



# **Depth to basement calculation in the Southern Thomson**

Janelle Simpson  
Roger Cant



**Queensland**  
Government

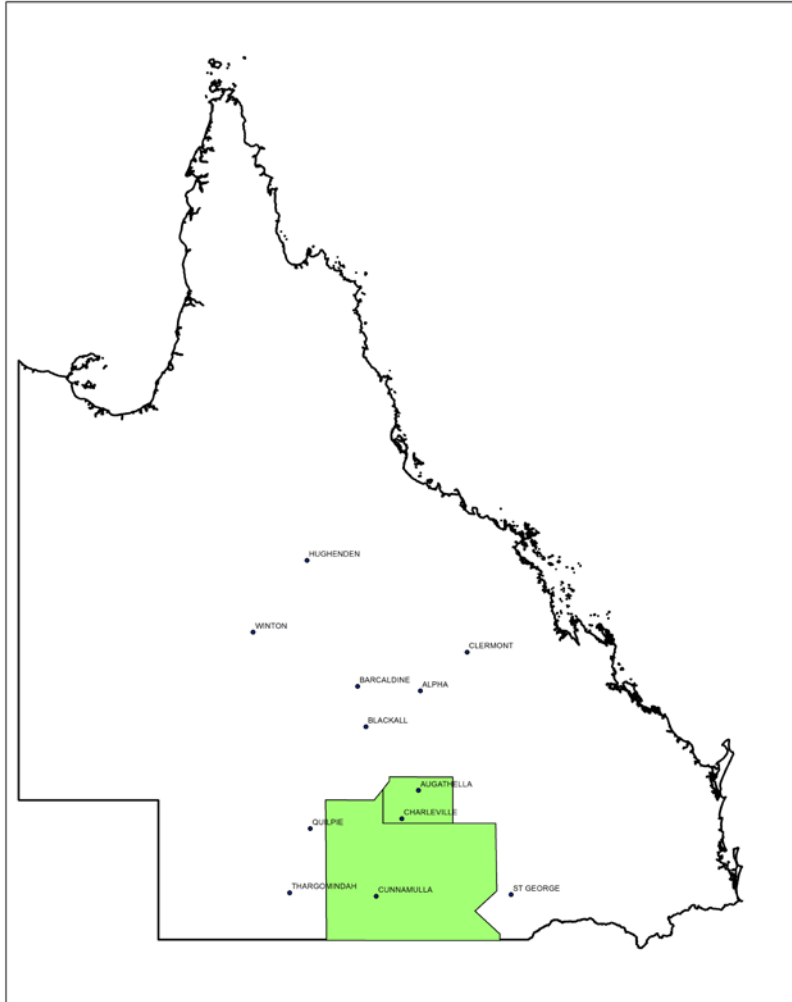


# Overview

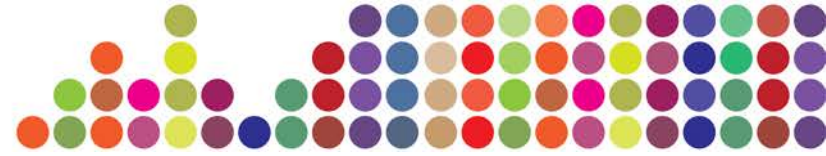
- Motivation
- Data
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- Automated depth estimates
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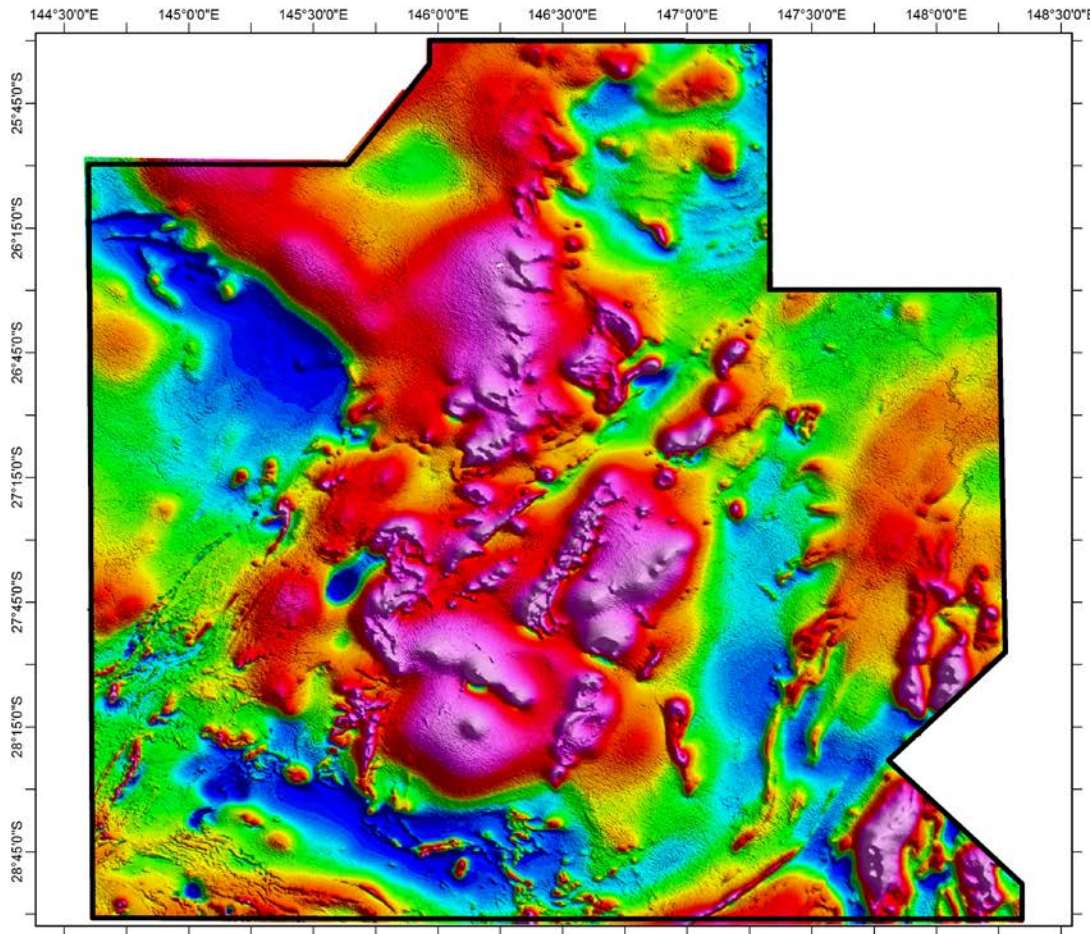
# Motivation



- Important consideration in minerals exploration
- Southern Thomson is a potentially prospective area
  - poorly understood
  - under explored
- New higher resolution magnetic data
- Approximately 330km x 360km



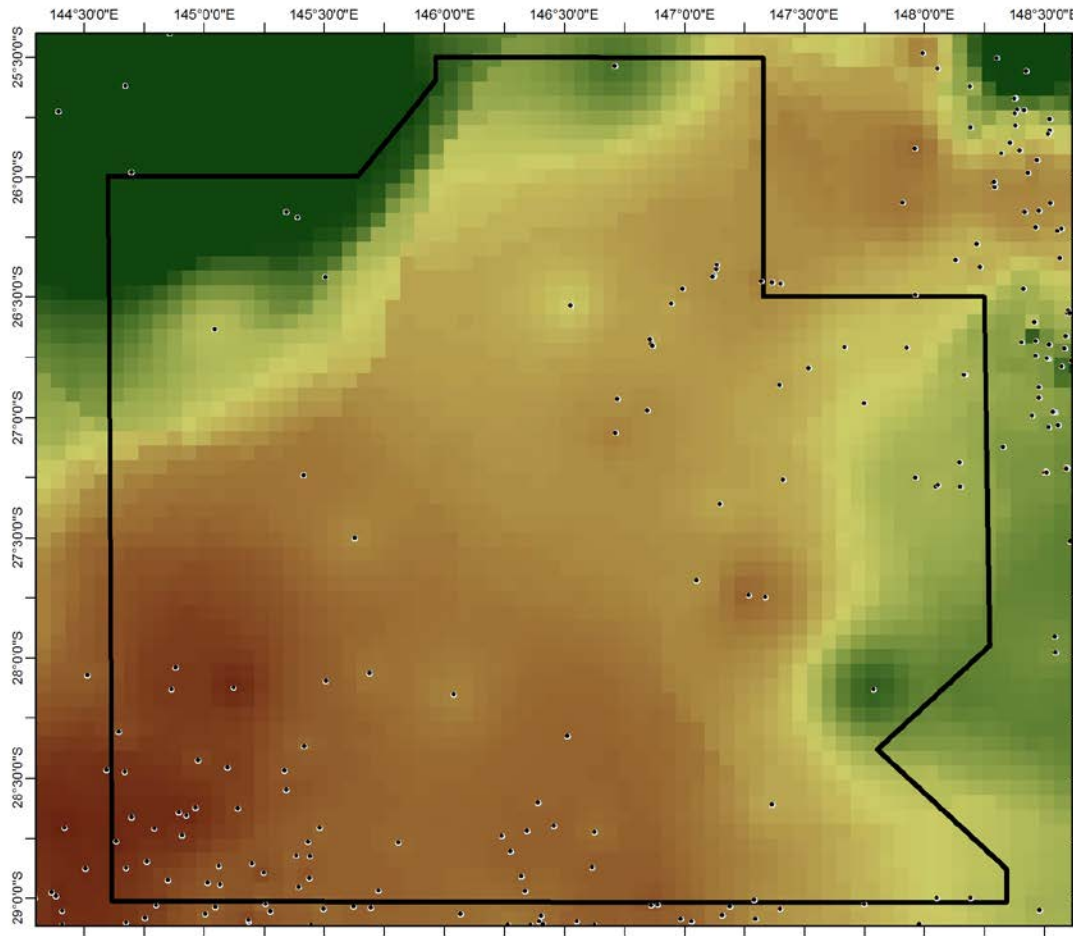
# Data



- Existing data poor quality
- Data collected during 2011 – 2012 on behalf of the Geological Survey of Queensland
- 400m line spacing
- E-W line orientation
- 80m nominal height



# Existing depth to basement



After Brown et al. 2012

- Limited drilling data
- Basement depth is poorly constrained
- Considerable geological complexity in unconstrained areas
- The Thomson Orogen surface and is defined as rocks which occur below the Devonian to Cenozoic basin systems in the Thomson Orogen





# Automated depth estimation

- Most commonly used depth to basement techniques
  - Euler deconvolution
  - Werner deconvolution
  - Naudy
  - SPI
  - CW
- Fast compared to manual depth estimation
- Characterised by large numbers of solutions which need to be refined
- Careful selection of technique required

	Horizontal derivative	Vertical derivative	Higher-order derivative
Naudy	No	optional	No
Werner	Yes	No	No
Euler	Yes	Yes	optional
SPI	Yes	Yes	Yes
CWT	Yes	Yes	optional

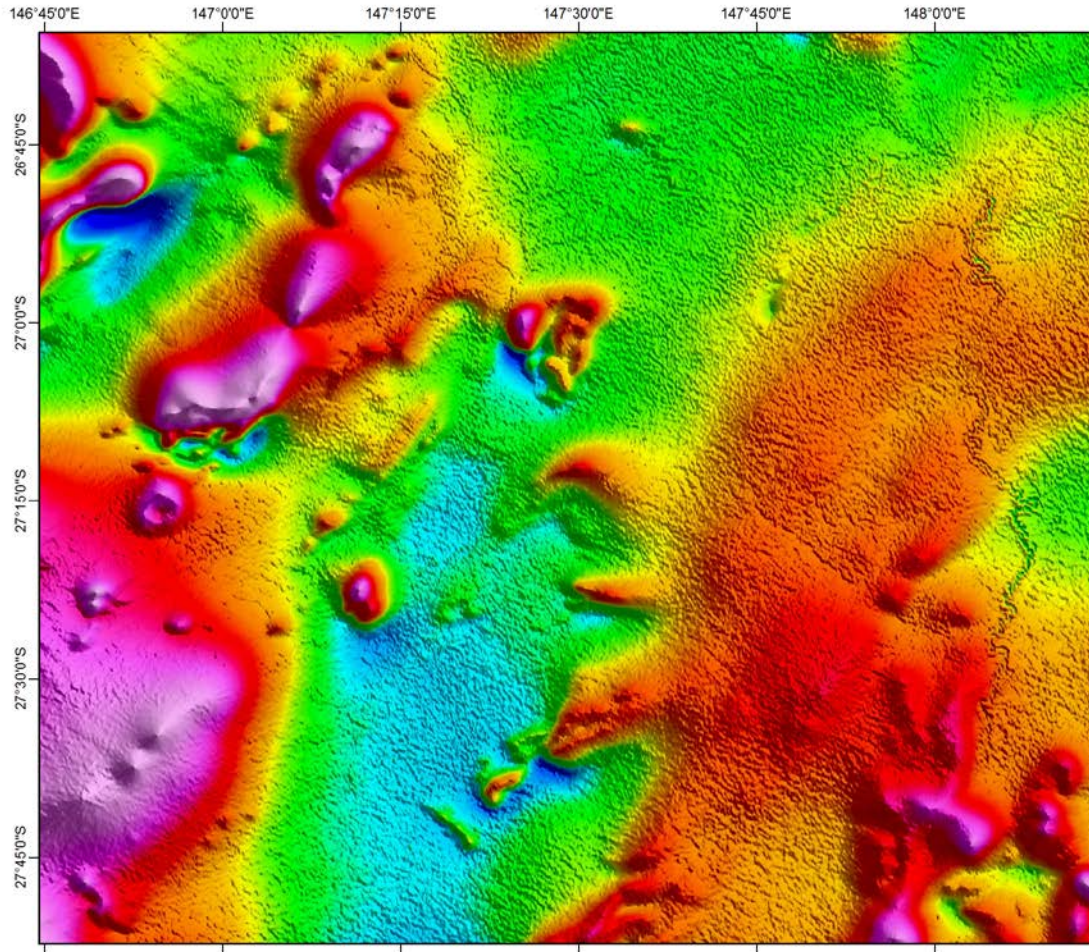
	Contact	Thin dike	Horizontal cylinder	Vertical cylinder	Sphere
Naudy	Yes	Yes	No	No	No
Werner	Yes	Yes	No	No	No
Euler	Yes	Yes	Yes	Yes	Yes
SPI	Yes	Yes	Yes	No	No
CWT	Yes	Yes	Yes	Yes	Yes

Method	Use of moving window
Naudy	Yes
Werner deconvolution	Yes
Euler deconvolution	Yes
SPI	No
CWT	No

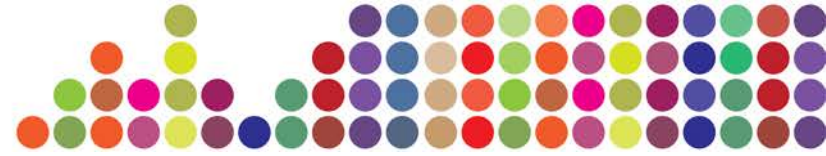
Taken from Li 2003



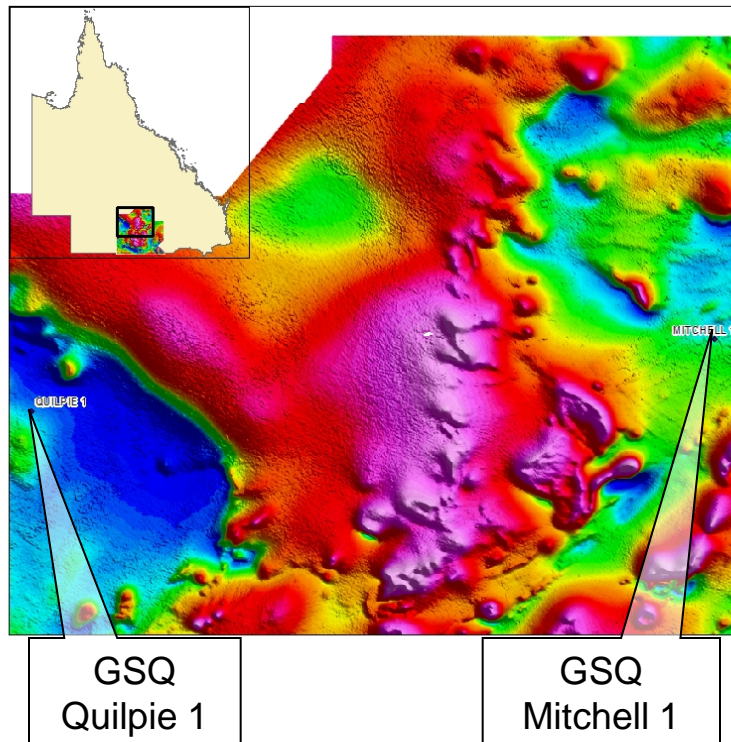
# Potential problems



- Depth to magnetic source used as proxy for depth to basement
  - Magnetic susceptibility measurements confirm this is reasonable
- Unexplained high frequency signal
  - Further investigation warranted



# High frequency signal analysis

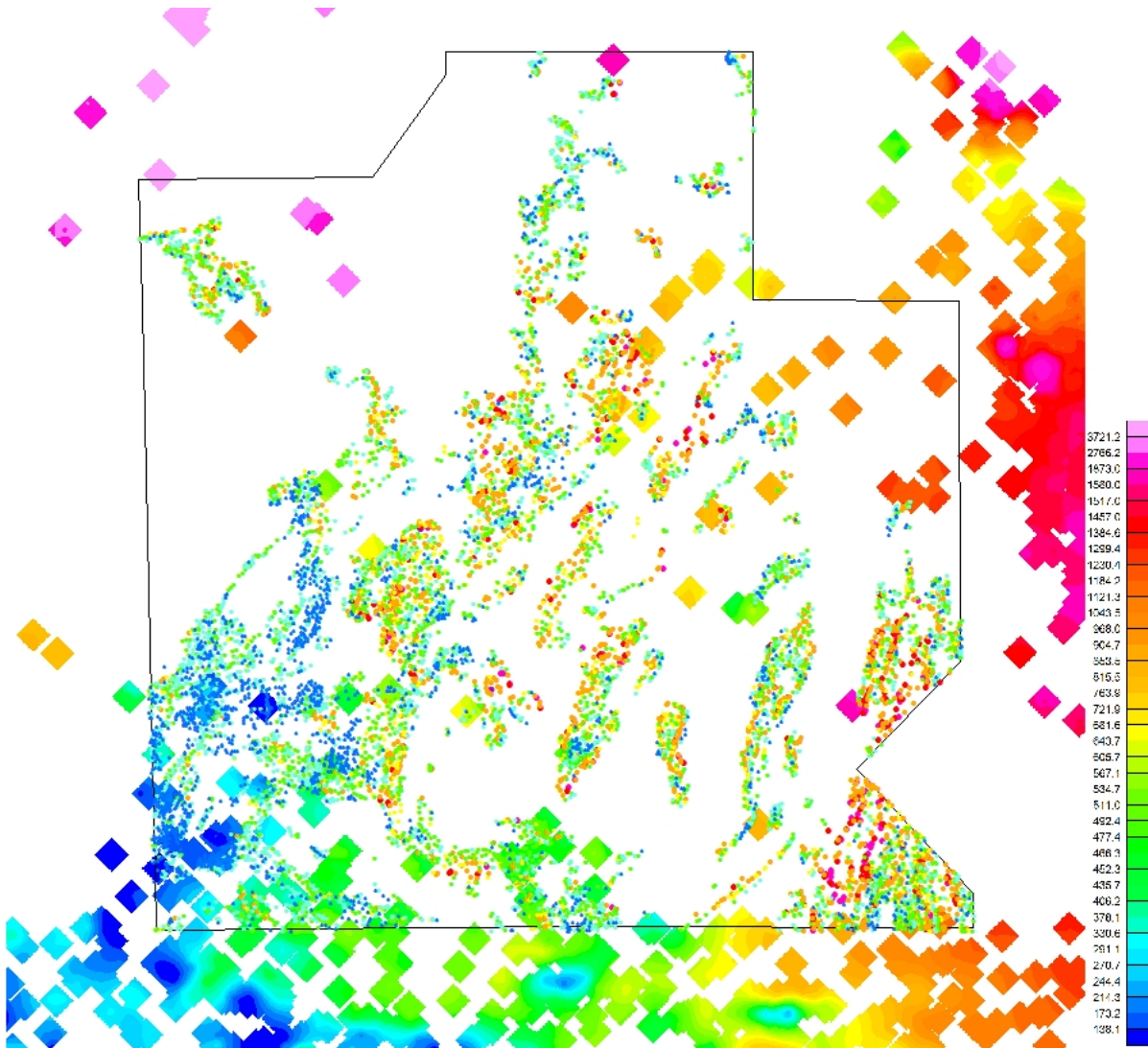


- High frequency indicates shallow source
- Profile modelling suggests depths up to 250m
- No elevated magnetic susceptibility values in Mitchell 1 – not particularly surprising
- Anomalous magnetic susceptibility values in Quilpie 1
  - 96.5m – 120.5m
  - Silty sandstone with no visible magnetite (logged as Mackunda formation)
  - Average susceptibility values  $0.3 \times 10^{-3}$  SI to  $0.5 \times 10^{-3}$  SI
  - Maximum  $6.4 \times 10^{-3}$  SI
- High frequency signal not relevant to basement depth





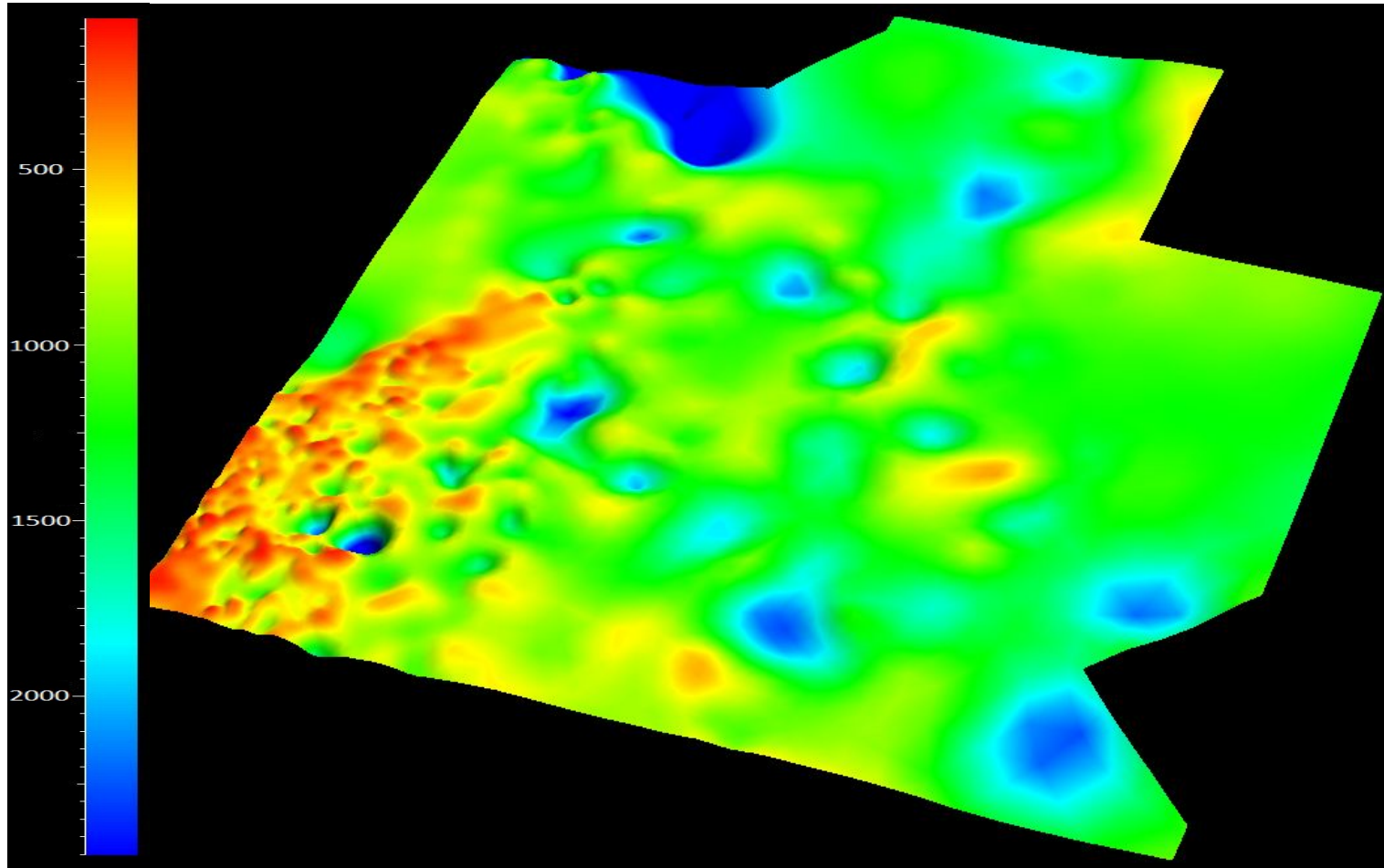
# Euler Deconvolution solutions



- Located Euler solutions
- $SI = 1$ 
  - Dykes
- $SI = 0.5$ 
  - Contact / fault with small throw



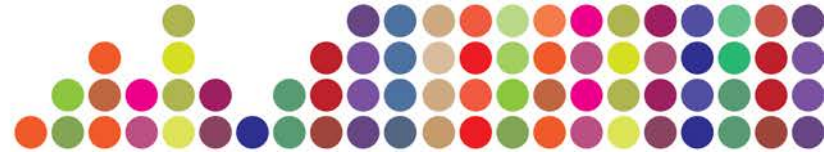
## Results to date





## Further work

- Refining the Euler solution sets
- Cross check solutions using Naudy depth estimation
- Incorporate the available seismic data into the basement interpretation



## References

- Brown, D., Carr, P.A., Purdy, D., 2012. Database of basement drill holes in the Thomson Orogen and Roma Shelf regions, Queensland, *Queensland Geological Record* **2012/06**.
- John, B.H., 1987. GSQ Quilpie 1, preliminary lithologic log and composite log, Geological Survey of Queensland Record 1983/66.
- Li, X., 2003. On the use of different method for estimating magnetic depth, *The Leading Edge*, pp 1090-1099.
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