Australian Government
Geoscience Australia

Geoscience Australia and Australia's Exploration Challenge

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Chief – Resources Division

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BUILDING AUSTRALIA'S RESOURCE WEALTH

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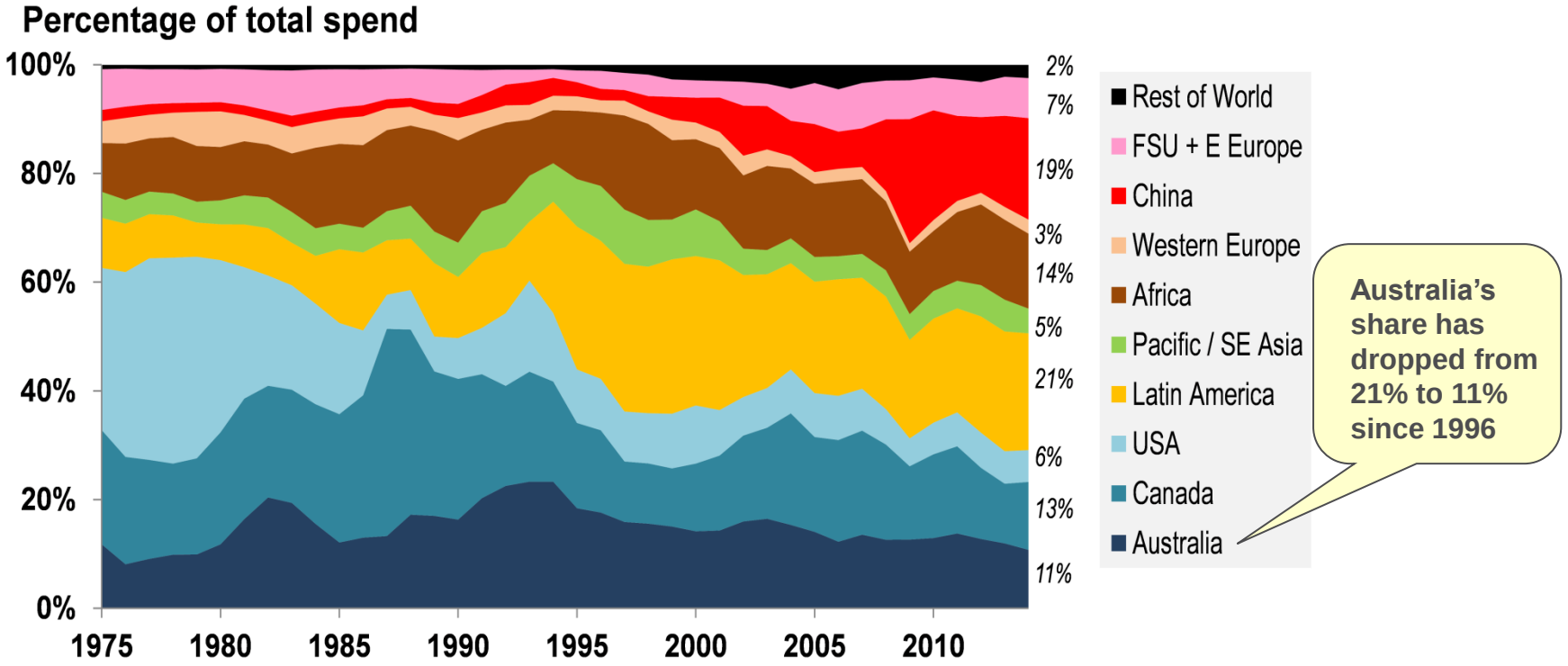
New discovery requires new exploration



Source: MinEx Consulting estimates June 2015

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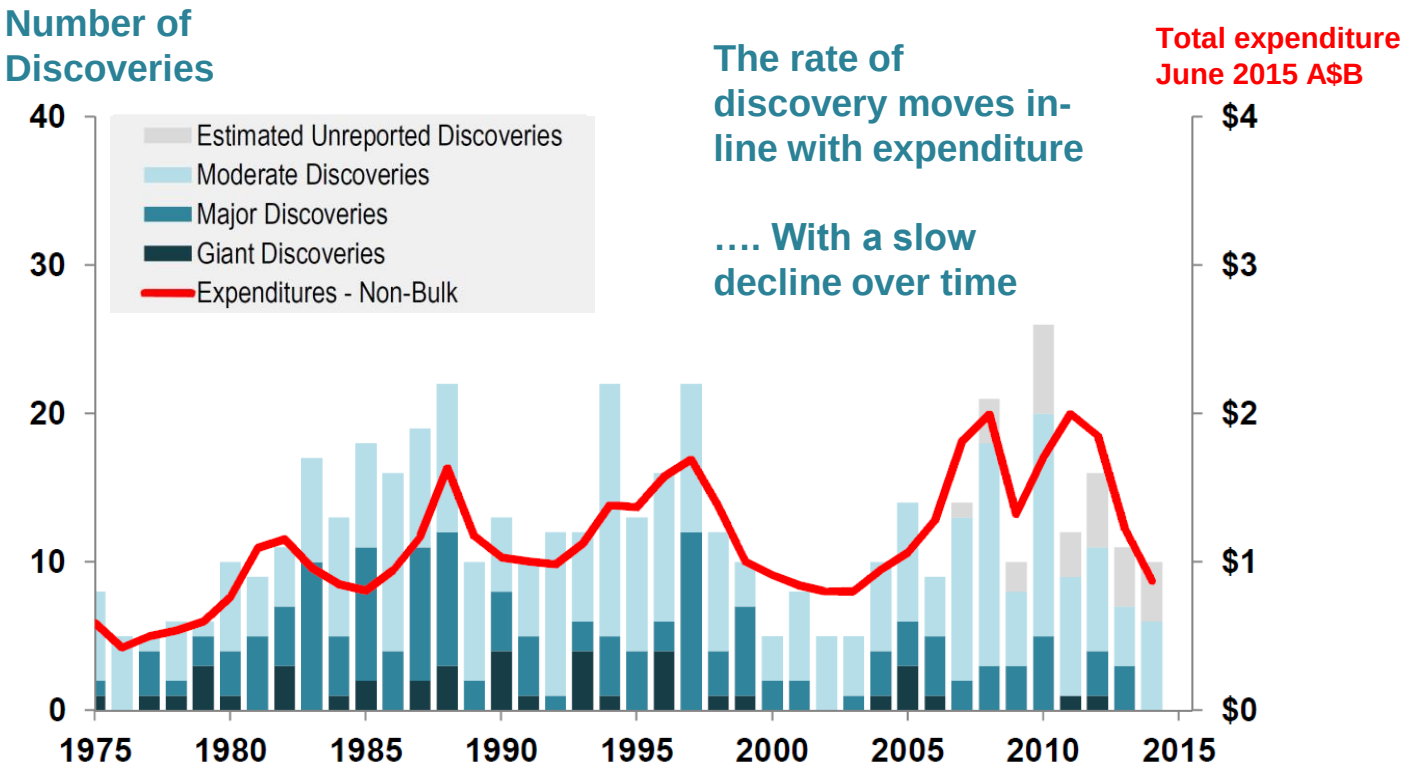
Despite exploration increase, discoveries not followed



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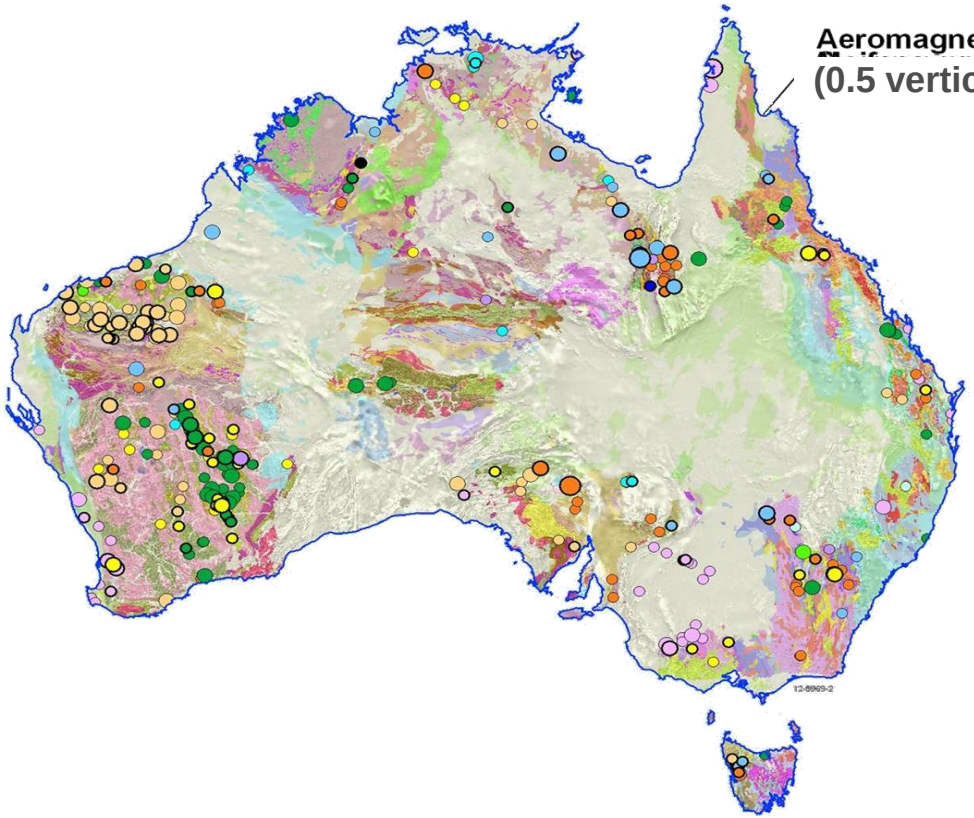
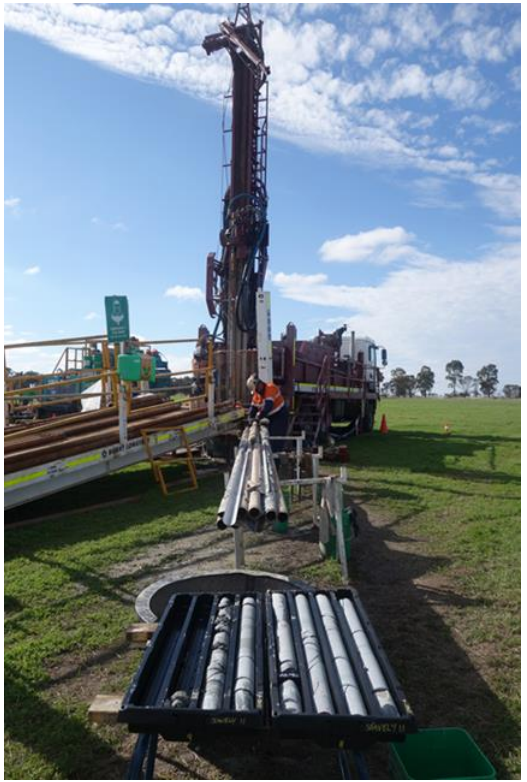
Australia's undercover mineral potential





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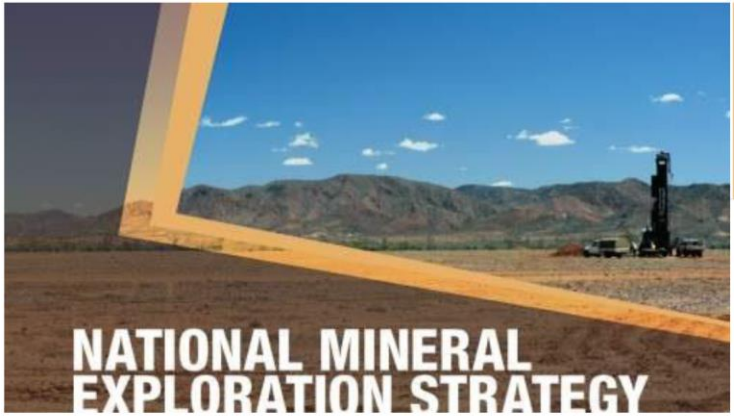
Government response



VISION:

Unlocking Australia's hidden resource potential.

MISSION:

To address greenfield exploration challenges, stimulate new discoveries, ensure continuity of the pipeline of mineral resource investments, and the longevity of Australia's mineral resources industry.

SCOPE OF THE STRATEGY

This National Mineral Exploration Strategy focuses on the acquisition and delivery of pre-competitive geoscience, applied geoscience research initiatives to assist exploring undercover and a mineral exploration investment attraction plan. Supporting activities associated with the strategy aimed at cross-jurisdictional collaboration on regulatory reform are also underway. The strategy will not address the financial challenges facing the minerals sector.

COAG Energy Council

UNCOVER
AUSTRALIAN EXPLORATION GEOSCIENCE RESEARCH

THE THREE ELEMENTS OF THE NATIONAL MINERAL EXPLORATION STRATEGY ARE:

- PRE-COMPETITIVE GEOSCIENCE INFORMATION
- MINERAL EXPLORATION INVESTMENT ATTRACTION PLAN
- NATIONAL GEOSCIENCE RESEARCH INITIATIVE

….and the Exploration Development Incentive (EDI)

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Continuing to build on national maps

Precompetitive data program with collaborative projects with States/NT geological surveys:

- airborne magnetic-radiometric
- gravity
- AEM
- Seismic/MT transects
- AusLAMP
- Regional drilling (Thomson)
- Geochronology and stratigraphy

Greenfields focus of combined Gov efforts

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Australia's exploration challenge and the opportunity

- Continent is ~80% covered
- How to more effectivity and efficiently explore through cover?
- **Need to be predictive – take an integrated systems view ….**

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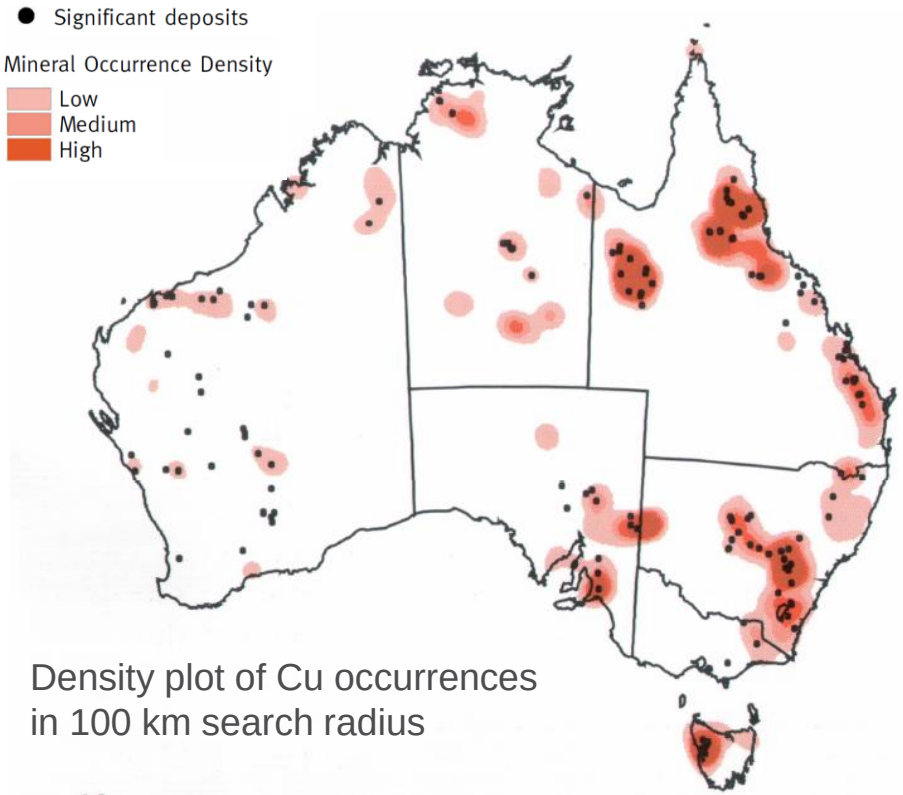
Data-driven or empirical approach: Cu



Density plot of Cu occurrences in 100 km search radius

- Density plots analysis of known occurrences
  - Identifies historic mineral provinces
- Most anomalously high distributions have 1 or more Tier 1 deposits (dots)
  - Some exceptions
- Results strongly driven by surface prospecting
- Substantial potential undercover extensions and greenfields areas

Jacques et al., 2001: AGSO Research Newsletter 34.

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Mineral Systems: a powerful method of prediction

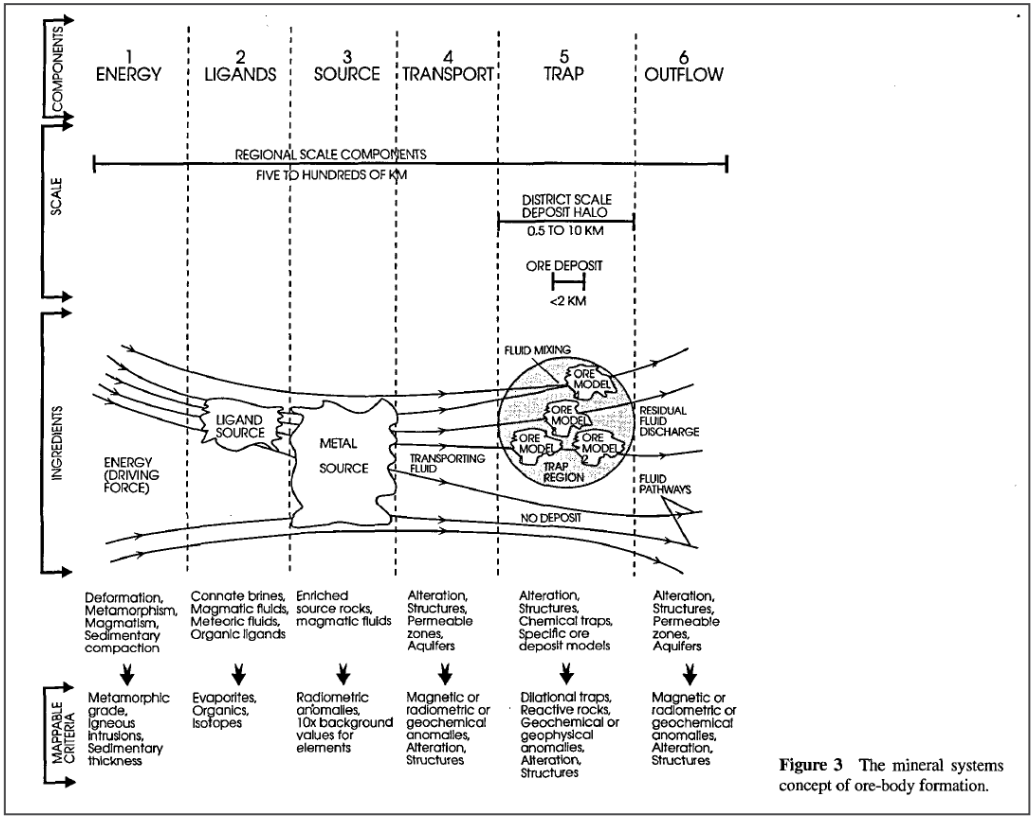

Figure 3 The mineral systems concept of ore-body formation.

A mineral system is defined as ALL the geological components that control the generation and preservation of mineral deposits Wyborn et al., (1994)

Energy (drivers)

Metal sources

Architecture

Ore deposition

→ Prospectivity

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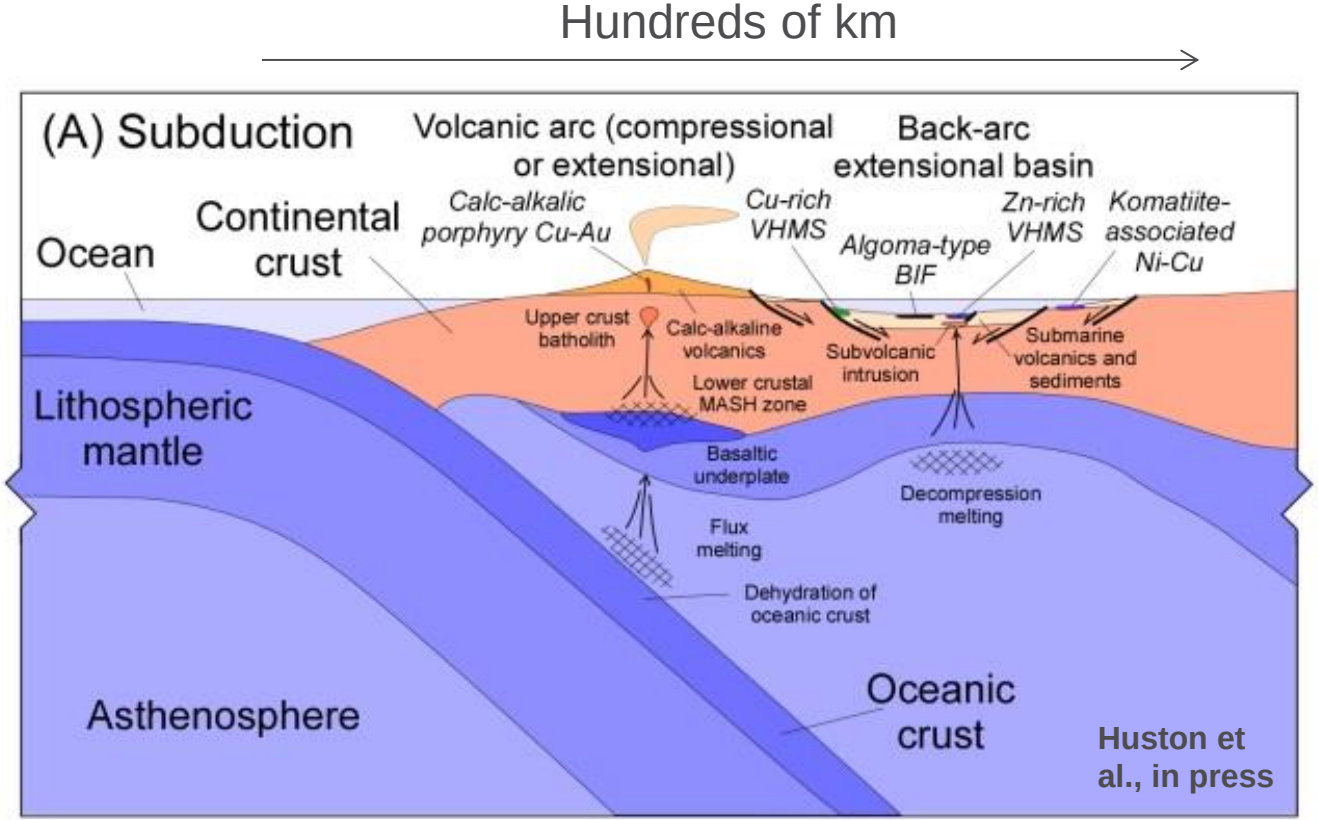
Tectonic framework for mineral systems & ore genesis



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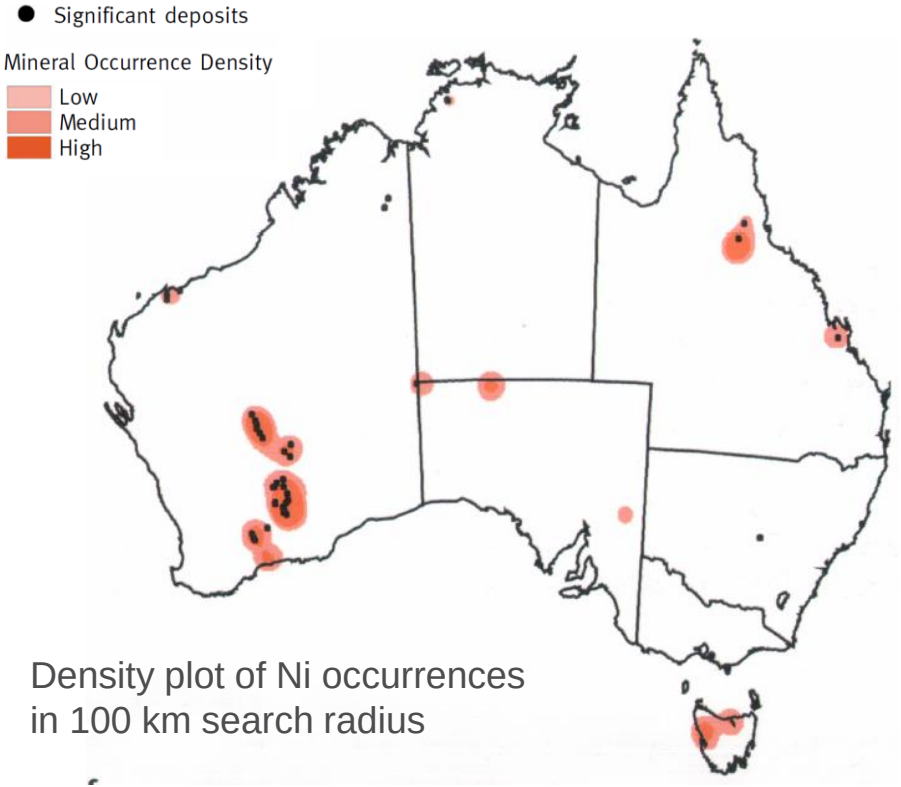
Data-driven or empirical approach: Ni



Density plot of Ni occurrences in 100 km search radius

- Density plots analysis of known occurrences
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Jacques et al., 2001: AGSO Research Newsletter 34.

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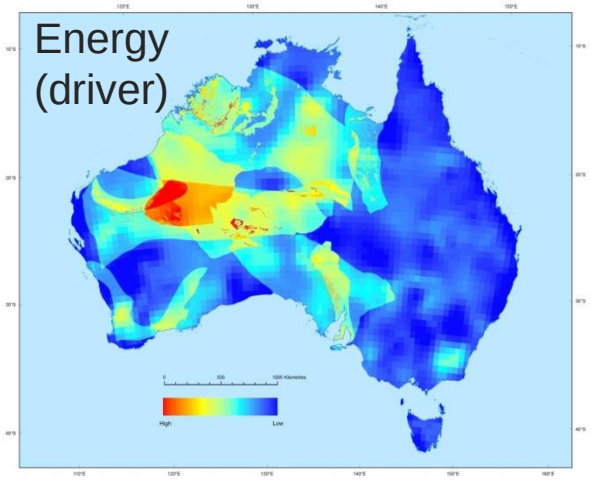
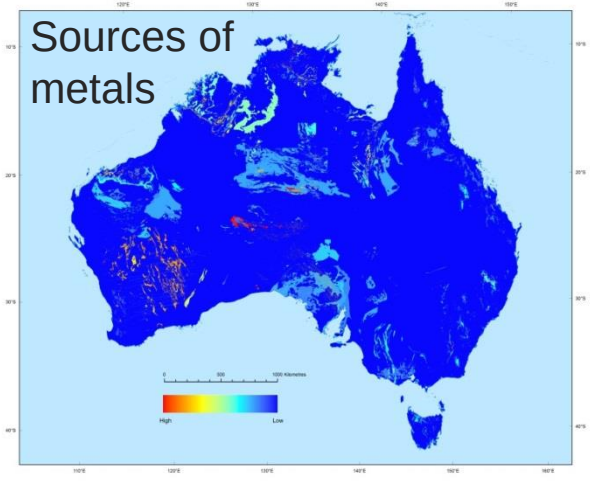
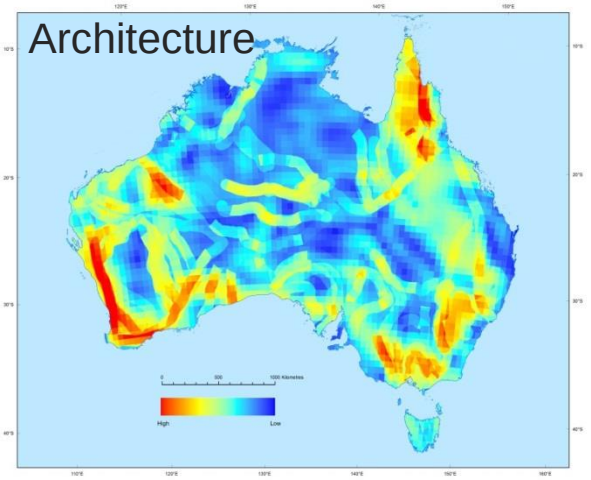
Magmatic Ni-PGE potential of Australia

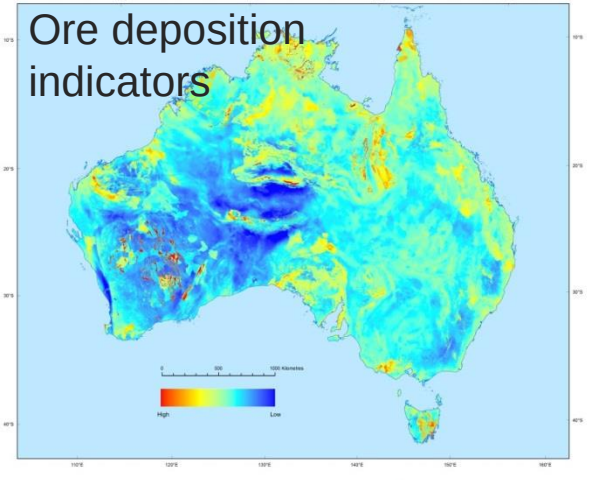




Each of 4 components combines geophysical, geological, geochronological, geochemical data

From: Dulfer, Skirrow, Champion, Czarnota et al. (in prep.)





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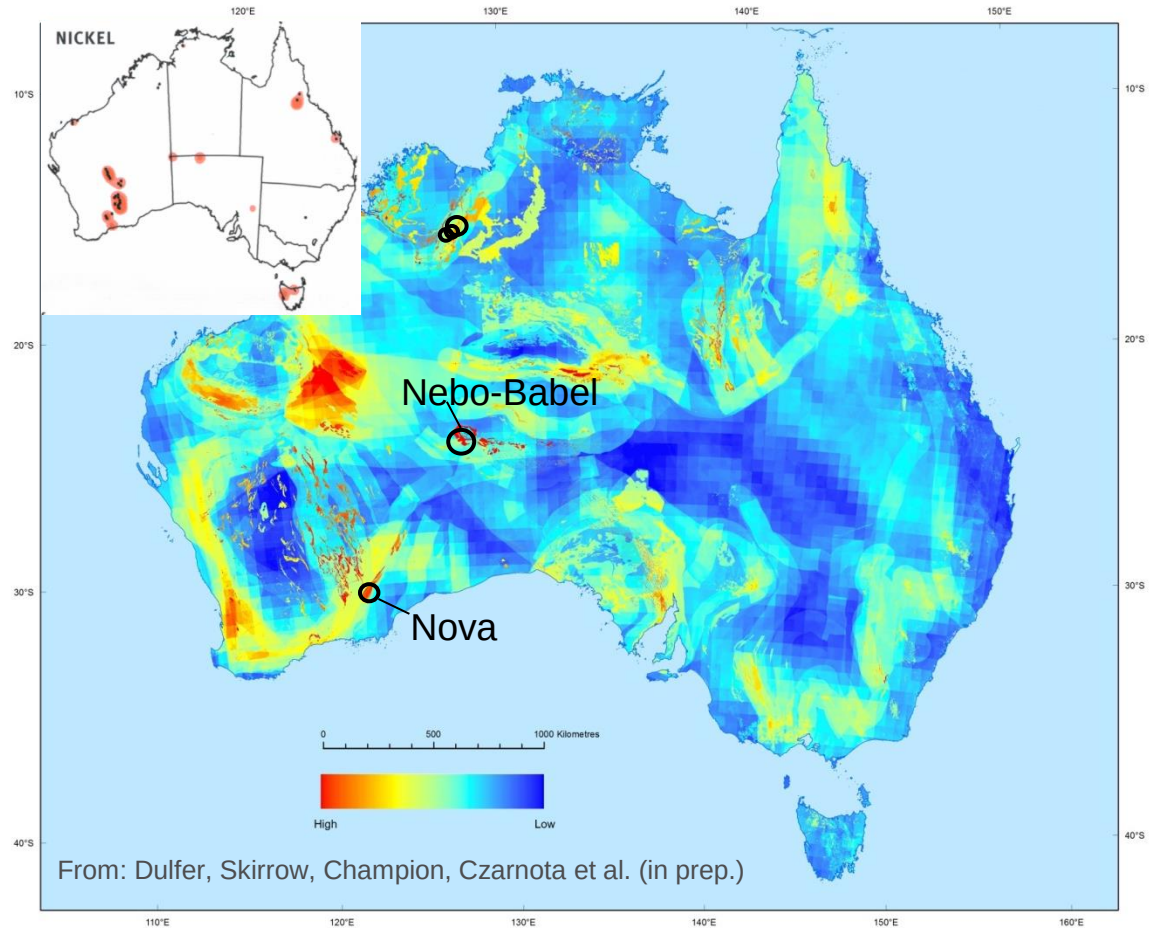

From: Dulfer, Skirrow, Champion, Czarnota et al. (in prep.)

Magmatic Ni-PGE potential of Australia:

- The first national assessment of its type
- Targeting Norils'k ($1t) and Voisey's Bay type deposits
- Predicts locations of major known deposits/districts
- Highlights many other areas for follow-up by industry (Victoria?)
- Predicts potential under cover

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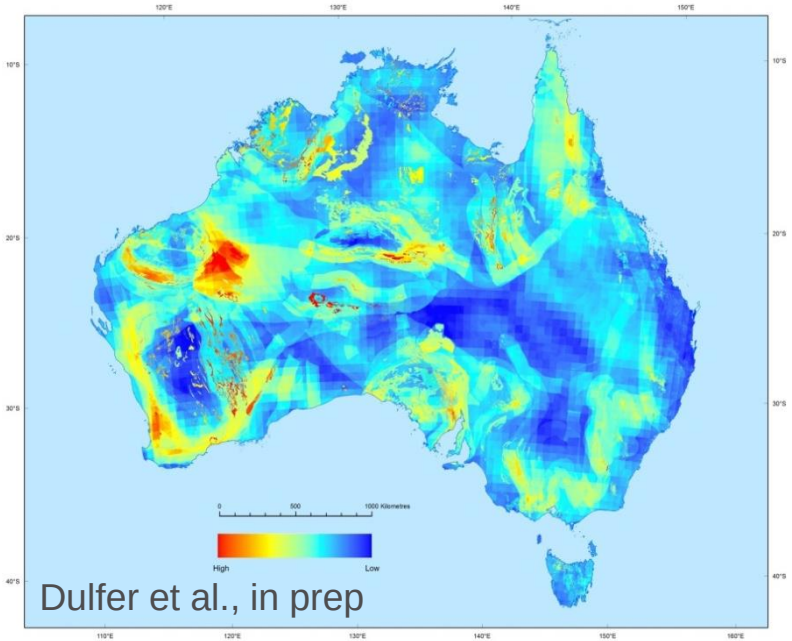
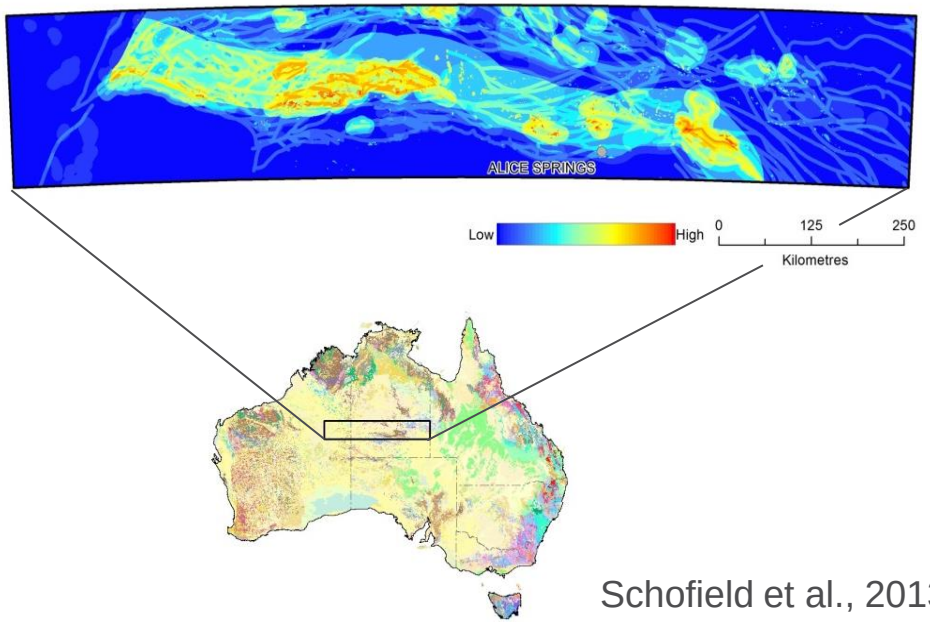
PREDICT new greenfields provinces

National-scale: Ni-PGE potential



Dulfer et al., in prep

Regional-scale: Cu-Au potential



Schofield et al., 2013

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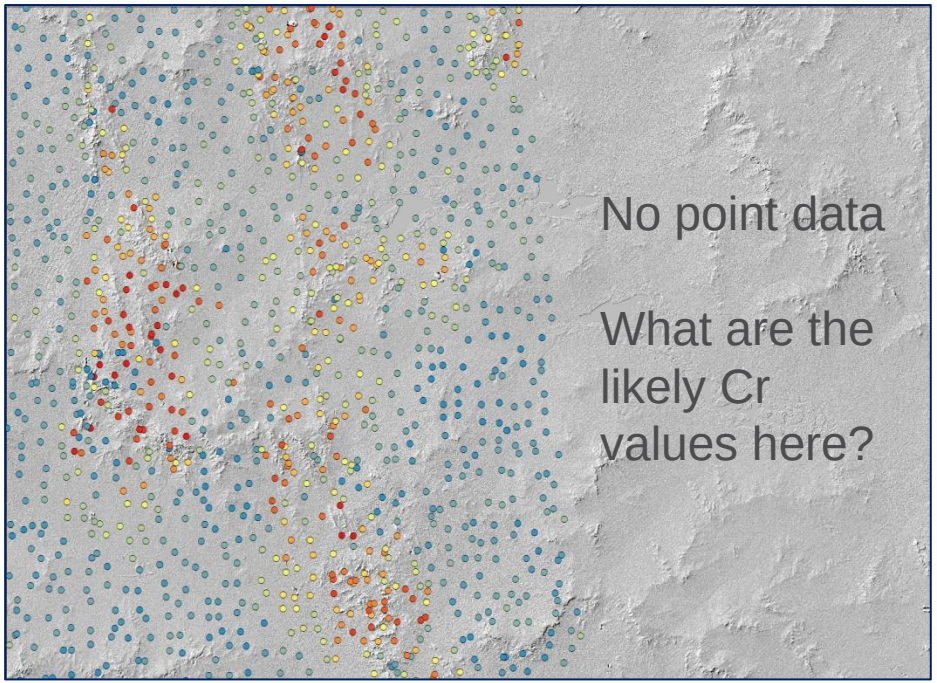
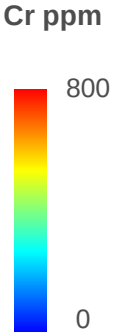
Geochemical points to surface predictions: data mining

Regional regolith geochemistry program of GSWA – (Paul Morris)





- Extensive soil geochemistry databases in state/NT survey (eg. Leinster WA)
- How do you predict what is between samples and in regions distant from the grid?

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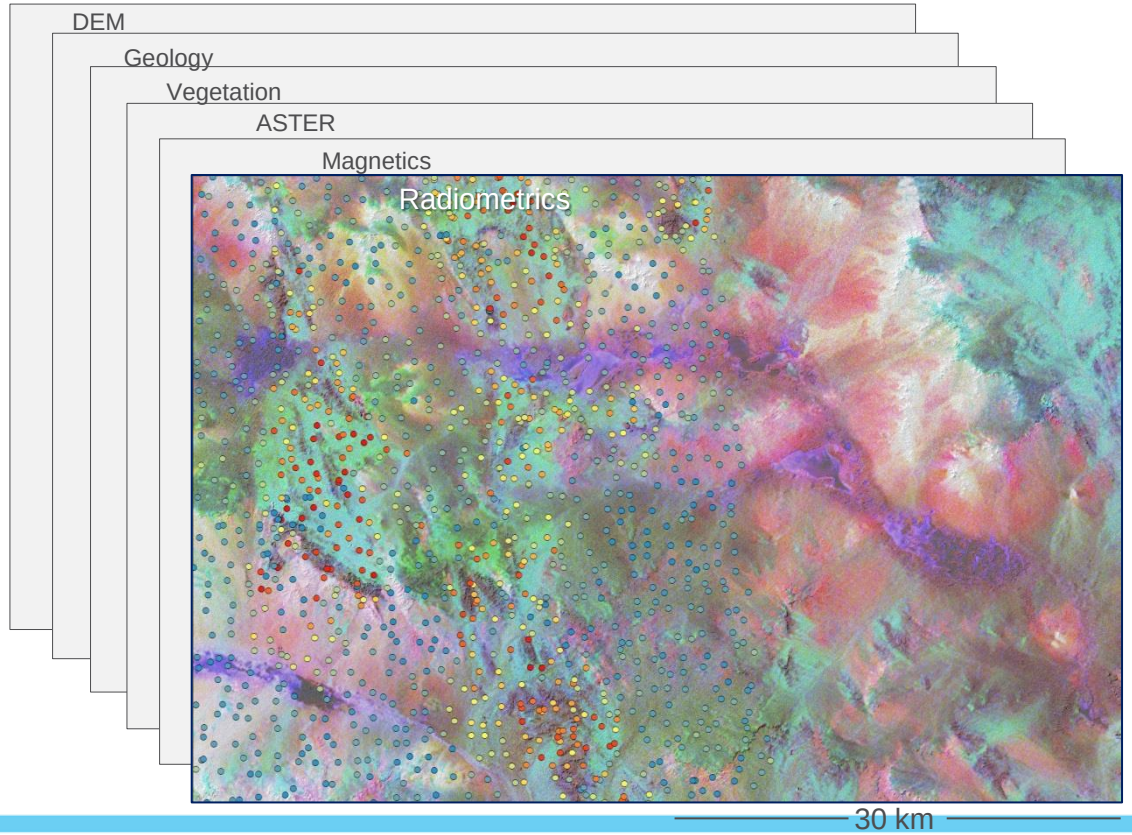
Geochemical points to surface predictions: data mining



- Chromium points on radiometrics grid
- uses radiometrics, DEM, geology, vegetation, ASTER, magnetics, gravity etc
- Cubist method uses open source R codes
- not interpolation between points but a model prediction based on environmental correlation

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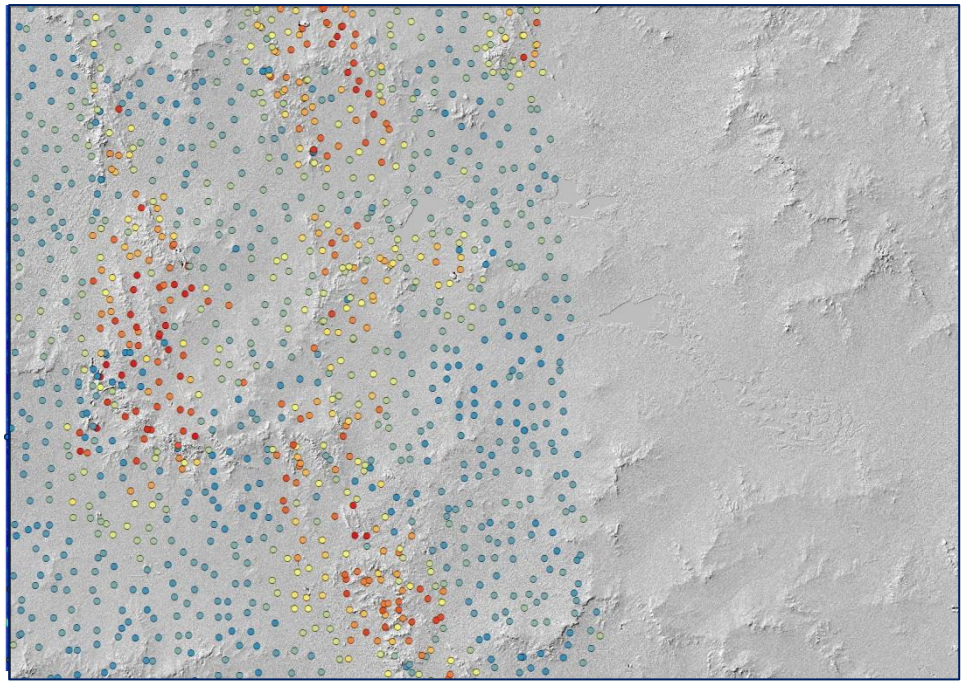
Geochemical points to surface predictions: data mining

Geochemical sample locations coloured on Cr concentration

Mafic outcrop = white polygons



- the method has generated a model prediction of Cr in the landscape
- The colours on the map are scaled the same as the Cr points
- out-of-sample cross validation $R^2 = 0.71$
- method can be applied to any point data relationship with other covariates (e.g. cover thickness estimates)

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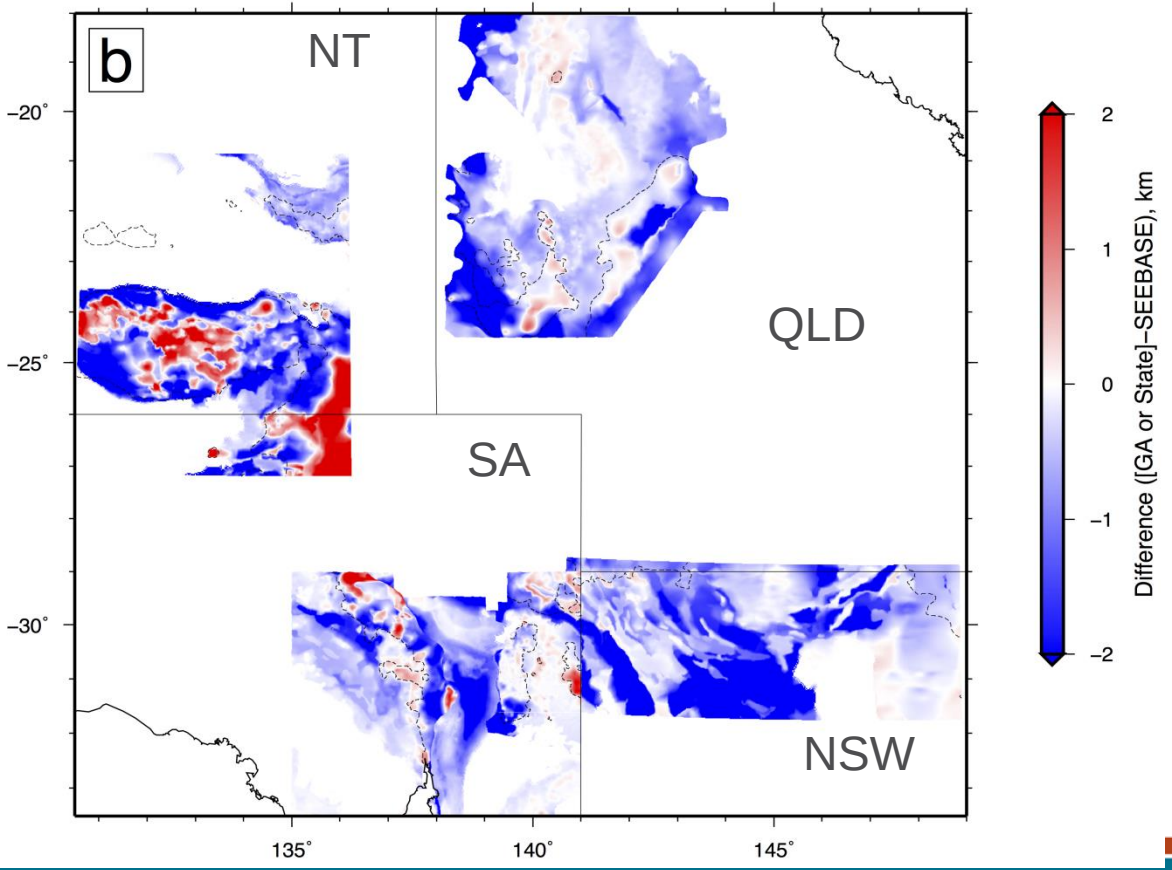
Mapping cover thickness: the science problem

- One person's cover is another person's basement
- Cover is just geology in 3D space plus time
- 'Cover' estimates difference map between GA and/or State maps and SeeBase as reference
- Lets go back to basics and deal with points



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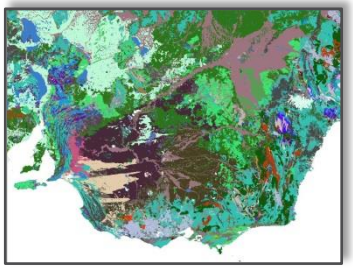
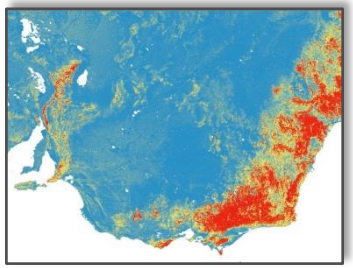
Points to surfaces: predictions through data mining

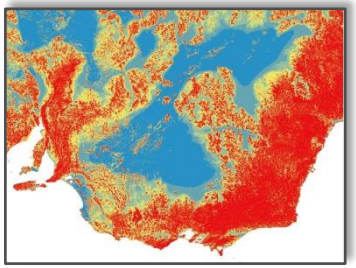
Surface geol.



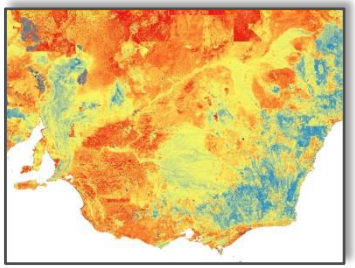
Topo. relief



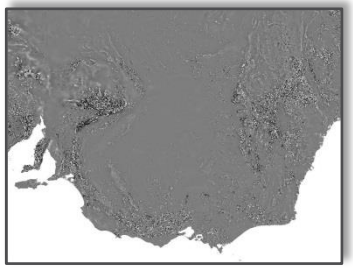
Valley flatness index



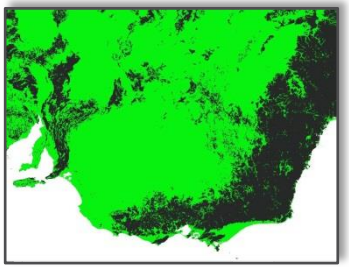
Weathering intensity



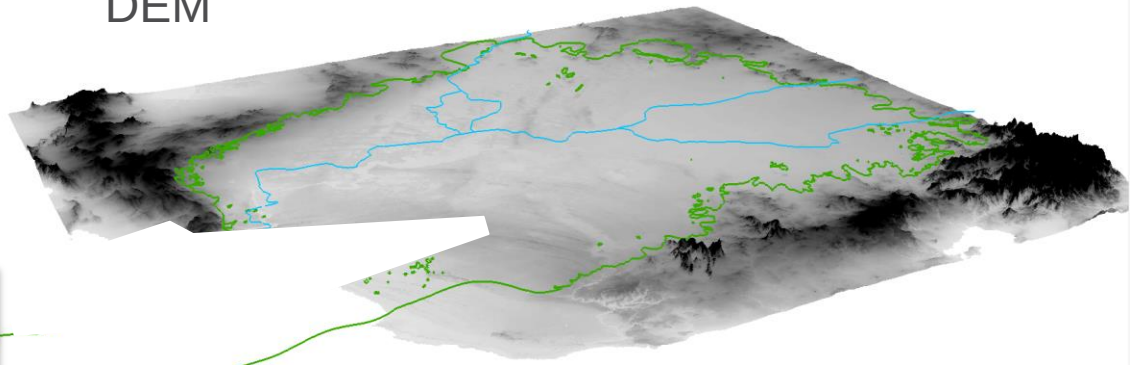
RTP TMI



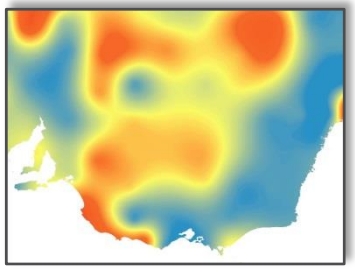
Cenozoic geology



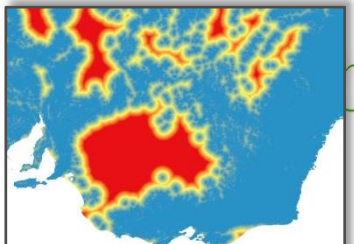
DEM



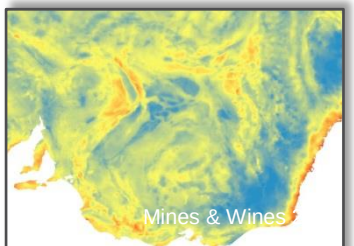
Filtered tilt est.



Distance from outcrop



Bouguer gravity



Green line – outline Murray Basin

Mines & Wines

Points to surfaces: predictions through data mining

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Conclusions

- Australia has excellent opportunities in the vast greenfield under cover regions
- We have prospective ground, good data, skilled & connected people
- Mineral exploration is a risk-based decision-making process of successive area and volume reduction
- To lower risk we need ways of working that fully utilise the data in a more predictive way
- We can do this with:
    - mineral systems science and its application to targeting science (eg Ni, Cu-Au)
    - data mining methods that integrate multidisciplinary datasets
    - methods that quantify uncertainty and preserve fundamental data

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