Regional biogeochemical exploration in southern Australia

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Outline:

Introduction

Objectives

Materials and Methodology

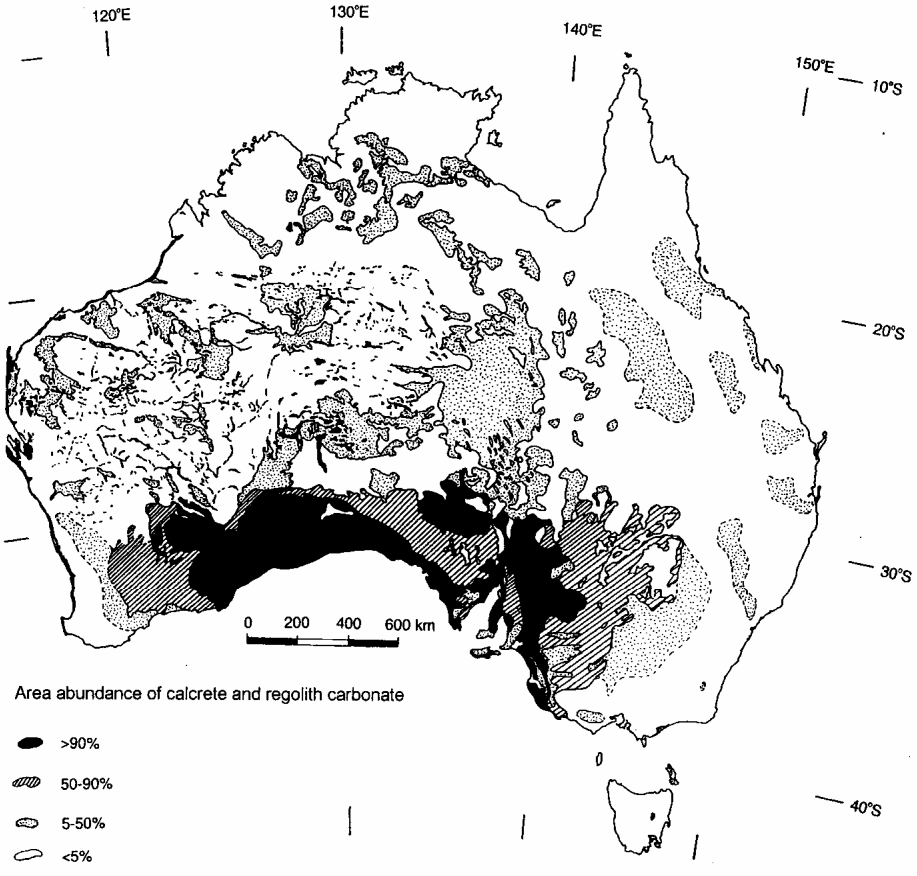
Results

Conclusion

Green plants are the miners of the Earth's crust,....(Baker, 1983)

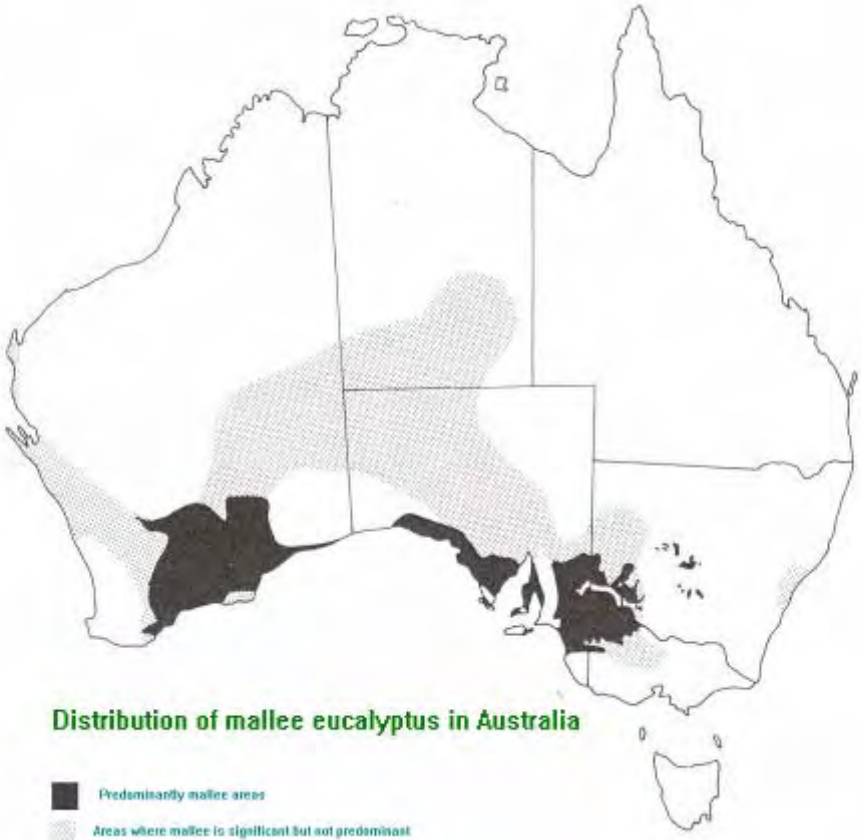
Introduction

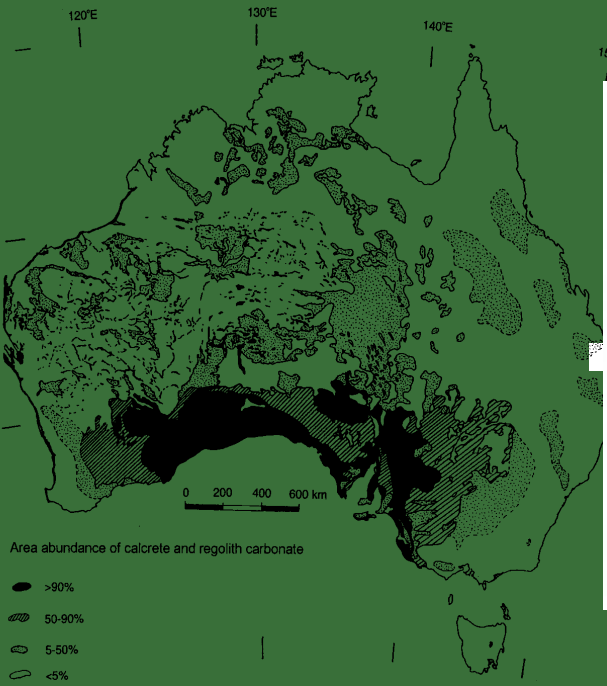
- Baseline biogeochemical studies have not been conducted widely for Australia.
- In particular, in southern Australia, presence of a regolith carbonate (calcrete) poses some advantages and disadvantages for mineral exploration.


120°E
130°E
140°E
150°E
10°S
20°S
30°S
40°S
0 200 400 600 km
Area abundance of calcrete and regolith carbonate
>90%
50-90%
5-50%
<5%

Objectives

- So, we considered this large area for a multi-element reconnaissance biogeochemical investigation to achieve the following objectives:
- To establish baseline concentrations and distributions of trace elements in vegetation and their adjacent substrate
- To characterize and compare the bio- and pedogeochemical patterns of these elements between two media
- To determine the contribution of different element sources to the observed regional biogeochemical dispersions


Distribution of mallee eucalyptus in Australia
Predominantly mallee areas
Areas where mallee is significant but not predominant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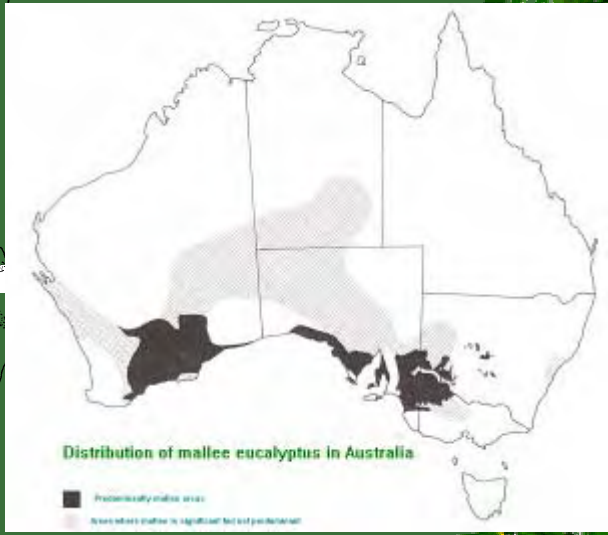
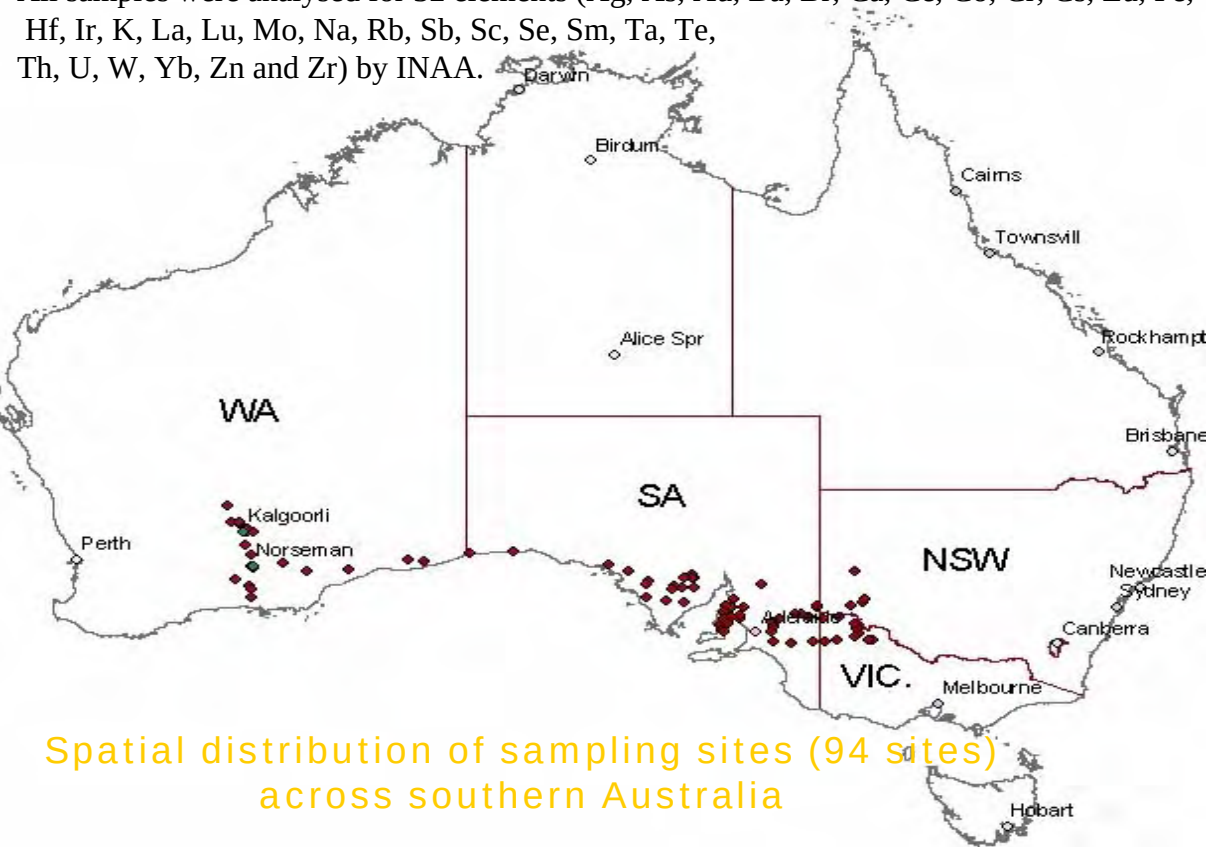

Distribution of mallee eucalyptus in Australia

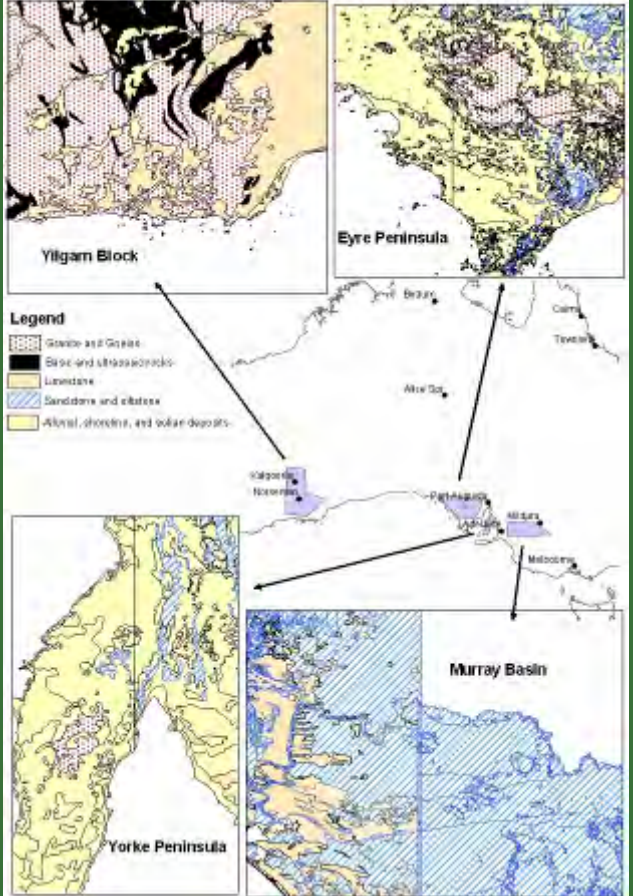
All samples were analysed for 32 elements (Ag, As, Au, Ba, Br, Ca, Ce, Co, Cr, Cs, Eu, Fe, Hf, Ir, K, La, Lu, Mo, Na, Rb, Sb, Sc, Se, Sm, Ta, Te, Th, U, W, Yb, Zn and Zr) by INAA.



Spatial distribution of sampling sites (94 sites) across southern Australia

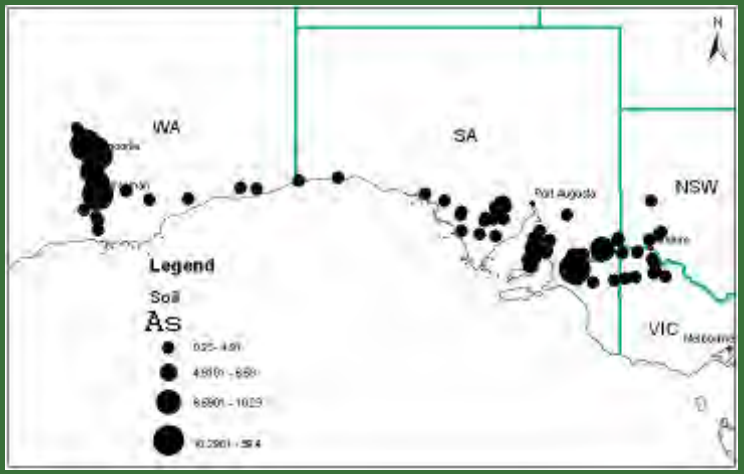
Results

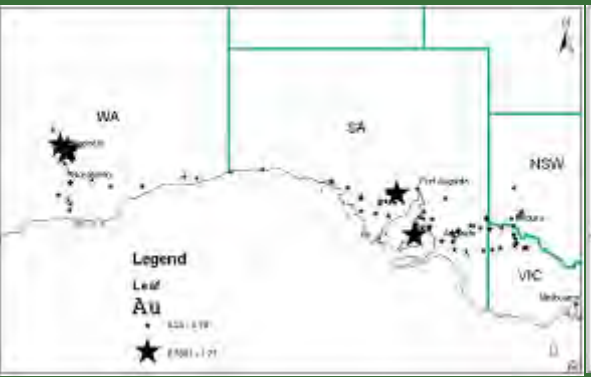
1) Bio- and pedogeochemical maps
2) Correlation Analysis
3) Biological Absorption Coefficient

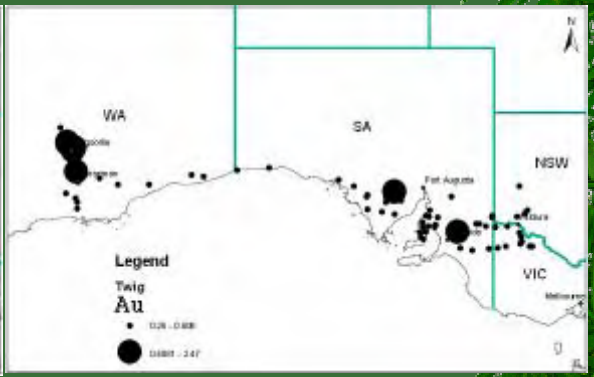

Yilgarn Block
Eyre Peninsula
Legend
Granite and Gneiss
Basic and ultrabasic rocks
Limestone
Sandstone and siltstone
Alluvial, shoreline, and eolian deposits
Yorke Peninsula
Murray Basin


WA
SA
NSW
VIC
Port Augusta
Legend
Leaf
As


WA
SA
NSW
VIC
Port Augusta
Legend
Twig
As


N
WA
SA
NSW
VIC
Port Augusta
Legend
Soil
As
0.25 - 4.91
4.910 - 6.80
6.8901 - 10.23
10.2901 - 58.4


WA
SA
NSW
VIC
Port Augusta
Melbourne
Legend
Leaf
Au


WA
SA
NSW
VIC
Port Augusta
Melbourne
Legend
Twig
Au


WA
SA
NSW
VIC
Port Augusta
Melbourne
Legend
Bark
Au

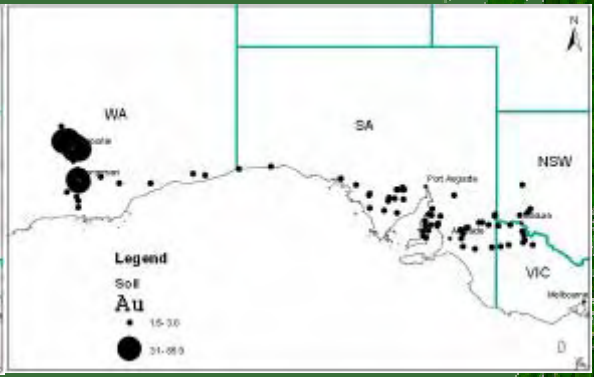

WA
SA
NSW
VIC
Port Augusta
Melbourne
Legend
Soil
Au

Table 1: Correlation analysis for As between soil and plants*

	Correlation coefficient (r)
soil vs. bark (n=5)	0.79
soil vs. leaf (n=13)	0.95
soil vs. twig (n=10)	0.90

Table 2: Correlation analysis for Au between soil and plants*

	correlation coefficient (r)
Au in bark and Au in soil (n=4)	0.67
Au in leaf and Au in soil (n=4)	0.93
Au in twig and Au in soil (n=5)	0.97

*Detection limit for As and Au are 0.1 ppm and 0.5 ppb in plants and 0.5 ppm and 3.0 ppb in soil

Table 3: Comparison of different media for Au (ppb) and its pathfinders (ppm)

site	Province	bark	leaf	twig	top soil	Au in depth
1	Murray Basin	Te (0.21)	-	Au (0.51)	-	**in granite at 5m depth (2.4)**
2	Murray Basin	-	-	Te (0.24)	-	**in claystone at 1.9m depth 2.6)**
3	Gawler Craton	Au (0.73) Te (0.28)	As (0.14)		-	**in calcrete at 1.05m (2.5)**
4	Yilgarn Block	-	-	[redacted] (0.55)	-	**in calcrete at 50cm depth (11.9)**
5	Gawler Craton	-	-	Te (0.31)	-	**in calcrete at 30cm depth (3.6)**
6	Yilgarn Block	Te (0.39)	-	-	-	**in calcrete at 45cm (5.5)**
7	Gawler Craton	Au (0.72)	Au (0.8)	-	-	**-**
8	Gawler Craton	Te (0.26)	Te (0.21)	-	-	**-**
9	Gawler Craton	-	Te (0.26)	Te (0.29)	-	**-**
10	Gawler Craton	Au (0.52)	-	Te (0.23)	-	**-**

Table 4: Mean biological absorption coefficients (BAC) for soil- plant relation

Results in this study

Element	Bark	Leaf	Twig
As	0.01	0.06	0.04
Au	0.07	0.06	0.07
Ba	0.04	0.05	0.04
Ca	1.05	0.84	1.41
Cr	0.011	0.007	0.016
Fe	0.005	0.007	0.004
K	0.22	0.94	0.45
Na	1.05	3.24	1.37
REE	0.02	0.02	0.03
Th	0.005	0.005	0.003
Zn	0.14	0.27	0.27

From Brooks, 1995 and Kovalevski, 1987

Element	BAC
As	0.04
Au	0.01
Ba	0.03
Ca	0.14
Cr	0.003
Fe	0.004
K	0.12
Na	0.01
REE	0.003
Th	0.005
Zn	0.62

$$BAC = C_{plant}/C_{soil}$$

Table 5: Mean biological absorption coefficients (BAC) for calcrete-plant relation

Element	Bark	Leaf	Twig
As	0.02	0.04	0.03
-Au	0.06	0.04	0.04
Ba	0.04	0.05	0.04
-Ca	0.05	0.03	0.06
Cr	0.01	0.01	0.02
+Fe	0.01	0.01	0.01
+K	0.40	1.68	0.82
Na	0.81	2.94	1.20
Th	0.01	0.01	0.01
+Zn	0.17	0.45	0.42

Conclusion

- Mallee vegetation's biochemical patterns have this capability to reflect lithological variation.
- The results show that biogeochemical methodology in reconnaissance scale in southern Australia is applicable and helpful in locating mineral potential targets over regolith terrains.