BIOGEOCHEMICAL ANOMALIES AT BARNS GOLD PROSPECT (EYRE PENINSULA, SOUTH AUSTRALIA)

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INTRODUCTION

Biogeochemistry has been used successfully to identify mineralization in North America, Russia and elsewhere. There are fewer Australian examples, probably because sampling of soils and other surficial media has been successful. However, as Australian exploration companies move away from traditional areas of outcrop or shallow cover, biogeochemistry may gain importance if it is able to detect mineralization beneath deep cover without the need to drill. The Barns Gold Prospect (northern Eyre Peninsula, South Australia), discovered using Au-in-calcrete methodology, provides an example where vegetation: (i) was anomalous in metals and might be sampled directly to see through transported overburden; and, (ii) has led to the formation of a Au-in-calcrete anomaly within the overlying dune. The dune setting, rising above the existing landforms, provides an opportunity to study the process of anomaly formation in a relatively simple and recent transported regolith setting without having to invoke the possibility of alluvial or colluvial dispersion.

SITE DESCRIPTION

The Barns Gold Prospect is overlain by aeolian quartz sand greater than 1 m thick, increasing to greater than 8 m thick in longitudinal sand dunes. Organic material (partly degraded bark, leaf litter and branches) has accumulated in sandy surficial material (imparting a grey colour) and is underlain by near-white quartz sand 1-2 m thick. Below this, the colour of the profile is altered because of illuviated or autochthonous orange-brown clay coatings on the sand. At the base of the dune is cemented calcareous clay that grades into a siliceous bleached saprolite derived from granodiorite. Mineralization is associated with quartz veins. The dune is well vegetated, with *Melaleuca* and *Eucalyptus* plants up to 5 m high.

METHOD AND RESULTS

Melaleuca uncinata and *Eucalyptus incrassata* litter, bark and terminals (combined leaves, small branches and fruiting bodies), and soil (0-10 cm) were sampled on two traverses: at ca. 200 m intervals on a 5 km long traverse partly bordering the longitudinal dune and at ca. 25 m intervals perpendicular to, and transecting, the dune and mineralization on a much shorter 125 m traverse. Terminals were sampled at the beginning and end of summer. The traverses cross buried mineralization occurring in weathered bedrock 35 m below the dune and leached saprolite unconformity. The shorter traverse is located entirely over mineralization.

Gold concentrations in *E. incrassata* terminals were greater than *M. uncinata* terminals, reaching a maximum of 1.2 ppb above mineralization; several samples were anomalous on the shorter traverse. Bark and litter samples were also anomalous over mineralization with maxima of 2.8 ppb and 1.7 ppb, respectively. *E. incrassata* vertical (tap) roots sampled at the base of an excavated sand dune close to the unconformity over mineralization, had a concentration of 1.2 ppb Au.

M. uncinata bark attained its maximum concentration of 3.6 ppb Au over mineralization against a background below detection (< 0.1 ppb). Litter was also anomalous (0.7 ppb) over mineralization. *M. uncinata* terminals were the least successful sample medium, reaching a maximum of 0.8 ppb Au, but only 0.5 ppb above mineralization.

While sampling at different times of the year did not improve the ability of *M. uncinata* terminals to indicate mineralization, there was a marked effect on *E. incrassata* terminals. Gold concentrations at the end of summer in *E. incrassata* terminals were significantly higher and of greater contrast when compared with the end of winter (as with data reported by Hulme & Hill 2004); Bi terminal concentrations, in contrast, were greatest at the beginning of summer. Overall, *E. incrassata* sample media are superior to *M. uncinata* as they tend to produce higher contrast anomalies in Au. This is probably due to the presence of the deep sinker roots which are able to source elements in the calcretes and saprolith. Statistical tests indicate that Ag, Bi and Pb and other elements not currently known to be associated with the deposit (e.g., REE, Co, Mo, Sb, W, Te and Ta), are anomalous in vegetation over mineralization.

In: Roach I.C. ed. 2005. *Regolith 2005 – Ten Years of CRC LEME*. CRC LEME, pp. 195-196.

Soil (0-10 cm) collected from underneath *E. incrassata* was anomalous in Au, Ag and Ta. A maximum of 1.6 ppb Au was attained in the bulk soil, however this concentration and contrast could clearly be amplified if partial extractions (to target clay or organic matter) or sieving (to remove barren quartz sand) was performed.

A trench was excavated in the southern face of the dune adjacent to the short biogeochemical transect. Regolith samples were analysed for geochemistry and optical luminescence dating. Gold concentrations from beneath the surface in the sand dune ranged from below detection (< 0.1 ppb) to 9.2 ppb (mean of 0.5 ppb from 60 analyses). The highest Au concentration occurs in calcareous rhizomorphs at least 5 m above the residual regolith and 2.3 m below the surface of the dune. The dune age was determined to be 25,000 years (Lintern & Rhodes 2005) and hence the anomaly could be as old as this or as young as a currently growing tree. Mass balance calculations indicate that Au-in-calcrete anomalies can form during these time frames as a result of vegetative processes alone (Lintern & Rhodes 2005).

DISCUSSION

The simplicity of the sand dune regolith profile at Barns makes it an important site for investigation of processes involved with geochemical anomaly formation. The vegetation is anomalous in Au and other metals and is playing a role in creating soil anomalies at Barns in two ways. Firstly, plant roots are directly accessing elements (including those associated with mineralization) within the saprolith and bringing them to the surface forming an anomaly in plant tissue and top soil. Secondly, elements are eluviated by rainwater through the porous sandy profile and concentrate and precipitate in the rhizosphere due to transpiration. Thus, the alkaline earth metals and translocated Au complex(es) precipitate together to form a second geochemical anomaly in the calcareous rhizomorphs.

REFERENCES

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