Australian Government

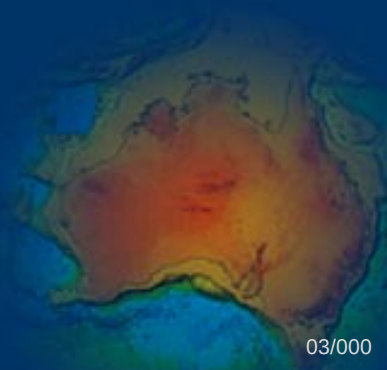
Geoscience Australia

New Insights from Key Proterozoic Mineral Provinces

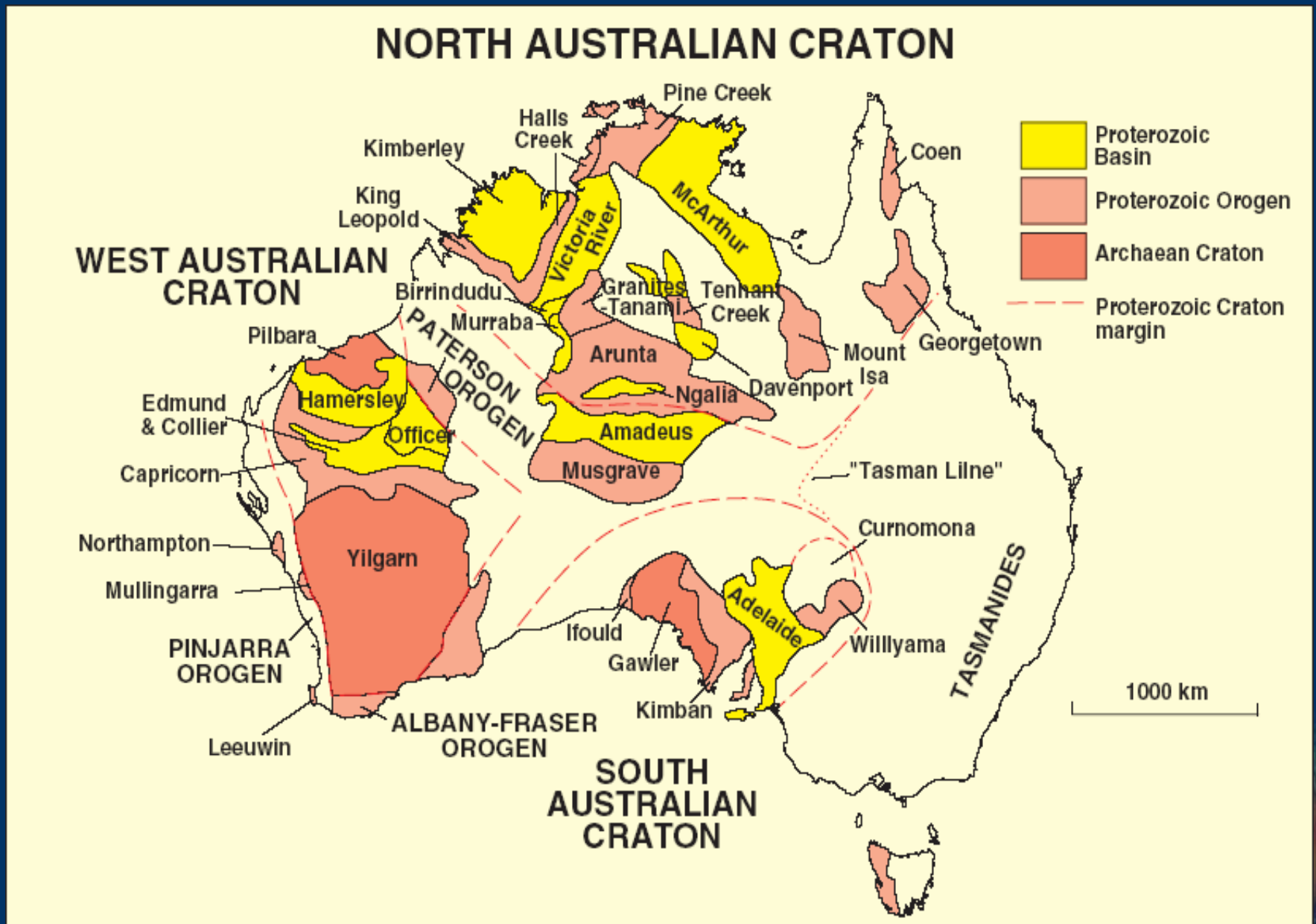
James Johnson

AMEC National Mining Congress 2007

Innovative Exploration - Geoscience

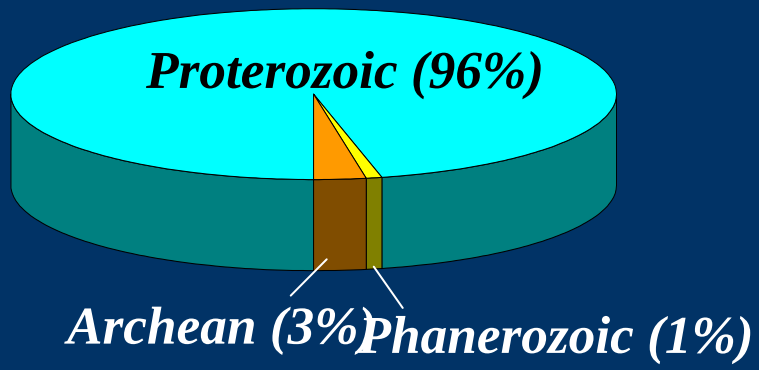


Outline

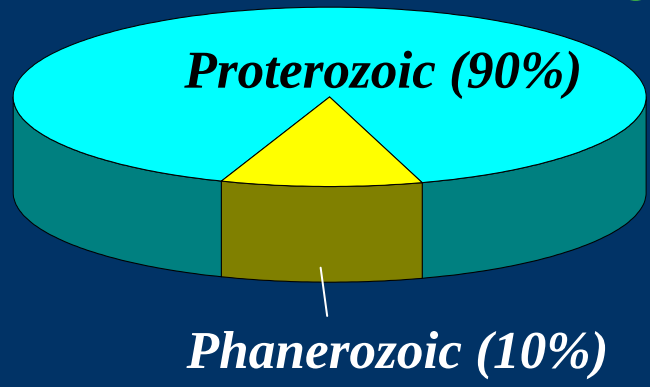

NORTH AUSTRALIAN CRATON
Pine Creek
Halls Creek
Kimberley
King Leopold
WEST AUSTRALIAN CRATON
Victoria River
McArthur
Coen
Birrindudu
Murraba
Granites Tanami
Tennant Creek
Mount Isa
Georgetown
Pilbara
PATERSON OROGEN
Arunta
Ngalia
Davenport
Edmund & Collier
Hamersley
Officer
Amadeus
Musgrave
Capricorn
"Tasman Line"
Curnomona
Northampton
Yilgarn
Mullingarra
Adelaide
TASMANIDES
Willyama
Ifould
Gawler
PINJARRA OROGEN
Kimban
1000 km
ALBANY-FRASER OROGEN
Leeuwin
SOUTH AUSTRALIAN CRATON
Proterozoic Basin
Proterozoic Orogen
Archaean Craton
Proterozoic Craton margin

Proterozoic systems - major source of many commodities

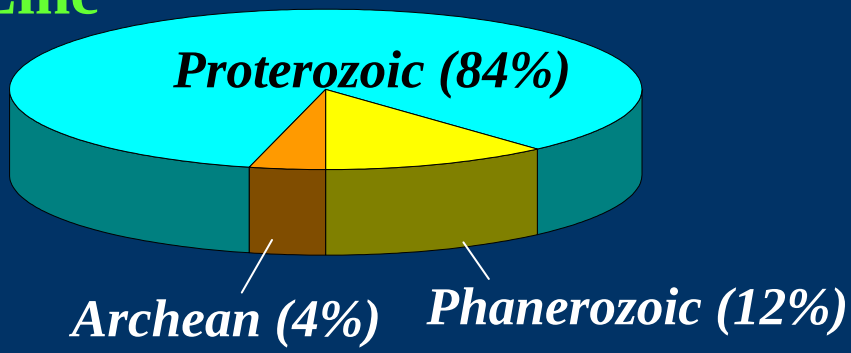
Iron



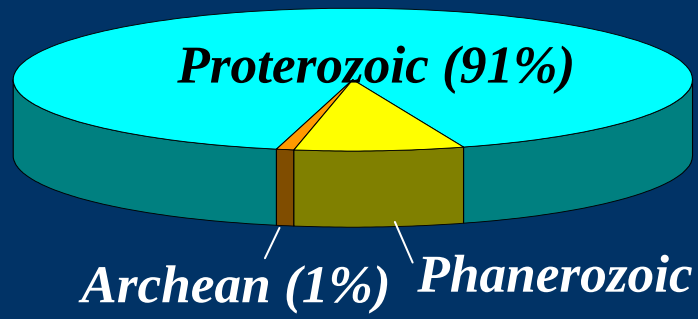
Uranium



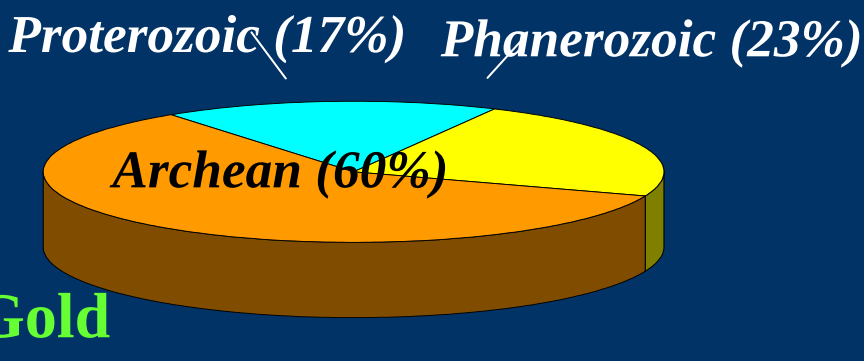
Zinc



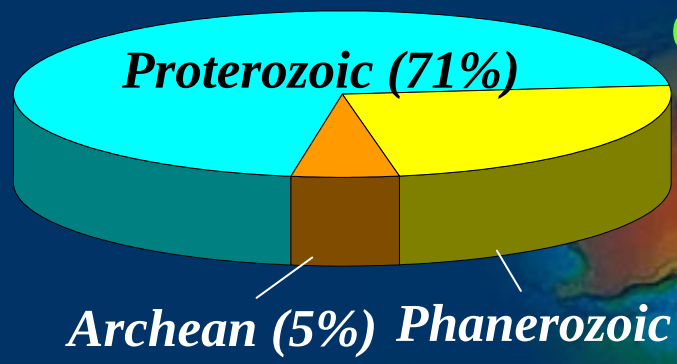
Lead

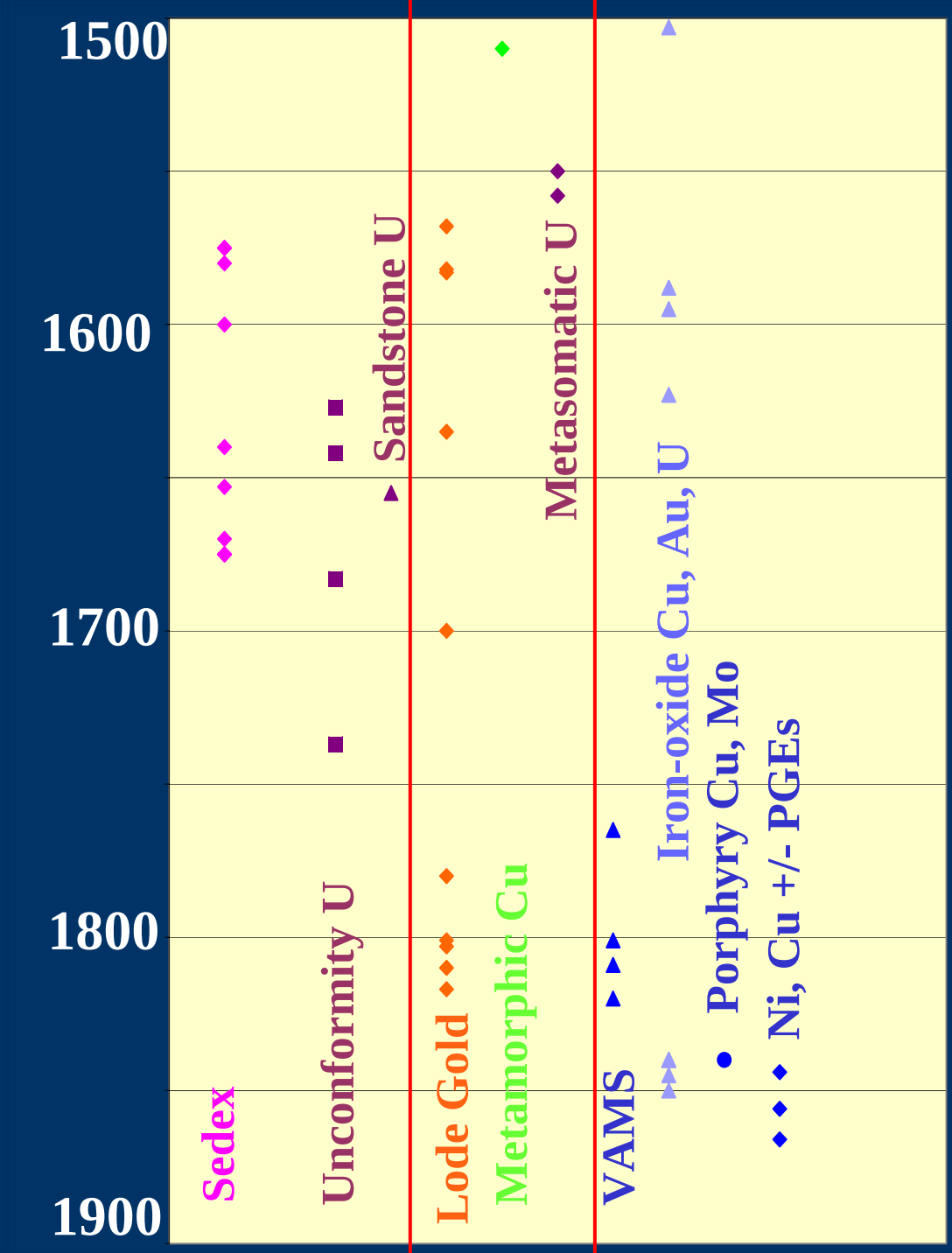


Gold



Copper

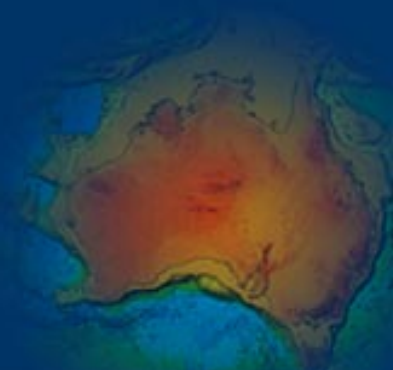




Metallogeny 2000 to 1500 Ma

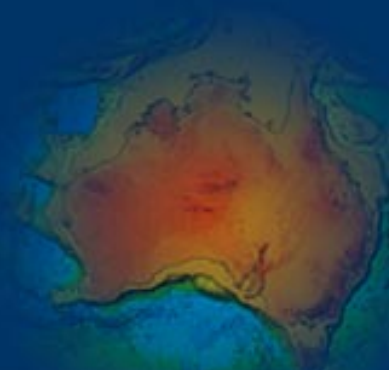
Most Fertile period: 1690 to 1500 Ma

Several mineral systems operating close in time

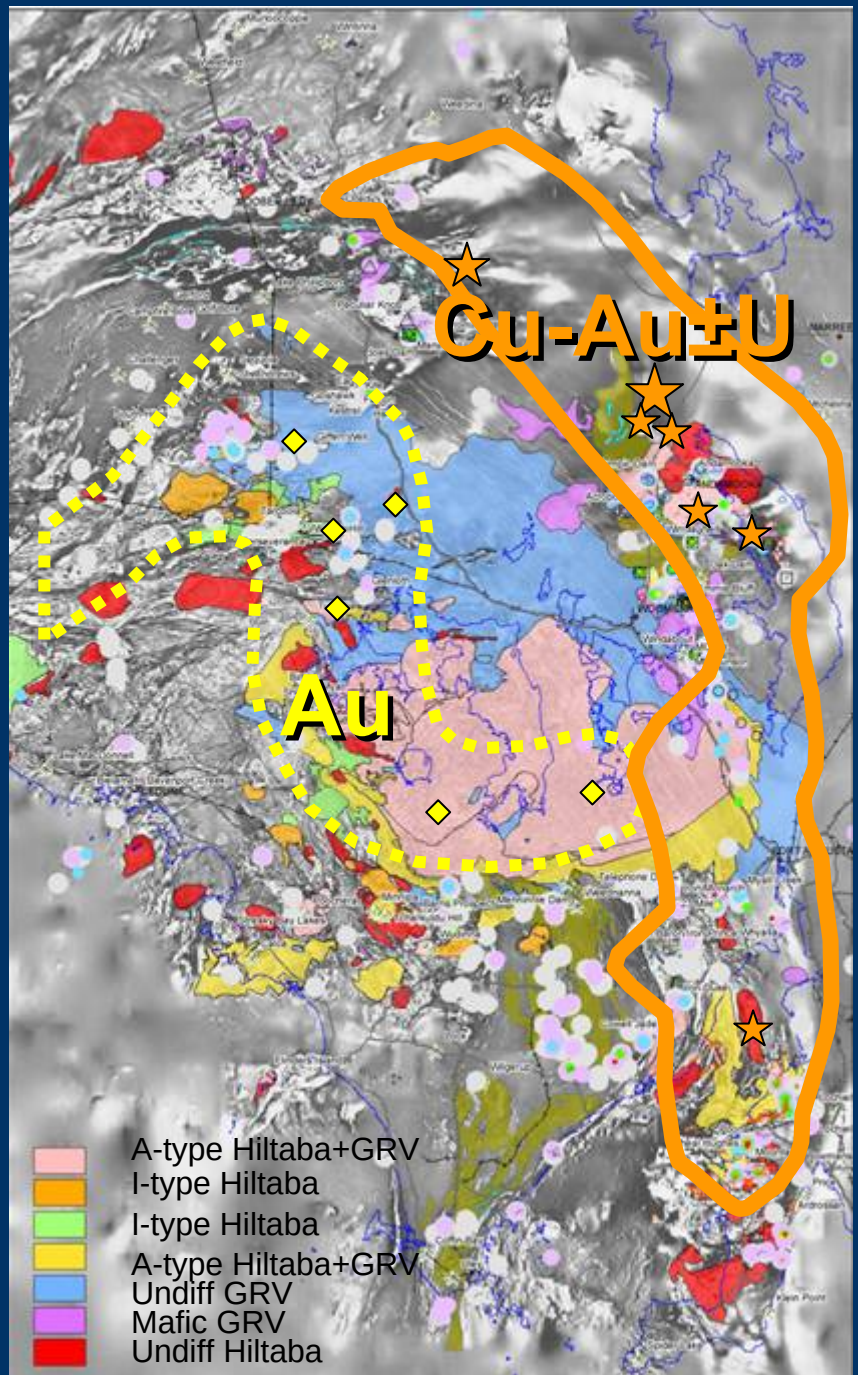


Gawler Project
(PIRSA & GA)

- 2000 to 2006
- Aim - assist with broad understanding of endowed Proterozoic province
- Produced solid geology map, empirical relationship themes
- New understanding of Cu-Au and Au mineral systems



Gawler Craton Project
(PIRSA & GA)
IOCG & Au Systems:
(subdivision from Budd, 2006)



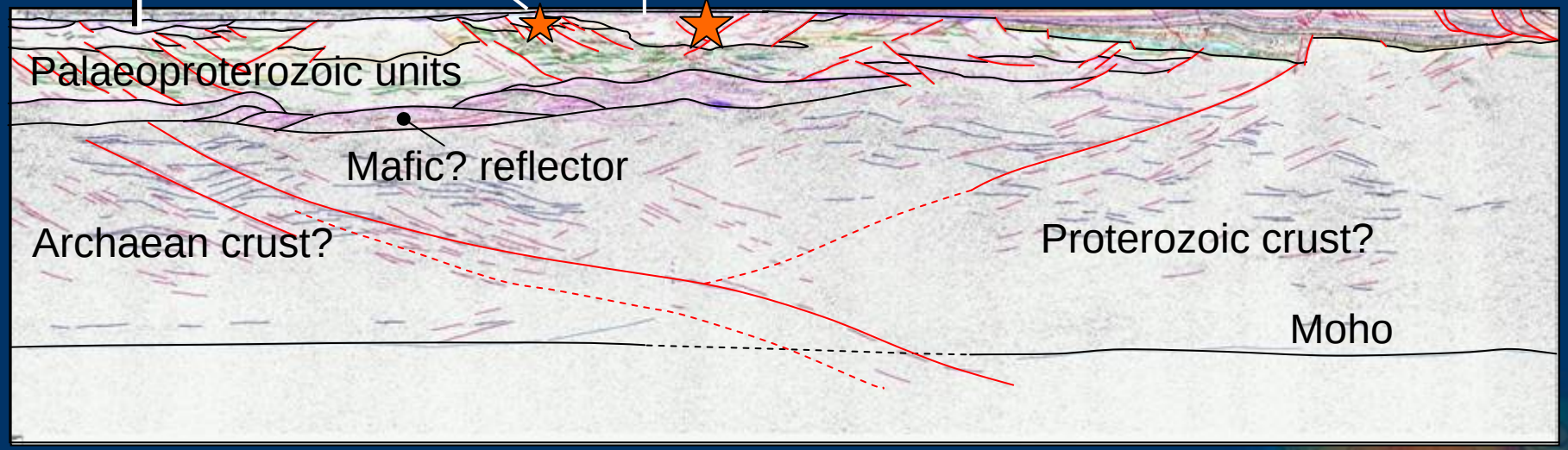
- *IOCG associated with high-temp, A-type granites*
- *Au associated with I-types*

- *Recognised thermal structure to ~1590 Ma crust*
- *Predictive product from empirical relationships*

Seismic Imaging of Crustal Architecture

– controls on mineralising systems

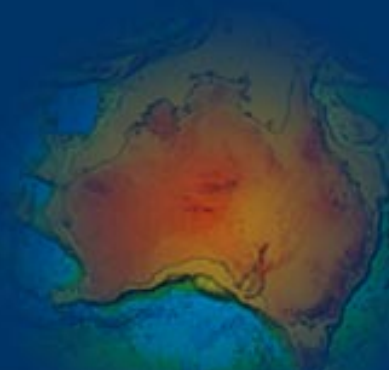
IOCG-U plays

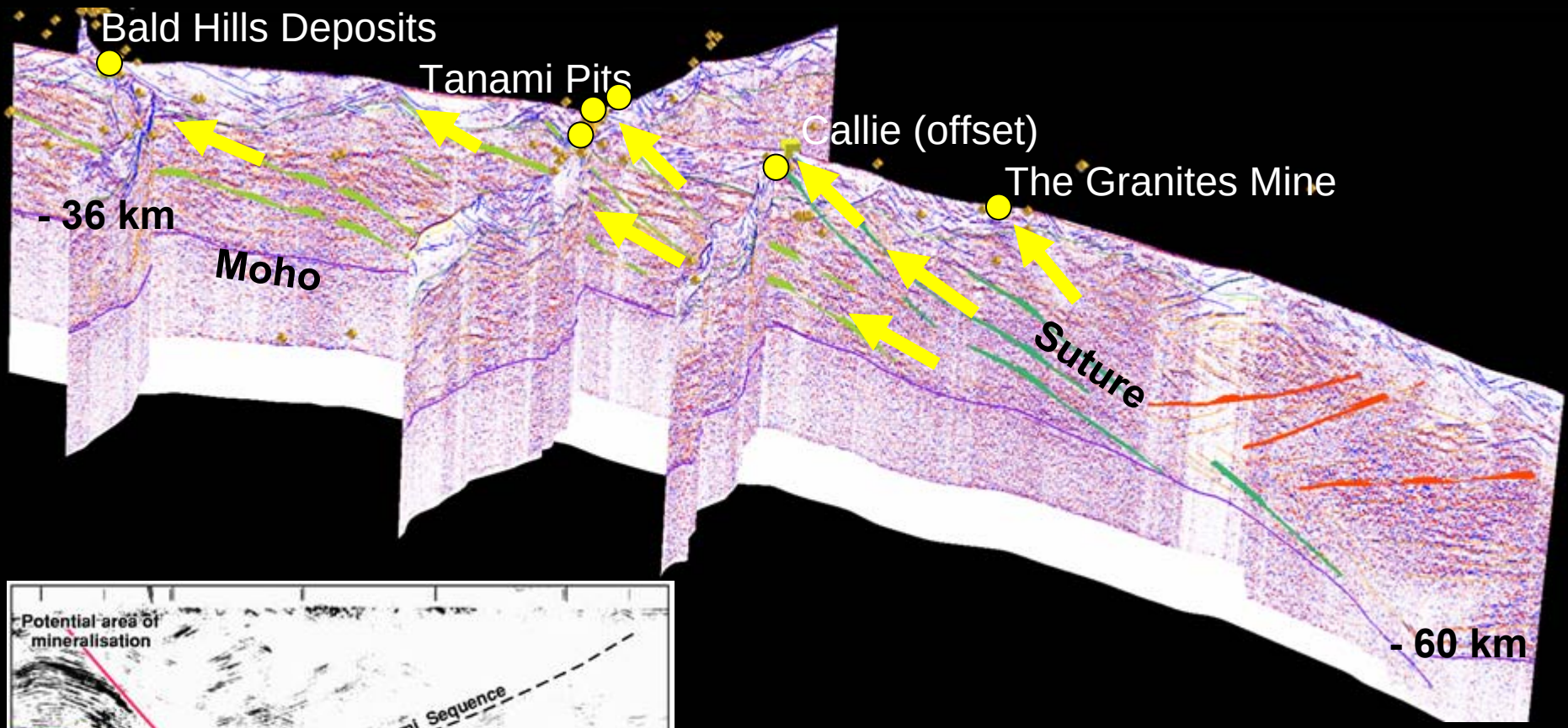


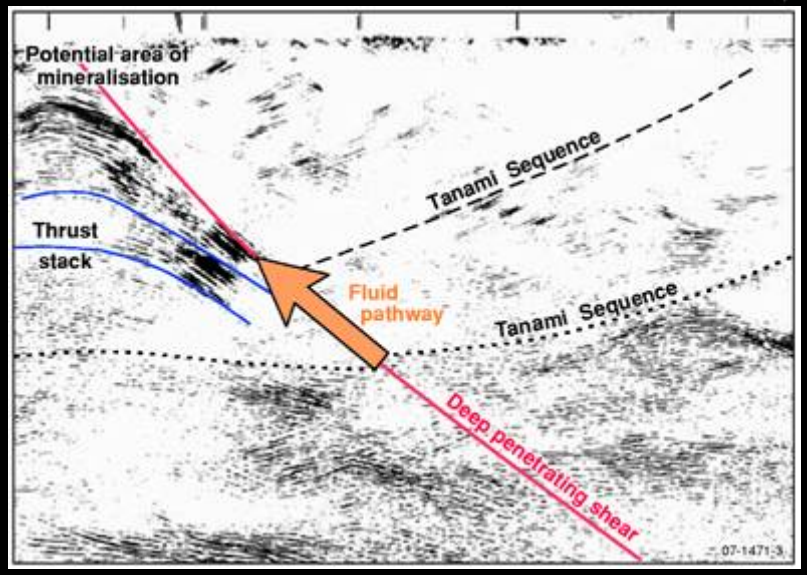
Olympic Dam above suture

Tanami project
(NTGS, GSWA, GA)

- World class Callie gold dep 7Moz, + others
- Area of very sparse outcrop
- Aim: Identify major structural controls on known gold deposits
- Solid geology, regional cross sections, seismic, isotope geochemical discriminant of favourable hosts





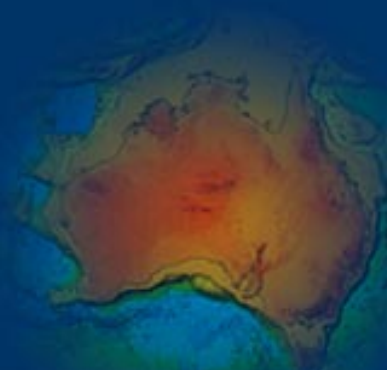


- Structures imposed on middle and lower crust appear to control structures within the upper crustal Tanami Group.
- Changes in depth to Moho appear to control location of deep penetrating shear zones.

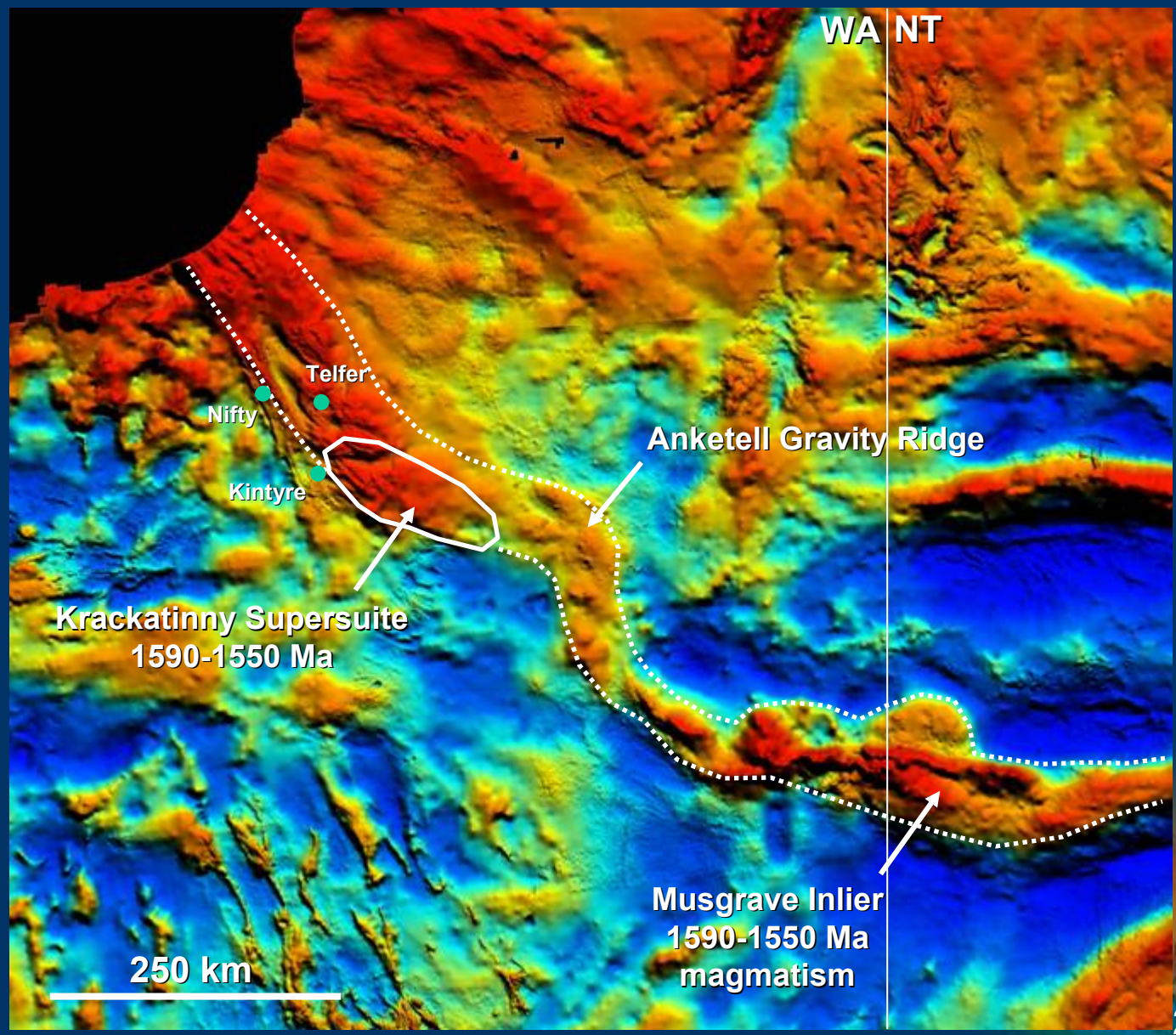
Paterson Project
(GSWA & GA)

- Aim – improve on the minimal documentation of a poorly understood but endowed province (includes Telfer, Kintyre, Nifty)
- Project – Acquired magnetics, gravity, geochronology, geochemistry
- Future AEM, seismic

- Outcomes – first identified 1590-1550Ma igneous rocks in WA
- Links to continent-wide event
- Identified possible rift event



Paterson Province
1590-1550 Ma magmatism



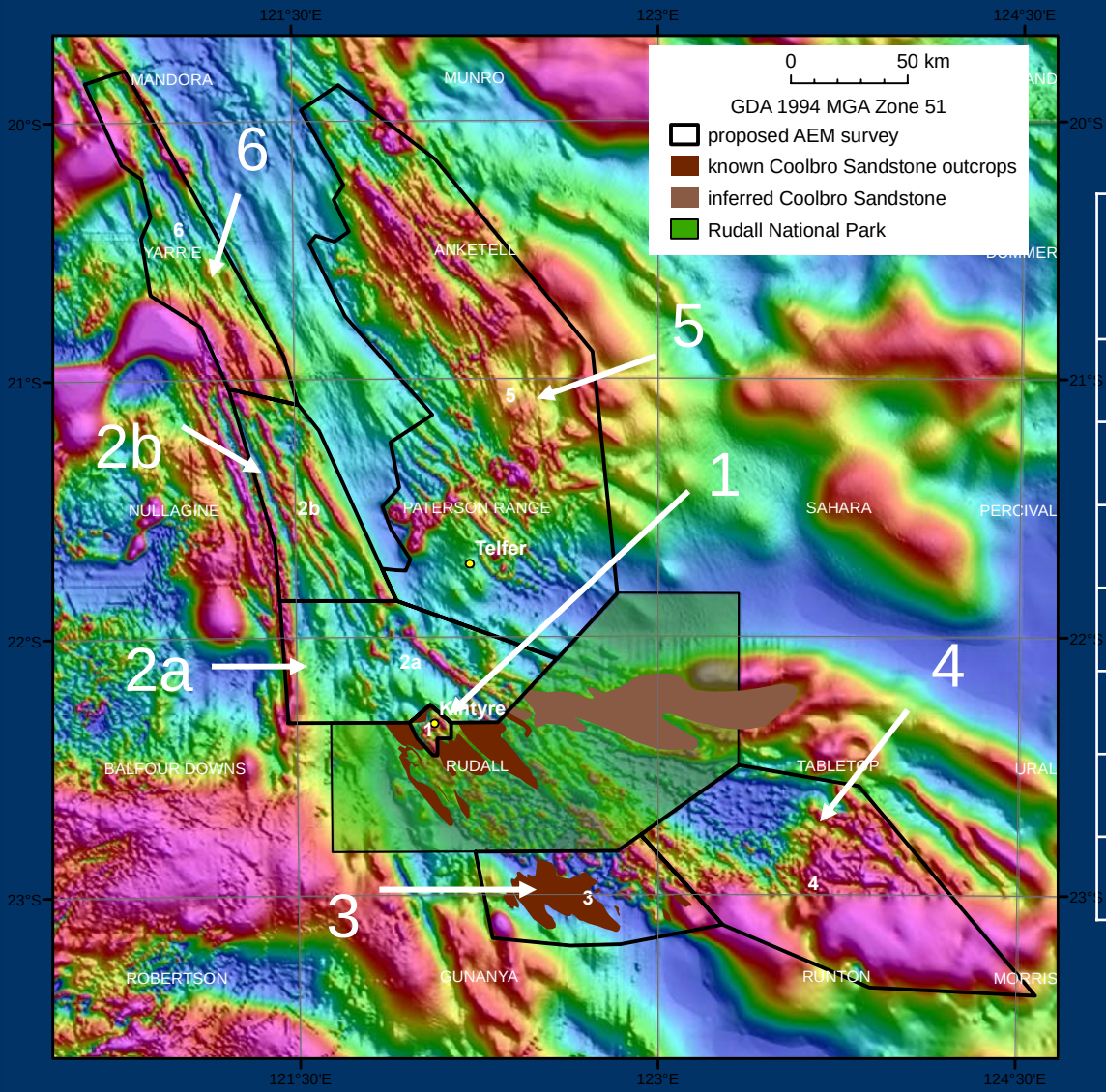
Newly-recognised 1590-1550 Ma bimodal Krackatinny Supersuite in Tabletop Terrane of Rudall Complex.

Mineral potential essentially untested.

Links with Musgrave Inlier.

Tectonic setting subject of ongoing study → possibly a Mesoprot. rift?

Paterson Airborne EM Survey



Area #	Line Spacing	Line kms
1	0.5	436
2a	1	4,825
2b	1	3,353
3	1	3,462
4	2	4,418
6	2	3,827
5	2	8,888

Proterozoic Synthesis Project

GEODYNAMICS

TECTONIC SETTINGS +
MINERALS-SYSTEMS

Prediction

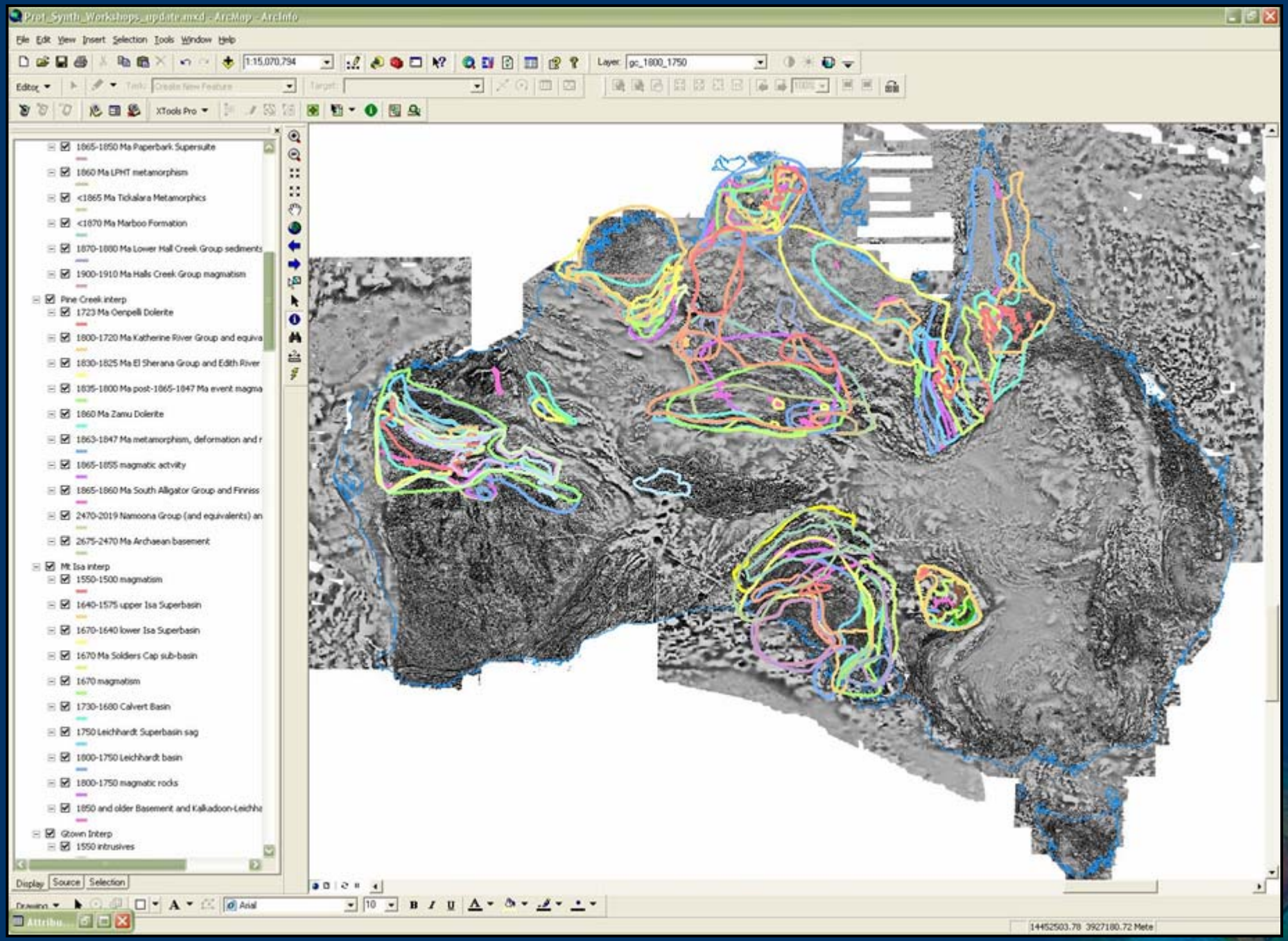
AREA SELECTION

DISTRICT

CAMP

PROSPECT

Detection


Prot_Synth_Workshops_update.mxd - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
1:15,070,794
Layer: gc_1800_1750
Editor
XTools Pro
1865-1850 Ma Paperbark Supersuite
1860 Ma LPHT metamorphism
<1865 Ma Tickalara Metamorphics
<1870 Ma Marboo Formation
1870-1880 Ma Lower Hall Creek Group sediments
1900-1910 Ma Halls Creek Group magmatism
Pine Creek interp
1723 Ma Oenpelli Dolerite
1800-1720 Ma Katherine River Group and equiva
1830-1825 Ma El Sherana Group and Edith River
1835-1800 Ma post-1865-1847 Ma event magma
1860 Ma Zamu Dolerite
1863-1847 Ma metamorphism, deformation and r
1865-1855 magmatic activity
1865-1860 Ma South Alligator Group and Finniss
2470-2019 Namoona Group (and equivalents) an
2675-2470 Ma Archaean basement
Mt Isa interp
1550-1500 magmatism
1640-1575 upper Isa Superbasin
1670-1640 lower Isa Superbasin
1670 Ma Soldiers Cap sub-basin
1670 magmatism
1730-1680 Calvert Basin
1750 Leichhardt Superbasin sag
1800-1750 Leichhardt basin
1800-1750 magmatic rocks
1850 and older Basement and Kalkadoon-Leichha
Gtown Interp
1550 intrusives
Display Source Selection
Drawing
Arial
10
14452503.78 3927180.72 Mete

Example – Curnamona

Event/domain	Tectonic setting	Metals	Mineral-system	Comment
Lower Willyama	Extensional (back-arc or rift?)	Au, Ag, Cu	Epithermal AuAg	
Basso Suite	Extensional (back-arc or rift?)	Au, Ag, Cu	Epithermal AuAg	
Alma Suite	Extensional (back-arc or rift?)	Sn, W, Mo, Ta?	Intrusion related SnWMo (skarn/greisen?)	
BHG-S sediments	Extensional (back-arc or rift?)	Ag, Zn, Pb	Stratabound Pb-Zn (BHT)	Thick BH, thin Olary
1700-1680 Bimodal mag	Extensional (back-arc or rift?)	Ag, Zn, Pb	Stratabound Pb-Zn (BHT)	thin crust, metamorphism?
Paragon	Sag?	Ag, Zn, Pb?	Stratabound Pb-Zn?	Change of provenance (primitive source)
1590 felsic syn-orogenic magmatism	Compressional orogen; intracont?		Intrusion related SnWMo (skarn/greisen?)	S-type (Mundi Mundi)
1590 felsic post-orogenic magmatism	Compressional then extensional?	Cu, Au, Mo, Ag, U	IOCG(U)	I-type (Crockers, Plumbago, Benagerie)
Olarian Orogeny	Fold and thrust belt	Au	Orogenic Au, northern Curnamona	1600-1580 metamorphism, 1620?
1555 magmatism	?	Cu-Au, U	IOCG, U, REE	LREE enriched

Ministerial Statement to Parliament on Energy Initiatives
14 August, 2006

" The Government will also commit an additional $58.9 million over five years to identify onshore energy sources such as petroleum and geothermal energy."

The Hon John Howard MP

Plan for the Energy Initiative

Aug 2006 now

June 2011

AWAGS 2, NGSA

Geothermal Project

Onshore Petroleum Project

Uranium Project, Thorium Project

National

TOOLS:
Seismic
AEM
MT
Radiometrics
Mags
Gravity
Geological synthesis
Geochemistry
Geochronology
Drilling
IM

Georgetown-Isa Project

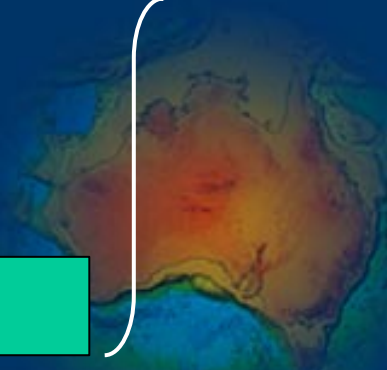
Gawler-Curnamona Project

Northern WA Project

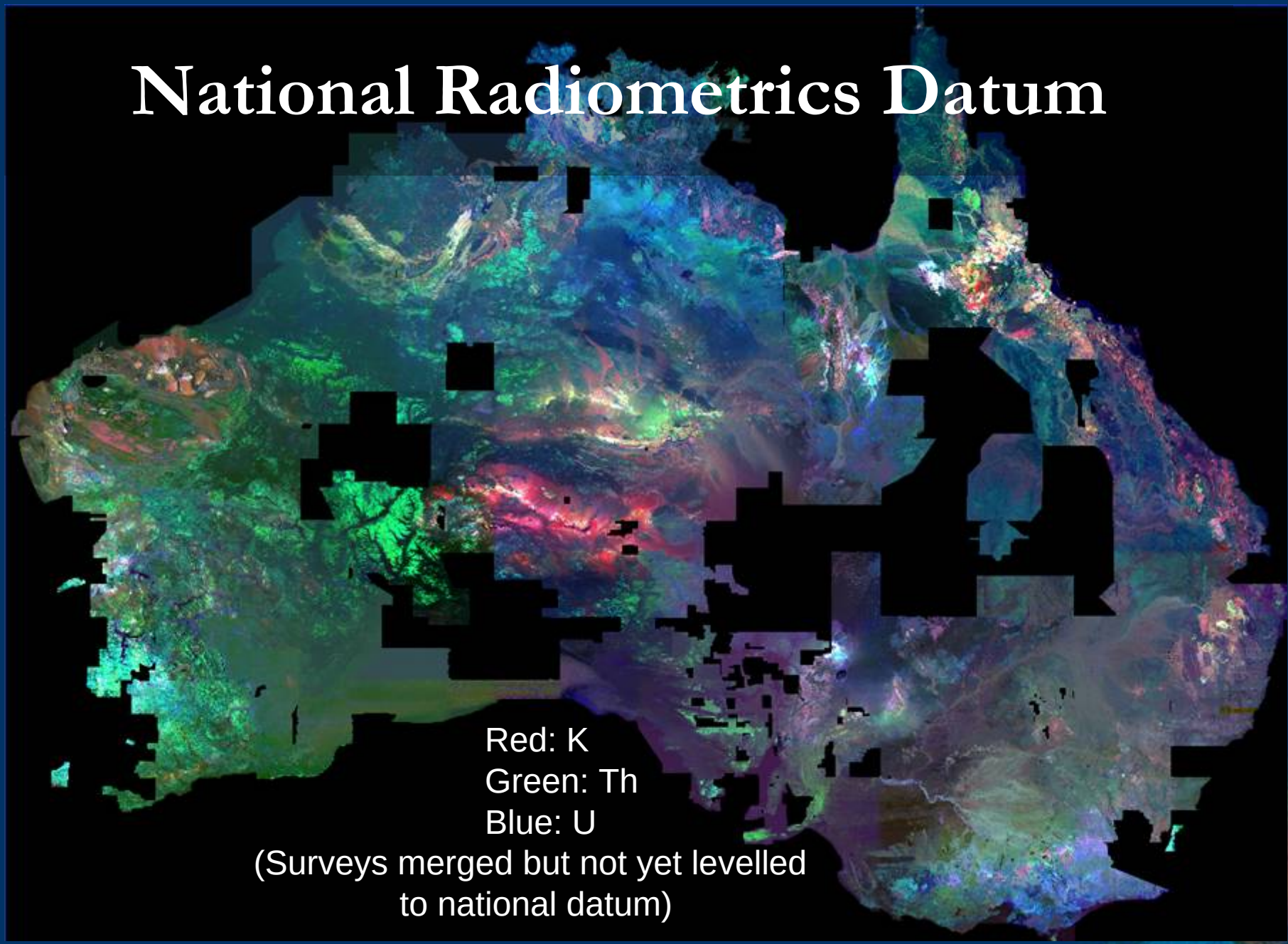
Northern Territory Project

New Projects

Regional

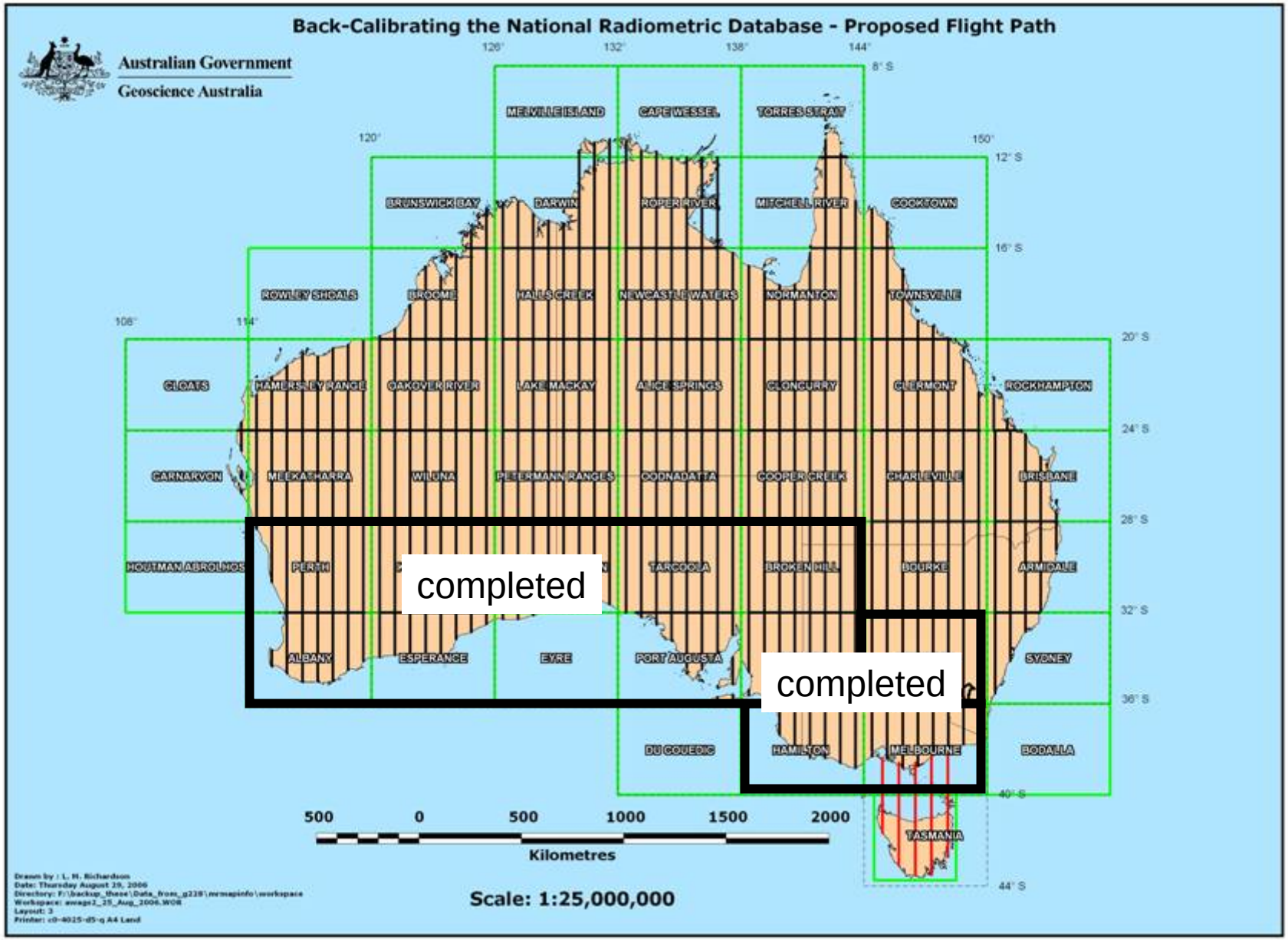


National Radiometrics Datum



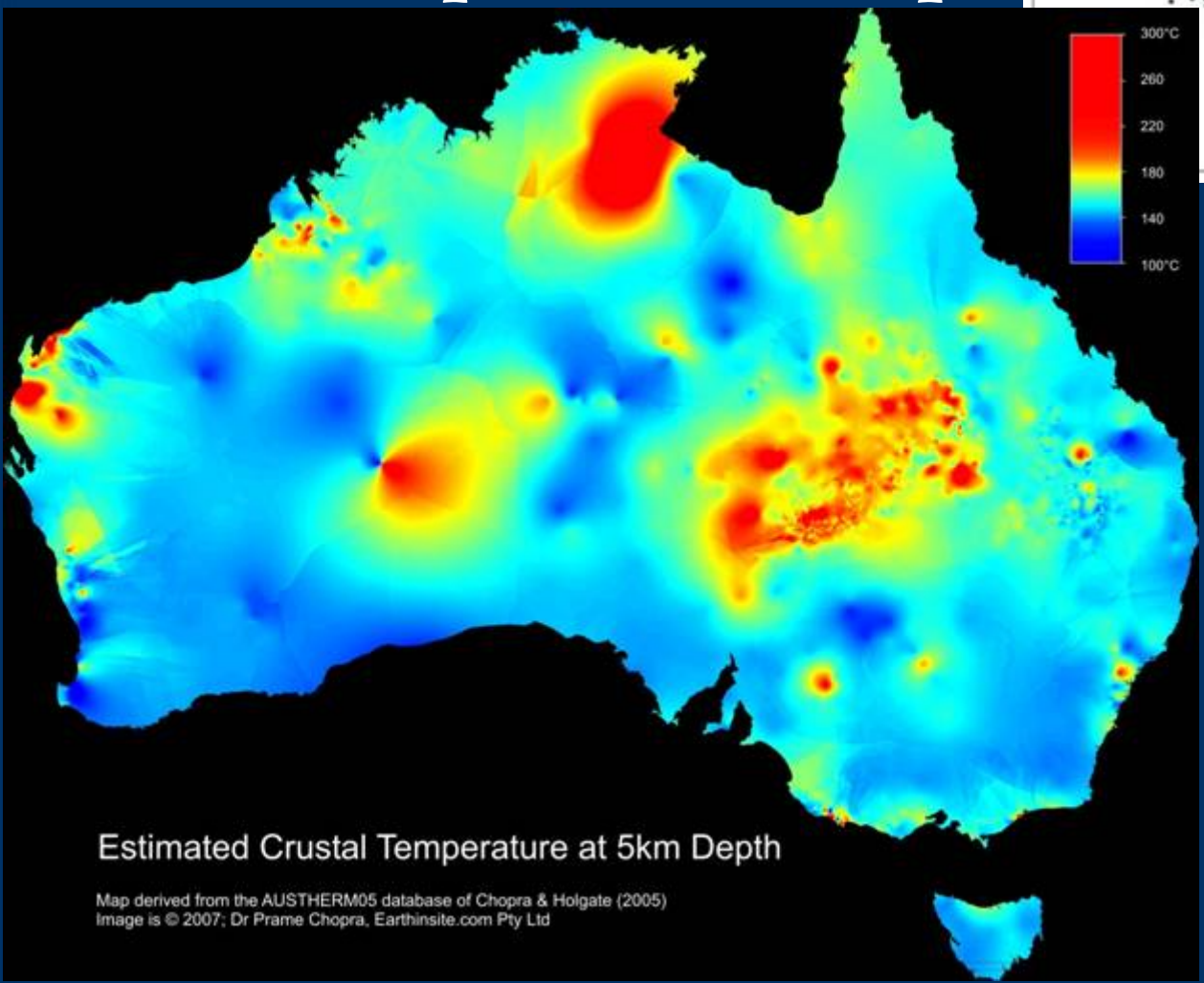
Red: K
Green: Th
Blue: U
(Surveys merged but not yet levelled to national datum)

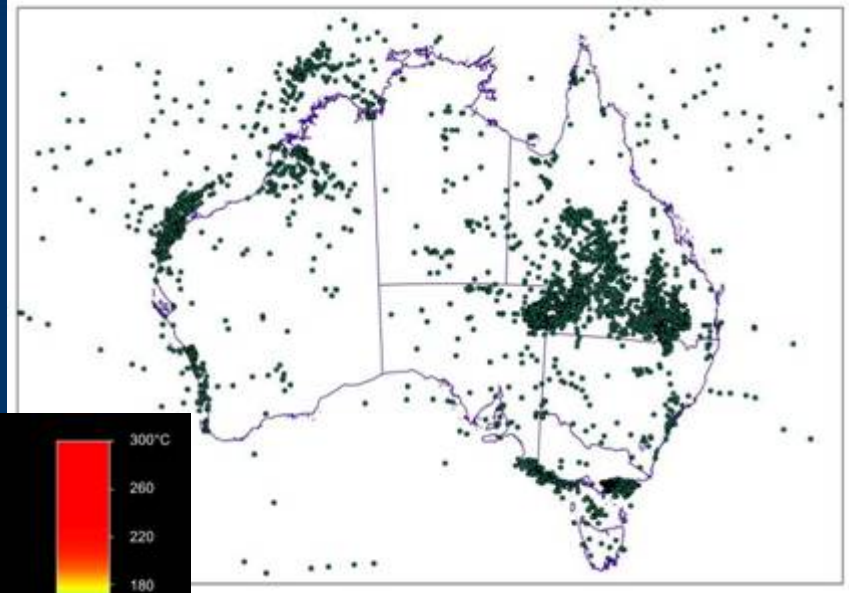
National Radiometrics Datum



Geothermal Project

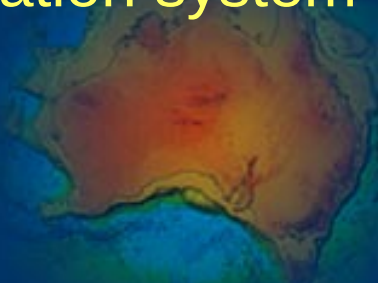
5km Temperature Map





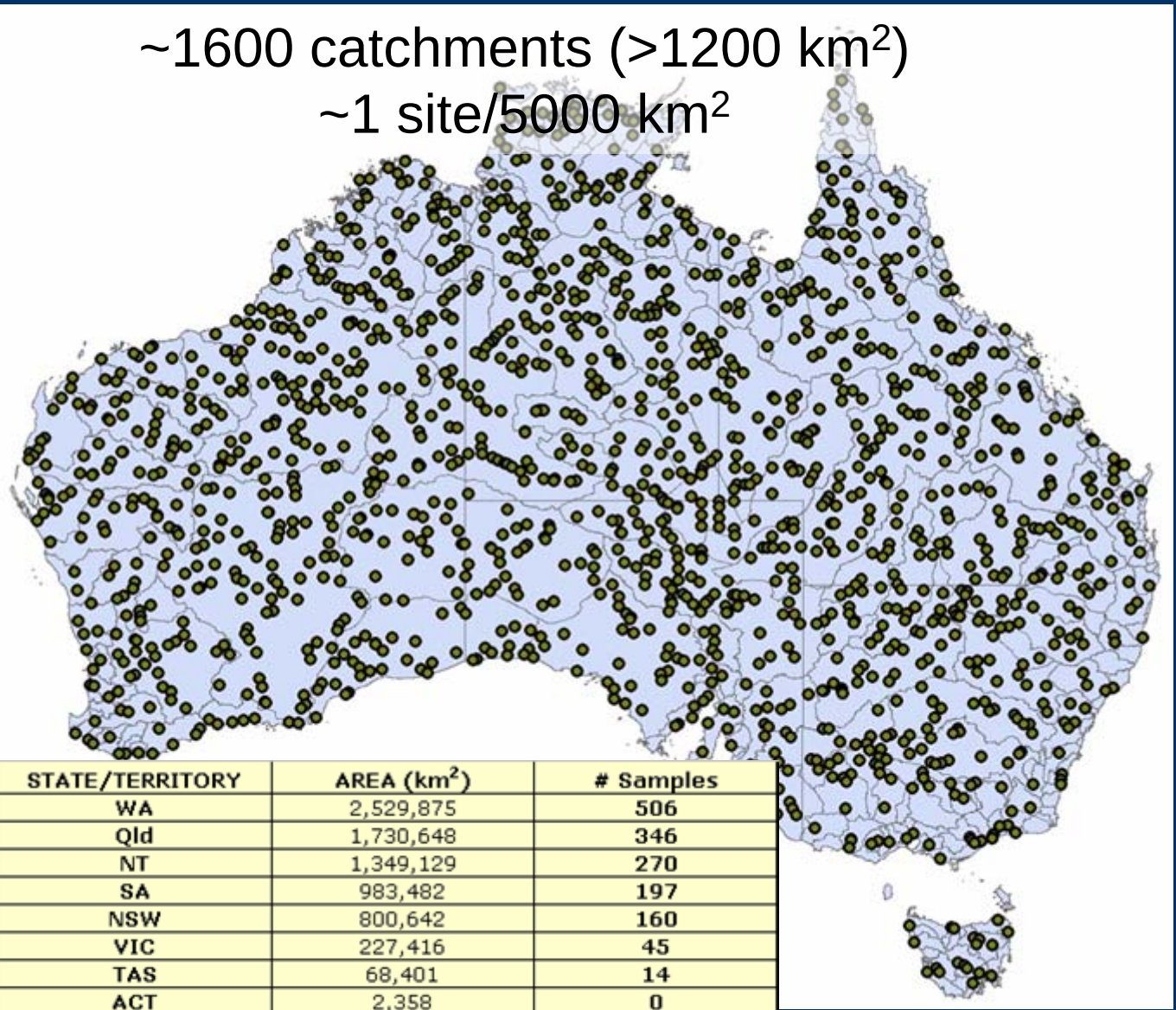
Outputs:

- Map HHP granites
- New 5km map
- Gravity data
- Information system



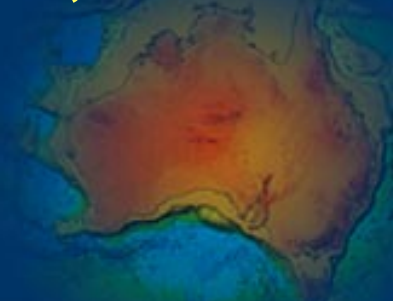
Baseline Geochemistry Survey

~1600 catchments (>1200 km^2)
~1 site/5000 km^2

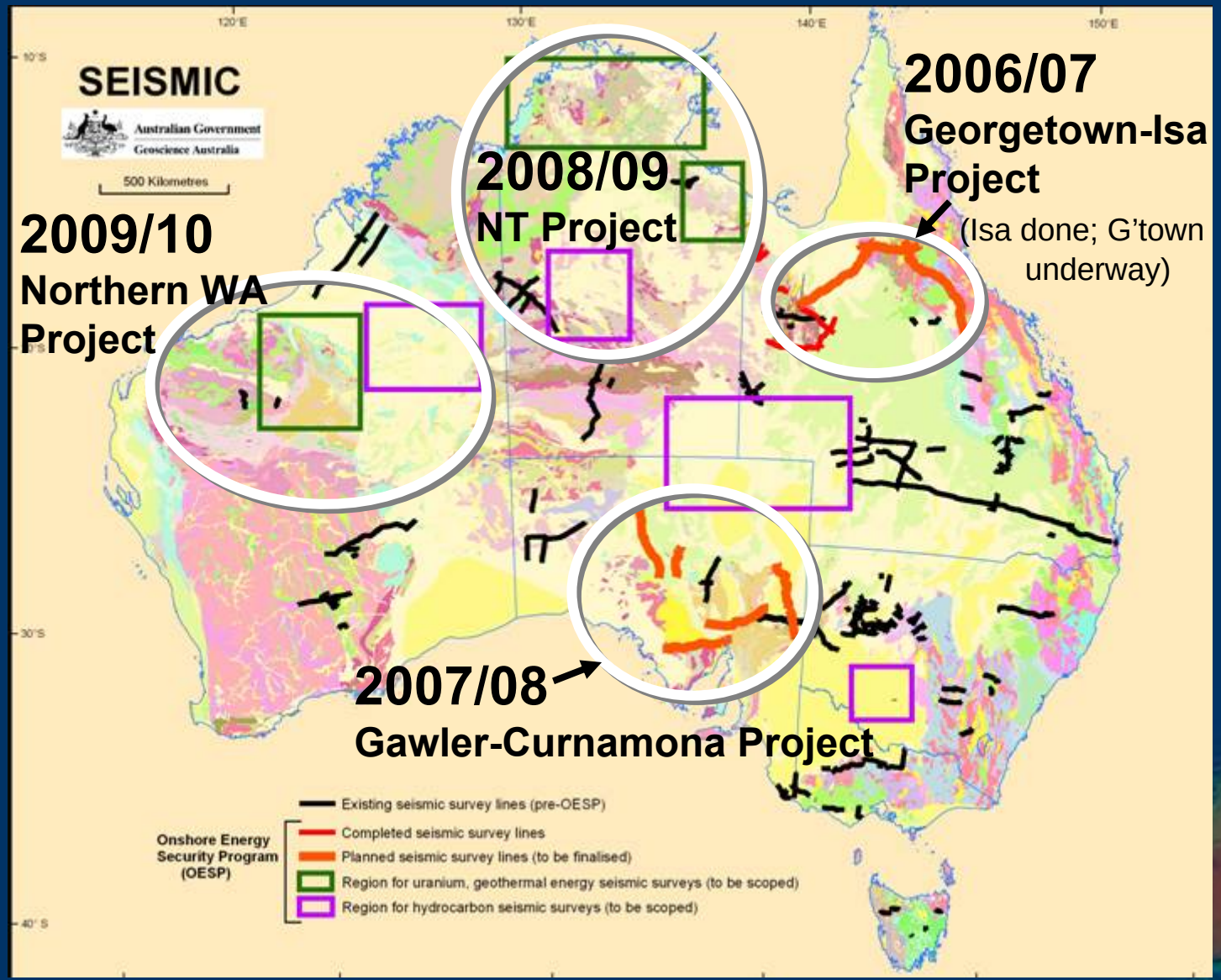


STATE/TERRITORY	AREA (km^2)	# Samples
WA	2,529,875	506
Qld	1,730,648	346
NT	1,349,129	270
SA	983,482	197
NSW	800,642	160
VIC	227,416	45
TAS	68,401	14
ACT	2,358	0
AUSTRALIA	7,692,024	1538

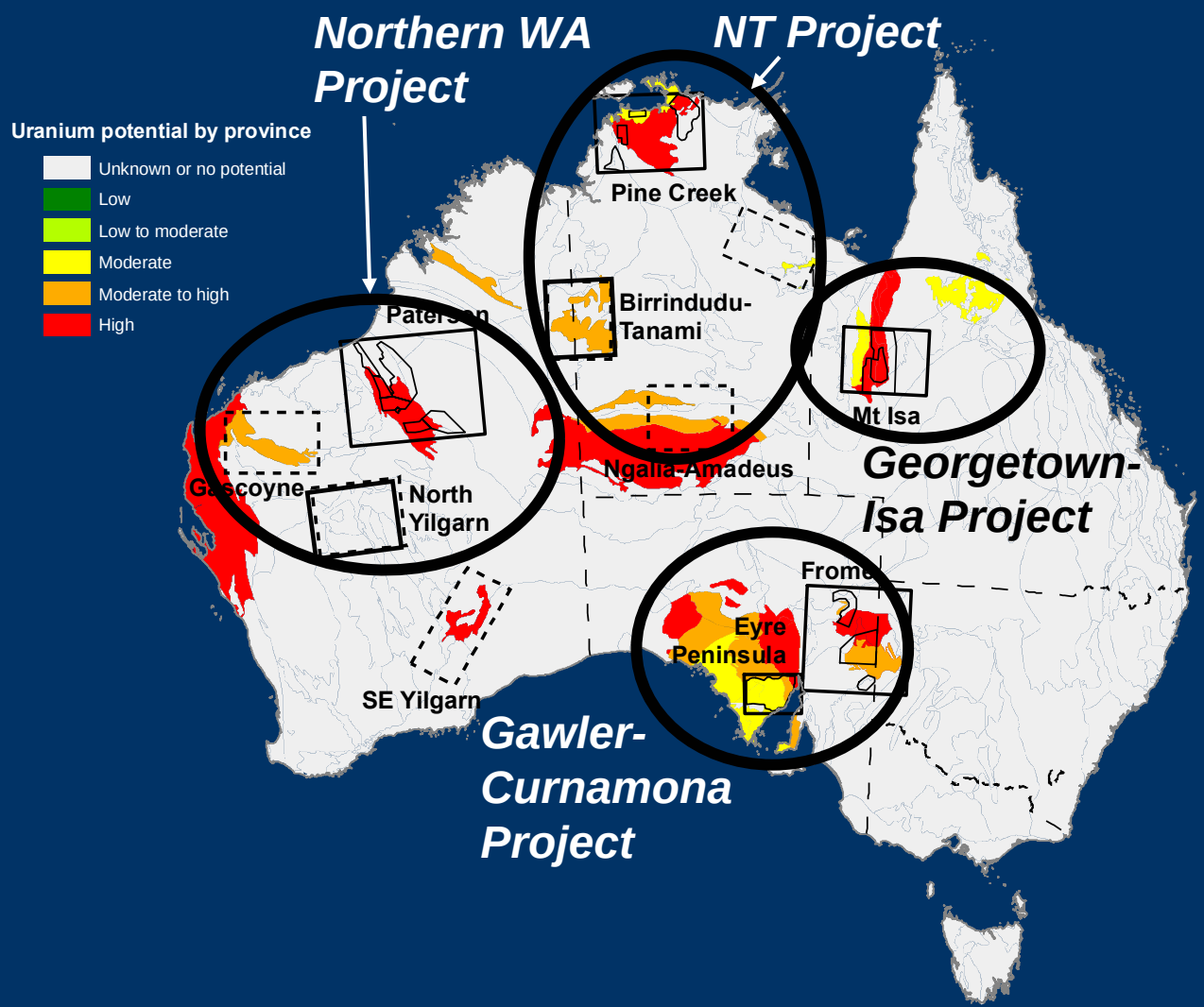
- **Sampling of transported regolith at outlets of ~1400 catchments**
- **Average density 1 site/~5000 km^2**
- **Samples at 2 depths (surface and ~80 cm)**
- **Whole rock analyses for 60+ elements incl. U, Th**



Regional Projects - seismic



AEM acquisition – paleochannel U, depth of cover, structure



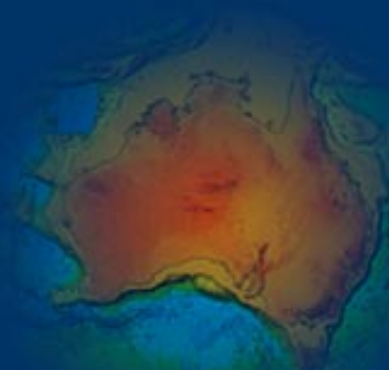
Planned AEM
- Paterson (June 07)

Proposed
- Frome
- Pine Creek

Possible
- Birrindudu/Tanami
- Eyre Peninsula
- Mt Isa
- Nth Yilgarn
- Gascoyne
- Westmoreland
- Amadeus-Ngalia
- Sth Yilgarn

Products for Mineral Explorers

- Seismic data, sections and interpretation
- 2D predictive maps; regional and national scale
- 3D maps of crustal structure & basin architecture,
- New mineral systems understanding
- GIS products with mineral systems criteria attributes
- Reports and publications



Summary