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Phyto-exploration in arid subtropical, arid mediterranean and tropical savanna environments: Biogeochemical mechanisms and implications for mineral exploration

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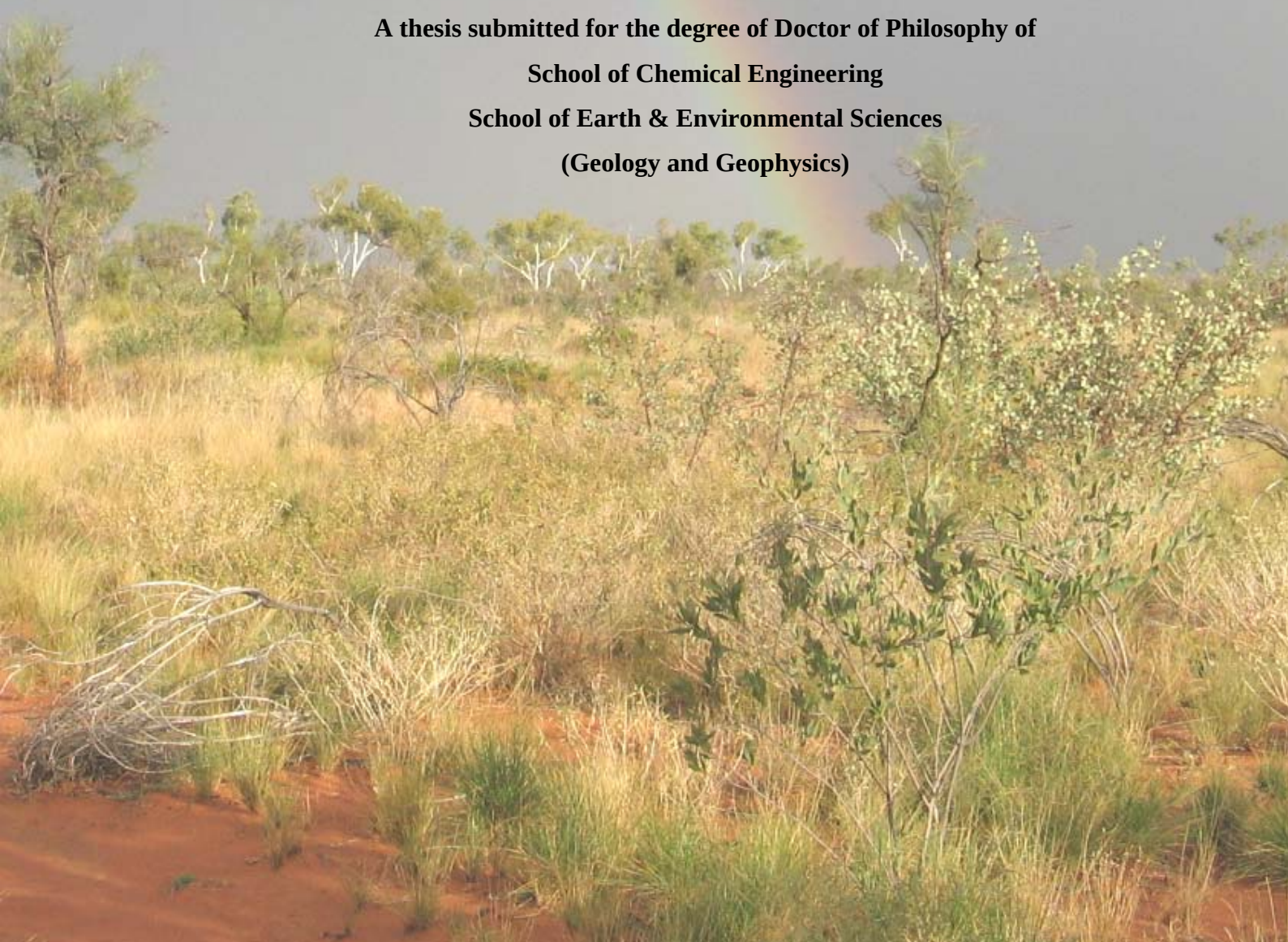

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Reid, N., Hill, S. M. and Lewis, D. M., 2008. Spinifex biogeochemical expressions of buried gold mineralisation: the great mineral exploration penetrator of transported regolith. Applied Geochemistry 123, p76-84.

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Abstract
Vegetation sampling is an effective exploration technique in areas of transported cover where other techniques have been of limited success. Several plant species were sampled along transects across 9 known Au ore bodies; *Triodia pungens* was found give a Au, As, ±Zn, ±S, ±Ce and ±La signature which represented mineralisation through cover materials and *Eucalyptus brevifolia* was found to give a geobotanical and ±Ca, ±Mg, P, S and Zn signature of underlying geological structure. The Hyperion prospect was used as a 'blind' target as there was no background information available until after interpretation was carried out. Mineralisation was located at the contact between granite and dolerite, biogeochemical signatures from *E. brevifolia* and *Acacia bivenosa* showed areas of change in ±Au, Ba, Ce, ±Cu, La, ±Mn, Nd, P, S, Sm, Y and Zn which corresponded to this contact. All species in the Pine Creek Orogen were able to present areas elevated in Au, As, ±Zn, ±S, ±Mo and ±Cu which provide future drilling targets. Biogeochemical sampling was able to determine the location of mineralisation at each site and identify underlying substrate changes, however, background knowledge relating to regolith, geology, hydrology and geophysics are important in aiding the interpretation of the elemental data as each component of the substrate influences the elements which a plant will uptake.

Mineral exploration in Australia has been driven by the search for large ore deposits close to the surface. This has led to the need to develop technologies for detecting mineral deposits under cover, which can be up to several hundred metres of transported sediments. The aim of this research was to test the feasibility of using vegetation biogeochemical sampling over known Au deposits within semi-arid and arid terrains. Biogeochemical sampling has the advantages of being cost effective, sustainable, environmentally friendly and relatively easy to perform.

Nine field sites were covered, 4 in the Tanami Region (Coyote, Larranganni, Hyperion and Titania), 4 in the Pine Creek Orogen (Johns Hill, Great Northern, Glencoe and McKinlay) and 1 in the Gawler Craton (Tunkillia). At each of these sites the dominant species were sampled and the elemental concentrations of the plant were analysed by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) to test if they were able to detect buried mineralisation. In general, all species identified as being deep rooted (larger trees, paperbarks and spinifex) were able to detect mineralisation in each location within multi-element dispersion haloes centring over the projected ore body. Variations were dependant upon species differences and root structures, groundwater influences, and the potential for detrital contamination. In arid Australia, *Triodia spp.* were shown to be ideal for closely spaced tenement/prospect scale exploration, and *Heteropogon spp.* show similar trends for the humid tropics. *Eucalyptus/Corymbia spp.* are more suitable for widely spaced regional sampling exploration as they amalgamate a wider signal with strong groundwater influences.

It was found that all plant species were effective at expressing buried mineralisation in a multi-element suite (pathfinders: Au, As, S, Zn, ±(Ce/La), ±Mo and ±Cu) through cover in these terrains provided care was taken with sampling and interpretation. Regolith materials, botanical properties and landforms are essential background knowledge for determining the effectiveness of biogeochemical sampling. Plants with deep root systems with little lateral spread are ideal for prospect/tenement mineral exploration programs, and plants with wide lateral spreads and large chemical uptake potentials are ideal for regional mineral exploration programs. This exploration strategy would be quick, sustainable and relatively cheap compared to other methods of exploration. This is not to say that biogeochemical sampling would be the only tool needed for further mineral exploration in Australia. This process would work best if used in conjunction with other sampling methods like geophysics and some soil sampling techniques.

Publications arising from this research

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