

CRC LEME Minerals Brief

Regolith Science in Mineral Exploration No 6 - May-June 2005

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Dear Mineral Explorer

Minerals Brief brings to your desktop concise summaries of recent LEME research of relevance to mineral explorers. This edition appears on the eve of our annual MINEX Seminar to be held in Perth on Wednesday 25 May. We have an excellent program involving new work, some recently completed PhD theses, and research recently out of moratorium. This work will demonstrate the sharpening focus on 3-D regolith models, hydrogeochemistry, metal mobility, and most importantly – the rapid developments in biogeochemistry. Details are given at the back end of this newsletter.

DENNIS GEE

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Curnamona Province

Patrice de Caritat (GA) and Dirk Kirste (ANU) have found that groundwaters from the Teilta 1:100 000 mapsheet area (100 km north of Broken Hill) are Na-HCO₃ rich, warm, reducing and depleted in SO₄ (which tends to have an elevated δ^{34} S composition) relative to the groundwaters in other parts of the Curnamona Province. This reflects incursion of Great Artesian Basin groundwaters from the north and makes indications of sulfide mineralisation less obvious than in other parts of the Curnamona Province. Nevertheless, five Teilta waters, including a permanent waterhole at Honeymoon Creek, have positive S excess values and δ^{34} S<15 ‰, suggestive of interaction with subsurface mineralisation. patrice.decaritat@ga.gov.au

A team from PIRSA, led by Andrew Burt and including LEME members George Gouthas and Adrian Fabris, has integrated drillhole information with interpretations from seismic and magnetic data to construct a 3-D representation of the depth to basement in the Curnamona Province. The resultant dataset defines specific structural elements like the Benagerie Ridge and a newly recognised graben to the southwest as well as defining the boundaries of the province. It also indicates that much of the Benagerie Ridge and basement east of Mt Painter are covered by less than 100 m of cover. gouthas.george@saugov.sa.gov.au

Yigarn Craton

Studies at the Lancefield Au deposit, 8 km north of Laverton, have demonstrated the Archaean bedrock is overlain by a sequence of Permian fluvioglacial material, Tertiary palaeochannel clays and Quaternary hardpanised colluvium and soil. Detailed studies of ferruginised materials in each of these horizons by Ravi Anand and Cajetan Phang (CSIRO EM) indicate that hydromorphic dispersion of Cu, As, Pb and Au was important in Permian and Tertiary sediments during the Late Cretaceous and Miocene when the water tables were high. However, under more arid conditions since the Miocene, Cu, As and Pb dispersion into the hardpan is much more subtle and is probably related to bioturbation and tree-roots Tertiary sediments tapping into mineralised or anomalous groundwaters. ravi.anand@csiro.au

Lachlan Fold Belt

At the Illewong Au prospect, 20 km southeast of Cobar, NSW, Au occurs in deeply weathered saprolite below 3 m of alluvium. Detailed mineralogical and chemical studies of profiles through the regolith by BSc Hons student, Tom Woolrych (ANU- supervised by Ken McQueen), reveal that dispersion of the chalcophile elements occurs into transported material, and surficial lag above the deposit can contain up to 42 ppb Au and 1400 ppm As. kmg@ems.anu.edu.au



MECHANISMS FOR ANOMALISM IN TRANSPORTED COVER

In the semi-arid environment of the Moonta Cu mines area of northern Yorke Peninsula, South Australia, Cu-Au occurs within Palaeoproterozoic rocks intruded by Mesoproterozoic Hiltiba Suite granitoids. John Keeling (PIRSA) is investigating mechanisms responsible for Cu anomalism in pedogenic calcrete in transported sediments where the water table is at 20 m depth. At the Poona deposit, Cu is present in calcrete and alunite but not at the nearby Wheal Hughes deposit.. John suggests that Cambrian sandstone above the mineralisation at Wheal Hughes prevents the operation of capillary rise of acid groundwaters at that deposit. Slow rates of transport by capillary action suggest that other processes like diffusion could also be important in such semi-arid and arid environments.

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Because of its abundance in the northern Yilgarn Craton, Ravi Anand, Matthias Cornelius and Balbir Singh (CSIRO EM) have evaluated the effectiveness of mulga (*Acacia aneura*.) biogeochemistry relative to soil samples in areas of cover. Studies above 10-20 m of alluvium and colluvium at the Jaguar Cu-Zn-Ag deposit indicate that only single point anomalies are present in total or partial extraction assays of the <250 µm soil fraction. However, ashed bark, phyllodes, roots, branch wood and litter samples of mulga show broad Zn, Cu, Pb, Cd, Ag, In, Sb and Sn anomalism over the mineralisation. Thus mulga appears to represent a better sampling medium than conventional or partial extraction soil analyses. ravi.anand@csiro.au

Ian Roach (ANU) is conducting an orientation biogeochemical study at Wyoming One Au deposit, Lachlan Fold Belt, NSW, where mineralisation occurs below two sequences of transported material with an aggregated thickness of 20-40 m. The area is cultivated but the study uses the remnant trees adjacent to fence lines and roads. Leaves from 25 m tall *Eucalyptus microcarpa* (Grey Box), the dominant species of the area, contain up to 4 ppb Au, levels similar to those found in the accompanying *Callitris* and *Casuarina* species which are known as aurophilic species. <u>ian.roach@anu.edu.au</u>

Mel Lintern (CSIRO EM) is evaluating the use of plant biogeochemistry at Barns gold prospect in the Gawler Craton of South Australia. A vegetated seif dune overlies mineralisation in weathered rock at 35 m depth. Leaves, twigs and fruiting bodies of *Eucalyptus* and *Melaleuca* are enriched in pathfinder elements (Ag, Bi and Pb), but not Au, above mineralisation. Sampling *Eucalyptus* is better than *Melaleuca* as it produces stronger anomalies, probably due to its long tap roots which can source elements deeper in the regolith. However, because the biogeochemical anomalies are not coherent, interpretation is more difficult than with calcrete sampling. <u>mel.lintern@csiro.au</u>



LITHOGEOCHEMISTRY

Michael Whitbread has completed a PhD study (supervised by Ken McQueen) using detailed chemical analyses to identify subtle alteration in the rocks around the Century and Elura Zn-Pb-Ag deposits. In these deposits, potassic alteration is accompanied by Fe-carbonate development and destruction of albite and chlorite. Thus he finds that Zn, Pb, Ag, Rb and Tl are enriched in the host rocks of both deposits but Na is consistently depleted in altered rocks. Using Pearce Element Ratios, he has been able to quantify alteration intensity and allow lithogeochemistry to be used as an alteration vector. These alteration signatures persist through weathering at Century but are generally destroyed at Elura. kmg@ems.anu.edu.au



Keith Scott (CSIRO EM and ANU) and Nigel Radford (Newmont Australia) have identified a characteristic V+W+Sb signature in accessory rutile associated with the highly metamorphosed Big Bell Au deposit, in the Murchison Province, 560 km north-northeast of Perth. This signature, which reflects hydrothermal alteration, is present for up to 200 m in the wall rocks and because of the stability of rutile during weathering, persists into weathered rocks. The presence of this signature in the rutiles of several nearby prospects enhances their exploration significance. keith.scott@csiro.au



NICKEL LATERITE DEPOSITS

Charles Butt (CSIRO EM) has reviewed the controls on the formation of nickel laterite deposits. Such deposits are developed on olivine-bearing ultramafic rocks (mainly dunites and peridotites) and their serpentinised equivalents. The Ni is derived by the weathering of Mg-rich olivine which commonly contains 1600-4000 ppm Ni. Elevated Ni contents in talc-carbonate rocks are not as readily available as those in olivine and such rocks do not give rise to potentially economic Ni deposits.

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URANIUM MINERALISATION

Because weathering of U from U-rich granites in the Curnamona Province is a likely source for U deposits in Tertiary sediments, Pierre-Alain Wulser (Adelaide University) is studying the mode of occurrence of U in such granites. He finds that commonly >95% of the U is present in accessory minerals, mainly zircon (60%) and monazite (20%) although other accessory minerals, like allanite, thorite, xenotime and brannerite, are also present. Zircon is commonly metamict, with up to 4% U in some zones. A process of mechanical transport of zircon and other U-rich heavy minerals and leaching of U from the least resistant phases may account for the formation of U deposits, like Beverley, in the Tertiary sediments of the Curnamona Province. pierre.wulser@adelaide.edu.au



In a recent addition to the case studies on Regolith Expression of Australian Ore Systems (www.crcleme.org.au/Pubs/Monographs/RegExpOre.html), Matthias Cornelius (CSIRO EM)

has evaluated sampling strategies for PGE mineralisation occurring in saprolite and ferruginous materials developed on poorly exposed mafic/ultramafic rocks at Yarawindah Brook, New Norcia, 130 km north-northeast of Perth. There, Pt+Pd >150ppb occurs in the subcropping saprolite, with Pt+Pd >20 ppb extending out for several hundred metres in ferruginous pisoliths and nodules, whereas Cr, Ni, Cu and Sc are dispersed for up to 2 km in lateritic gravels. Thus sampling lateritic gravel on an isometric grid would reveal the mafic/ultramafic bodies at a 3 km spacing, but a spacing of 500 m or less would be required to identify the presence of PGEs. <u>matthias.cornelius@csiro.au</u>



LEME KNOWLEDGE TRANSFER

Upcoming LEME Minex presentations:

- 25 May 05 LEME Minerals Exploration Seminar, Perth. 8.30 Registration, 18 presentations, 4.40pm Refreshments courtesy of LionOre Australia Pty Ltd. Program and Registration form <u>http://crcleme.org.au/NewsEvents/Events/MinexSeminarMay05.html</u> We are almost at capacity, but please call Sue Game on 08 6436 8695
- 24 June 2005 MINERAL EXPLORATION THROUGH COVER. University of Adelaide. Themes:
 - Advances in Landscape Evolution and Regolith Geoscience
 - Tectonic Provinces and Mineralising Systems
 - Geophysical and Remote Sensing Methods.

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- November 05 Regolith 2005 Symposia, Canberra, Adelaide and Perth.
- 19-23 Sept 05 22nd International Geochemical Exploration Symposium, Perth.

Recent Minex Publications

OPEN FILE REPORTS http://crcleme.org.au/Pubs/OFRSindex.html

- **OFR No 168 -** *Preliminary biogeochemical studies at Barns Gold Prospect, Gawler Craton, SA.* M J Lintern.
- OFR No 188 Laterite geochemical database for the Central Yilgarn Craton, WA. AJ Cornelius et al.
- Two new Case Histories for the LEME Monograph Regolith Expression of Ore Systems in the Australian Regolith http://crcleme.org.au/Pubs/Monographs/RegExpOre.html
 - Flying Doctor Ag-Pg-Zn Prospect Northern Leases, Broken Hill NSW
 - Hercules and Southern Hercules Zn-Pb-Ag-Au Deposits, western Tasmania

Visit the LEME website at http://crcleme.org.au/