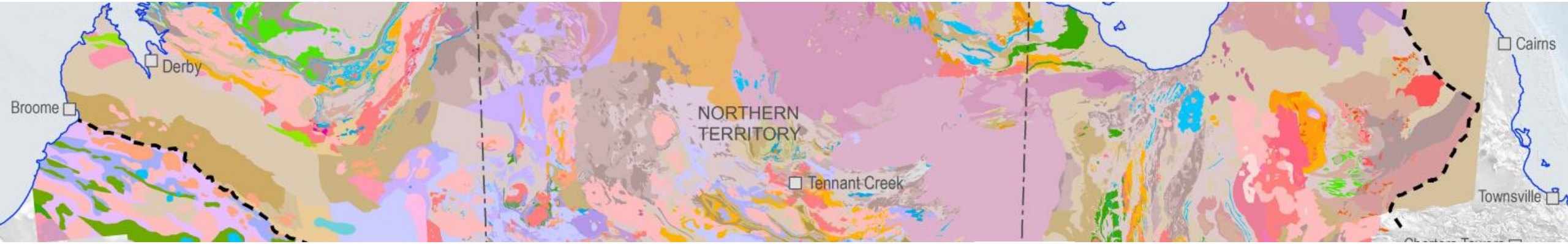
Australian Government
Geoscience Australia

Exploring for the Future
minerals | energy | groundwater

Unravelling Australia's geological architecture

Marie-Aude Bonnardot (and many colleagues at Geoscience Australia)



NSW Government Trade & Investment Rersources & Energy

State Government Victoria Department of Primary Industries

Northern Territory Government

Tasmanian Government

NCI National Computational Infrastructure

Loop

Queensland Government

Government of South Australia

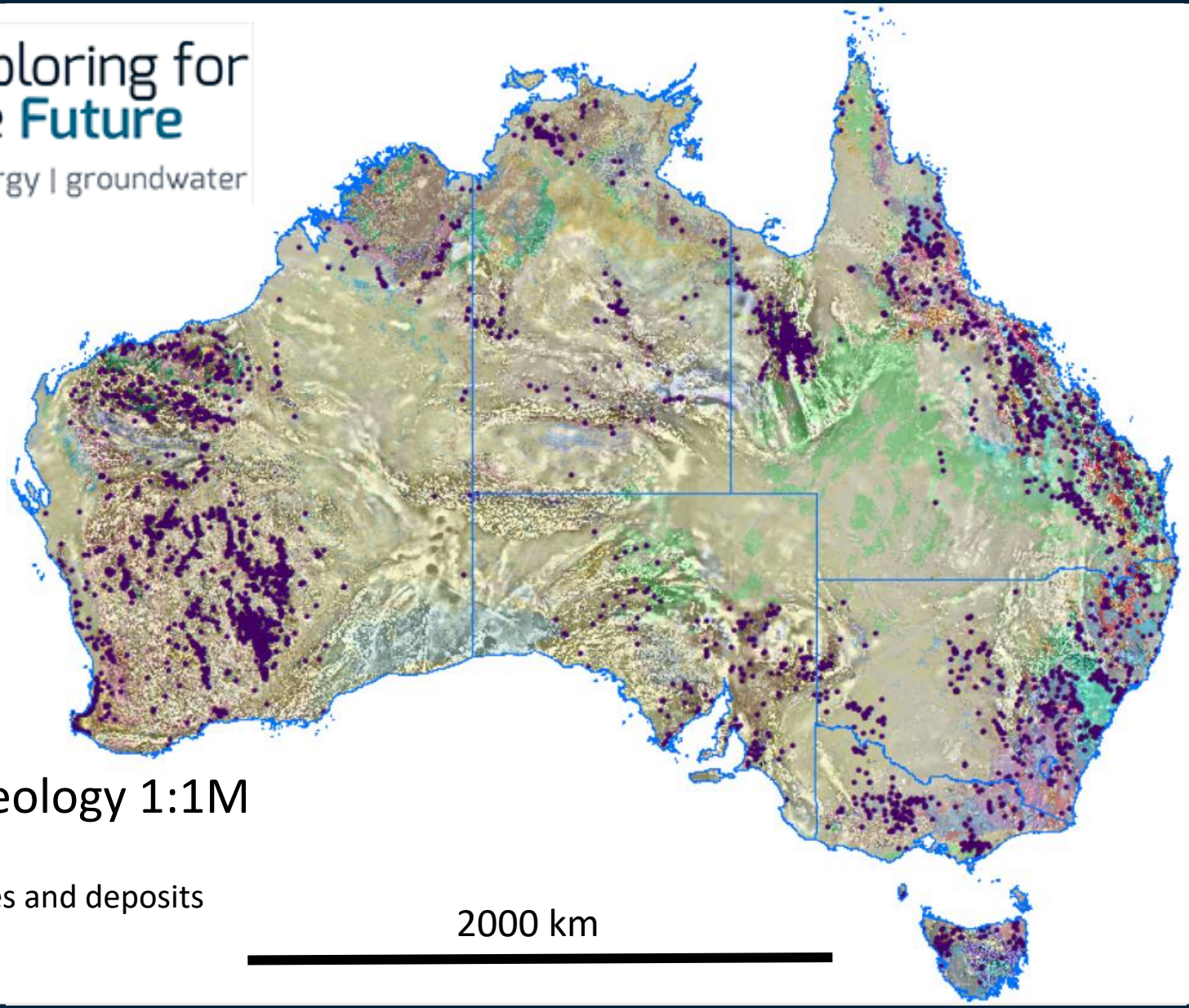
Government of Western Australia
Department of Mines, Industry Regulation and Safety

CSIRO DATA 61

MinEx CRC

Introduction

Exploring for the Future
minerals | energy | groundwater

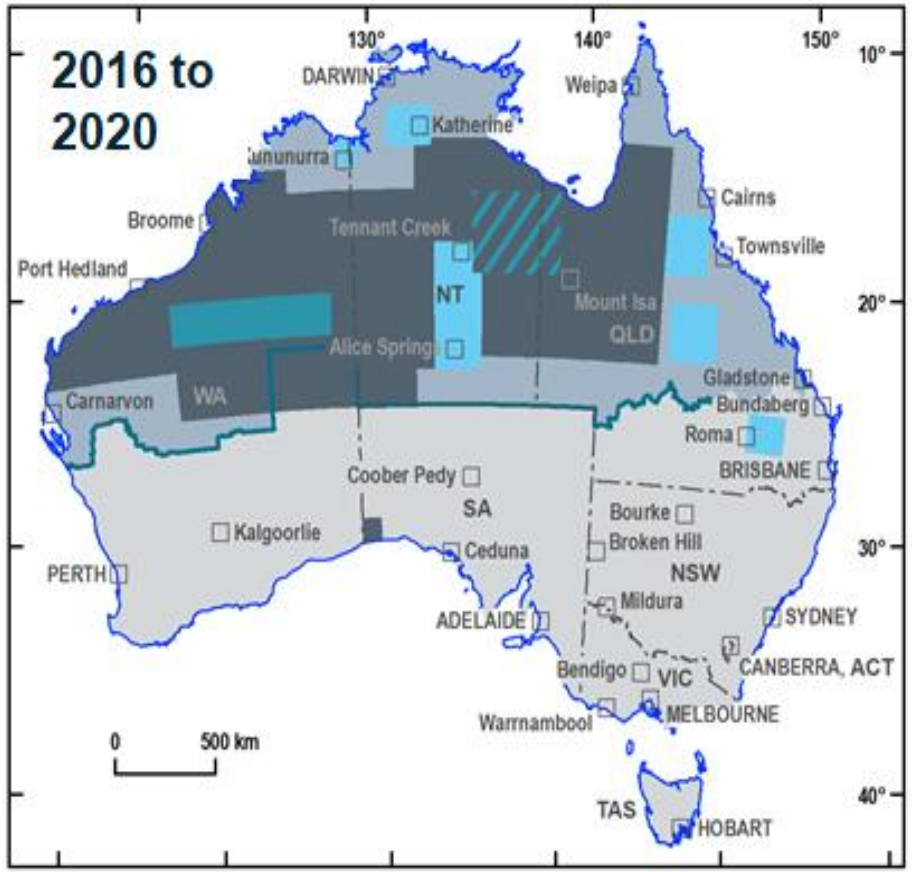


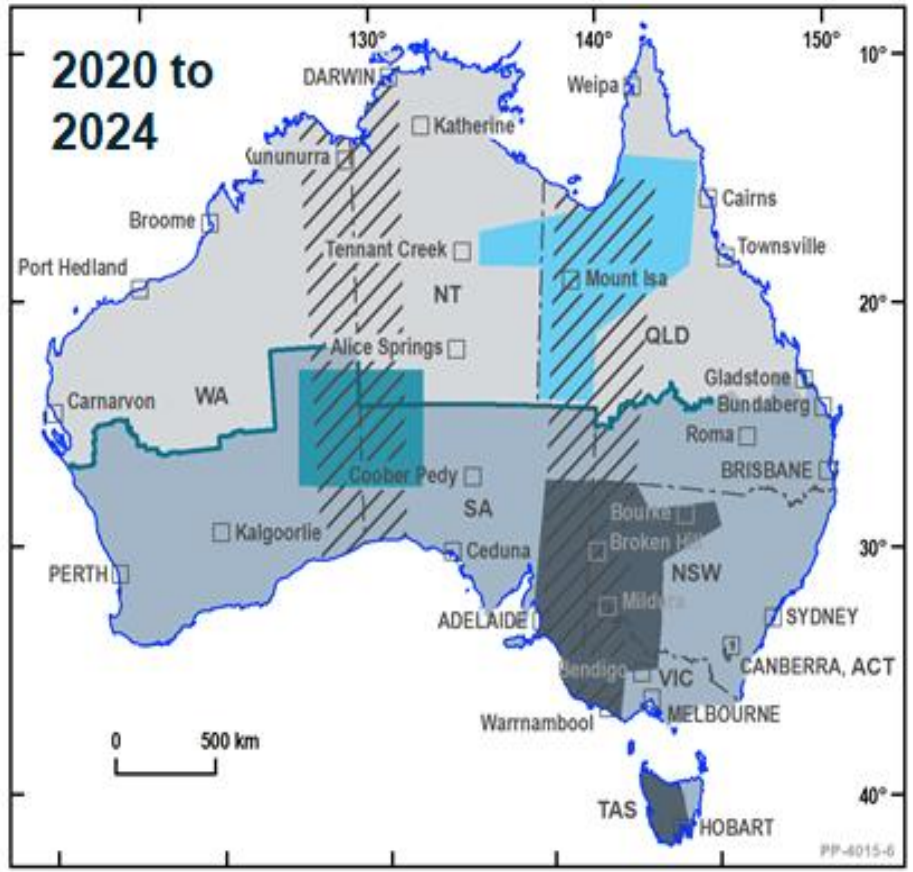
Surface geology 1:1M

- Major mines and deposits

Characterise the composition and architecture of the cover to advance our knowledge on resource distribution and de-risk exploration under cover.

Exploring for the Future – Extended and expanded ($225 M)





- **3 Continental-scale projects** with a focus on southern Australia:
  - Australia's Resources Framework
  - Australia's Future Energy Resources
  - National Groundwater Systems
- **3 Deep-dive projects** in two trans-continental corridors
  - Barkly-Isa-Georgetown
  - Darling-Curnamona-Delamerian
  - Officer-Musgrave
- **2 Program-support projects**
  - Enhanced data delivery
  - Geoscience knowledge transfer

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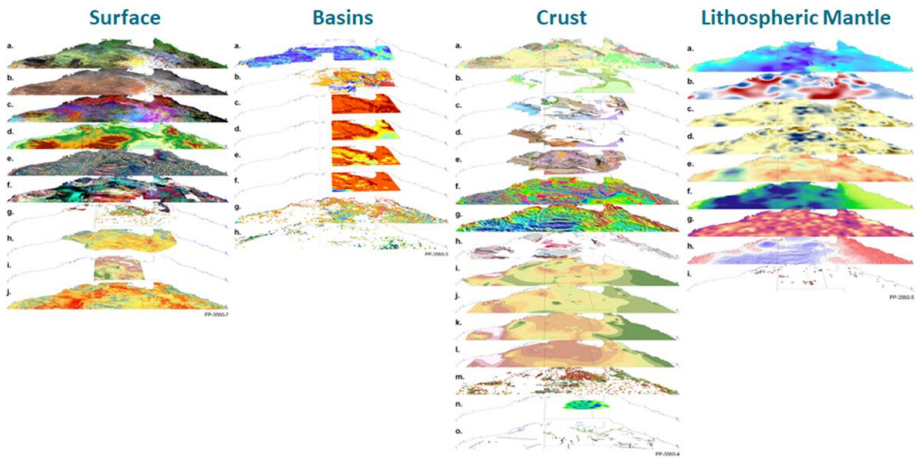
EFTF Australia's Resources Framework project

National Geological Framework

Provide geological understanding of lithospheric architecture

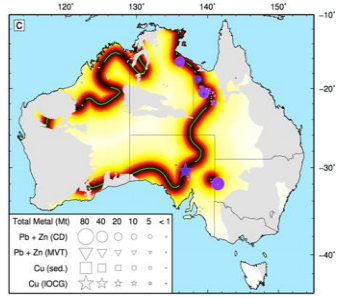


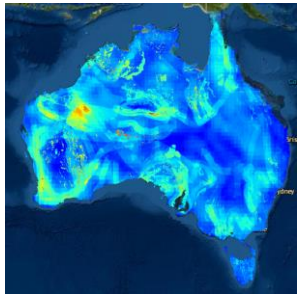
Deliver a portfolio of geochemical surfaces to complement geophysical grids

National Geochemical Framework

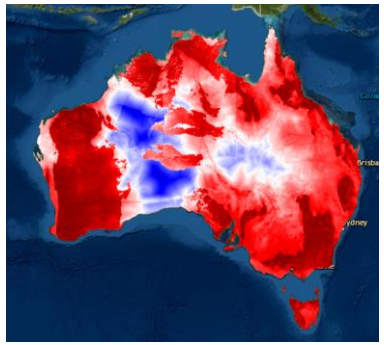
National Mineral Potential

Deliver predictive tools to stimulate exploration investment and drive new discoveries





Mineral Systems Combination of features



Economic feasibility

Investment

Critical Minerals Mapping Initiative

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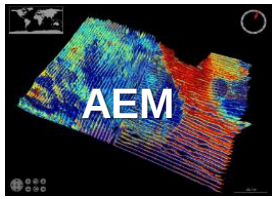
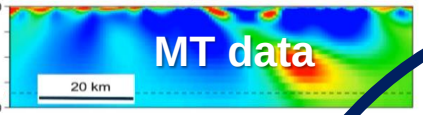
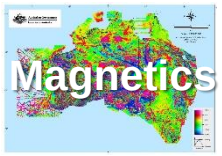
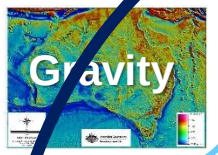
3D geological model workflow

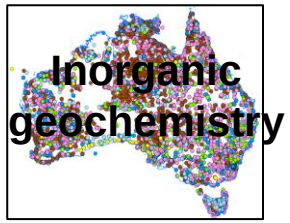
Pre-competitive datasets

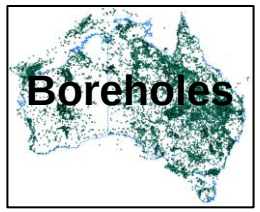


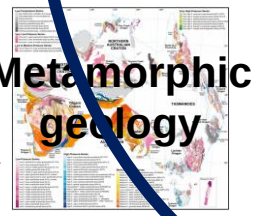


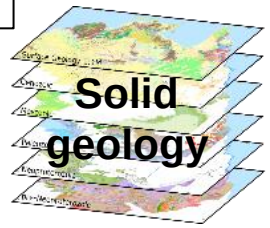




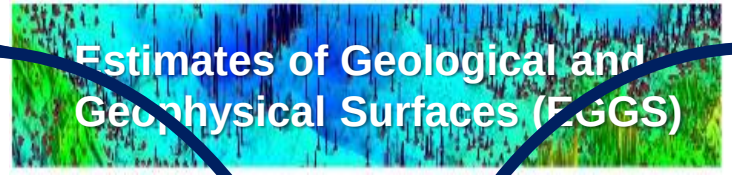








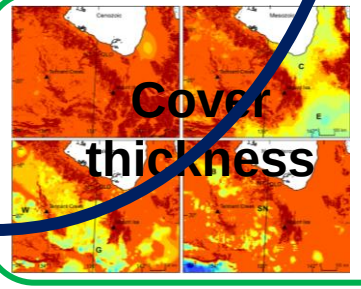
Database and tools

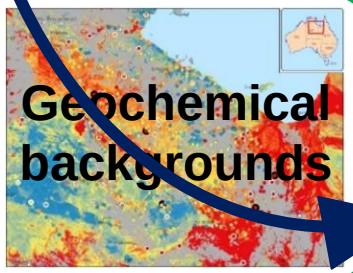


Uncover ML

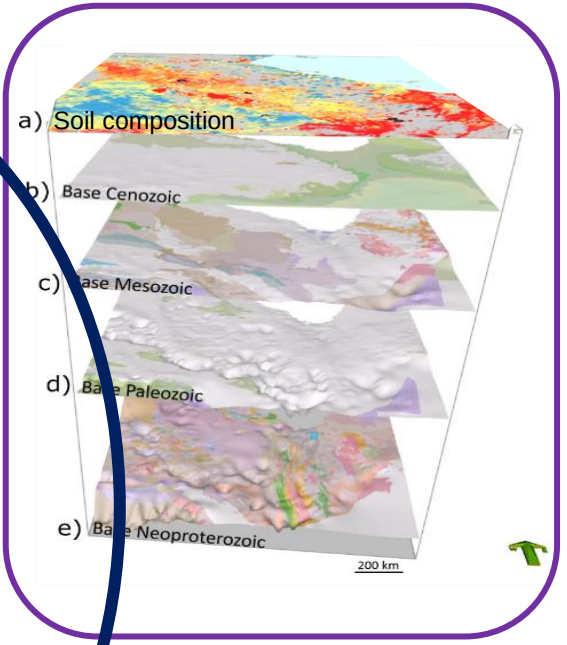
Loop

Predictive datasets





3D integrated model



Findable
Accessible
Interoperable
Reusable

https://github.com/
https://portal.ga.gov.au/

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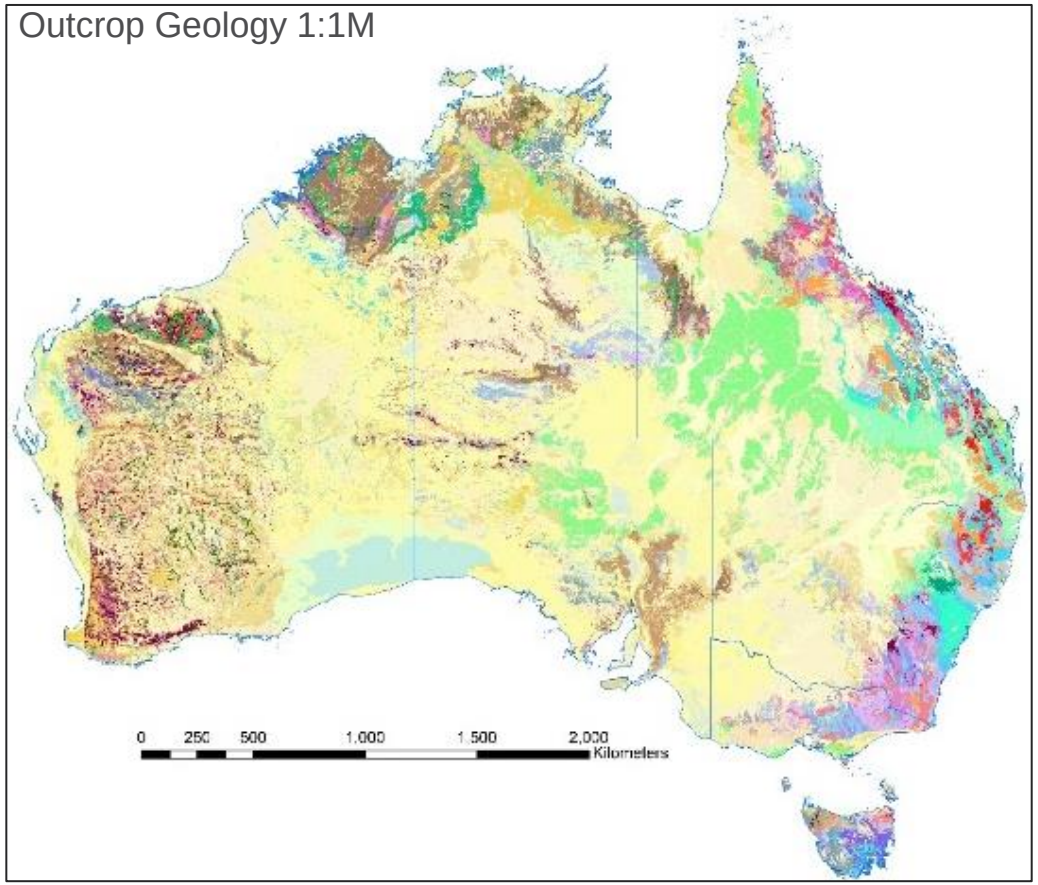
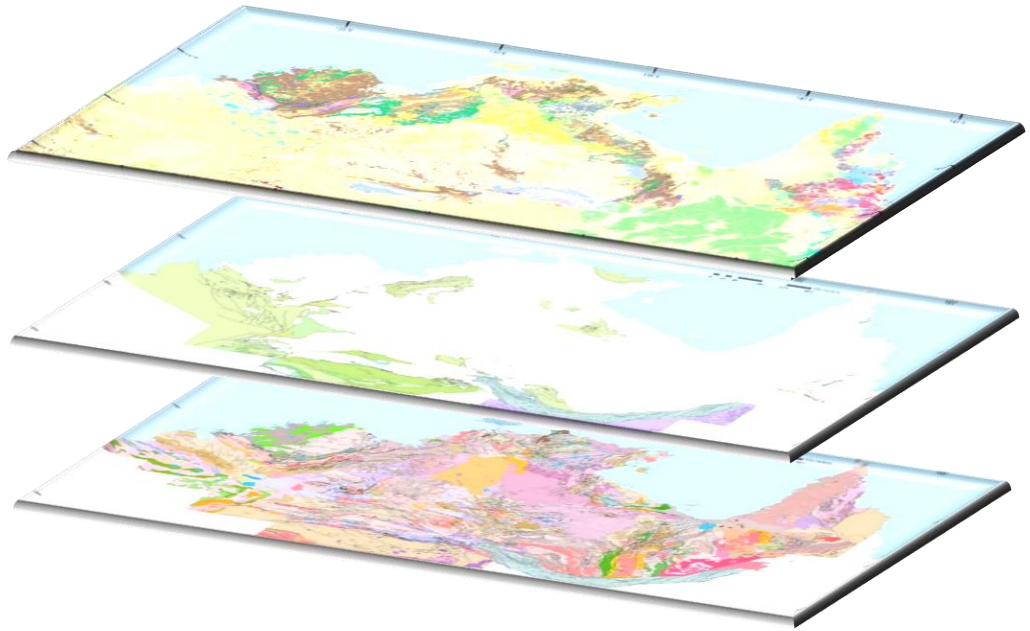
A Chronostratigraphic Approach





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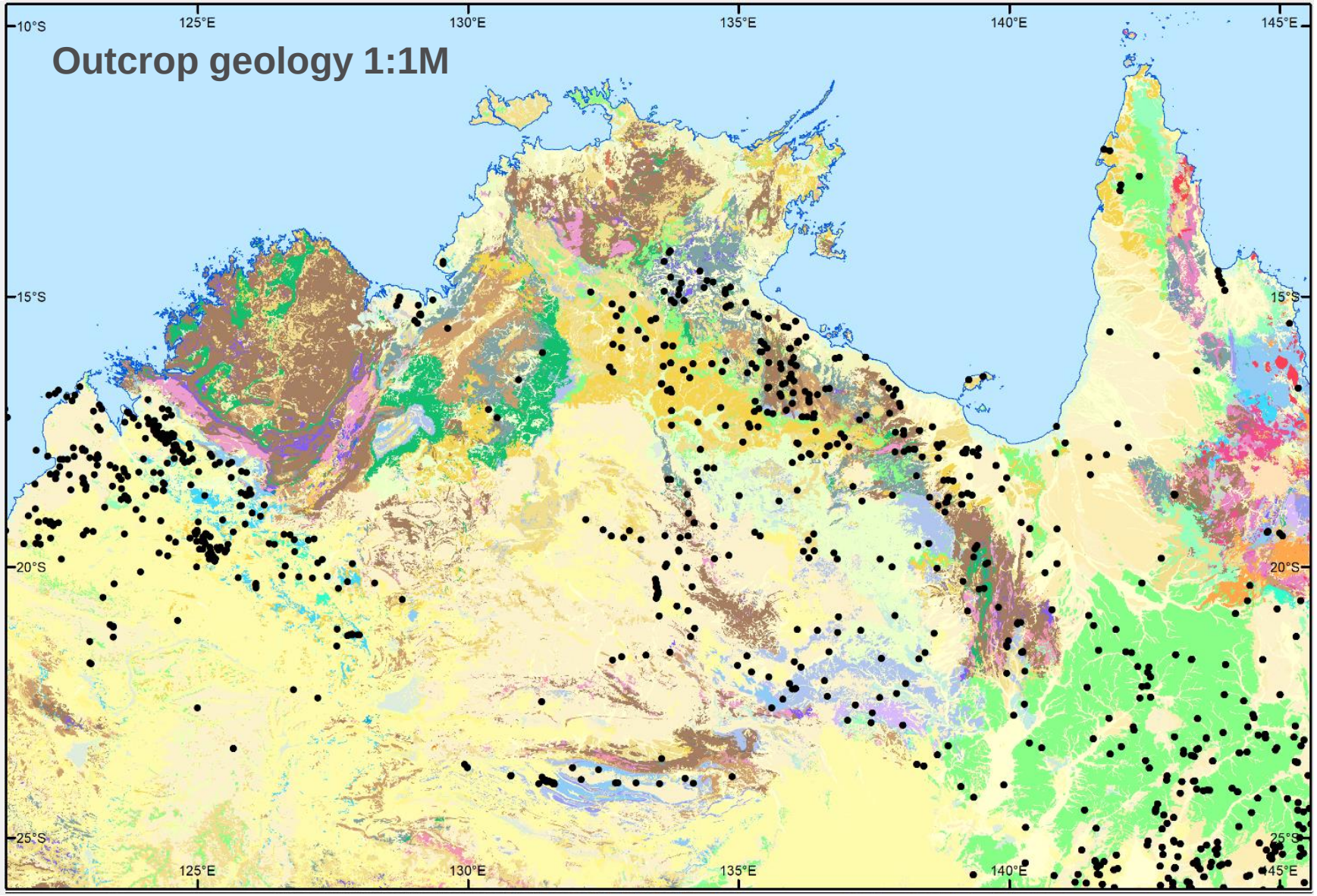
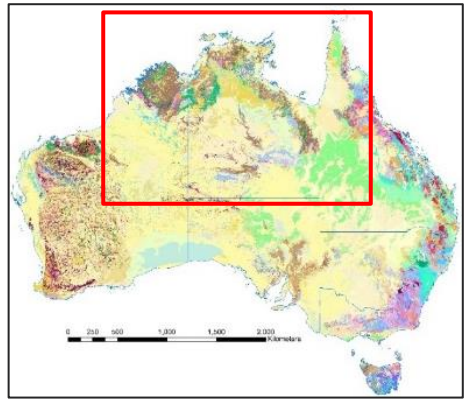
Seamless Solid Geology Mapping





Stewart et al., 2020

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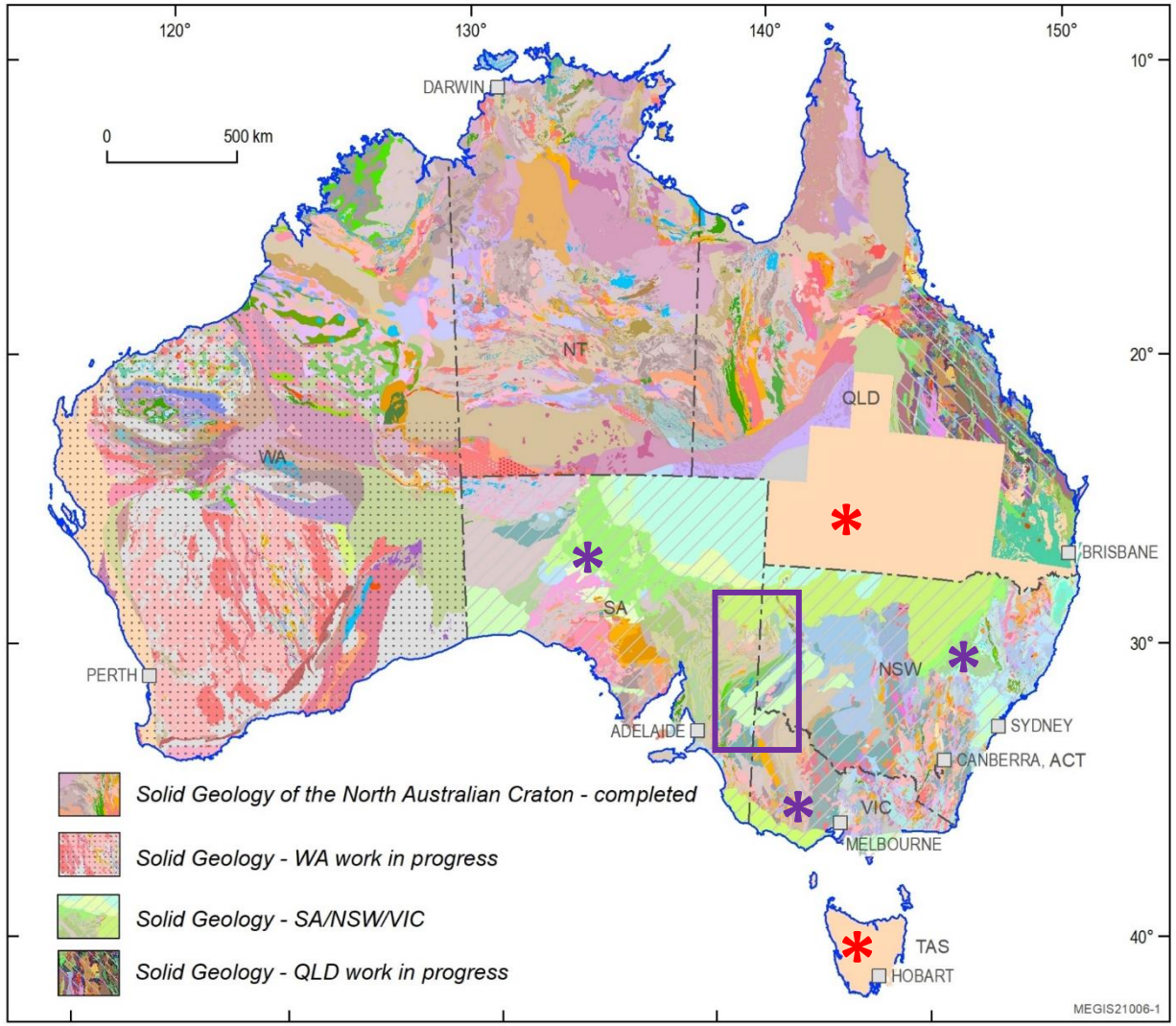
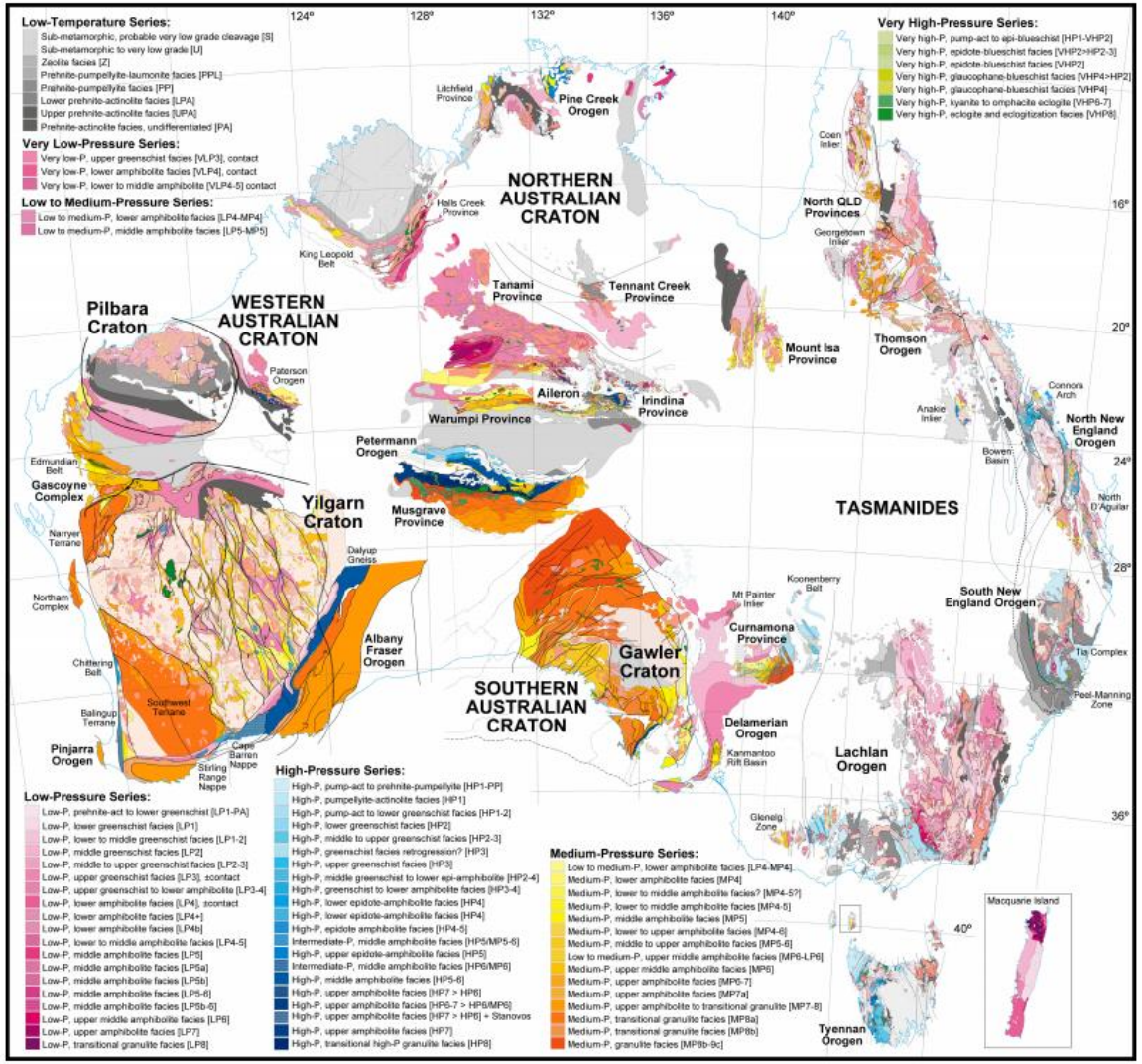
Seamless Solid Geology Mapping



Stewart et al. (2020)



Goscombe et al. (2020)

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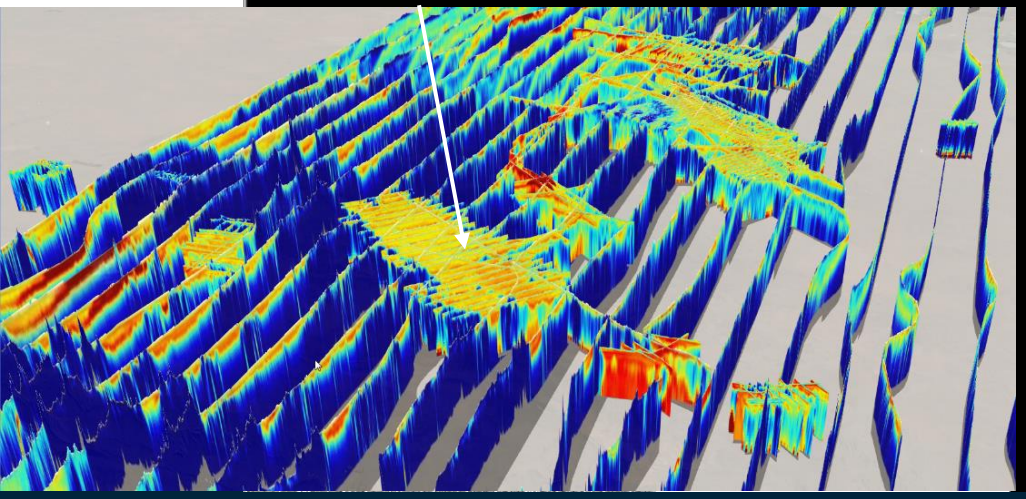
World largest Airborne Electromagnetic Survey - AusAEM



Neoproterozoic to Paleozoic basins

Resistive basement

Mesozoic basins

Resistive basement

Cenozoic basins
and Paleovalleys

A collaboration with State and Territory geological surveys

~500 km

Conductivity (S/m)

1.000

0.100

0.010

0.001

Ley-Cooper et al., 2022

Uncover ML
(Wilford et al., in prep)

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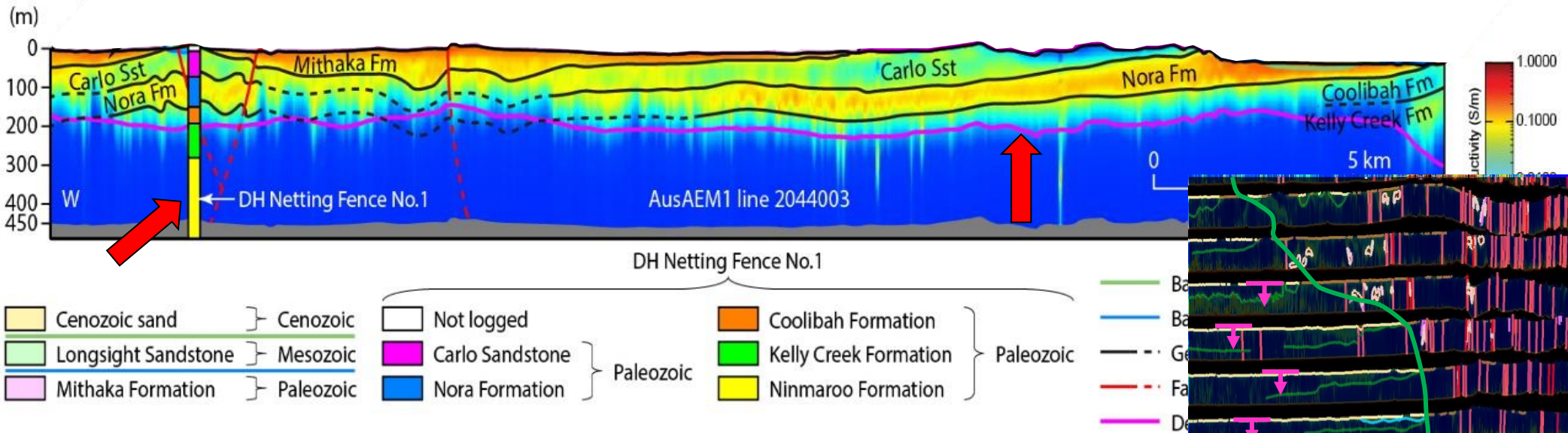
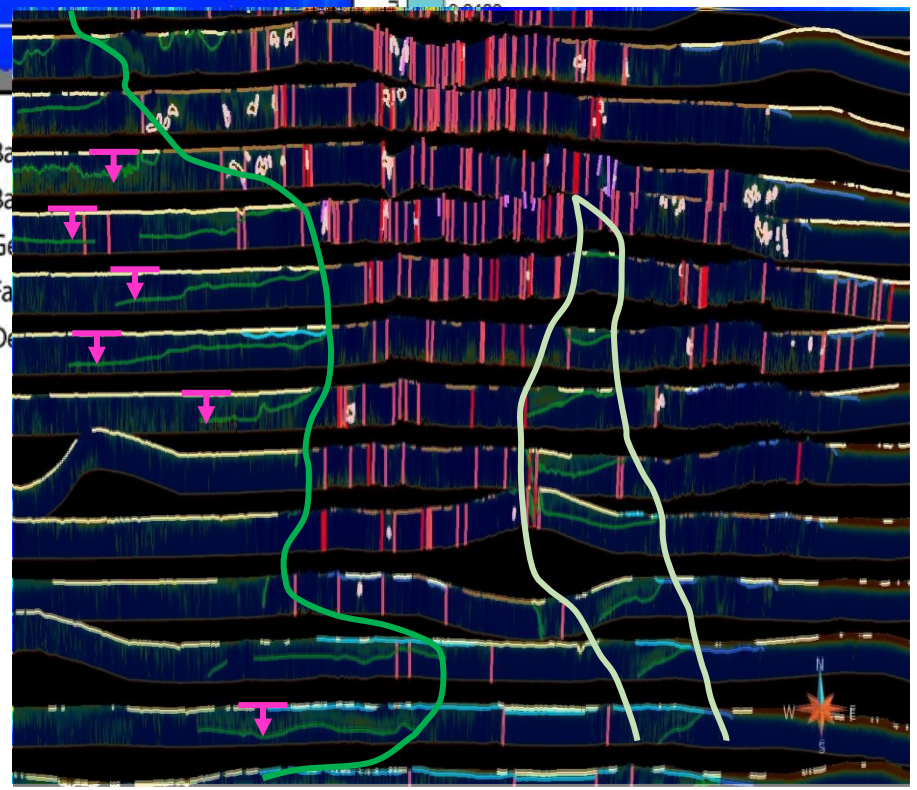
AusAEM – Mapping the near surface



Queensland



Cover mapping

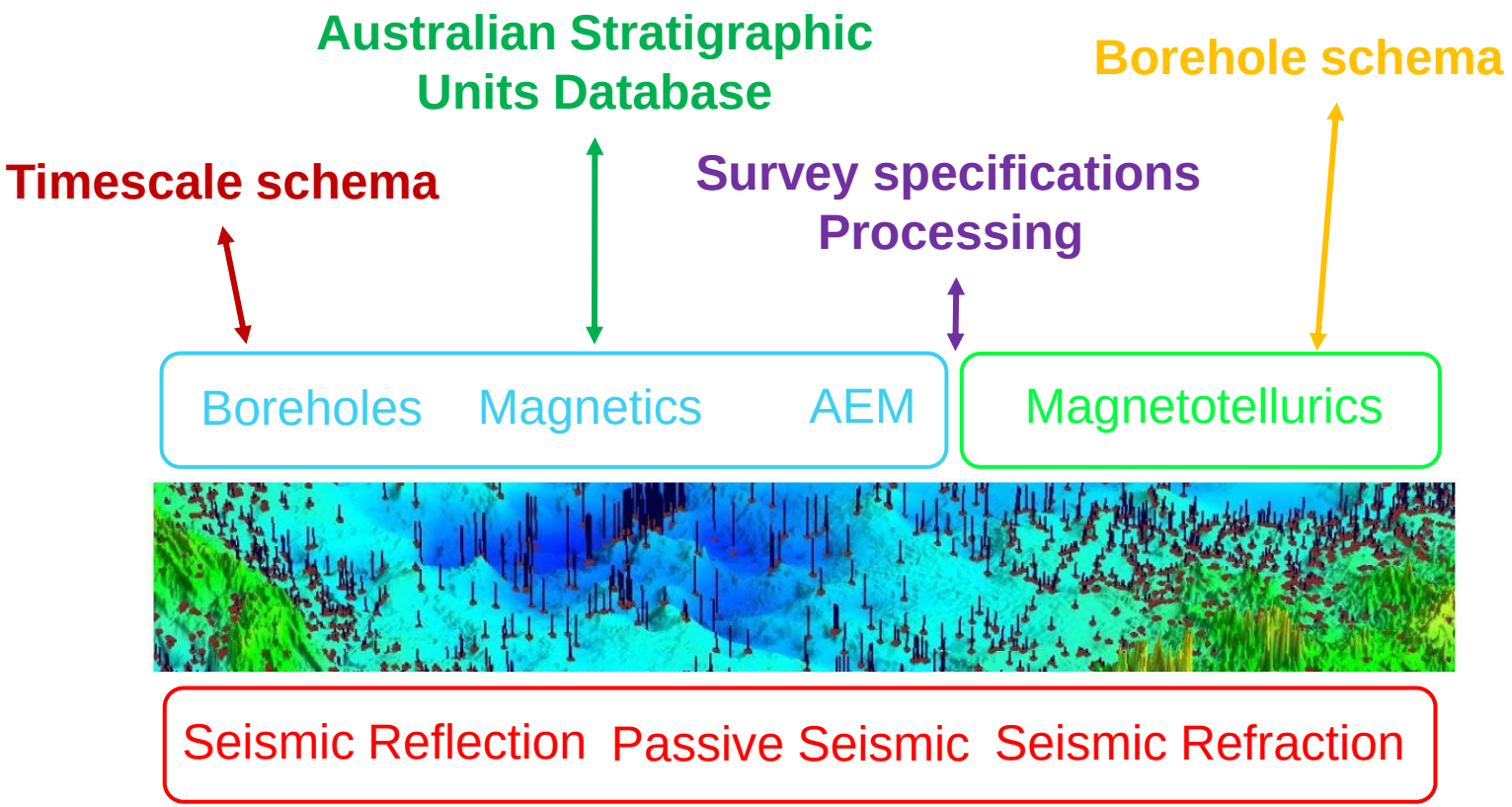
Basin extent

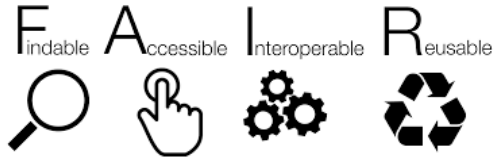
Paleovalleys

Wong et al., 2020

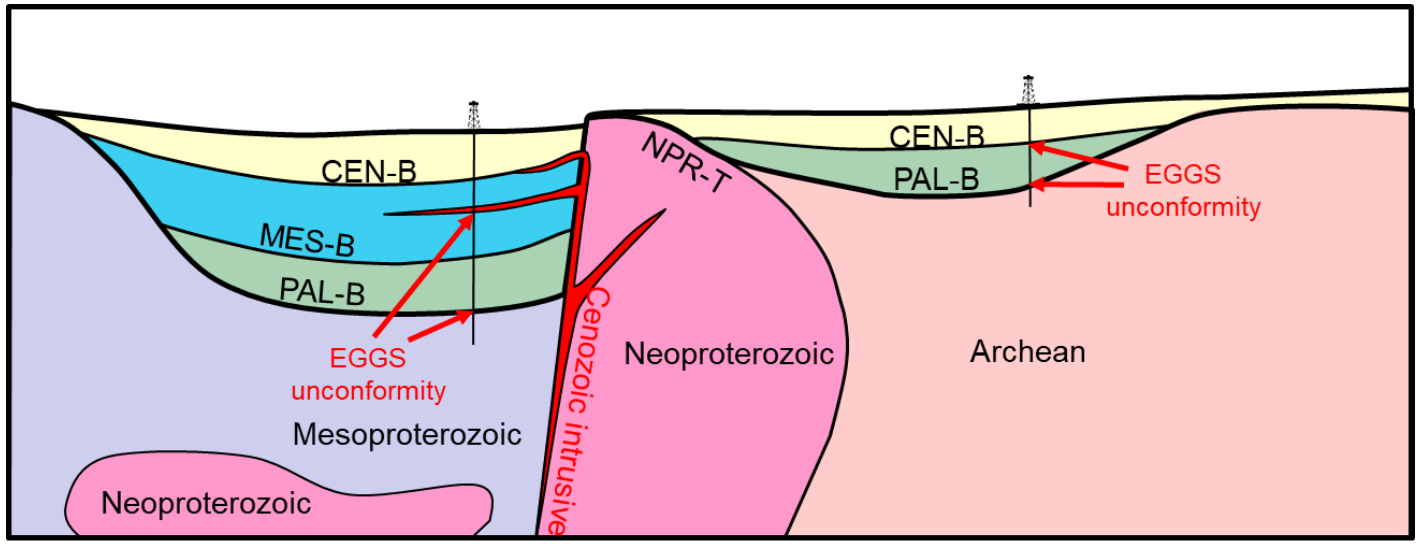
Estimates of Geological and Geophysical Surfaces (EGGS)

- Consistently store point depth estimates from geological and geophysical data – Depth estimate pick, not interpolation
- Be dynamic and grow with evolving geological framework
- Track changes, e.g. new data, new interpretation, new processing
- Capture uncertainties
- Accessible to external users though the GA portal





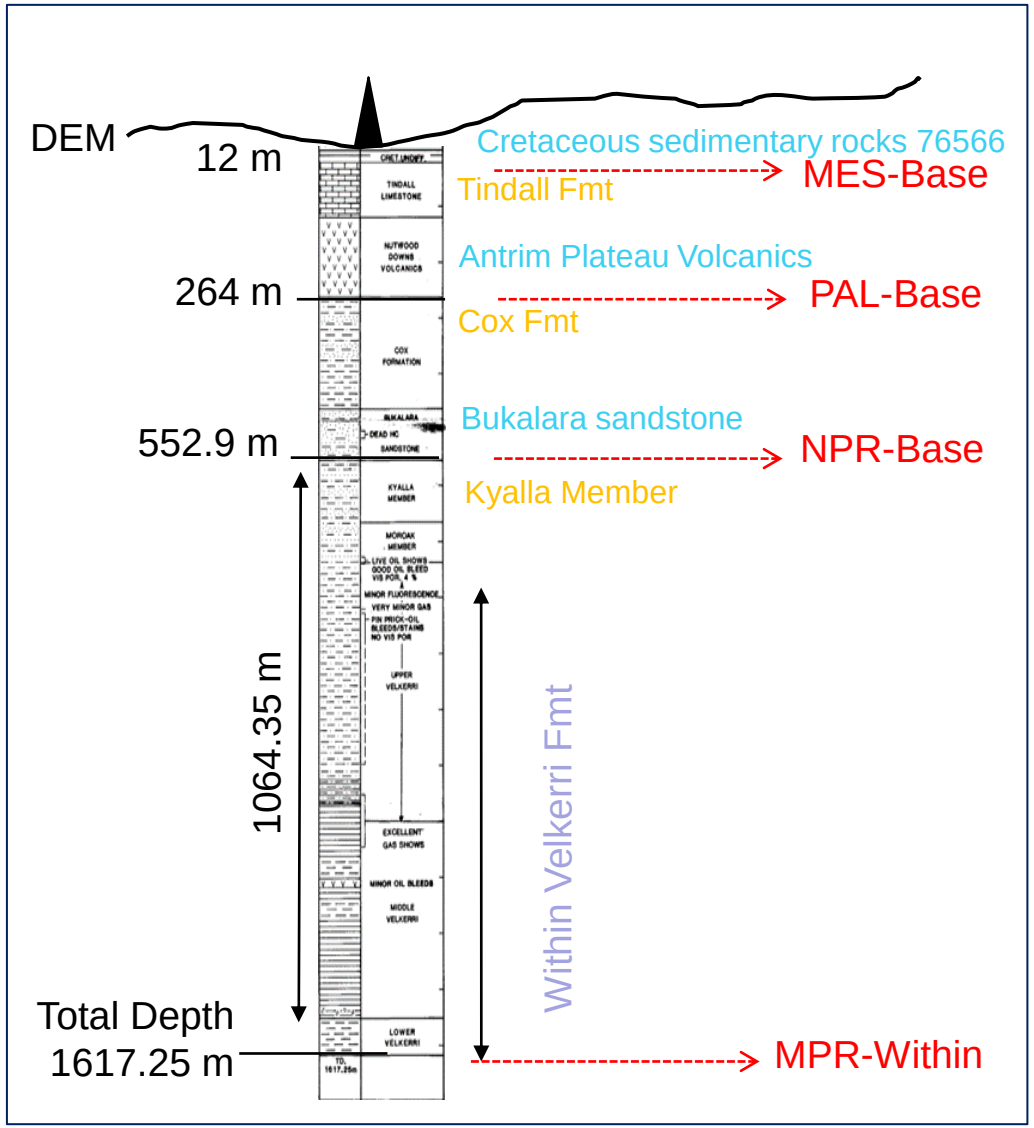
Estimates of Geological and Geophysical Surfaces (EGGS)



Australian Stratigraphic Units Database (ASUD)

Findable Accessible Interoperable Reusable

Hope et al., in prep



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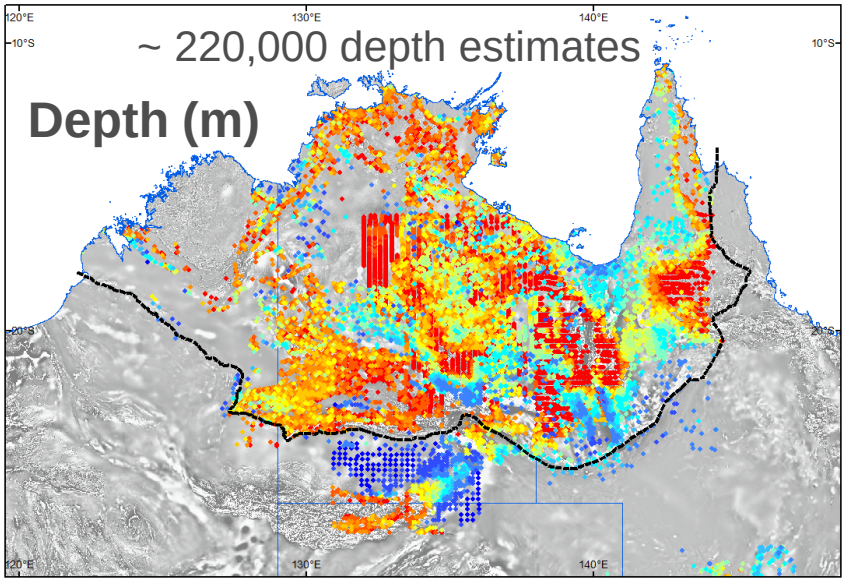
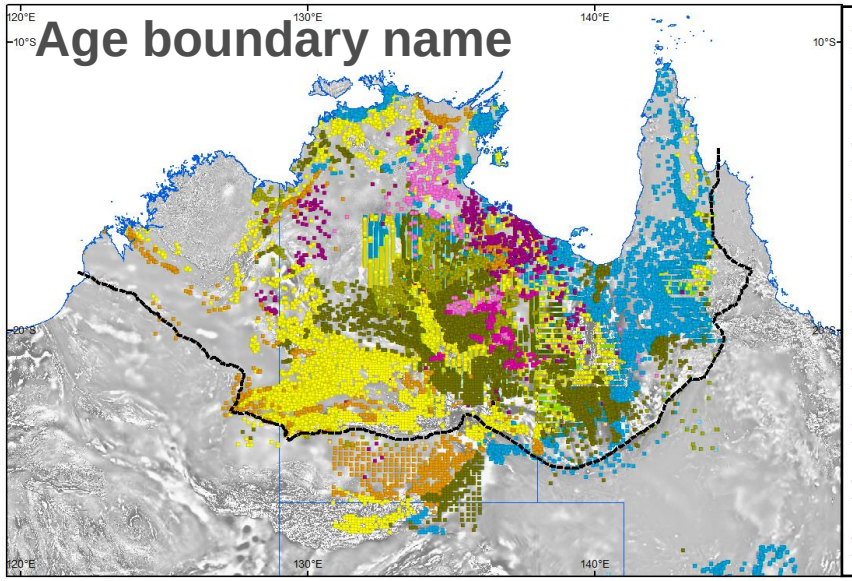
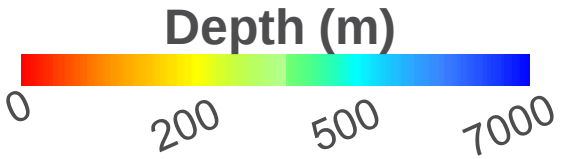
Estimates of Geological and Geophysical Surfaces (EGGS)

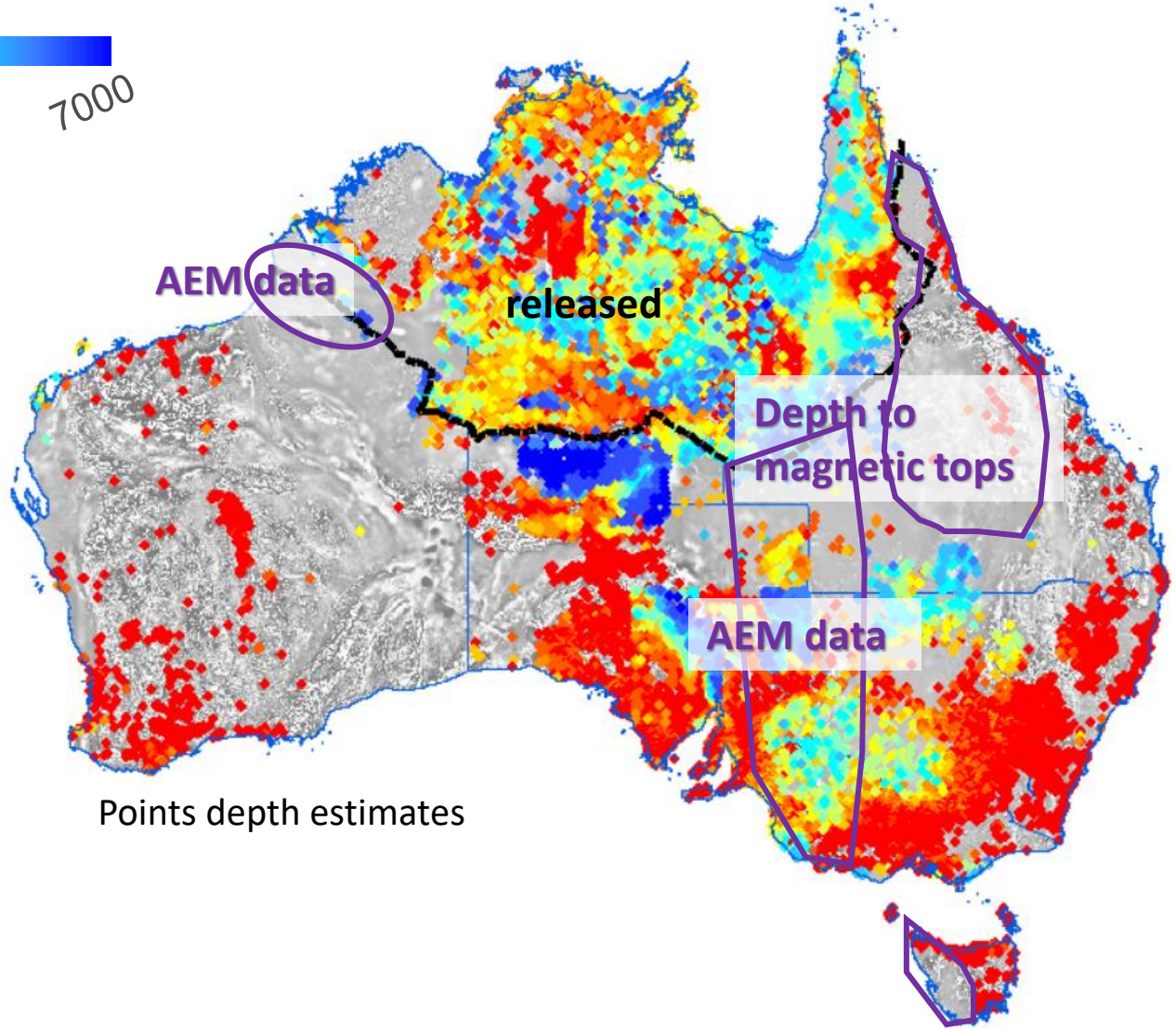




- Base of Cenozoic
- Base of Mesozoic
- Base of Paleozoic
- Within Paleozoic
- Base of Neoproterozoic
- Within Neoproterozoic
- Base of Mesoproterozoic
- Within Mesoproterozoic
- Base of Paleoproterozoic
- Within Paleoproterozoic

Mathews et al., 2020





Points depth estimates

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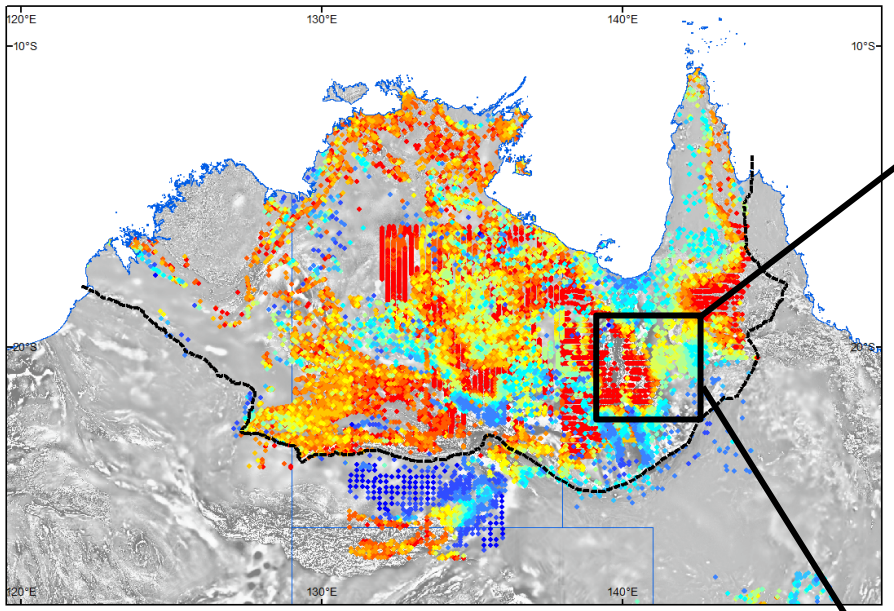
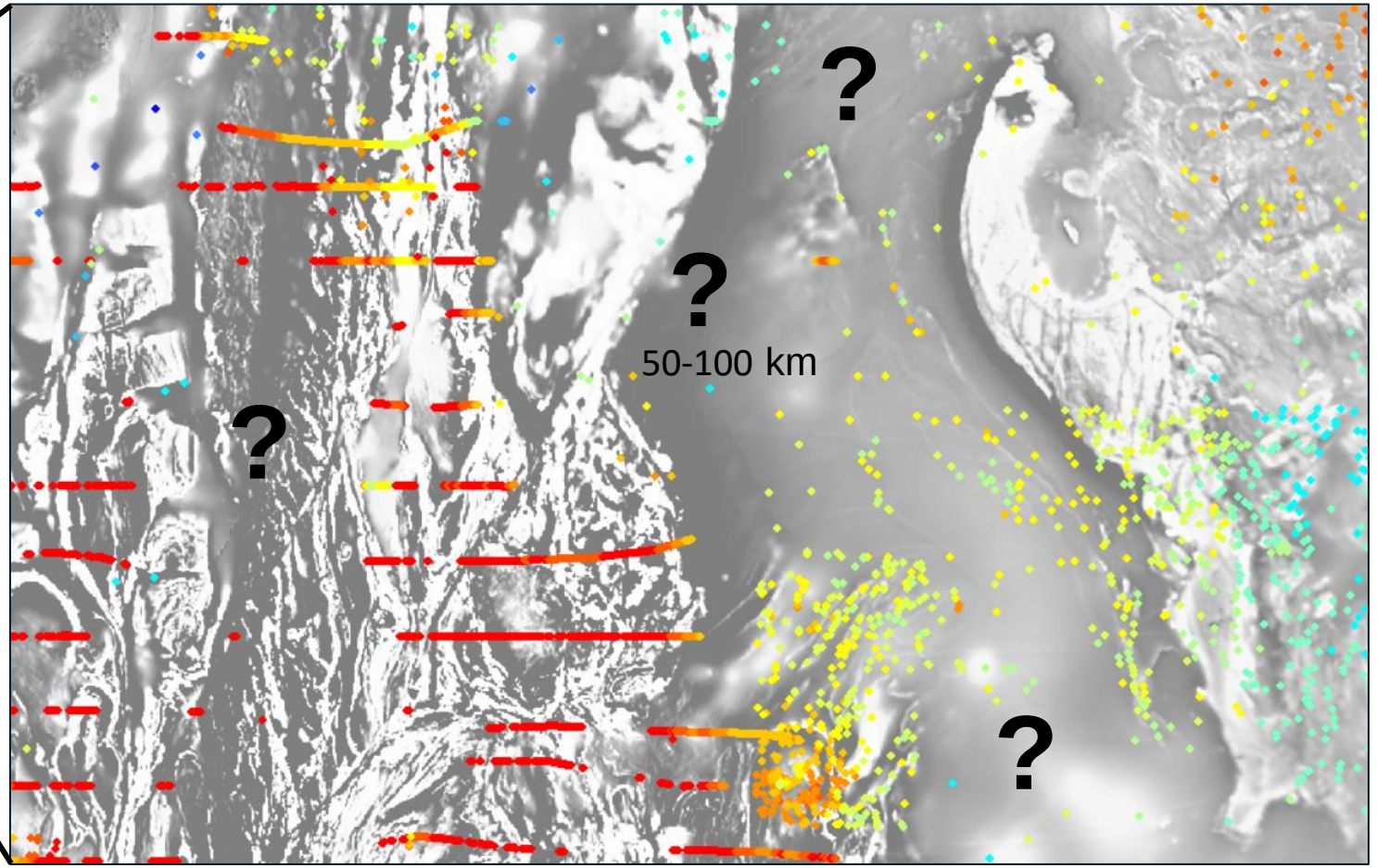
Depth to cover modelling



Depth (m)

0 200 500 7000



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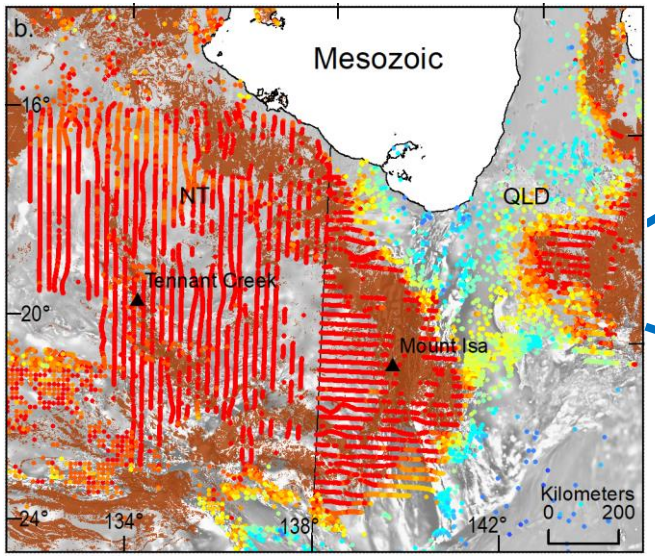
Depth to cover modelling

Observations

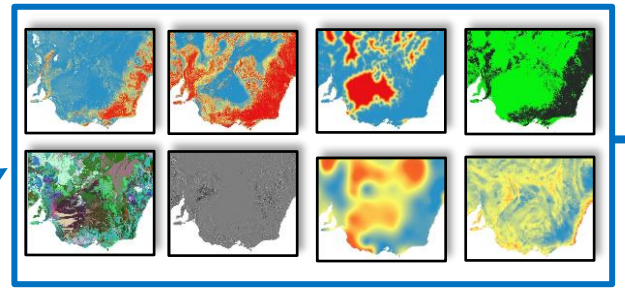
68 414 input points



Depth (m)

Wilford et al., 2020
Bonnardot et al., 2020

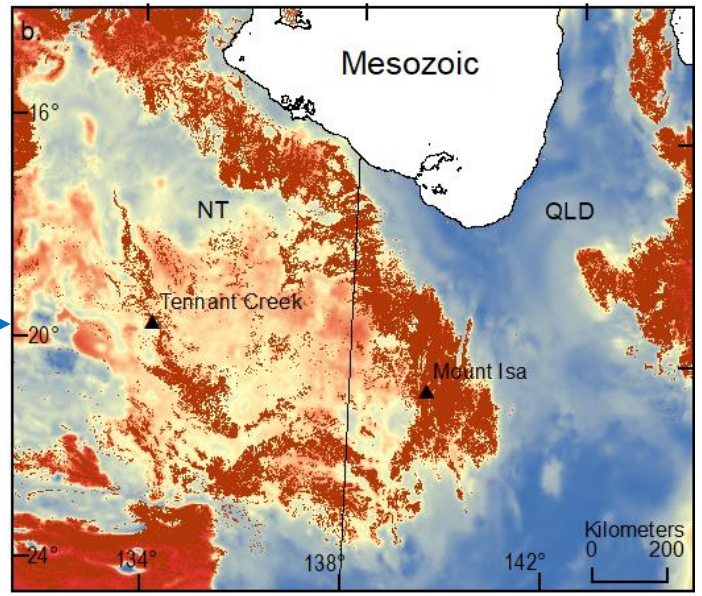
Predictive input datasets



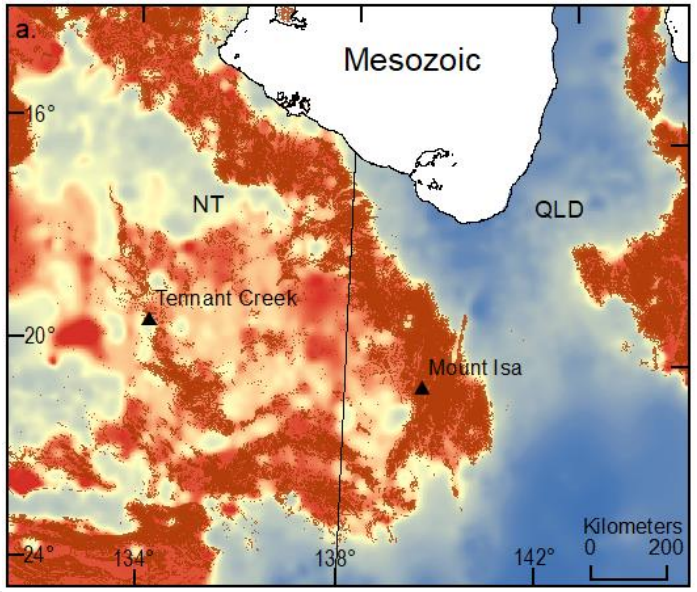
2km cell size

2km cell size

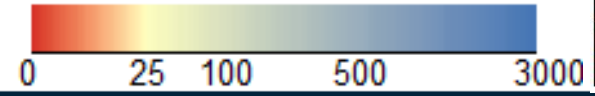
Machine Learning



Interpolation



Depth below surface (m)



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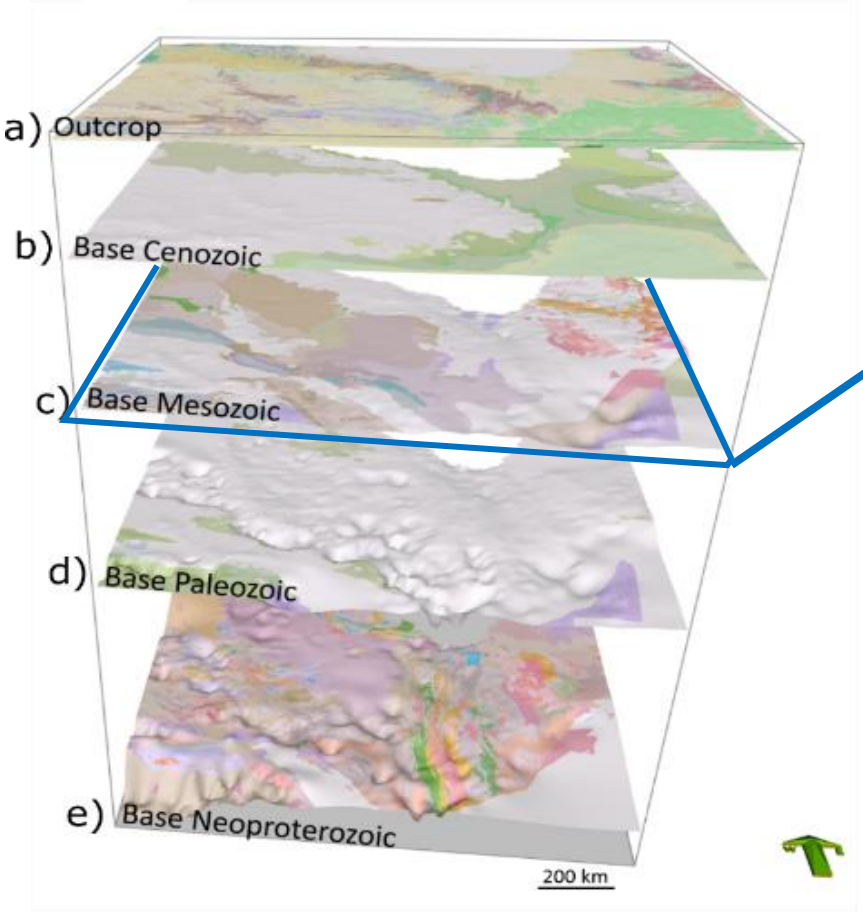
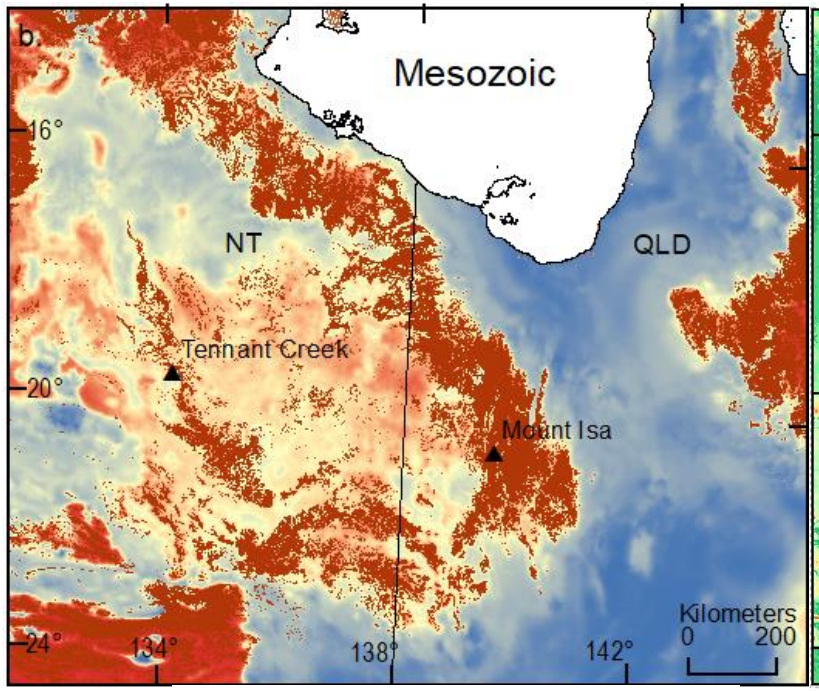
Cover thickness models – Base Mesozoic

3D integrated model (interpolation)



Bonnardot et al., 2020

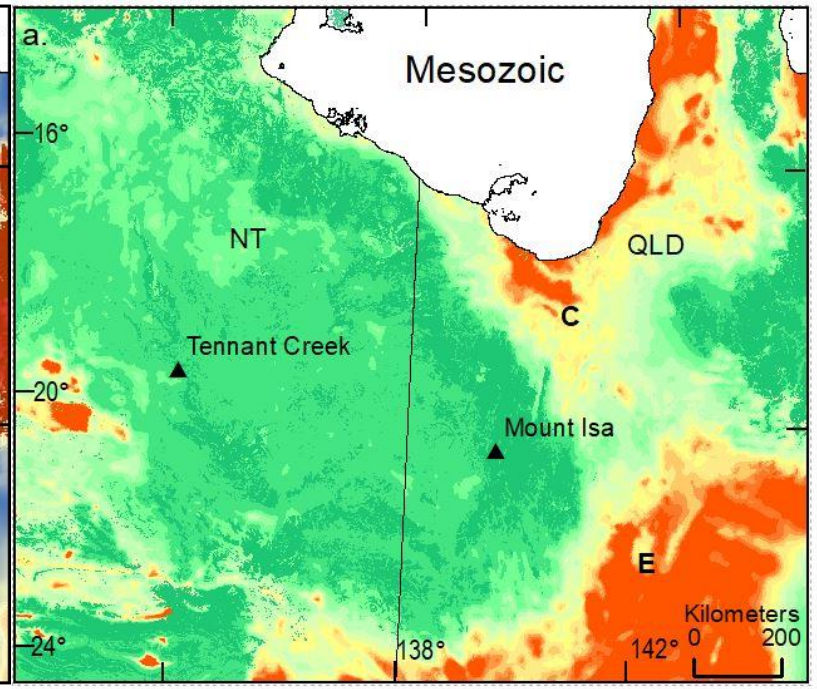
Predictive Surface - ML



Depth below surface (m)

0 25 100 500 3000

Model Uncertainties



Standard deviation (sigma) (m)

0 10 50 120 220

Uncover ML

Loop

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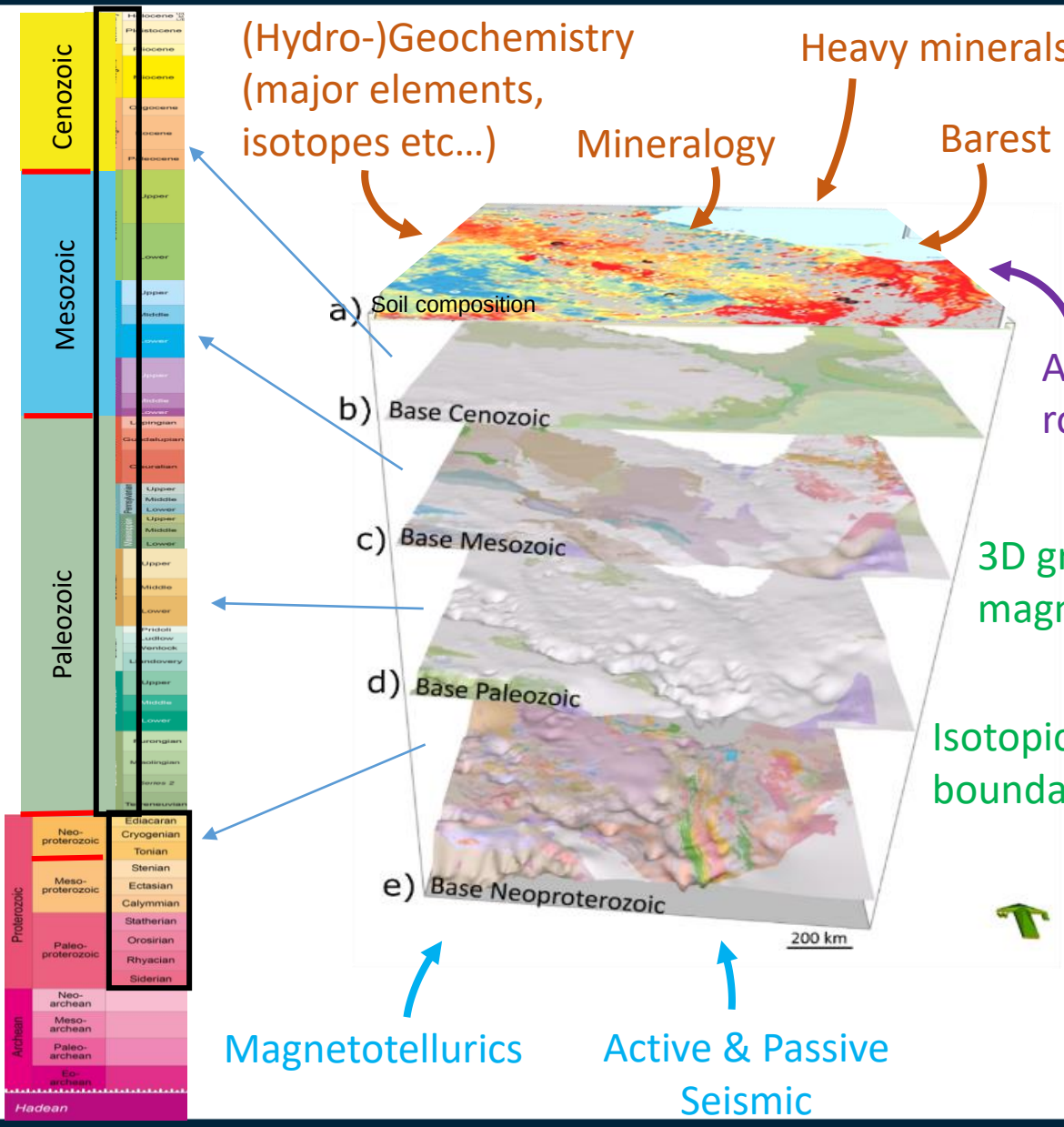
What are the next steps?

Surface modelling ⟹ Volume modelling



How do we identify which geochemical parameters will improve targeting for basin-hosted base-metals and critical minerals deposits?

What is temporal and spatial distribution of alkaline rocks, their relationship to mineralisation and their geophysical expression?

How deep are the prospective rocks and could that make an economically viable prospect?

How well do our conceptual mineral system models actually predict observed deposition?

How do we better identify which sedimentary basins are most prospective for basin-hosted mineralisation?

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Australian Government
Geoscience Australia

Exploring for the Future
minerals | energy | groundwater

Thank you!

Dr Marie-Aude Bonnardot
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Mineral Systems Branch

Exploring for the Future

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https://portal.ga.gov.au/

https://github.com/GeoscienceAustralia/uncover-ml

https://loop3d.github.io/