NRM BRIEF

Regolith Science in Natural Resource Management

December 2006 Edition No 2

CRCLEME
Cooperative Research Centre for
Landscape Environments
and Mineral Exploration

The future of Australian regolith science

Regolith science is a relatively emerging science that CRC LEME has been engaged through its research and training programs – much to the benefit of the natural resource management industry.

However, the Centre and its fully focused regolith science programs will cease to exist after 30 June 2008. The demise of CRC LEME has raised concerns about what organisation(s) will continue the development of regolith science research in Australia.

To address this issue, the Centre has appointed a special taskforce chaired by CEO, Dr Steve Rogers. This taskforce will soon be seeking input from its existing and potential end users and will shortly send out a letter for comment. For more information,
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New geophysical data to give Mildura a clearer salinity picture

A new high-resolution three-dimensional insight into saline groundwater flow, salt stores and floodplain processes along the Sunraysia Region of the River Murray is one step closer following the completion of an airborne geophysical survey. The survey was flown in support of the development and implementation of salinity management initiatives.

The Sunraysia Airborne Electromagnetic (AEM) Project carried out by LEME in September 2006 targeted the Sunraysia Region in a project initiated by the Sunraysia Salt Interception Integration and Optimisation Steering Committee and the Mallee Catchment Management Authority. Data from the survey, will support high-priority projects in the region, including the development of a Sunraysia Disposal Strategy, a refurbishment plan for the ageing and underperforming Mildura-Merbein Salt Interception Scheme, the design of a potential scheme in the Red Cliffs area and supporting technical investigations looking at flood plain processes around King's Billabong.

At the behest of the Lower Murray Darling Catchment Management Authority (CMA) and the NSW Department of Natural Resources, the AEM survey was extended into NSW to include Gol Gol Lake and swamp, and the Mourquong Disposal Basin to examine the links between these systems and salinity inflow into the Murray.

The RESOLVE Bird and helicopter prior to take off near Mildura.

The most notable aspect of the project, especially for Mildura residents, was the use of a torpedo-shaped, high-tech sensor that measured and recorded variations in the electrical conductivity of the ground.

Known as the RESOLVE Helicopter Electromagnetic (HEM) System or the 'RESOLVE Bird', its sensor consists of a six-frequency Electromagnetic (EM) coil set comprised of a series of transmitters and receivers housed in a nine metre long kelvar tube. As it flies 30 metres above the surface, the Bird's six different frequency coil combinations pick up induced ground EM responses generated from its EM transmissions.

LEME geophysicist Dr Andrew Fitzpatrick said the airborne data was acquired every three to five metres along projected flight lines.

"The Bird's measure response is a function of frequency, so the higher frequencies help detect near surface conductors that could represent clay-rich floodplain materials or salt stored in near surface sediments," Dr Fitzpatrick said.

"Decreasing the frequency, increases the depth of penetration."

While the resolve bird is not new technology, the project has used, for the first time, an attitude sensor system consisting of a boom mounted at right angles to the bird housing. Two Global Positioning Systems (GPS) mounted at both ends of the boom supplied accurate altitude information to assist in the recovery of high-quality near surface electrical conductivity data.

"The raw data collected by the Bird needs to be calibrated and corrected for survey artefacts and levelling before it can be used to create accurate conductivity models which will help define the sources of saline seepages into the Murray River," Dr Fitzpatrick said.

"We are now embarking on a ground validation and calibration program to ensure that accurate maps of ground and groundwater conductivity can be completed by early 2007."

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2006 LEME Regolith Symposium

Departing from the previous tradition of holding separate regolith symposia at LEME's three nodes in Perth, Adelaide and Canberra, a combined Regolith Symposium was held at the Hahndorf Resort, South Australia, in November 2006.

For four days, staff and students delivered more than 90 presentations that showcased the Centre's latest research covering a wide range of topics from dryland salinity in Queensland to improving the outcomes of salinity management in Australian regolith landscapes.

Some natural research management research highlights of the 2006 Regolith Symposium included:

Urbanisation near estuaries results in high lead levels

Preliminary research by LEME PhD student Fern Beavis (ANU) has shown that some Merimbula and Pambula estuary sediments, located in south eastern New South Wales, contain anomalously high lead levels (up to 20ppm).

By examining the weathering products from lead fishing sinkers and estimating the human-derived lead inputs into the estuaries, Fern's research suggests the anomalous readings are most likely man made.

Her research raises the question of what the long-term environmental impacts are of increased heavy metal concentrations in unconsolidated sediments adjacent to urbanised areas - especially if they become remobilised.

As the coastal regions of Australia continue to undergo rapid urbanisation, the level of heavy metal inputs into similar sedimentary environments may increase. Concerns about the potential environmental impacts of high concentrations of heavy metals in sediments are also likely to increase.

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New archea species discovered in Tweed Valley Acid Sulfate Soils

Twenty one new species of a single celled organism known as archea have been discovered by ANU PhD student Mira Dürr in the Acid Sulfate Soils (ASS) of the Tweed Valley Floodplain, New South Wales.

As part of her Sugar Research and Development Corporation Scholarship, a total of 158 species have been recorded in a sampled soil profile situated in the river's low lying tidal floodplain drained in the 1960s to assist sugar cane agriculture in the area.

The abundant presence of these organisms, known to occur in other extreme environments, have raised important questions about the possible role that archea could play in ASS formation.

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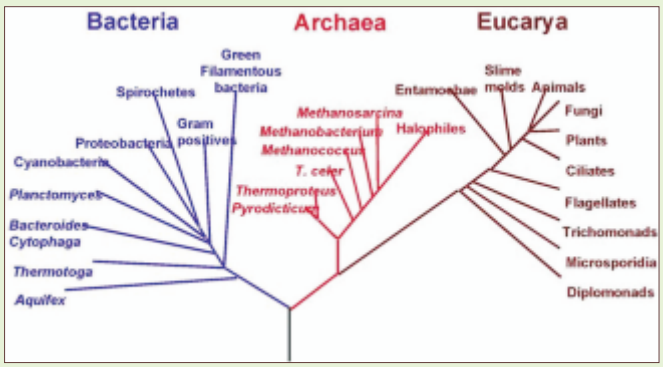

The Archea branch of organisms (red) in the Phylogenetic Tree of Life.

Loveday Basin reflooding study shows persistent water stratification

Water column electrical conductivity measurements taken by LEME researchers (CSIRO Land and Water and the South Australian Department of Water Land and Biodiversity Conservation) from the recently reflooded Loveday Basin in South Australia's Lower Murray Region have revealed unexpected water density stratification.

The presence of strong density stratification in the northern section of the Loveday Basin during the early phase of its reflooding has important implications for the monitoring of hydrological experiments in wetland environments.

To achieve better research outcomes, such wetland experiments need to ensure that electrical conductivity, and other water quality readings, are made throughout the whole water column, not just at the surface.

The reflooding of the Loveday Basin, located on the Lower River Murray Region occurred in May 2006, is part of a remediation strategy to reduce noxious smells events in the area and improve conditions for native plants and animals.

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The reflooded Loveday Basin.

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Salt minerals provide insight in acid drain geochemistry

Geochemical and mineralogical analyses of salt efflorescences along drains in a sub-coastal, interdune landscape near Tilley Swamp in the upper south east of South Australia, have provided a window into the seasonal geochemical processes occurring within the drain.

The Tilly Swamp drains were dug to help manage the projected increase in land subjected to dryland salinity and flooding by intercepting both saline groundwater and fresher water surfaces.

Aerial view of a Tilley Swamp Drain, South Australia.

Joint research by LEME and CSIRO Land and Water has shown that salt efflorescences provide an indication of the complex biogeochemical conditions and transformations occurring in and around the drains. Research suggests the soluble sulfate/chloride-containing minerals in the salt efflorescences found in the drains were most likely produced by a combination of unique geochemical reactions resulting from the mixing of groundwater, drainage water and drained soils in the region.

Salt efflorescence analyses have revealed the minerals contain high levels of sodium, sulfate and calcium ions with pedogenic eugsterite ($Na_4Ca(SO_4)3.2H_2O$) identified for the first time in Australia. These soluble minerals play important roles in the transient storage of components (Na, Ca, Mg, Ba, Sr, Cl, Br, I and SO4). They can detach soil during crystal growth, degrade drain walls, dissolve during rainfall and contribute to formation of saline monosulfidic black ooze in drains.

Salt mineral formation most likely took place through the oxidation of pyrite to sulfuric acid, which dissolved the more soluble soil constituents such as calcite ($CaCO_3$) into the lower parts of the drain, and by capillarity and evaporation in the upper part of the drain surface. As such, these minerals are indicators of soil, water and redox processes operating in specific landscapes.

The biogeochemical processes in the Tilley Swamp drains provide good mineralogical and soil indicators that can used to help understand and manage the drainage system.

An in-depth evaluation on the soils of Tilley Swamp can be found in Open File Report 195, *(An evaluation of the soils of Tilley Swamp and Morella Basin, South Australia)*. Copies of the report can be downloaded from: http://crcleme.org.au/Pubs/OFRSindex.html

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Copies of Regolith 2006, Consolidation and Dispersion of Ideas, Proceedings of the CRC LEME Regolith Symposium can be purchased from LEME head office for $55 including GST.

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LEME Technology transfer

Upcoming presentations:

- 13-15 December 2006. 9th Australasian Environmental Isotope Conference and 2nd Australasian Hydrogeology Research Conference, Adelaide, SA
- 26-30 March 2007. Introduction to Hydrogeochemistry (Honours/MSc course), University of Melbourne, Vic
- 22-23 May 2007. Urban Salinity Conference, Homebush Bay, NSW
- 18-22 June 2007. Environmental Mineralogy (Honours/MSc course), Australian National University, ACT
- February 2008. Australia New Zealand Geomorphology Group Conference, Queenstown, Tas
- 30 March - 4 April 2008. International Salinity Forum, Adelaide, SA

Further information about CRC LEME regolith courses can be found here:
http://crcleme.org.au/Educ/MTECourses

Recent Publications

(available via our web site http://crcleme.org.au):

- Open File Report 185 - The measurement of ξ34S in environment samples by Continuous Flow Mass Spectrometry (CFMS)
- Open File Report 208 - A guide to sulfur gas emissions from wetlands and disposal basins: Implications for salinity management
  Open File Report 209 - Synopsis of potential amendments and techniques for the neutralisation of acidic drainage in the Western Australian Wheatbelt
- CRC LEME 2005-06 Annual Report
  (Downloadable from
  http://crcleme.org.au/Pubs/annualreports.html)
- Regolith 2006, Consolidation and Dispersion of Ideas. Proceedings of the CRC LEME Regolith Symposium, November 2006

Past issues of the NRM 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.

CRC AUSTRALIA

ANU · Curtin University of Technology · Adelaide University Australia · CSIRO · NSW Department of Primary Industries

Your organisation can benefit from CRC LEME expertise.

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