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**FROM THE CEO**

Dear Mineral Explorers

I have now been two months in the job as CEO and take on the role with much enthusiasm for this impressive collaborative research organisation. Our projects are maturing and we are well into delivery mode. Please feel free to contact the project staff via email if you have specific queries but, as always, I refer you to our web site for more detail on our research news, projects development and publications. I recommend the first of our **Thematic Volumes** advertised at the end of this Brief.

I draw your attention to a report commissioned by the CRC Association - "*The Economic Impact of Cooperative Research Centres in Australia: Delivering benefits for Australia*". This demonstrates that there are **real benefits from this Federal program of some \$1.1 billion thus far**. Key findings and the full report as a .pdf are on our web site:

<http://crclme.org.au>

**I wish everyone a pleasant Festive Season and a  
Prosperous New Year**

**Steve Rogers, CEO**

[steve.rogers@csiro.au](mailto:steve.rogers@csiro.au)



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**REGIONAL STUDIES**

**Lachlan Fold Belt**

Patrice de Caritat and colleagues (GA) have constructed a low density geochemical data base (62 elements) for the Riverina region using overbank sediment samples collected at 0-10 cm

and 60-90cm depths at the outlets or spill points of large catchments (142 sites within an area of 123 000 km<sup>2</sup>). Most elements have similar or higher median contents in the lower sample but Br, Hf, Mn, LOI, P, Si and Zr are higher in the surficial samples, probably reflecting the accumulation of more resistive minerals, organics and fertilisers. The survey also reveals features relevant to regional exploration. In particular, northward decreasing As and Sb abundances reflect mechanical dispersion from Ordovician bedrocks further south and, perhaps, below Murray Basin sediments. [patrice.decaritat@ga.gov.au](mailto:patrice.decaritat@ga.gov.au)

### **Gawler Craton**

Baohong Hou and Alan Mauger (PIRSA) have evaluated the use of various remotely sensed data sets (Landsat TM, digital elevation models, airborne electromagnetics and night-time thermal images) in delineating palaeochannels in the Gawler Craton. They found that the latter two techniques provide more information than Landsat and DEM data because buried palaeochannels are generally not related to surface features. However, high resolution DEM and AEM data help determine the relationship between the current surficial regolith, palaeogeomorphology and geological settings. Thus, the remotely sensed data can provide a synoptic view of palaeochannel distribution to assist in planning the field checking and drilling needed for a detailed understanding. [hou.baohong@saugov.sa.gov.au](mailto:houbao@saugov.sa.gov.au)

### **Yilgarn Craton**

Balbir Singh and Ravi Anand (CSIRO EM) are assessing the potential for utilisation of kaolin from the Boddington Au Mine as an industrial mineral. They find that white patches from the saprolite commonly contain 50-70% kaolin, most of which is finer than 5 µm and contains minimal Fe- and Ti oxide impurities. Quartz in such white areas is coarser than 5 µm. The brightness of the kaolin makes it acceptable for use in ceramics and as a filler in paper, paint and plastics without beneficiation. Thus it is superior to many commercial deposits. [balbir.singh@csiro.au](mailto:balbir.singh@csiro.au)



## **DIAMOND EXPLORATION**

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John Keeling, Alan Mauger and Vicki Stamoulis (PIRSA) recently identified two new kimberlitic intrusions in the Terowie area of South Australia using soil geochemistry to follow up the targets defined by hyperspectral characteristics. During weathering, the phlogopite and serpentinite in the kimberlite alters to vermiculite and Mg-smectite, with the latter characterised by a spectral adsorption feature at 2303-2309 nm. This feature is sufficiently different from the broad dolomite adsorption (also present in that spectral region) that discrete anomalies (including the two newly found kimberlites) are defined. The researchers argue that integration of spectral and detailed magnetic data offers a means of prioritising subtle features (in both data sets) that might otherwise be overlooked. [keeling.john@saugov.sa.gov.au](mailto:keeling.john@saugov.sa.gov.au)

Matthias Cornelius and colleagues (CSIRO EM) have searched for kimberlites in the Yilgarn Craton using regional laterite sampling. Although the study did not locate a kimberlite pipe, ferruginous material north of Merredin appears to have formed from a previously unrecognised alkaline bedrock, possibly a lamprophyre. Due to mechanical and hydromorphic dispersion within the regolith, ferruginous materials on alkaline ultramafic rocks show haloes approximately three times the size of the pipe. Because the intense weathering in the craton destroys the diamond indicator minerals (with the exception of chromite and diamond itself), aeromagnetic data is commonly noisy due to maghemite and electromagnetic techniques are affected by highly conductive overburden, laterite geochemistry is an effective exploration tool. [matthias.cornelius@csiro.au](mailto:matthias.cornelius@csiro.au)

Balbir Singh and Matthias Cornelius (CSIRO EM) have noted that the morphology and carbonate mineralogy of calcretes developed over kimberlites in India and Africa is indistinguishable from those found over granites in the Yilgarn Craton. The calcretes over kimberlites incorporate significant amounts of diamond indicator minerals and hence are anomalous in P, Nb and, to a lesser extent, Cr, Cu, Ni, Zn, Ce and Zr, due to the development of these calcretes in shallow weathering profiles. However, in the Yilgarn Craton, more intense weathering makes survival of the indicator minerals less likely and, in the calcretes developed in transported material, anomalous geochemistry may not occur, even when the bulk of the Ca and Mg is derived from underlying kimberlite. [balbir.singh@csiro.au](mailto:balbir.singh@csiro.au)



## BIOGEOCHEMICAL STUDIES

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Karen Hulme and Steven Hill (Adelaide University) have determined that the dense root system of River Red Gums (*Eucalyptus camaldulensis*) in the Curnamona Province of SA and NSW extends more than 20 m horizontally and much more than 10 m vertically. Thus such trees can potentially sample more than 4000 m<sup>3</sup> from adjacent stream sediments, shallow aquifers in alluvium and residual rock/saprolite (see also CRC LEME Minerals Brief 7). Comparison of leaves from trees over different lithologies at Tibooburra suggest that most of the As (a potential pathfinder for Au) is sourced from shallow rather than deeper sources. [karen.hulme@adelaide.edu.au](mailto:karen.hulme@adelaide.edu.au)

Ravi Anand and Mel Lintern have carried out extensive sampling of mulga and salmon gum in northern and southern Yilgarn to establish spatial footprint over large areas. They have also collected vegetation samples from tailings dam to investigate the distribution of metals in different plant parts. Regional background values for mulga litter are established. [ravi.anand@csiro.au](mailto:ravi.anand@csiro.au)



## CALCRETE STUDIES

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Robert Dart, Karin Barovich and David Chittleborough (Adelaide University) are investigating the formation and origin of regolith carbonates in southern Australia with particular reference to underlying Au mineralisation. Sr isotopic analysis of the carbonates from the southern Australian coast to more than 450 km inland indicates that the Ca of the calcrete is almost exclusively derived from a marine source rather than from the underlying bedrock. The most likely source of this Ca is from sedimentary carbonates from the continental shelf when exposed during the last glacial maximum. Because of the exogenic origin of Ca, the association of Au and Ca in calcrete is due to physical, chemical or biological processes during or since pedogenesis. [robert.dart@adelaide.edu.au](mailto:robert.dart@adelaide.edu.au)



## GOLD TRANSPORT MECHANISMS

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Mel Lintern (CSIRO EM) and Ed Rhodes (ANU) have conducted detailed studies on the Au distribution in a 27 000 year old dune above mineralisation at the Barns Au deposit, Gawler Craton. Gold varied between <0.1 and 9.2 ppb within the dune, with the highest concentration in calcareous accumulations around a root channel at least 5m above the residual saprolite.

Soil above the mineralisation is also anomalous in Au. Knowing that the roots of *Eucalyptus* can readily penetrate into the saprolite (CRC LEME Minerals Brief 6), they have calculated that vegetation could easily supply all the Au to the dune surface and allow meteoric water to translocate it down the porous sandy profile and concentrate in rhizomorphs within a 10 000 year time frame. [mel.lintern@csiro.au](mailto:mel.lintern@csiro.au)

Frank Reith (ANU) has evaluated the relative importance of microbiota and plants in moving Au in the regolith. Experimental results and model calculations indicate that common Australian plants mediate the vertical transport of Au in the regolith. In contrast, micro-organisms recycle Au more locally, but their turnover rates may exceed the plant mediated turnover of Au by a factor of 1000. [frank.reith@anu.edu.au](mailto:frank.reith@anu.edu.au)



## HYDROGEOCHEMISTRY

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Bear McPhail (ANU) and Nigel Radford (Newmont) are investigating the exploration potential of groundwaters in unconfined aquifers adjacent to the Moolart Well Au deposit. (See CRC LEME Minerals Brief 7 for biogeochemical studies at this deposit). There the water has low salinity, is Cl<sup>-</sup> dominated and near neutral with low trace element contents (although the Mo, Ni and I contents may indicate contact with mineralisation). However, waters to the west of the deposit have high Ca and low SO<sub>4</sub><sup>2-</sup> contents, reflecting a different drainage system and no contact with mineralisation. Although the potential for Au dispersion under the present dry conditions is limited, over geological time it may have been important. [bear.mcphail@ems.anu.edu.au](mailto:bear.mcphail@ems.anu.edu.au)

Mark Pirlo and David Gray (CSIRO EM) with industry collaborators (Placer Dome and Sipa Resources) have investigated 139 groundwaters in the Ularring Rock region of the WA Wheatbelt where potential for Boddington-type mineralisation exists. There the groundwaters are near neutral and of the NaCl type, with relatively low salinity (mean TDS=3500 mg/L). Anomalous W (up to 530 µg/L) forms a coherent anomaly. Gold data is more sporadic but several samples with associated anomalous Ag were found to the north of the known mineralisation. [david.gray@csiro.au](mailto:david.gray@csiro.au)



## MINERAL HOST STUDIES

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Maite Le Gleuher, Ravi Anand, Tony Eggleton and Nigel Radford have determined the distribution of metals in the regolith at Boddington, Mt Percy and Scuddles. Trace elements are concentrated in minerals of marginal abundance which might remain undetected by X-ray diffraction analysis of bulk samples. For example, at Boddington, the study reveals that up to 270 ppb Au, 4% Cu, 5000 ppm As, 340 ppm Bi, 200ppm Mo and 100ppm W are concentrated in goethite, formed by the weathering of vermiculite, and goethite/hematite pseudomorphs in the saprolite. Large amounts of Cu are incorporated in vermiculite (>1.5% cu) which also inherits some of the hydrothermal chlorite octahedral cations, Mn and Zn. Kaolinite and gibbsite in the deposit do not scavenge these trace elements. In the duricrust, enrichment in W, Ta, Bi and V reflects residual accumulation of anatase. [maite@ems.anu.edu.au](mailto:maite@ems.anu.edu.au)

## Upcoming presentations 2006:

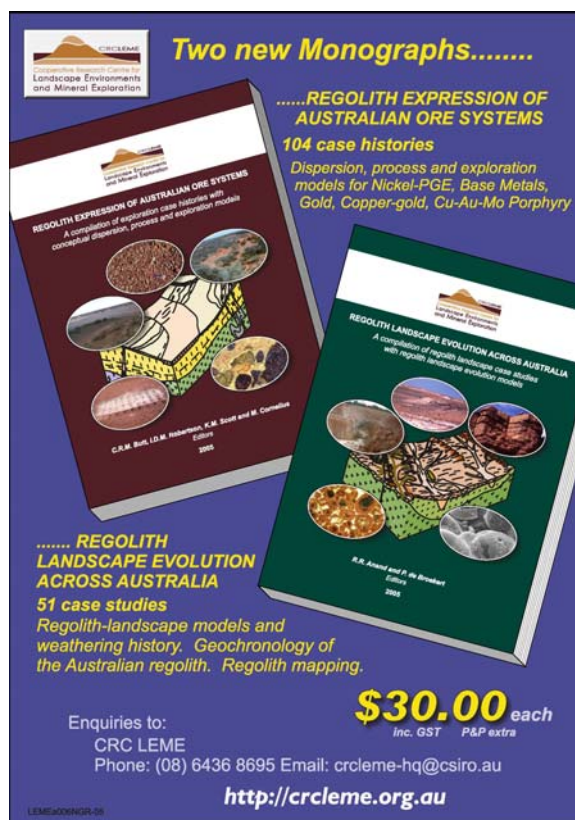
- 11-19 Feb - ANZ Geomorphology Group Conference, Taipa Bay, NZ
- 27-29 Mar - AGES 2006, Alice Springs, NT
- 1-3 May - AIG-AMEC Conference, Kalgoorlie, WA
- 24 May - LEME Minex Seminar, Sydney
- 2-7 Jul - Australian Earth Sciences Convention LEME session and field trips
- July - date tbc - LEME Minex Seminar, Perth, WA
- 27 Aug - 3 Sept - Goldschmidt Conference, Melbourne

## LEME - MCA Regolith Geoscience Course Programme for 2006:

- 20-24 Feb - Regolith Geology and Geochemistry, Wilson's Promontory, Vic
- 27-31 Mar - Introduction to Hydrogeochemistry, University of Melbourne, Vic
- 3-24 April - Regolith Geology and Mineral Exploration (Masters Course), Fowlers Gap, via Broken Hill, NSW
- 10-14 April - Regolith Mapping and Field Techniques, Fowlers Gap, via Broken Hill, NSW
- 19-23 June - Environmental Mineralogy, Australian National University, ACT

## Recent Publications (available via our web site):

- LEME Open File Report 194 - Hydrogeochemistry of the Tunkilla Gold Prospect SA (Gray DJ and Pirlo MC).
- LEME Open File Report 195 - An evaluation of the soils of Tilley Swamp and Morella Basin SA (Merry RH and Fitzpatrick RW)
- Thematic Volumes



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