

MINERALS BRIEF

Regolith Science in Mineral Exploration

June 2007 Edition No 14



WA Chief Scientist gets LEME project briefing



WA Chief Scientist, Professor Lyn Beazley (R), with Dr Ryan Noble and LEME CEO Dr Steve Rogers (L) at the CSIRO Exploration and Mining Laboratories, Perth.

A recent visitor to LEME Head Office and its CSIRO Exploration and Mining based activities at the Australian Resources Research Centre (ARRC), Perth, was Professor Lyn Beazley, Western Australia's Chief Scientist.

While at ARRC, LEME CEO Steve Rogers showed Professor Beazley one of the laboratory activities underway as part of the Centre's involvement in the AMIRA P778 Research Project to find new geochemical methods that detect mineralisation below covered terrains.

LEME Researcher Dr Ryan Noble (CSIRO Exploration and Mining) said the laboratory experiments involve the placement of various ore samples or metal-bearing solutions at the bottom of large cylinders containing regolith materials.

"These experiments will allow us to have a more controlled and accurate assessment of gold, copper, nickel and zinc mobility in different regolith types, while gaining a greater understanding about how microbes influence metal mobility," Dr Noble said.

"To make these metal ions move quicker than they would in the natural environment, we have installed peristaltic pumps which push dissolved metals through various regolith media. In our evaporation columns, we have installed heat lamps and made sure there is shallow depth of cover and water table, and high porosity to ensure consistent oxygen input to maintain sulphide ore mineral oxidation."

The possible role that bacteria play in metal mobilisation is also an important aspect of the lab work. To investigate this potential, Dr Noble is cultivating naturally occurring microbes found in regolith and increasing their population through the addition of organic extracts derived from plants found adjacent to the microbe sample sites.

"I have added different metals to these cultures and intend to measure the rates of metal ions released by the microbes. These results will then be compared with materials which do not contain enhanced microbial activity," Dr Noble explained.

"Bacteria counts and molecular techniques will also be used to determine changes in the microbial community, which will then help determine their relationship to the observed metal migration.

Research of this type has been done before, but there has not been a concentrated effort like the P778 Project led by Dr Ravi Anand (CSIRO Exploration and Mining), to integrate biological and chemical aspects of regolith processes and their relationships to metal dispersion.

One fascinating aspect of Dr Noble's work with fellow researcher Dr Rob Hough (CSIRO Exploration and Mining), is an examination of the factors responsible for the creation of tiny triangular gold crystals in regolith, which could play a role in future cancer treatments.

"These gold crystals are small enough to be placed in the blood stream but can become lodged in body tissue next to a tumour where blood vessels are rapidly growing. The crystals can then be selectively heated by infrared radiation to kill adjacent cancerous cells. As pure gold is chemically inert, it also means the crystals will not chemically react with the uninfected parts of the body's system," Dr Noble explained.

"Our research is looking into how these gold triangles occur naturally, in particular the factors responsible for particle formation, which could result in a better way to synthesise the gold triangles. So far we think they form following the reduction of gold in gold-chloride solutions assisted by evaporation."

To find out more about the LEME's involvement in the AMIRA P778 Project, visit <http://www.crcleme.org.au/Research/Programs/program2.html>

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Dating publication to aid weathered terrain exploration

The first in a series of Special Volumes to be released by LEME is *Regolith Geochronology and Landscape Evolution* (Open File Report 189), a useful publication that provides an overview about geochronology dating in regolith environments and its application to mineral exploration.

Put simply, regolith geochronology is the application of traditional geological dating methods to regolith materials, such as clay minerals and oxides created by chemical weathering.

LEME Researcher and Volume Editor, Professor Brad Pillans, Australian National University (ANU), said potassium-argon (K-Ar) dating, which is traditionally used for dating potassium rich minerals such as feldspars and micas, can be used to date secondary minerals formed in the weathering profile.

"Minerals formed by weathering such as manganese oxides and sulphate minerals, like alunite and jarosite, contain small amounts of radioactive potassium, which make them suitable candidates for K-Ar dating," Prof Pillans said.

The volume was put together from a selection of abstracts from a Regolith Dating Workshop held at ANU's Research School of Earth Sciences in 2002. The publication also features research highlights and outcomes from other geochronology projects undertaken in Australia during the last ten years. Dating case studies undertaken in the Lachlan Fold Belt of Western New South Wales (near the Northparkes Mine), Western Australia's Yilgarn Craton, and other projects located in South Australia and the Northern Territory are also featured.

Professor Pillans said many kinds of mineral deposits are formed by weathering processes operating in regolith environments.

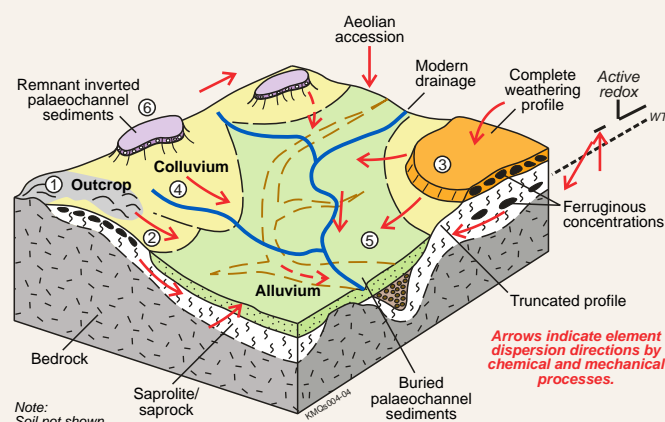
"Supergene gold, bauxite and roll-front uranium deposits are some better known examples. Weathering processes in the regolith can also create geochemical dispersion halos around primary ore bodies," Dr Pillans explained.

"Having a greater understanding and use of regolith geochronology can assist in the formulation of better exploration strategies in weathered or transported terrains. Researchers can also use this understanding to develop long-term evolution models for Australian landscapes."

The report can be downloaded free of charge from: <http://www.crclme.org.au/Pubs/OFRSindex.html>
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LEME Explorers' Guides in the pipeline

Set for release later this year is a new series of LEME Explorers' Guide publications. These guides will be practical summaries of the Centre's work designed specifically for use by exploration geologists active in regolith-dominated terrains in Australia.



A regolith-landform model of the Cobar Region in the Lachlan Fold Belt.

LEME Assistant Director Dr Ken McQueen said the Guides will be created using the results of LEME research in specific regolith terrains, with input and discussion from industry geologists active in these areas.

"The feedback I have got so far strongly suggests there is a need for practical science publications to assist mineral explorers in interpreting the prospectivity of regolith landscapes," Dr McQueen said.

"The Guides will provide a user friendly introduction to the regolith and include advice on the most suitable geochemical sampling media and preferred lab techniques for identifying anomalies."

LEME currently has on the drawing board Explorers' Guides for the Lachlan Fold Belt, Tanami, Thomson Orogen, Gawler Craton and the Curnamona Province.

Each will provide an overview of the region's regolith setting and history and cover such factors as climatic controls, regolith evolution and mineralogy, weathering geochemistry and parent rock identification. Specific locations of interest will be documented with photographs, field descriptions, drill hole log data and profile interpretations.

"Better identification of regolith materials will allow mineral explorers to work out if the regolith is *in situ* or transported and help identify regolith-related element associations and set appropriate geochemical background levels," Dr McQueen said.

"The information contained in these Guides can also be used in conjunction with other available geological information to make more informed decisions to determine appropriate exploration strategies. They will explain the use of regolith-landform maps and other derivative exploration 'go' maps."

The first guide, for the Cobar Region of the Lachlan Fold Belt, will be available for mineral explorers late in 2007.

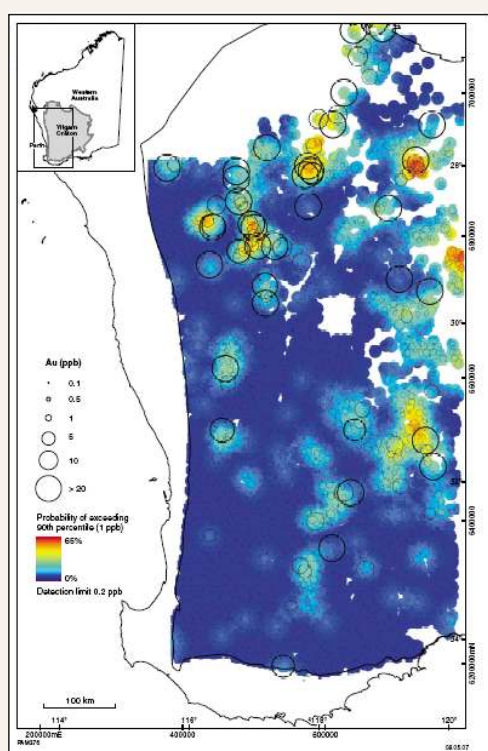
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Final Yilgarn Craton Laterite Geochemical Database now available

The long awaited final LEME project report entitled, *Laterite Geochemical Database for the Western Yilgarn Craton, Western Australia*, (OFR 116, GSWA Records 2007/9) is now available.

Designed to encourage more mineral exploration in the Yilgarn Craton, the report is the final release of a 53-element dataset created from 3,150 laterites sampled throughout the region. The database has been specifically designed to provide a regional geochemical framework at a sampling spacing that can recognise regional geochemical trends and major rock type differences.

Some of the significant trends identified by the database include increased gold abundances in the northeast part of the sampling area around known gold deposits, the potential for gold and base-metal mineralisation in the western most part of the Yilgarn Craton and a regional mercury anomaly that trends northwest for more than 500km.



Bubble plot of laterite gold abundance in the Western Yilgarn Craton, Western Australia.

The project is a collaboration between LEME, CSIRO Exploration and Mining and the Geological Survey of Western Australia (GSWA) with funding from the Minerals and Energy Research Institute of Western Australia (MERIWA).

A PDF of the report and associated dataset can be downloaded from:
<http://www.crclme.org.au/Pubs/OFRSindex.html>

2007 LEME Mineral Exploration Seminar

LEME's penultimate Mineral Exploration Seminar will take place on Tuesday, 28 August 2007 at the Australian Resources Research Centre Auditorium, Kensington, Perth.

The Seminar will showcase a series of presentations on LEME research that is highly relevant to mineral explorers interested in making informed and cost-effective decisions when assessing the prospectivity of regolith dominated terrains. Presentation topics covered at the Seminar include:

- A commemorative address by Dr Ravi Anand, 2006 CSIRO-CRC LEME Butt Smith Medallist. This medal is awarded every two years in recognition of outstanding and sustained contribution linking regolith science to exploration in Australia
- Twenty five years of geology and geochemical exploration in the Yilgarn
- Geochemical extraction methods applied to soil anomalies
- New developments in hydrogeochemistry
- Supergene gold from salty water in the Southern Yilgarn Craton
- Metal biogeochemical accumulations in soil and vegetation
- Calcrete sampling
- Interpreting automated regolith spectra.

For more information about the Seminar, and to download a registration form, visit:
<http://crclme.org.au/NewsEvents/Events/newevents.html>

LEME Project Profile: Geochronology and Quantitative Models of Landscape Evolution Project

Providing reliable numerical ages for regolith material and developing quantitative models of landscape evolution in regions important for mineral exploration and land management is LEME's Program One's Geochronology and Quantitative Models of Landscape Evolution Project.

The Project's focus regions include Yilgarn Craton, Curnamona Province, Eucla Margins and the Northern Territory, especially the Tanami Region.

A recent project breakthrough has been the successful dating of Beudantite, a lead arsenate mineral that occurs in the oxide zone of some ore-bodies in the Cobar region, such as the Elura mine. The mineral contains about one to three percent potassium, which has resulted in project researchers successfully demonstrating the feasibility of dating beudantite using the potassium-argon (K-Ar) method.

Researcher Professor Brad Pillans said determining the ages of minerals in the oxide zone is significant for understanding the supergene history of ore-bodies, which often contain enriched element concentrations.

LEME Technology Transfer

Upcoming presentations/courses 2006-07:

- 14-19 June 2007. 23rd International Applied Geochemistry Symposium, Oviedo, Spain
- 18-22 June 2007. Environmental Mineralogy Course, Australian National University, Canberra, ACT
- 26-28 June 2007. Frontiers in Mineral Science, Cambridge, UK
- 8-12 July 2007, World Conference on Science and Technology Education, Perth, WA
- 28 July-3 August 2007. XVII Inqua Congress 2007, Cairns Convention Centre, Qld
- 19-24 August 2007. Goldschmidt 2007, Cologne, Germany
- 28 August LEME Minex Seminar, Perth, WA
- 20-21 Sept 2007. Mines and Wines Conference, Orange, NSW
- 25-27 Sept 2007. KALGOORLIE '07, Kalgoorlie, WA

Further information about CRC LEME regolith courses can be found here:
<http://crcleme.org.au/Educ/MTECcourses.html>

Recent Publications

(Available via our website <http://crcleme.org.au>)

- Special Volume (OFR189) - Regolith Geochronology and Landscape Evolution.
- OFR 184 - 3D Modelling of the Callabonna Sub-basin (Southern Curnamona Region).
- OFR 116 - Laterite Geochemical Database for the Western Yilgarn Craton, Western Australia.

Recently Published Papers

- Apatite (U-Th)/He age constraints on the Mesozoic and Cenozoic evolution of the Bathurst region New South Wales: evidence for antiquity of continental drainage divide along a passive margin. C. Persano, P. Bishop and F.M. Stuart. Australian Journal of Earth Sciences 53, pp 1041-1050.
- Recent results from a geochemical survey in the New South Wales part of the Thomson Orogen in Australia: Implication for mineral exploration. AusGeo News June 2007, Issue No 86.
- Biomediation of calcrete at the gold anomaly of the Barns Prospect, Gawler Craton, South Australia. A. Schmidt Mumm and F. Reith. Journal of Geochemical Exploration, Volume 92 (2007).

Past issues of the Minerals Brief can be downloaded from: <http://crcleme.org.au/Pubs/index.html>

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CRC LEME is the cooperative research centre for regolith geoscience with some 130 contributing researchers from eight Core Parties around Australia. We generate and apply regolith knowledge for mineral exploration and environmental management.



Your organisation can benefit from CRC LEME expertise.

<http://crcleme.org.au>