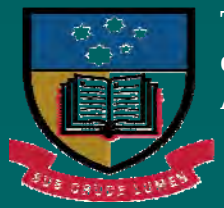
River red gums and mineral exploration in Australia

Karen Hulme & Steve Hill



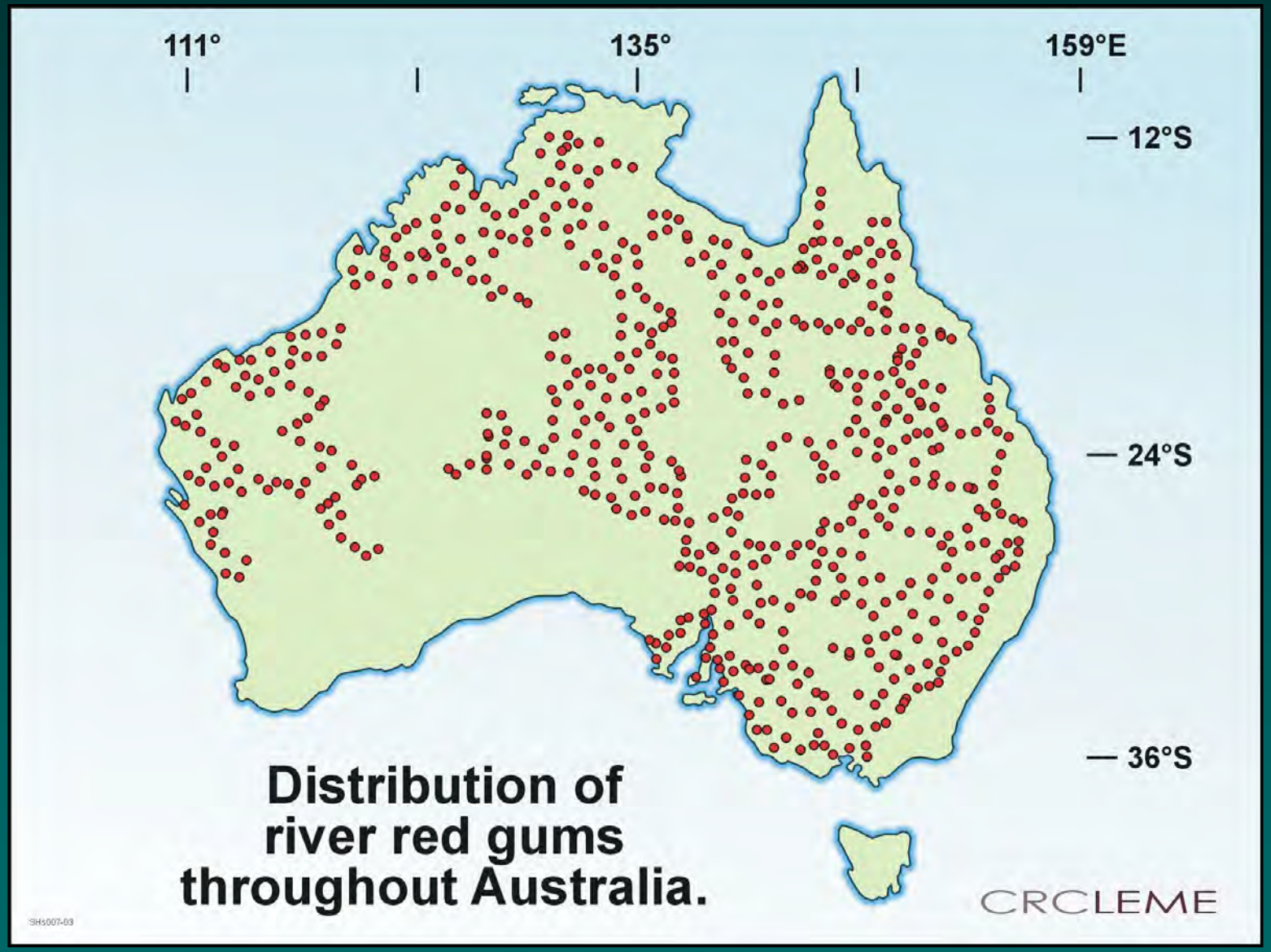
The University
of Adelaide
Australia

River Red Gums

- *Eucalyptus camaldulensis*

Widespread regional distribution

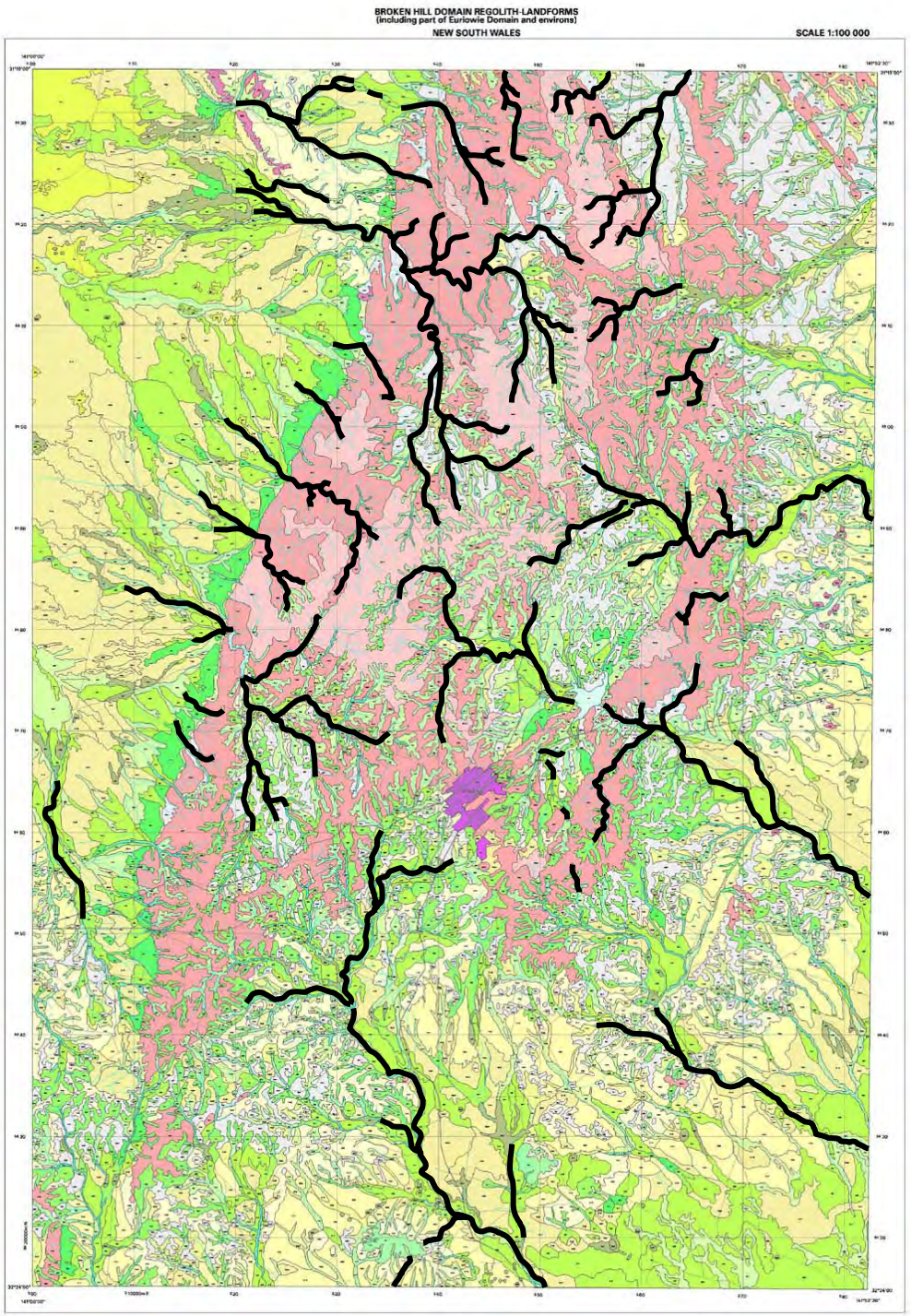
- one of the most widespread tree species in Australia!



Widespread local distribution

e.g. Broken Hill Domain

River red gum distribution along major creeks in the Broken Hill region (Hill, 2001)

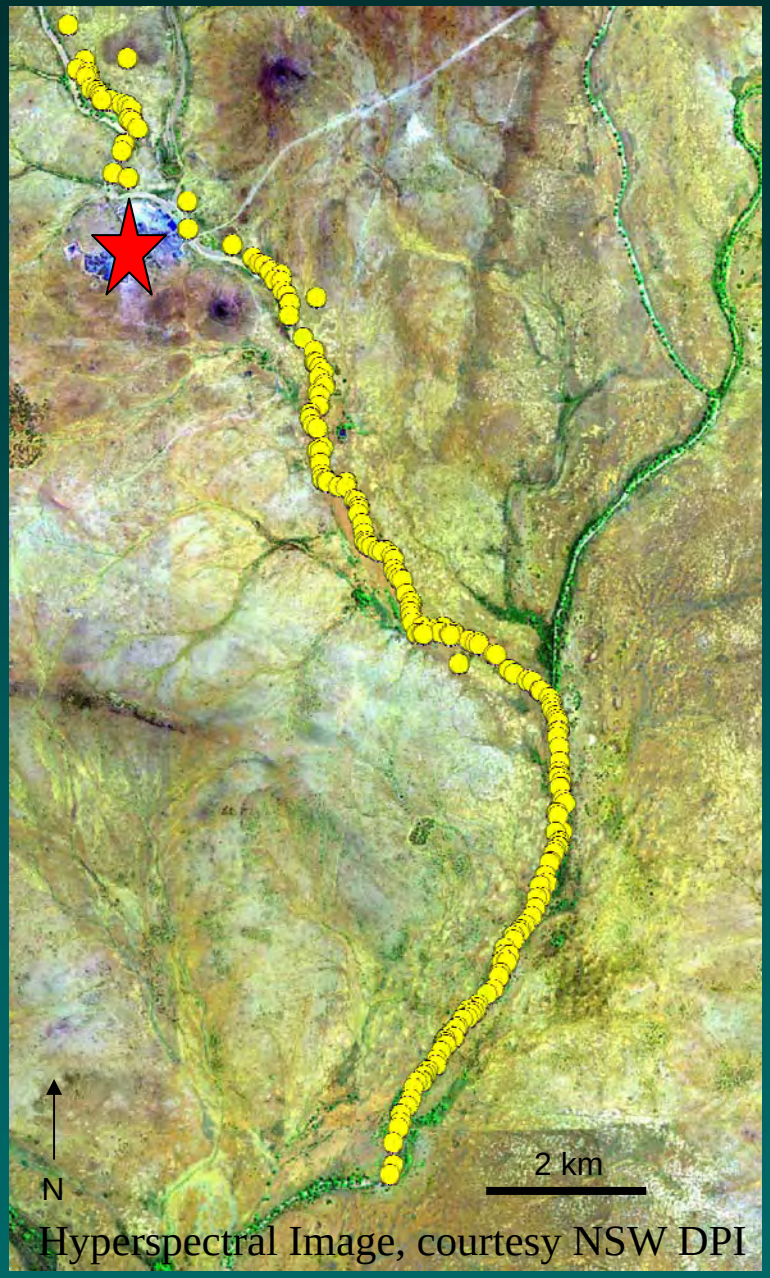


Widespread local distribution

e.g. Pinnacles Broken Hill

★ Pinnacles Mine

● River red gums



Hyperspectral Image, courtesy NSW DPI

Easy to identify

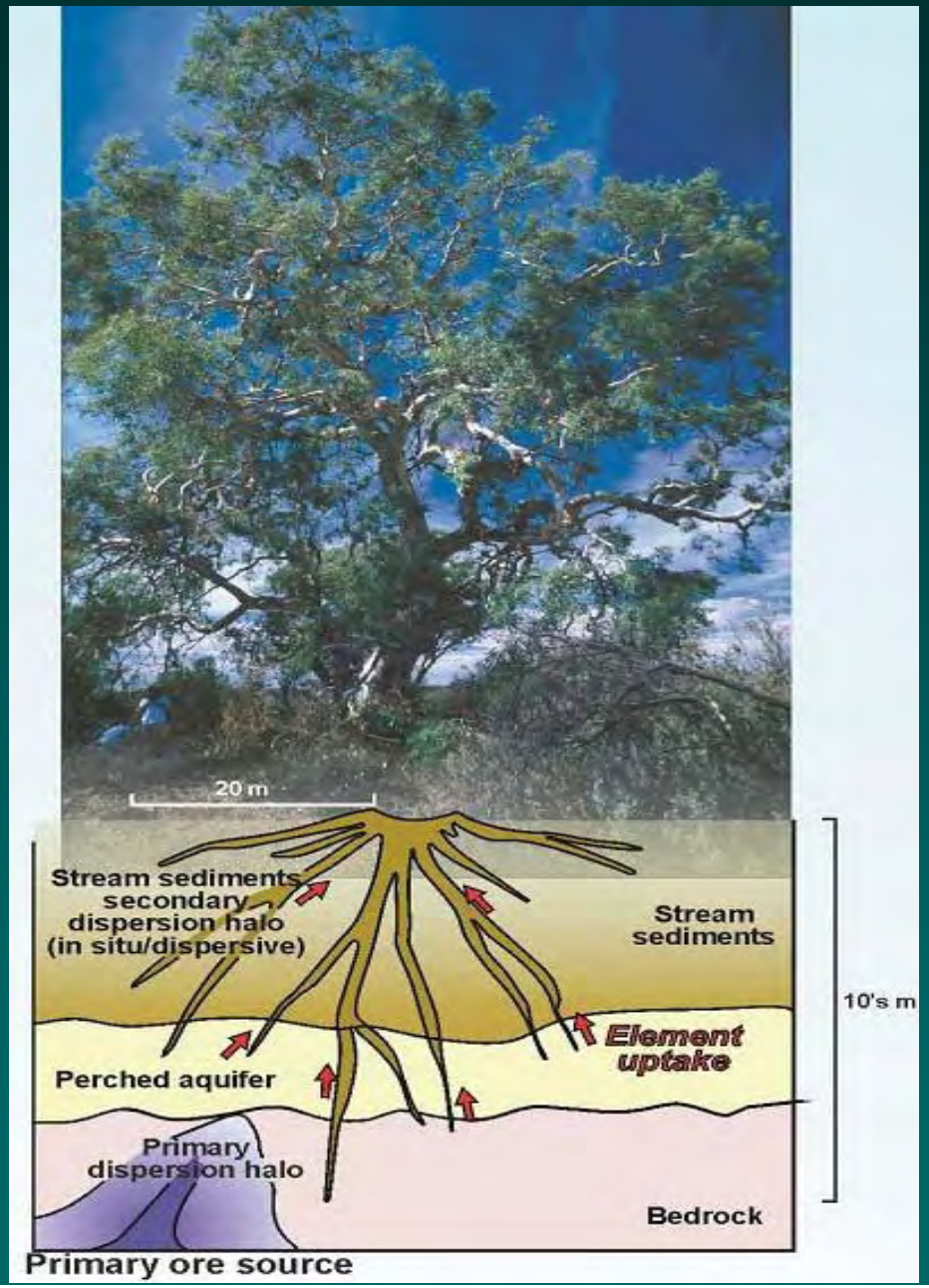
- mostly mono-specific stands along alluvial systems

Ease of sampling

- Spreading evergreen canopy
  - therefore media available all year
- Large, smooth and waxy leaves
  - minimise detrital contamination
- Easy to find and sample along stream transects

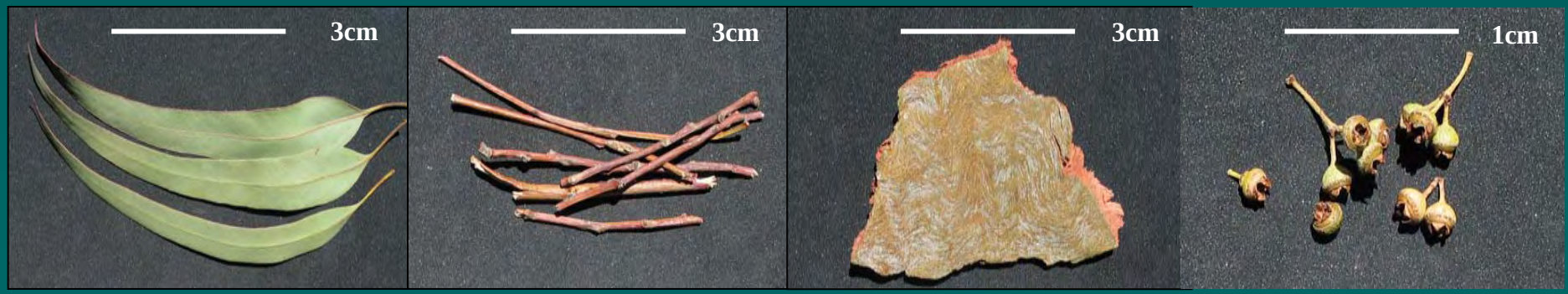
Chemical Characteristics

- extensive root system
  - >4000 m^3
- dispersion pathways
  - stream sediments
  - perched aquifers
  - primary dispersion halo
  - primary ore source



Sampling procedures

- chest height
- samples (leaves, fruit, bark and twigs)
- at compass sectors of 45^{o}
- sample size ~ 300g
- latex non-powdered gloves
- brown paper bags



Field sites
– mineral exploration significance

Tibooburra → Alluvial Au

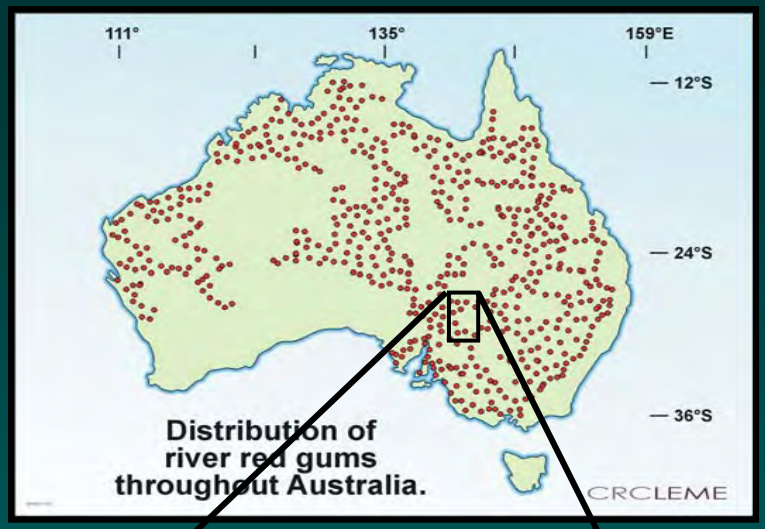
Williams Peak → Au & diamonds

Teilta → potential Cu-Au/Ag-Pb-Zn

Flying Doc → Ag-Pb-Zn

Bindarah → possible Ag-Pb-Zn

Yunta → potential Cu-Au



This presentation…

Some of the highlights from my PhD research

In particular…

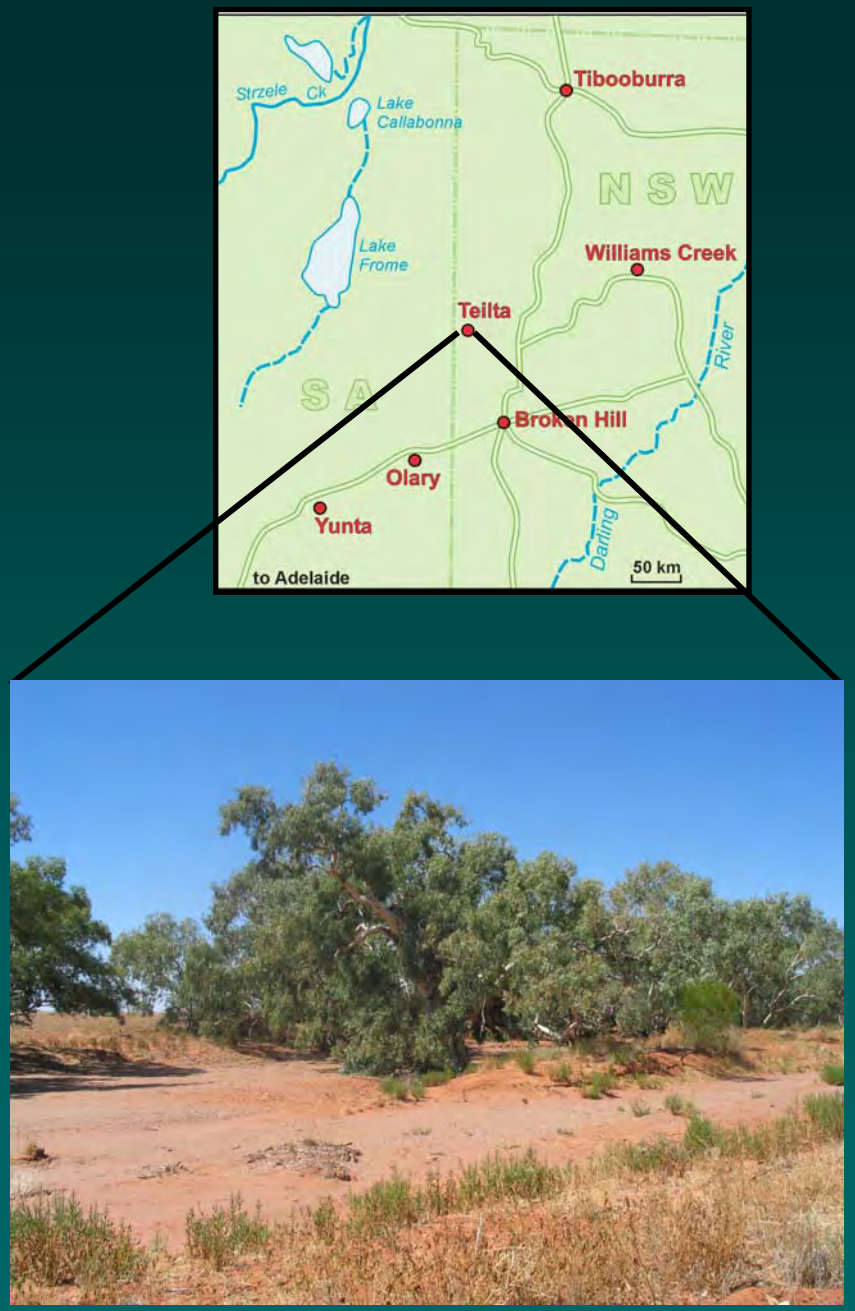
- – temporal element variations and their implications for mineral exploration….
- – mineralisation discovery through transported cover at the Barrier Pinnacles Mine….

Biogeochemical studies ….

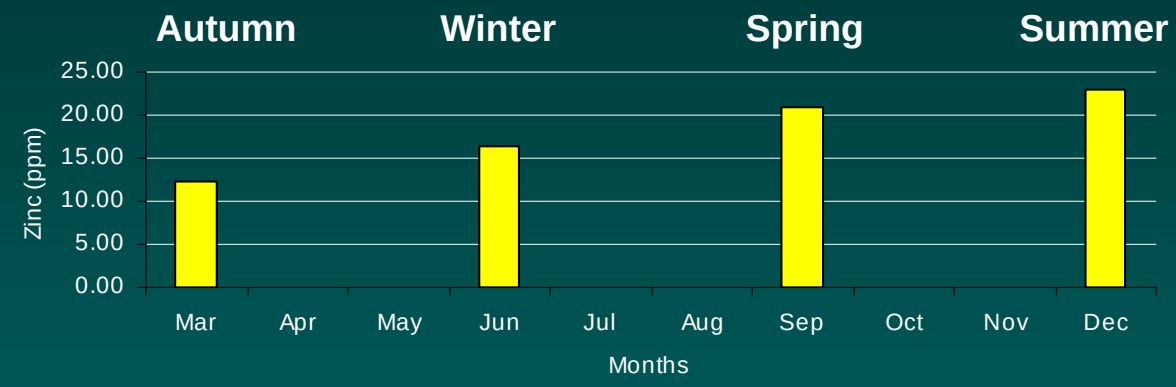
- **Cold to temperate environments**
  - Demonstrated temporal variations
  - Greatest Au assays achieved from the spring time
- **Semi-arid and arid regions (limited understanding)**
  - No distinct/regular growth pattern
  - Irregular rainfall patterns
- **Therefore….**
  - Does the *E. camaldulensis* display equivalent/similar temporal chemical trends?

Tielta field site…

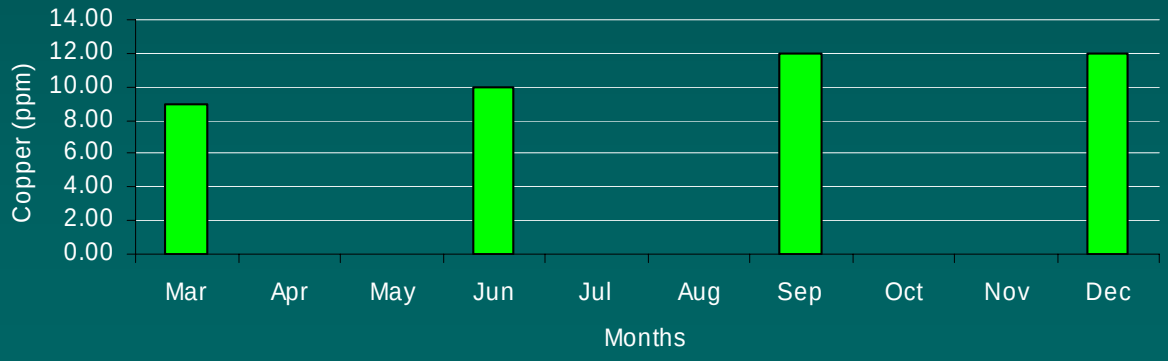
- ~ 150 km NNW of B Hill
- Potential Cu-Au and Zn-Pb-Ag mineralisation
- Paleoproterozoic Willyama Supergroup
- Neoproterozoic Adelaidean metasediments



Teilta Temporal results…

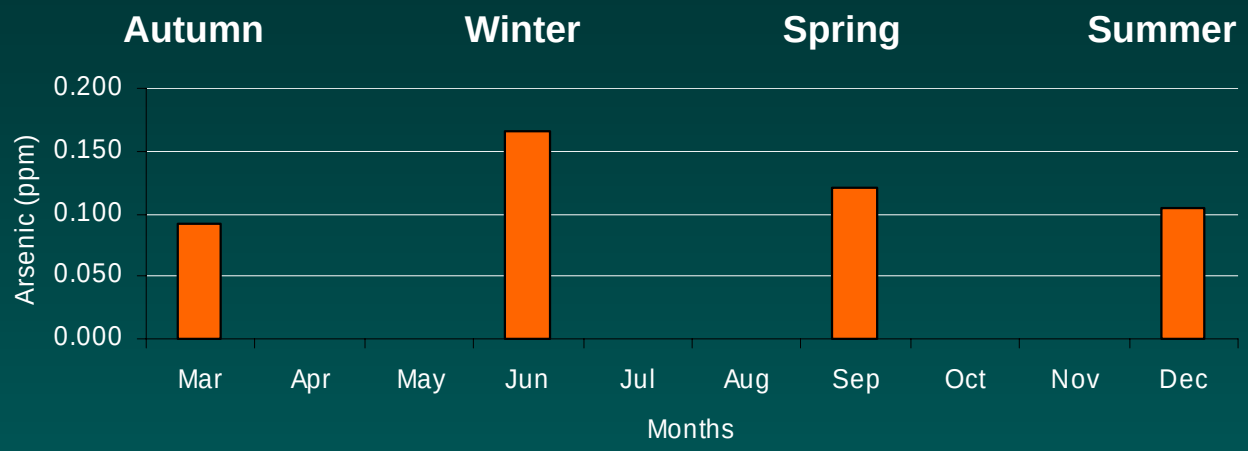


- Zn – 23 ppm
- Summer
- Chlorophyll synthesis



- Cu – 12 ppm
- Summer
- e- transfer

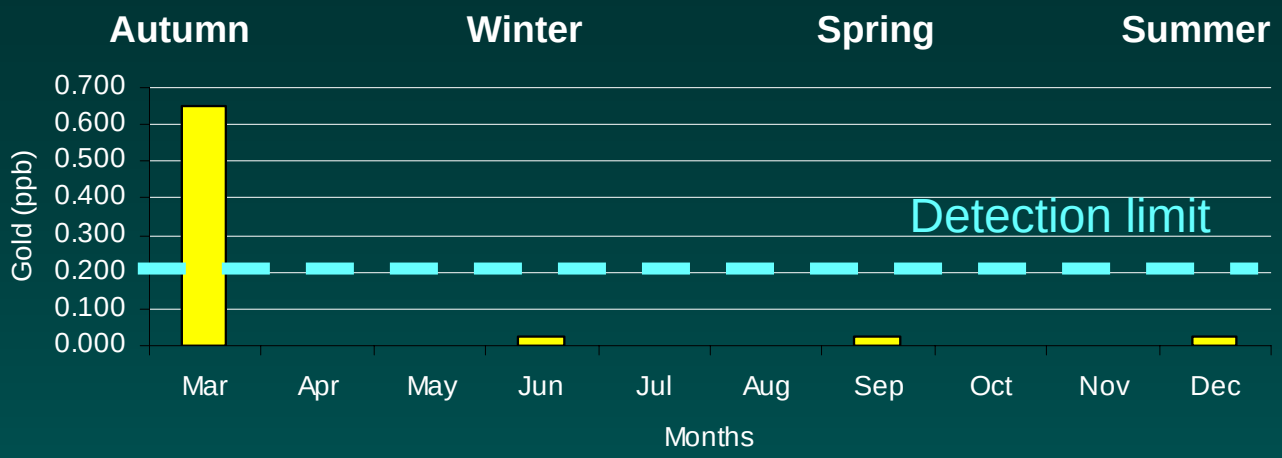
Teilta Temporal results…



- As – 0.17
- Winter

- Non-essential element
  - Plays no physiological role in plant nutrition
  - Relationship to Au and sulphide pathfinder properties
- Highest assay recorded for winter
  - River red gum considered to be less active
  - As associated with P uptake
  - Decreased P during winter increase in As

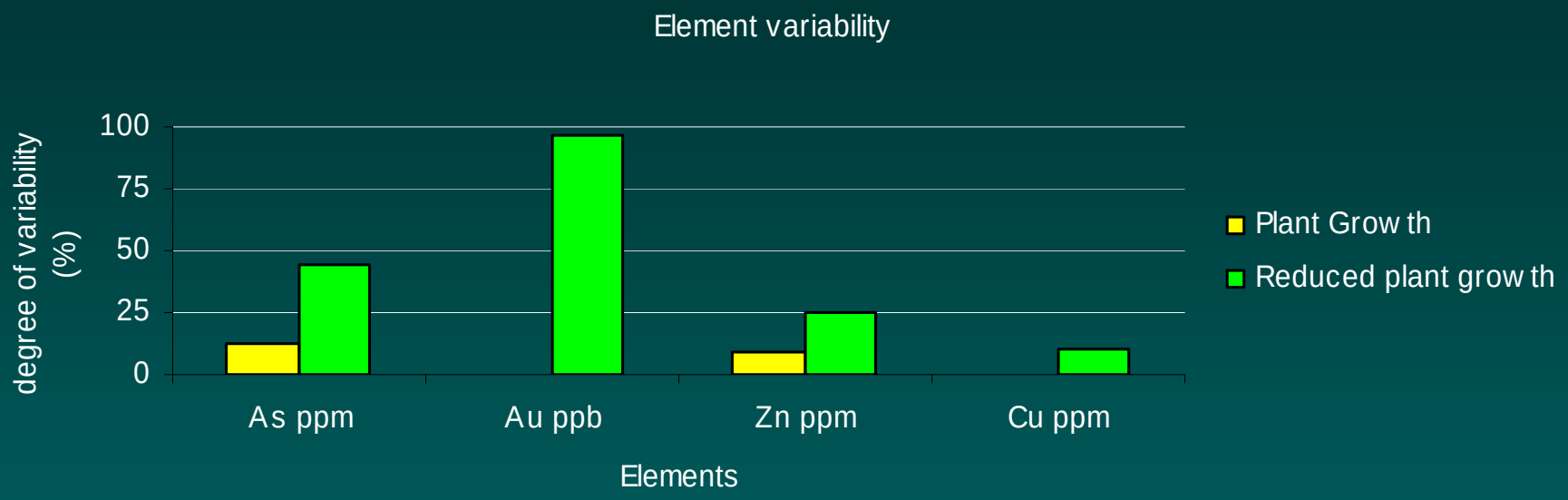
Teilta Temporal results…



- Au – .56 ppb
- Autumn

- **Non-essential element**
  - Economic interest
  - Plays no physiological role in plant nutrition
- **Highest assay recorded for autumn**
  - Period of peak biomass
  - Distribution of other elements across a large biomass
- **Below detection**
  - Spring/summer dilution due to increase in cellulose & starches
  - Winter period of dormancy

Element variability results…



- High seasonal variability > 80% → Au
- Intermediate seasonal variability ~ 50% →As
- Low seasonal variability ~ 30% → none
- Slight seasonal variability < 30% → Zn and Cu

A DISCOVERY!!!

Unearthing the buried Barrier Pinnacles mineralisation...

Pinnacles field site…

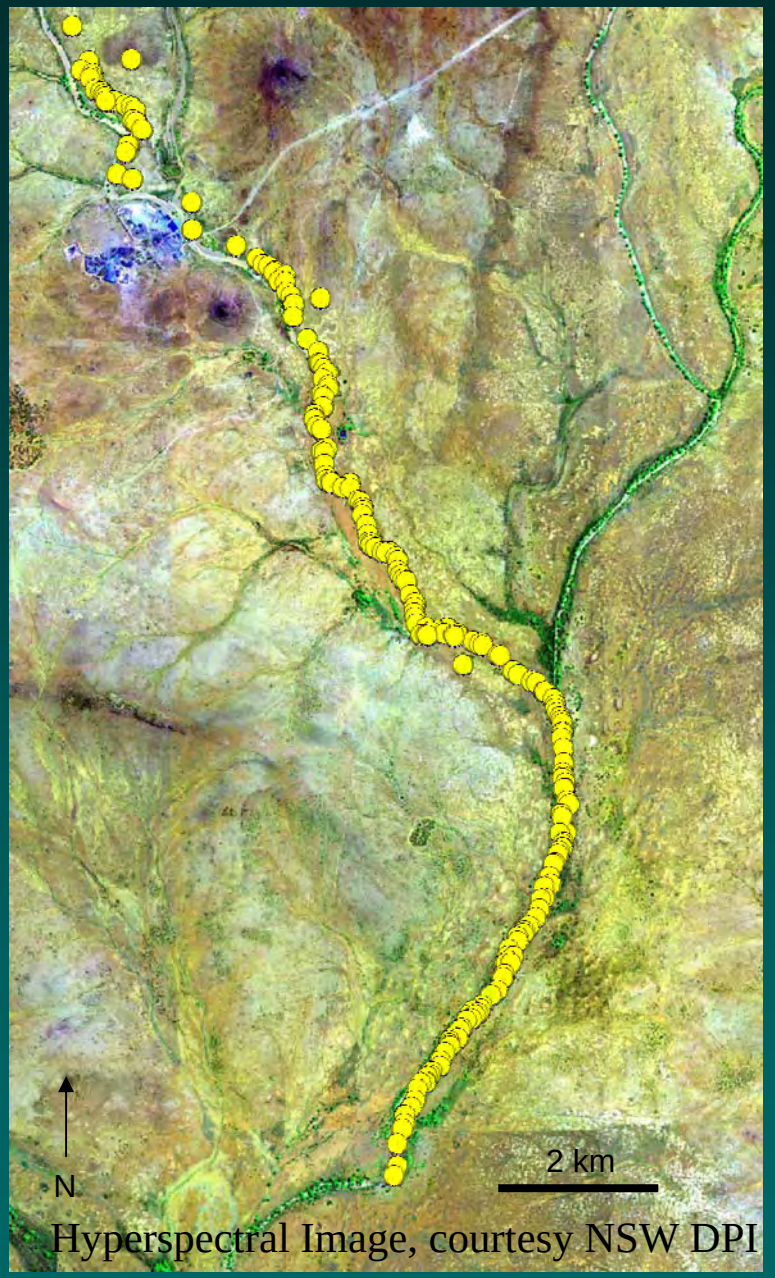
- Barrier Pinnacles Mine
  ~ 10 km SW of Broken Hill
- Base metal Pb-Zn-Ag
- Paleoproterozoic Willyama Supergroup

Pine Creek…

Sample spacing

– every “collectable” RRG

- 215 RRGs sampled
  - – Media
    - Leaves
    - Chest height
    - Sample size ~300 g
- Analytical methods
    - XRF
    - ICP-MS



Hyperspectral Image, courtesy NSW DPI

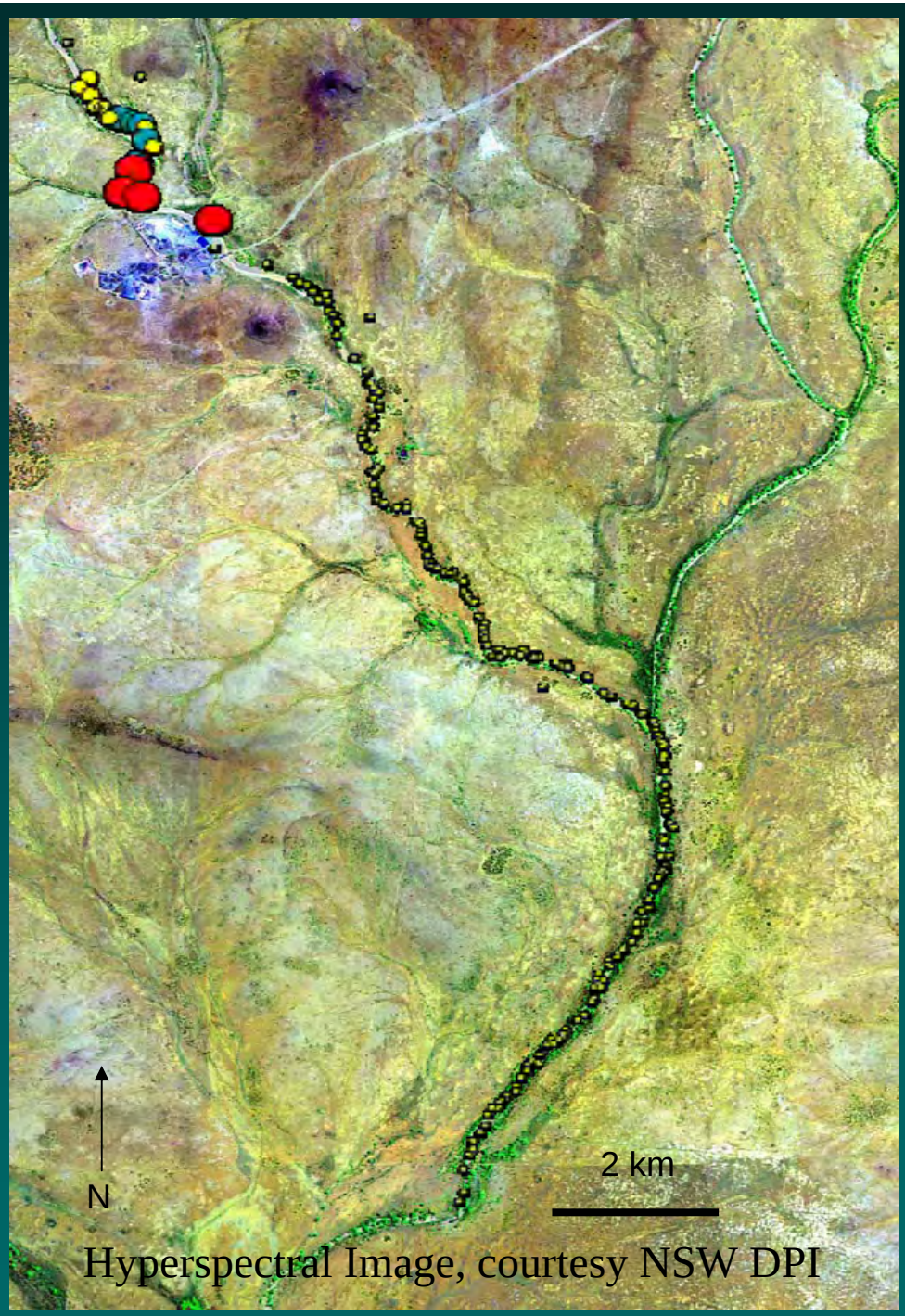
Results…

- Pb up to 205 times background levels
- Geochemical footprint

~ 2.5 km

2:1 Pb/Zn & 3:2 Pb/Zn

- 0 – 36 ppm
- 37 – 99 ppm
- 100 – 190 ppm
- 191 – 411 ppm



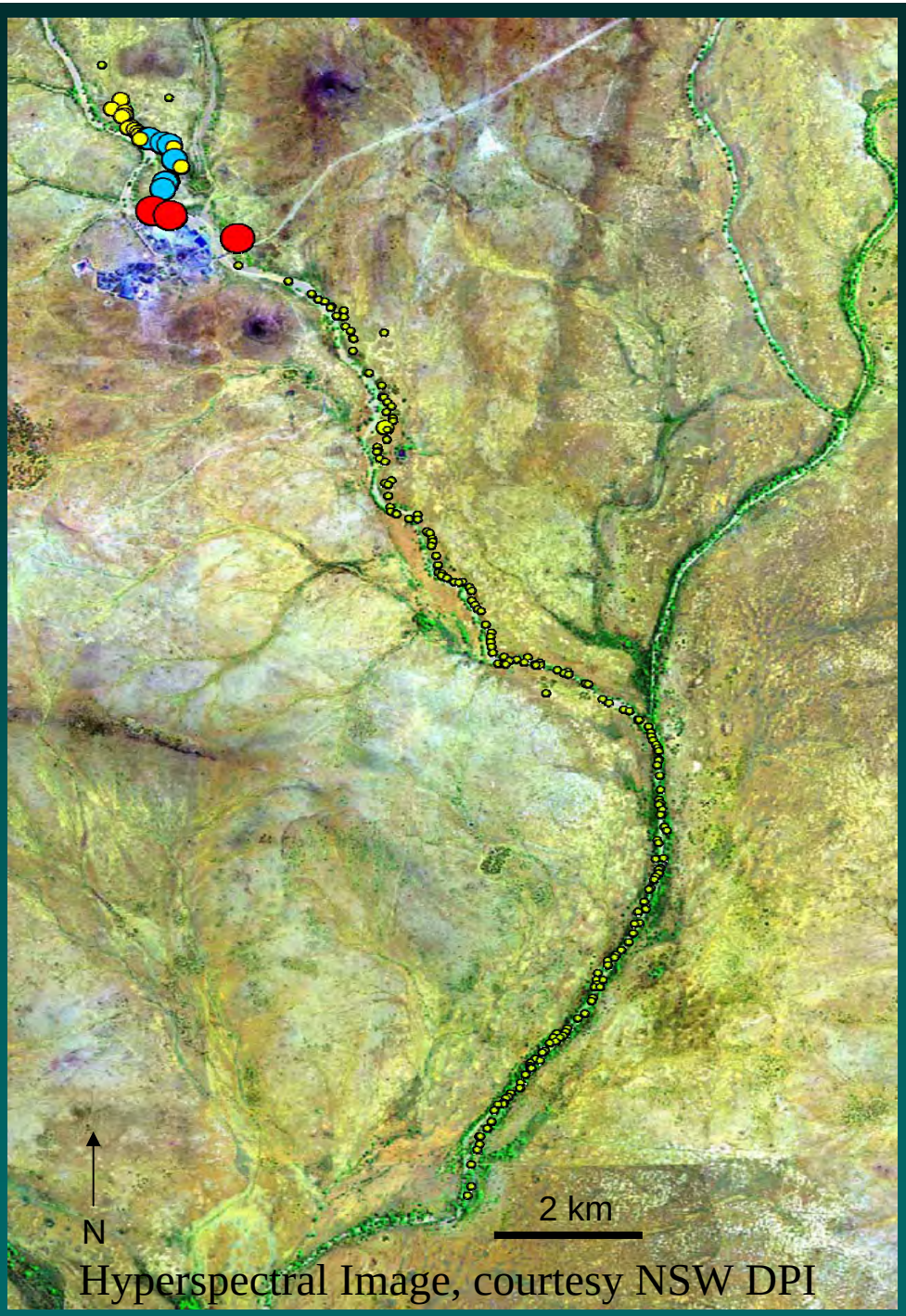
Hyperspectral Image, courtesy NSW DPI

Results…

- Ag up to 136 times background value

- Geochemical footprint 2.2 km

  - 0.005 – 0.100 ppm
  - 0.101 – 0.340 ppm
  - 0.341 – 0.710 ppm
  - 0.711 – 1.360 ppm



Hyperspectral Image, courtesy NSW DPI

Results…

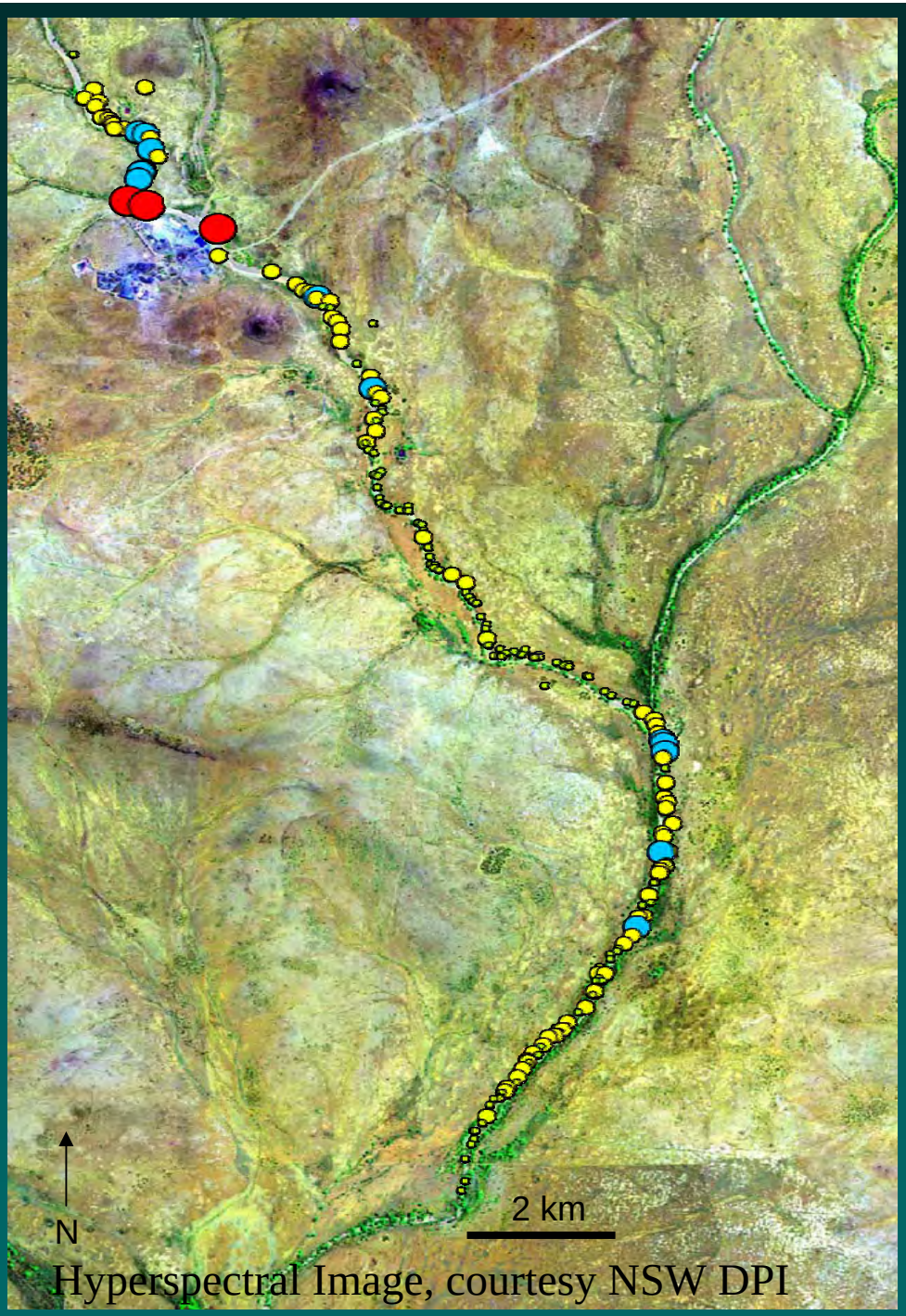
- Zn up to 7 times background values
- Erratic pattern (repeated)
  - mobility
  - peaks related to floodouts

17 - 47 ppm

48 - 80 ppm

81 - 141 ppm

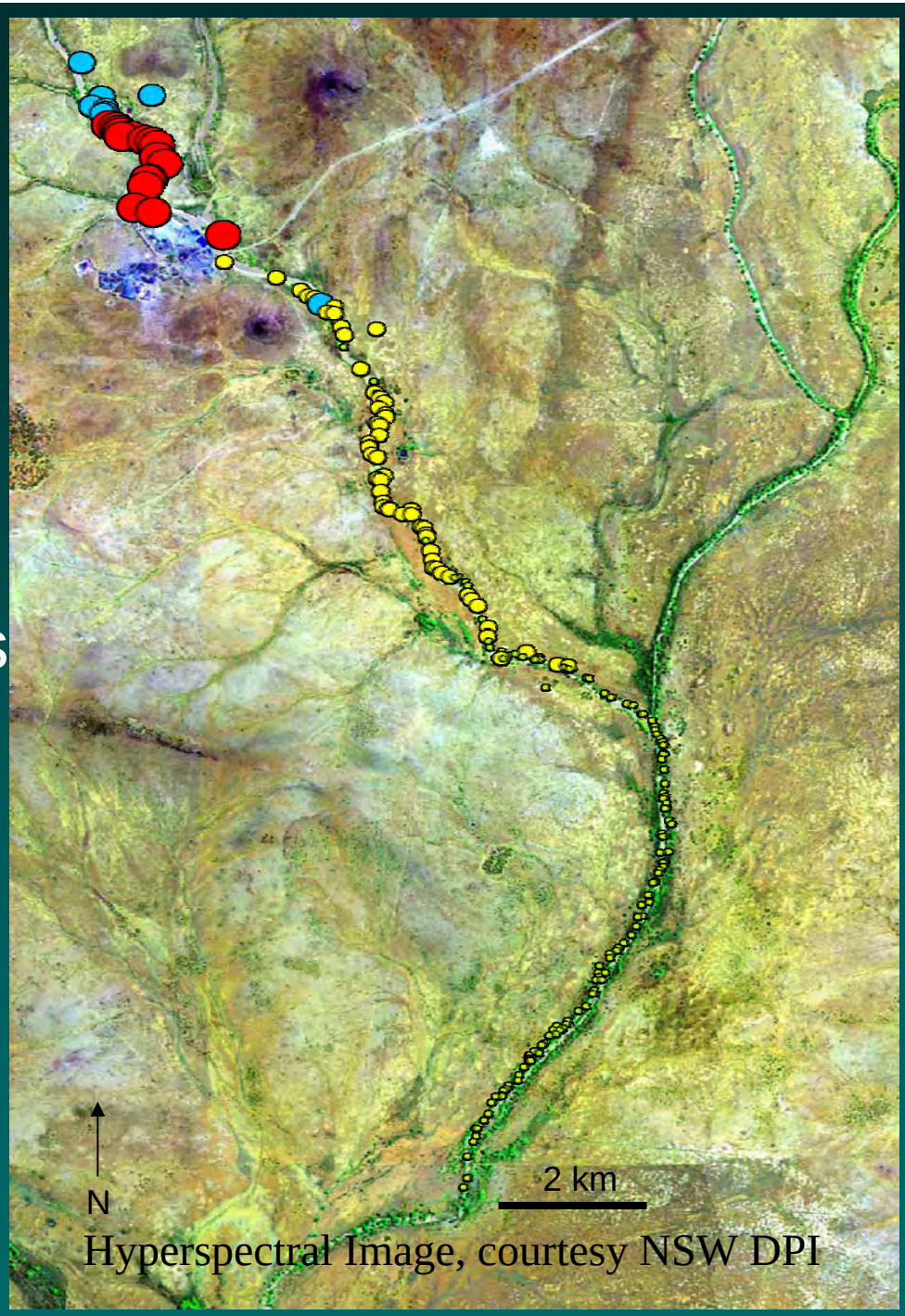
141 – 338 ppm



Results…

- Pb/Zn ratio
  - Zn ‘peaks’ related to floodouts
  - reduces “false” or transported anomalies

- 0 – 0.1 ppm
- 0.11 – 0.38 ppm
- 0.39 – 0.97 ppm
- 0.98 – 2.1 ppm



Hyperspectral Image, courtesy NSW DPI

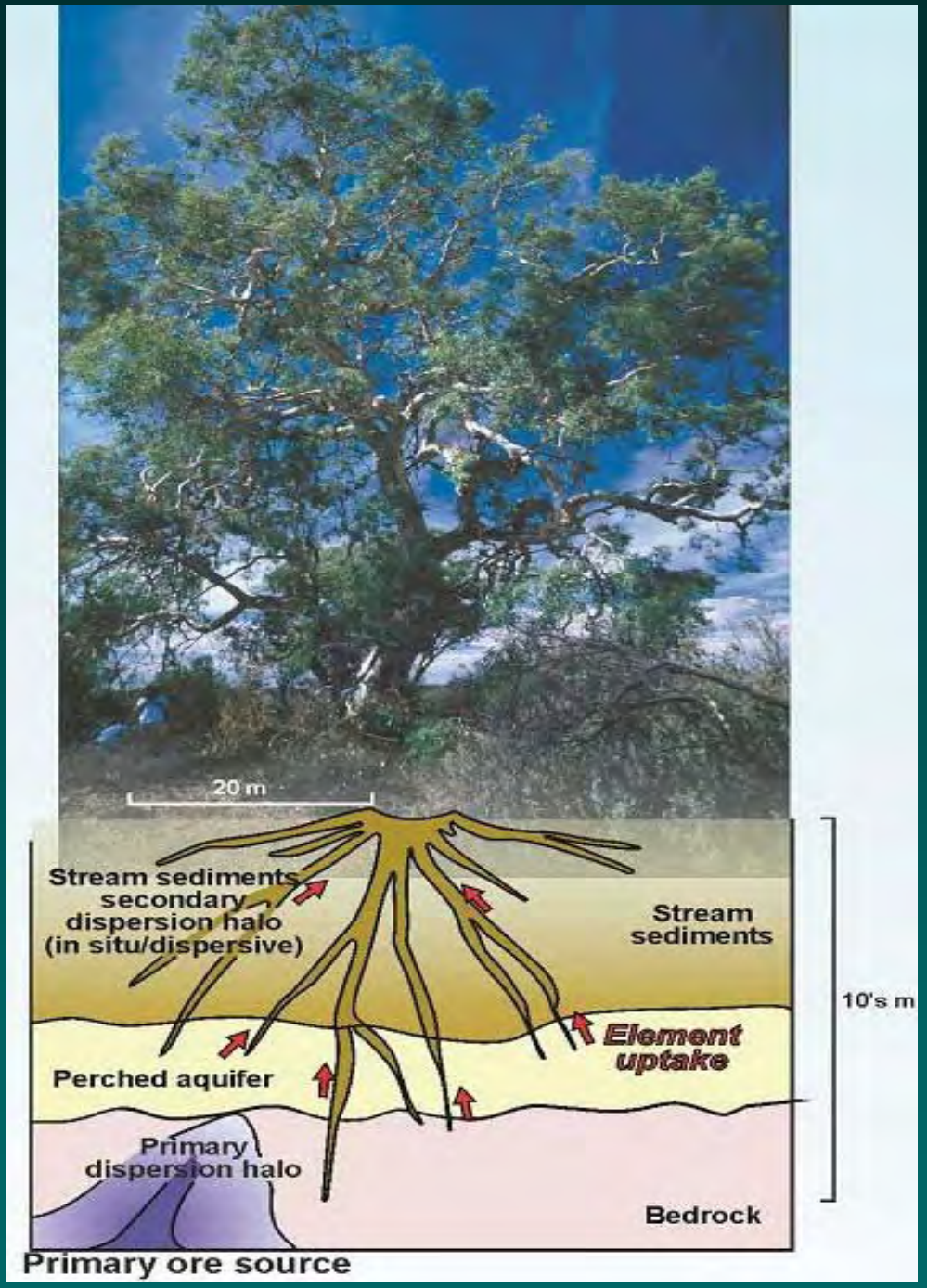
Detrital contamination…

Elements	Unwashed	Washed	Unwashed	Washed	Unwashed	Washed
	Pine Crk 5b		Pine Crk 6		Pine Crk 6a	
As ppm	7.400	8.040	4.360	5.490	5.780	5.990
Ag ppm	0.800	1.070	0.530	0.480	0.780	1.040
Pb ppm	539	464	207	266	354	383
Zn ppm	168	148	106	132	215	269

- No significant decrease in element concentration
  - elements partitioned to veins
  - movement of mobile elements (N, P, K, Mg …)
  - element concentration variable ∴ difference between washed & unwashed is within the range of natural variation

Sources…

- Stream sediments
- Perched aquifer
- Bedrock
- Primary ore source

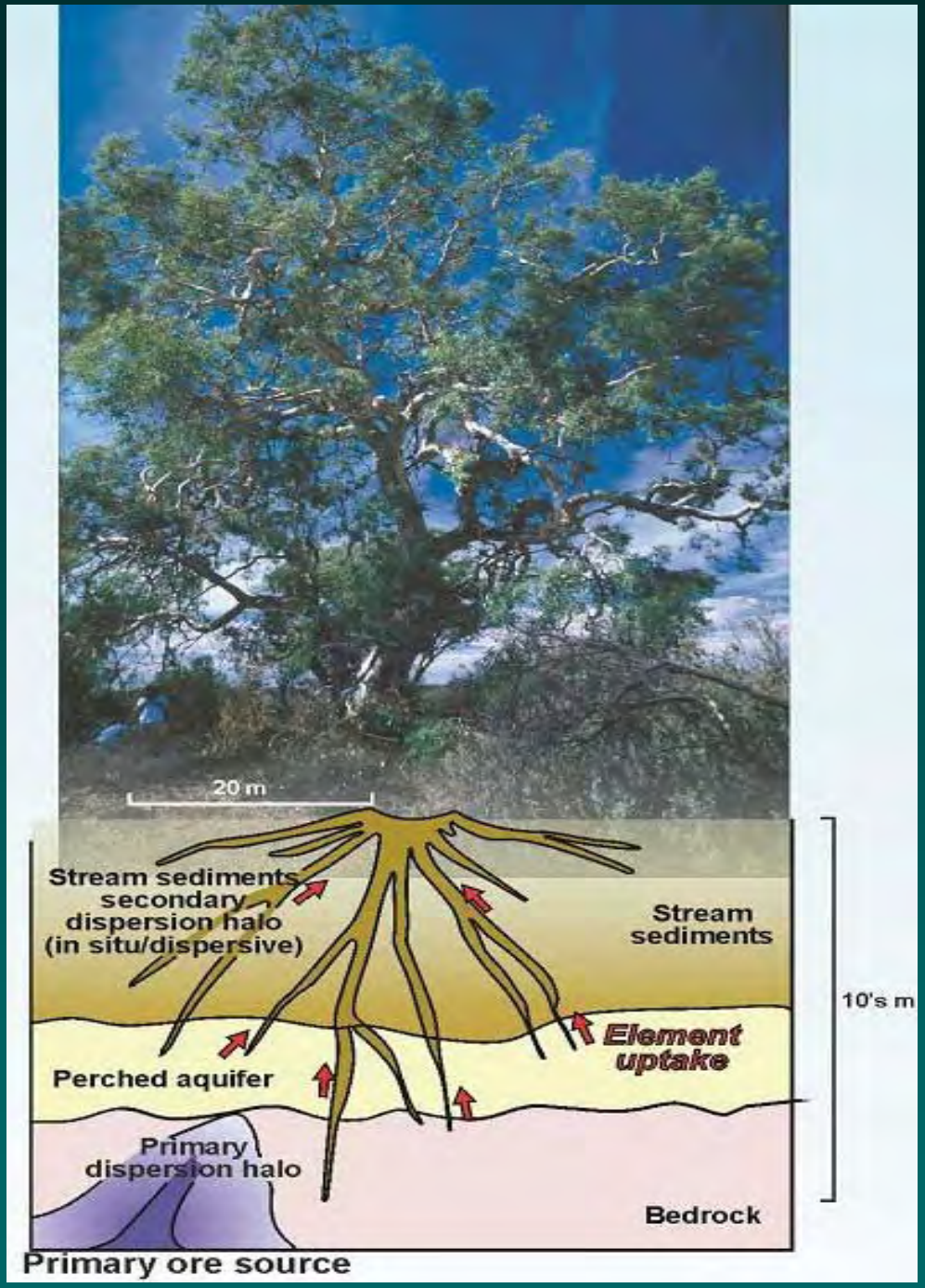


Excavation…

– ‘Gibbo’

(*earnest hard-working CRC LEME Honours student*)


1 m


20 m
Stream sediments secondary dispersion halo (in situ/dispersive)
Stream sediments
10's m
Element uptake
Perched aquifer
Primary dispersion halo
Bedrock
Primary ore source

Conclusions…

- Temporal variations in *E. camaldulensis* may not be extreme but they do exist
- Macro- and micro-elements possibly outline periods of growth development
- The understanding of growth periods and associated element variations allow optimal sampling periods to be defined
- The slight to intermediate variability for Cu, Zn and As suggests that samples from throughout the year would be comparable
- Large seasonal variations for Au reveals a restricted sampling period…possibly autumn for southern Australia

Conclusions…

- River red gums are a useful regional exploration sampling media across large parts of Australia
- These results show polymetallic expression of buried polymetallic mineralisation
- Biogeochemistry can “see through” surface contamination in upper transported regolith
- This has now resulted in the discovery of previously unknown mineralisation lodes

Acknowledgements

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