DELIVERING RESULTS

Department for Manufacturing, Innovation, Trade, Resources and Energy

The Cover: Love thy Enemy

(building truth, honesty and an enduring relationship with the cover)

Steve Hill

Steve.Hill@sa.gov.au

Government of South Australia

Department for Manufacturing, Innovation, Trade, Resources and Energy

PACE 2020 exploration mining energy global

SOUTH AUSTRALIA

Love thy Enemy

Lots of cruel things said about the cover….

- **“Impediment”**
- **“punch through” it!**
- **The rocks “suffered” weathering**
- **Ignore it**
- **“Stuff”**
- **“Overburden”**
- **“Crud”**
- **“Dirt”**
- **“*^#>” !!!**

Why are people so unkind?
Fear and loathing. Where does it come from?
We don’t know it properly?
We don’t trust it

Be a Cover Lover!

This presentation

1. **Geological Processes in the Cover** (What are some of the special things that can happen?)

2. **Implications of these processes** (How the cover can be our BFF)

3. **Characterising the cover** (What do we really know about our new found love?)

4. **How to get to know the cover better into the future** (our enduring love)

5. **Cover savvy geoscientists of the future** (Who will be part of this love affair?)

Geological Processes in the Cover: What are some of the special things that can happen?

Weathering / erosion / sediment and element accumulation

Element mobility – source, transport, accumulation, preservation

Supergene enrichments

Biogeochemical processes

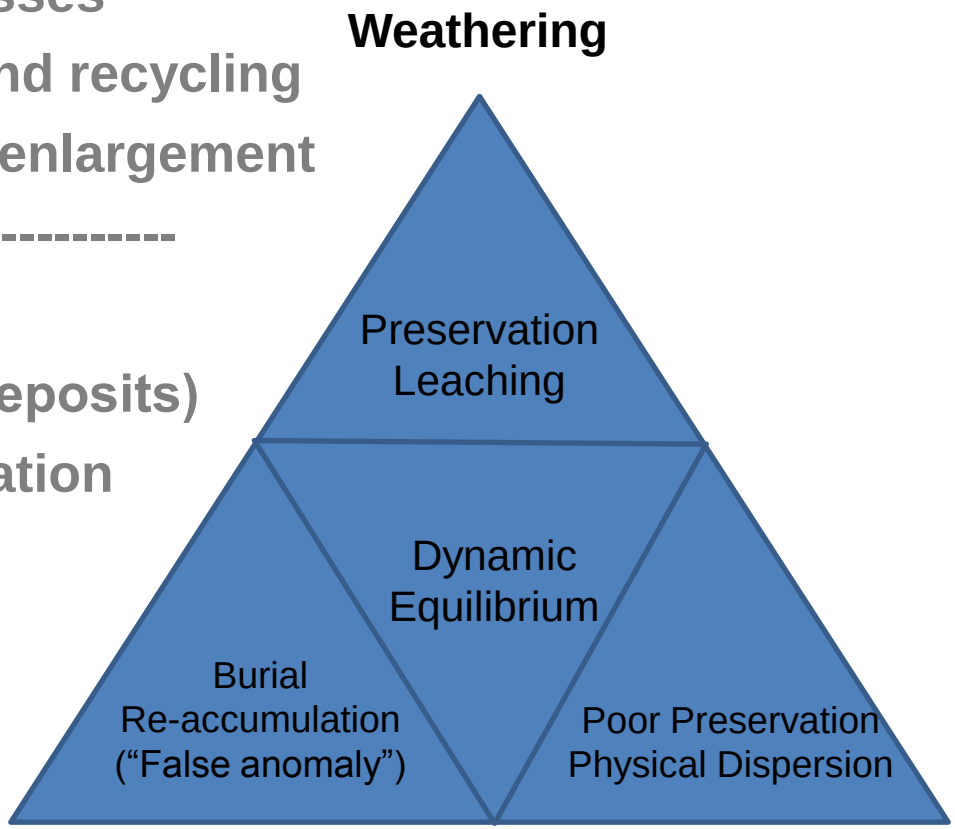
Placer concentration and recycling

Geochemical footprint enlargement

Dilution

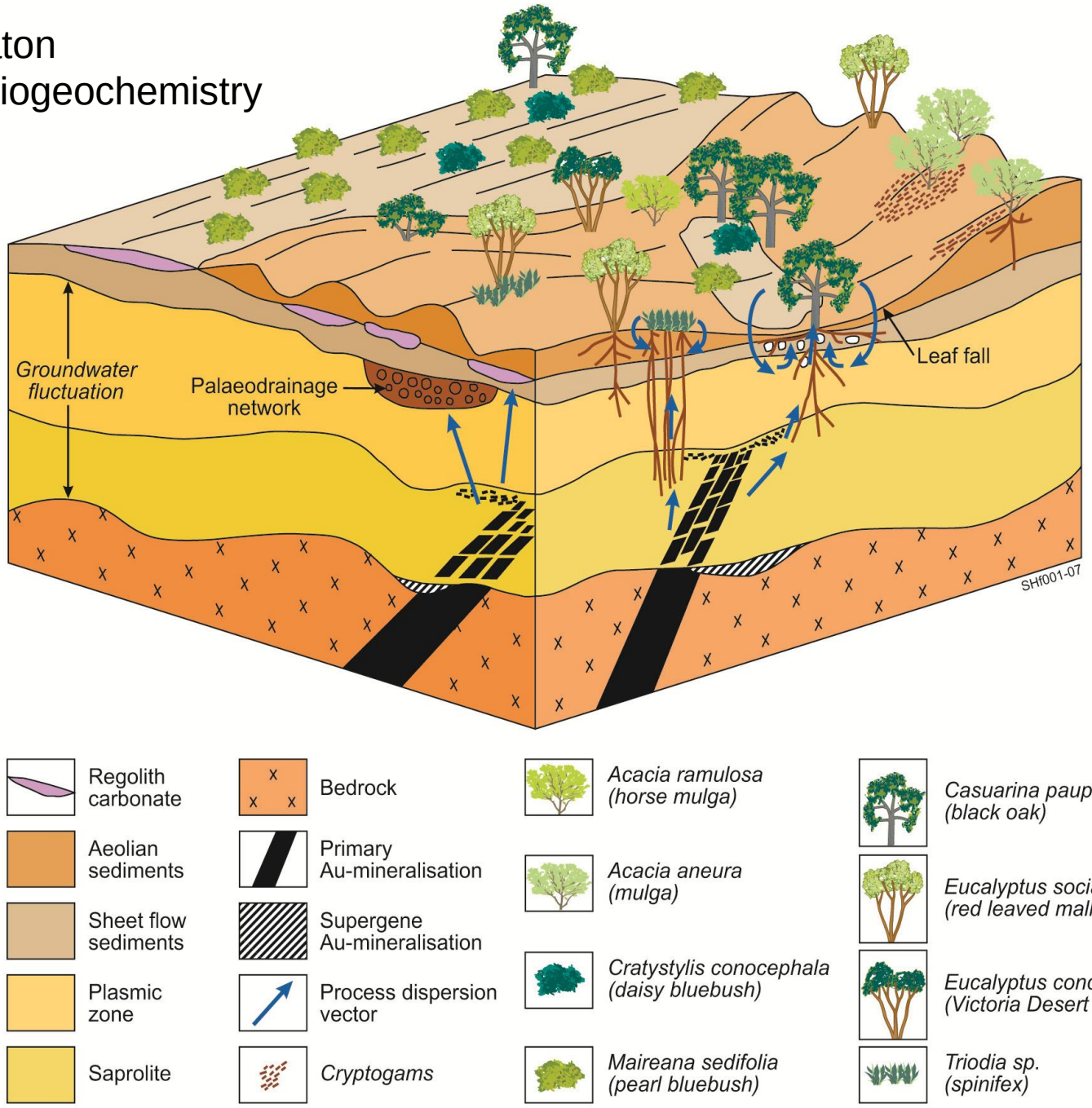
Barren cover (‘blind” deposits)

Erosion / poor preservation



HILLSIDE REGOLITH PROFILE

Central Gawler Craton
Deep cover Plant biogeochemistry



Tunkillia, Gawler Craton

UoA Honours students
Black oak sampling April 2009

Minotaur Exploration
Drilling April 2010

Implications of these processes: How the cover can be our BFF

Haloes / footprints

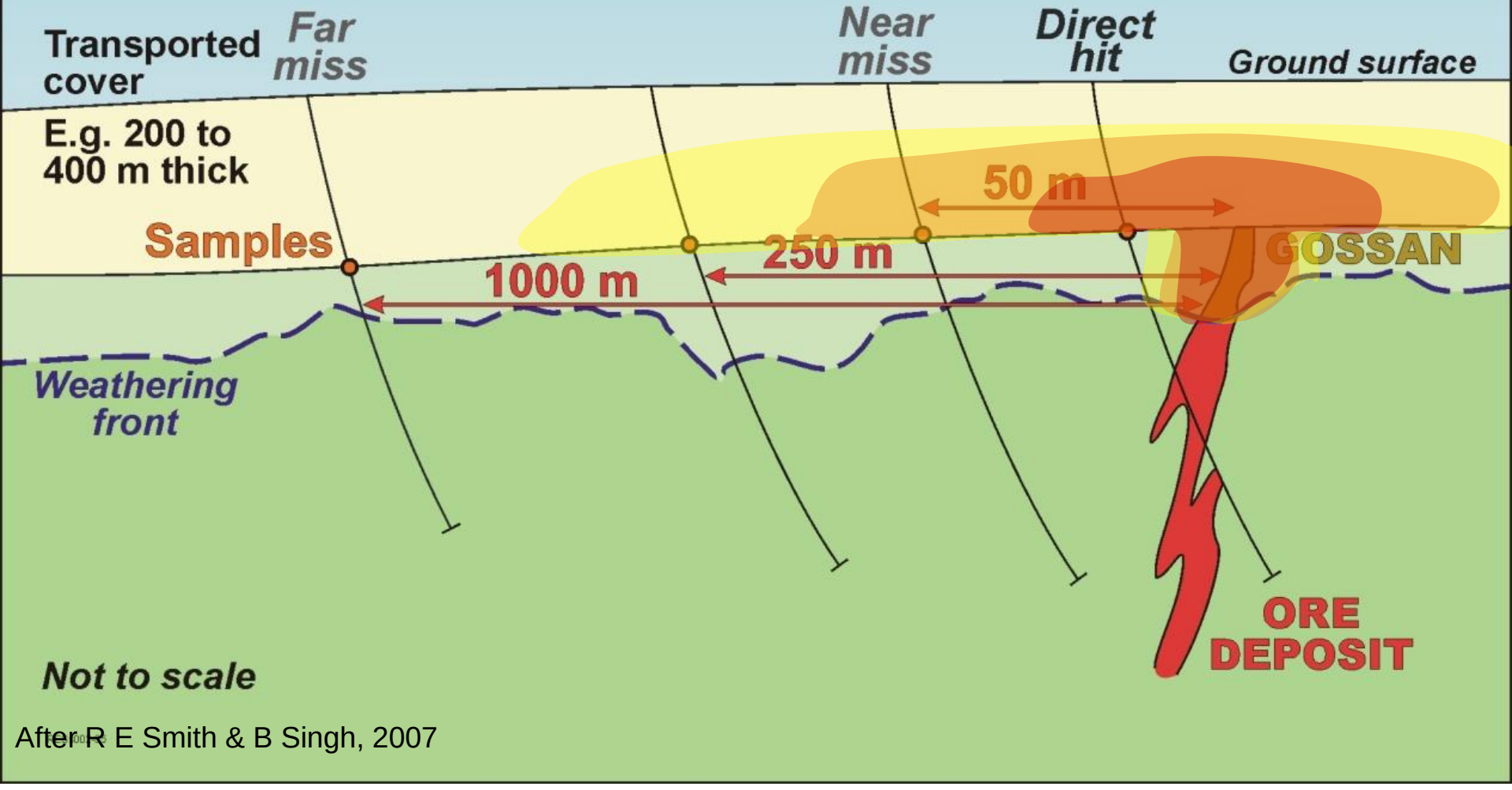
3D dispersion

Secondary accumulations

Other resources

e.g groundwater, soils …..

Industry Issue: Exploring through deep cover

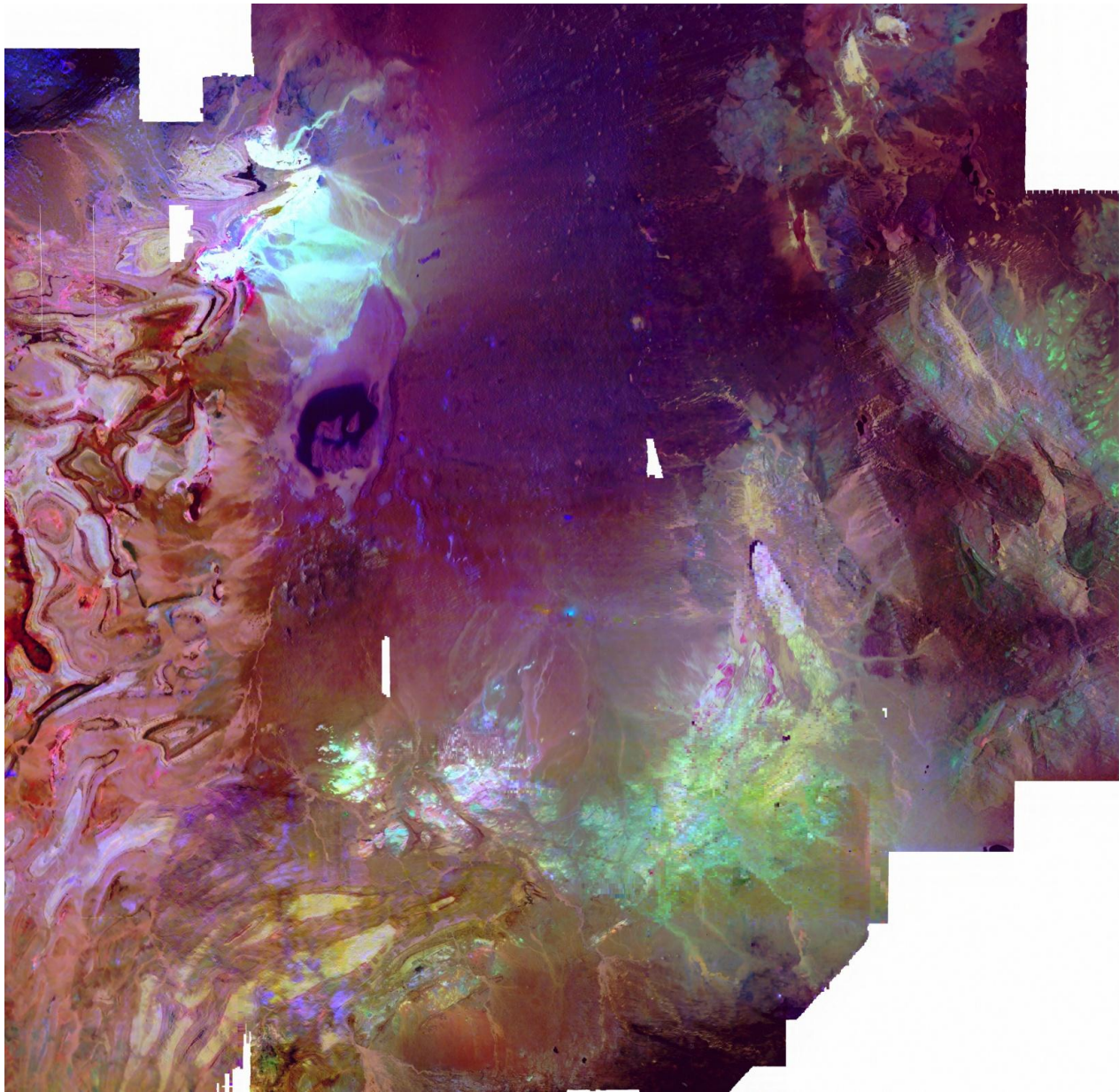


After R E Smith & B Singh, 2007

Curnamona Province dispersion haloes shown on radiometrics image

Mt Painter

Broken Hill



50 km

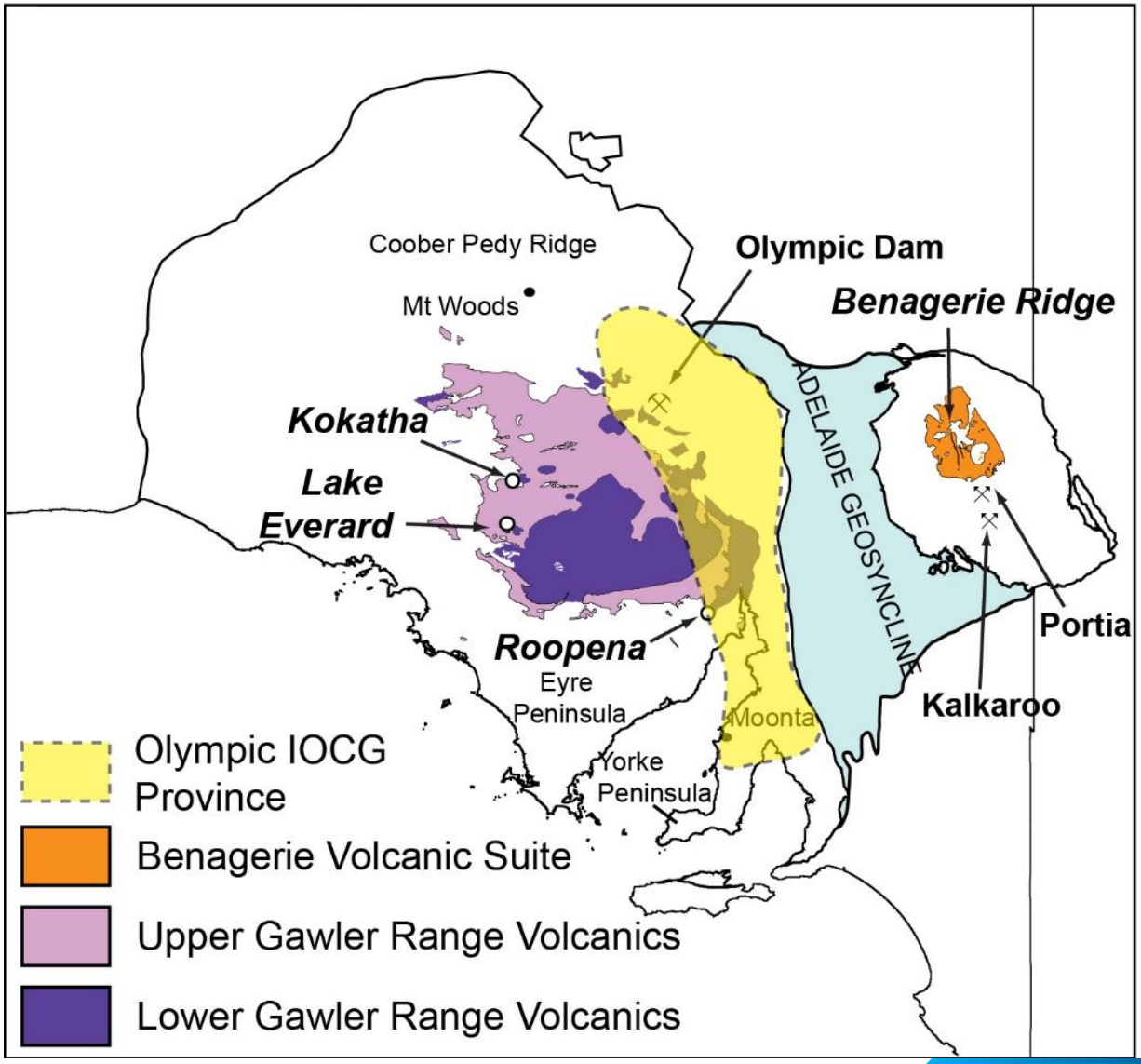
Implications of these processes: How the cover can be our BFF

Eastern Gawler Craton – Curnamona Province links

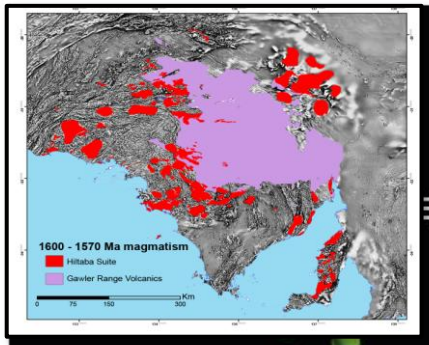
~1590 Ma mineralising event

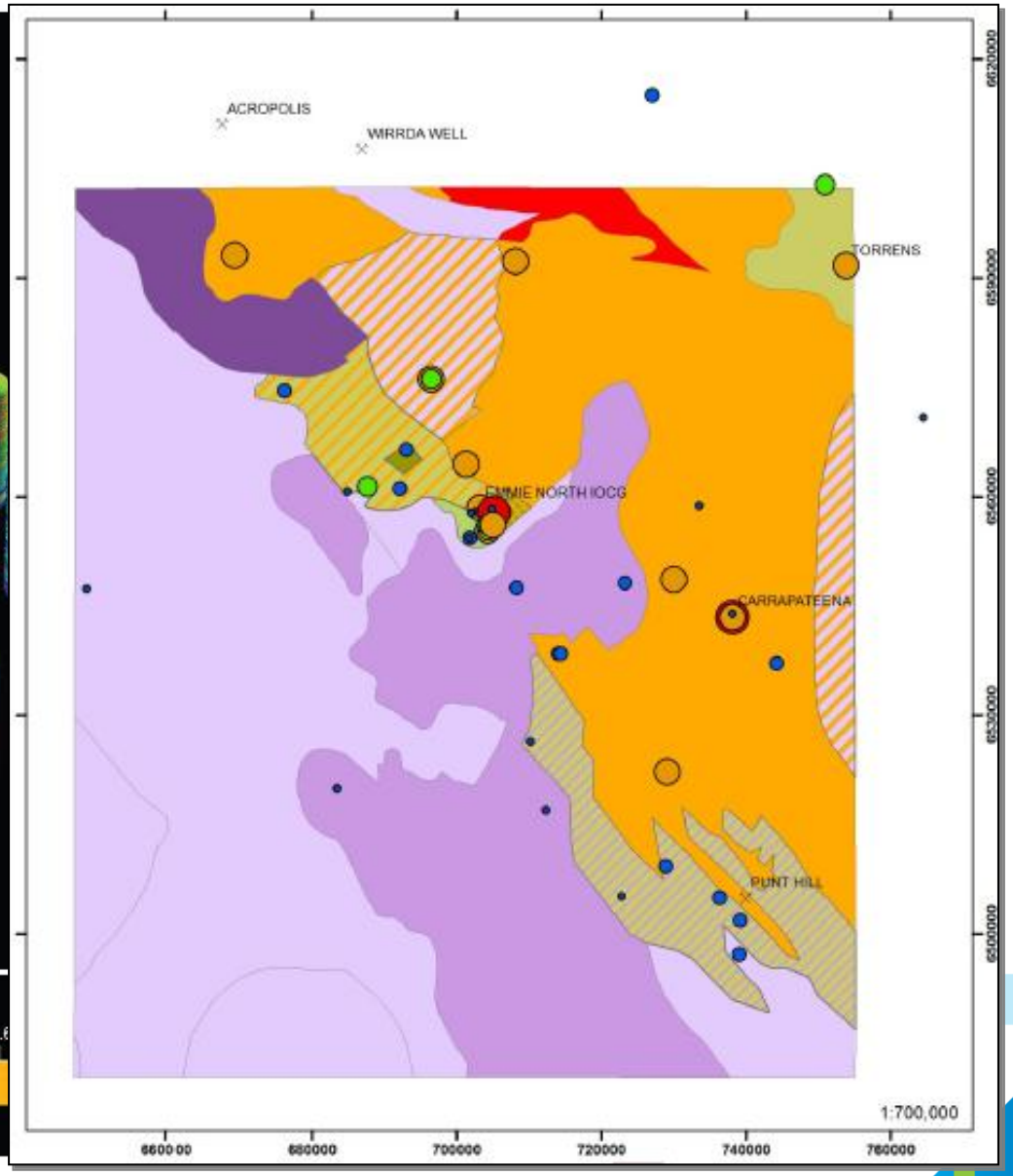
But dominated by different exploration strategies

Eastern Gawler: IOCG in basement
Curnamona: sedimentary U



Eastern Gawler Craton – geochemistry from drilling (Adrian Fabris, DET CRC)





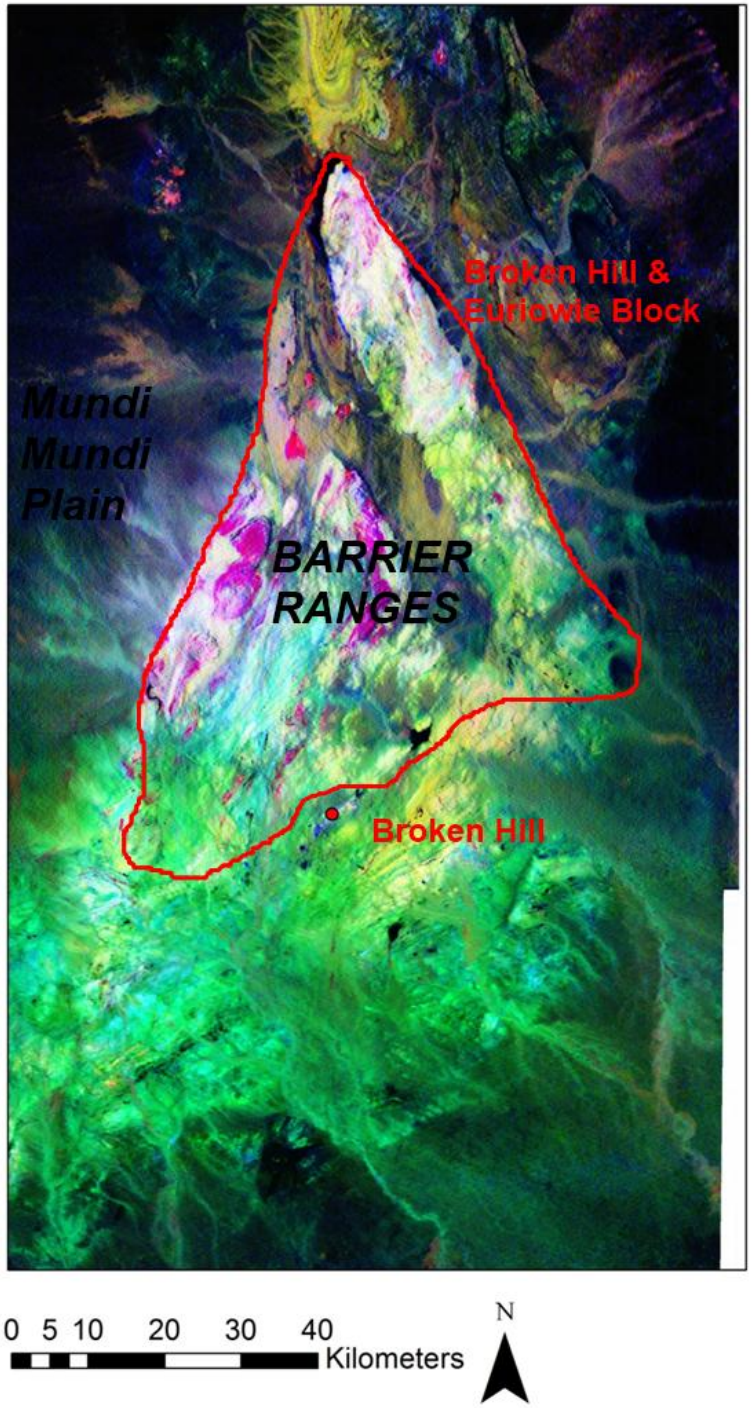
Scale of the distal footprint of the Broken Hill mineral system

Lateral dispersion for >100 km

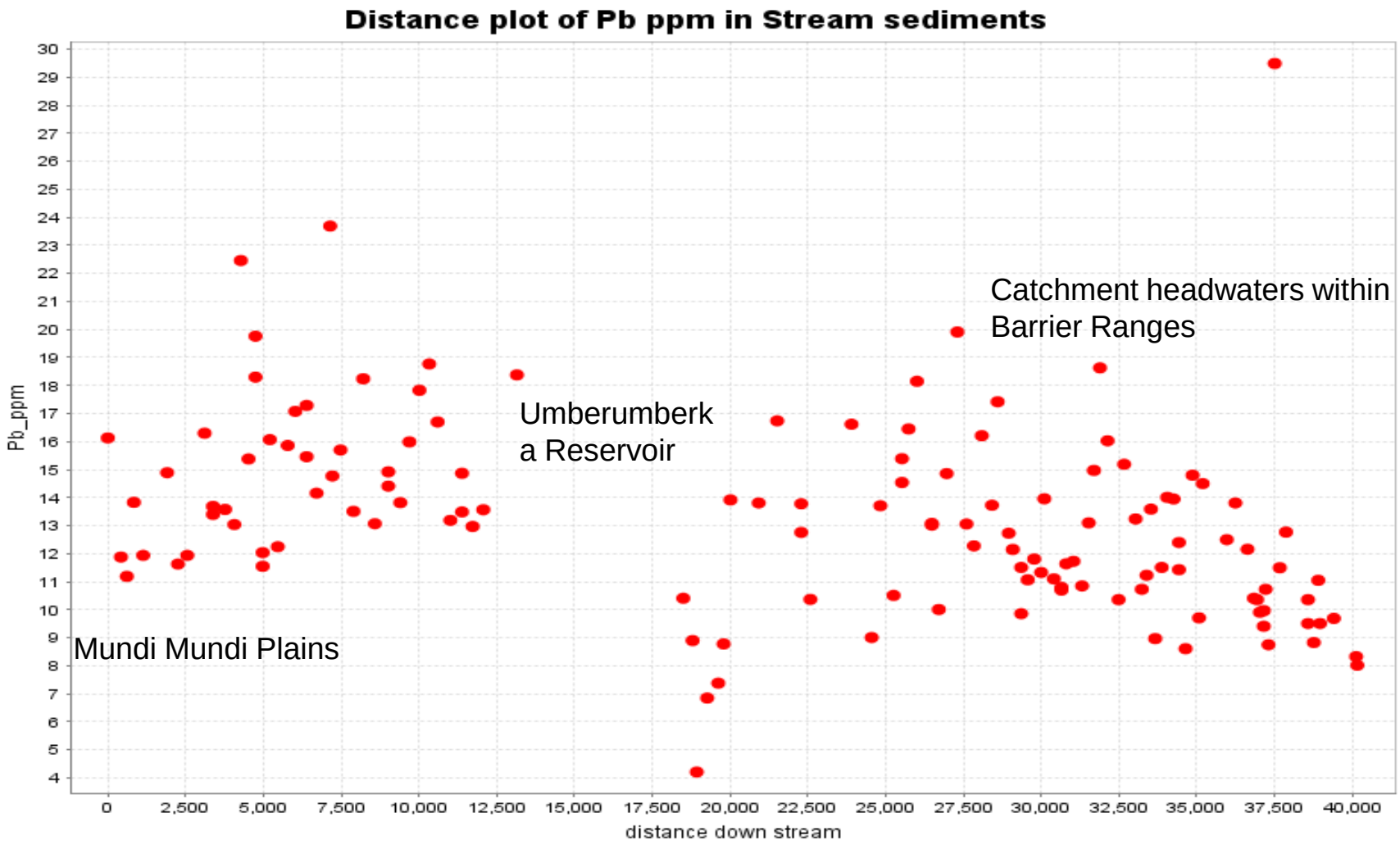
High grade garnets in beach sands at Menindee Lakes (>100 km to SE)

Staurolite and other high grade metamorphic minerals in sediments overlying low-grade metamorphic rocks in the Fowlers Gap and Bancannia Basin (>100 km to N)

Lateral dispersion onto Mundi Mundi Plains (30-50 km to W and NW)



Umberumberka Creek - Broken Hill (Charlotte Mitchell, DET CRC)



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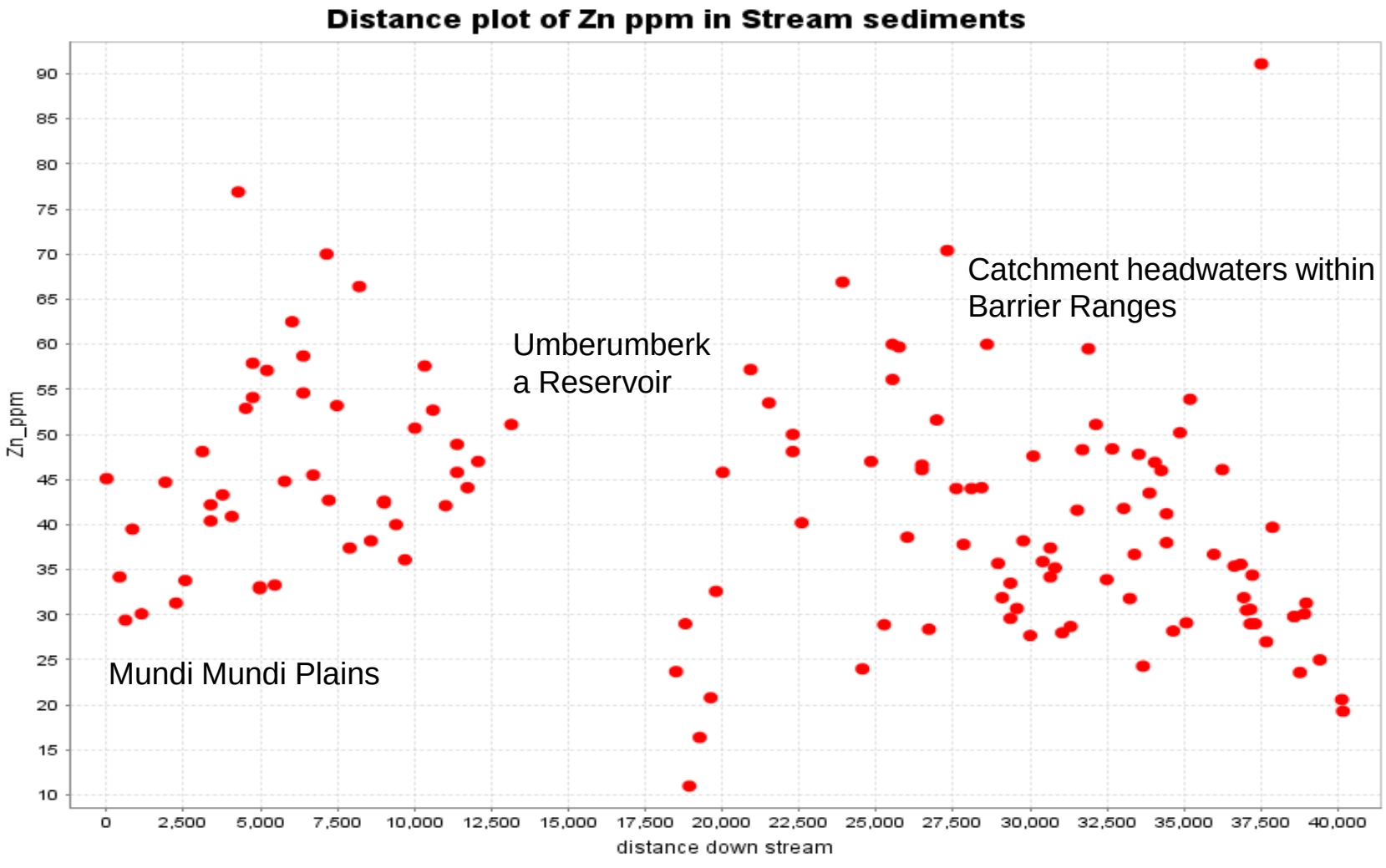
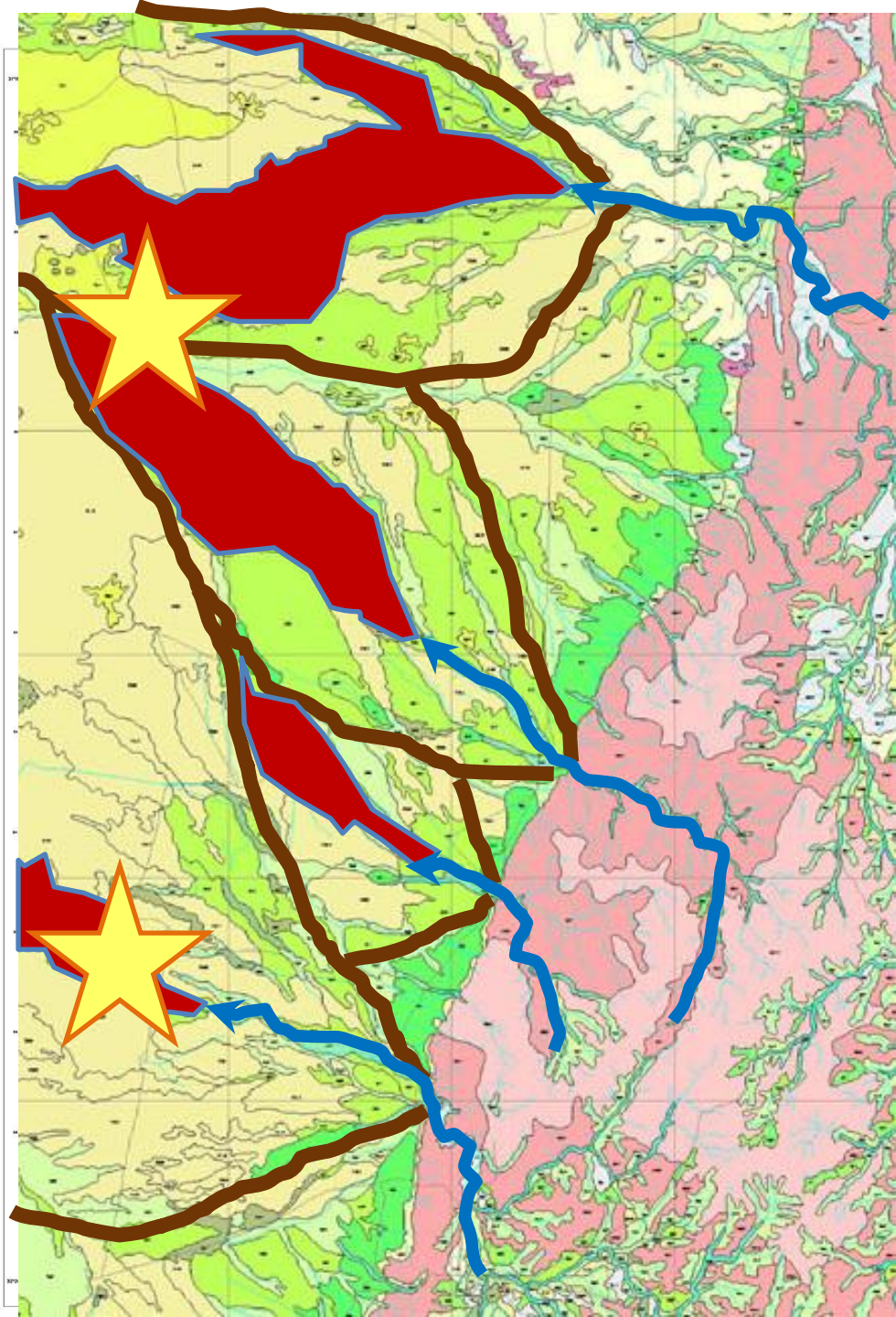
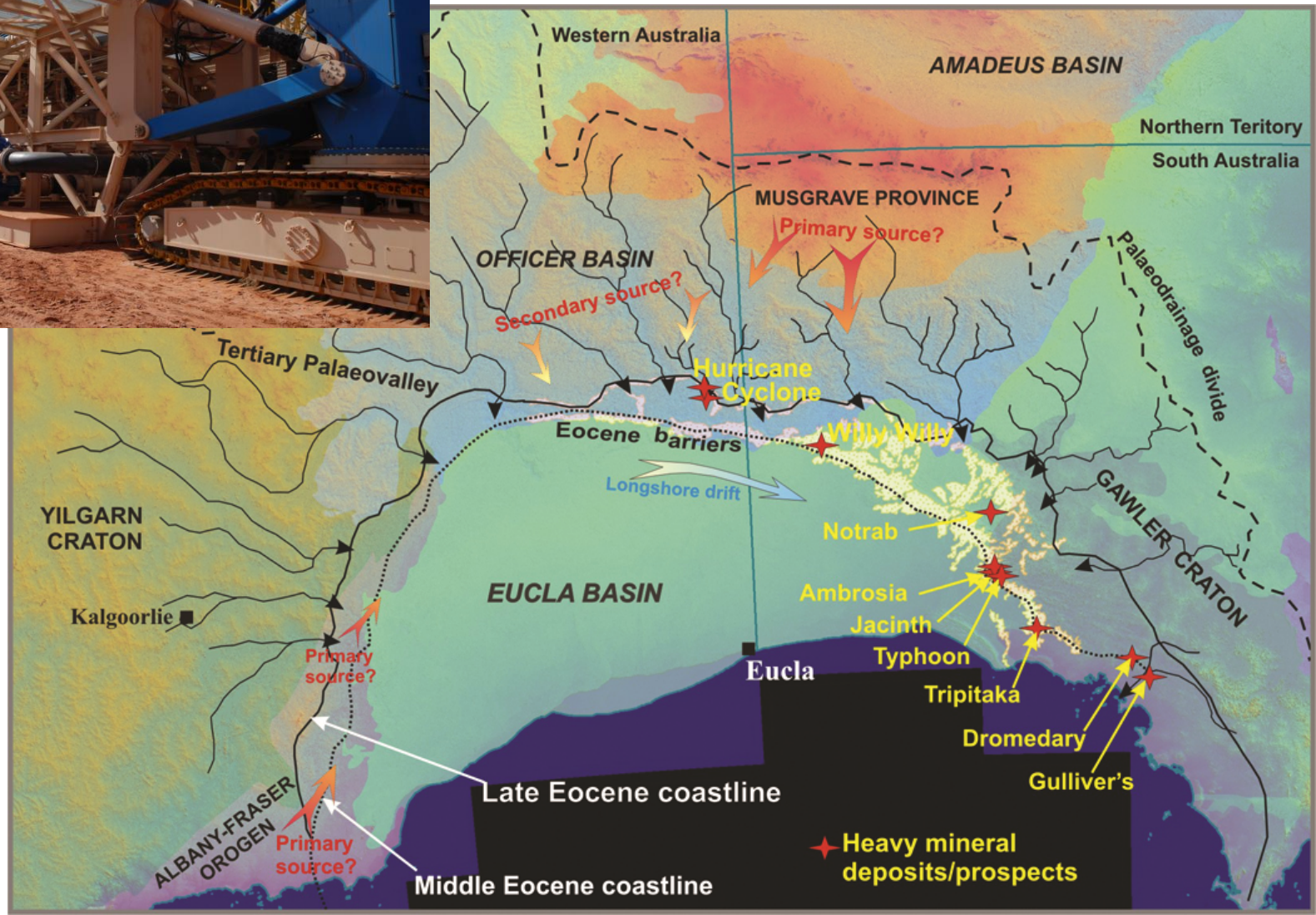


Mundi Mundi Plain

Lateral dispersion and reaccumulation



Eastern Eucla Basin Zircons – Musgrave Provenance



Exploration Sampling Media within the Cover (DET CRC)

An ideal sampling medium needs to be:

- Abundant
- Generic (e.g. not just restricted to a particular stratigraphic unit)
- Readily identifiable (esp. down-hole)
- Hosts target geochemical suite for mineral system
- Can be linked to dispersion vectors (can be used as geochemical vector to mineralisation)
- Able to be effectively and efficiently sampled

Exploration Sampling Media within the Cover

- Deep basin calcrete vs limestone
- Palaeo and contemporary redox interfaces
- Groundwater (hydrogeochemistry)
- Base of Transport (BOT) / Top of Saprolith (TOS)
- Acid-sulphate secondary minerals (e.g. kaolin, alunite, silcrete ….)

Exploration Sampling Media on the Cover

- Stream sediments
- Soils (full digest and partial leaches)
- Plants
- Water Bores
- Indurated materials (‘calcretes’, ferricretes, silcretes…)

Characterising the cover: What do we really know about our new found love?

Characterising the cover – a big opportunity!

Greater amount of surficial data but really decreases with depth

Key attributes:

- **Detailed lithological logging**
- **Whole-rock geochemistry (chemical context?)**
- **Mineralogy (XRD and spectral)**
- **Physical properties**

Deep Cover Reference Sections

Geological type sections and their associated data have received diminished attention, particularly since the GSSA work in basin areas in 1970s and 1980s

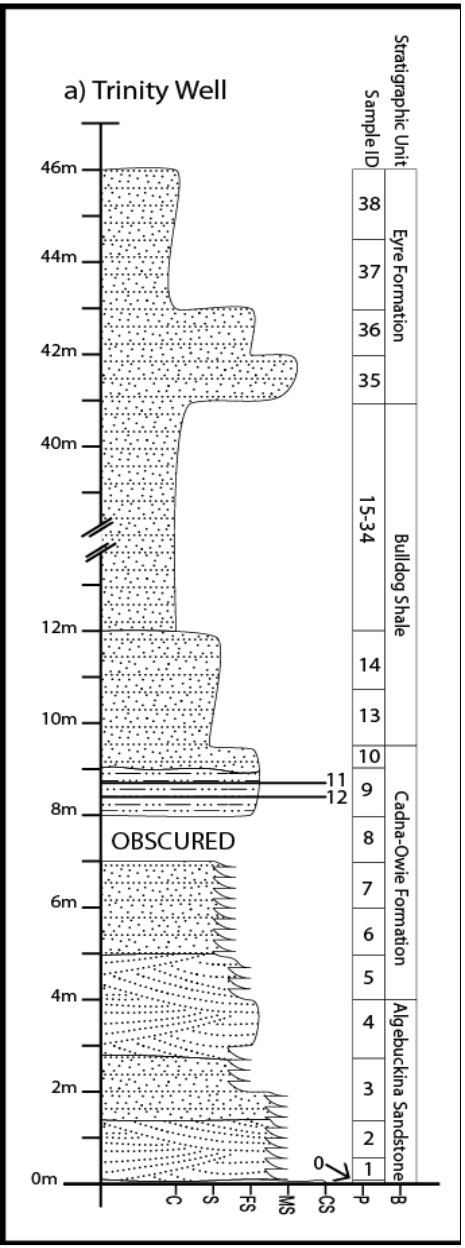
These are important reference sections, particularly as exploration moves into surrounding covered areas.

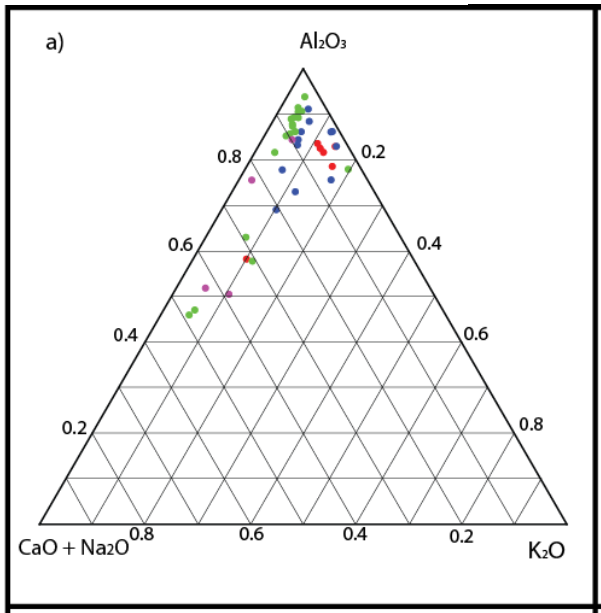
Modern data for these sections can include:

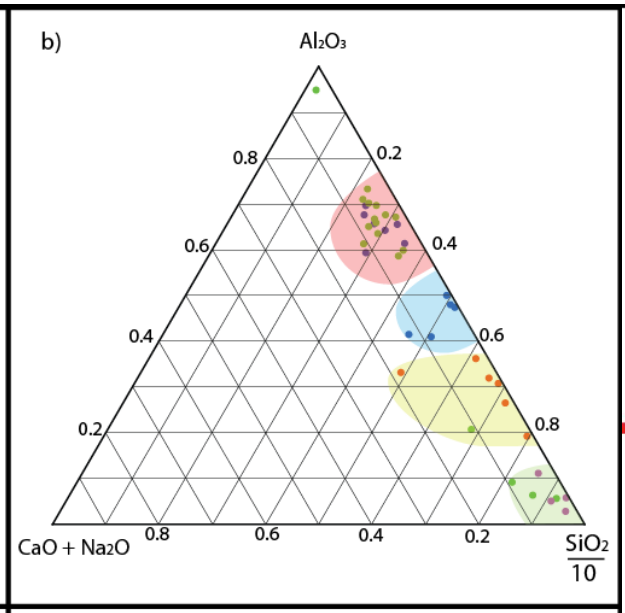
- **GPS coordinates**
- **Lithological logging**
- **Biostratigraphy**
- **HyLogger mineralogy**
- **Lithogeochemistry**
- **Detrital zircon dating**
- **et al……**

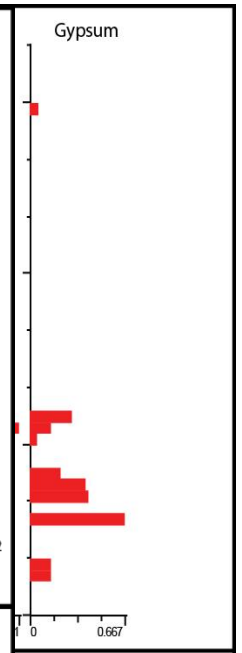
Trinity Well type section, Marree 1:250k mapsheet

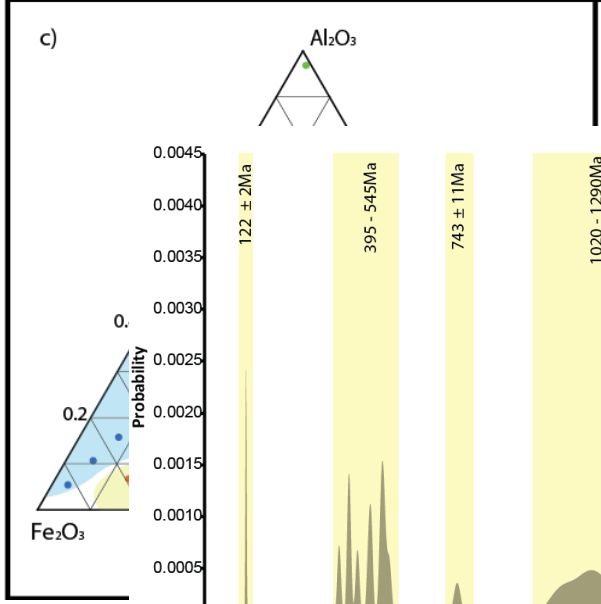
Trinity Well Reference Section











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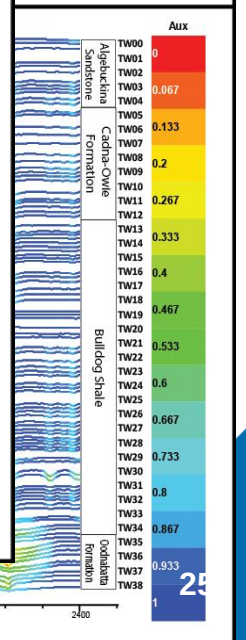
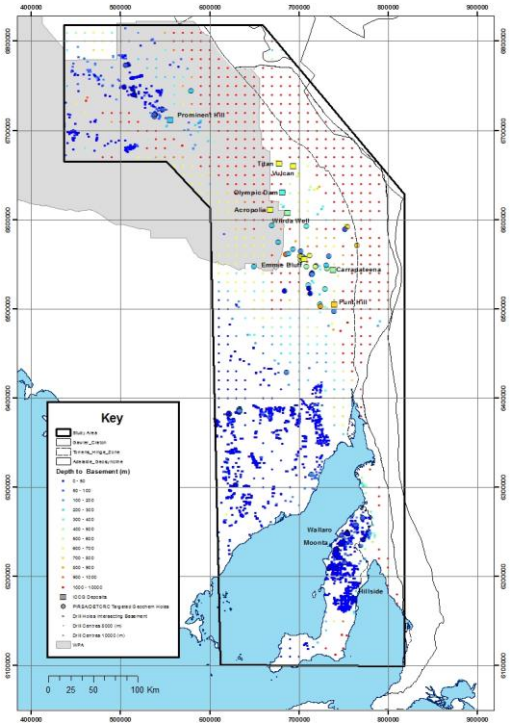


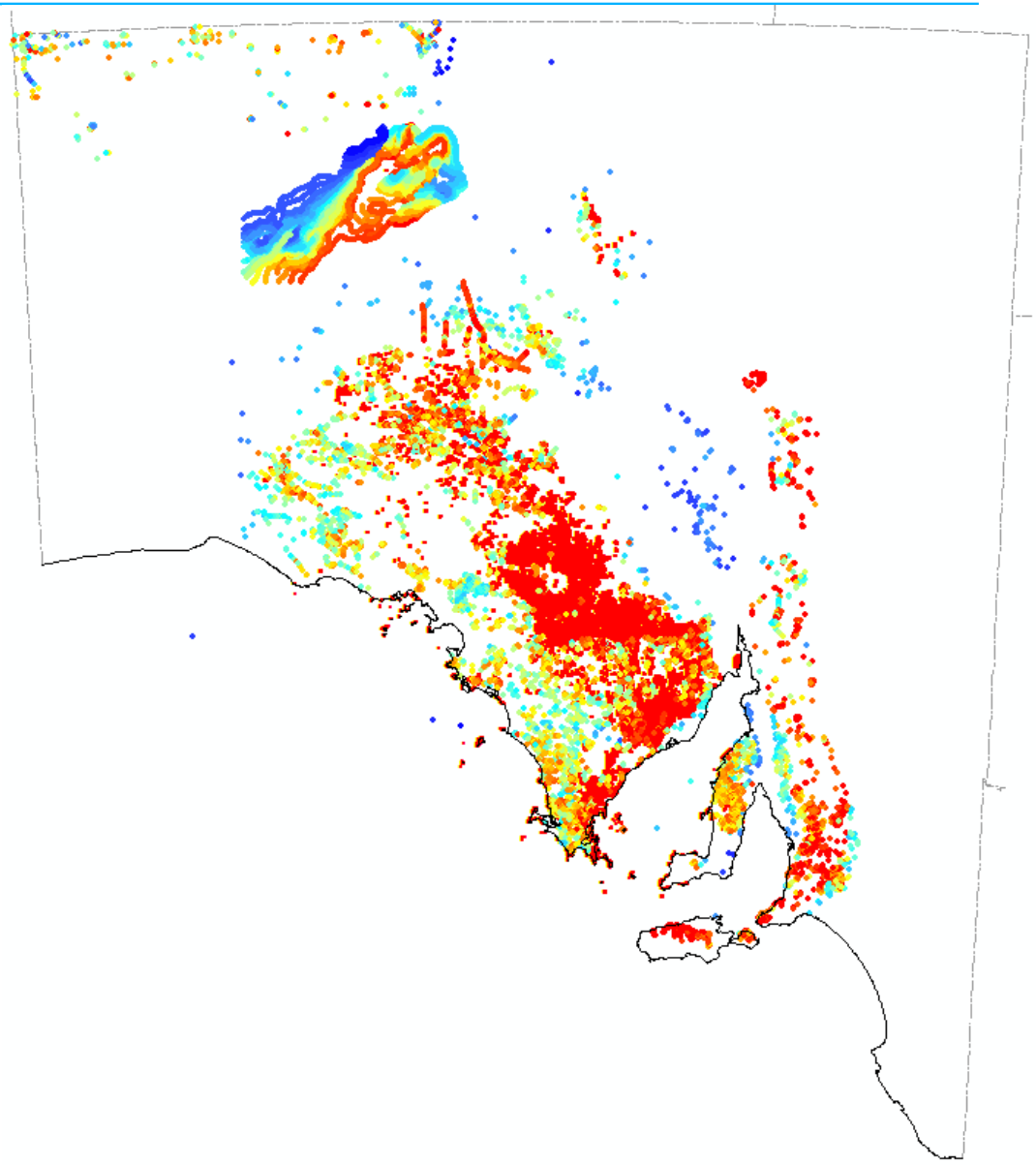
How to get to know the cover better into the future: our enduring love

- **Imaging**
- **Modelling**
- **Boots on the Ground**
- **reference sections**
- **mapping (lithology and key attributes)**
- **Continental scale Drilling (National Uncover Drilling Endeavor)**



All of Australia!

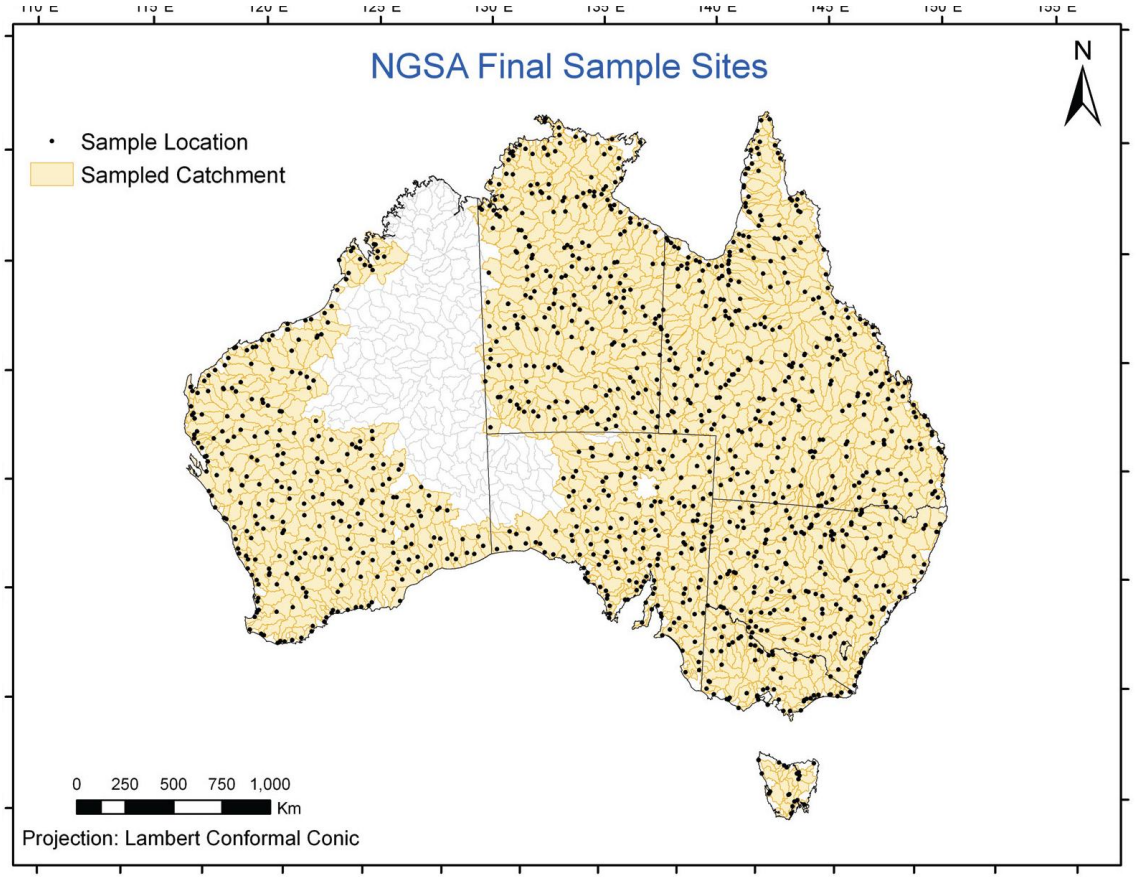
Depth to Crystalline Basement largely from drilling data



Into the Future…

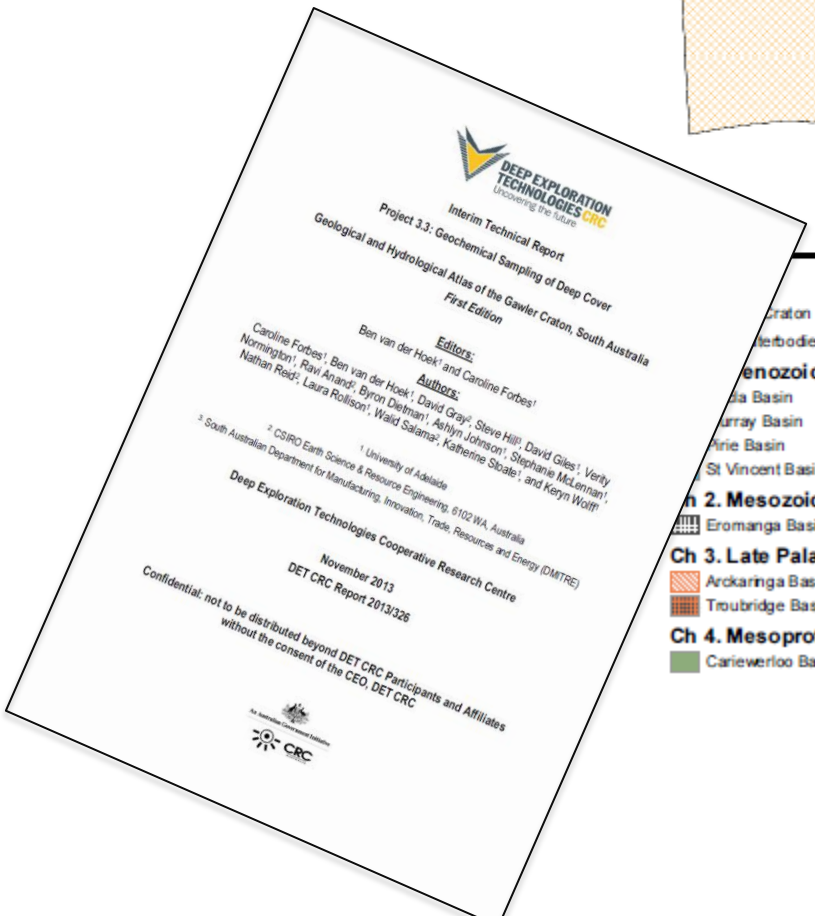
National Geochemistry Survey of Australia …. Great start!

- **more detail?**
- **other media?**
- **other dimension (depth)?**



Into the Future…

Deep cover atlas of SA (DET CRC)



DEEP EXPLORATION TECHNOLOGIES CRC
Uncovering the future

Interim Technical Report

Project 3.3: Geochemical Sampling of Deep Cover

Geological and Hydrological Atlas of the Gawler Craton, South Australia

First Edition

Editors:

Ben van der Hoek[1] and Caroline Forbes[1]

Authors:

Caroline Forbes[1], Ben van der Hoek[1], David Gray[2], Steve Hill[2], David Giles[1], Verity Normington[1], Ravi Anand[2], Byron Dietman[1], Ashlyn Johnson[1], Stephanie McLennan[1], Nathan Reed[3], Laura Rollison[1], Walid Salama[2], Katherine Sibiate[1], and Kerryn Wolff[1]

[1] University of Adelaide

[2] CSIRO Earth Science & Resource Engineering, 6102 WA, Australia

[3] South Australian Department for Manufacturing, Innovation, Trade, Resources and Energy (DMITRE)

Deep Exploration Technologies Cooperative Research Centre

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DET CRC Report 2013/326

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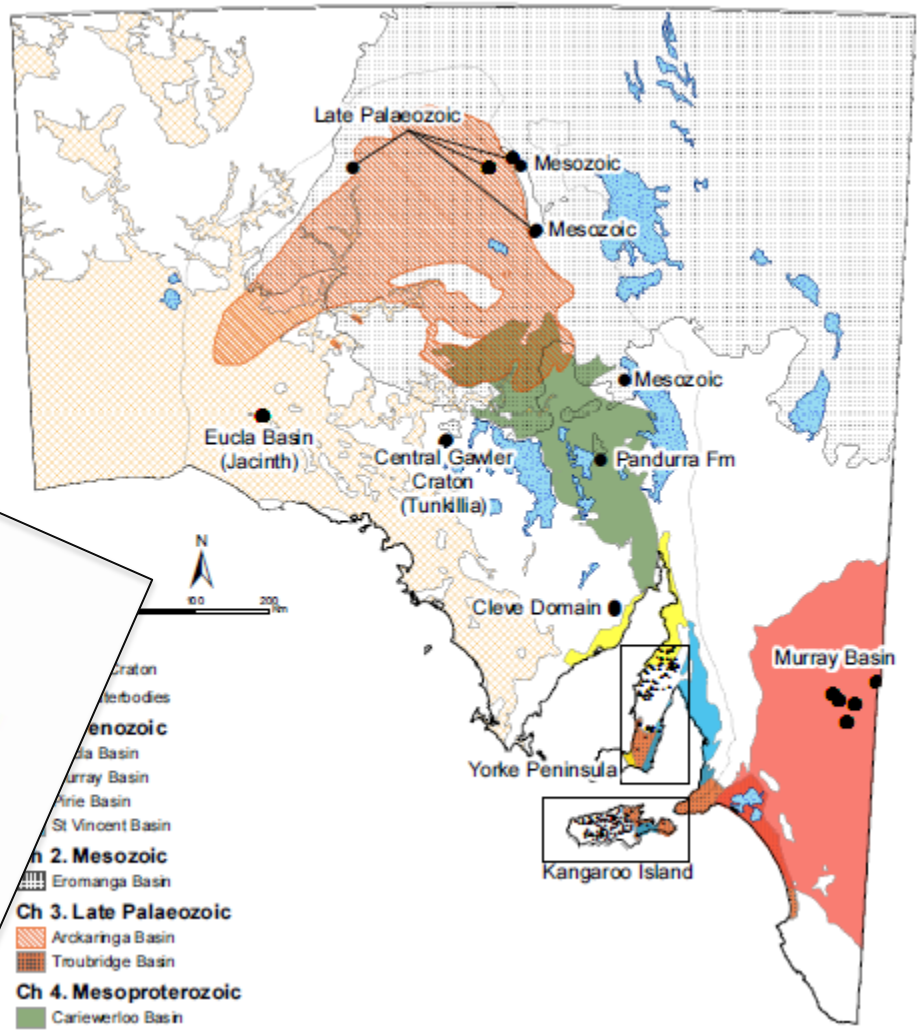
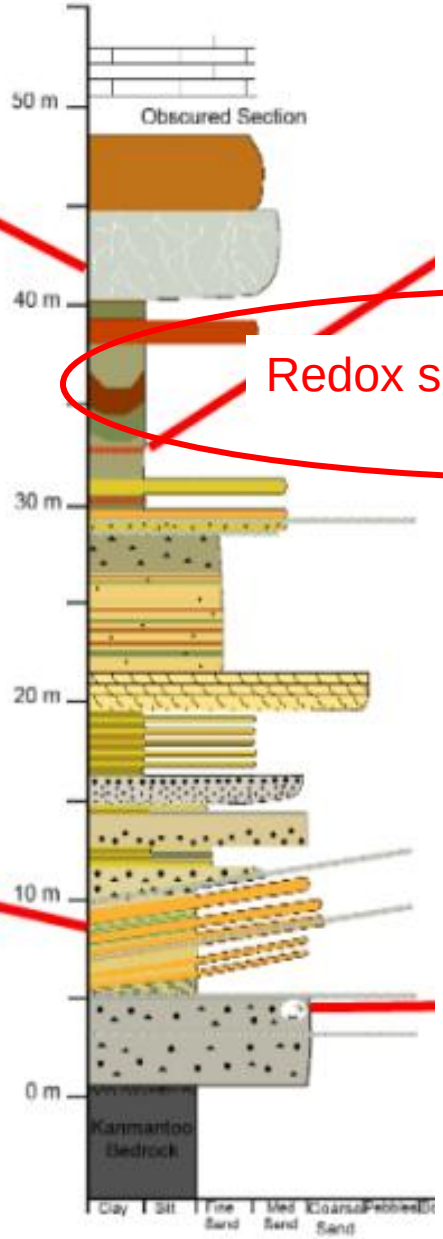
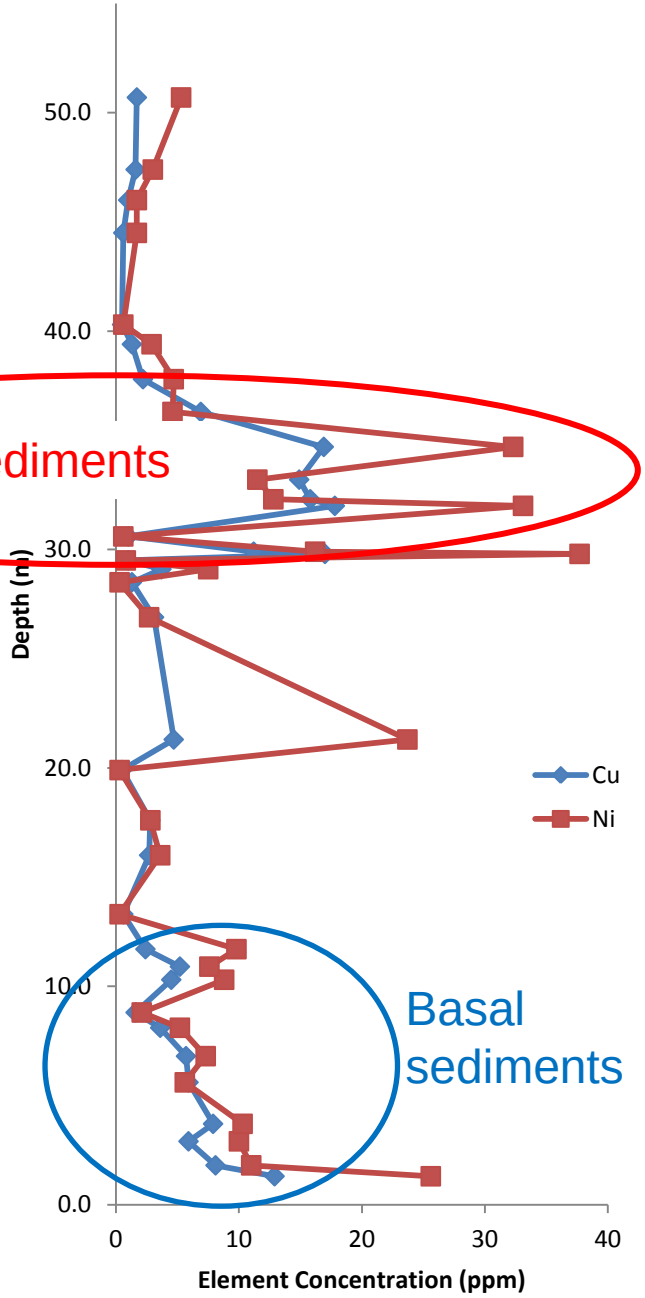
CRC



Troubridge Basin – Permian - Cape Jervis Profile

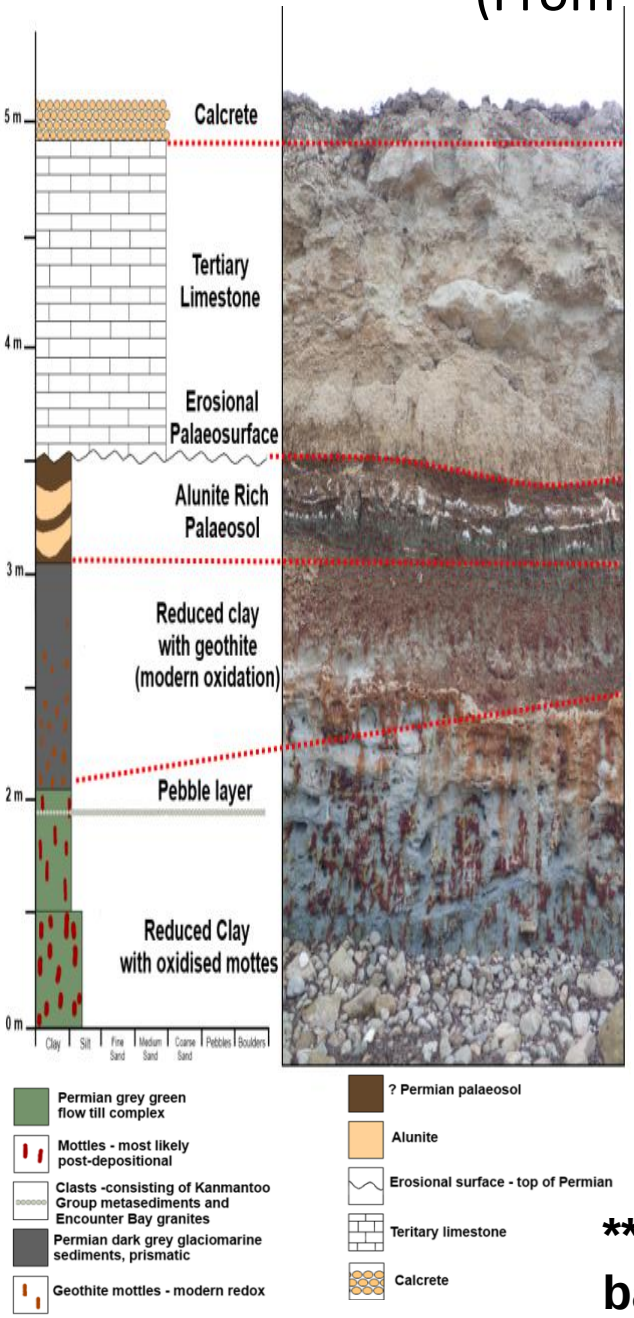
(from Verity Normington, DET CRC)

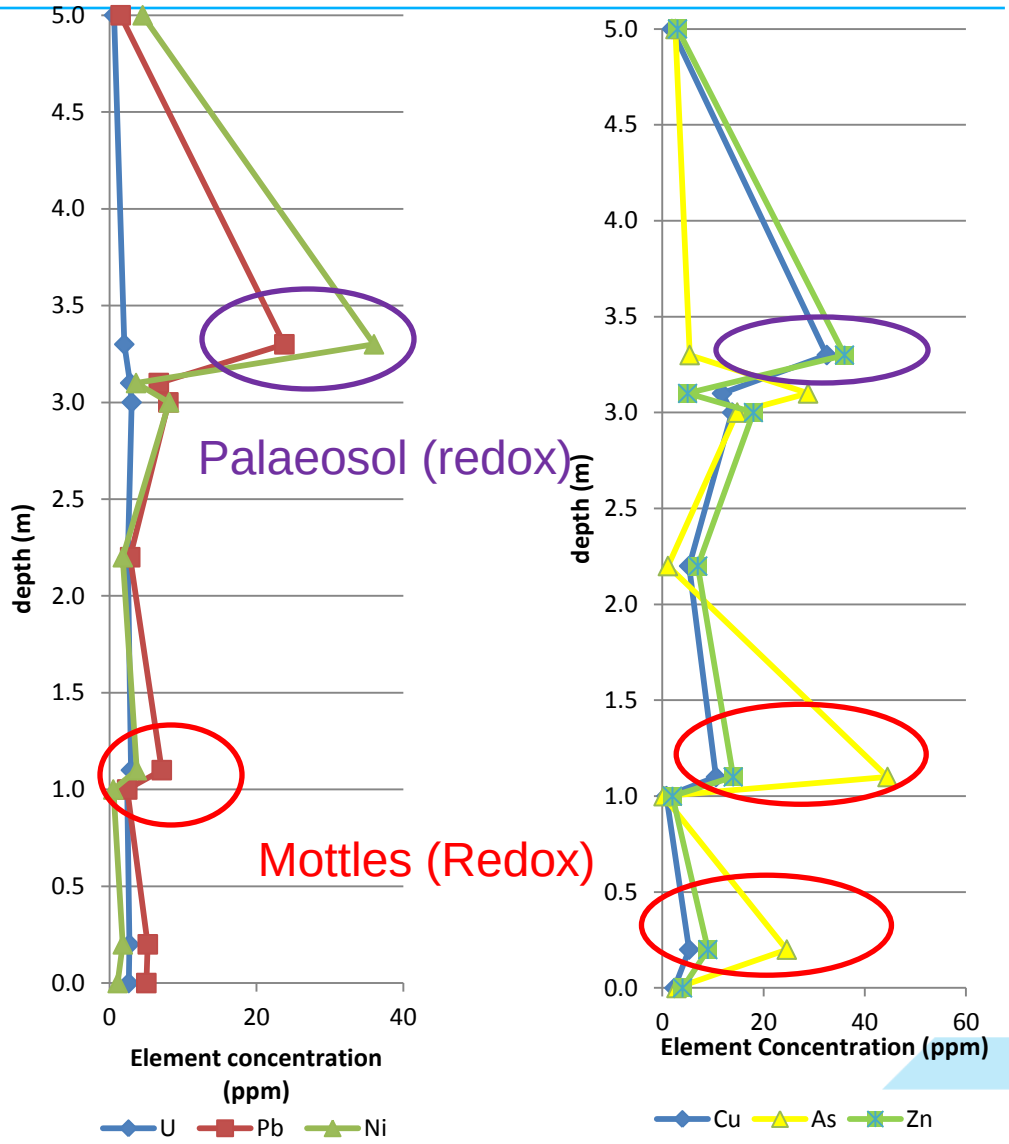




Troubridge Basin Permian - Waterloo Bay Profile

(From Verity Normington, DET CRC)





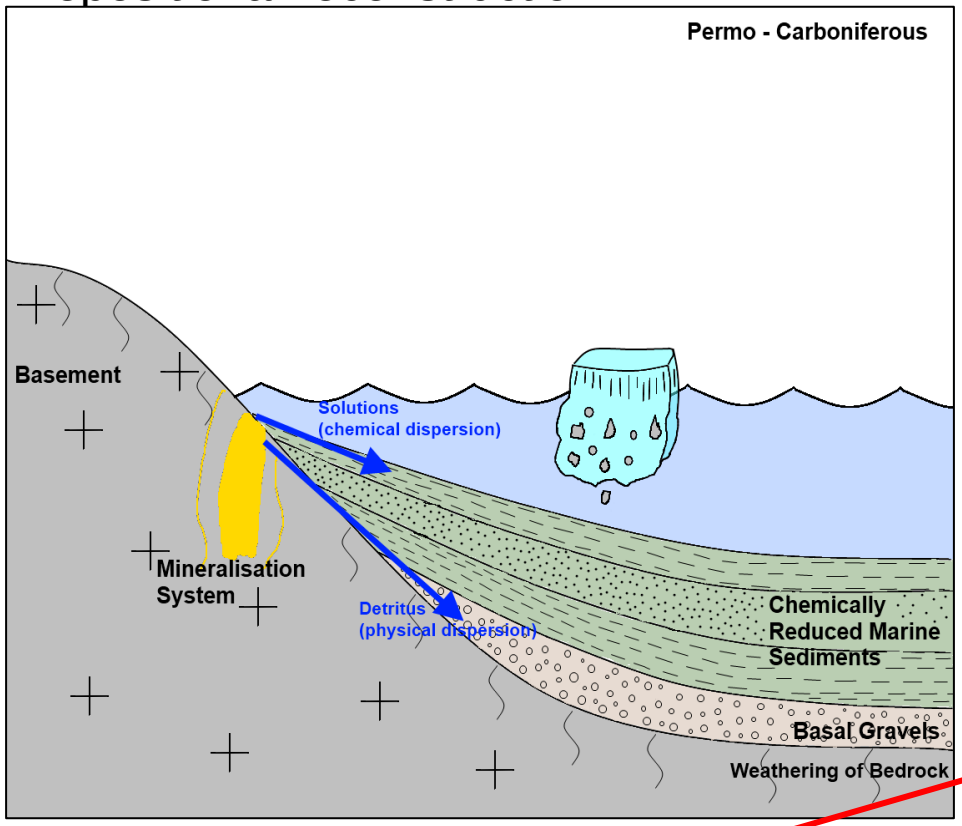
****New results near Hillside show up to 41 ppm Cu basal Permian sediments in REX Minerals drillhole****

4D Landscape Geochemical Models

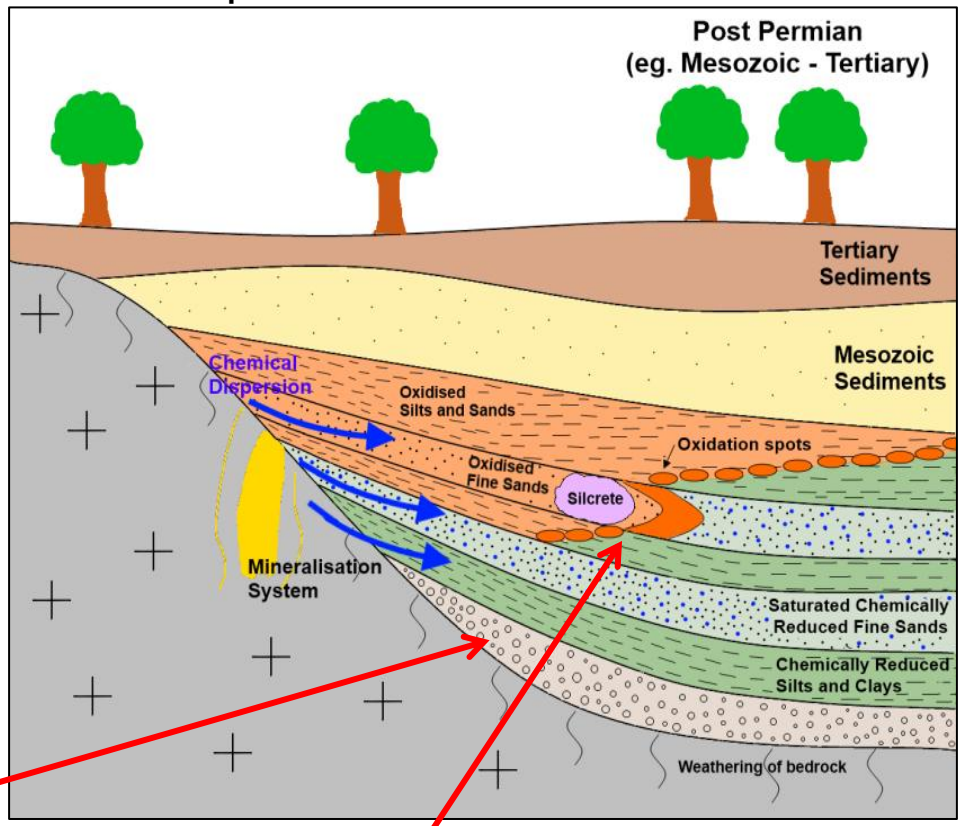
Sampling interfaces in the context of palaeolandscape / environment reconstructions for Troubridge Basin

(from Verity Normington DET CRC)

Depositional reconstruction

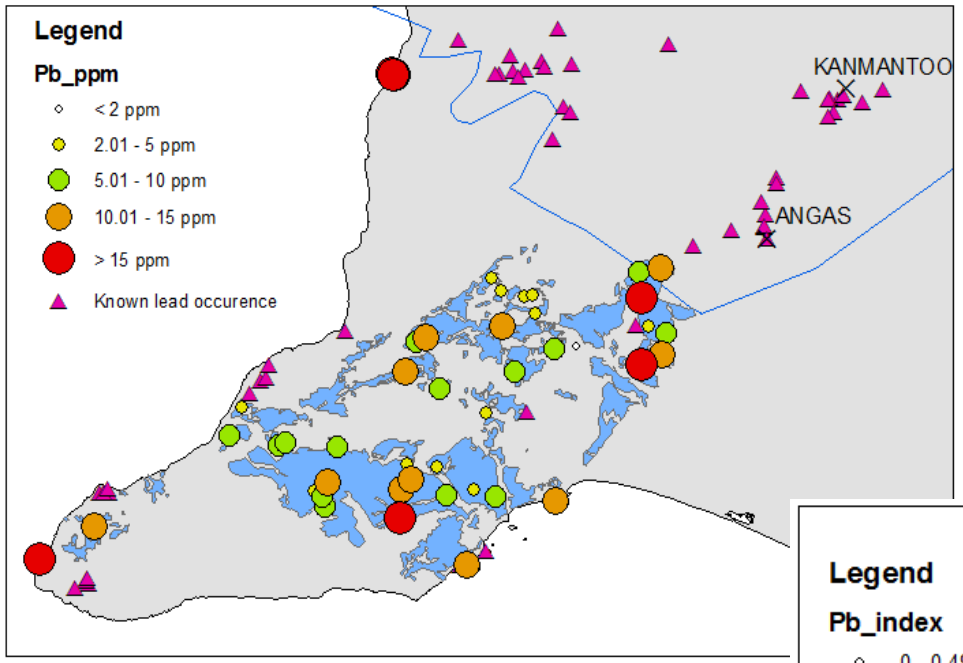


Post -Depositional reconstruction



Key interfaces – basal sediments and reduced/oxidised (redox) sediments

Kanmantoo Belt base metal prospectivity expressed in Permian sediments geochemistry (Verity Norrington PET CRC)



Lead Concentrations

10 samples >15 ppm

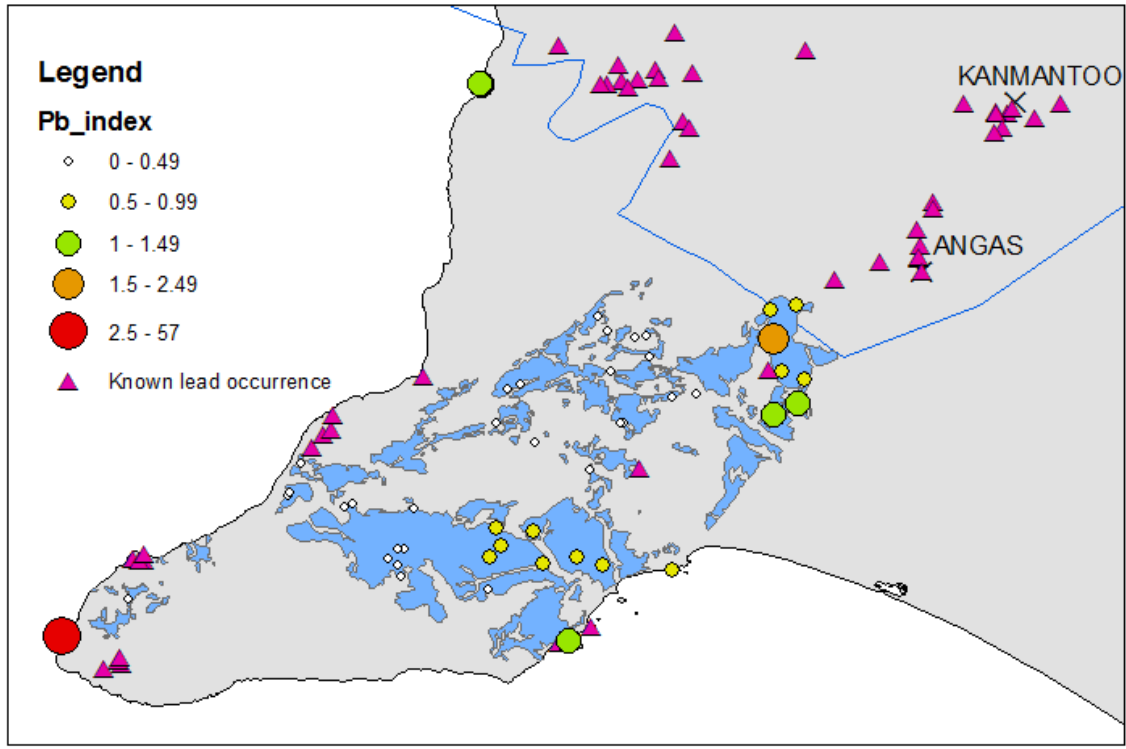
Ferruginous sediments at Cape Jervis (156 and 124 ppm) and Ashbourne (16 ppm)

Clay sediments at Cape Jervis, Hallett Cove, Myponga and Inman Valley, range from 15.3 to 20.4 ppm

Using Lead Indices

Ferruginous sediments at Cape Jervis remain (92 and 80 time background), Ashbourne becomes less significant (twice background)

Clay sediments at Ashbourne in two times background, the other



Cover savvy geoscientists of the future: Who will be part of this love affair?

Part of integrated geoscience workflow

Given the expanse of cover …. Where are our cover savvy geoscientists coming from?

Are training institutions engaged and providing the relevant foundations?

Thank-you….

Yours Lovingly

Steve

(Your Cover Lover Brother)

Disclaimer

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