RESULTS OF A PRELIMINARY BIOGEOCHEMICAL SURVEY OF THE WYOMING AU DEPOSIT, TOMINGLEY, NSW

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INTRODUCTION

The Wyoming and Tomingley Au deposits are located to the north and south of the town of Tomingley, ca. 20 km north of the town of Peak Hill in central NSW (Figure 1). They were discovered after drilling in 2001-02 by Alkane Exploration Ltd., following up on older workings and structural trends in the local area. Mineralisation is associated with a feldspar porphyry intruded into andesitic Goonumbla volcanics (Sherwin 1996) and Au is present in a series of sheeted quartz veins oriented roughly N-S, parallel to the structural grain of the Ordovician volcanic bedrocks of the Lachlan Fold Belt. The Wyoming deposits contain > 500,000 ounces of Au (Alkane 2003) and are covered by 20-40 m of transported regolith (Scott *et al.* 2003), explaining why the deposits had not been discovered previously. Previous regolith research, detailed by Scott *et al.* (2003), involved the use of partial leach techniques on soils at the prospect, returning interesting results that did not, however, directly correspond with the anomaly known from drilling (Cruikshank *et al.* 1999). This led Scott *et al.* (2003) to postulate that the anomaly was either transported downstream, or was the fortuitous result of Au-enriched windblown dust from the nearby McPhails Mine, where the dumps were at that time being reprocessed for their remaining Au.

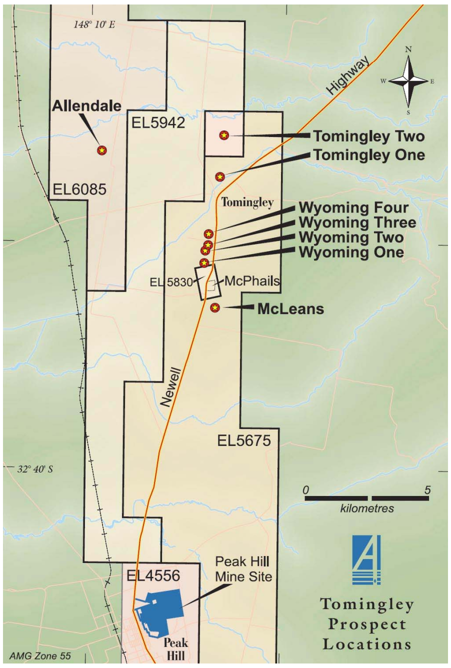

Figure 1: Location of the Wyoming Au deposits near Tomingley in central NSW. From the Alkane WWW site (http://www.alkane.com.au/).

The site is crossed by a number of windrows of remnant vegetation near fencelines and roads (Figure 2). These were left by the local property owners as shelter belts around paddocks, which are used for grazing and mixed grain cultivation. Windrows are oriented roughly E-W and N-S across the area and are composed of mature native trees. These provide ideal transects across the newly discovered deposits and a great opportunity to research possible biogeochemical relationships between the solid geology, regolith cover and flora. This paper describes the results of a preliminary biogeochemical survey of the Wyoming 1 deposit conducted in May 2004.

TREES AS BIOGEOCHEMICAL SAMPLING MEDIA

There is growing acceptance within Australia of the value of biogeochemical prospecting for mineral deposits, geohazard chemical detection and pollution tracing. The method has been recognised for decades in North America and Europe, however, it has not been taken up by the minerals industry in this country. Numerous studies have been conducted on using biogeochemistry to search for mineral deposits in eastern Australia, however, these have all been in areas of known mineralisation. Mineral explorers are yet to pick up the method with any commitment in so-called "greenfields" exploration areas. Recently, the worth of the method has been shown around western NSW by CRC LEME staff and students including Dann (2001), Senior & Hill (2002), Hill & Hill (2003) and Hulme (2003) using bluebush (*Maireana spp.*) and River Red Gum (*Eucalyptus camaldulensis*) to detect base metal and Au anomalies. Further details on many more biogeochemical indicator species around the Broken Hill area can be found in Hill & Hill (2003). Eucalypts have also been recognised as useful in other areas, for instance around Ballarat in Victoria (Arne *et al.* 1999) and northeastern NSW in the Clarence River catchment (Cohen *et al.* 1999). In southeastern NSW early work on the Woodlawn Cu-Pb-Zn-Ag VMS sulphide orebody by Ryall & Nicholas (1979) recognised the use of Late Black Wattle (*Acacia mearnsii*) and Mountain Kangaroo Apple (*Solanum linearifolium*) bark and especially leaves to detect concealed base metal mineralization. The work was conducted as an adjunct to stream sediment and soil B-horizon sampling, but the knowledge was not used in any further exploration initiatives. Around Cobar the needles of the White Cypress Pine (*Callitris columellaris*) are recognized as being a useful sampling medium in Au and base metal exploration (Cohen *et al.* 1998) and there are on-going projects using these to detect possible buried Cobar-style orebodies in the work of CRC LEME's Girilambone Project.

The potential of large trees as sampling media to detect ore deposits is huge. Eucalypts are recognized to have large root systems; Hulme & Hill (2003) noted that the root systems of *E. camaldulensis* extend, (and I add, *conservatively*), for over 20 m laterally (Dexter 1967) and over 10 m vertically (Davies 1953). Recently Hill added that he has personally observed *E. camaldulensis* roots that may extend for over one hundred metres laterally (Hill 2004). This means that Eucalypts have the potential to penetrate moderate transported regolith cover and sample basement regolith and rocks. Similarly, *C. columellaris* and *Casuarina spp*. are recognized as having significant root systems too, tapping into bedrock through thin transported regolith in the case of *C. columellaris*, and into sandy aquifers in transported regolith in the case of *Casuarina spp.*

DOMINANT TREE SPECIES AT WYOMING

Remnant native woodland is distributed over the landscape at Wyoming. The site occupies a flat-bottomed valley, largely cleared apart from the windrows and shade trees scattered about the paddocks. Dominant species include the Grey Box (*E. microcarpa*), White Cypress Pine (*C. columellaris*) and a *Casuarina*, possibly Belah (*Cas. cristata*) or Buloke (*Cas. luehmannii*) plus rare White Box (*E. rossii*) (Costermans 1981). The surrounding hills are more heavily wooded. The windrows and shade trees immediately over the Wyoming 1 deposit appear to contain solely *E. microcarpa*, *C. Columellaris* and *Casuarina spp*.

Figure 2: Remnant vegetation in a windrow running approximately E-W over the top of the Wyoming 1 deposit. Large *E. microcarpa* trees (up to ca. 25 m high) and smaller *C. columellaris* trees (up to ca. 10 m high) occupy the windrow. Scattered *C. columellaris* and *Casuarina ssp.* can be seen as shade trees in the paddock to the left. Drilling spoil can be seen as the bright patches in the foreground.

SAMPLING CONSIDERATIONS AND PREPARATION

The Wyoming deposits, at the time of sampling, were being extensively resource-drilled using Reverse Circulation (RC) drilling, which can be a very dusty business. Cuttings were bagged directly from the RC's cyclone concentrator, however, much airborne dust is also evolved and must be taken into consideration as a possible contamination source for vegetation samples. Other potential sources of contamination included dust from roadworks on the Newell Highway, which runs N-S through the area approximately 200 m to the east of the Wyoming 1 anomaly, and vehicle exhaust from the Highway. However, dust and exhaust contamination on leaves was not deemed to be a major problem because it had rained voluminously two to three days prior to the sampling procedure, and drilling had moved away from the site before this rain event.

Given that this was a "smash-and-grab" reconnaissance survey, normal protocols (e.g., Hill 2002) were not strictly followed for sample collection, in that samples were not taken using Teflon-coated shears, nor were latex gloves worn. Rather, samples were quickly taken by hand, making sure that no jewellery was worn, and placed directly into zip-lock plastic bags. GPS coordinates were taken at the base of each tree using a Garmin GPS76 with the WAAS feature enabled to increase spherical accuracy (typically 4 m). Samples were air dried at room temperature in the same bags (with tops opened) on return to Canberra that night to prevent condensation and mould build-up. Samples were transferred to brown paper sandwich bags the next day, and then dried for 48 hours at 60°C in a drying oven at EMS according to Hill's (2002) protocol. Sample preparation was more rigorous. This involved picking the dried leaves wearing powder-free latex gloves and discarding twigs before milling in a new stainless steel coffee grinder (the industry-standard Breville™ "Coffee 'n' Spice" grinder). The grinder was dusted with compressed air, wiped clean with ethanol and clean tissues, then dried between samples. A small amount of the next sample was then milled and discarded before the bulk of the next sample was pulverised. Gloves were also discarded between each sample. Once pulverised, samples were transferred to new, clean polycarbonate sample vials. Approximately 10 g of each sample was taken and sent to Becquerel Laboratories, Lucas Heights NSW, for encapsulation for Instrumental Neutron Activation Analysis (INAA), one of the last batches to be run before the laboratory closed forever in August 2004. Analyses were conducted using the biogeochemistry package of Bequerel, and results returned within approximately 6 weeks. Samples were analysed for Sb, As, Ba, Br, Ca, Ce, Cs, Cr, Co, Eu, Au, Hf, Ir, Fe, La, Lu, Mo, K, Rb, Sm, Sc, Se, Ag, Na, Ta, Te, Th, W, U, Yb, Zn and Zr.

RESULTS

Those elements that returned results above detection are included in Table 1. Results, hardly surprisingly, showed Au in each of the species sampled probably because the trees were actually growing into the top of the orebody, which has a moderately thick transported regolith cover. After sampling, we realised that we had not sampled any trees off the primary and secondary dispersion haloes of the orebody. What has probably not been recognised before, however, is that the *E. microcarpa* are holding significant amounts of Au in their leaves, in similar concentrations to the *Callitris* and *Casuarina* species on site, which are already known as aurophilic species. Given the small sample size, it is difficult to say more about the results because they are not statistically relevant, however, the *E. microcarpa* appear not to host Au pathfinder elements as efficiently as the other two species sampled. *C. columellaris* appears to contain significantly more As, Cr and REE, and the single *Casuarina spp*. sampled, which has the highest Au content, also contains significant Cr and As, although no more As than the *E. microcarpa* on site.

Table 1: INAA results for leaves on trees over the Wyoming 1 Au deposit. Gold results in **bold**.

Sample No.	Species	As ppm	Ba ppm	Br ppm	Ca %	Ce ppm	Cr ppm	Au ppb	Fe ppm	La ppm	K %	Sm ppm	Sc ppm	Na ppm
WYO-0001	*Callitris columellaris*	0.34	90.9	9.03	1.04	1.33	2.3	**1.66**	543.0	0.62	0.50	0.12	0.21	377.0
WYO-0002	*Eucalyptus microcarpa*	-0.10	-20.0	38.10	0.31	-0.50	-0.5	**0.68**	179.0	0.15	1.02	0.04	0.05	79.5
WYO-0003	*Callitris columellaris*	1.31	24.5	9.18	1.10	2.18	2.5	**0.65**	875.0	0.99	0.53	0.20	0.34	810.0
WYO-0004	*Eucalyptus microcarpa*	0.25	21.1	34.20	0.62	0.65	-0.5	**0.64**	170.0	0.29	0.93	0.08	0.06	241.0
WYO-0005	*Eucalyptus microcarpa*	0.11	47.8	62.60	0.67	0.54	-0.5	**4.11**	290.0	0.34	1.30	0.07	0.04	175.0
WYO-0006	*Eucalyptus microcarpa*	0.52	26.0	44.30	1.20	1.05	-0.5	**2.38**	290.0	0.45	0.71	0.09	0.08	423.0
WYO-0007	*Casuarina sp.*	0.58	-20.0	20.40	0.46	0.76	3.3	**5.13**	380.0	0.32	0.60	0.08	0.16	2470.0
Detection Limit (DL)		0.10	20.0	0.20	0.10	0.50	0.5	0.50	100.0	0.10	0.05	0.02	0.01	10.0

"-" = below DL.

To put these results in context, Hulme & Hill (2003) reported Au values from Below Detection Limit (BDL) to 0.68 ppb in leaves and from BDL to 6.41 ppb in twigs from *E. camaldulensis* along Racecourse Creek at Tibooburra, known for its rich alluvial Au deposits.

CONCLUSIONS AND FUTURE WORK

The potential for *E. microcarpa* as a sampling medium for Au and base metal mineralisation will be further investigated. It is intended to return to the site in January 2005 to conduct a more rigorous sampling program. All three tree species will be taken as a series of transects from the basement rises on the west and east of the site across the orebody. *C. columellaris* and *Casuarina spp*. are already recognized for their potential as biogeochemical sampling media, and procedures are well established for their use. However, the various organs of *E. microcarpa* (leaves, twigs, bark, wood) need to be sampled to determine which organ has the greatest potential as a sampling medium. Previous work on *E. camaldulensis* provides some clues, and it may be only necessary to sample leaves, twigs and bark, rather than hack into the wood of these stately trees.

The Wyoming results are very promising, and further work is needed to establish the local biogeochemical baselines. It will also be interesting to learn whether one species is more successful in scavenging Au pathfinders, which may be important micro-nutrients, and whether anomalies are overlapping in each species, or whether one may be used for regional exploration and another for more detail tenement-scale work.

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