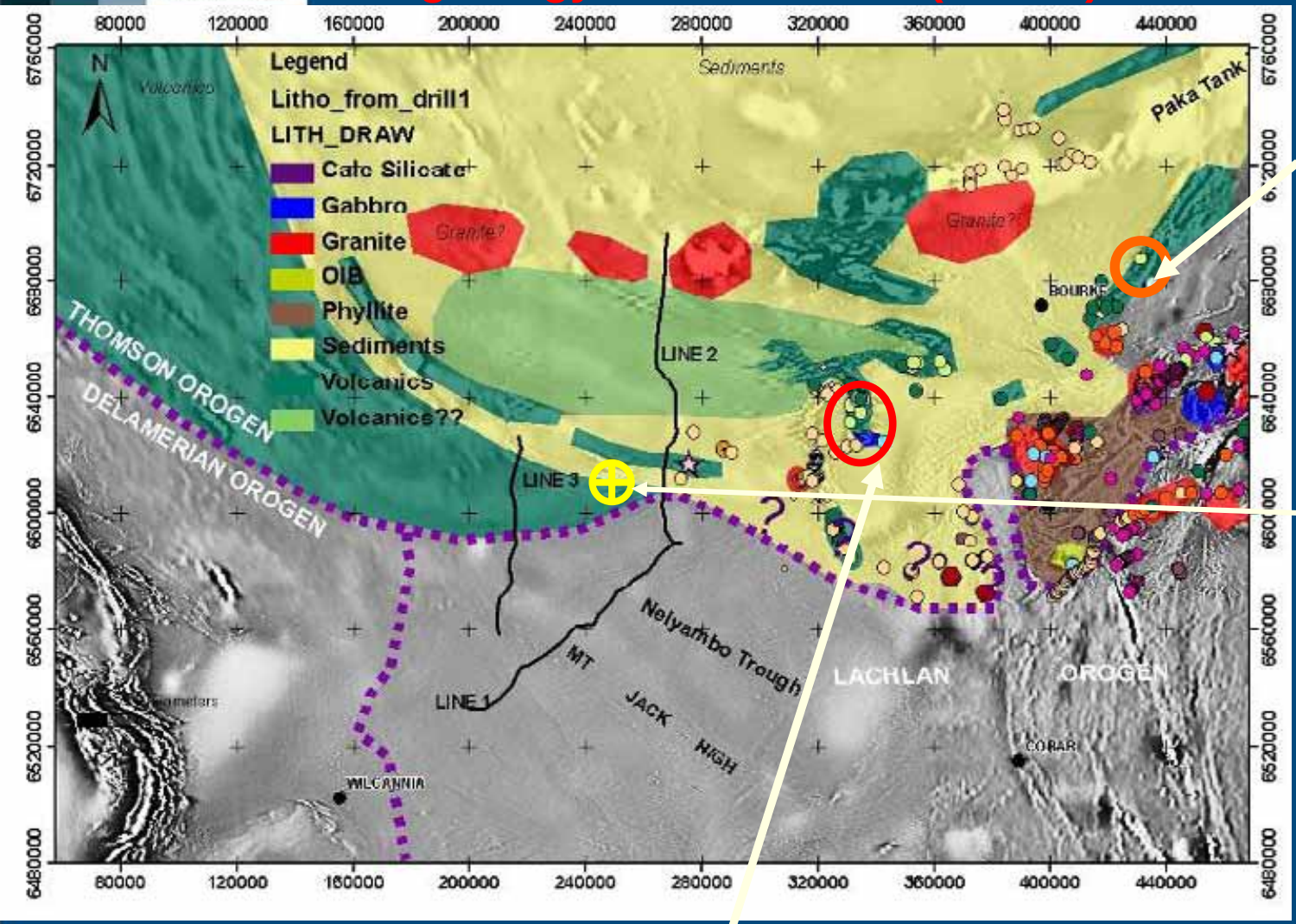
- Early Devonian sediments and volcanics in rift basins

- Late Devonian fluviatile cover rocks

Thomson – very poorly known, obscured by 0-300 m of Mesozoic cover from the Eromanga Basin

Information available from old petroleum and mineral exploration drill holes

Solid geology from drill hole (~ 1200) and some field mapping



Andesitic volcanics drilled by Newcrest
Calc-alkaline, arc signature (Burton, 2007) – subduction related.

Compass drilling: pyrite and pyrrhotite 87-228 m

Volcanic and volcaniclastic mafic-intermediate package with Ocean Island Basalt (OIB) affinity (Dadd, 2006)

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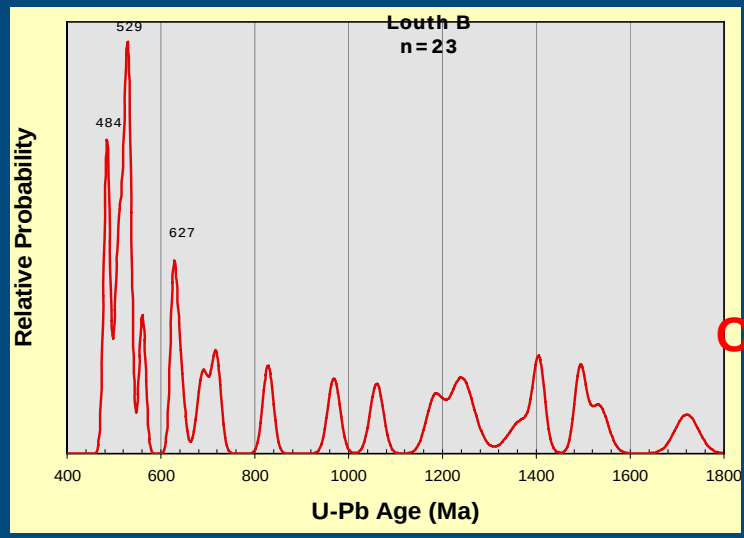
Background geology

Thomson

Preliminary dating from GEMOC, Macquarie University, Sydney

Sedimentary rocks to the south and west of Louth

Sandstone/siltstone/shale



Peaks at
627 Ma
529 Ma
484 Ma

Ordovician

U-Pb dating from detrital zircons

This dating is consistent with black shales in Louth containing Late Ordovician graptolites

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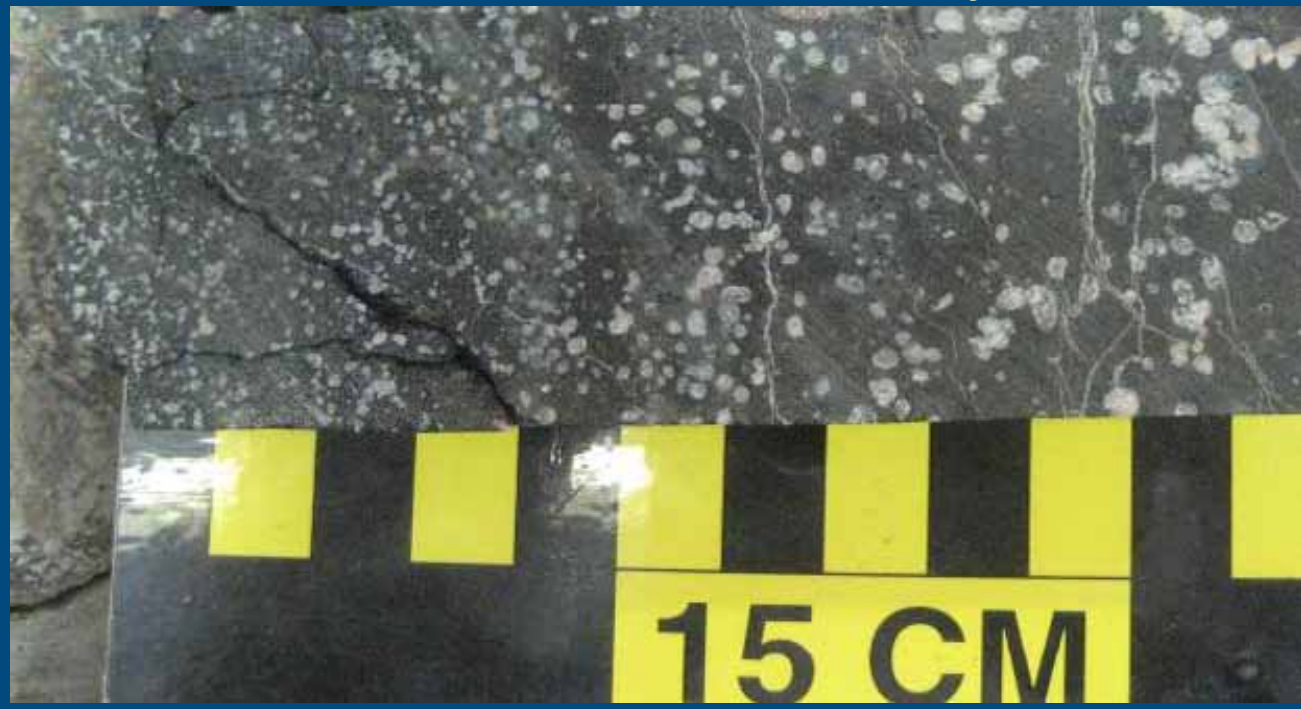
Background geology

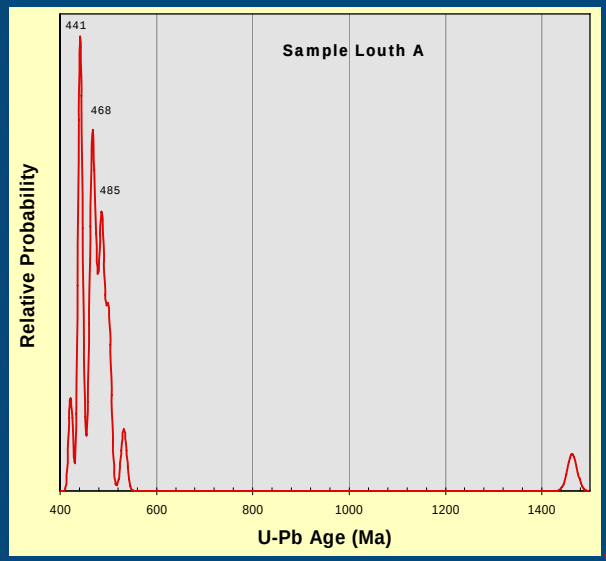
Mafic-intermediate volcanics to the east (Louth)

Volcaniclastics

Vesicules filled by calcite



Variation in size of the vesicules



U-Pb dating from detrital zircons

Peaks at
485 Ma
468 Ma
441 Ma

Silurian

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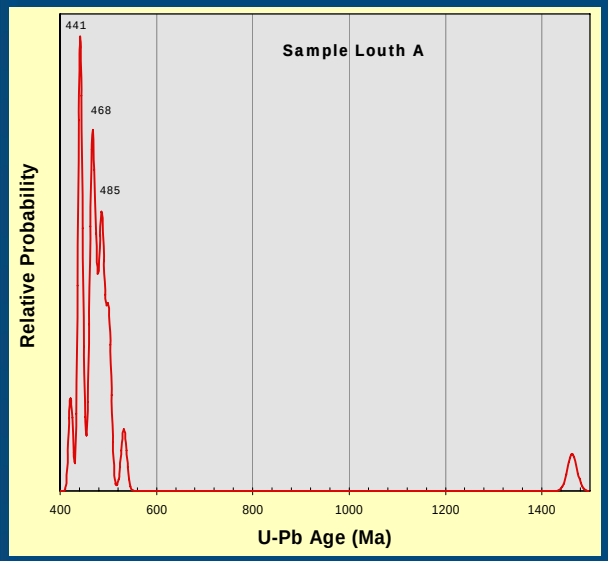
Background geology

Mafic-intermediate volcanics to the east (Louth)

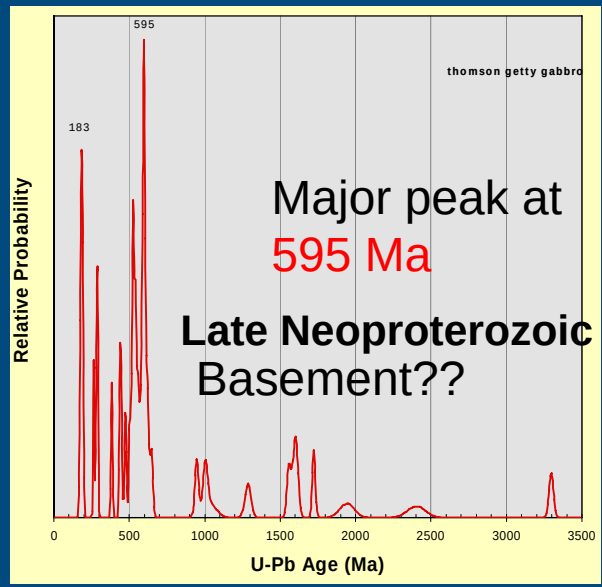
Volcaniclastics



U-Pb dating from detrital zircons

Peaks at
485 Ma
468 Ma
441 Ma
Silurian

Gabbro



Major peak at
595 Ma

Late Neoproterozoic
Basement??

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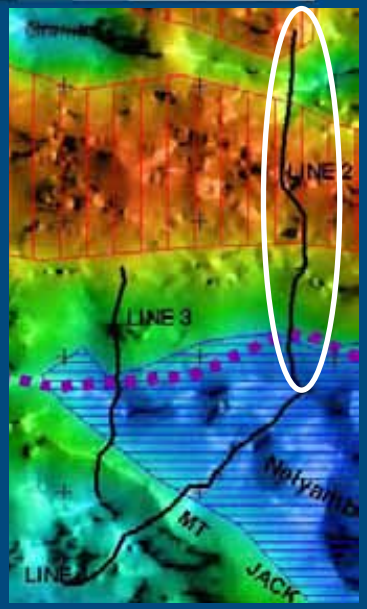
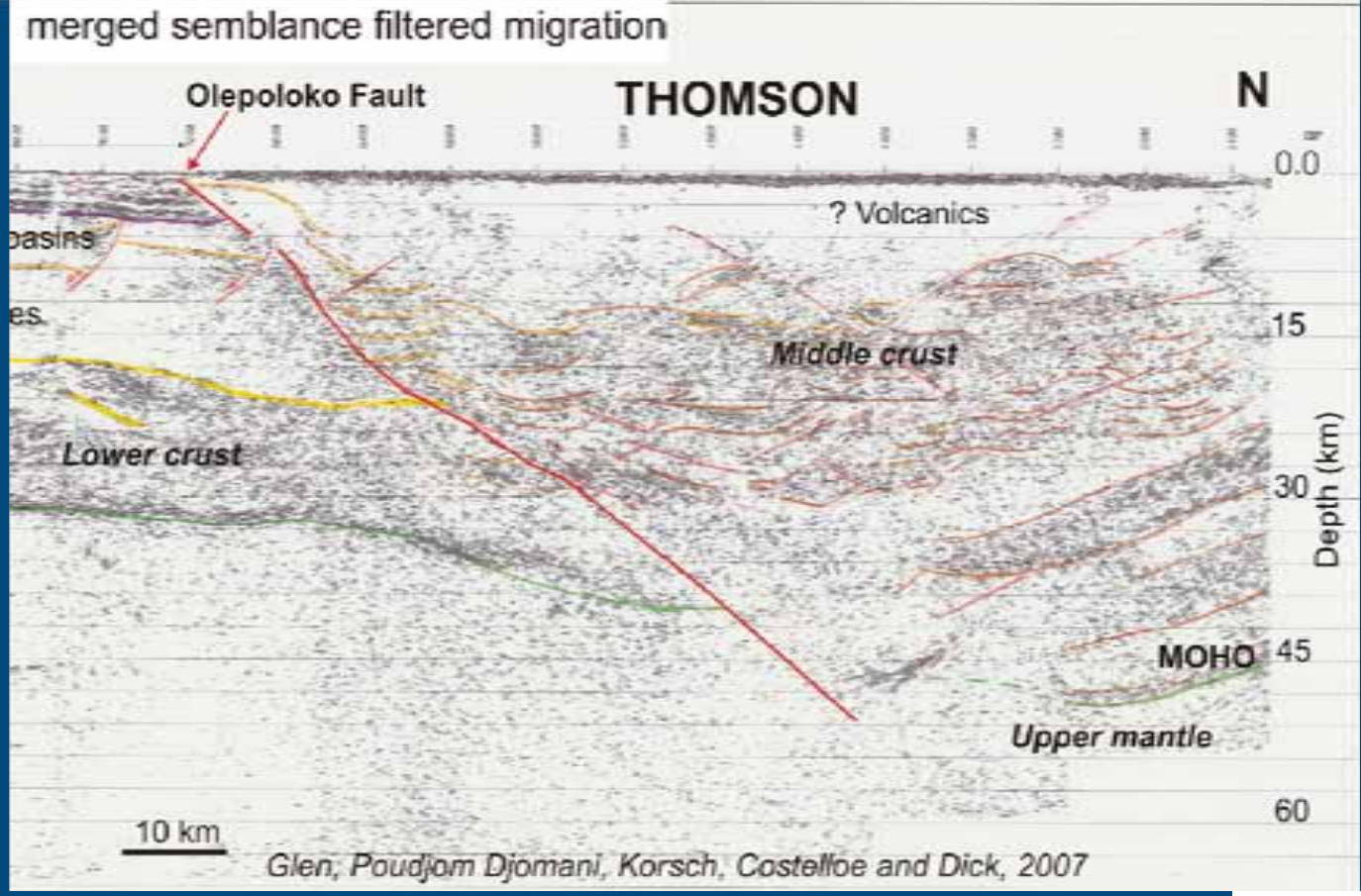
Seismic interpretation



line TL2



Thomson Orogen

Lower crust = band of highly reflective material up to 6km thick interlayered with similar thickness bands of lower reflectivity. Moho at ~ 48 km.

Middle crust (10-25 km) = shorter length bands up to 3 km thick around less reflective packets

Upper crust less reflective, not much info from seismic data

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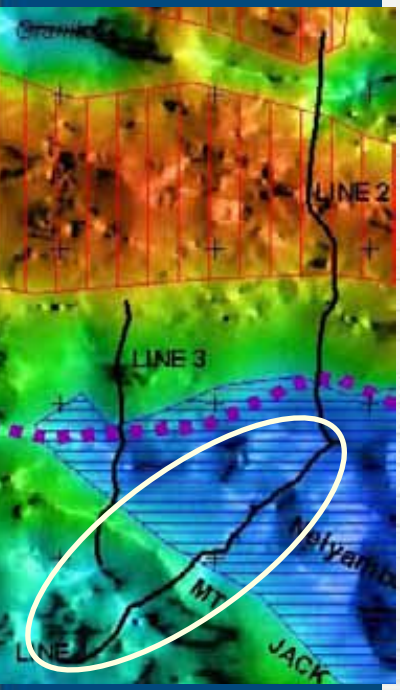

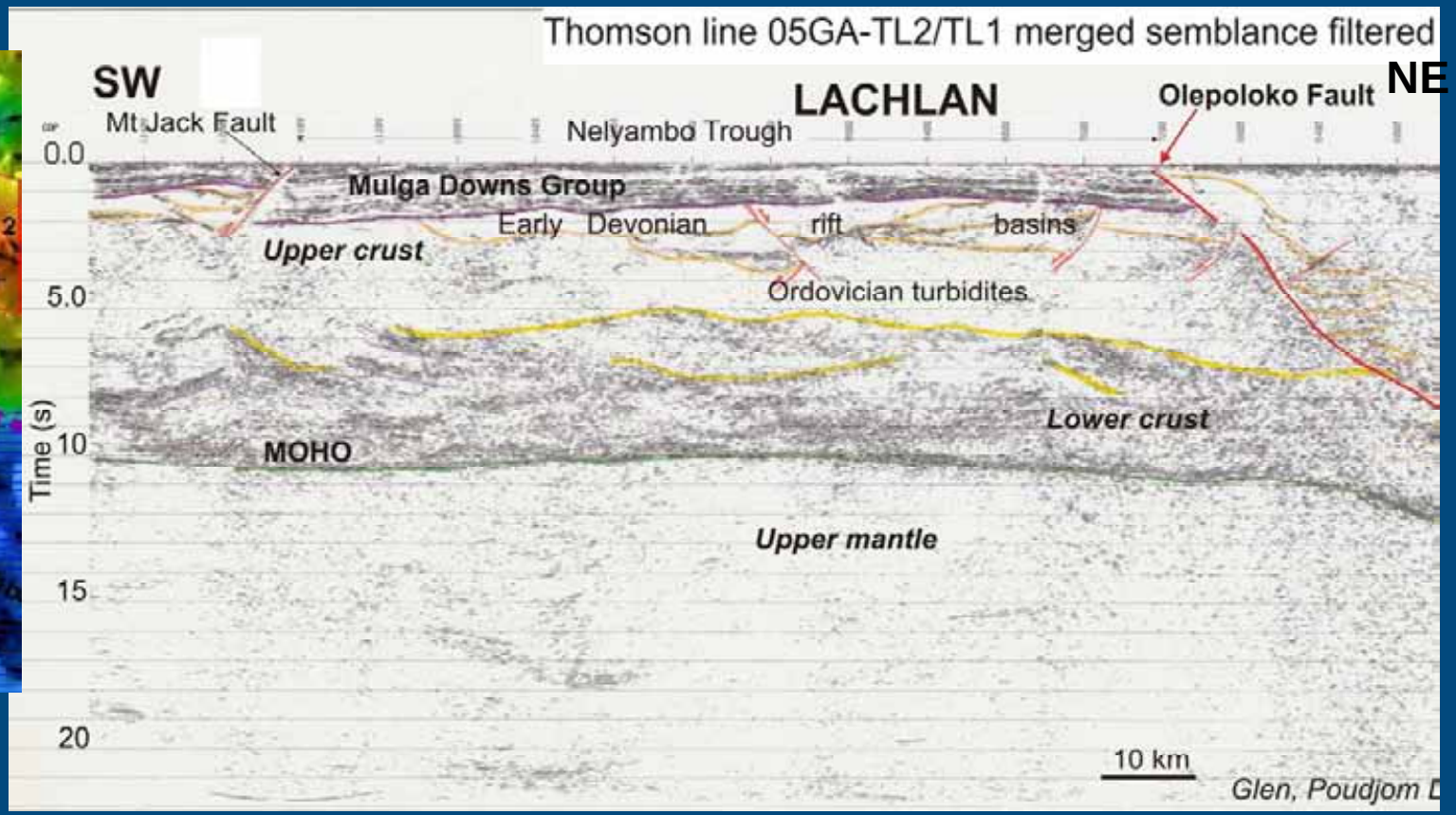

line TL1

Lachlan Orogen

Lower crust = highly reflective lower crust between 18-33km, strong reflector interpreted as a flat lying Moho

Middle crust poorly reflective

Upper crust made of basement, rift basins, cover

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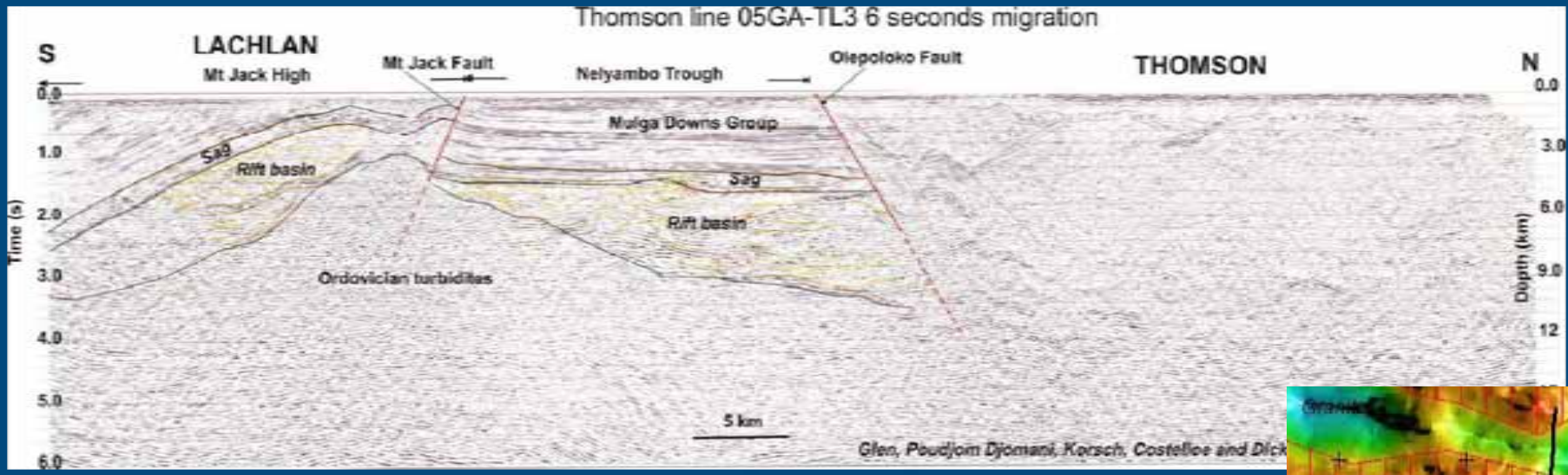
Seismic line TL3



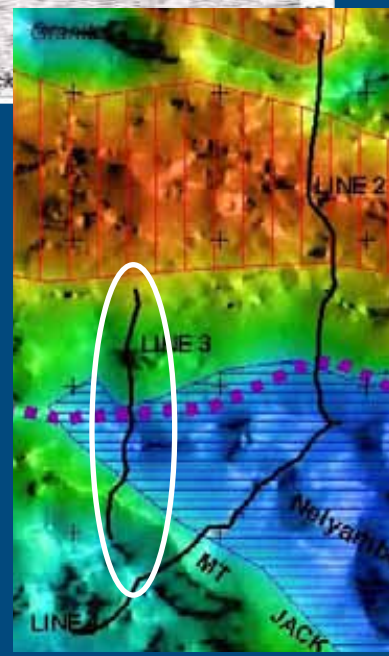
Lachlan Orogen: Upper crust on seismic interpretation of line TL3

Basement = Ordovician turbidites,

Early Devonian rift basins (Cobar SuperGroup) + sag phase

Cover = mainly Mulga Downs Group

Mt Jack Fault zone

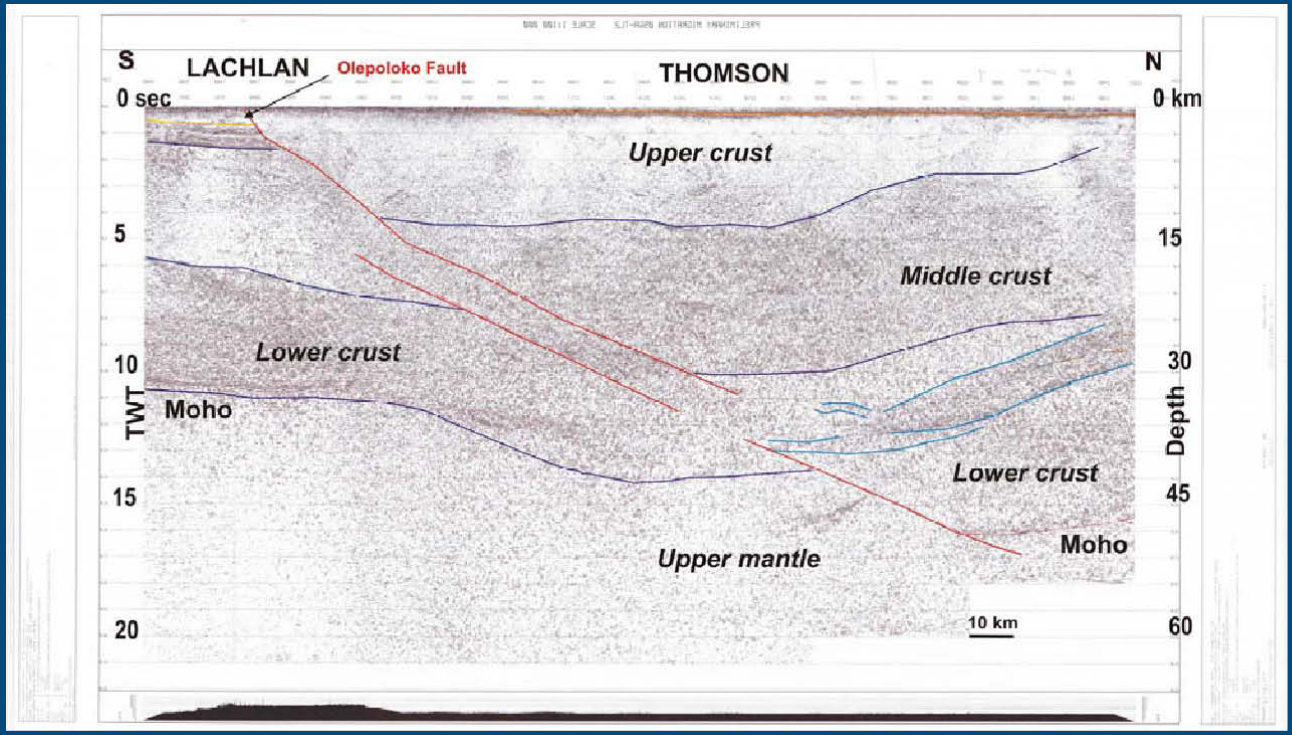


line TL3

Structures

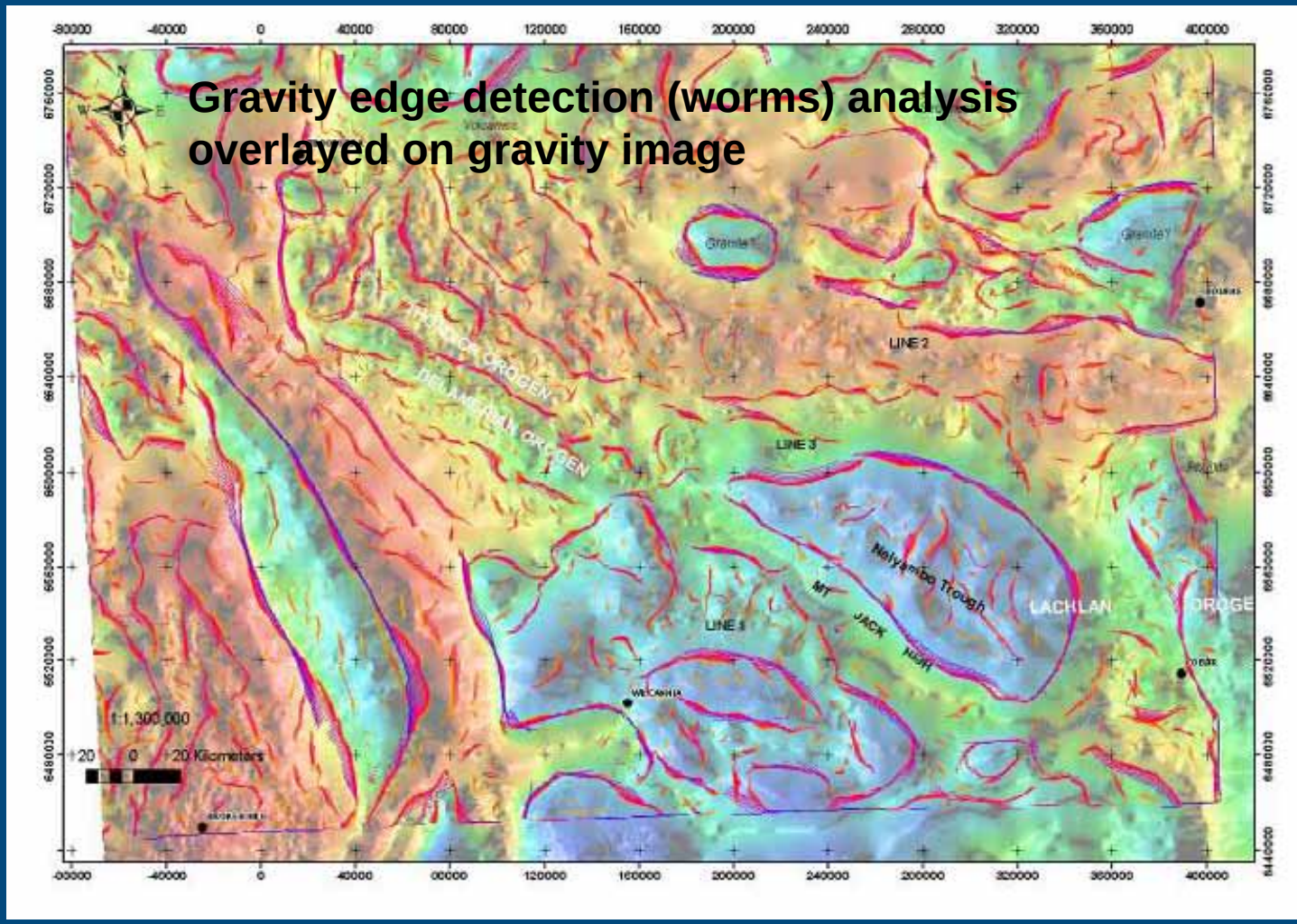
Olepoloko Fault – major planar fault dipping to the north at 45deg, and cutting through the entire crust

This fault separates thick crust of the Thomson (Moho at 48 km)
from thinner but more reflective crust of the Lachlan (Moho at 32 km)



Structures

Nelyambo Trough

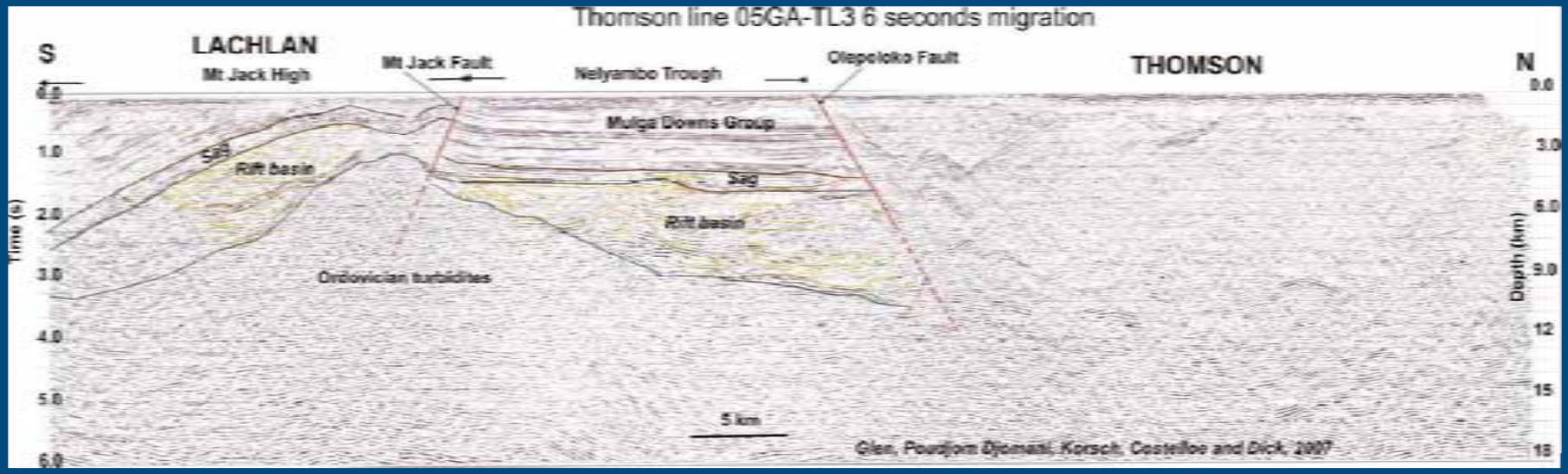


Mt Jack High

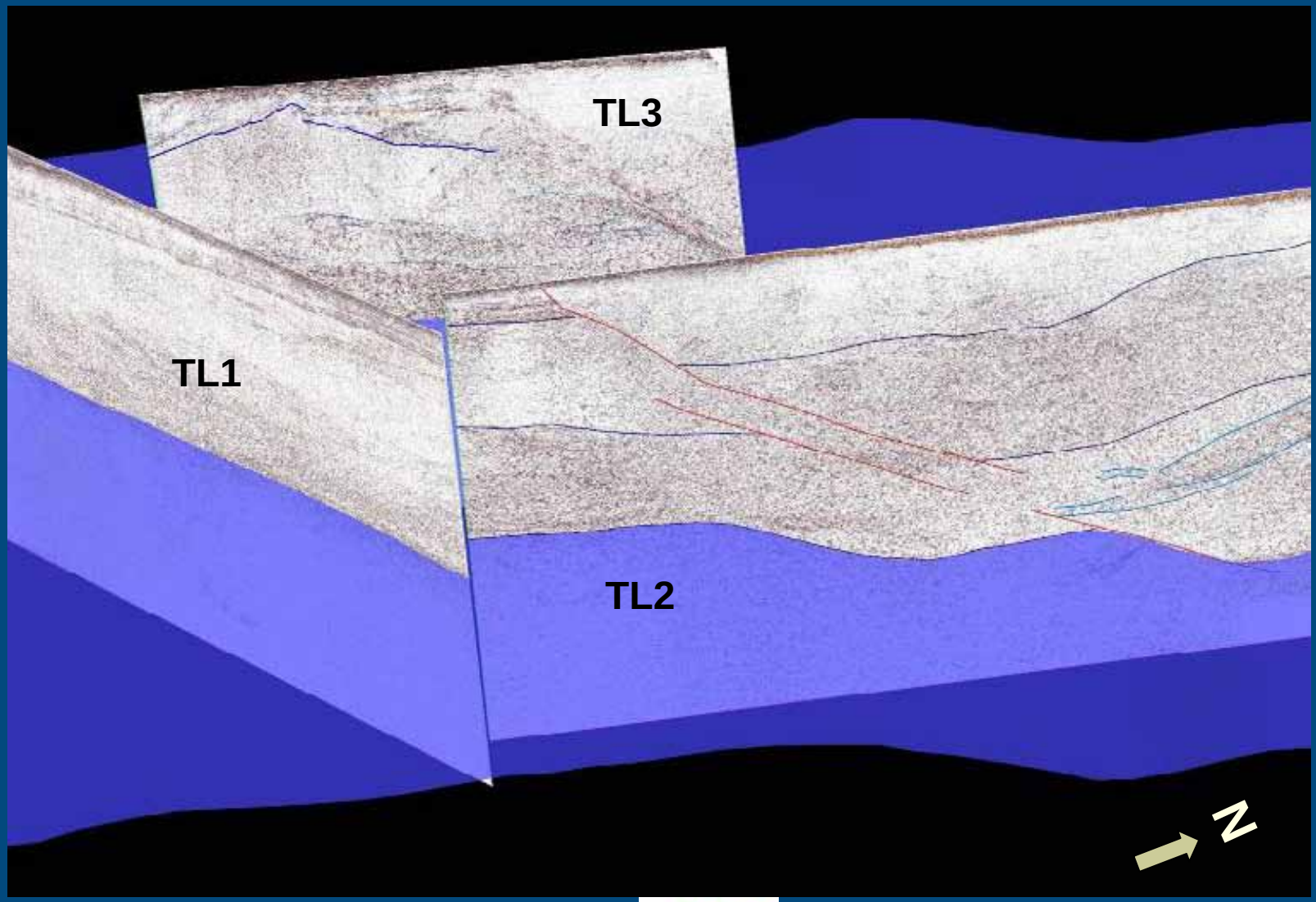
identified from regional gravity as a 20 km wide WNW-trending zone south west of the Nelyambo Trough.

Structures

Mt Jack Fault Zone – identified from seismic data, lies parallel to, and northeast of the Mt Jack gravity high.



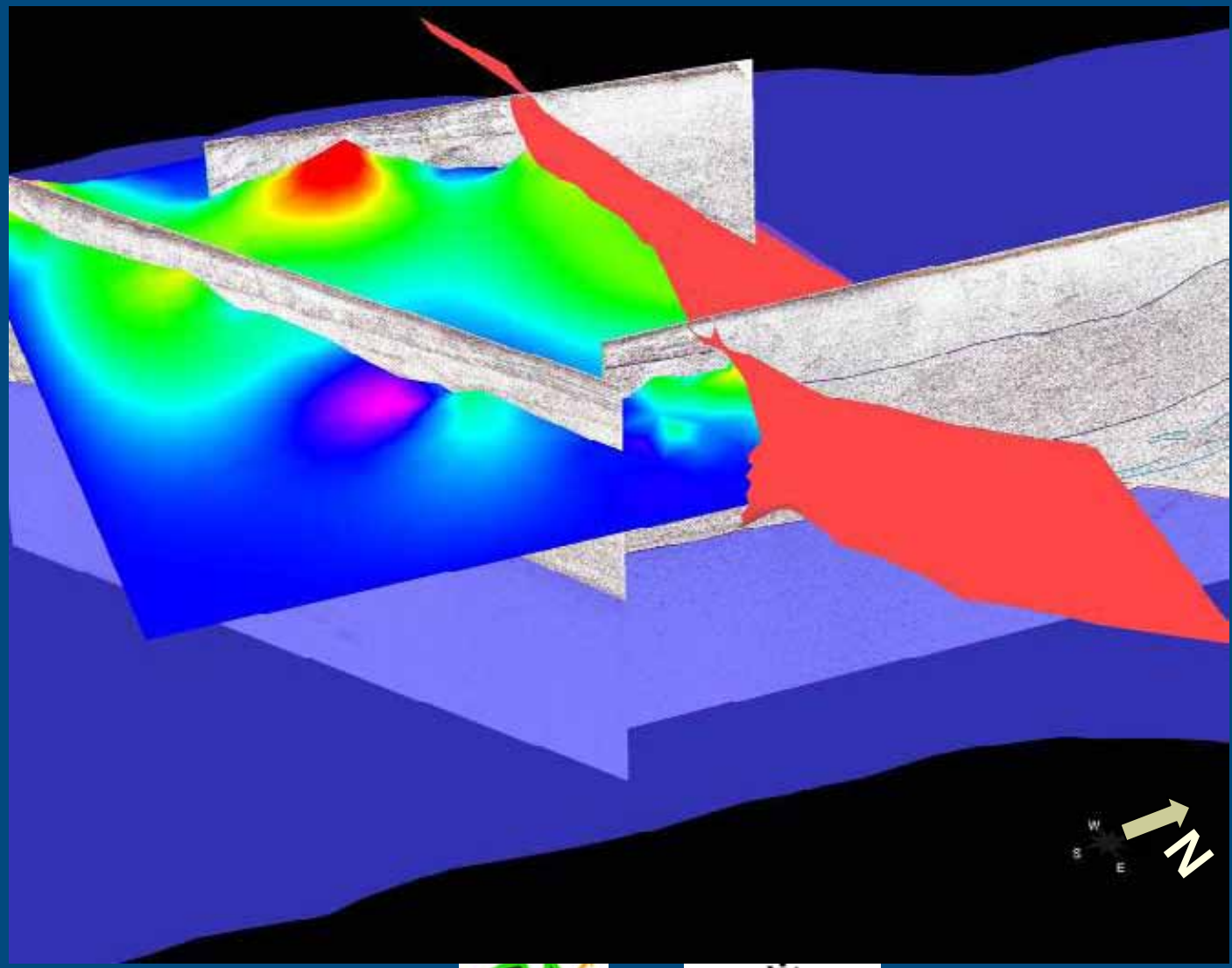
3D views



3D views

Olepoloko Fault

Mt Jack High



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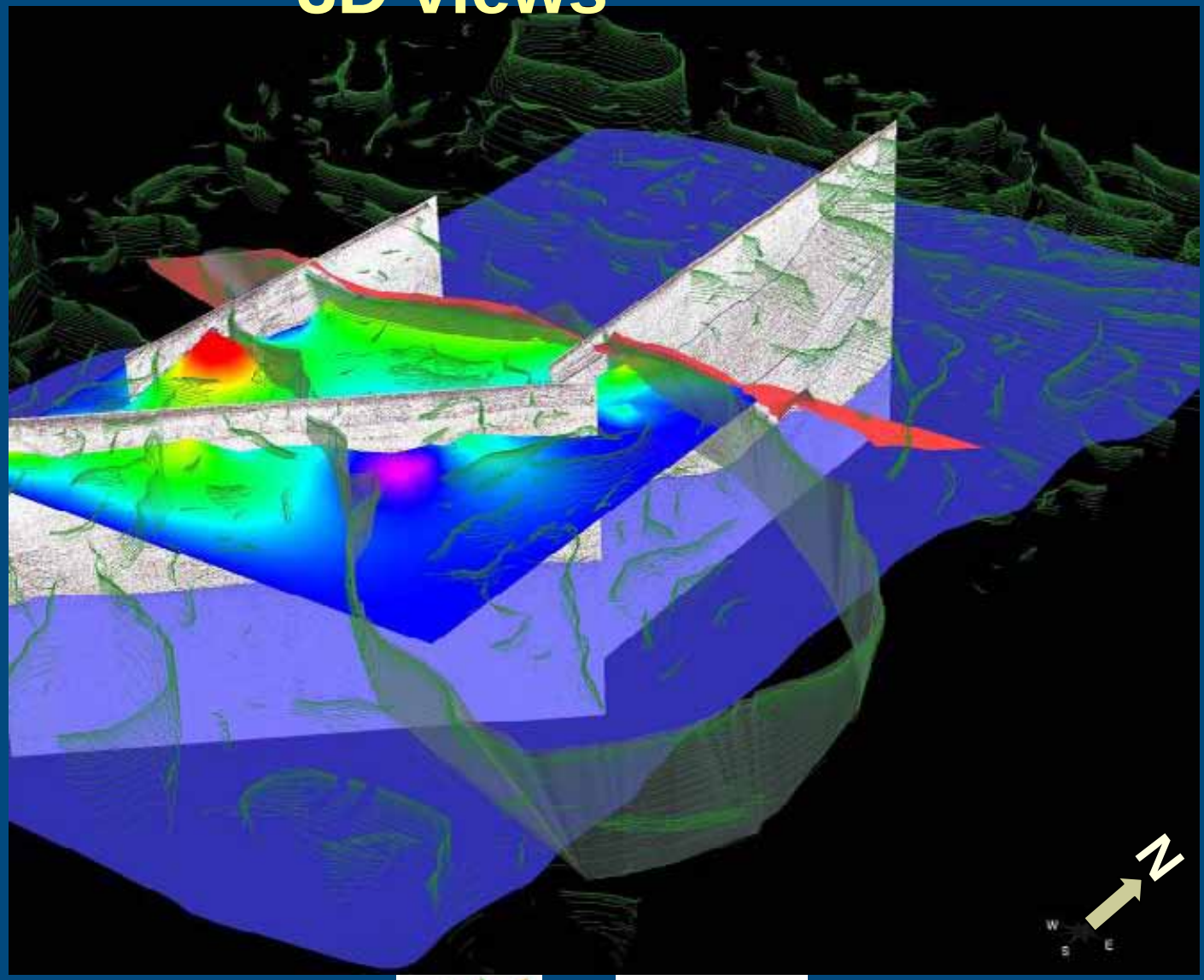
3D views

Olepoloko Fault

Mt Jack High

Nelyambo Trough



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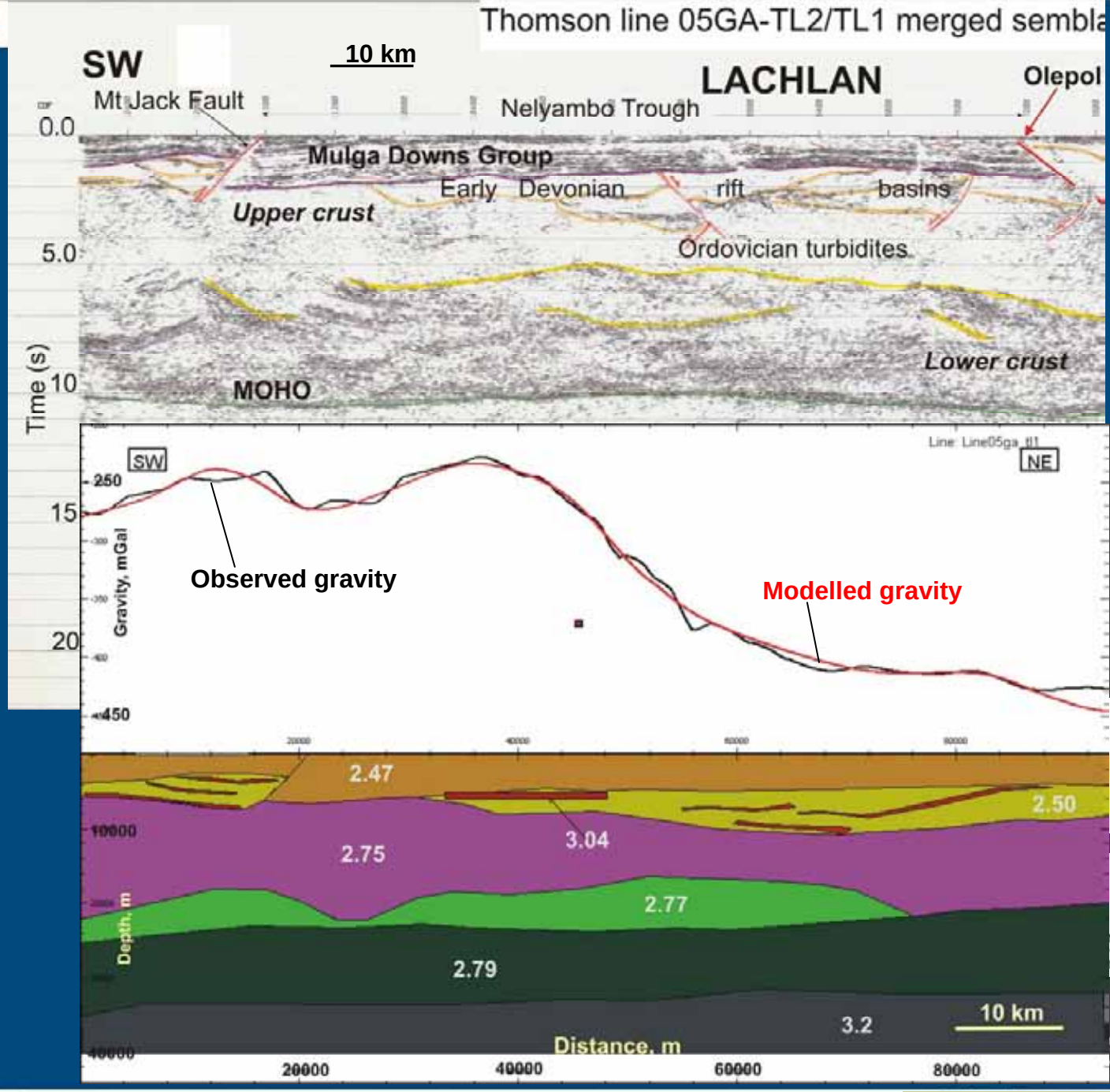
Gravity modelling

Starting models based on the seismic interpretation

line TL1



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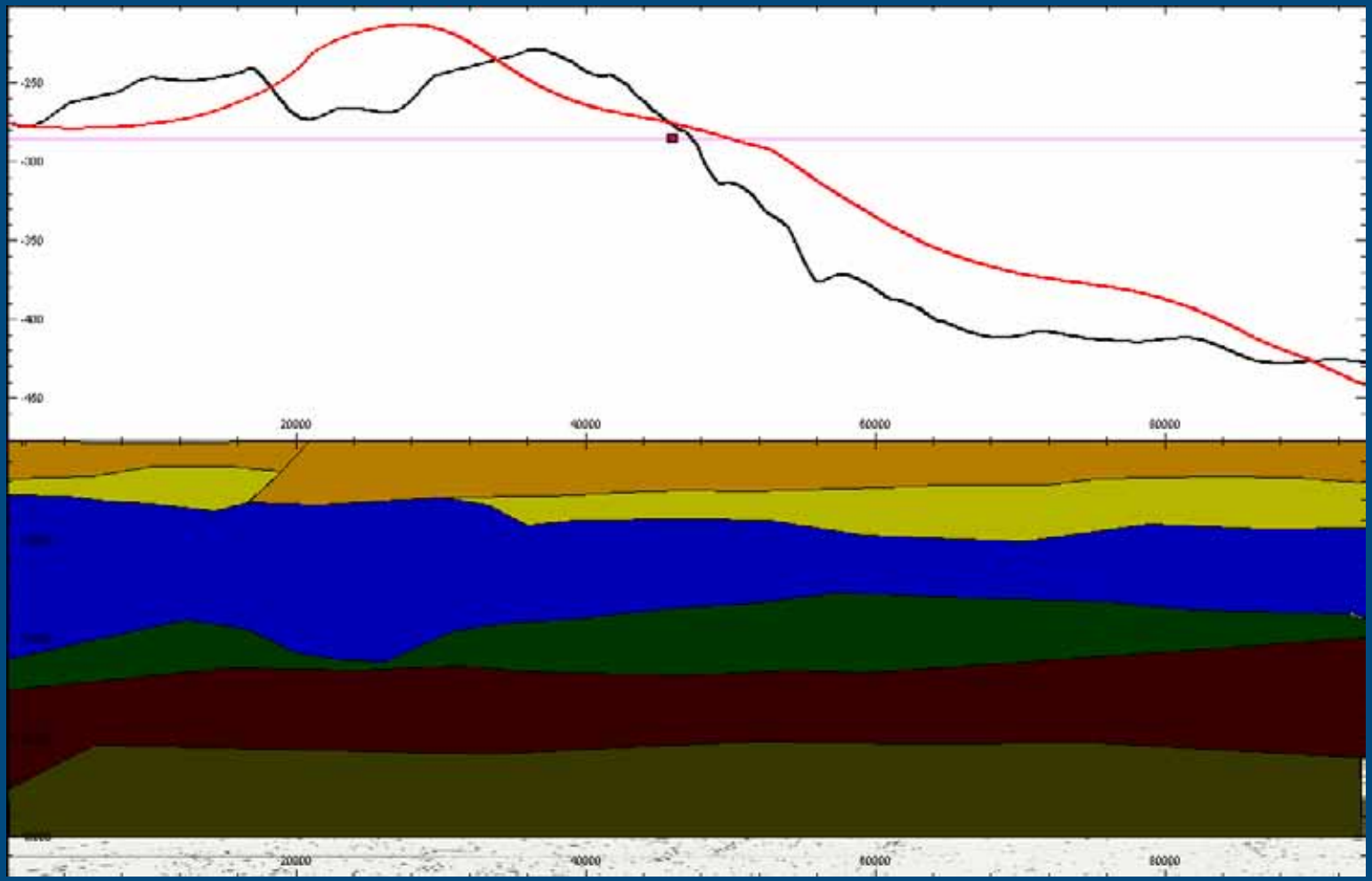
Seismic line TL1 – no igneous bodies



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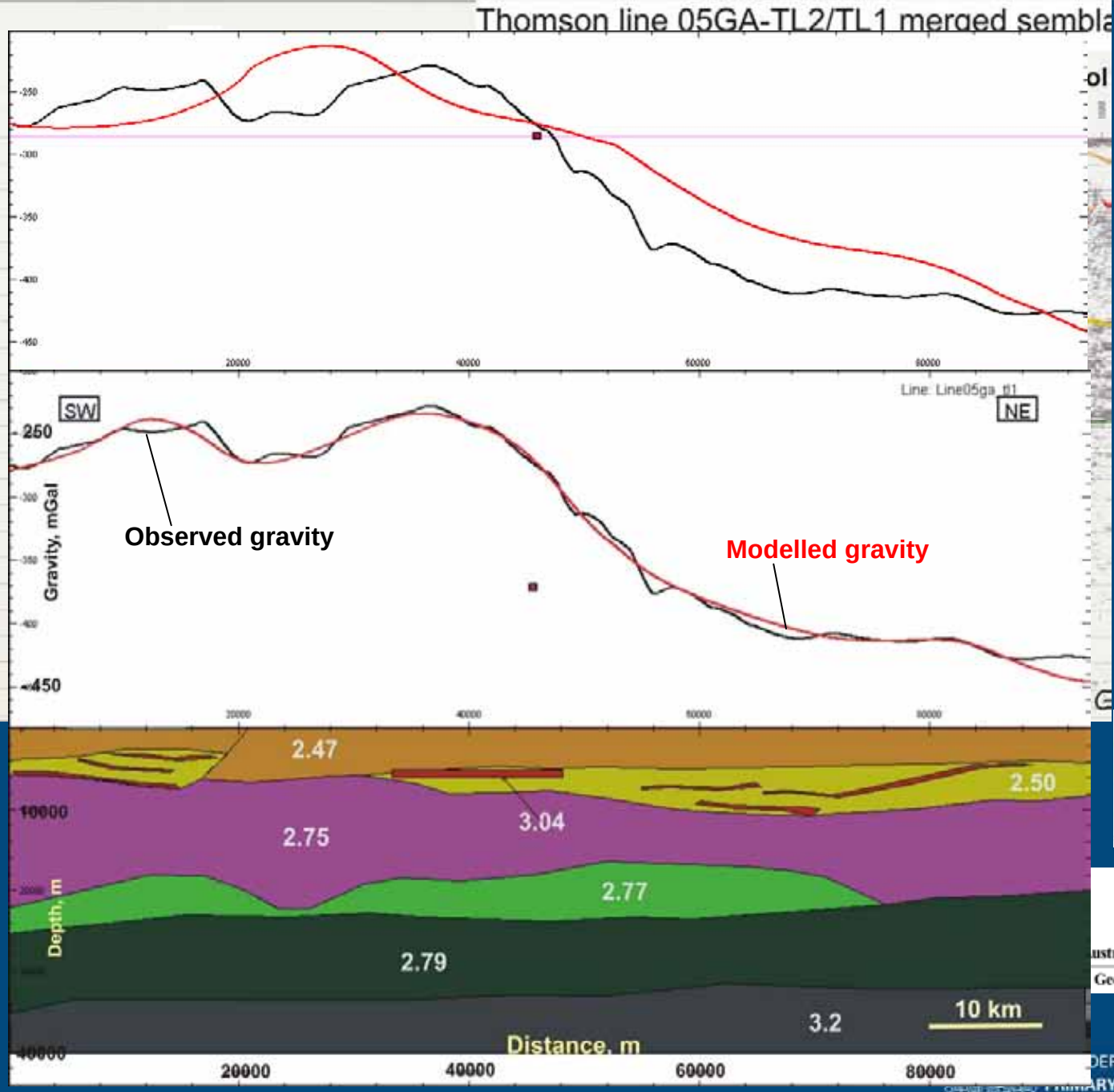
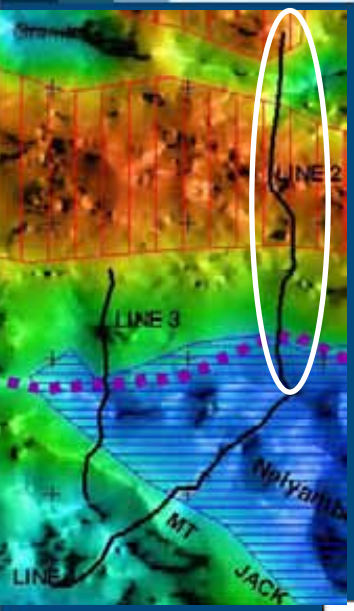
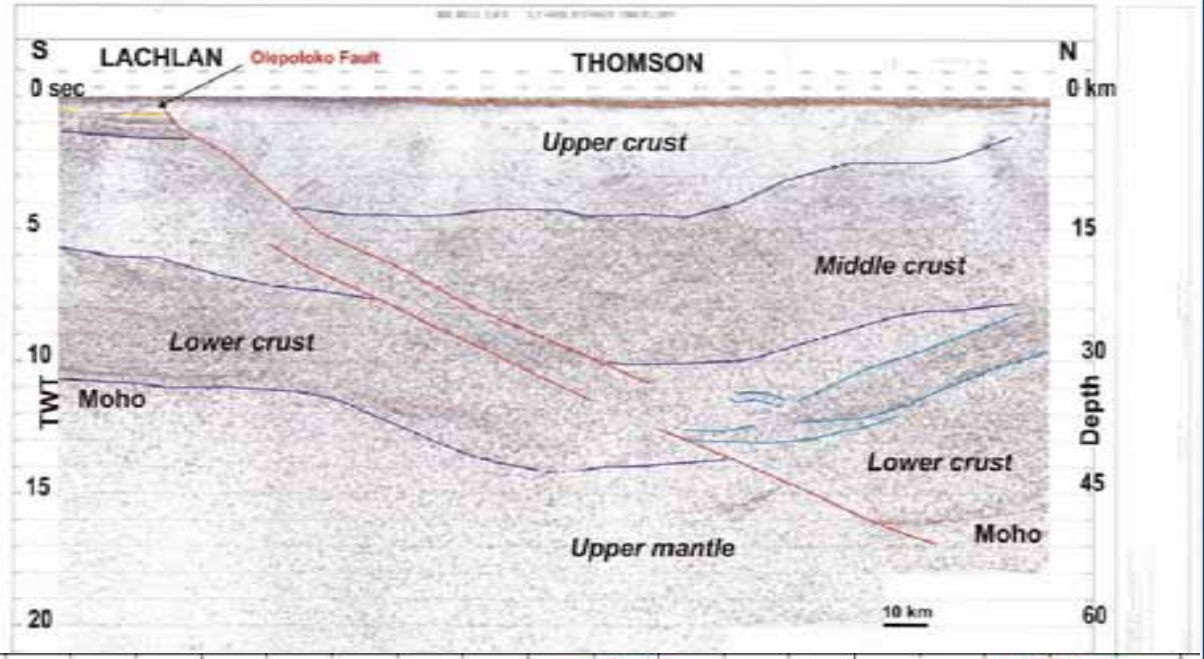
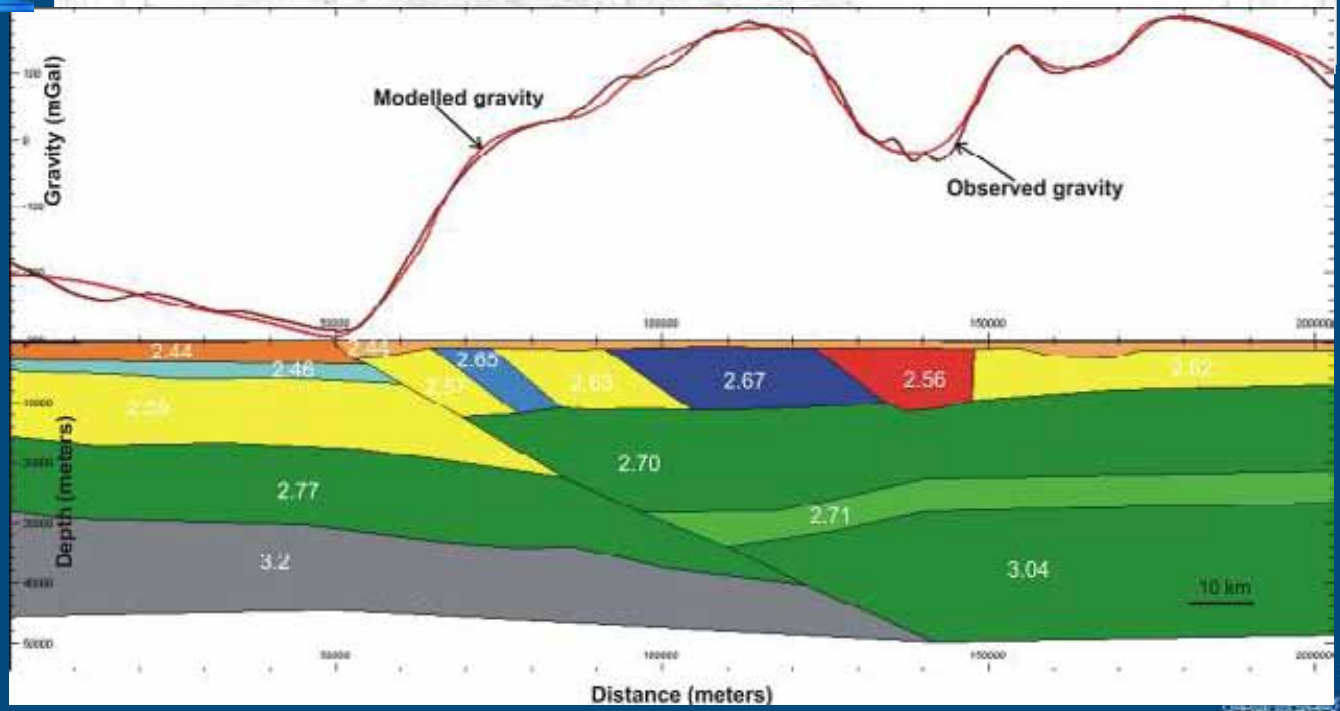
line TL1


Thomson line 05GA-TL2/TL1 merged sembla
SW
NE
Line: Line05ga_tl1
Gravity, mGal
Observed gravity
Modelled gravity
2.47
2.50
2.75
3.04
2.77
2.79
3.2
10 km
Depth, m
Distance, m
10000
20000
40000
60000
80000





line TL2



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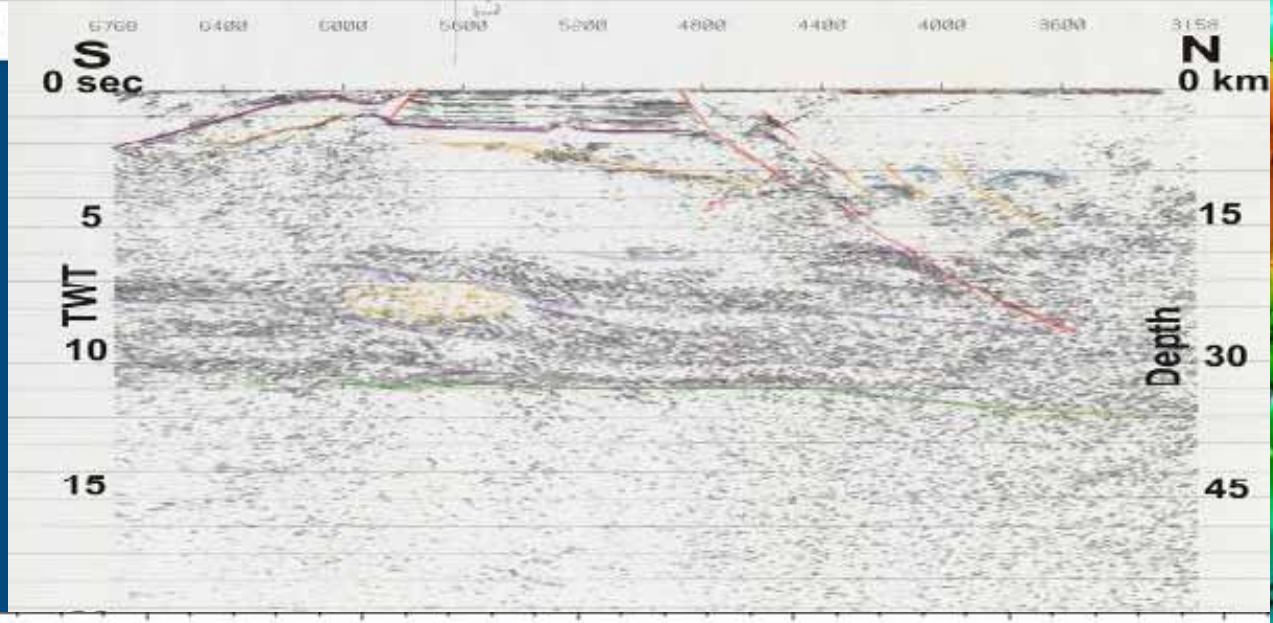

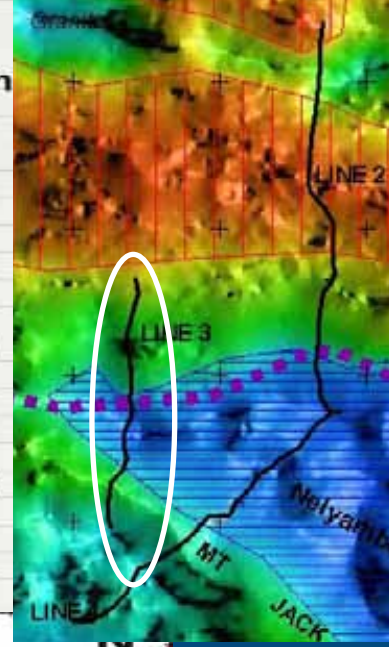

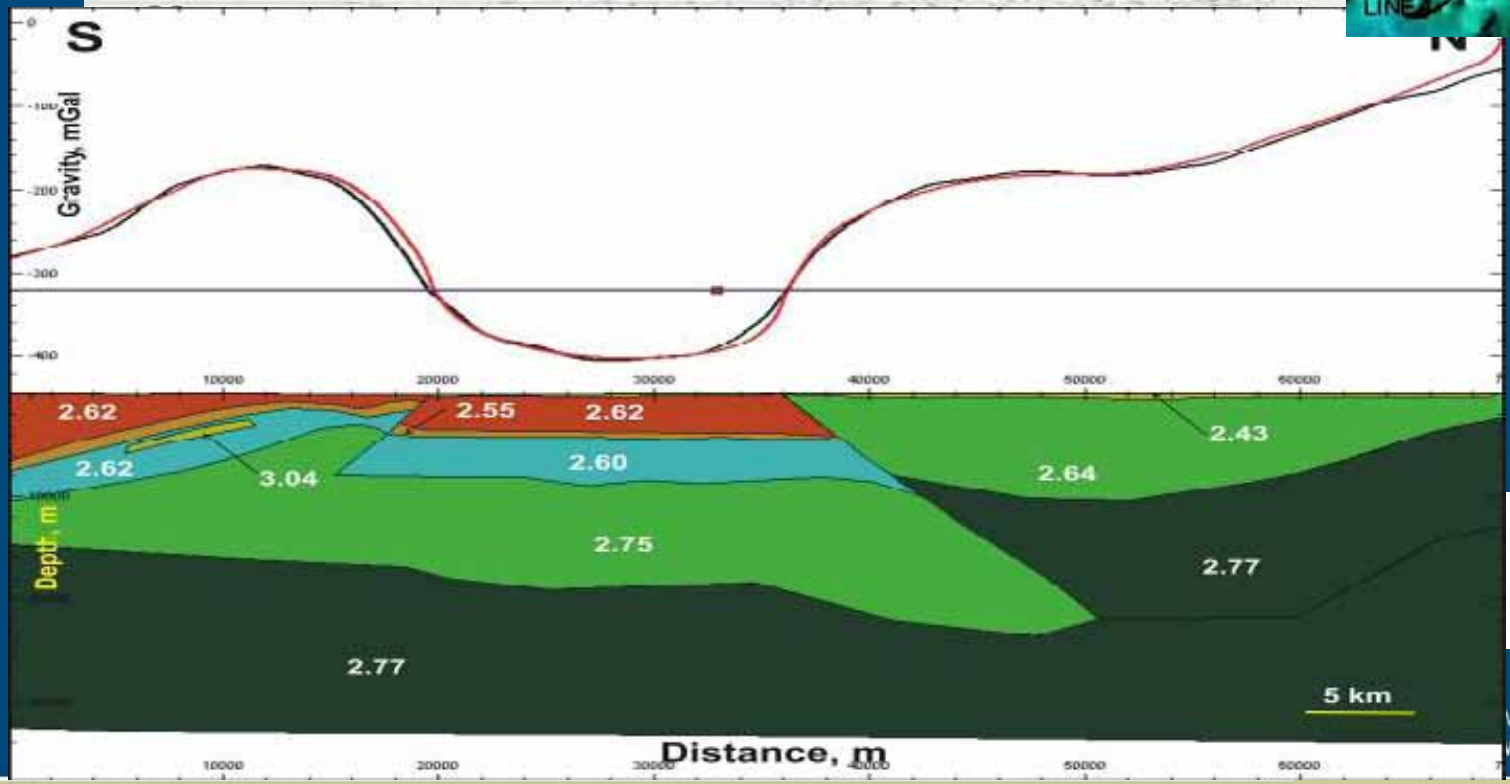

TL3

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Conclusions - 1

The Olepoloko Fault marks the boundary between the Thomson and the Lachlan, It is a north dipping fault that cuts through the crust

The Moho is at 48 km depth beneath the Thomson, and at 33 km on the Lachlan. Thick crust : (?) tectonic stacking, magmatic underplating or a combination of both?

The differences in character of the lower crust (more reflective under the Lachlan than the Thomson) confirms a major difference between the two orogens

The east-west gravity high in the Thomson is due to high density rocks in the lower crust, rather than near-surface rocks

Conclusions - 2

Gravity modelling of the Mt Jack High indicates the presence of dense, igneous rocks within the rift package

The Mt Jack Fault Zone consists of a SW-dipping thrust with folds and back thrusts developed in the hangingwall. The major fault marks the southwestern edge of the Nelyambo Trough

The Nelyambo Trough is a structural basin bounded by thrusts on each side, it contains up to 6-7 km of sediments of the Mulga Downs Group and 4 km of rift sequence

Implications -1

LACHLAN

Ages and units

- ?Ordovician basement
- ?Devonian rift basins - Cobar Supergroup
- Mid to Late Devonian sediments of the Mulga Downs Group

Tectonics

- Early and Late Devonian Nelyambo Trough
- Mt Jack High Carboniferous ?reactivation of Early Devonian rift margin

Mineralisation

- Hydrocarbons in Nelyambo Trough
- Cobar style and MVT on Mt Jack High
- Rift package gets shallower to NW on Mt Jack High

Implications - 2

THOMSON

Ages

- very preliminary ages : (Pre)cambrian gabbro basement??
- ?? Ordovician q rich turbidites
- Siluran volcanics (OIB volcanics)
- undated arc andesites

Tectonics

- convergent margin
- major contractional orogeny focussed in southern QLD

Mineralisation

- Veins in sediments with pyrite and pyrrhotite– compass drilling
- Mineralisation in arc rocks ?

DVD RELEASE

Thomson – Lachlan seismic survey

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THANK YOU

Merci…

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