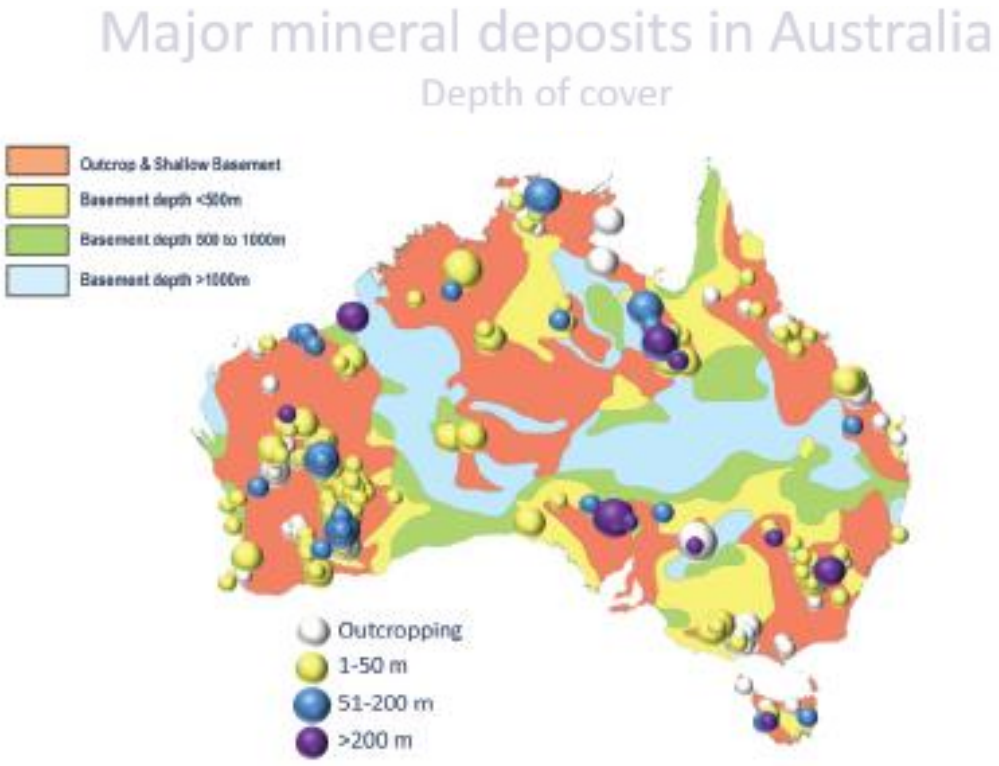
Understanding the regolith

A proposal for regional airborne EM survey to support exploration under cover



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April 1 2014

Regolith map of Australia
What benefits would this provide explorers?

A semi detailed map of the broad **composition**, depth and specifically the **variation in depth** of the *regolith* is required by todays & future explorers

- Feasibility of rapid **drilling to bedrock**
- The suitability of **geochemical** exploration techniques is largely controlled by the depth of transported cover
- The effectiveness and interpretability of surface and airborne **geophysical techniques are dependent on the depth of overburden**

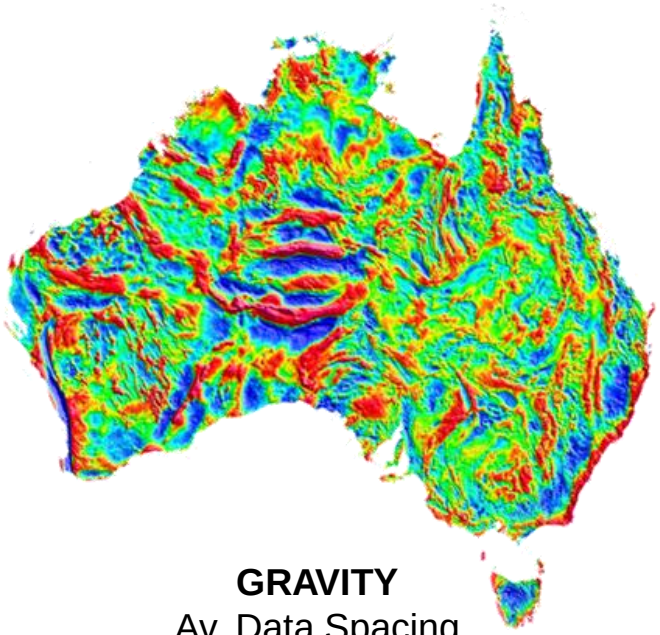
Ground Rules

Images sourced from
Geoscience Australia

Regolith = Transported overburden + Weathered bedrock (1)

Regolith = Overburden (2)

Regolith ≠ Cover (3)

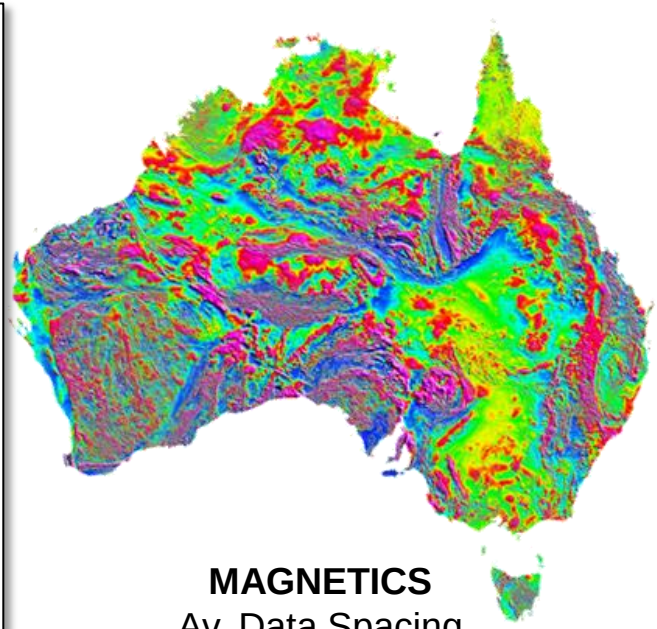


GRAVITY
Av. Data Spacing
4 km centres

At this scale Gravity & Magnetic coverage of Australia look equivalent..

They are not

AGG is the only realistic means to bridge the gap in resolution and thereby improve the detection of deposits undercover



MAGNETICS
Av. Data Spacing
400 m line spacing @ 10 m

Factors effecting Airborne Gravity Gradiometry (AGG)

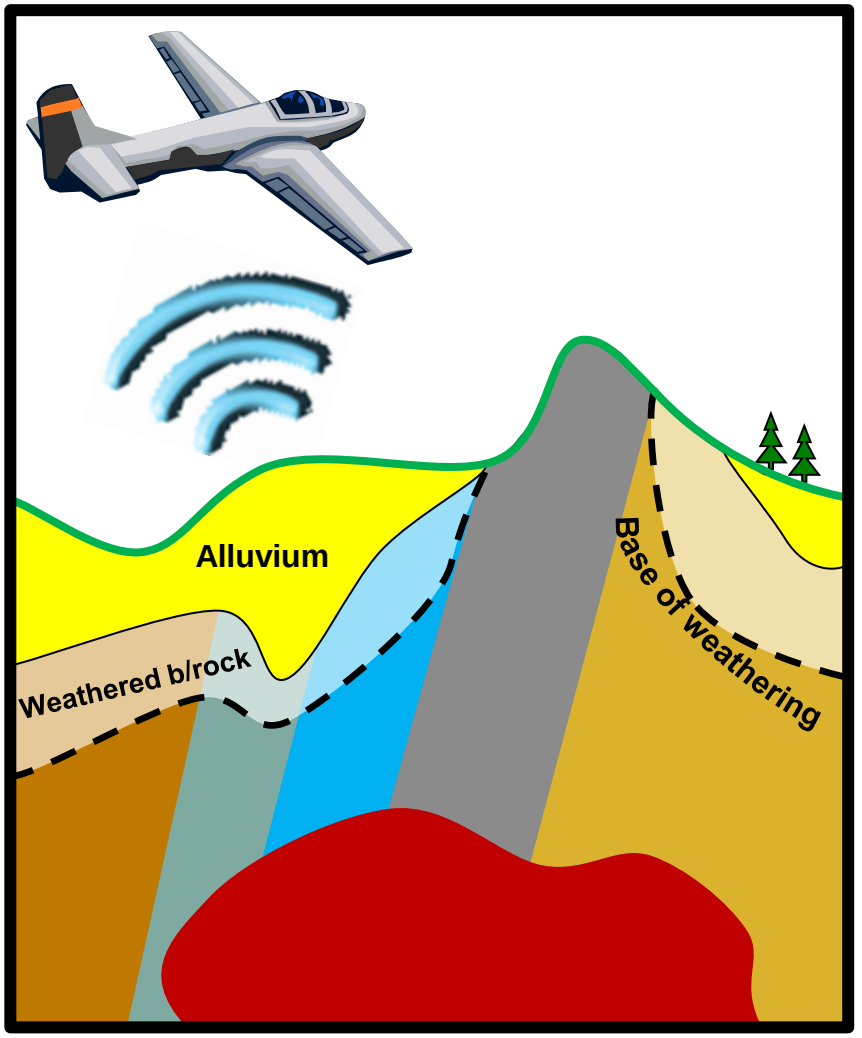
Density changes ($\Delta\delta$) relative to average bedrock geology

1) **Topography** $\Delta\delta \approx$ - 2.6 g/cc

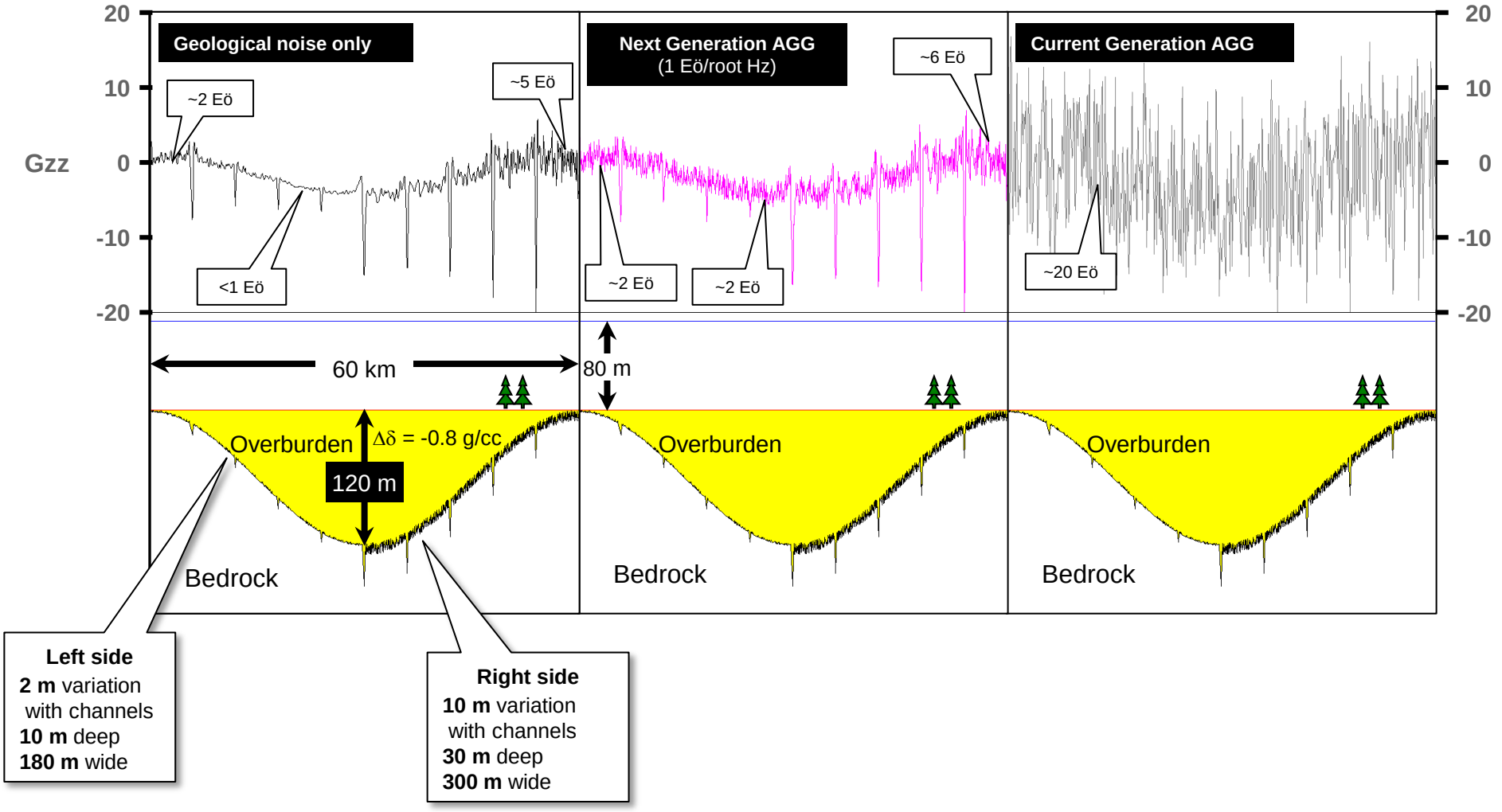
2) **Regolith**

   - Transported o/b $\Delta\delta \approx$ -0.8 g/cc
   - Weathered b/rock $\Delta\delta \approx$ -0.4 g/cc

3) **Bedrock geology** (2.4 – 2.8 g/cc)

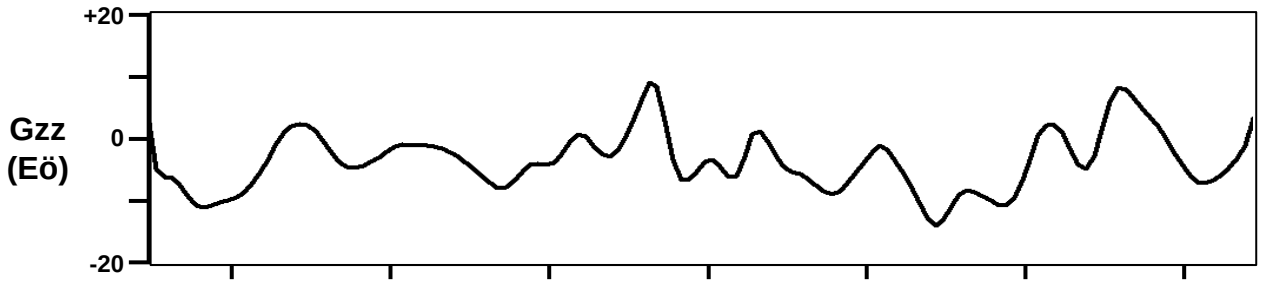


Airborne Gravity Gradiometry
Sensitivity to overburden thickness variations

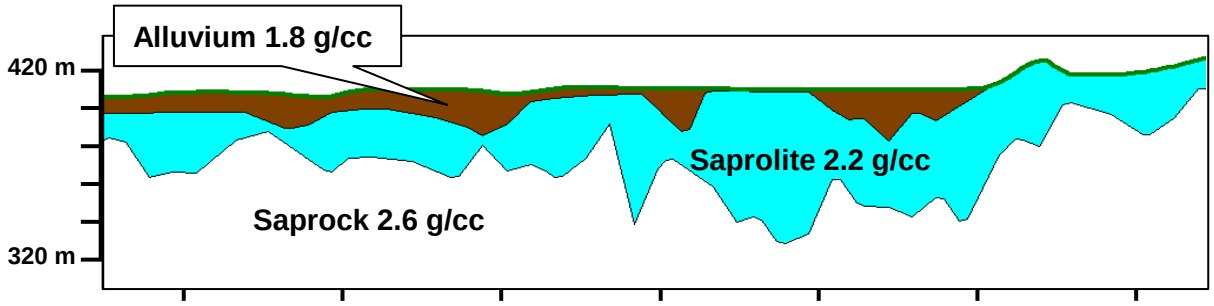


Geological noise in AGG Balgarri, Eastern Goldfields WA

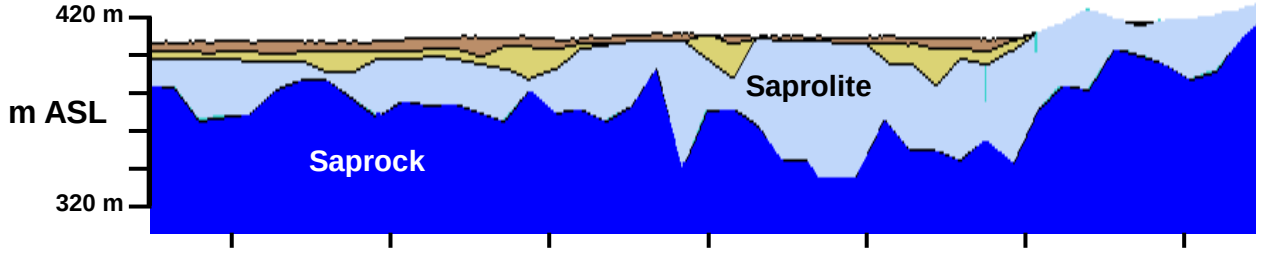
Adobe Acrobat Document
Worrall et al, 2001
Exploration Geophysics 32



AGG Profile
Without instrument noise



Density Profile
Assumed densities

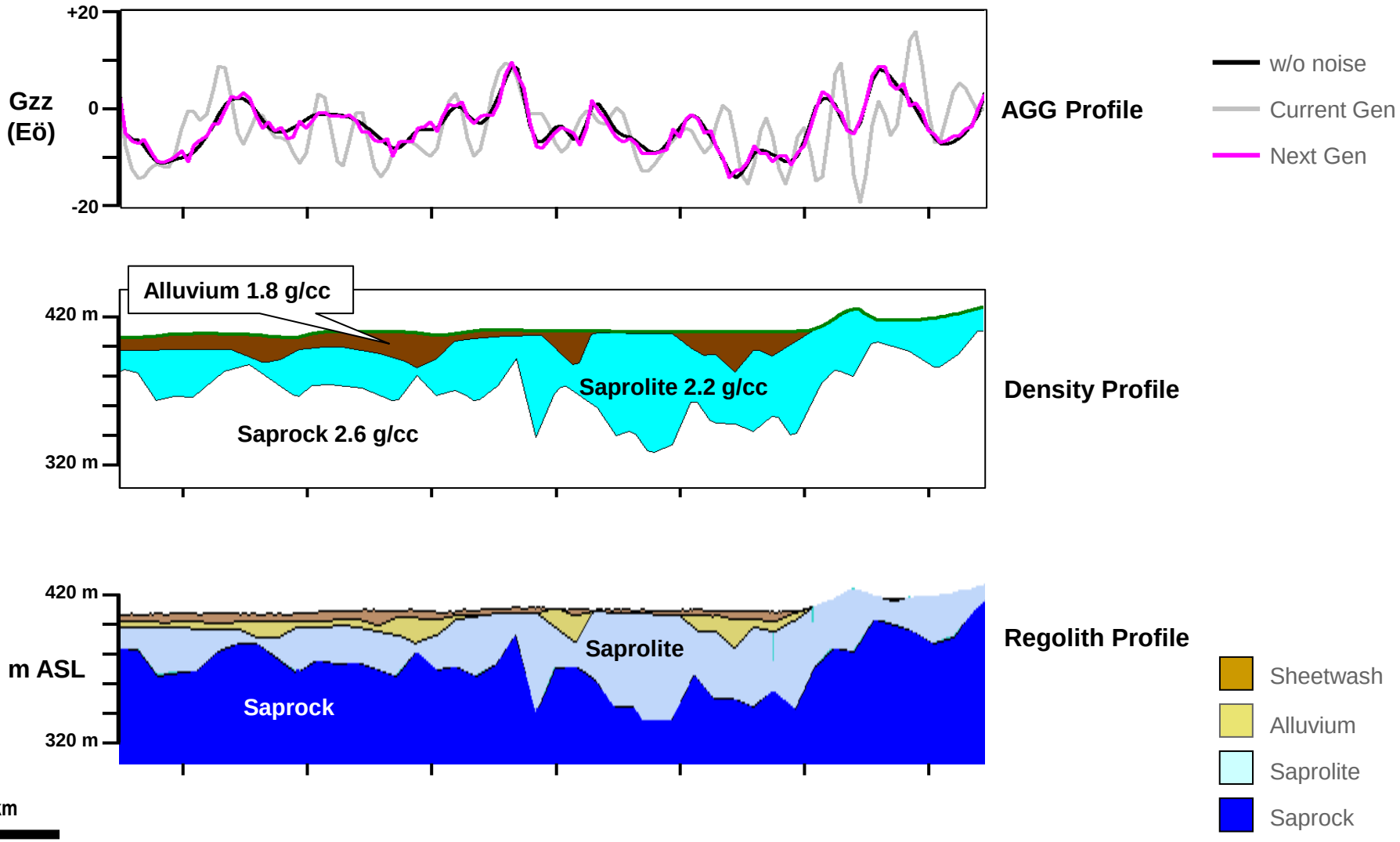


Regolith Profile
derived from
50 DH

Sheetwash
Alluvium
Saprolite
Saprock

1 km

Geological noise in AGG
Balgarri, Eastern Goldfields WA



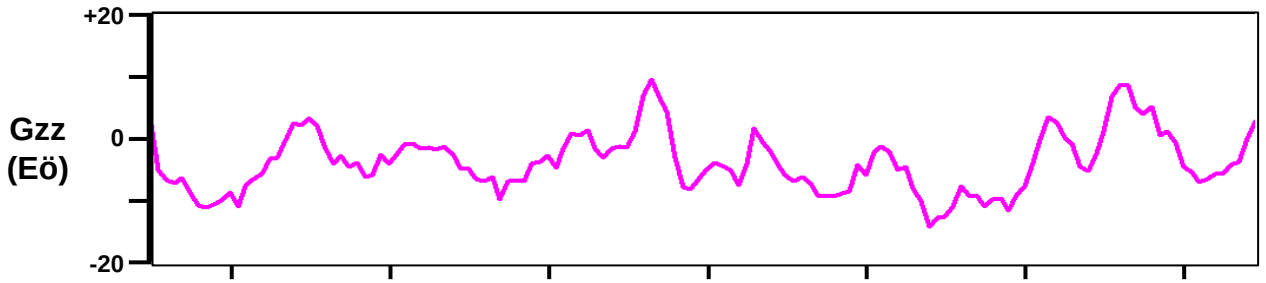
Recap

1. AGG will improve the detection rate of Tier-1 deposits undercover but…

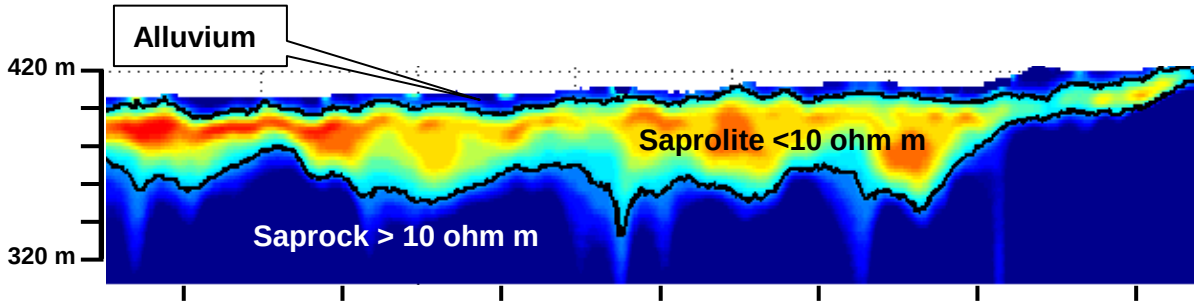
2. …variations in the regolith could adversely impact on the interpretability of AGG

Therefore an independent and cheap means of account for density variations due to the regolith is required

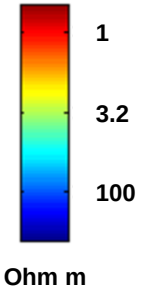
Geological signal in AGG and AEM Balgarri, Eastern Goldfields WA

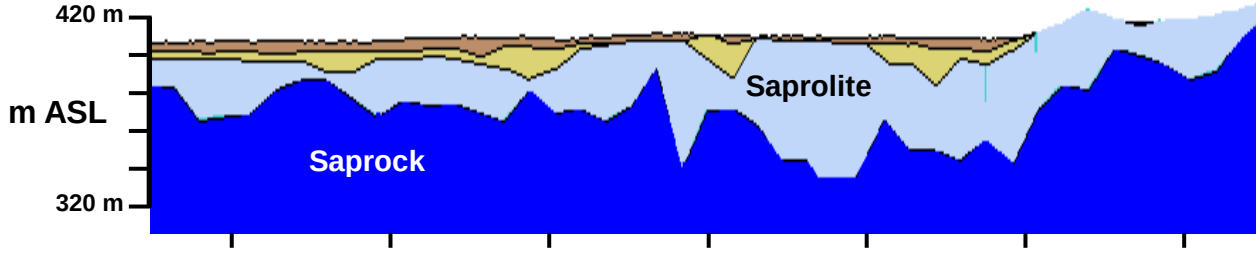


AGG Profile
Next Generation



AEM Profile
TEMPEST





Regolith Profile
derived from drilling

Sheetwash
Alluvium
Saprolite
Saprock

1 km

Conclusion

1. AEM can potentially correct for density variations in the regolith **post** survey (like terrain corrections) …

…if AEM is collected on an adequate line spacing

2. Feasibility of acquiring AGG can be based on the modelled response of the interpreted regolith (from AEM) relative to the target response **before** acquiring AGG

Having access to AEM before surveying is of **greater value** for AGG and for exploration in general

Proposal

Image sourced from CGG
Survey funded by Geoscience Australia

Wide spaced traverses of **AEM** across the **shallow** (<500 m) covered portion of the Australian continent, **supplemented** with ancillary information from existing drilling, water bores,…

What is wide spaced?

- Along line variation more important than full coverage
- 10 km seems reasonable

What about hyper saline areas?

- Even an indication of depth of the regolith is better than no information

What this likely to cost?

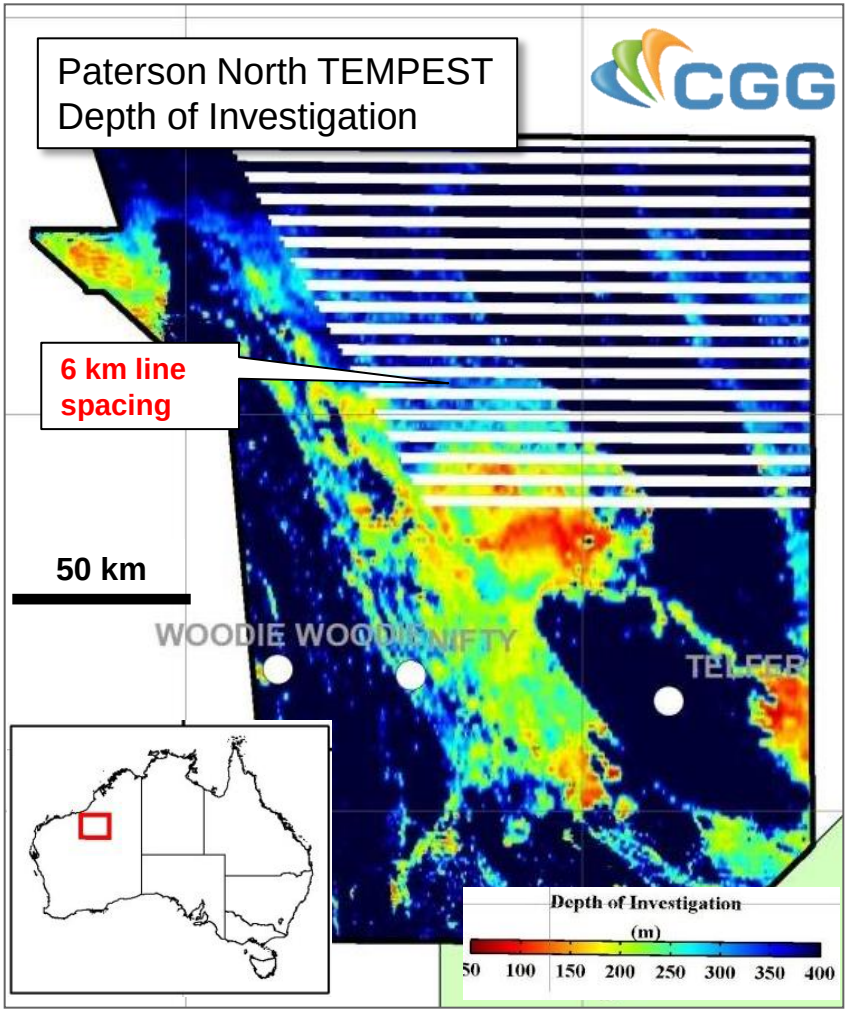
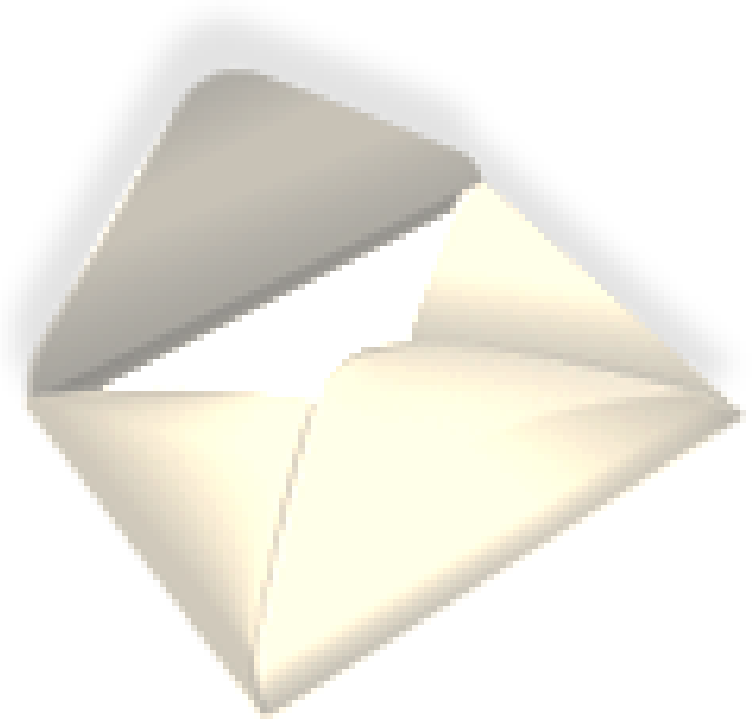


Image from: “Mapping through cover with regional AEM surveys” Williams et al, Mining 2010, Brisbane

Cost Estimate*



Australian continent 7.7M km^2

Assumption #1

2M km^2 required to be flown

Assumption #2

10 km line sp. ≈ 200,000 km

Assumption #3

acquired @ $100/km ≈ **$20 M**

…collected over multiple years

* Needs to be validated

UNCOVER initiatives - Priorities

1. Characterisation of the regolith (not cover)
2. Investigating the lithospheric architecture
3. Distal footprints
4. Resolving the 4D geodynamic & metallogenic evolution

Note a little internal debate within RTX re swapping the order of 2 & 3