IN-SITU MICROANALYSIS TO STUDY REGOLITH MINERAL HOSTS IN FERRICRETE FROM THE ENTERPRISE PIT, MOUNT GIBSON GOLD DEPOSIT

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INTRODUCTION
Insitu geochemical microanalysis is a powerful method to search for specific mineral and regolith features that act as hosts for ore related elements (e.g. Au, Cu, Pb, As and Zn) and we have applied this approach to a pit-wall regolith profile from the Enterprise Pit, Mount Gibson gold deposit. The physical features of the landscape, bedrock geology and regolith profiles of the Mount Gibson gold deposit (300 km NNE of Perth) and its environs, have all been studied extensively (e.g. Anand et al., 1989; Yeates and Groves, 1998). Transported overburden at the Enterprise pit at Mt. Gibson has been subjected to ferruginisation, calcification and silicification. As previously reported (Hough et al., 2003) these sediments, and their weathering products, provide a good setting to study mineral and regolith features that act as hosts for ore-related elements, and may provide pathfinders for underlying mineralisation. Ultimately such studies are expected to identify minerals that act as deep geochemical sensors and are therefore, exploration sampling media in areas of deep cover.

ENTERPRISE PIT: Transported overburden.
In the Enterprise pit in-situ regolith is overlain by Tertiary and Quaternary sediments. Slabby to pisolitic ferricrete is formed in the Tertiary sediments with anomalous (up to 587 ppb Au), whereas white clay between the slabby layers contains 112 ppb Au and 85 ppm arsenic. The uppermost sandy to sandy-clay Quaternary unit is 3-4 m thick, and has been calcified and silicified to produce calcrete and hardpans with 128-436 ppb Au.

Building on our previous study (Hough et al., 2003) we have conducted XRD analyses of the ferricrete, this revealed that it contains alunite, a potassium aluminium sulphate that is commonly precipitated from acidic groundwaters, kaolinite, and only minor goethite. Alunite occurs within the matrix of the sample, and is very fine grained with a red-brown colour. It appears as a late stage, pervasive precipitate that surrounds clay spheres and clasts.

We have also performed new laser ablation ICPMS (LA-ICPMS) and electron microprobe studies on the ferricrete, LA-ICPMS has been shown to be a powerful technique in the analysis of regolith samples, especially for Au (Le Gleuher, 2003a; b; Hough et al. 2003). Our previous LA-ICPMS analyses on the kaolinite-rich matrix from this ferricrete sample revealed that it contained 1-1.5 ppm Au, 290 ppm Cu and 360 ppm As. At this stage we interpreted that kaolinites within the matrix were authigenic, and as such were trapping hydromorphically dispersed Au from underlying mineralisation. Minor iron oxides in the matrix were thought to be preferential sinks for the Cu and As. Our new XRD data and some SEM work suggest this matrix is dominated by alunite.
An electron-microprobe transect from the core of a clay sphere into the alunite rich matrix reveals the sharp change in trace element concentrations with substantial Cu (290 ppm), Pb (500 ppm), and As (360 ppm) in the alunite rich areas. The new LA-ICPMS analyses confirm the probe data and building on our preliminary results (Hough et al., 2003) several analyses found 1-2 ppm Au within alunite rich areas. Hematite veins and large kaolinite rich clasts within the ferricrete are devoid of Au and have much lower levels of Cu, Pb and As.

Butt (2001) reported a similar alunite Au association in the mid-upper saprolite at the Mount Percy gold deposit near Kalgoorlie, bulk S contents of 0.5-5% were reported in this horizon.

During LA-ICPMS spot analyses we were able to monitor the count levels for the Au isotope in the mass spectrometer as the laser gently ablated the samples. This allows us to reveal if the Au is present as small grains, whereby it would give peaks, or is homogeneously distributed giving a constant plateau. Within the alunite matrix Au counts formed a constant plateau suggesting the Au is homogeneously distributed throughout the ablated material, and is therefore likely to be either extremely fine grained or chemically bound within the alunite mineral lattice. In the near future we hope to utilise X-ray adsorption spectroscopy using synchrotron radiation to investigate this further, and to attempt to identify the oxidation state of the Cu, Pb and As.

We have also recently employed laser transect analyses in combination with ICPMS, here the laser continuously ablates as the sample moves on a motorised stage creating a transect. The neoformed sample travels through, and is analysed by, the mass spectrometer in the same way as for single spot analyses. This method creates large datasets as many elements can be collected contemporaneously and over a relatively long time scale, but is a rapid means of identifying the location of anomalously high levels (largely qualitative) of specific elements including Au in a heterogeneous sample e.g. regolith samples. Some new results from this technique will also be presented.

SUMMARY

Minerals precipitated from groundwaters in the upper sediments of regolith profiles could provide an interesting sample medium to search for hydromorphic dispersion from underlying, and deeply buried mineralisation. Alunite appears to be one such mineral occurring in the regolith profile of the Enterprise pit, Mount Gibson that contains appreciable Au, Cu, Pb and As.

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