GEOBOTANICAL AND BIOGEOCHEMICAL ASSOCIATIONS OF SNAPPY GUM (EUCALYPTUS BREVIFOLIA): TANAMI REGION, W.A.

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INTRODUCTION

The landscape in the Tanami Region in northern Australia (approximately 600 km northwest of Alice Springs) is complex and comprised of a variety of regolith materials overlying two major Precambrian tectonic units (Granites-Tanami block and the Birrindudu Basin) (Wilford, 2003). There is little outcrop in the region (Wygralak *et al.* 2001; Worrall & Pillans, 2006), which drives the need to develop strategies for exploring through the regolith. The dominant process for material transport in the region is sheetflow (Wilford, 2000). The extensive cover of sheetflow sediments means that surface materials are of little use in determining the underlying bedrock structure or chemistry.

Geobotany, which is relating vegetation properties to geological features, is one method for understanding the underlying strata. Mapping of vegetation assemblages or plant communities that relate to rock type may aid the mapping of geological units or structural features (Cole, 1965). Biogeochemistry uses chemical analyses of organisms to determine geological properties. Biogeochemical studies have demonstrated the potential for detection of mineral deposits with vegetation (Hulme & Hill, 2003). All plants uptake nutrients for growth, which can be substituted by economic indicator elements (Cu, Ni, Zn, As) (Hulme & Hill, 2003).

A case study designed to identify plant species suitable for use in biogeochemical prospecting in the Tanami Region was carried out at the Coyote Prospect in Western Australia (Figure 1). One of the most dominant species growing in this location was the snappy gum (*Eucalyptus brevifolia*). *Eucalyptus brevifolia* is a low tree to 7 m high, which occurs mostly on stony hill slopes on sandstones or quartzites (Perry, 1962) where the rainfall is less than 700mm (Perry, 1962). The distribution of *Eucalyptus brevifolia* (snappy gum) and the related *Eucalyptus leucophloia* can be seen in Figure 1.

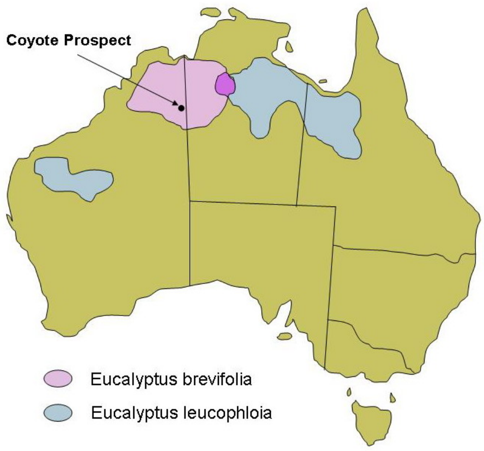

Figure 1: Snappy gum distribution including field site location. (Adapted from Moore, 2005).

This case study is part of a wider investigation into the nature of the regolith and regolith forming processes in the Tanami which includes detailed regolith mapping and a study of termites and termitaria being carried out by Anna Petts (a CRC LEME PhD student at the University of Adelaide), hydrogeological and hydrogeochemical studies being carried out by Dirk Kirste (Simon Fraser University), geophysical surveys being carried out by John Joseph (CRC LEME/ UA), regolith profile logging and characterisation being carried out by Lisa Worrall (CRC LEME / GA) and regolith geochronology being carried out by Brad Pillans (CRC LEME / ANU).

METHODS

Vegetation assemblages, tree and large shrub species and tree height were recorded along a 3 km N-S transect over the Coyote mineralisation in February 2005. This was further extended in January 2006 to include two 1.5 km transects 250 and 500 m to the east of the original transect.

Snappy gum leaves were collected from trees at 50 metre spacings across most of the transect, providing 28 samples. Each snappy gum sample was collected using powder-free latex gloves to minimise contamination from sunscreen and other metal sources. The gloves were changed between samples to prevent chemical build-up on the surface of the glove. Plants in good health were chosen and immature plants were avoided. Leaves were chosen as they had been found to give the best results, they had minimal disease and infestation, were middle aged (i.e. not juvenile or senescent), were readily available, and had a healthy appearance (Lintern *et al.* 1997; Brooks, 1998).

Samples were placed in brown paper bags, allowing the samples to breathe and reduce sample degradation, and were dried in a low temperature oven (< 60^{o} C). Dried vegetation samples were ground to a fine powder at the University of Adelaide using a commercial coffee and spice grinder. Inductively Coupled Plasma Mass Spectrometry (ICP-MS), and Optical Emission Spectrometry (ICP-OES) analyses were performed through Genalysis Laboratories, Western Australia, and Neutron Activation (INAA) analysis was performed by Becquerel Laboratories, Canada.

RESULTS

Snappy gum distribution over the Coyote Prospect can be seen in Figure 2. This plot shows that the snappy gum is abundant throughout the area except for a northwest to southeast band. This band is around 300 m wide and corresponds with the Coyote Fault. This fault zone is around 50 m wide and is difficult to make out in most geophysical imagery. Other *Eucalyptus* - *Corymbia* species (bloodwood, twin-leaf, mallee species) are more abundant in the band due to the lack of competition from the snappy gum.

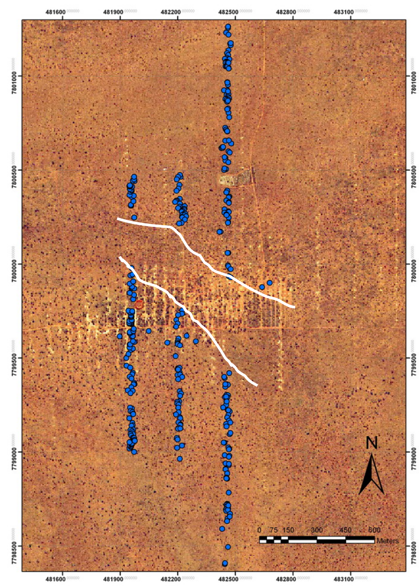

Figure 2: Snappy gum locations along transect surrounding Coyote mineralisation. Coyote Fault zone is enclosed within the two white lines.

There is a chemical signature from mineralisation dispersed to the south (down slope and hydrological gradients) within the snappy gum biogeochemistry results. This can be seen in the S and Zn results (Figure 3), the more mobile elements (eg. Ba, Ca, Mg, P, Sr) also have the same dispersion pattern; the distance of anomalism from the mineralisation being dictated by the element's relative chemical mobility. Au and As however were not detected, probably due to the lack of samples over mineralisation along this transect, therefore making Zn and S the only detectable ore indicator elements.

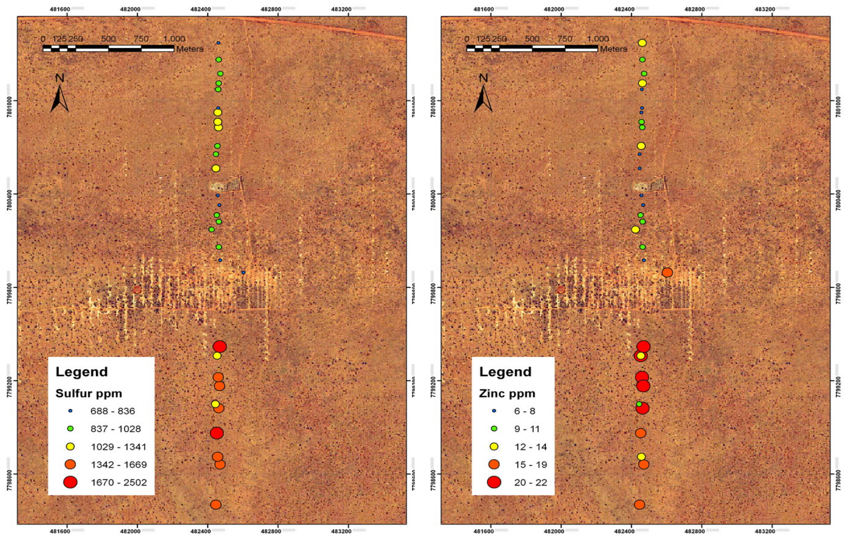

Figure 3: Concentration plots for Sulfur and Zinc.

CONCLUSIONS

At the Coyote Prospect the absence of *Eucalyptus brevifolia* closely reflects the Coyote Fault zone through several metres of transported cover. There is a substrate change associated with this fault, thought to be influencing the growth of snappy gum. This association suggests that it might be possible to use detailed vegetation mapping in the Tanami to gain information about structural features represented by broad vegetation community changes. Hyperspectral data could be used to map the distribution of snappy gum on a regional basis and to identify gaps that could correspond with the location of bedrock structures.

The chemical maps shown in Figure 3 indicate that the snappy gum assays provide a multi-element expression of dispersion patterns away from buried mineralisation, with different size elemental ‘footprints’ reflecting element solubility. Sulphur is the most soluble element so it disperses widely; Zn is less soluble and hence travels less distance. This information is being used to develop a better understanding about subsurface dispersion processes.

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