



LEME Information Dump

May/June 2006 report to LEMERs

The Information Dump is a series of bimonthly reports to keep Centre staff and students informed about what is happening at CRC LEME.

Many thanks to the Program Leaders and Assistant Directors for their contributions to this edition.

PROGRAM 1 – REGOLITH GEOSCIENCE

LISA WORRALL

Highlights

- NT Regolith Map and Atlas released as public documents at AGES Alice Springs (28 - 29th March, 2006).
- Radio interviews conducted for ABC Country Hour Program (CRC LEME CEO and NTGS Director interviewed at AGES Alice Springs (29th March, 2006).
- NT Ministerial press release prepared for Monday 3rd April 2006 about the NT Regolith Project products.
- A regolith workshop was held for CAMECO Australia P/L (a Darwin based uranium exploration company) between 9 -10th May.
- An informal presentation about the relevance of regolith knowledge given to ACT Canberra Institute of Technology (CIT) Horticultural students during their visit to the GA Education Centre. NT Regolith products used as examples of regolith work. GA display was also used.
- Negotiations with GSQ about the Queensland Regolith Map Project are well advanced. It is expected that a contract between CRC LEME and QLD DNRMW will be signed before the end of this financial year.

- Martin Smith (Geochronology Project ANU) submitted his PhD thesis entitled 'Towards a geochronology of long term landscape evolution in northwestern NSW'.
- Augustine Alorbi (Lachlan Fold Belt Project ANU Hons student) has now completed his research on appropriate sampling media at the Miandetta and Gilgai Prospects west of Nyngan. He submitted his thesis on 6th June. This work was done in collaboration with Jervois Mining.
- Megan Lech, Adrian Fisher and Karen Hulme completed the first major field trip for the Thomson Orogen Project. The trio left on March 27th and return on 13th April. During that time, they visited 57 sites across the region in order to sample overbank deposits and vegetation for geochemical analysis. The overbank samples were subjected to on site NITON (portable XRF) analysis. The analytical data will be used to generate baseline geochemical maps.
- Dave McAveney and Layla Tucker (Thomson Orogen Project AU Hons students) completed their main field trip in the Tibooburra area and have already come up with some new ideas on the morphotectonics, palaeo gold-dispersion and mineralisation of and in the New Bendigo area. Jesse Davey (Thomson Orogen Project AU PhD) has completed her first field trip which was focused on constraining the mapping done in the Warratta Inlier.
- The Thomson Orogen Project had its first public exposure at the SMEDG Wines and Mines Conference in Cessnock, NSW. The team made a poster and gave an oral presentation. The poster showed preliminary NITON geochemistry results across 76 catchments, as well as basement geology and depth-to-basement interpretations. The oral presentation outlined the project aims and methods, as well as 2005-06 results. Both the poster and the talk generated a lot of interest. Several company reps inquired about the baseline geochemistry technique and two companies inquired about gaining tenements over the Thomson.
- On the 30th of May, Platsearch NL lodged applications for three large ELs on the White Cliffs 250k sheet, in the Thomson Orogen. These lodgements were at least partially a result of the presentation and discussion of the new Thomson data at the SMEDG conference. Increased exploration activity is a KPI in the Thomson Orogen Project, so this early success is very pleasing.
- Geochemical surveys at Christmas Ball, Kalkaroo and Polygonum prospects in the Curnamona Province have been completed. 378 samples were collected. 202 samples from the near surface and 176 from 70-300cm within the zone of maximum evaporation. Samples have been sieved to -80# and submitted to Amdel to be digested using aqua regia and Deep Leach 11. Near surface samples have been submitted to ALS Chemex in Perth for analysis by MMI-M.

- A groundwater sampling trip to Kalkaroo and Poygonum has resulted in three high quality samples and one low quality sample. The sampling strategy for subsequent trips is now in place.
- Ground EM surveys at Kalkaroo have been successfully completed. The data is currently being processed and interpreted.
- The Central Gawler Gold GIS has been completed and compiled onto DVD, copies will be available at Exploration Through Cover Conference in Adelaide on 23rd June 2006.

New business

- **Central Gawler:** Minotaur Exploration is to provide operational support for student vegetation sampling over the Tunkillia Gold Prospect under the supervision of Steve Hill.
- **Geophysical Signatures of the Regolith:** Collaborative project between University of Adelaide and DWLBC with funding from a National Water Initiative grant has commenced. The project is about using geophysics to map fluids in fractured rock in the Mount Lofty Ranges.
- **Curnaminex/Central Gawler:** An International Science Linkages Funding Agreement has been finalised. The China-Australia Fund is to provide \$44.5k to Dr Baohong Hou to facilitate collaboration with Chinese researchers on development of CHIM electrochemical techniques.
- **Tanami:** Negotiations are underway with NT DNRETA, NTGS, WA Water and GA regarding a joint Water Smart Australia Project Proposal. If successful the Project will fund an AEM survey in the Tanami Region.
- **Thomson Orogen:** At the September 5th Project meeting in Canberra, a possible addition to the Thomson Project will be discussed. Richard Greene and Tony Eggleton are proposing to look at the clay morphology, mineralogy and chemistry of our overbank samples. It is hoped they will be able to estimate the amount of aeolian material in the samples, and the effect of this material on the geochemistry of the overbank soils.

Discussions with outside agencies

- **Tanami:** Lisa Worrall and other project staff are engaged in ongoing discussions with *GSWA, NTGS, Tanami Gold NL, Newmont Australia, Barrick Australia, WA Water* and *NTNRETA* regarding collaboration on the Project.

- **Central Gawler:** Discussions with *Adelaide Resources* regarding their response to the draft regolith map and access to their RC and RAB drill chips.
- **Central Gawler:** Discussions with *Minotaur* regarding vegetation sampling at Tunkillia.
- **Central Gawler:** Discussions with *Iluka Resources* regarding the availability of night-time thermal imagery.
- **Northern Territory Regolith:** Discussions held with *NTGS* senior staff about the options for further collaboration in the NT.
- **QLD Regolith Map:** Discussions with *QLD DNRMW* and *GA* regarding collaboration on the Project.
- **Thomson Orogen:** Liaison with *MMI Technologies* regarding the best sampling techniques required for their samples.
- **Thomson Orogen:** Discussions with *Platsearch NL* at the SMEDG Mines and Wines conference which have resulted in *Platsearch* lodging applications for three large ELs on the White Cliffs 250k sheet, in the Thomson Orogen. The contacts made at SMEDG were Bob Richardson and Wendy Corbett www.platsearch.com.au.
- **Eucla Margins:** Project staff are engaged in ongoing discussions with *Iluka Resources*.
- **Curnaminex:** Discussions with *Southern Cross* and *Heathgate* about ground and airborne EM data from the Curnamona region.
- **Physiographic regions:** Discussions with *ACLEP* regarding funding of project activities next financial year.
- **Physiographic regions:** Discussions with *ASRIS* staff regarding the consistency of line work across Australia. This will be resolved at meetings with state and territory agencies in the coming year.
- **Physiographic regions:** Colin Pain attended the annual meeting of the *National Committee on Soil and Terrain* (used to be the Working Group on Land Resource Assessment) in Hobart. The Committee reaffirmed the importance of regolith as a fundamental data layer in ASRIS, and stressed the importance of a national regolith map and classification. A list of the committee membership for the client database can be provided if appropriate.
- **Weipa:** Discussions with *Comalco* and *Rio Tinto* regarding the forthcoming field visit.

Exciting new science

- Much of the exciting new science in P1 in March is currently confidential to individual projects.
- A new heavy mineral sands discovery has been announced by Iluka at Gulliver.
- Brian Barrett, Michael Hatch, Andrew Telfer and Graham Heinson have submitted an application for a Eureka Prize for the development of the river NanoTEM system.

PROGRAM 2 - MINERAL EXPLORATION IN AREAS OF COVER

RAVI ANAND

Highlights

- First sponsors meeting for the new AMIRA Project 'Predictive Geochemistry in Areas of Transportable Overburden' – AMIRA P778 was held in Perth on 7th April.
- A field trip to the Jaguar base metal deposit was undertaken by Rob Hough, Cajetan Phang, Frank Reith, Craig McFarlane and Ravi Anand. Extensive sampling of soils, vegetation and regolith was carried out for a variety of geochemical and microbial investigations. Litter traps were installed. Preliminary samples by Mel Lintern and Ravi Anand were collected from North Miitel Nickel Prospect. Hydroponics experiments using graded quartz sand will enable true ebb and flow application. A preliminary examination of the raw SDP data did not reveal any startling anomalies over mineralization at Rose Dam. Acacia and Eucalyptus samples grown under pseudo-hydroponic conditions with various gold concentrations have been processed and with results expected soon. EDAX analysis of LA ICPMS lines through Au-bearing calcrete has been undertaken and interpretation is in progress.

Processing of the synchrotron data acquired by Rob Hough in March revealed how trace elements sited within plant tissue, especially zinc, can be differentiated from external contamination in the form of dust. 3D tomography of the Acacia leaf again acquired by synchrotron is providing an excellent means to reveal the level of detail of the internal structure of the phyllode.

- Frank Reith revised two manuscripts (one of which was accepted by SCIENCE) and prepared a book chapter on Exploration Geomicrobiology. He also conducted an incubation study to establish a microbial mechanism for the formation of Au-in-calcrete anomalies with samples from the Banes anomaly in South Australia.

- CSIRO Land and Water along with CSIRO Exploration and Mining have made the offer of a new appointment in Synchrotron science, the post-doctoral fellowship is being taken up by Dr Rosalie Hocking who is currently at Stanford.
- Patrice de Caritat recently received an expression of interest to carry out a hydrogeochemical survey on a Au tenement in north-central Victoria. Discussions have started to establish how this could be done, what information the company is hoping to get out of it, etc. Anglo-American continues to collaborate with Bear McPhail and Patrice de Caritat on interpretation of groundwater chemical and isotopic composition on various tenements worldwide. They had a meeting with us on 4 May 2006 where recent results and interpretations were presented. Anglo-American expressed great enthusiasm and support for this collaborative work.
- Mel Lintern completed the Boomerang Open File Report. Isotope manuscript corrections have been made and the document is now with CRM Butt for final comments before re-submission to Chemical Geology.
- As part of the Objective Logging Project, a five week collaborative trial of HyChips technology with Genalysis started. The project has two aims (i) familiarisation of the HyLogging technologies for Genalysis and (ii) our familiarisation of service opportunities through analytical laboratories.

Specific issues tackled include:

- Material/measurement issues, ie how does the observed spectral response vary with different sample preparations?
 - Where might HyChips technology sit in the analytical workflow?
 - Market testing – what industry interest is there in the technology being collocated with other analytical capabilities.
- Progress continued regarding the development of unmixing regolith spectral mineralogy with extension of regolith mineral library, collaborative with CSIRO MIS.

Discussions with outside agencies

- On 7th April the first sponsors meeting for the new AMIRA Project 'Predictive Geochemistry in Areas of Transportable Overburden' – AMIRA P778 was held in Perth. The meeting's focus was on the work plan for the next 12 months including site selection for the detailed studies. From all reports, it was a very positive affair generating a lot of

enthusiastic interaction. Along with the staff from CEM and CRC LEME, sponsor companies present included: Barrick Gold, BHP Billiton, Inco Resources, Independence Group, Newmont, SGS Minerals and Teck Cominco. Other Project sponsor Cameco Corporation was absent on the day.

- Discussions continued with Jon Huntington on LEME's role and involvement in Virtual Core Library Facility (see http://www.auscope.org.au/home_frame.htm), which forms part of an earth sciences initiative being developed in response to the 28th February 2006, release of the National Collaborative Research Infrastructure Strategy (NCRIS) Strategic Roadmap (available at http://www.dest.gov.au/sectors/research_sector/policies_issues_reviews/key_issues/ncris) developed to inform decision makers about how Australia should make strategically important infrastructure investments to further develop its research capability.

New science

- As part of the Yilgarn Laterite Geochemistry Project, sampling continued on the Yalgoo, Kirkalocka, Ninghan and Perenjori 1:250 000 sheets with approximately 150 samples collected. Sampling progress is slow as it is limited to one field team with access restrictions.

Multivariate statistical analysis of the laterite data for the SW and NW segments of the Yilgarn effectively discriminates between dominantly ultramafic and felsic bedrock types with some terrains showing mixed signatures that may indicate the presence of some mafic or ultramafic components in granite-gneiss dominated terrain.

- Geological Survey of WA geochemical analyses of various regolith materials from the Byro, Glengarry, Leonora, Menzies and Sir Samuel 1:250 000 sheets have been included in some interpretations to detect craton-scale geochemical trends. Discussions are being held with the Geological Survey of WA to investigate the possibility of reanalysing specific fractions of these samples using the Yilgarn laterite analytical suite. Standard materials for two laterite standards have been obtained by the Geological Survey and will be supplied to the Yilgarn laterite atlas project as an in-kind contribution.

PROGRAM 3 – ENVIRONMENTAL APPLICATIONS OF REGOLITH

PAUL SHAND

Highlights

- Paul Shand, based at CSIRO Land and Water Urrbrae, South Australia, was appointed as Program 3 Leader on 5th June.
- Rob Fitzpatrick gave a presentation to the Natural Resource Management Ministerial Council Meeting in Sydney on recent outcomes/future work in the 'Atlas of Australian Acid Sulfate Soils Project (led by Theme 2 staff under the auspices of the National Committee for Acid Sulfate Soils (NatCASS)). This motivated the joint Media Release from the Australian Minister for the Environment and Heritage Senator, The Hon Ian Campbell and Australian Minister for Agriculture, Fisheries and Forestry, The Hon Peter McGauran released on Friday 21 April 2006:
<http://eriss.erin.gov.au/minister/env/2006/mr21apr206.html>
- Keynote address on 'Acid Sulfate Soils: National Atlas and Future Scenarios' presented by Rob Fitzpatrick at the Coast to Coast Conference in Melbourne on 23rd May, 2006.
- LEME Open File Report and Report to Client completed for Morella Basin trace elements study.
- Completed CRC LEME report entitled: 'Evaluation of Floodplain Soils along the Loxton Salt Interception Scheme Pipeline Corridor near Loxton, South Australia by Rob Fitzpatrick, Warren Hicks, Andrew Baker and Julianne James-Smith for the South Australian Water Corporation.
- Filling of Loveday basin started on 1 June. Surface water quality monitoring program will be intensified for the next month while the basin is being filled.
- Journal paper accepted with revisions: Lamontagne, S., Hicks, W.S., Fitzpatrick, R.W., Rogers, S. 'Occurrence and properties of sulfidic materials in Lower River Murray Wetlands.' *Marine and Freshwater Research.*
- Samples from the Gawler Survey have been analysed for Au, F and Se, as well as major elements by XRF.
- Sue Welch visited CSIRO L&W for two weeks in May to complete molecular biology work.

New Business

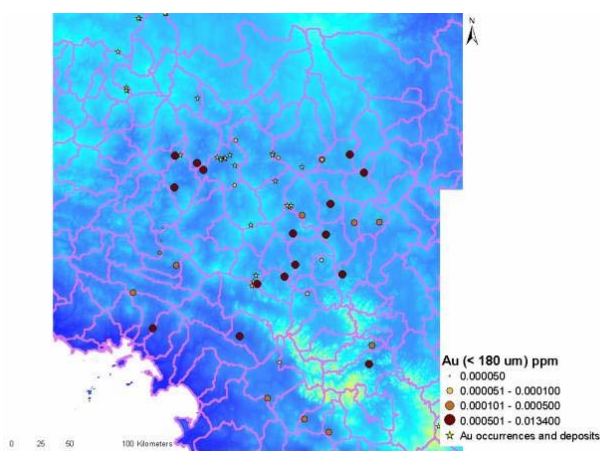
- South Para Biodiversity Project/Catchment Board, DWLBC and SA Water have invited CRC LEME staff to assist in a significant water quality problem caused by the formation of sulfuric materials in Inland Acid Sulfate Soils following a major landslide/erosion event (i.e. over 8,000 tonnes of mainly sulfidic material) in September 2005 at Puddledock only two kilometres from the South Para reservoir.
- Meeting with DWLBC planned on 22nd June to draft contract for monitoring at Loveday for 2006-07.

Discussions with outside agencies

- Rob Fitzpatrick is developing a research project with staff members from the South Para Biodiversity Project/Catchment Board, DWLBC and SA Water – site will be included in the CRC LEME Inland ASS project.
- A mineral exploration company has expressed interest in the geochemical survey data from the Gawler Region.
- Discussions started with the ICP-MS lab manager at ANU/EMS and 20 QA/QC samples submitted to test suitability of equipment and method for GS project needs for Gawler survey (and others).

Exciting new science

- All catchments in the Gawler Survey Region that have a known gold occurrence or deposit within them show measurable Au in the regolith sample collected near their outlet (see Figure below).



- There appears to be a rough inverse correlation between absolute Au concentration in the regolith materials and distance from Au

occurrence/deposit. This could have profound implications for mineral exploration in the region, as several catchments have high Au concentrations in the regolith sample, but as yet no discovered Au occurrence.

- Salt efflorescences along the Loxton Salt Interception Scheme Pipeline Corridor near Loxton were found to be seleniferous (i.e. selenium-rich) and some soils had slightly elevated concentrations of chromium and antimony. Developed a user-friendly 'Soil Identification Key' to allow the easy identification of the various Acid Sulfate Soils (ASS) along the SIS pipeline near Loxton.
- Results of preliminary Sulfur flux experiments at Loveday show that acidification will have limited effect on S flux from the sediments.
- Results of infiltration experiments at Loveday show maximum infiltration along the sandier edges of the basin and in the wet-dry zone where ped development is optimal. Infiltration decreases in the wet zone where pedal structures are deteriorating.

Significant delays, problems

- The demise of the ICP-MS at GA means that there will be some delay in getting the Gawler samples analysed for trace elements in GS project (queued since December 2005).
- Amy Kernich, who was a 1.0 FTE contribution from GA to the GS project, resigned at the end of May. Adrian Fisher, a recent GA graduate recruit, has taken up some of the slack by contributing to the collaborative LEME-GA project.
- Delays in characterising samples collected in February from the acid lakes (receiving environments) in the WA wheatbelt due to a shortage in staff. This has now been corrected.

PROGRAM 4 – SALINITY MAPPING AND HAZARD ASSESSMENT

KEN LAWRIE

New business

- **Murray Corridor Project, Vic:** Contract agreement reached with BRS and GA for analysis and interpretation of AEM-surveys in a Federal Government project, managed by BRS, for salinity mapping and management in the Murray floodplain in Victoria. Work schedule agreed for 2005-2006. Arrangements in place with DPIVic to subcontract staff to assist with project. Value of 05-06 work \$95k. Discussions on-going to develop costed workplan for 2006-08 (estimated in range \$600k - \$1m).

- **Central-West, NSW:** Contract agreement signed with Central-West CMA, NSW, for phase one of the new project. This project is phase one of a broader project, and in this phase, work will be undertaken jointly with NSW DPI and the Central-West CMA to validate value-added GFS products, produce a GIS for salinity assessments in the Central-West CMA, and develop a new methodology for GFS products in depositional landscapes. Value \$85k.
- **Sunraysia, Vic:** Draft project schedule being iterated by Tim Munday, to be sent back to Goulburn Murray Water by Monday 5th June. Agreement on project budget: \$404k. Aim to have signed agreement in place by 16th June.
- **Coffin Bay, SA:** SA Water agreed to fund stage two of Coffin Bay work involving AEM data acquisition, linked to Fugro Multi-client survey in South Australia. Quote to SA Water being prepared to include cost for data acquisition and project management – value ~ \$85K. Once Fugro quote received, Tim Munday to prepare service agreement based on Stage 1 study (June 06). Costed workplan has been developed for Stage 2 proposal to interpret the data.
- **Beaufort palaeochannel, WA:** Fully costed project plan developed for clients (approx. \$400k). Awaiting decision on funding approval.
- **Avon Catchment, WA:** Discussions held with Avon Catchment Council, and AgWA to develop a project proposal to produce value-added GFS-style products. Draft project proposal has been developed, with further discussions planned for July 2006.
- **Angas-Bremer Plains, SA:** Draft contract agreed with BRS. Liason with Gary Kong on minor changes in progress. Expect final agreement to be with CRC LEME by 2nd June.
- **Ord, WA:** New project proposal requested by Ord Irrigation Cooperative to carry out an airborne geophysical survey for both the existing irrigation area and the Stage 2 area (baseline studies). Proposal submitted through the regional accreditation process has been welcomed, and has gone forward for State and Commonwealth consideration. Project, valued at \$490k, would commence in 2007-08.
- **Burdekin, WA:** LEME included in a major new proposal to the National Water Commission for an AEM study. Proposal submitted in June 2006. Project would be joint with CSIRO and local water boards. Project valued in range \$300k-\$500k.
- **Other potential projects, SA:**
 - Discussions being held with potential clients in SA for further AEM work related to salinity disposal basins.

- Approaches from Land Council representatives interested in acquiring AEM data for water resources and water quality investigations.

Discussions with outside agencies

- Discussions to develop new project proposals have been held with BRS and GA, and water boards (Goulburn-Murray and Wimmera-Mallee), catchment management authorities (Mallee and North-Central) and government agencies (DPI, DSE) in Victoria regarding the Murray Corridor project.
- Discussions held with AgWA, CMAs and State agencies in NSW, SA, WA, Qld and Victoria, and Goulburn-Murray Water, the Queensland Murray Darling Committee Inc and the University of Queensland.
- Discussions continuing with CRC Salinity to develop joint project proposal to assist with salinity modelling work in our MDB Uplands/Drylands research.
- Discussions held with Spatial Information CRC on joint project arrangements in Bet Bet Project, Victoria.
- Discussions being held with MDBC and State agencies to develop new workplan for 06-07. Focus will be more balanced between uplands and floodplain research, and on developing communication products.

Exciting new science

- **MDBC- co-funded projects:** CRC LEME has now developed a range of products at a range of scales for work on salinity in upland/erosional catchments. The theme throughout these products is value-adding to GFS-type products by improving the soil, regolith and bedrock geology layers. These data layers can be used as stand-alone products (eg as refined GFS products), or more usefully, incorporated into hydrogeological models.

These products can be tailored on the basis of data and resource availability, and range from high resolution (sub-catchment to farm scale) products that require acquisition of new field data through to sub-catchment and catchment scale products compiled through largely desktop studies, but informed by both national scale and smaller scale studies.

Examples of the products are:

- **High resolution (sub-catchment to farm scale) GFS+ products.** Generation of these products involves the acquisition of new regolith, soil and bedrock + structural data. This product

was developed in the Bet Bet sub-catchment of the Upper Loddon Catchment, Victoria. Products include new soils, regolith and fractured rock aquifer maps. This involves analysis of air photos, satellite imagery, available geophysics, DEMs, and ground truthing by drilling and field studies. Data layers incorporated into 2C Salt and CAT3D models. Utility: for within valley salinity assessments, and targeting management actions at sub-catchment scales. Individual finer-scale GFS+ units have also been aggregated up to represent larger scale units.

- **Moderate resolution (sub-catchment to catchment scale) GFS+ products.** Generation of these GFS+ products involves limited acquisition of new regolith, soil and bedrock + structural data, combined with desk top studies. This product was developed in sub-catchments within the Lachlan and Macquarie Catchments in NSW (Proof of concept report). The project is multi-scale, and involves a national scale-down approach, mapping physiographic region boundaries to identify increasingly smaller sub-catchments with similar geomorphic expression, combined with more detailed sub-catchment scale field studies to calibrate GFS+ products. Desk top studies are used to extrapolate the more detailed studies out to physiographic region boundaries. Utility: for within valley salinity assessments, and targeting management actions at sub-catchment scales.

Several new products are being produced:

- New detailed soils, regolith and fractured rock aquifer products within the 'calibration' areas at sub-catchment scales.
 - Physiographic region maps (national to sub-catchment scales).
 - 'Extrapolation' GFS+ maps (sub-catchment to catchment scales).
- **3D map of depth to bedrock beneath valleys.** These products can be produced at a variety of scales, and are essentially constrained by DEMs, borehole data, geomorphic principles and available geophysics. They give a 3D representation of the basement-regolith interface beneath valleys. They can be produced at a variety of scales, depending on data density/availability. This product has been trialled in valleys in the Lachlan Catchment.
 - **3D models of valley infill.** This uses a geological model-and rules based approach (using 'Geomodeller' software) to predict valley-infill materials. Constraints include available borehole data, geological rules and principles. Provides a best approximation of the likely infill of valley systems. Accuracy of

product dependent on data density. This product has been trialled in the Bet Bet Sub-catchment.

- **Physiographic regions maps.** These products are produced at a range of scales and detail, and the finer scale examples of these are crucial in defining the boundaries of similar landscapes (similar in landscape evolution, expression, likely salt store potential and hydrogeological character).

Project Updates

- **Ord Project:** This project set out to explore the appropriateness of ground and airborne electromagnetic (EM) techniques to delineate aquifer systems, and to map water quality variations, recharge and infrastructure leakage in the Ord irrigation Area (ORIA). A re-assessment of aquifer stratigraphy and connectivity was also undertaken. Ground and borehole geophysical surveys combined with a re-examination of soil and regolith data have demonstrated that specific electromagnetic (EM) techniques can successfully delineate sand and gravel aquifers, clay-rich layers, and the regolith-basement interface. However in most of the ORIA Stage 1 irrigation area, there is insufficient water quality and therefore electrical contrast between surface and groundwaters for EM techniques to map water quality variations and channel leakage. In the course of this project, important new insights into landscape evolution in the area have been gained.
- **Burdekin Project:** Recognition of a fan-delta origin and geometry for the Burdekin has major implications for modelling of groundwater flow in the irrigation region, whether for groundwater resource estimation, artificial recharge calculation, or managing salt water intrusion. Previous interpretations emphasised the presence or absence of interstitial mud and represented the succession as mud-dominant, with isolated channel sands. Fan-delta geometry implies the reverse, with isolated lenses or drapes of mud locally separating stacked bodies of gravely sand. The greatest variability in hydraulic properties is likely to be down fan, with variations of approximately 14 orders of magnitude predicted in fan systems. This contrasts with conventional deltas where variability is greater across the distributary system.

Furthermore, new ground, in-river, in-irrigation channel and borehole electromagnetic (EM) surveys, combined with a re-examination of soil and regolith data, have demonstrated that specific electromagnetic (EM) techniques can map water quality variations, and hence map infrastructure leakage and recharge of aquifer systems in some areas. These techniques are particularly effective in the coastal zone where there is a contrast in water quality and electrical conductivities in the shallow sub-surface between irrigation and river waters as compared to the more saline groundwaters related to salt water intrusion. In more inland areas of the delta, conductivity contrasts are also evident where dryland salinity processes are present. Elsewhere in the delta, where

salt water occurs at depth, EM techniques, primarily map the textures of aquifer systems in the shallow sub-surface, although deeper saline groundwaters can also be mapped with the appropriate geophysical systems.

Preliminary assessment of seismic reflection data reveals possible evidence for neotectonics. The significance of this assessment to groundwater management and earthquake risk is being followed up.

- **Chowilla/SE Murray Floodplains Project:** Preliminary interpretation shows AEM datasets providing valuable new insights into floodplain processes. Conductivity models predicted from the airborne electromagnetic data help identify local recharge and discharge areas, and links with river salinity. The AEM data have delimited a fairly extensive flushed zone adjacent to the River Murray itself, and provide insights into its geometry. Near surface conductivity data correlates well with recharge maps developed from an interpretation of multi-temporal satellite data and vegetation mapping.

Observed variations in conductivity mapped at depth suggest the HEM data is mapping variations in the porosity of the Loxton sands below the Monomon Formation. This may have implication for the siting of bores linked to proposed bores for salt interception and ecological protection. The three-dimensional distribution of salinity in the saturated and unsaturated zones is being incorporated into hydrogeological models for the Chowilla Floodplains, to assess future management strategies.

Also, inverted RESOLVE FDEM data for a stretch of the River Murray at Bookpurnong, SA, have been compared with the Insteam NonTEM data and available river-bed core data. The HEM data showed very similar trends in conductivity variation mapped in the corresponding NanoTEM data. For this reach of the river, the HEM data effectively mapped gaining and losing stream conditions and provided significant insights into the interplay between an irrigation induced groundwater mound, the regional groundwater system and river salinity. We also considered the economic and logistical issues involving the acquisition of HEM data along the River.

- **Landscapes Analysis project:** A key element of this project has been value-adding to existing datasets. As an important part of this project, published K-Ar ages for Cainozoic basalts and other igneous rocks from eastern Australia, along with locations and other data for 770 analyses, encompassing about 500 locations, have been collated. Data from Western Victoria and Northern Queensland are still to be collated. These ages and locations will be built into a GIS layer that will allow rapid assessment of rates and timing of landscape development when displayed with DEMS, and digital geology and regolith. Some locations are recorded as yard grid references, and migrating these into MGA grid references is continuing.

- **Salinity Dynamics Project:**

- Richard Greene has just spent the last two months at the University of Wisconsin-Madison investigating the genesis, formation and stability of aeolian dust particles with Professor Joe Mason (and partly funded by the AAS). He has been comparing Australian “parna” to US “loess”, using a combination of field and laboratory-based studies. Preliminary results will be presented at the up-coming Aerosol Conference in Brisbane (Greene, Joeckel and Mason: Dry saline lakebeds as potential source areas of aeolian dust: a case study for the Laramie Basin, Wyoming, USA).
- Field results from a trip by Richard Cresswell (with collaborators from QDNRMW and UQ) to the Pioneer Valley (Mackay) revealed extreme salinity gradients between coastal rivers and adjacent groundwaters. High tides in this region are thought to be responsible for sea-water intrusion along river courses, but no localised evidence of this, or of groundwater freshening adjacent to fresh streams was recorded. Long-term studies have been installed and geochemistry is being carried out to compare and contrast the different waters.
- Dirk Kirste has been looking at the differences between the chemistry of EC1:5, EC1:2, EC1:1 and pore fluids and has found significant differences suggesting that cation exchange processes are affecting the results. Different pore fluid extraction techniques are also revealing differences in final chemistry, suggesting that physical processes are also important. This work will be combined with earlier work on extraction procedures to provide a coherent summary of extraction chemistry, with inferences for salt mobilisation in weathered materials.
- The third milestone report to the Corangamite CMA has been delivered. Dighton, Dalhaus, Davies, Cox, Barton, Smitt and Smith: ‘Defining groundwater flow systems on the Basalt Plains to accurately assess the risks of salinity and impacts of changed landuse.’
- KP Tan and colleagues have integrated AEM data, down-hole induction logs, petrophysical attributes collected from drill cores and cuttings (moisture content, porosity, salinity and texture) and lithological framework to model the textural distribution of the Bland sub-catchment, NSW. The resulting model has three sedimentary textural classes (sand, muddy sand and mud) and with bedrock and saprolite delineated. From the textural model, preferential flow-paths and flow impedance at a scale resolvable on the conductivity depth-slice intervals (10 – 20 m thick) are established. In addition to the pump-test results and the calculated storativity, the in-situ moisture contents of various lithological units were compared against the moisture contents at -15 bar matric potential to derive a model depicting the

proportion of saline pore fluids that can or cannot be mobilised within the sub-catchment.

Significant delays and problems

- Delays continued in the Salinity Dynamics projects due to problems with drilling rigs, and the lack thereof. Some delays also in delivery of some CUT projects. Remaining projects are essentially on track.

Other issues

- **AESC 2006 Environmental and Geological Hazards and Risks Symposium:** Conference program now finalised and media strategy being developed. Pre-conference field guide is finalised.
- **ISF 2008:** Conference themes and structure agreed, and call for abstracts brochure and website finalised.

PROGRAM 5 – EDUCATION AND TRAINING

STEVE HILL

New Business

- E&T projects submitted and Executive Meeting for first pass of projects held on 27th April.
- Compilation of Fifth Year Review data.

Adelaide University

- Michael Neimanis and Jess Davey conducted first PhD fieldtrip with Steve Hill into the Curnamona Province and Northern Flinders Ranges. This included field collaboration with Steve Hore (LEME / PIRSA) in the Mt Painter area.
- Layla Tucker and David McAvaney conducted their first Honours fieldtrip with Steve Hill into the Milparinka - Tibooburra area. Layla completed her biogeochemistry sampling in the vicinity of the New Bendigo Au-mineralisation and David made preliminary field observations on neotectonic features in the New Bendigo and Warratta South areas.
- Undergraduate subject '*Surficial Geology I*' has now been renamed '*Regolith, Landscapes and Environments II*' to reflect the greater emphasis and inclusion of regolith geology into the undergraduate teaching program at the University of Adelaide. The third year undergraduate subjects with major regolith content have also been renamed '*Environmental Geoscience Applications III*' and '*Environmental Geoscience Processes III*' and cover mineral

exploration and environmental management applications of regolith geoscience, and the fundamental scientific theory, respectively.

CUT

- Siriporn Soongpankhaio conducted her first PhD field trip with Mehrooz Aspandiar to Gnaweeda field site near Meekatharra. The site is being investigated in collaboration with TeckCominco Ltd.
- Lindsay Collins and Mehrooz Aspandiar demonstrated regolith materials in the field to 28 third-year Geology students as part of the third year field trip to Carnarvon Basin.

MCA/MTEC Courses

- Regolith Mapping & Field Techniques (RMF) Honours course and Regolith Geology and Mineral Exploration masters courses, Fowlers Gap. Enrolments in RMF included 19 Honours, one PhD, two industry. MSc enrolments were two industry professional development participants, one each from JCU and UWA.
- Regolith Geology and Geochemistry (RGG) Honours course returned very good to excellent (mean = very good) student evaluations. RMF and HGC courses are still being evaluated.
- Barrier Daily Truth article (Ian Roach and Steve Hill), ABC Regional Broken Hill radio interview (Ian Roach) regarding joint RMF-MSc course at Fowlers Gap.

Exciting New Science

- Student science outcomes and outputs incorporated into Research Program reports.

Future Planning

- CRC LEME Fifth Year Review: Program data submitted late May; Review 19-20 July (Perth).
- Advanced Remote Sensing (RSM) Honours course 5-9 June.
- Environmental Mineralogy (EMN) Honours course 19-23 June.
- Undergraduate regolith geology fieldtrip (Fowlers Gap), July 8-15 (Steve Hill, Ian Roach, Graham Heinson).
- CRC LEME Regolith Symposium (Hahndorf), November 2006 (All).

ASSISTANT DIRECTOR CANBERRA:

KEN MCQUEEN

Highlights

- LEME Connection Meetings were held on 6th April, 20th April, 4th May, 18th May and 1st June with interesting student presentations. Kathryn Fitzsimmons has been a great help in organising the speakers and venues for these important meetings.
- Steve Rogers attended the LEME Connection held on the 1st June at the ANU and updated staff and students on current and future activities in LEME, as well as reporting on his attendance at 'Mineral Week' held in Canberra from 30th May to 1st June.
- Three meetings of the Writers Co-op were held during the period and there is now a substantial portfolio of articles at various stages of preparation, acceptance and publication prepared by the small dedicated team of students and staff.
- Maree Coldrick has been appointed as the part-time PA to the Canberra LEME node (as of 4th May) and will be working for LEME all day on Wednesdays and Thursdays. Maree's email contact is: leme.admin@ems.anu.edu.au.
- PhD candidate Martin Smith presented his final PhD Seminar at RSES ANU on the 25th of May. Martin is now nervously awaiting the outcome of his thesis examination.
- Keith Scott (ANU - LEME visiting fellow) visited the ANU on the 27th April and 22nd May for discussions with staff and students.
- Roslyn Chan retired from GA (and LEME) on the 5th May and was farewelled by GA and LEME colleagues at an afternoon tea function on the same day.
- I was involved in the LEME-MTEC Masters Course on 'Regolith Geology and Mineral Exploration' held at Fowlers Gap from 3-14 April. LEME staff involved in this course and the subsequent regolith mapping component were Steve Hill, Bear McPhail, Ian Roach, Ian Roberston and Keith Scott with help from Adelaide Uni students Jess Davey, Layla and Dave.
- I visited LEME HQ at Bentley on the 28th April for meetings and discussions with LEME staff in Perth.

- From 30th April - 4th May, I attended 'Outcrop to Orebody: Innovative Geoscience in Exploration and Mining,' a three day conference sponsored by AIG and AMEC, held in Kalgoorlie from 30th April to 4th May. This meeting had a number of contributions from LEME staff and was very well attended by industry (more than 240 registrants).

ASSISTANT DIRECTOR ADELAIDE:

JOHN KEELING

Highlights

- Extended abstracts finalised for CHIM and Hyperspectral Surveys in Diamond Exploration for presentation at AESC, Melbourne 1-5 July.
- Discussions held with PIRSA executive on LEME project proposals involving PIRSA staff, restructuring administration of LEME in-kind staff for the final two years of LEME, and PIRSA budget support for LEME staff in 2006-07.
- Project proposals for 2006-07 finalised and submitted.
- Committee meetings attended for Exploration Through Cover Conference held at Adelaide University on 23rd June 2006. Advertisement placed in PIRSA's MESA Journal for distribution at SA Resources and Energy Investment Conference (SAERIC), Adelaide 1-3rd May, 2006.
- Presentation on 'Integrated Techniques for Diamond Exploration' given at South Australian Resources and Energy Investment Conference (SAERIC) Hilton Hotel, Adelaide 3th May. Posters promoting LEME work on the Gawler Craton prepared with assistance from Mel Lintern.
- Soil sampling and shallow auger drilling sampling program completed over Christmas Ball, Kalkaroo and Polygonum prospects in the Curnamona.

Discussions with outside agencies

- John Keeling attended SA Diamond Interest Group (DIG) meeting on 3rd April. Organised by Vicki Stamoulis (LEME) with guest speaker David Jones from Blina Diamonds. Results of LEME work on kimberlite at Terowie discussed and Flinders Diamonds tabled new helimag data over part of LEME HyMap survey. Further work on integration of magnetic and spectral data sets was discussed.