FALCON® AGG inversion to constrain 3D geological models in the Glyde Sub-Basin, Northern Territory

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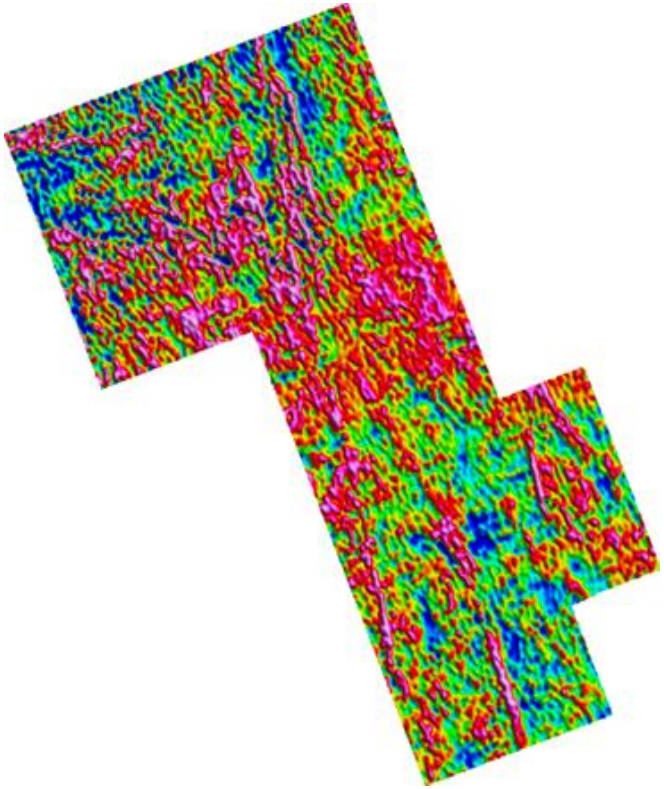
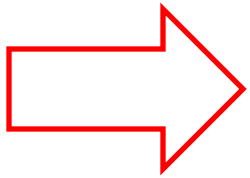
Outline

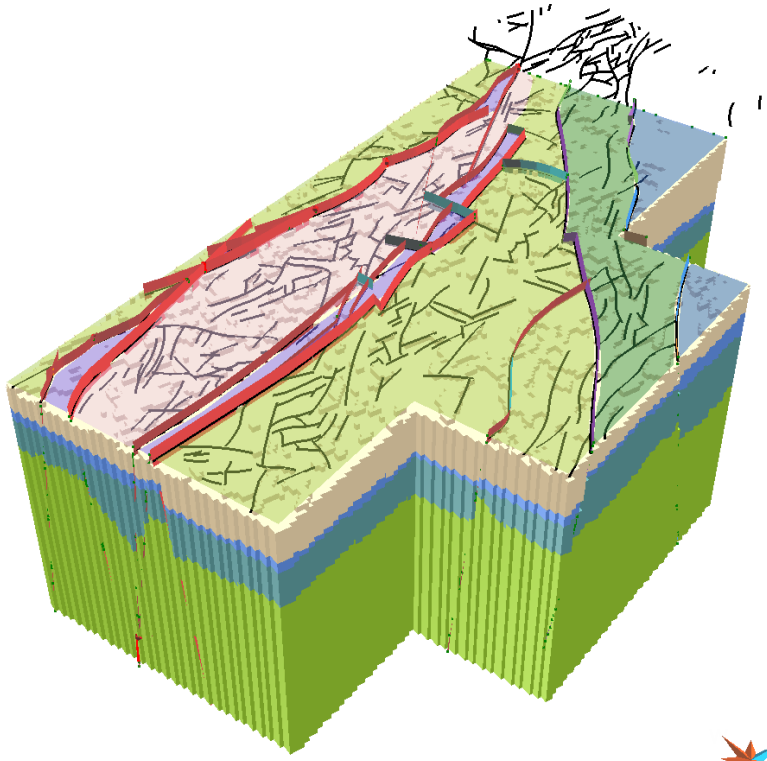
- Introduction
- Geological Setting
- Data and data processing
- Structural interpretation
- Earth Model and inversion
- Conclusions

Introduction

How can we improve our geological models using inversions?





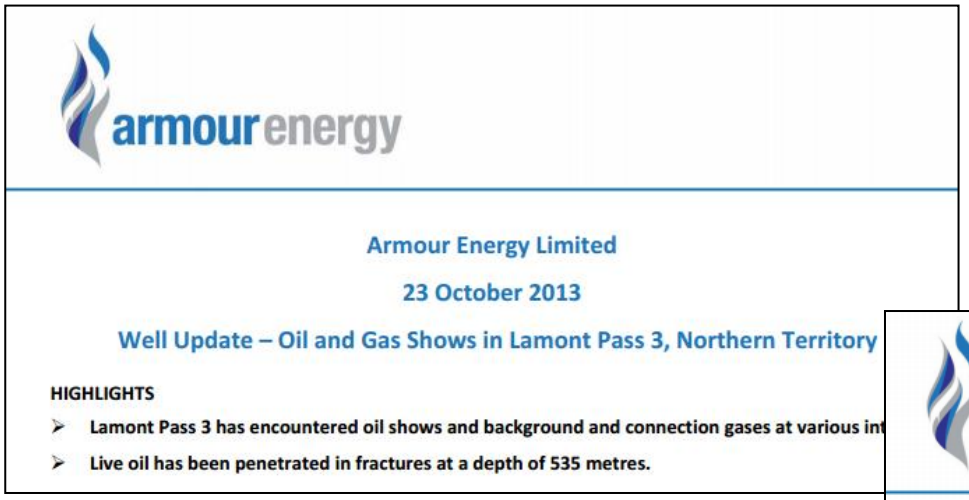


…inversions are just one step in the geological interpretation of geophysical data

Introduction

- Armour Energy
- Acquisition
- Integrated interpretation (Airborne AGG and Mag, seismic, geology, public domain datasets)
- Goal: identify hydrocarbon plays in the Glyde Basin

Successful drilling!



armour energy

Armour Energy Limited

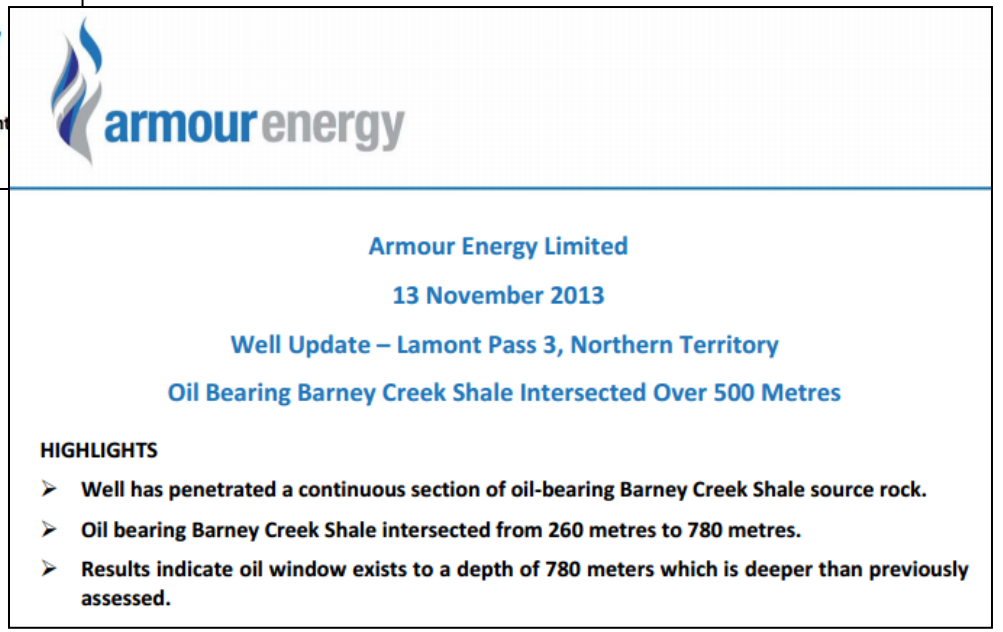
23 October 2013

Well Update – Oil and Gas Shows in Lamont Pass 3, Northern Territory

HIGHLIGHTS

- Lamont Pass 3 has encountered oil shows and background and connection gases at various int
- Live oil has been penetrated in fractures at a depth of 535 metres.

ASX Announcement, 23rd October 2013



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13 November 2013

Well Update – Lamont Pass 3, Northern Territory

Oil Bearing Barney Creek Shale Intersected Over 500 Metres

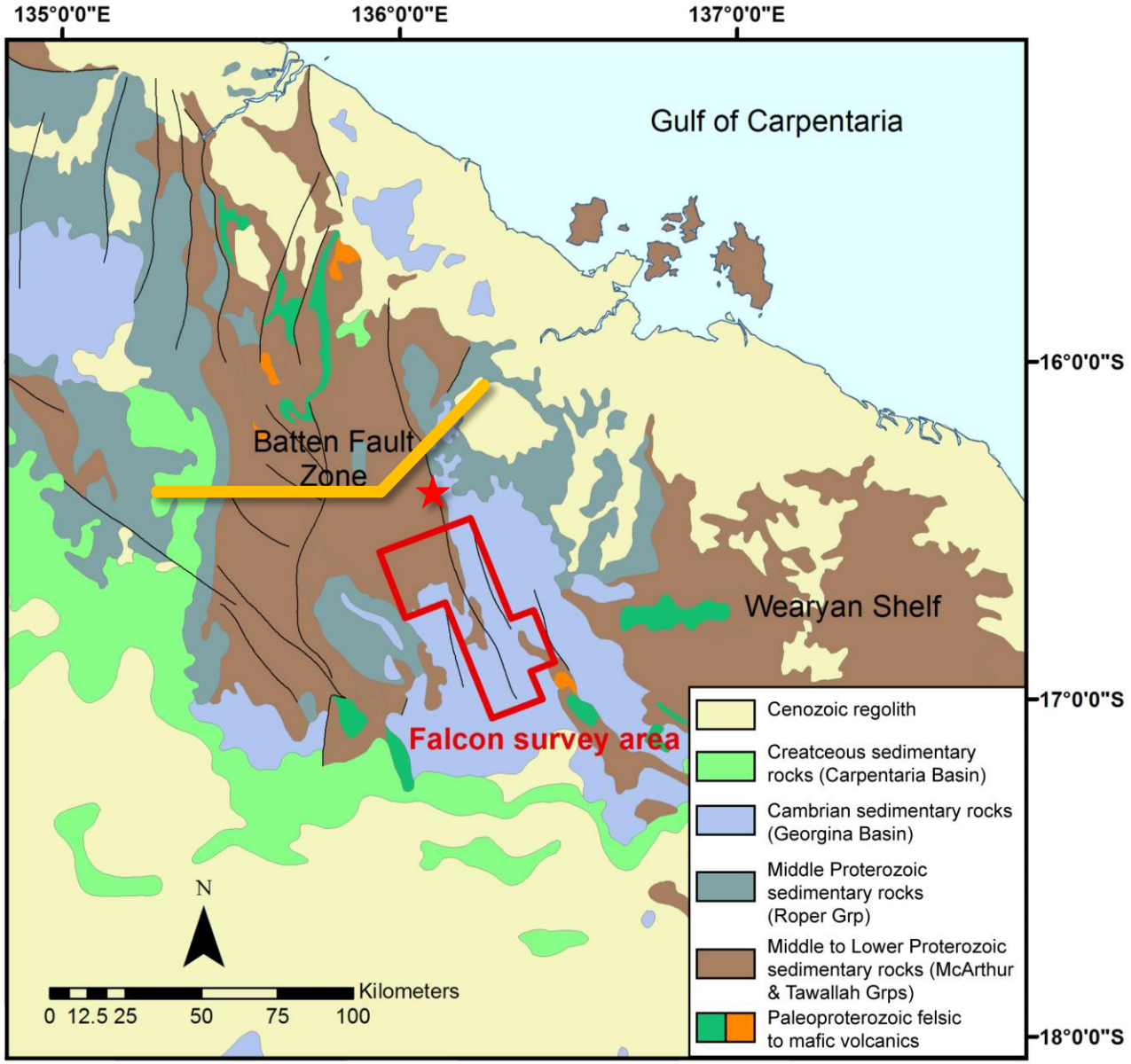
HIGHLIGHTS

- Well has penetrated a continuous section of oil-bearing Barney Creek Shale source rock.
- Oil bearing Barney Creek Shale intersected from 260 metres to 780 metres.
- Results indicate oil window exists to a depth of 780 meters which is deeper than previously assessed.

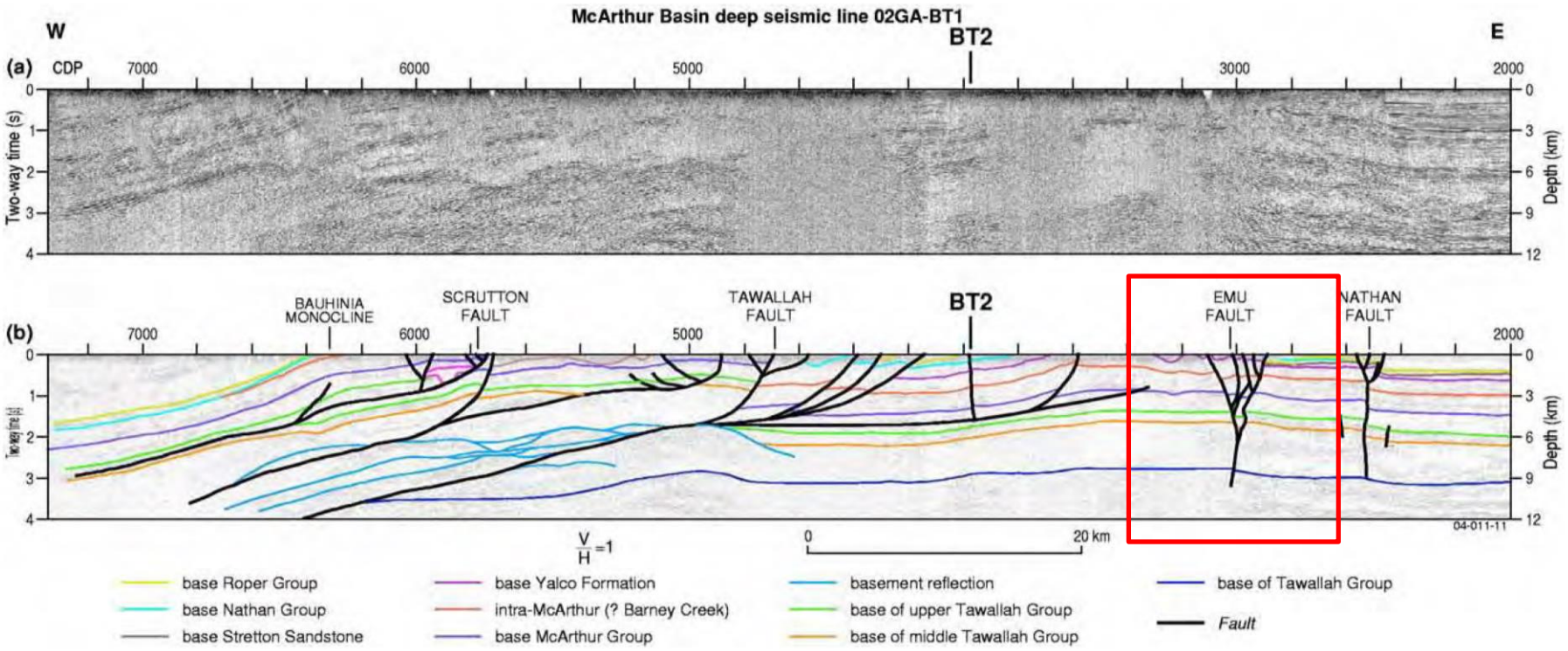
ASX Announcement, 13th November 2013

Geological setting

Geological Setting - Regional



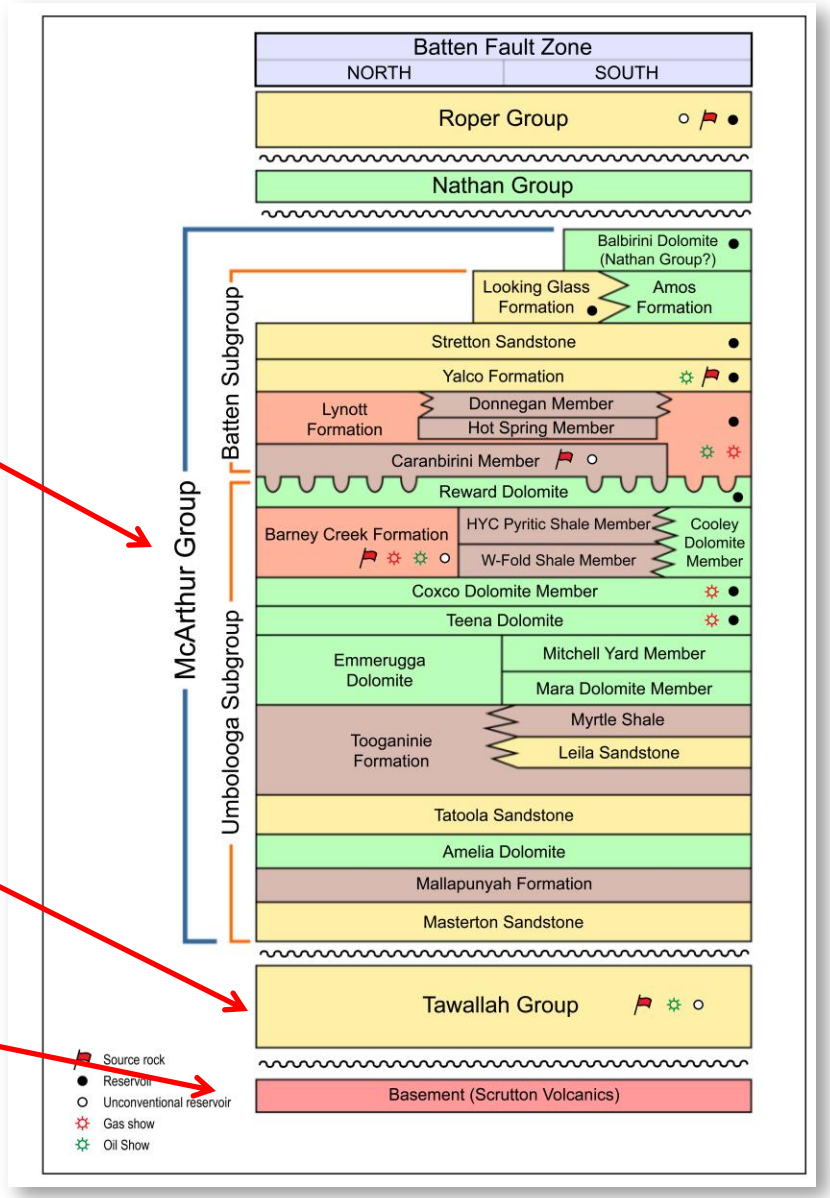
Geological Setting - Regional



Rawlings (2002)

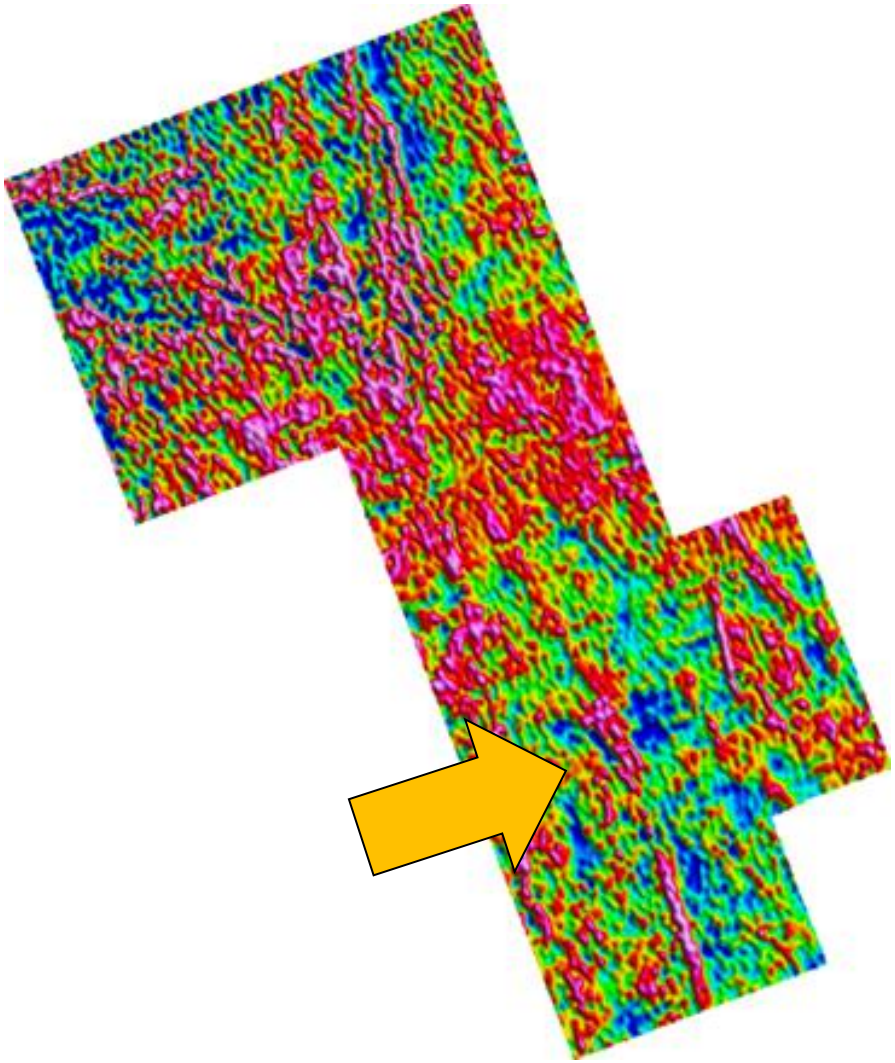
Geological Setting – Glyde Sub-basin

- McArthur Group: up to 4.5 km; carbonates, sandstone, fine-grained clastics and minor tuffaceous mudstone
- Depositional environments: fluvial and lacustrine to shallow marginal marine
- Intracratonic setting
- Oldest rocks: Palaeoproterozoic volcano-sedimentary sequence of the Tawallah Group
- Basement: Scrutton volcanics – correlated to Cliffdale Volcanics and Nicholson Granite emplaced at about 1860 – 1845 Ma

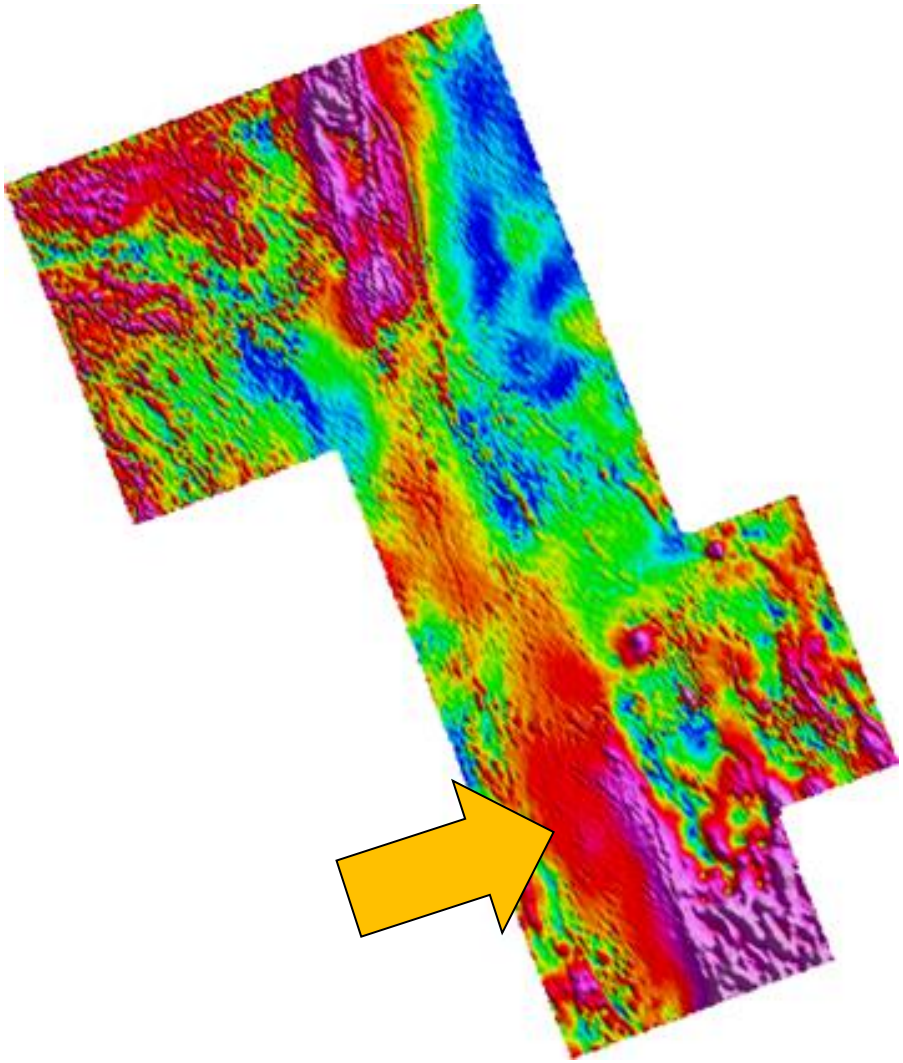


Data and data processing

Data – GDD, Mag

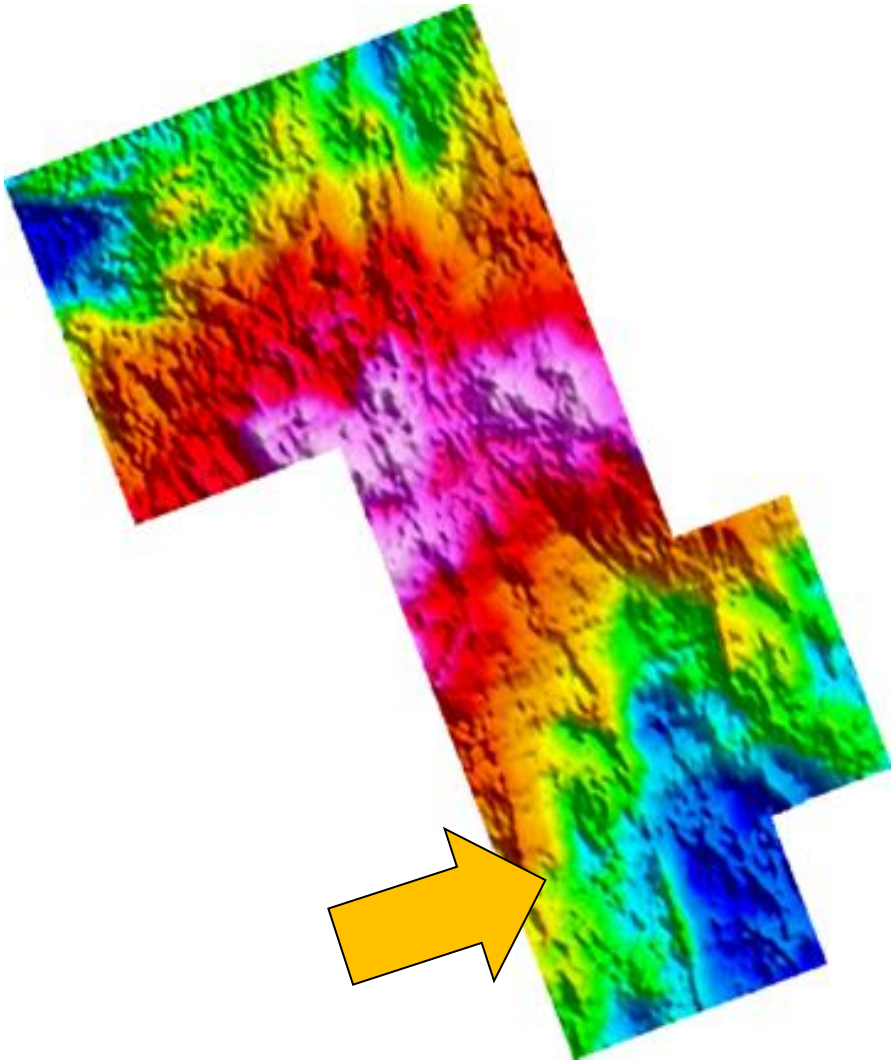


GDD



TMI AS

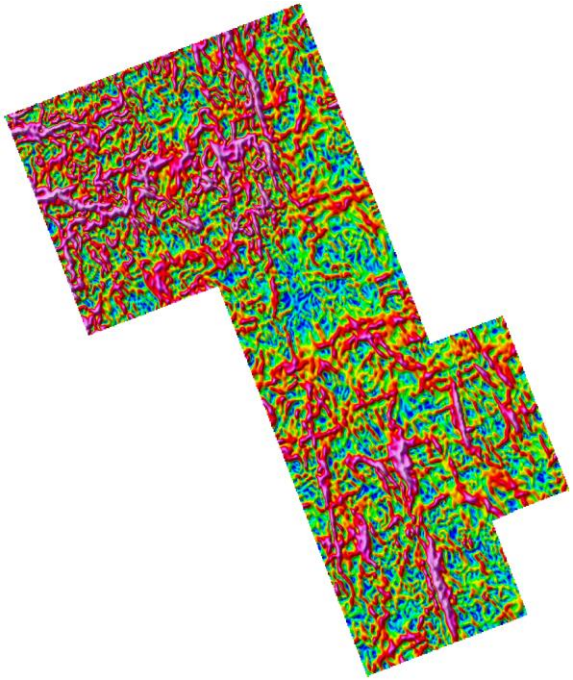
Data – gD



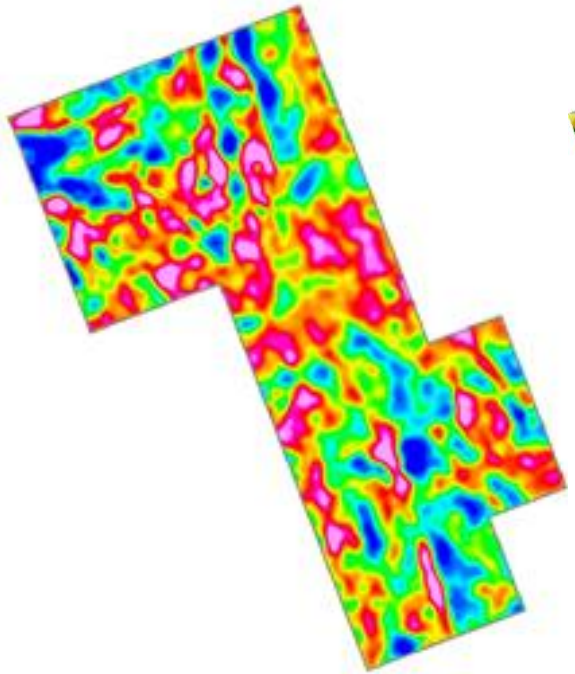
gD

Data processing

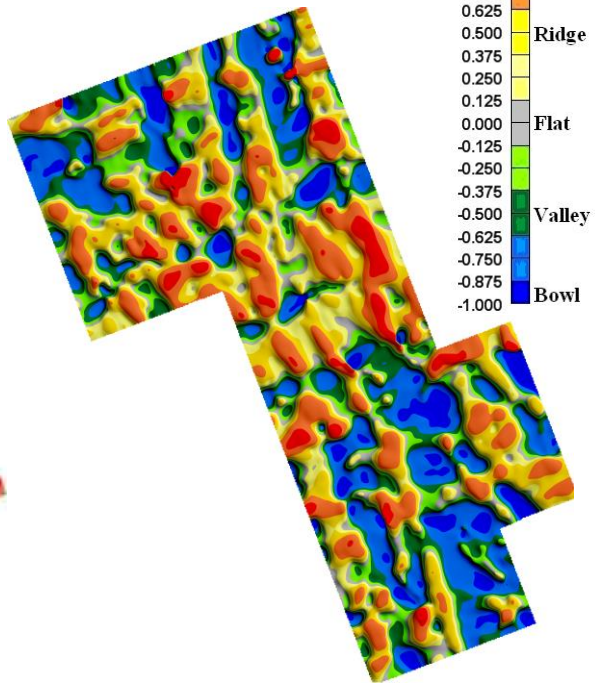
gD HD



GDD 1020m



SI 1020m

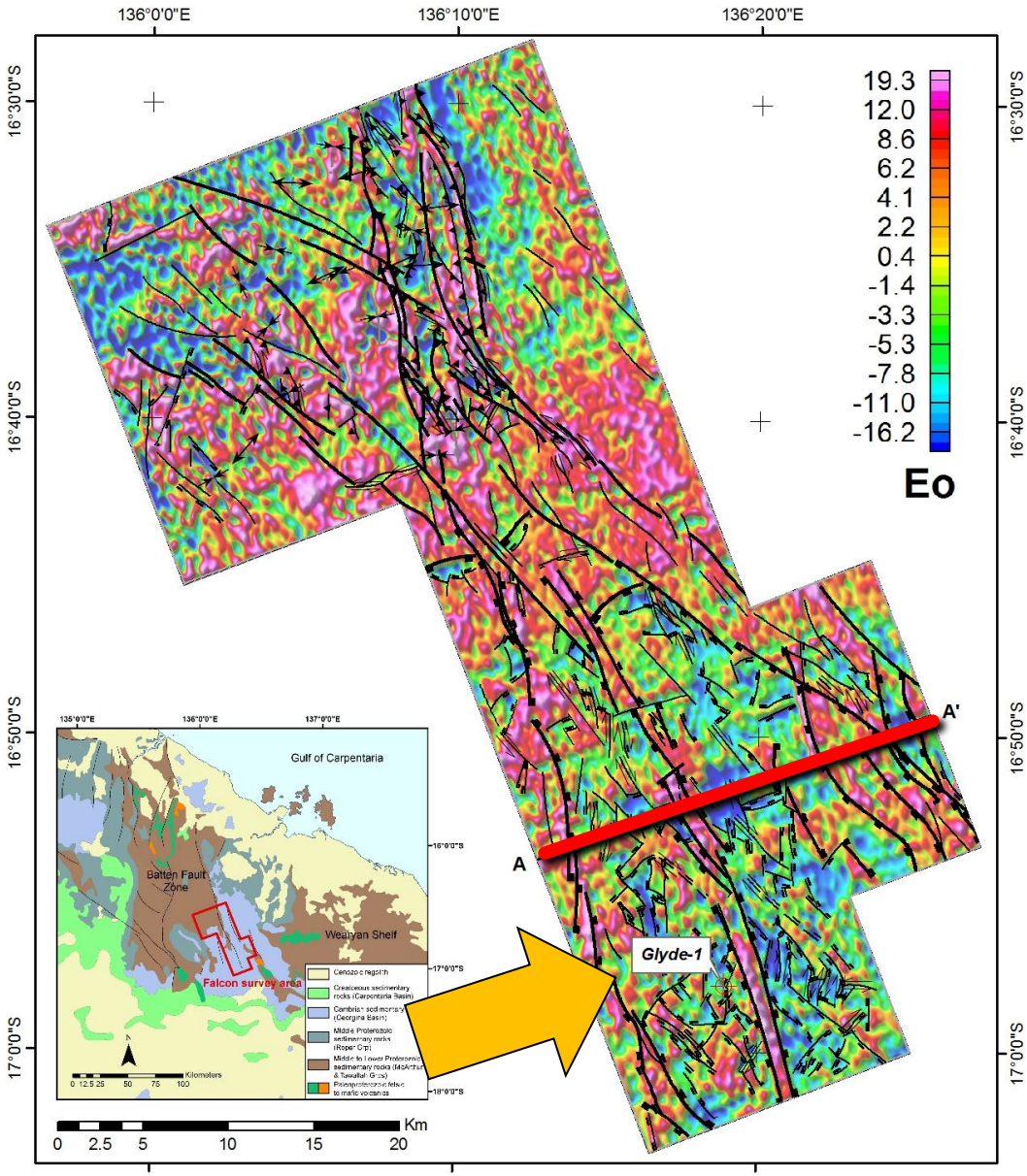


- Image enhancement of the AGG and magnetic data
- Shape Index of equipotential surface of the gravity field to understand nature of AGG and its relation to geometries of geological bodies (Cevallos, 2013)
- Pseudo depth slices of the GDD, the Shape Index and magnetic data to constrain the vertical distribution of geological units (Spector and Grant, 1970)

Structural interpretation

Integrated structural interpretation

- Complex structural evolution
- Regional size ‘pop up’ structure in the north, represented by a pattern of reverse, transpressional and strike-slip faults, and abundant synclines and anticlines
- In the south, the transtensional Emu Fault Zone controlled development of several regularly oriented, fault bounded depocentres (Glyde)

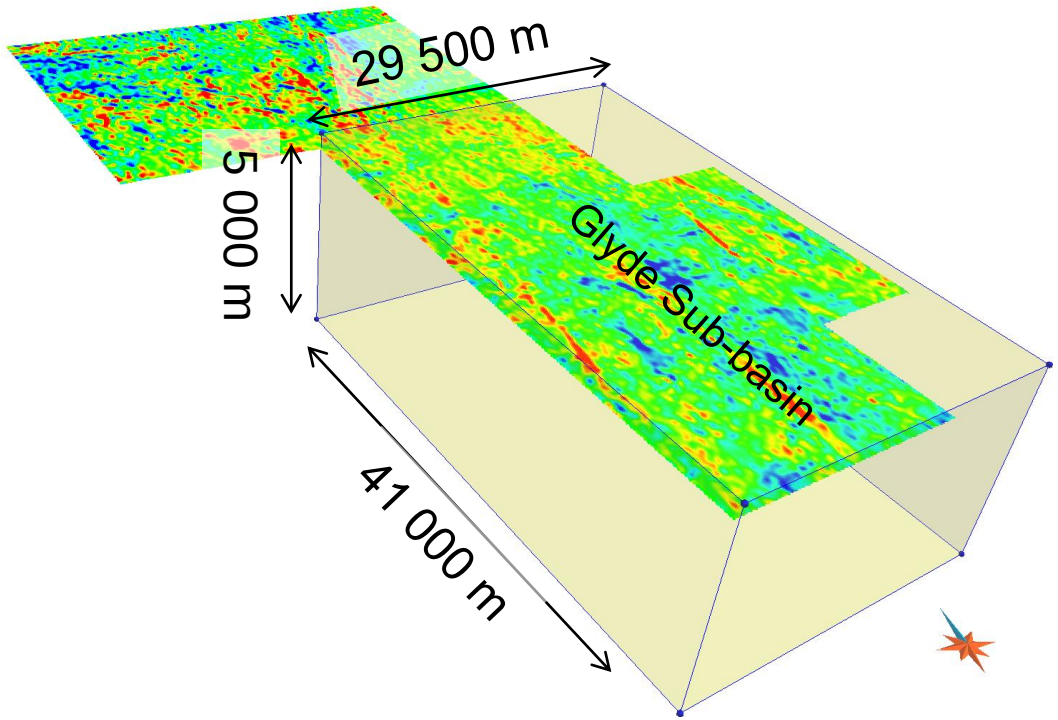


Structural interpretation and GDD

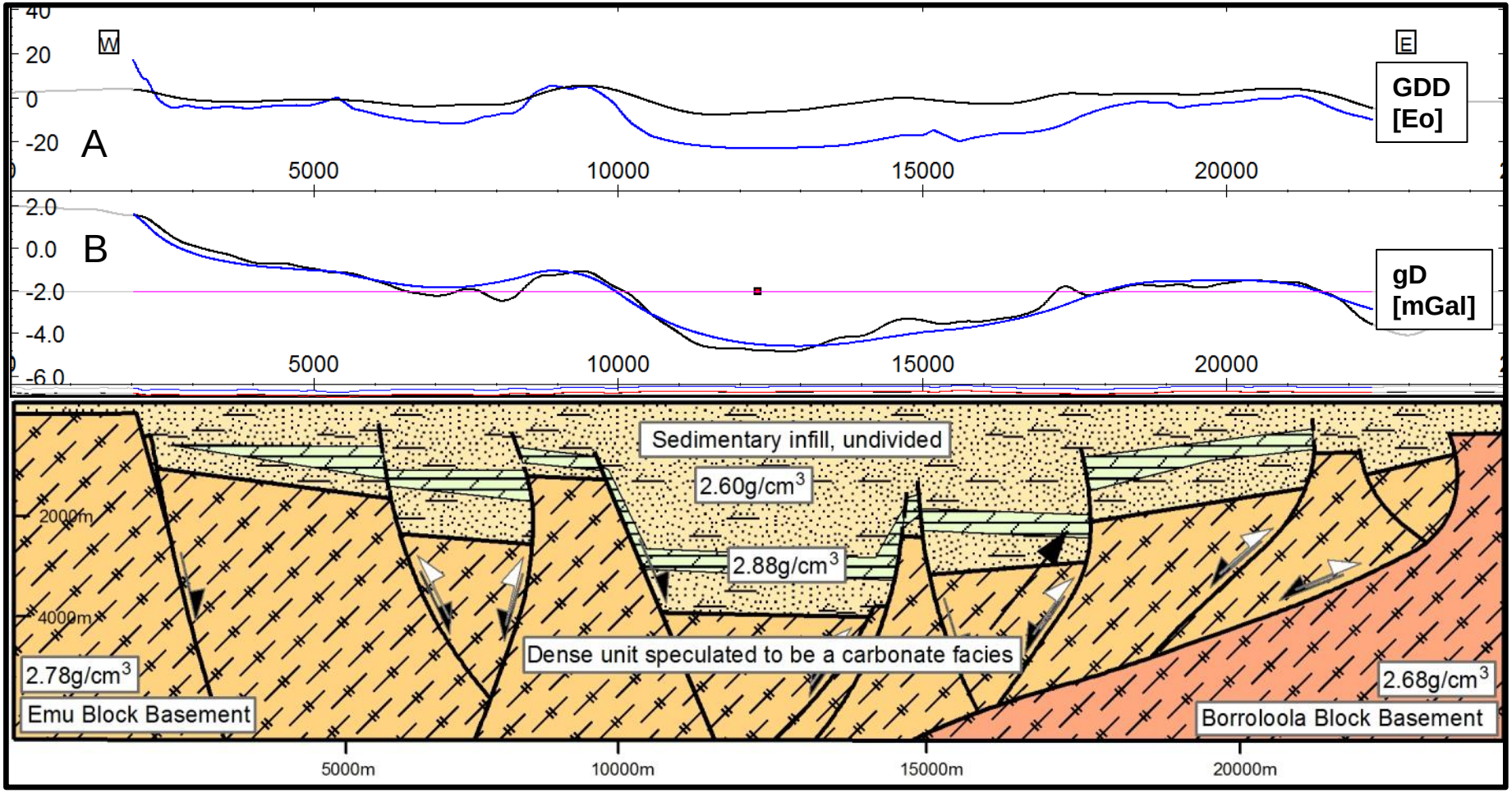
Earth Model

Earth Model

- 2D forward modelling
- Fault network and magnetic basement
- 3D model (surfaces)
- 3D model (grid)
- Inversion



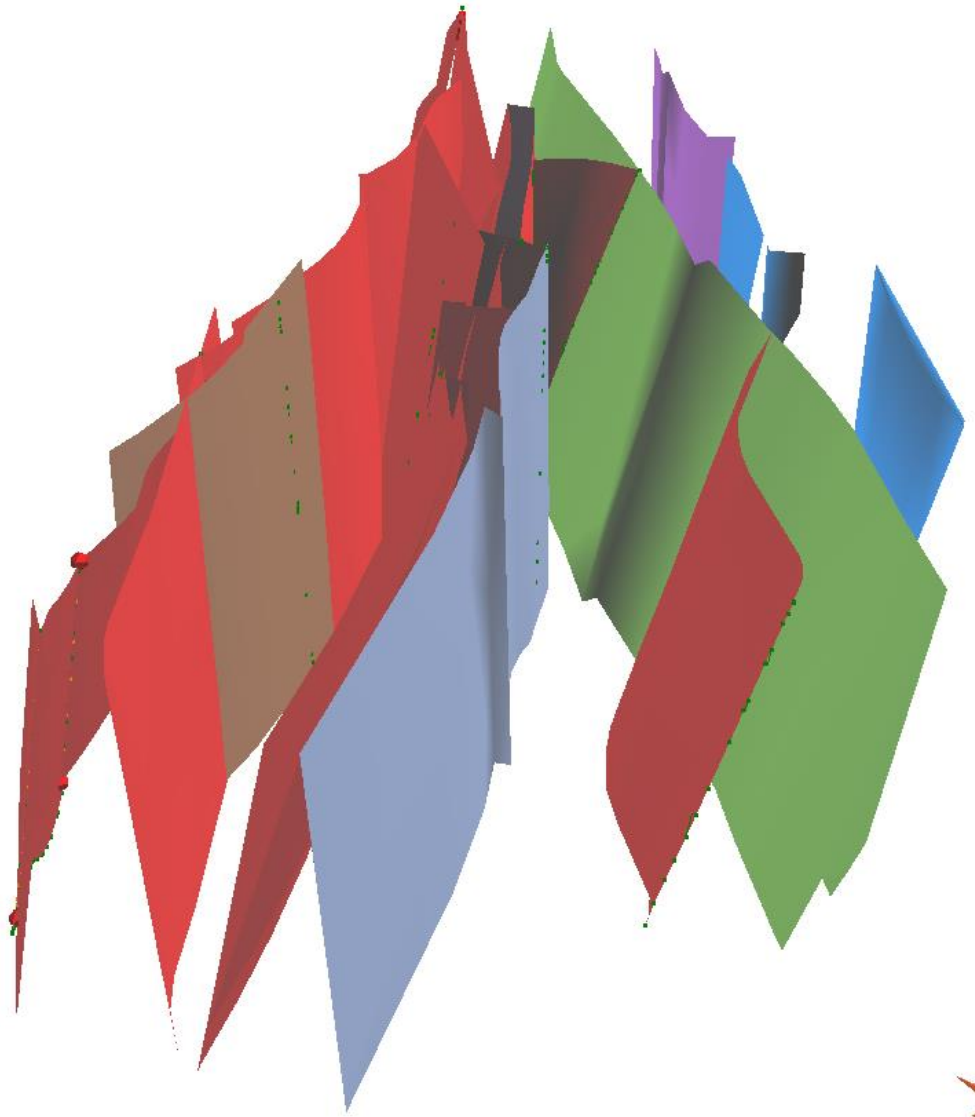
2D modelling



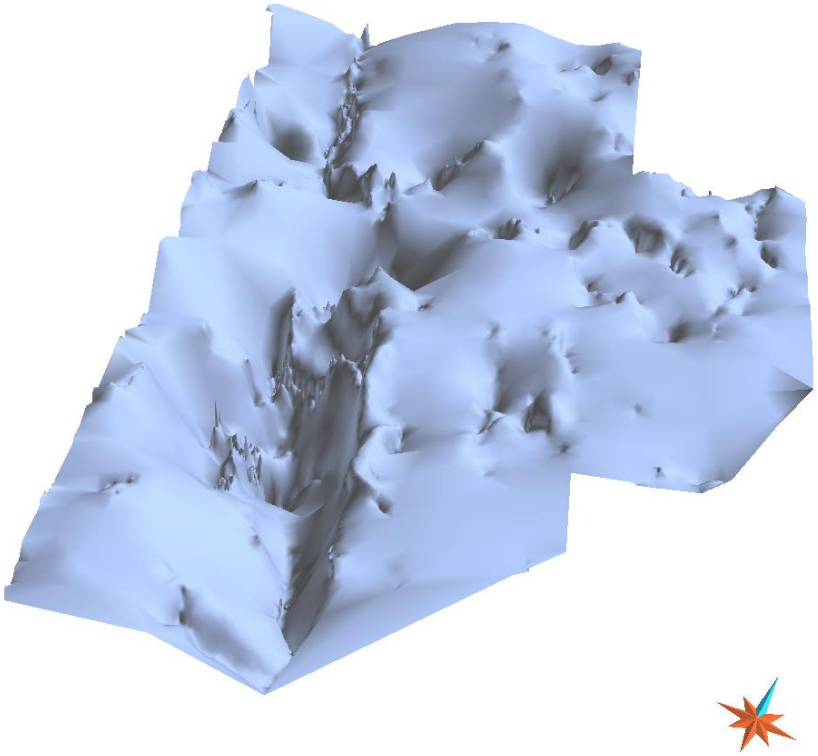
Geological cross-section A – A'

A) Pseudodepth slice of 1020m of first vertical derivative of vertical component of gravity (GDD) response (measured – black; calculated – blue); B) Vertical gravity (gD) response (measured – black; calculated – blue)

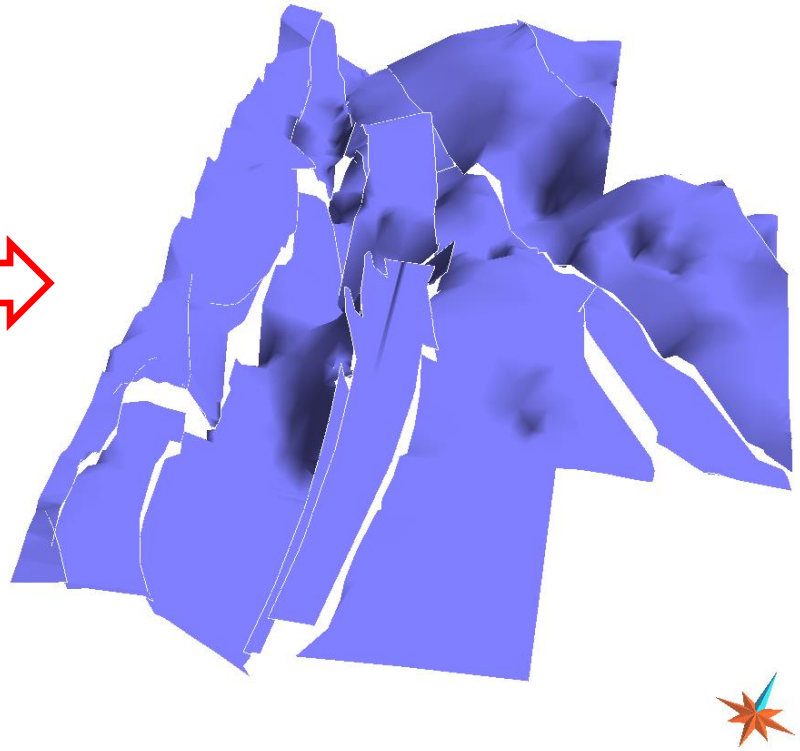
Earth Model – Fault network



Earth Model – Depth to magnetic basement

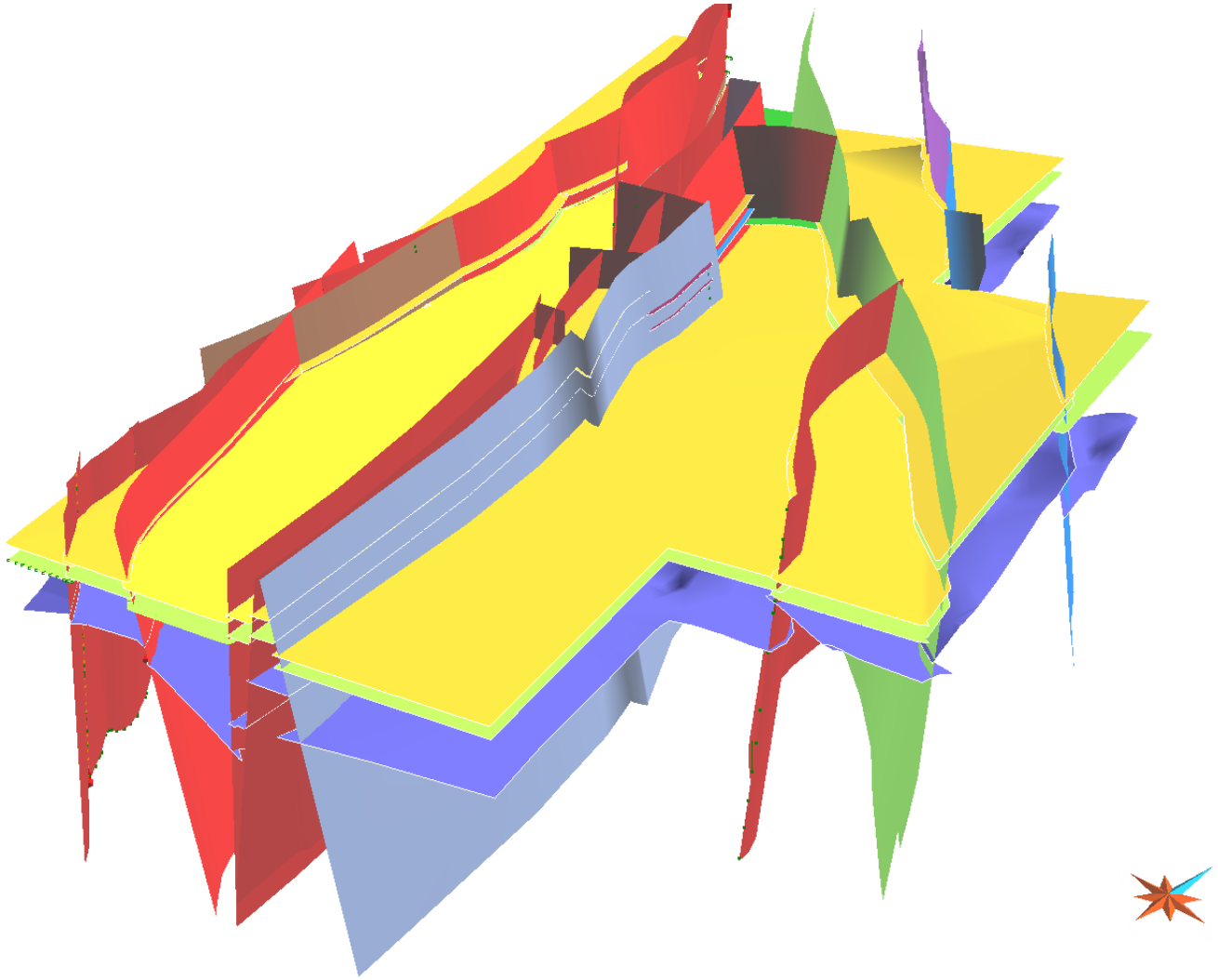


Gridded Euler contact (Structural Index = 0) magnetic solutions at 15% error level



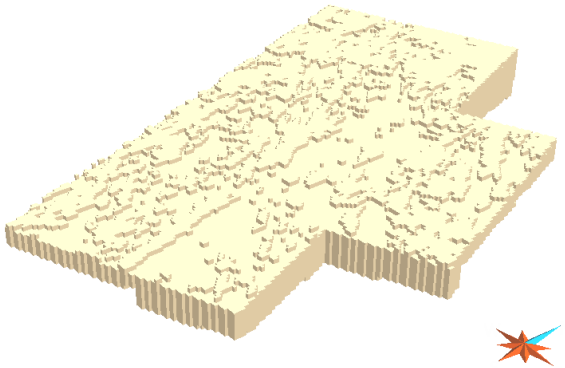
Interpreted top surface of the magnetic basement (Tawallah Group, Scrutton volcanics)

Earth Model - Stratigraphy

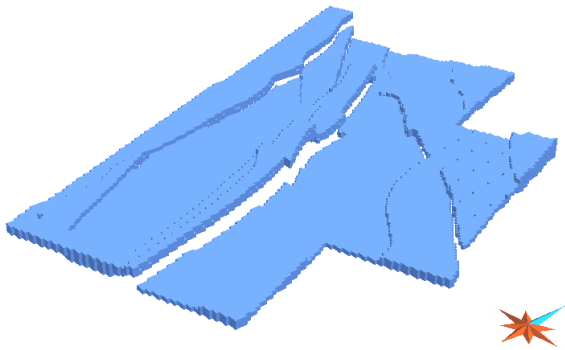


Geological model constructed from interpreted geological interfaces and faults

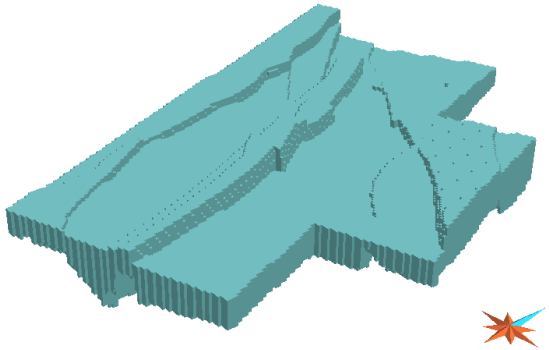
Earth Model - Voxet



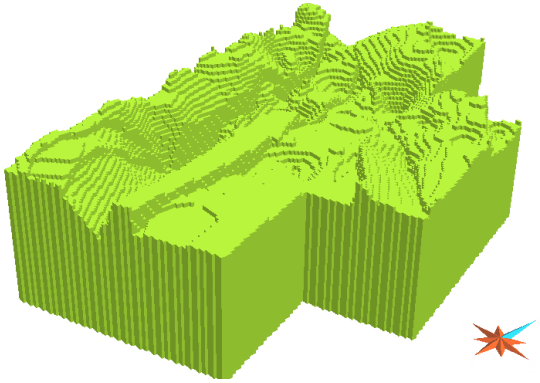
Barney Creek Fm + younger sequences



Teena and Coxco Dolomite Layer

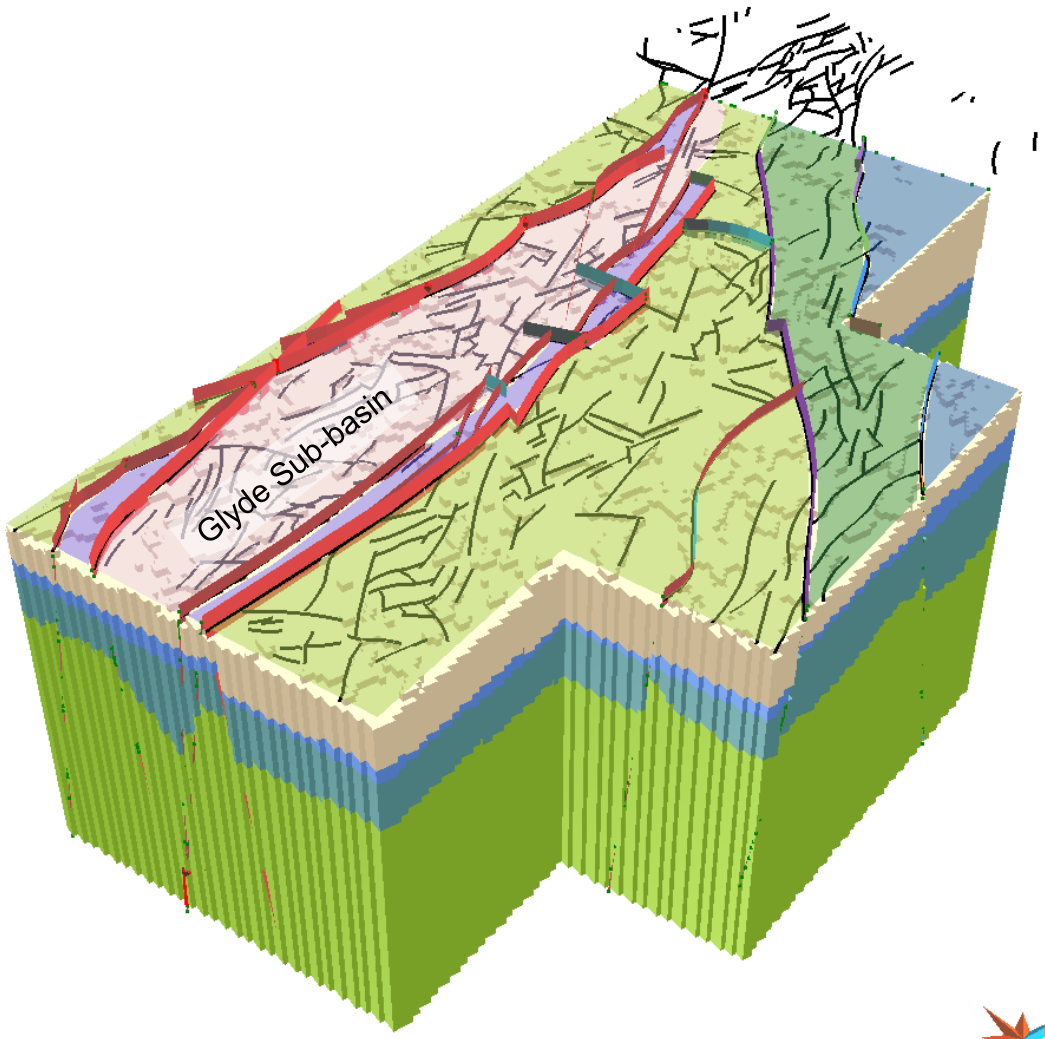


Lower Umbolooga Subgroup

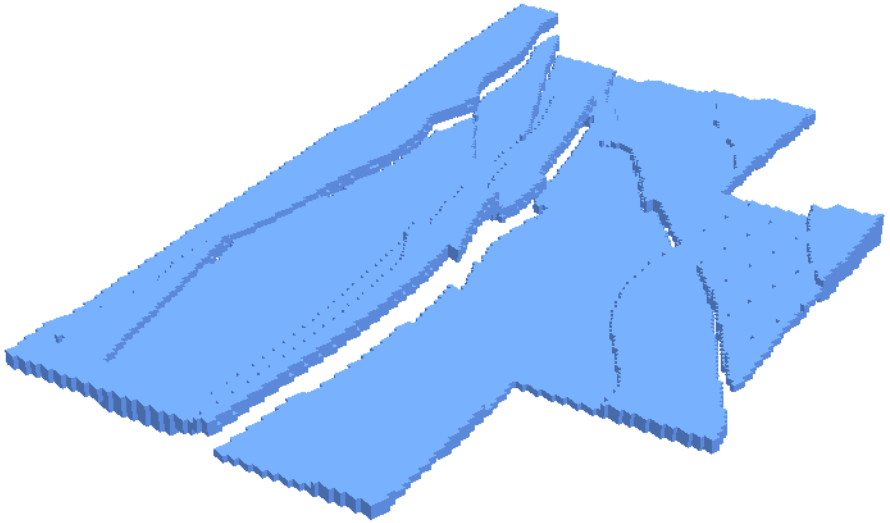


Basement (Tawallah Gr., Scrutton volcanics)

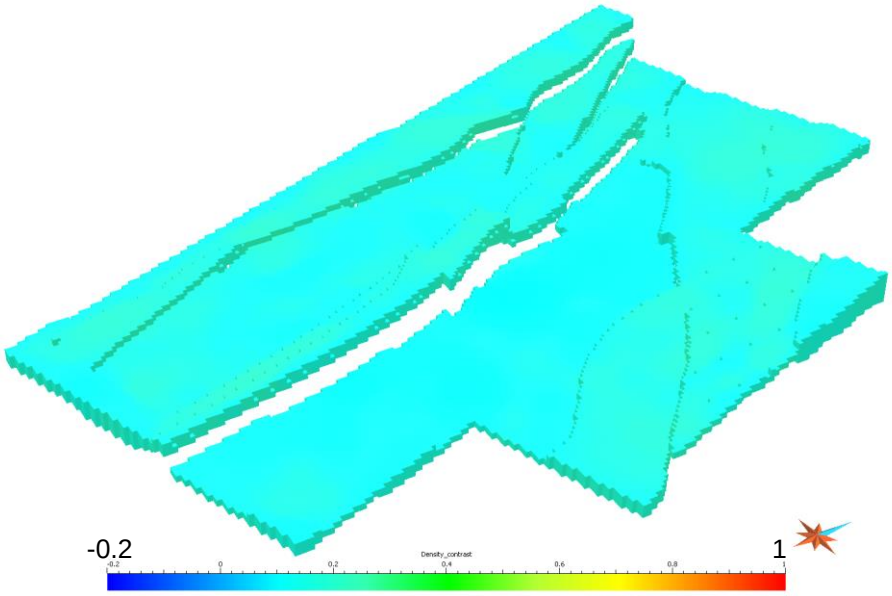
Earth Model - Voxet



Earth Model - Inversion

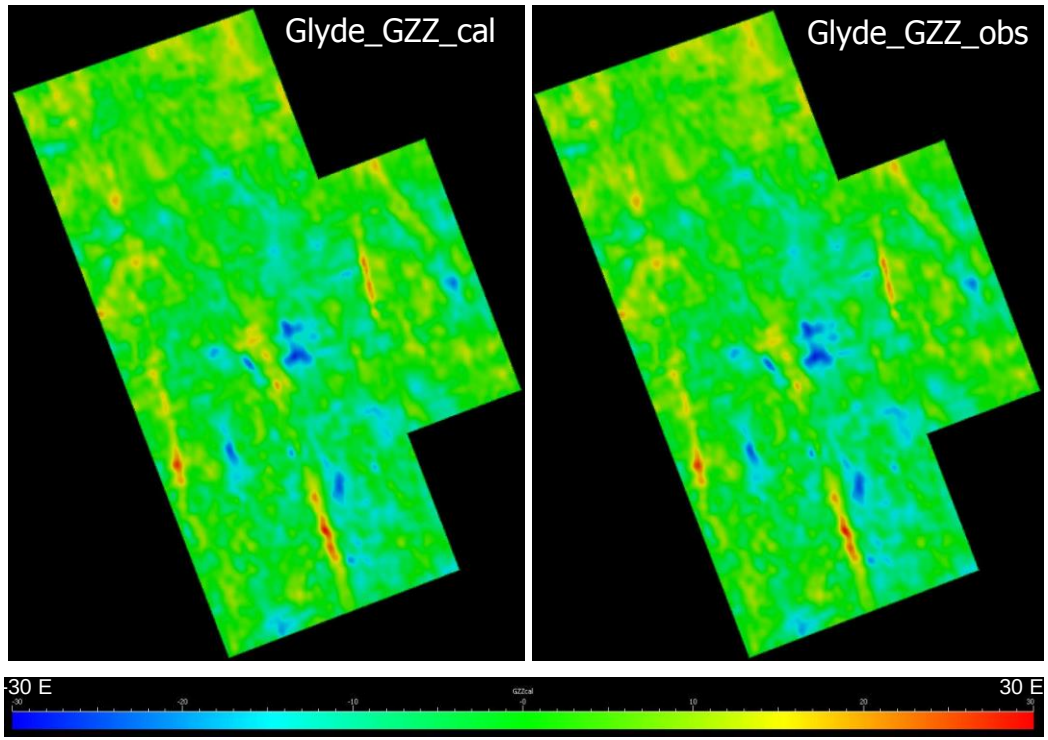


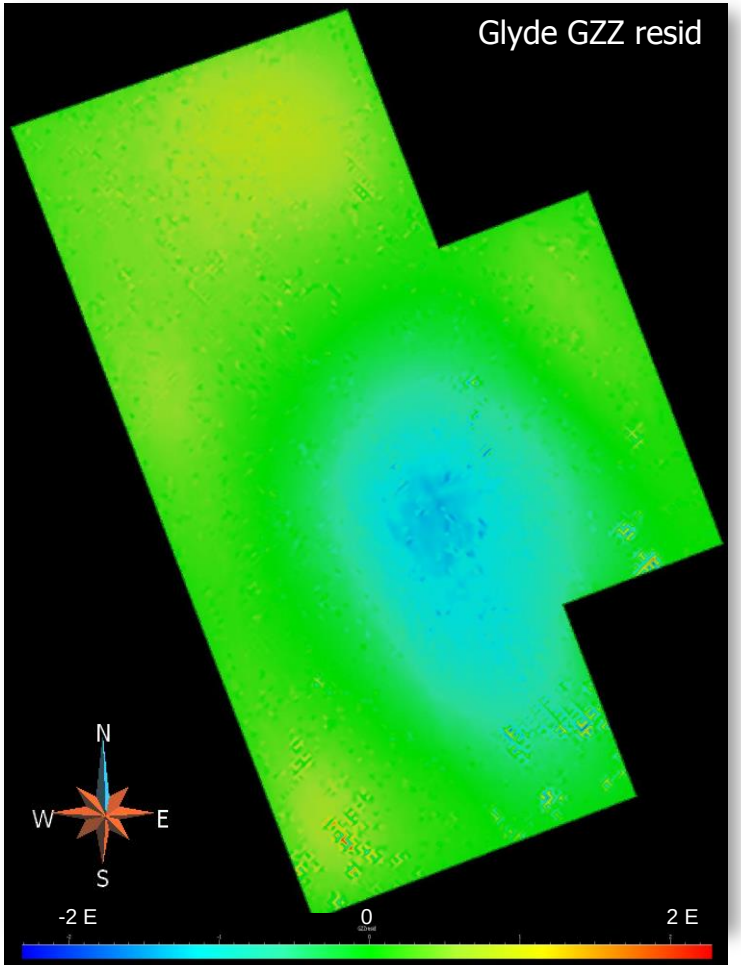
Coxco and Teena Dolomites - geological interpretation



Coxco and Teena Dolomites - Heterogeneous density inversion results

Earth Model - Inversion

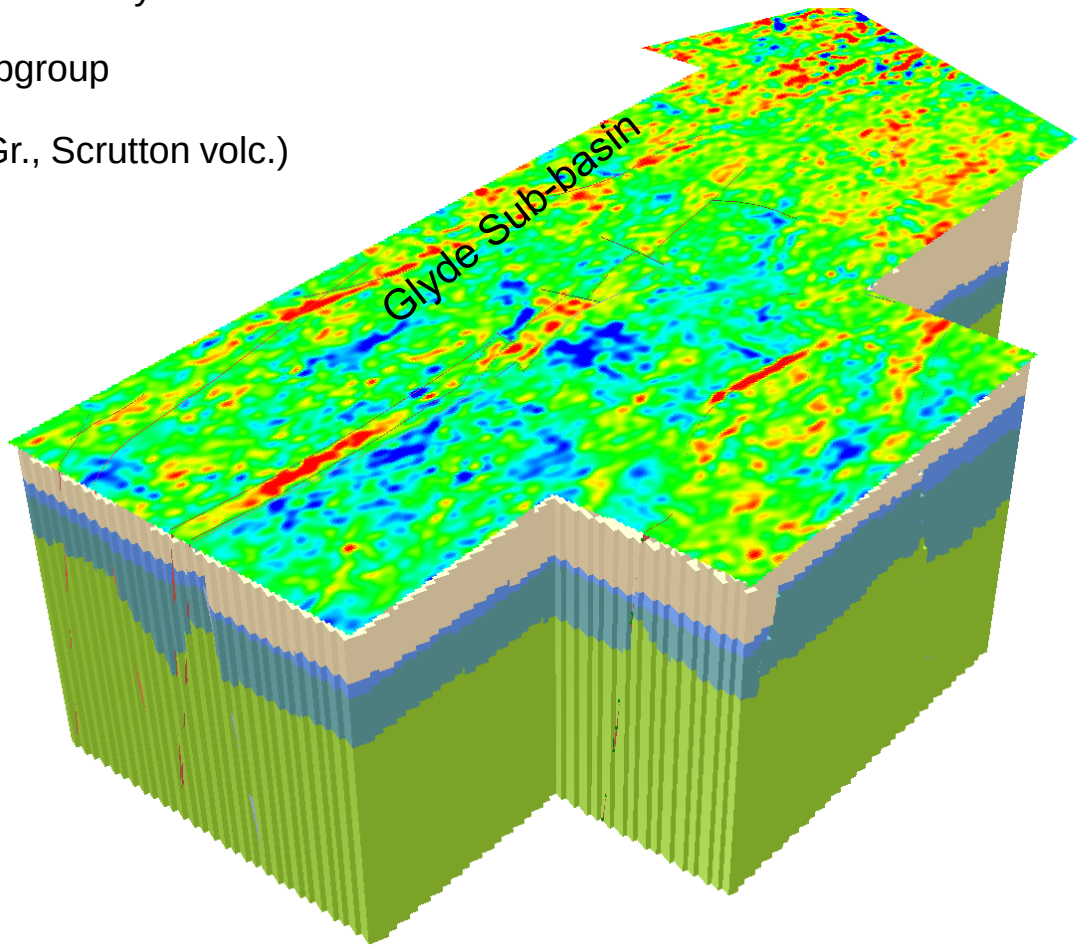




Validity of the proposed geological model was evaluated by inverting of gravity gradiometer data
Inversion indicated quantitative consistency between geological and geophysical data

Final Earth Model

- Barney Creek Fm and younger sequences
- Teena and Coxco Dolomite Layer
- Lower Umbolooga Subgroup
- Basement (Tawallah Gr., Scrutton volc.)



Conclusions

- The **interpretation and 3D modelling workflow** applied in the Glyde Sub-basin project represents a solid approach to integrate available geological and geophysical data in a comprehensive 3D interpretation
- 3D inversions proved valuable to **refine the final model** and as a quantitative tool to **assess model reliability**
- When integrated with a **solid geological understanding**, 3D inversions represent an additional **tool** for the geologists and the geophysicist to aid interpretation and improve 3D geological models
- High-resolution **airborne gravity gradiometer** and magnetic survey effectively images tectonic pattern to aid in **minerals** and **hydrocarbon** prospecting

Thank you!

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