TANAMI GEOBOTANY AND BIOGEOCHEMISTRY: TOWARDS ITS CHARACTERISATION, ROLE IN REGOLITH EVOLUTION AND IMPLICATIONS FOR MINERAL EXPLORATION

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INTRODUCTION

The Tanami Desert in northern Australia is a regolith-dominated terrain. Exposed bedrock constitutes only about 5% of the region. In some cases the regolith is up to 100 m thick, presenting a challenge for most mineral exploration methods. Traditional methods for mineral exploration in Australia have involved sampling stream sediments, groundwater, soils or drilling to underlying bedrock. Stream sediments are very rare in the Tanami Desert region with most of the surface runoff moving as shallow overland flow, including sheet flow. Pattern drilling of surface geochemical or geophysical targets has been widely used in this area, but it is expensive and can be argued to have been of limited success across broad areas.

Biogeochemistry and geobotany research in this region has two main implications:

1. The development of tools and techniques to determine the chemistry of underlying bedrock without the expense of pattern drilling. Some plant roots can sample a wide area (amalgamators) or deep within a regolith profile (penetrators); and,
2. A better understanding of the biological contribution to near-surface geochemical characteristics of the regolith.

The Tanami Desert contains a large number of different plant species, some of which colonise vast parts of the region (e.g., spinifex, turpentine, snappy gum, bloodwood, dogwood). This means that instead of the 5% of bedrock that geological mapping uses to interpret the underlying lithologies, geobotanical mapping and biogeochemical sampling can cover over 90% of the region.

AIMS OF THIS STUDY

The main aims of this PhD research are to:

1. Map geobotanical associations and the biogeochemistry of selected study sites within the Tanami;
2. Develop an understanding of the factors responsible for observed geobotanical associations and biogeochemical anomalies; and,
3. Develop new mineral exploration strategies.

This work is running concurrently with other ongoing CRC LEME regolith studies in the Tanami region. This includes linking geobotany and biogeochemistry to the detailed 3D regolith mapping and termitaria study associated with Anna Petts' (CRC LEME/UA) PhD project to find whether vegetation can be used as a surrogate for regolith landform units in the Tanami Desert. Hydrogeological studies by Dirk Kirste (CRC LEME/ANU); regolith profile logging and characterisation by Lisa Worrall (CRC LEME/GA); regolith geochronology by Brad Pillans (CRC LEME/ANU) and geophysical investigations (Lachlan Gibbins - CRC LEME/UA) at the same field sites will be examined as checks for the validity of the vegetation data. This should provide a multi-disciplinary characterisation and understanding of the regolith and landscape in parts of this region.

PROSPECT CASE STUDIES

There are two case studies in this research: Tanami Gold NL's Coyote Prospect; and, Newmont's Titania Prospect. The Coyote Prospect is approximately 15 km west of the Northern Territory-Western Australian border near the Tanami Road (Figure 1). The Titania Prospect is approximately 50 km west of the Granites Mine, south of Rabbit Flat in the Northern Territory. Both sites have low topographic relief with minimal bedrock exposure. Sheetflow-dominated sandplains extend across most of these areas, and transported regolith thicknesses range from quite minor (sub-cropping bedrock) to over 100 metres (within palaeovalley systems). Spinifex grasses (*Triodia pungens*) are the most abundant and widespread plant species for both sites with bloodwood (*Corymbia opaca*), dogwood and corkwood trees also abundant at both sites. Snappy gums (*Eucalyptus brevifolia*) are more abundant at Coyote, whereas dogwoods (*Acacia coriacea ssp. sericophylla*) and beefwoods (*Grevillea striata*) are more abundant at Titania, possibly reflecting regional-

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scale plant-hydrogeochemistry associations as groundwaters are more saline at Titania.

To date, detailed fieldwork has been conducted at Coyote, with fieldwork planned for Titania in October 2005. During fieldwork at Coyote in February 2005, plant species and terrestrial microalgae were surveyed and sampled along a 3 km transect which passed over the mineralization and flanking “background” settings. The plant samples were dried at low temperature and milled in preparation for assay by Inductively Coupled Plasma Mass Spectrometry (ICP-MS), ICP-Optical Emission Spectrophotometry (ICP-OES) and Neutron Activation Analysis (NAA) Terrestrial microalgae samples were sampled by collecting 500 grams of topsoil, including the black surface crust, which contains the most soil organisms and will be analysed using a Laser Ablation ICP-MS to provide elemental concentrations for a number of different species within each sample.

Figure 1: Coyote and Titania prospect locations.

PRELIMINARY GEOBOTANICAL CHARACTERISATION

Vegetation assemblages, tree and large shrub species and tree height were recorded along the transect over the Coyote mineralisation. This transect corresponded to the ground EM transect performed by Lachlan Gibbins (CRC LEME/UA). The end points were 0482325 mE, 7801250 mN and 0482325 mE, 7798250 mN (AGD84). This transect included 456 data points (Figure 2). This information will be used to produce a vegetation map in conjunction with the regolith-landform and termitaria maps produced by Anna Petts (CRC LEME/UA). This map will aid the interpretation of biogeochemical sampling over the Coyote prospect. A preliminary interpretation of the raw data shows geobotanical patterns over the Coyote mineralisation. The most significant finding is that adjacent to mineralisation there is an abundance of bloodwoods and a decline in the abundance of snappy gums.

Sixteen soil algae samples were collected at 500 m spacing along the transect. Soil samples were placed in zip-seal plastic bags to prevent moisture loss from the algae and repeat samples were sprayed with iodine to preserve them. The samples were then sieved through a 75 micron nylon mesh. Iodine solution-treated samples are being examined under SEM to identify species of algae. The untreated soil samples are being streaked onto agar plates to culture the algae so that their properties can be determined for further investigations. Liquid media enrichment cultures were examined to grow several types of biota from the soil. Previous literature indicates that the growth media BG-11 and Z8 are the best for growing cyanobacteria and microalgae . Initial testing of the two media showed that BG-11 effectively grew microalgae from the soil and this media is being used for the agar plate tests.

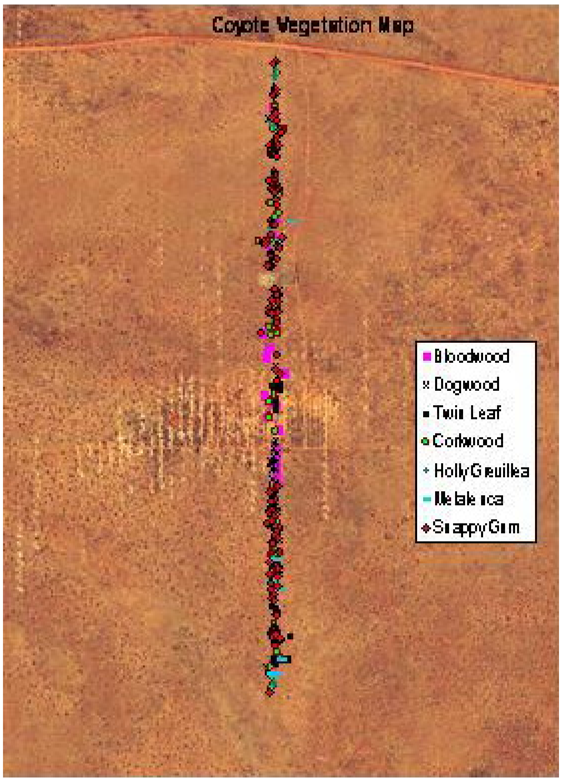

Figure 2: Vegetation Map over Coyote Mineralisation.

BIOGEOCHEMICAL CHARACTERISATION

Various plant materials were collected from the Coyote Prospect including snappy gum (*Eucalyptus brevifolia*) leaves, buds, twigs, litter, red-bud mallee (*Eucalyptus pachyphylla*) leaves, bloodwood (*Corymbia opaca*) leaves, dogwood (*Acacia coriacea subsp. sericophylla*) leaves, bark, litter, twigs, and corkwood (*Hakea suberea*) leaves. Snappy gum leaves were collected at 50 metre spacing across most of the transect providing a population of 28 samples. Thirty five spinifex samples were also collected at the same spacing. Other trees sampled along the transect include twin-leaf (*Eucalyptus pruinosa*), both over mineralisation and other selected sites.

Each sample was collected by hand using powder-free latex gloves to prevent contamination from sunscreen and other metal sources. The gloves were changed for every sample to prevent cross-contamination of samples. Trees close to drill piles were avoided where possible and healthy plants were chosen while avoiding immature trees. Samples were taken from about chest height around the tree canopy. Leaves were chosen that had minimal disease and infestation, were mid-aged (i.e., not juvenile or senescent) and generally looked healthy. Vegetation samples were placed in paper bags allowing the samples to breathe, and each night the samples were placed in a low temperature oven (< 60°C) to aid the drying process. Further drying and milling was undertaken at the University of Adelaide. ICP-MS and ICP-OES analyses were performed through Genalysis Laboratories, Western Australia, and NAA analyses were conducted at Becquerel Laboratories, Ontario, Canada.

Initial results are promising (Figure 3). For example, Zn and several of the other elements show high elemental abundances over the surface projection of the mineralisation. The results for Zn in spinifex show that there is an anomaly constrained around the ore body. There is also a possible dispersed signature to the south (down slope and hydrological gradients) within the snappy gum results (although snappy gums were sparse over mineralisation).

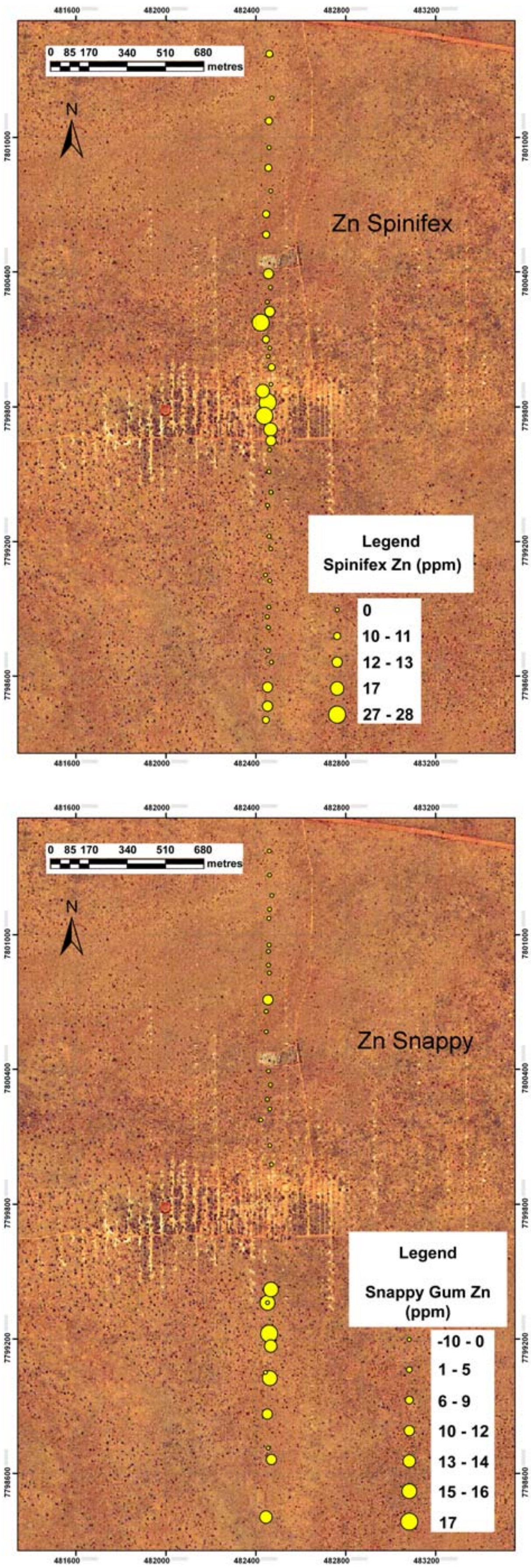

Figure 3: Preliminary Zn results for 2 species.

CONCLUSION

Early results of biogeochemical sampling in the Tanami region suggest that biogeochemistry is a promising method for the detection of mineralisation through cover. Thus far this study has highlighted several species that have the potential for becoming regional sampling media. Early work also suggests that geobotanical surveys may provide important clues about changes in the nature of the substrate.

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