

# MINERALS BRIEF

## Regolith Science in Mineral Exploration

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### LEME and Geoscience Australia sampling technique helps assess Australia's energy potential

A methodology developed by LEME and Geoscience Australia (GA) to collect, prepare and analyse samples will form the basis of a national-scale, GA lead regolith sampling program to assess the country's onshore energy potential.

The new regolith sampling program, known as the National Geochemical Survey of Australia (NGSA) project, forms part of the Commonwealth Government's Onshore Energy Security Initiative announced in August 2006 to acquire new geophysical and geochemical data to attract investment in onshore petroleum, geothermal energy and uranium exploration.

In a collaborative effort between GA and State and Territory geoscience agencies, the NGSA will deploy the LEME/GA cost-effective, ultra-low density sampling approach. The sampling program will aim to collect surface and near-surface transported regolith materials at about 1,600 sites covering the majority of the continent. The program's methodology was refined over the last few years during pilot projects carried out in the Riverina (NSW and Vic), the Gawler Craton (SA) and in the NSW part of the Thomson Orogen.

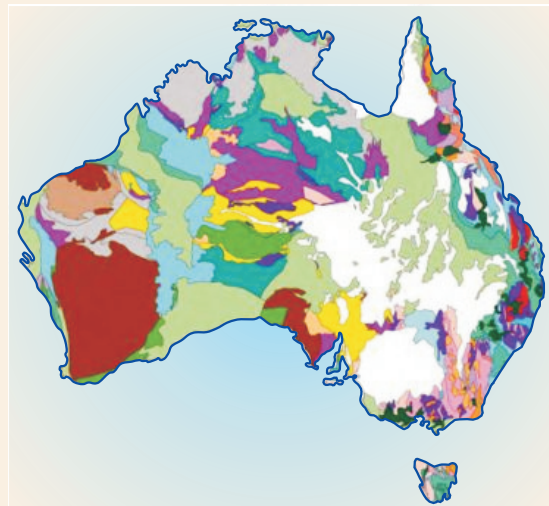
Principal LEME Research Scientist and Project Leader Dr Patrice de Caritat (GA) said the NGSA's main purpose is to acquire actual uranium and thorium concentration measurements.

"The level and distribution of these concentrations can assist in establishing new uranium-rich provinces and, together with other elements, help define areas containing hot granites – a potential source of geothermal energy," Dr de Caritat said.

"Data generated by this project will also be used to compare actual concentrations of uranium with those derived from airborne radiometric surveys. In so doing, we will gain insights into potential disequilibria in the radioactive decay chain, resulting in a better understanding of radiometric patterns and a more accurate calibration of airborne data acquired during different surveys during the last decades."

A suite of 60 elements will be measured in at least one size fraction of the materials collected. Additional measurements will include grain size distribution, pH and electrical conductivity.

Despite the common occurrence of a thick regolith cover over much of the pilot areas,



clear bedrock signatures were detected in the form of dispersion trains for gold mineralisation pathfinder elements, such as arsenic and antimony, distinct geochemical signatures reflecting I- and A-type granites or elements like chromium indicating the presence of ultramafic bedrock.

"The results from the pilot projects leave me in no doubt that we are seeing a geochemical expression of bedrock even in areas deeply buried under sediments, aeolian blankets or just weathered materials."

The pilot projects have yielded geochemical patterns reflecting known mineralisation. They have also shown interesting anomalies over areas where no previous mineralisation had been identified. Such anomalies can be used to target specific regions for mineral exploration. In one instance, a junior explorer coincidentally drilled sulfide mineralisation within a catchment where the pilot geochemical survey revealed elevated copper and lead values.

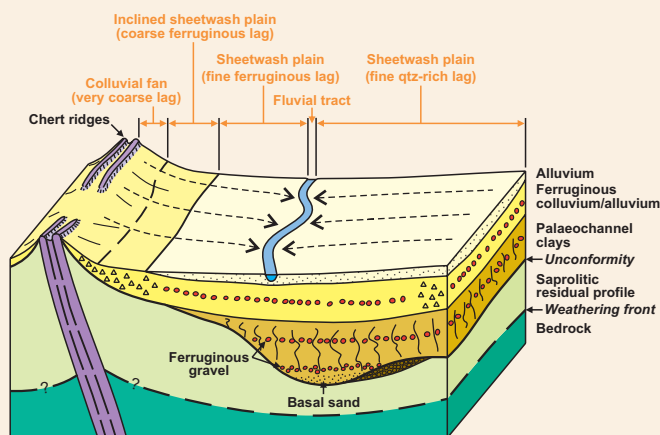
"The method developed for the pilot projects was adapted from experiences learned elsewhere around the world, and it is comforting to see it appears to robustly reflect bedrock composition in the context of Australian landscape and climate evolution. Applying this approach to the new focus on energy resources should be fairly straight forward," concluded Dr de Caritat.

The Onshore Energy Security Initiative concludes in 2011, by which time the NGSA aims to deliver reports on uranium and thorium trends and hot granites, as well as a web-based geochemical atlas and database accessible to the public.

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### LEME develops gold exploration techniques over transported cover near Leonora, Western Australia

Now available from LEME is a new report highlighting regolith sampling techniques specifically created for gold exploration in the Karari and Northern Leonora regions of Western Australian's Eastern Goldfields.



*The McGrath Gold Deposit Landscape Model as featured in the recently released OFR 152.*

Originally devised as part of a collaborative project between LEME and the now defunct resources company, Sons of Gwalia Ltd, the report highlights a selection of gold exploration techniques suited to those regions. The techniques were developed following the project's investigation into the processes that lead to gold anomaly formation within and on transported regolith over known mineral deposits.

LEME researcher Dr Ravi Anand (CSIRO Exploration and Mining) said regional geochemical anomalies could be detected by sampling ferruginous material in transported cover at or near its base.

"Ferruginous gravel near the base of transported cover, which over lie fresh gold mineralisation, can act as sinks for transported gold, cadmium, mercury and other pathfinder elements," Dr Anand said.

"To get the best results from this sampling method, the report recommends selective sampling of ferruginous nodules and pisoliths, either visually or through magnetic separation."

The study also suggests that calcrete sampling along the Carosue Dam mine corridor could be used as an effective regional surface exploration tool.

"The most useful results from calcrete sampling will occur when samples are selectively taken from zero to four metres depth – ideally from a specific depth," Dr Anand said.

"Samples should then be tested using diluted hydrochloric acid to avoid ferruginous or non-carbonated materials contamination."

Geochemical sampling of biota at McGrath, such as native shrubs including mulga, has revealed anomalies that appear to be associated with known gold mineralisation under cover.

The report, entitled Gold Anomaly Formation in Areas of Cover at Karari and North Leonora and Implications for Exploration (CRC LEME Open File Report 152), can be downloaded free of charge from [www.crcleme.org.au](http://www.crcleme.org.au). Contact: [ravi.anand@csiro.au](mailto:ravi.anand@csiro.au)

### Report shows groundwater geochemistry can help in nickel search

A new LEME report has highlighted the potential use of hydrogeochemistry as a nickel exploration tool in Western Australia's North-eastern Yilgarn Craton.

The report was created from the results of a groundwater investigation undertaken by the Centre in the Agnew Wiluna Greenstone Belt of Western Australia for four mineral exploration companies actively exploring for nickel in the area.

As part of the investigation, about 300 samples were collected from exploration drill holes, wells, farm bores and groundwater monitoring systems in the region. An additional 210 previous collected samples were also incorporated into the study.

LEME Researcher Dr David Gray (CSIRO Exploration and Mining) said the study's principle objective was to develop reliable regional and smaller-scale hydrochemical nickel sulphide mineralisation indicators.

"The measurements taken, including pH, redox potential (Eh) and electrical conductivity, showed the hydrogeochemistry of the region was predominantly freshwater within a neutral pH range, with an increase in salinity commonly experienced at the base of palaeochannels and near salt lakes," Dr Gray said.

"While the region has relatively low concentrations of dissolved metals compared to the groundwaters of the Central and Southern Yilgarn, the study results suggest that groundwater has significant potential as a medium-scale, nickel exploration tool."

The report's findings have implications to smaller-scale investigations to assess near-miss drilling in brownfield regions and hydrogeochemically similar greenfield prospects.

"Most high concentrations of metals associated with the nickel hydrogeochemical signatures are indicative of sulphides in mineralisation," Dr Gray explained.

"Chromium is the best indicator element for ultramafic rocks especially if they are sulphur-poor, while nickel, cobalt, platinum and tungsten are the best pathfinders for nickel sulphide mineralisation."

The study also showed that larger, more mineralised deposits have the largest hydrogeochemical signatures,



Map showing location of the NE Yilgarn Craton groundwater geochemical study (brown).

with the best anomalies associated with massive sulphide deposits.

Mineral saturation indices studies were unsuccessful with respect to nickel-ore minerals. However, they proved useful for uranium targeting with preliminary results indicating hydrogeochemistry would be an effective exploration tool for uranium mineralisation in the Northeastern Yilgarn.

The report entitled Nickel Hydrogeochemistry of the North-eastern Yilgarn Craton, Western Australia, CRC LEME Open File Report 212 can be downloaded free of charge from: [www.crcleme.org.au](http://www.crcleme.org.au)

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### LEME environmental mineralogy course enrolments now open

As part of its commitment to provide high-quality, regolith science training, LEME is conducting its Environmental Mineralogy Course on 18-22 June 2007 at the Australian National University, Canberra.

Suitable for industry professionals, Honours and Masters by coursework students, the course provides an overview about regolith minerals and mineralogical structures associated with different forms of environmental degradation, such as salinity, sodicity and Acid Sulfate Soils (ASS).

Course Coordinator Dr Ian Roach (ANU) said better management decisions about environmental degradation, minesite rehabilitation, agriculture, water resource management and other disciplines can be made through an appreciation and consideration of regolith mineralogy.

"For example, an understanding of regolith mineralogy, such as clay minerals, can help engineers make more informed decisions when searching for suitable locations for structures such as dams," Dr Roach said.

Any one considering a career in natural resource management, environmental management or agriculture must first have a reasonable understanding of regolith mineralogy.

The Environmental Mineralogy Course will provide first hand skills involved in determining qualitative and quantitative regolith mineralogy such as Xray Diffraction Analysis (XRD), Scanning Electron Microscopy (SEM), Infra-red Spectroscopy, as well as other methods.

Attendance costs vary depending on background and course type:

- Master By Coursework Students - \$2,000 plus transport, accommodation and meals
- Industry - \$1,100 plus transport, accommodation and meals
- Minerals Tertiary Education Council (MTEC) Students transport, accommodation and meals costs only
- Other students - \$275 plus transport, accommodation and meals.

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### 2007 Cooperative Research Centres Association Conference to share innovation experiences

A selection of high-profile speakers will share their perspectives on the innovation process at the 2007 Cooperative Research Centres Association (CRCA) Conference on 16 -18 May in Perth, Western Australia.

In 2007, the Conference looks beyond CRC-based research and invites anyone interested in research and development to attend and hear eight highly-regarded international and national speakers present their own invaluable perspectives on science and technology innovation.

2007 CRCA Conference Chairman Mark Woffenden said some of the Conference Keynote Speakers include Australia's Chief Scientist Dr Jim Peacock; Retired Lockheed Martin Corporation Chairman and CEO, Mr Norman Augustine; and Professor Anil Gupta, Executive Vice-Chairman of India's National Innovation Foundation – the guru of grass-roots invention.

"In addition, Professor Leo Tan from Singapore's Nanyang Technological University will give his insights into how Singapore has implemented innovative solutions to deal with domestic problems such as the creation of a sustainable, high-quality water supply for the island," Mr Woffenden said.

"ANU Professor Tim Brown will provide an insight into how the Chinese Government has planned to use science and technology as pivotal drivers for continued economic expansion."



Other keynote speakers include:

- Dr BI Choe: Director, Office of Strategic Planning and Policy, Samsung Medical Centre, Korea
- Mr David White: Director of Lifelong Learning, Education and Training Policy Education and Culture Directorate General, European Commission, Belgium
- Mr Anthony S K Wong: Commissioner for Innovation and Technology, Innovation and Technology Commission, The Government of the Hong Kong Special Administrative Region of the People's Republic of China, Hong Kong.

Since its inception in 1990, the CRC Programme has delivered tangible benefits to the Australian economy across a broad range of sciences, technologies and industries through strategically focused and successful collaborative research between industry, government and universities.

A 2006 study by Insight Economics showed that as a result of CRC research training and commercialisation activities, Australian Gross Domestic Product (GDP) has been increased by nearly \$2.7 billion.

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### Recent Publications

(Available as .pdf files via our website:  
<http://crlcme.org.au>)

- Open File Report 152 - Gold anomaly formation in areas of cover at Karari and North Leonora and implications for exploration.
- Open File Report 212 - Nickel hydrogeochemistry of the North-eastern Yilgarn Craton, Western Australia.
- Open File Report 189 - Regolith geochronology and landscape evolution.

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

### LEME Technology Transfer

#### Upcoming presentations/courses 2006-07:

- 26-30 March 2007. Introduction to Hydrogeochemistry (Honours/MSc course), University of Melbourne, Vic
- 26-29 March 2007. 7th AMIRA Biennial Exploration Managers Conference, Barossa Valley, SA
- 30-April - 1 May 2007. South Australian Resources and Investment Conference, Adelaide, SA
- 16-18 May 2007. CRC Association 12th Annual Conference 2007, Perth Convention Centre, Perth, WA
- June 2007. Mineral Exploration Under Cover Symposium, Adelaide, SA
- 14-19 June 2007. 23rd International Applied Geochemistry Symposium, Oviedo, Spain
- 18-22 June 2007. Environmental Mineralogy Course, Australian National University, Canberra, ACT
- 28 July - 3 August 2007. XVII Inqua Congress 2007, Cairns Convention Centre, Qld
- 19-24 August 2007. Goldschmidt 2007, Cologne, Germany
- Sept 2007. KALGOORLIE '07, Kalgoorlie, WA.

Further information about CRC LEME regolith courses can be found here:

<http://crlcme.org.au/Educ/MTECcourses.html>

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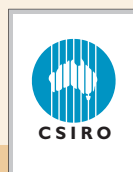
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CRC LEME is the cooperative research centre for regolith geoscience with some 130 contributing researchers from eight Core Parties around Australia. We generate and apply regolith knowledge for mineral exploration and environmental management.



Your organisation can benefit from CRC LEME expertise.

<http://crlcme.org.au>