BIOGEOCHEMICAL DATA RANGES FROM TUNKILLIA PROSPECT, CENTRAL GAWLER CRATON, SOUTH AUSTRALIA

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INTRODUCTION

The Tunkillia Prospect is in the Central Gawler region, approximately 60 km SW of Kingoonya, South Australia. The prospect was extensively sampled for regolith carbonate accumulations (RCAs, also known as calcrete) and nearly two thousand samples were collected with spacing down to 0.2 by 0.5 km. A drilling program followed the delineation of Au anomalies found by the RCA sampling program. In May 2003 a localised vegetation sampling program provided baseline data for readily available plant species in the region to:

1. investigate the capabilities of plants to reflect mineralisation through significant transported cover (sand dunes); and,
2. test and compare biogeochemical anomalies with the known Au-in-RCA anomalies and interpreted geology derived from the drilling program and other studies in the area.

Vegetation in the Tunkillia region is mainly low open woodlands and chenopod shrublands, over mostly stable dune fields, depositional plains and erosional hills, and rises. The biogeochemical survey was conducted mainly over the stable dune fields with a few sites located in adjacent sheetwash plains.

SAMPLING METHODOLOGY

Vegetation samples were collected by hand using non-powdered latex gloves, following the method of Hill (002). Contact with all possible contaminants such as metal objects, and sunscreen, was avoided and possible contamination from drilling activity and roads was recorded along with detailed descriptions of regolith materials and landforms. The species sampled during the program are listed in Table 1.

Samples were taken from around the circumference of the plant to make sampling as representative as possible and to try to balance-out aspect-related influences such as wind-born contamination. Tree species were sampled at chest-height, and bushes were sampled from at least 30 cm above ground level (generally 80-100 cm above the ground). Plants of average size and appearance were targeted for sampling for each species, and any discoloured or dead-looking material was avoided. Any unusual features or possible contamination at the sites was noted including weather conditions and proximity to drilling holes and rehabilitation zones.

Two main species were sampled: a chenopod shrub *Mariana sedifolia* (pearl bluebush); and a perennial cassia shrub *Senna ft. petiolaris* (desert cassia). Both plants were sampled at each site and a brief regolith-landform setting description, plant species distribution and abundance description, and a GPS location were taken. Three minor species—western myall (*Acacia papyrocarpa*), mallee (*Eucalyptus sp*.), and mulga (*Acacia aneura*)—were also collected at two sites; one site outside the main zone of known mineralisation, and one site within, close to an area of high Au-in-calcrete anomalies.

Table 1: Species sampled during the program.

Species sampled	Samples collected
Main:	
Desert Cassia (*Senna ft. petiolaris*)*	31
Pearl Bluebush (*Marieana sedifolia*)*	30
Minor:	
Mulga (*Acacia aneura*)	5
Mallee (*Eucalyptus sp.*)	2
Western Myall (*Acacia papyrocarpa)*	2
Total =	**70**

* *Duplicate samples collected every 15 samples.*

Pearl bluebush shrubs are widespread throughout the area and are particularly abundant in the dune swales. Leaves and small twigs were picked by hand from the 0.2-1 m high bushes. Pearl bluebush is associated with friable regolith substrates that allow extensive root penetration, such as fractured bedrock or, most typically, sites with RCAs within 60 cm of the landsurface (Cunningham *et al*. 1992). They have a relatively deep tap-root system (up to 3 m) with shallow deciduous feeding roots (Cunningham *et al*. 1992). Flowering and leaf generation is generally in summer. Leaf sampling is relatively simple, especially with the aid of clippers, where mixed leaf and twig samples can be further subdivided before analysis (Hill & Hill 2003).

Desert cassia, an erect perennial shrub, is a quick-growing but short-lived cassia (Kutsche & Lay 2003) and is also common in the area. It occurs on both dune crest and swales as well as adjacent sandplains. This species is particularly easy to sample, and its relative abundance across the central Gawler Craton makes it a potentially ideal target for further regional biogeochemical investigation. Phyllodes (flattened leafstalk that appears and functions as a leaf) were stripped from twigs by hand from all around the circumference of the 0.5-2m high shrubs.

OBJECTIVES

1. To compare and contrast biogeochemical sampling with the extensive RCA sampling in the area and to determine the suitability and effectiveness of biogeochemical techniques for the area;
2. To test chemical sensitivity of the vegetation over dunes crests, midslopes, toeslopes and swales and to compare to the RCA results for the same localities. This will help determine the ability of vegetation to express mineralisation buried at various depths of cover;
3. To provide preliminary baseline biogeochemical data for several plant species abundant in the Tunkillia region.

PRELIMINARY BIOGEOCHEMICAL RESULTS

The small number of sample sites and thick transported regolith cover in the area has resulted in limitations on the ability to fully meet objectives 1 and 2, however, the dataset is useful as a preliminary starting point for other work in the region. The lack of baseline data is one of the greatest challenges in planning and designing this type of research. The presentation of the Tunkillia survey ICP-MS and XRF elemental ranges for selected species in the region in Table 2 will hopefully present useful information and provide a basis for further and continuing work in the Gawler Craton and around Australia.

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REFERENCES

CUNNINGHAM G.M., MULHAM W.E., MILTHORPE P.L. & LEIGH J.H. 1992. *Plants of Western New South Wales*. Inkata Press, Melbourne, 766 p.

KUTSCHE F. & LAY B. 2003. *Field guide to the Plants of Outback South Australia*. Department of Water, Land and Biodiversity Conservation, South Australia.

HILL L.J. 2002. Branching out into biogeochemical surveys: A guide to vegetation sampling. *In:* Roach I.C. ed. *Regolith and Landscapes of Eastern Australia*. CRC LEME, pp. 50-53.

HILL S.M. & HILL L.J. 2003. Some important plant characteristics and assay overviews for biogeochemical surveys in Western New South Wales. *In:* Roach I.C. ed. *Advances in Regolith*. CRC LEME, pp. 187-192.

THOMAS M., EARL K.L., HILL S.M. & FOSTER K.A. 2002. A framework for regolith-landform mapping in the Flying Doctor Prospect, Broken Hill, NSW. *In:* ROACH I.C. ed. *Regolith and Landscapes of Eastern Australia*. CRC LEME, pp.127-132.

Table 2: Tunkillia biogeochemistry value ranges for ICP-MS and XRF. Units in ppm.

	Pearl Blubush (30 samples	**Cassia (30 samples)**	**Mulga (2 samples)**	**Mallee (2 samples)**	**Western Myall (2 samples)**
Ag	-0.01 – 0.29	-0.01 – 0.24	-0.01 – 0.03	-0.01	-0.01
Al	128 – 868	-2 – 220	168 - 411	78 – 129	108 – 171
As	-	-	-	-	-
Ba	-	-10 – 17	-	-	-
Be	-	-	-	-	-
Bi	-	-	-	-	-
Ca	0.218 – 0.989	1.029 – 2.065	1.046 – 1.493	0.519 – 0.607	0.836 – 1.049
Cd	-	-	-	-	-
Ce	0.12 – 0.56	-0.1 – 0.16	0.21 – 0.33	-0.1 – 0.1	0.13 – 0.46
Cl	12052 – 24046	7894 – 18262	3463 – 5223	3151 – 3822	10222 – 11031
Cs	0.01 – 0.04	-0.01 – 0.01	0.01 – 0.02	-	0.01 – 0.02
Cu	2 – 6	3 - 6	5 – 8	3 – 5	6 – 8
Dy	0.01 – 0.04	-	0.01 – 0.02	-	0.01 – 0.05
Er	-0.01 – 0.02	-	0.01	-	-0.01 – 0.03
Eu	3 – 11	-1 – 2	0.01 – 0.03	1 – 2	2 – 8
Fe	63 – 390	7 – 86	110 – 155	26 – 36	87 – 147
Ga	-	-	-	-	-
Gd	0.01 – 0.05	-	0.01 – 0.03	-	0.01 – 0.03
Ge	-	-	-	-	-
Hf	0.1 – 0.5	-	0.1 – 0.2	0.2	0.2
Ho	-	-	-	-	-0.01 – 0.01
K	0.558 – 2.162	1.043 – 2.178	0.765 – 1.203	0.479 – 0.594	0.625 – 0.747
La	0.06 – 0.28	0.02 – 0.08	0.11 – 0.17	0.04 – 0.05	0.07 – 0.25
Lu	-	-	-	-	0.01 – 0.01
Mg	0.117 – 0.42	0.104 – 0.22	0.091 – 0.153	0.099 – 0.127	0.123 – 0.194
Mn	15 – 107	16 – 51	30 – 39	46 – 115	25 – 48
Mo	-0.1 – 0.7	0.1 – 0.6	-0.1 – 0.1	0.1	0.3
Na	1.89 – 6.199	0.026 – 0.113	0.61 – 0.69	0.415 – 0.421	0.154 – 0.174
Nb	-	-	-	-	-0.1 – 0.3
Nd	0.06 – 0.26	0.01 – 0.08	0.09 – 0.15	0.04	0.06 – 0.18
Ni	-	-	-	-	-
P	0.038 – 0.067	0.08 – 0.13	0.07 – 0.08	0.06	0.07 – 0.09
Pb	-	-	-	-1 – 1	-
Pr	0.01 – 0.07	-0.1 – 0.1	0.02 – 0.04	0.01	0.02 – 0.05
Rb	8 – 28.4	5.5 – 16.5	4.2 – 4.8	1.2 – 2	4.7 – 8.9
S	0.117 – 0.216	0.141 – 0.247	0.125 – 0.52	0.135 – 0.14	0.162 – 0.168
Sb	-	-	-	-	-
Si	0.095 – 0.659	0.031 – 0.128	0.118 – 0.232	0.084 – 0.089	0.09 – 0.138
Sm	-0.02 – 0.06	-	0.02 – 0.03	-0.02 – 0.02	-0.02 – 0.05
Sn	-	-	-	-	-
Sr	9.5 – 50.8	114.9 – 349.7	78.7 – 90.7	45.6 – 51.8	68.3 – 67.6
Ta	-	-	-	-	-
Tb	-	-	-	-	-0.01 – 0.01
Th	-	-	-	-	-
U	-	-	-	0.1 – 0.15	-
Y	-	-	-	-	-
Yb	0.01 – 0.05	-	-0.01 – 0.01	-	-0.01 – 0.03
Zn	1 - 15	3 - 8	19 - 23	5 – 10	26 – 28
Zr	N/A	N/A	N/A	N/A	N/A

- indicates value below detection limit

Laboratories and analytical suites:

- ICP-MS - Geoscience Australia Laboratories, Canberra: Ag, As, Be, Bi, Cd, Ce, Cs, Dy, Er, Eu, Ga, Gd, Ge, Hf, Ho, La, Lu, Mo, Nb, Nd, Pr, Sb, Sm, Sn, Ta, Tb, Th, U, Y, and Yb.
- XRF - Geoscience Australia Laboratories, Canberra: Al, Ba, Ca, Cl, Cu, Fe, K, Mg, Mn, Na, Ni, P, Pb, Rb, S,Si, Sr, Zn, and Zr.