



Australian Government
Geoscience Australia

Uranium Systems Project: new results from Geoscience Australia

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Outline

- Overview of Onshore Energy Security Program (OESP): the framework for GA's work on uranium.
- OESP and Uranium Systems Project update:
 1. Uranium deposit models re-evaluation
 2. Continental scale results: U distribution (radiometrics, geochemistry)
 3. Regionally targeted 3D mapping of U systems (AEM, seismic, Frome numerical modelling)

GA's Five Year Onshore Energy Security Program (OESP)

- **\$59 million Fed. Govt. OESP (2006-2011), jointly with States, NT:**
 - Onshore hydrocarbons, uranium, thorium, geothermal energy.
 - New precompetitive data to assess potential for energy resources and to reduce risk in exploration.
- **National and regional scope:**
 - Multidisciplinary, holistic approach to mapping energy & mineralising systems.
 - Continental and targeted regional data acquisition.
 - Greenfields focus; predictive products.



Onshore Energy Security Program

Aug 2006

July 2007

June 2011

Geothermal Project

METHODS:

Seismic

AEM

MT

Radiometrics

Mags

Gravity

Geological

synthesis

Geochemistry

Geochronology

Drilling

IM

Onshore Petroleum Project

Uranium Systems Project

National Geochemical Survey of Australia

Mt Isa-Georgetown project

Gawler-Curnamona project

Northern Territory project

Northern WA project

PRODUCTS

Seismic, AEM,
geochem data

3D geology
maps

Basin &
basement
architecture
& evolution

Heatflow &
uranium
distribution

Alteration
mapping

Models
(conceptual,
predictive)

**National
Projects**

**Regional
studies**

Uranium Systems Project

Three Objectives (2007-2011):

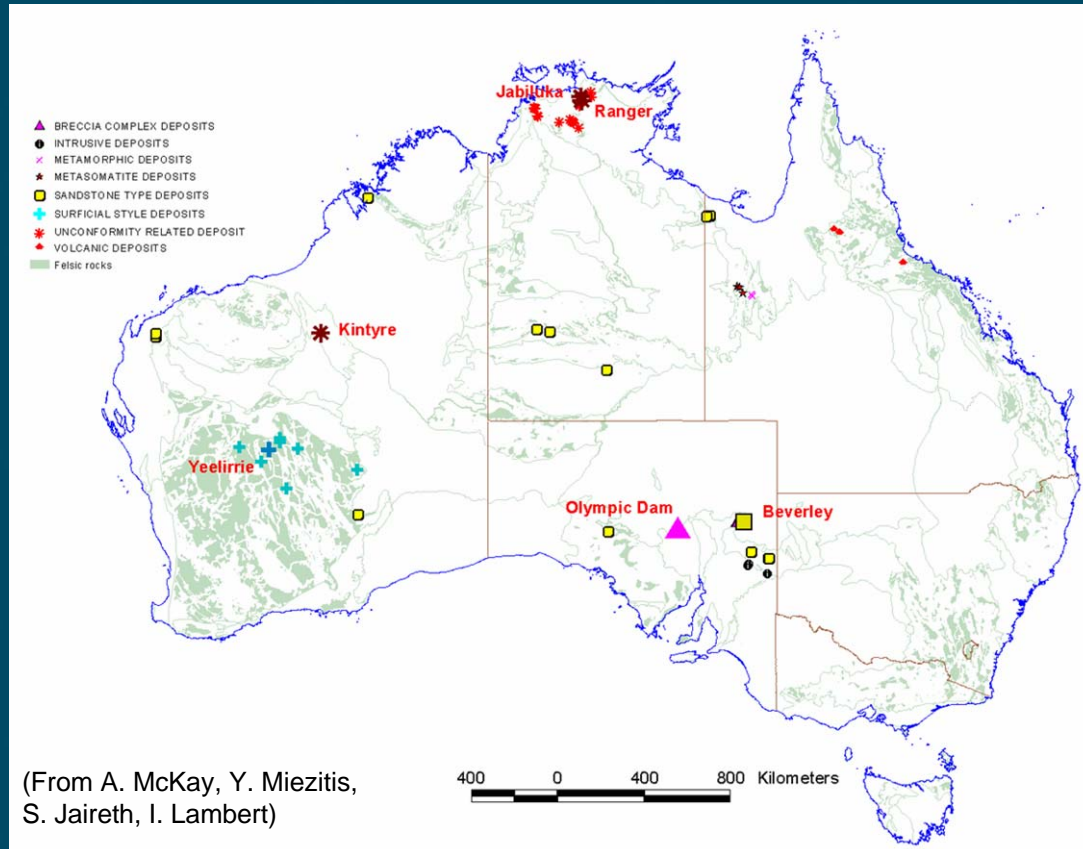
1. Re-evaluate models and develop new understandings of *processes* in U mineral systems. } "How"
2. Deliver continental scale information on U distribution and potential. }
3. Deliver regionally targeted datasets to reduce risk in uranium exploration (with OESP team and State, NT partners). } "Where"

1. MODELS & PROCESSES IN URANIUM MINERAL SYSTEMS

A RE-EVALUATION

Uranium deposit classification

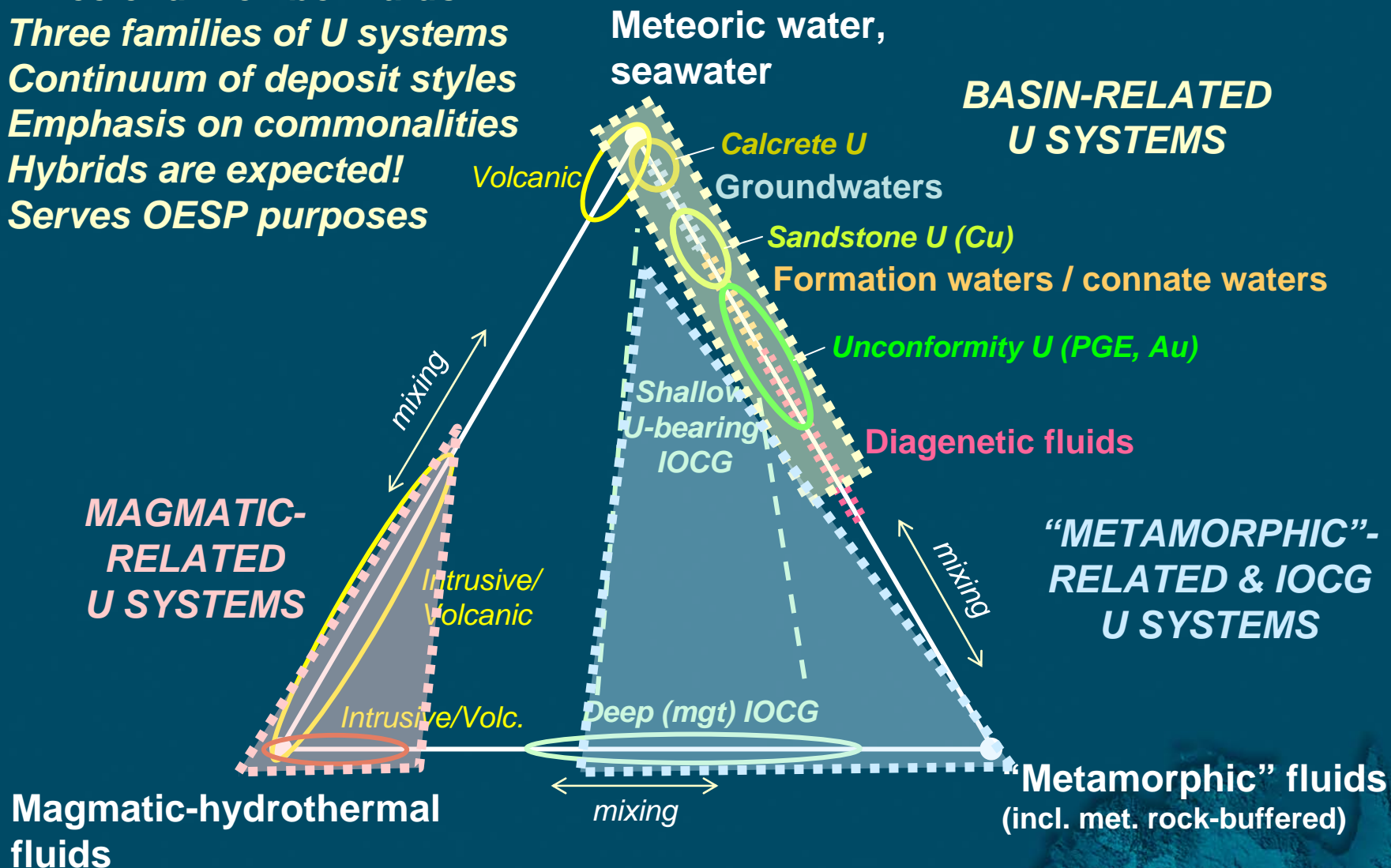
IAEA Red Book



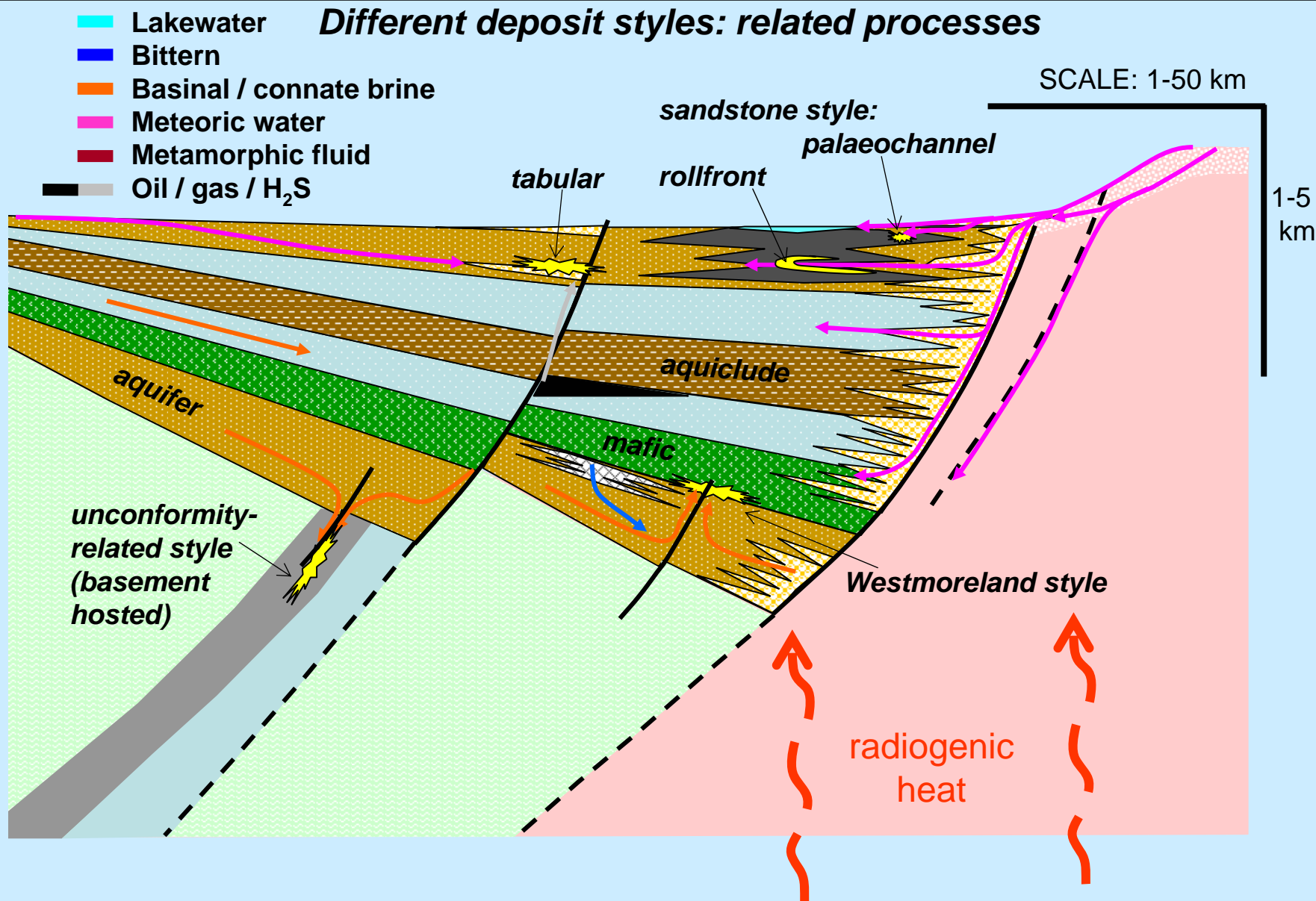
- Breccia complex (IOCG)
- Unconformity-related
- Sandstone
- Surficial
- Metasomatite
- Metamorphic
- Volcanic
- Intrusive
- Vein
- Quartz-pebble conglomerate
- Collapse breccia pipe
- Phosphorite
- Lignite
- Black shale

AN ALTERNATIVE VIEW: URANIUM MINERAL SYSTEMS

- *Three end-member fluids*
- *Three families of U systems*
- *Continuum of deposit styles*
- *Emphasis on commonalities*
- *Hybrids are expected!*
- *Serves OESP purposes*



EXAMPLE 1. BASIN-RELATED URANIUM SYSTEMS



Basin-related Uranium Systems –

Key mappable regional criteria

and methods being applied in OESP

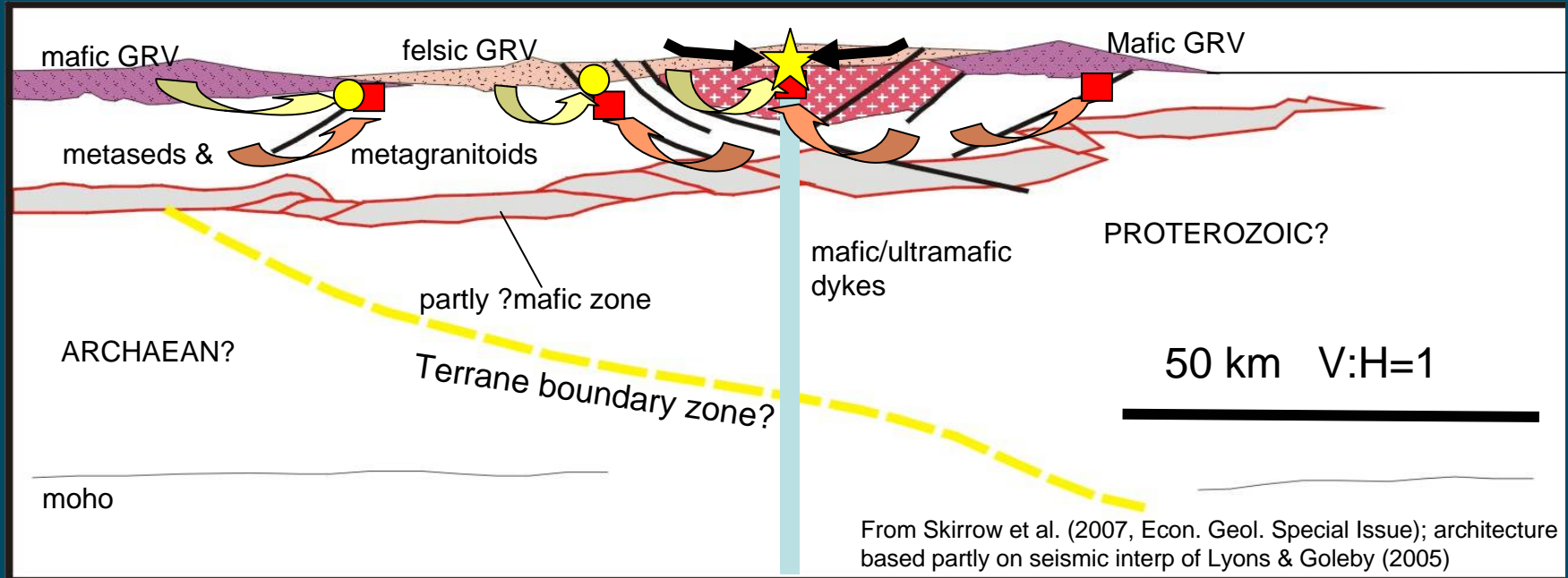
- Basin architecture (geometry of ‘container’, lithology, sequence stratigraphy, evolution)
 - ***AEM, seismic, basin/regolith analysis, geochron***
- Basement structure, lithology (e.g. reductants) & evolution
 - ***Geology, seismic, MT, mag, gravity, geochron***
- Evidence of fluid flow in U system (alteration, anomalous geochem, diagenetic history)
 - ***Geochem, radiometrics, petrology, geochron***
- U source (primary igneous, secondary/seds, etc)
 - ***Geochem, radiometrics, petrology***

EXAMPLE 2: IOCG URANIUM SYSTEM

Olympic Dam region reconstruction, 1575-1595 Ma

SW

NE



1. Hiltaba granite emplacement, unroofing
2. Magnetite alteration & low grade Cu (syn-orogenic, pre-syn volc); fluids leached Cu, S from metagranitoids, metaseds
3. Hematite alteration & Cu-U-Au (syn-post-volcanic, syn-extensional): Cu input at OD from mantle-derived + crustal sources; meteoric water input; U from granite host?

IOCG Uranium Systems –

Key mappable regional criteria

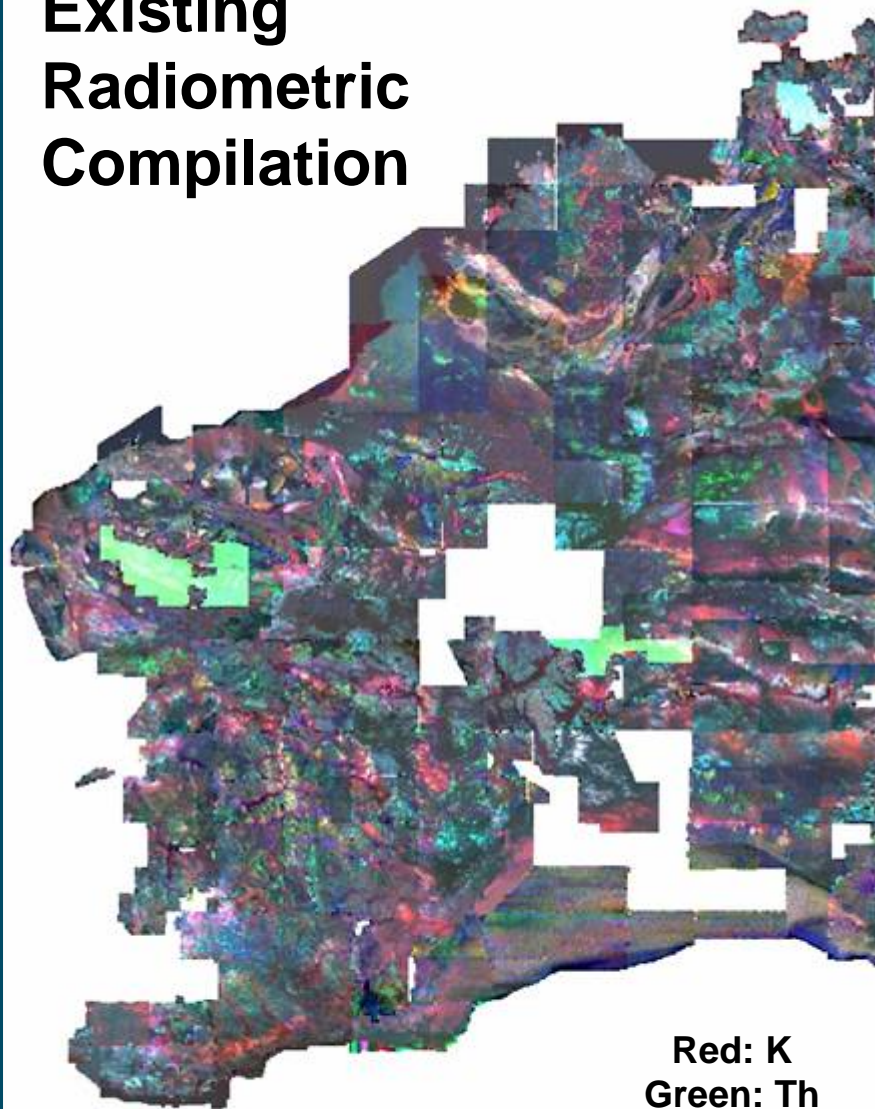
and methods being applied in OESP

- Crustal architecture (major breaks, craton margins), & evolution (multiple orogenies)
 - ***Basement geology, seismic, MT, mag, gravity, geochron***
- Evidence of fluid flow in IOCGU system (high- & low-T alteration, anomalous geochem)
 - ***Petrology, geochem, radiometrics, geochron***
- Magmatism (high-T) and U-Cu-Au sources
 - ***Geochem, petrology, geochron***

2. CONTINENTAL SCALE URANIUM DISTRIBUTION

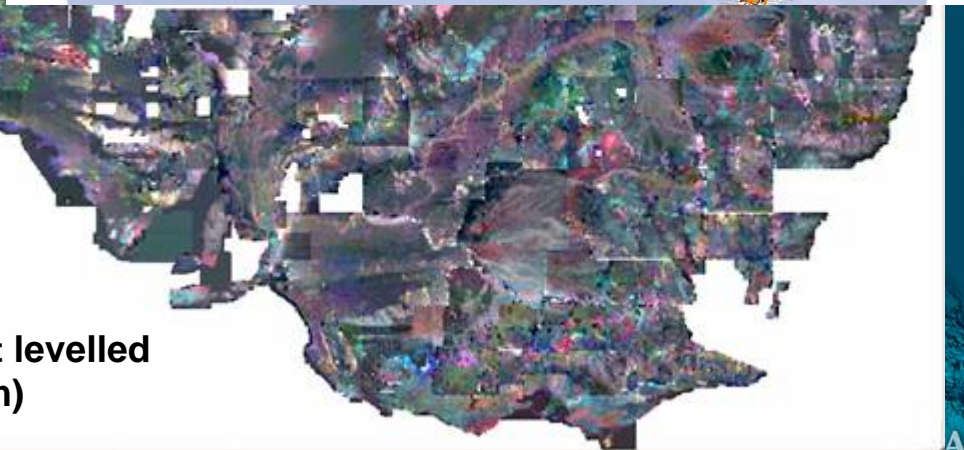
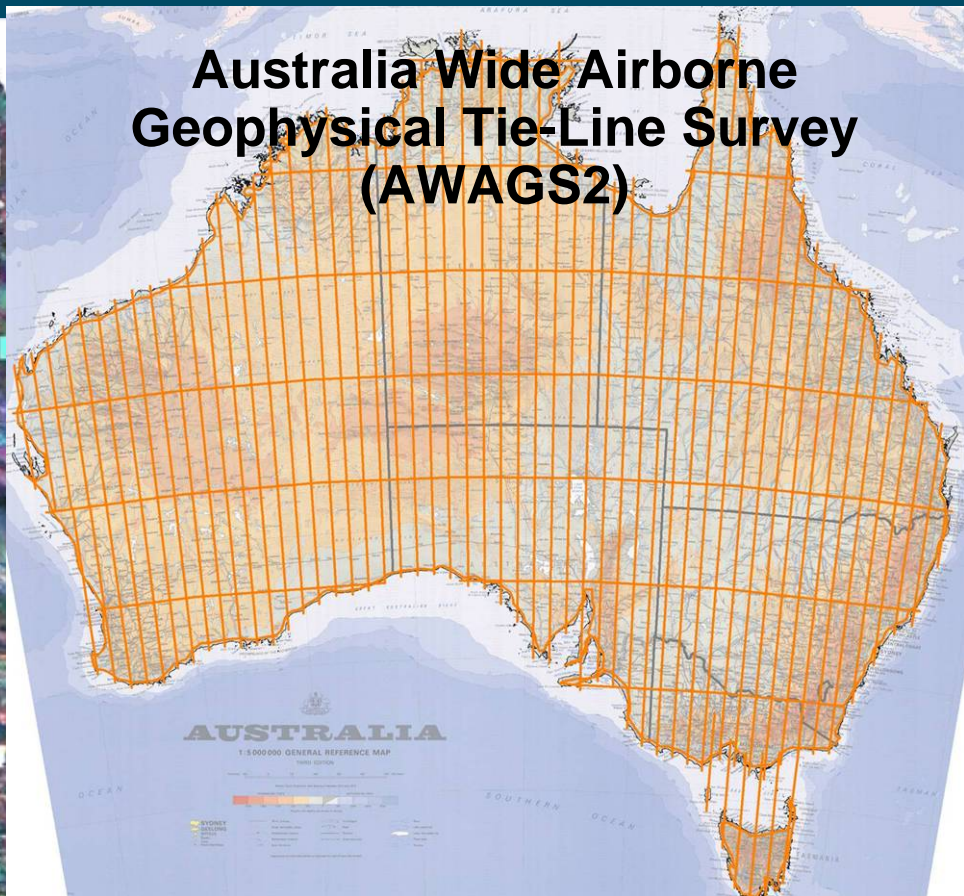
OESP AND URANIUM SYSTEMS PROJECT RESULTS

Existing Radiometric Compilation

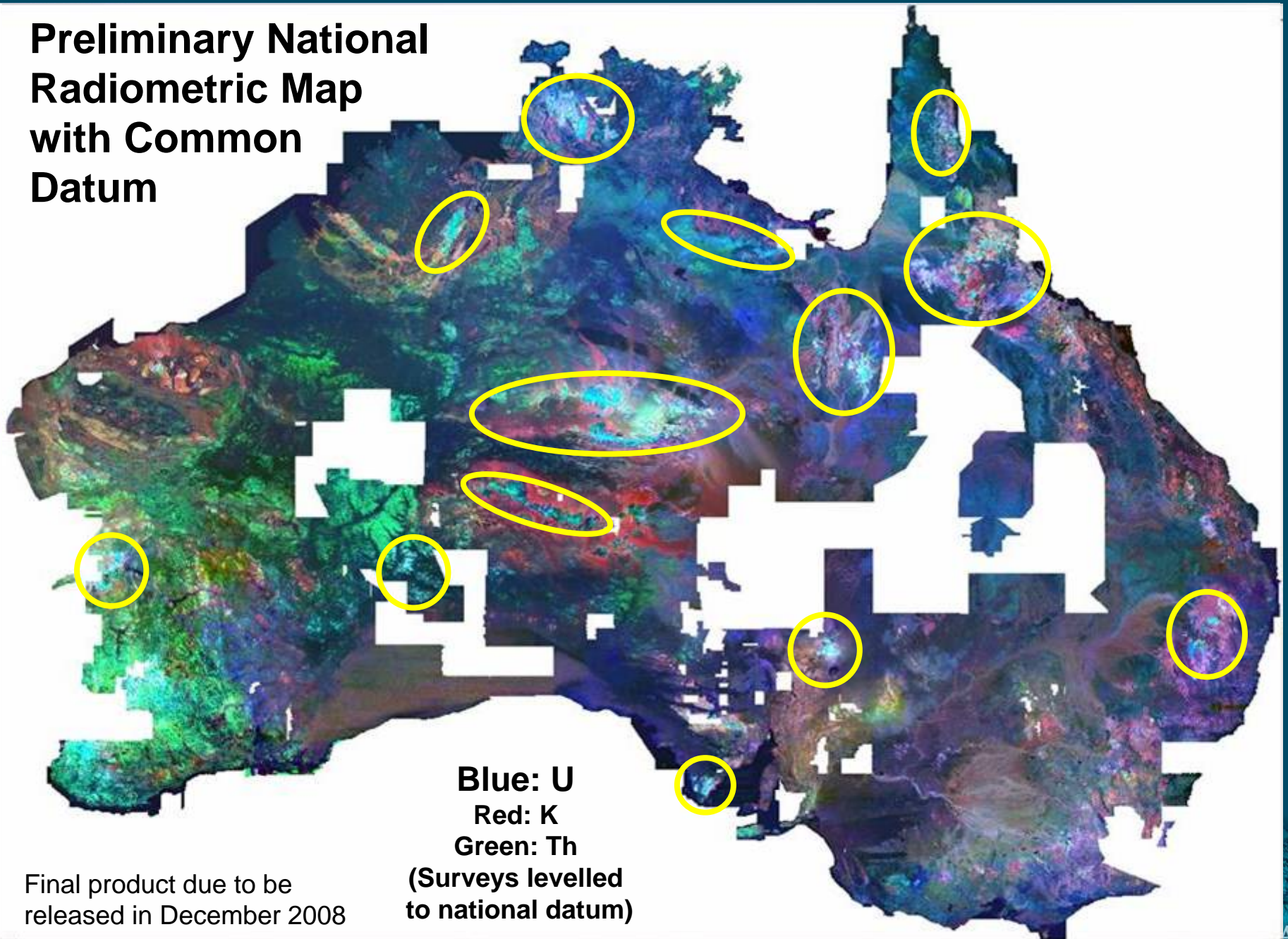


Red: K
Green: Th
Blue: U
(Surveys merged but not levelled
to national datum)

Australia Wide Airborne Geophysical Tie-Line Survey (AWAGS2)



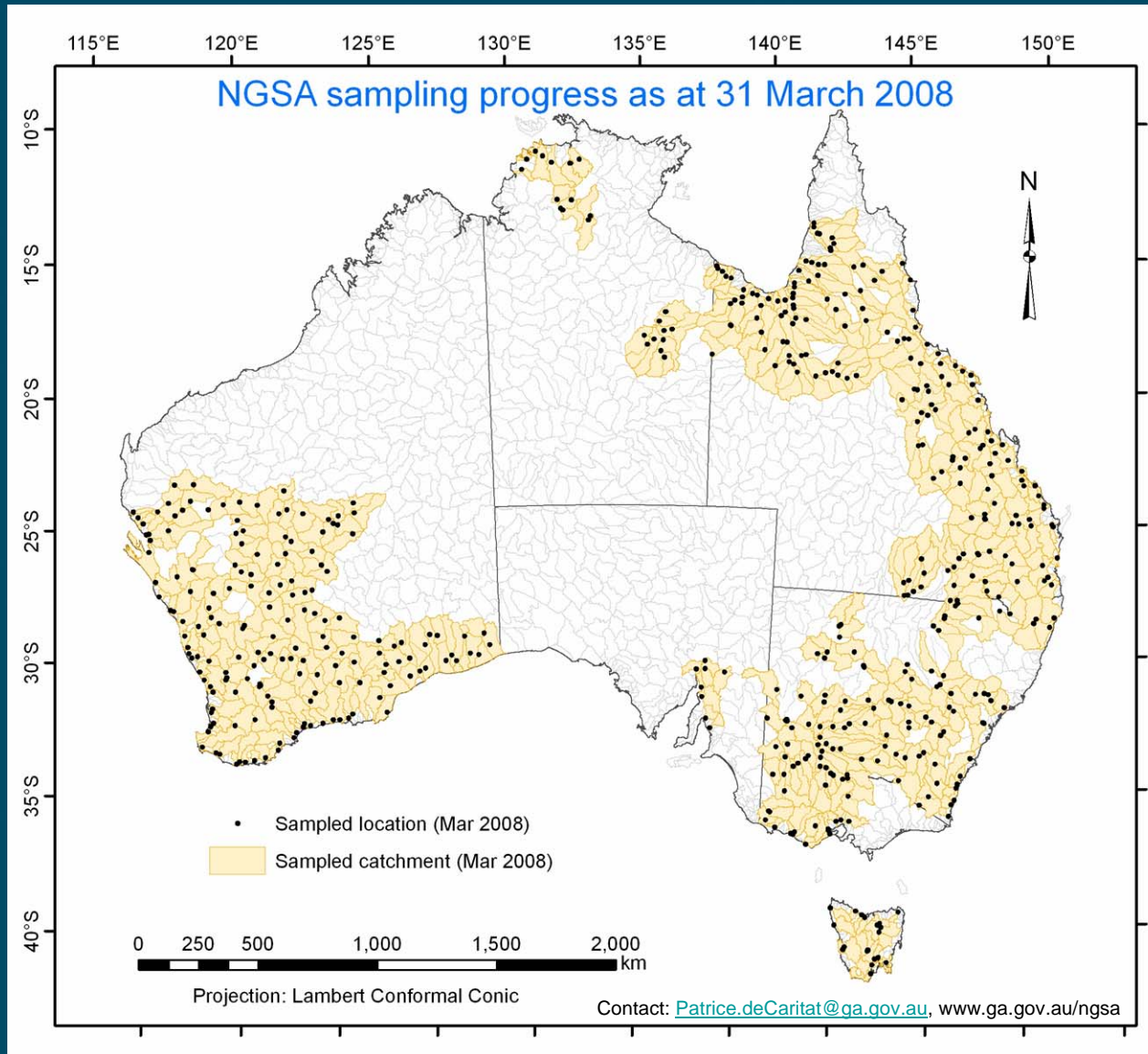
Preliminary National Radiometric Map with Common Datum



Blue: U
Red: K
Green: Th
(Surveys levelled to national datum)

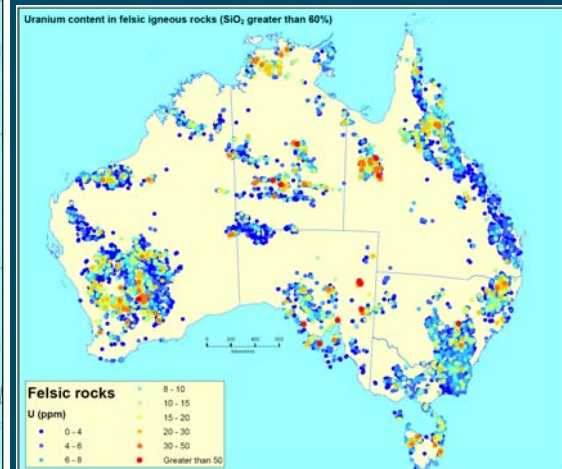
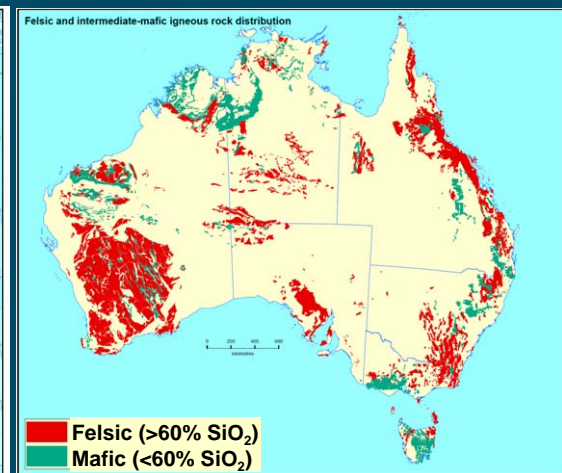
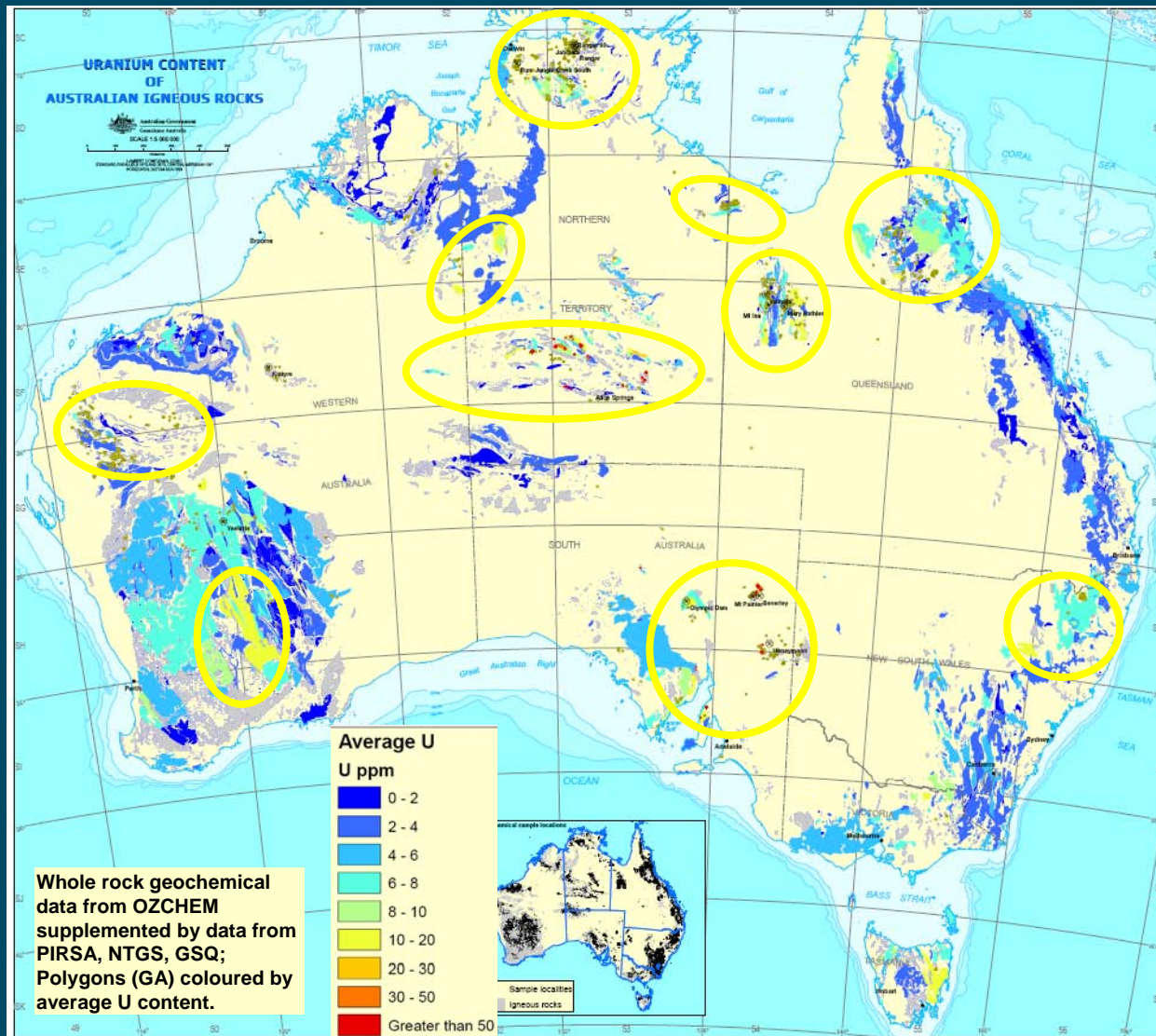
Final product due to be
released in December 2008

National Geochemical Survey of Australia



- Sampling of transported regolith at outlets of ~1400 catchments
- Average density 1 site/~5,500 km²
- Samples at 2 depths <10 cm & 60-80 cm
- Analyses for 60+ elements incl. U, Th
- Partnership with State/NT surveys

Uranium content of igneous rocks: *New map of potential U sources*



(Preliminary map by Anthony Schofield, Uranium Systems Project; see poster in GA booth)

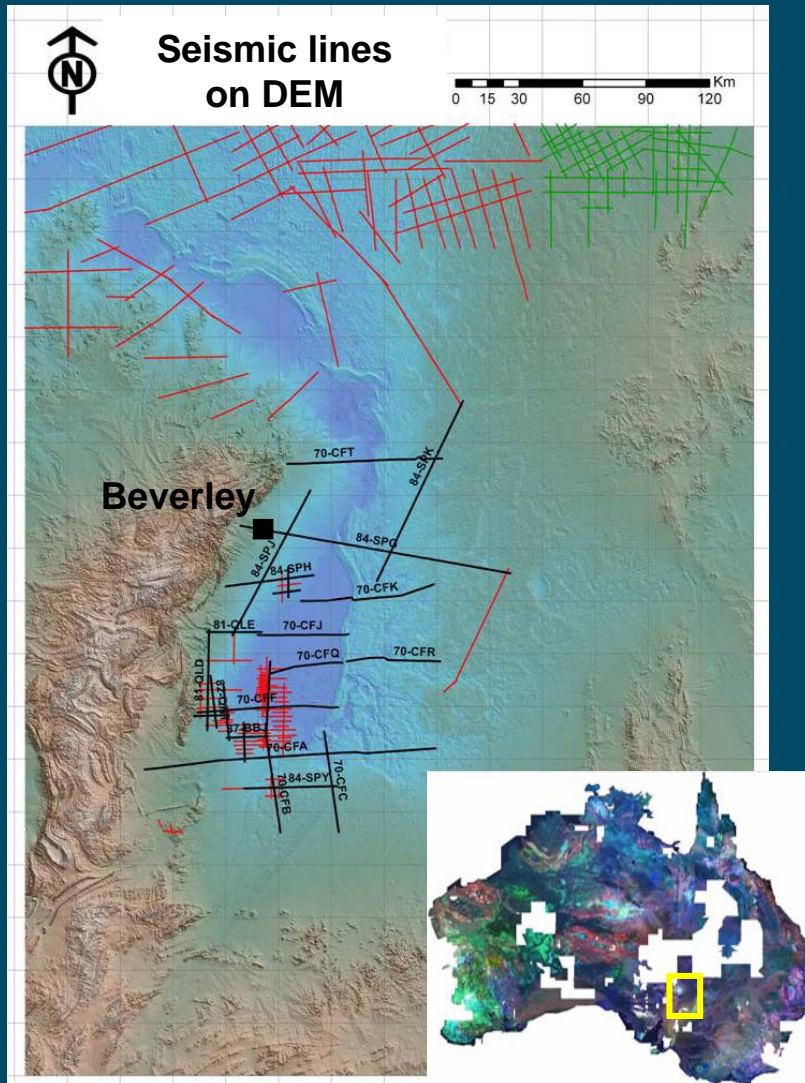
3. REGIONALLY TARGETED 3D MAPPING OF URANIUM MINERAL SYSTEMS

OESP AND URANIUM SYSTEMS PROJECT RESULTS

Prominent Hill area,
Gawler Craton

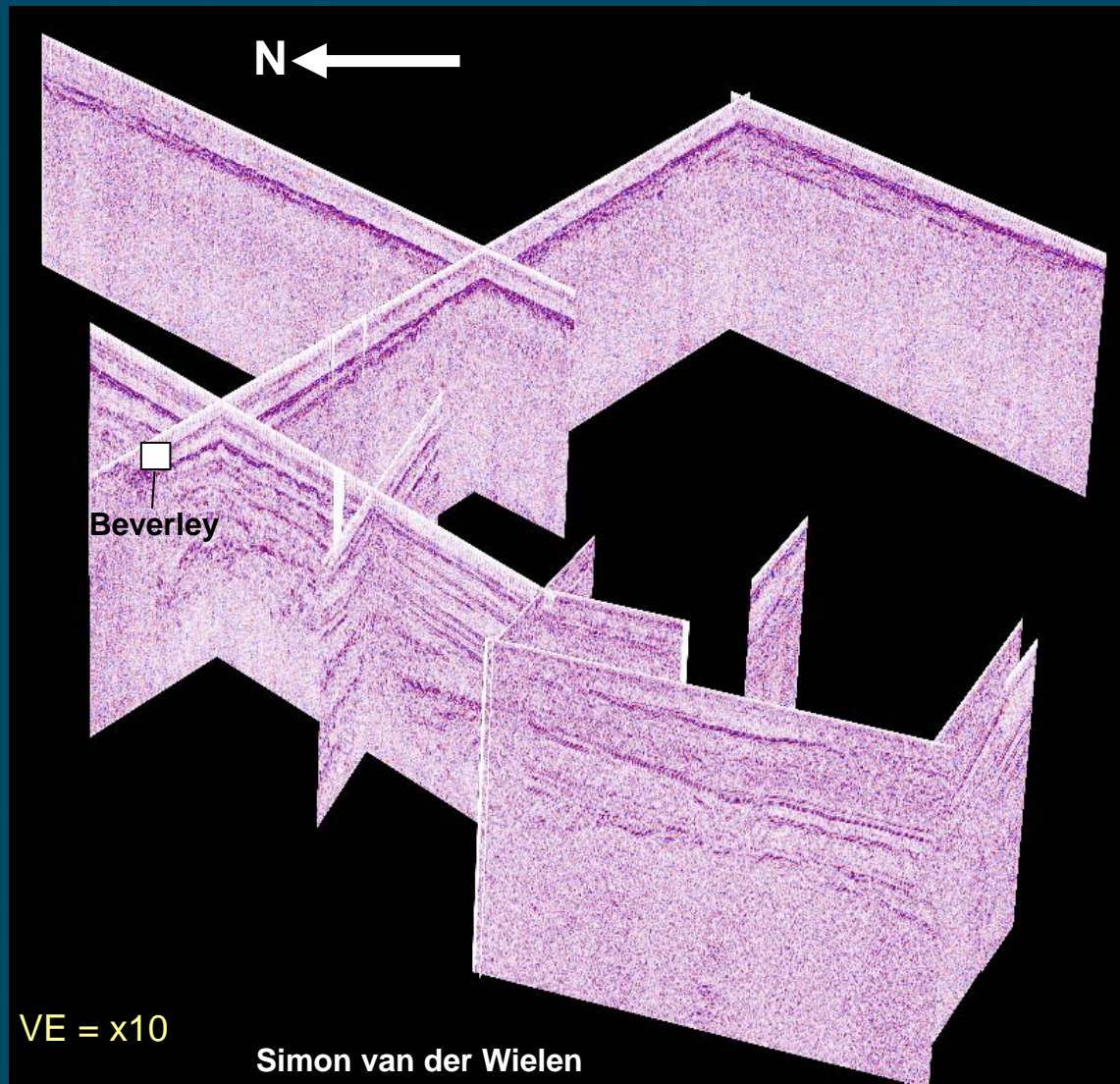


From Embayment 3D geology and U systems numerical modelling

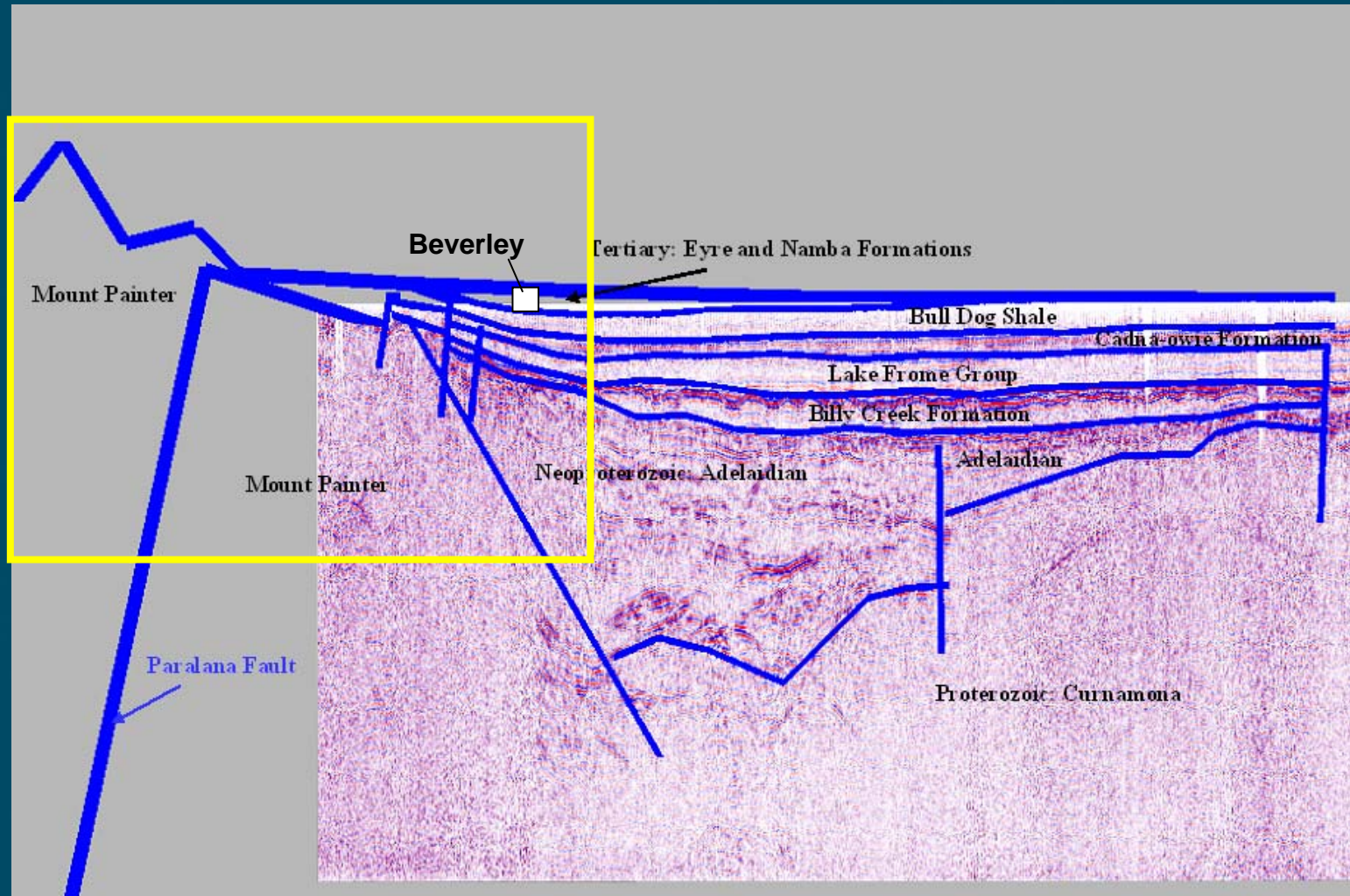


- Compilation in GoCad of public domain seismic, drill hole and other 3D data
- **Uranium Systems Project in collaboration with CSIRO, PIRSA.**
- Regional scale numerical simulation of fluid flow and chemistry of U systems.
- **Complementary modelling of deposits & districts by CSIRO with PIRSA, NTGS and companies; commencing soon.**

Seismic data in 3D

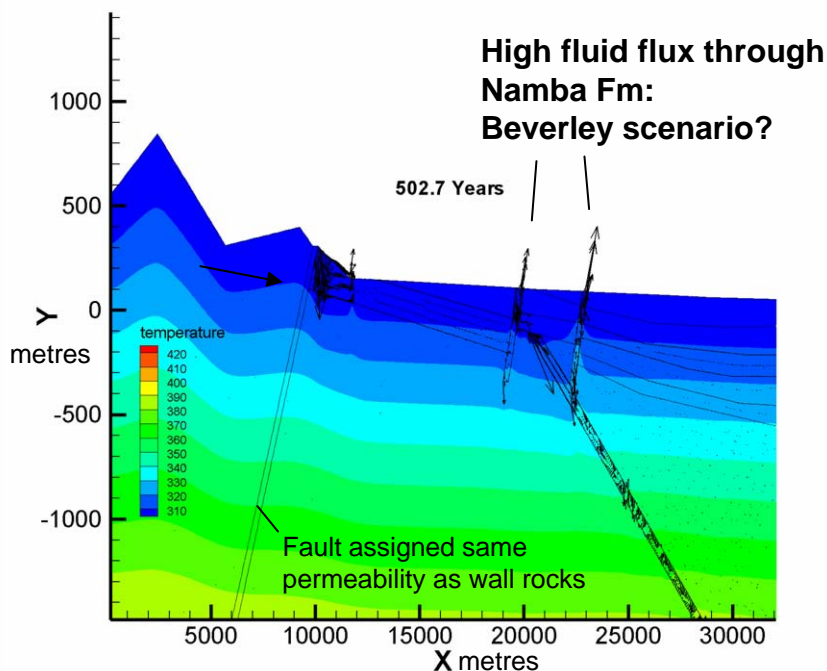


Preliminary interpretation of seismic data – architecture for modelling fluid flow and chemistry

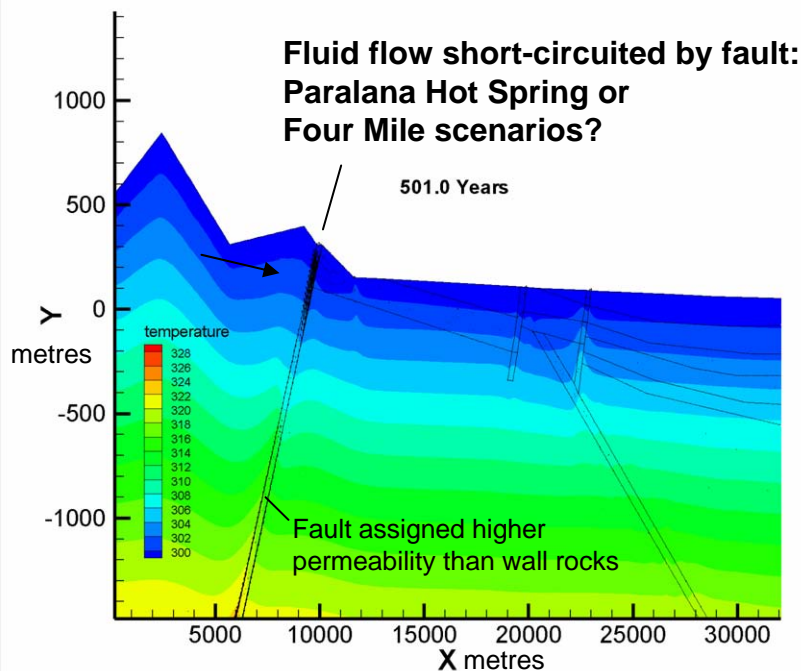


Preliminary modelling of fluid flow: two uranium mineralising systems?

Scenario 1: pre-Paralana Fault



Scenario 2: post-Paralana Fault



Evgeniy Bastrakov, Subhash Jaireth (GA)
Louise Fisher (CSIRO)

OESP AIRBORNE EM SURVEYS

AEM acquisition objectives

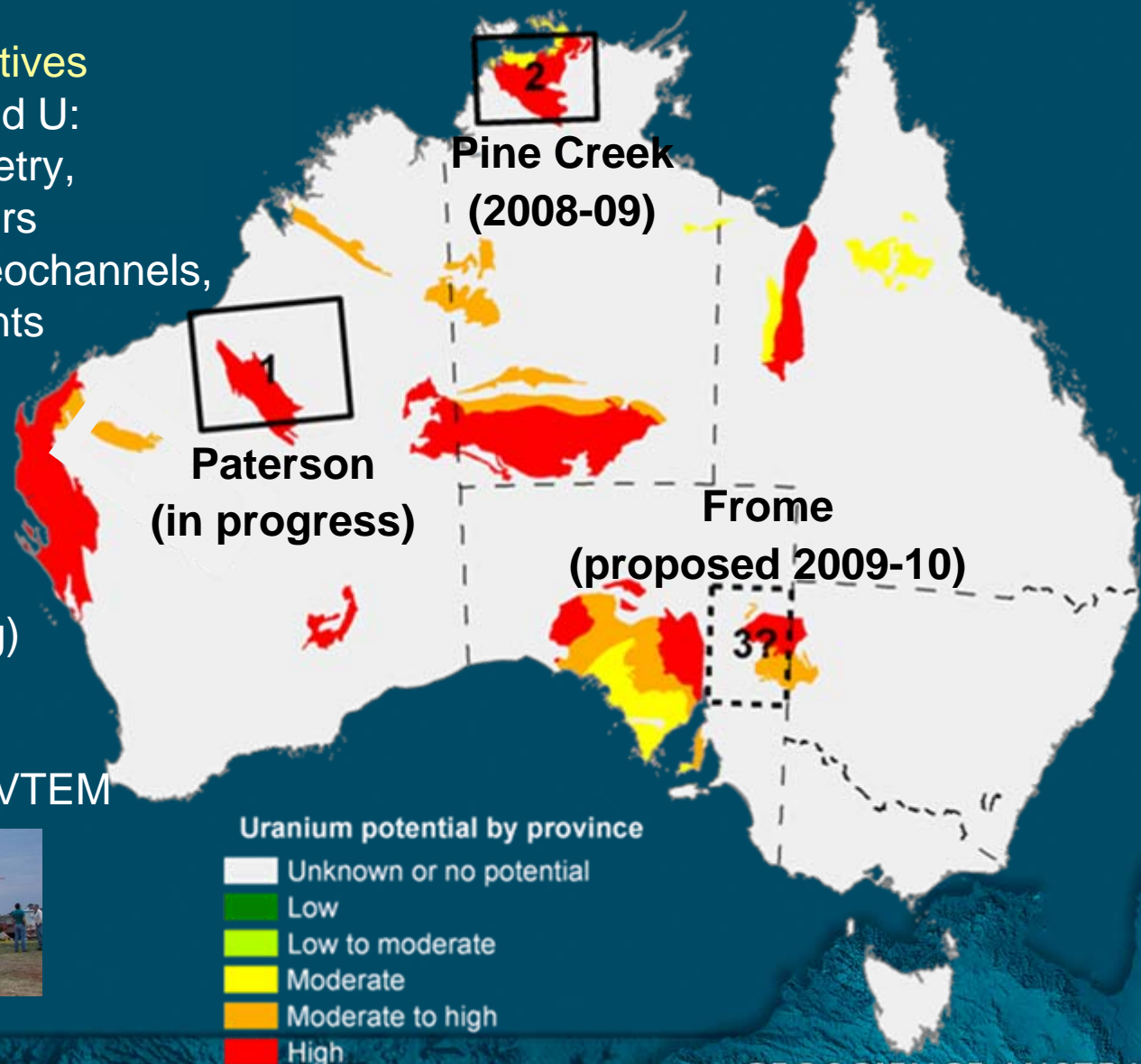
- Unconformity-related U: unconformity geometry, basement conductors
- Sandstone U: palaeochannels, conductive reductants
- Depth of cover
- Basement structure

Line spacing

Regional scale
(1 to 5 km line spacing)

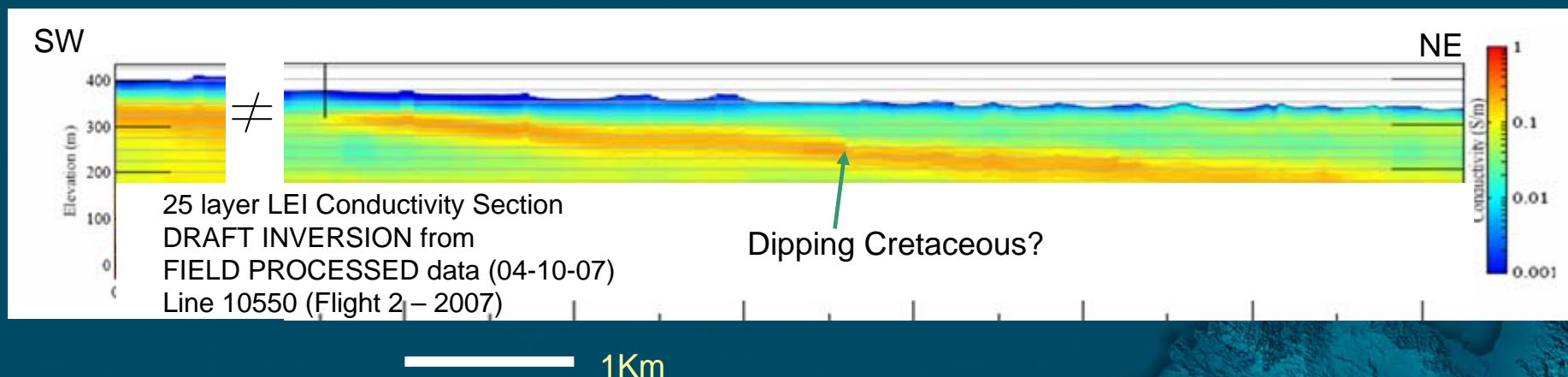
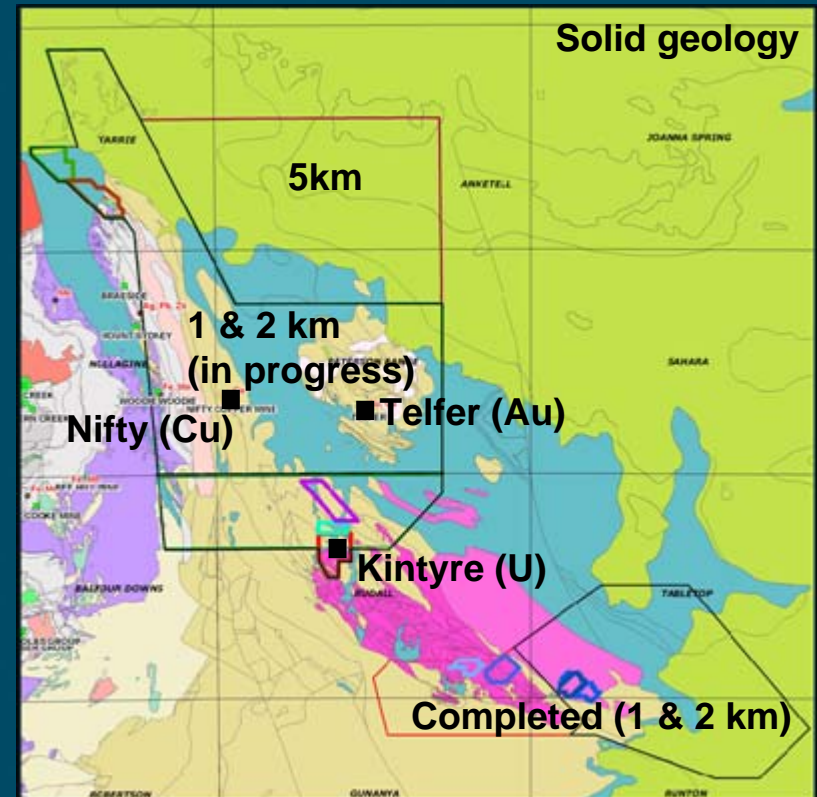
Systems

Tempest / SKYTEM / VTEM



Paterson Province TEMPEST AEM Survey

- 6 companies infilling (~20% value of survey)
- All new data to public domain after 12 months confidentiality
- From outcrop to covered regions
- Southern area completed; data to be released by Dec 2008.



OESP regionally targeted seismic reflection surveys

Acquisition objectives

- Hydrocarbons: basin architecture; direct detection
- Geothermal energy: granite & basin architecture
- Unconformity-related U: basin architecture, unconformity geometry, basement structure
- IOCGU: basement structure, esp. major breaks
- Sandstone U: shallow basin/regolith architecture
- Geodynamic settings, crustal evolution
- Depth of cover

System

- Vibroseis

SEISMIC



500 Kilometres

OESP

Seismic Program

(subject to change)

Pine Creek

Georgina

Kidson-Paterson

Officer-Musgrave
2009

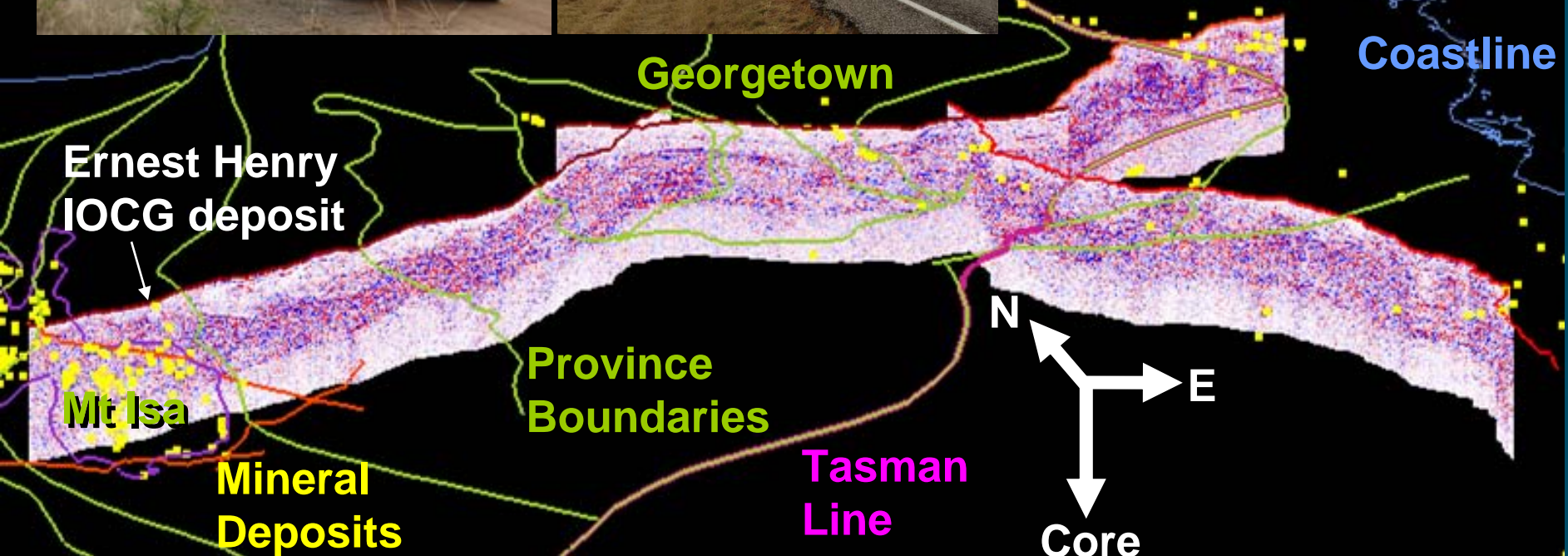
Gawler-Curnamona
(in progress)

Rankin
Springs
2008

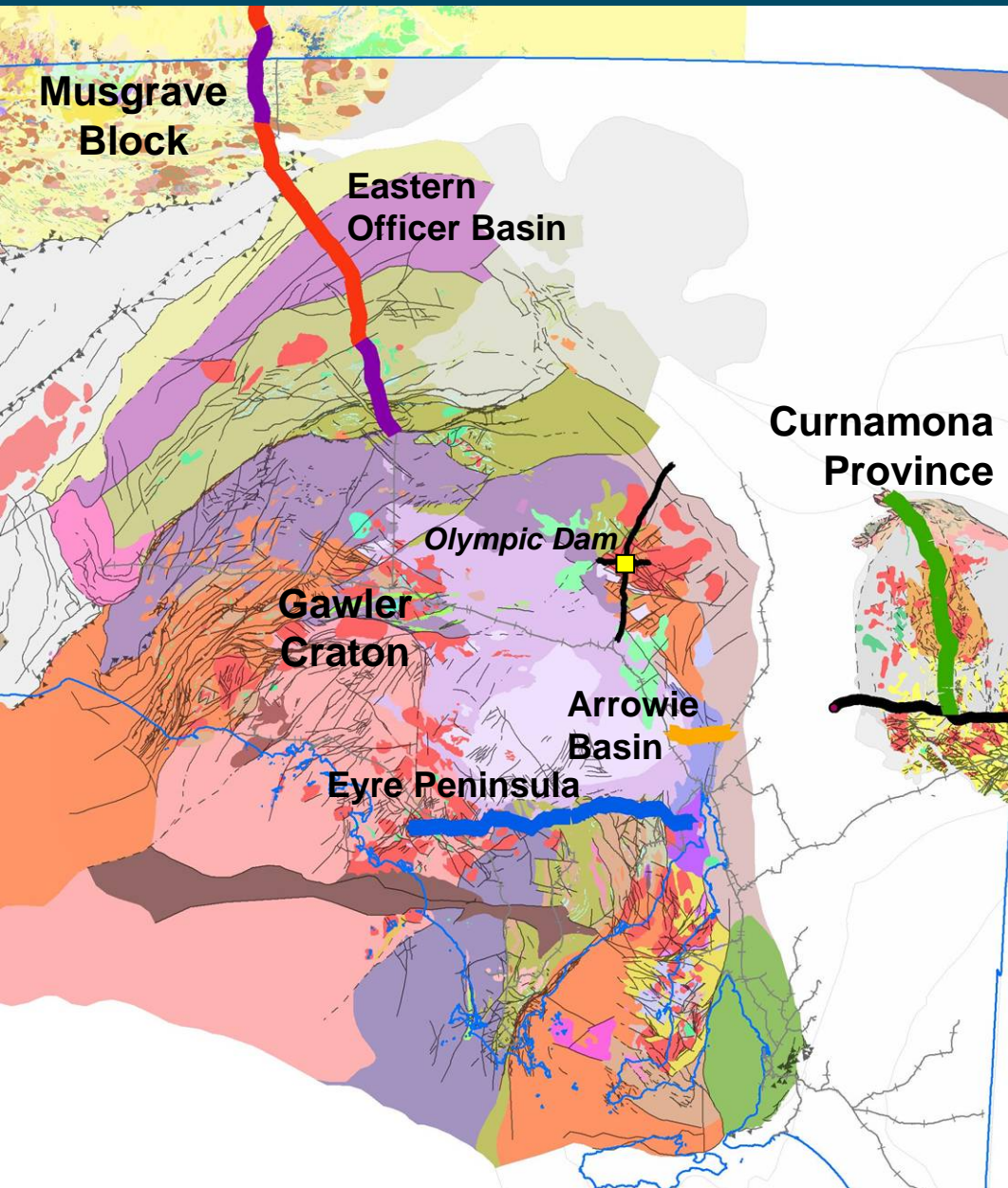
Onshore Energy Security Program (OESP)

- Existing seismic survey lines (pre-OESP)
- Completed seismic survey lines (Nth Queensland)
- Completed seismic survey lines (Rankin Springs)
- Proposed location of seismic survey (as at 28/02/08)

2007 Isa-Georgetown-Charters Towers Seismic reflection profiles



New seismic acquisition, Gawler Craton, Curnamona Province



June 2008 onwards:

- 1) Eyre Peninsula: IOCGU, unconformity-U, geothermal
- 2) Curnamona-Mt Painter: sandstone-U, IOCGU, geothermal
- 3) Arrowie Basin: hydrocarbons

~March 2009

- 1) Eastern Officer Basin: hydrocarbons + AusScope)

Conclusions

- Year 2 of 5-year \$59m federally-funded energy security program led by GA.
- Uranium, geothermal & hydrocarbons are major drivers for new seismic, AEM, MT, radiometrics & geochemical data acquisition & 3D geology.
- New concepts of uranium mineral systems and new data aimed at identifying new uranium provinces.

<http://www.ga.gov.au/minerals/research/oesp/index.jsp>

