CRCLEME

Cooperative Research Centre for
Landscape Environments
and Mineral Exploration

STRATEGIC PLAN
2002 TO 2008

Using regolith science to provide breakthroughs in mineral exploration and natural resource management

Our vision... *is of an environmentally healthy, wealthy Australia, where regolith geoscience plays a fundamental role in mineral discovery and land management.*

Our mission... *is to create breakthroughs in mineral exploration and environmental management through generating and applying new knowledge of the regolith. In so doing we will develop CRC LEME and its core parties to become global leaders in regolith research and its application to mineral exploration and natural resources management.*

CRC LEME is established and supported under the Australian Government's Cooperative Research Centres Program.

An unincorporated joint venture between
The Australian National University, Commonwealth Scientific and Industrial Research Organisation, Curtin University of Technology, Geoscience Australia, Minerals Council of Australia, NSW Department of Mineral Resources, Primary Industry and Resources South Australia, University of Adelaide

Chief Executive Officer: Dr R Dennis Gee
Head Office: Australian Resources Research Centre
26 Dick Perry Avenue, Kensington, Perth WA 6151 PO Box 1130, Bentley WA 6102
Tel: 08 6436 8695

Web page: http://crcleme.org.au

About this Plan... This document presents the second year update of the initial CRC LEME Strategic Plan, as prescribed in Schedule 1 of the Commonwealth Agreement. It sets out objectives, strategies to meet those objectives, and indicators to measure performance, all within a framework of four strategic priorities. Special emphasis is given to research themes. It focuses on outcomes as well as outputs.

1. THE IMPORTANCE OF REGOLITH

Regolith is the surficial blanket of material including weathered rock, sediments, soils and biota that forms by the natural processes of weathering, erosion, transport and deposition. It has complex architecture, and may vary in thickness from a few centimetres to hundreds of metres. It hosts or hides valuable mineral deposits, we live on it, we grow our food in it, it is the foundation of many major engineering works, and much of our water supplies are stored in it. It underpins our economic, social and infrastructure systems.

Prolonged deep weathering over the last 50 to 300 million years, on a predominantly stable continent of great antiquity, has created a unique Australian regolith. An understanding of regolith architecture and the processes that act within it, is essential to address the challenges of sustainable economic development. Regolith science has important applications in the fields of mineral exploration and natural resource management. However the uniqueness of the Australian regolith means research has to be done here, and cannot be borrowed from anywhere else in the world.

2. REGOLITH RESEARCH IN AUSTRALIA

In 1995 the Federal Government, through the Cooperative Research Centre (CRC) program acknowledged the need for research targeted at mineral exploration. Along with the mining industry, it supported the CRC for Landscape Evolution and Mineral Exploration - known as LEME1. That venture capitalised on the earlier pioneering work of CSIRO and Geoscience Australia and some universities, a portion of which was funded by the Australian Minerals Industries Research Association (AMIRA). LEME1 primarily examined the geochemistry of the regolith in relation to landscape evolution. Memorable achievements of LEME1 were:

- Development of practical techniques for the identification and discrimination of geochemical anomalies in regolith material.
- Acceptance of regolith mapping as an important dataset for mineral exploration.
- Discovery of ore bodies resulting from regolith knowledge.
- Development of the new discipline of regolith geoscience and its databases.

CRC for Landscape Environments and Mineral Exploration (LEME2) takes over where LEME1 left off. It is more process-oriented. It will focus on the third dimension of depth and the fourth dimension of time. It will look at mineral and chemical dispersion systems and geochemical and geophysical mapping methods. Most importantly, it will include broad-scale environmental issues, where practices in the field of natural resource management are at an early stage compared to where mineral exploration was a decade ago.

3. THE CHALLENGE OF REGOLITH

More than 70% of Australia is covered with regolith, much of it being a blanket of geochemically “opaque”, physically continuous transported material, typically less than 25m thick. Despite inherently high mineral prospectivity, these areas remain largely under-explored. Regolith geoscience offers a mechanism to make mineral exploration under cover more effective and efficient. More reliable, predictive and cost effective methods for reconnaissance exploration in these terrains will materially help to sustain the Australian mining industry. The Australian regolith hosts substantial amounts of natural salt. In many places, agricultural practices over the last 200 years have mobilised this salt, leading to serious degradation of agricultural land, and salination of inland waterways and aquifers. Rising sulfate-bearing groundwater can also mobilise sulfur and associated metals (such as Zn, Pb, Au) to produce acid sulfate soils and releases of deleterious elements into the environment. Currently there is little understanding of regolith architecture, and a lack of knowledge of salt distribution and mobility pathways in most of regional and rural Australia. Reliable, predictive, cost-effective methods for mapping and assessing salt stores and movement channels are essential to the design of engineering or agroforestry remedies.

4. OUR STAKEHOLDERS AND THEIR NEEDS

Consultation with clients, colleagues and other interested parties, both individually and through the LEME Advisory Councils, identifies the following stakeholders, and their needs:

- Mineral explorers, who require predictive methods to generate meaningful exploration targets within and under regolith.
- Politicians and community decision makers who need independent sound scientific advice to develop policy on matters of land use and resource management.
- Rural industries including rural R & D corporations that require information for strategic planning.
- Government mineral resource agencies (particularly our core parties Geoscience Australia, Dept of Mineral Resources NSW and Primary Industries and Resources SA) who require regolith information in pre-competitive geoscientific datasets to enhance mineral prospectivity in their jurisdictions.
- Government natural resource management agencies that require understanding of the dynamics of regolith systems in a three-dimensional (depth) framework to underpin strategies for dryland salinity mitigation, water quality controls, and acid sulphate soil problems.
- Catchment management authorities, local governments, engineering groups, community-based Landcare groups and individual farmers who require practical input to mitigation schemes.
- Students of earth and environmental sciences who require support for research in regolith processes.

In effect there are two separate groups of stakeholders - mineral explorers and land and water managers - each with their own specific requirements. However it is the science of regolith, with its multiple applications to the challenges faced by both groups that will bind together these two seemingly separate streams of applied research.

5. STRATEGIC PRIORITIES

In its overall business, LEME will pursue four strategic priorities:

- Research Priorities
- Education and Training
- Communication
- Management and Business Development

These priorities will lay the foundation for growth in the total knowledge base of regolith science, and encourage its increasing application to sustainable development and environmental management in Australia, during and beyond the life of LEME.

Over the life of LEME there will be a shift in strategic direction from the predominantly minerals focus of LEME1, to an appropriate balance with natural resource management. The exact weighting of that balance will be judged by consultation with stakeholders, and will also take into account emerging opportunities for delivering scientific breakthroughs and the availability of external funding. In practical terms the balance will be managed by the formal processes of project review, project termination, and new project adoption.

6. RESEARCH PRIORITIES.

The core of LEME business will be to undertake and deliver multi-disciplinary, leading-edge research in regolith science that can be applied to mineral exploration and land management solutions. Research will be conducted along a number of themes, each of which has its own separate objectives, often with different stakeholders, but all interrelated by regolith geoscience. Research themes to meet this core priority are:

6.1. Improve our understanding of regolith processes and landscape evolution.

Improved knowledge will drive the further application of regolith geoscience in mineral exploration and natural resource management. We will integrate, at a range of scales, the distribution of regolith with the factors that influence landscape development by undertaking 3D mapping of residual and transported regolith, characterising its mineralogy, petrography, chemistry, and physical and hydrological properties. Where transported regolith stores salt, or covers mineral-prospective basement, we will model the landscape evolution by determining the provenance, diagenesis and weathering history of the sediments.

To introduce the fourth dimension we will determine absolute ages for regolith materials by innovative methods which, together with quantitative modelling of landscape evolution, will improve our knowledge of rates of change of regolith and landscape processes. We will investigate the role of biota in the formation of regolith, and relate this to chemical mobility and fluid dynamics. We will also determine what regolith minerals host geochemical anomalies using modern micro-analytical techniques. Ultimately we will construct well-constrained 4D regolith models in key regions for direct application to mineral exploration and natural resource management.

The Centre will largely fund much of this work.

6.2. Make exploration geochemistry work through cover

This is the supreme challenge of mineral exploration. Near-surface geochemical sampling detects only some shallowly buried ore bodies. Unless we know what mechanisms drive trace-levels of metals through cover, the technique remains empirical, not predictive. Site studies will elucidate the regolith-forming processes, and palaeo-climatic environments under which these processes operated. Once the mechanisms are understood, we will predict where near-surface geochemical techniques can be applied, and deliver techniques for ranking geochemical anomalies for exploratory drilling. For subtle anomalies, we will identify the host regolithic minerals and assess dilution (for example by windblown materials), in order to enhance geochemical signals. An understanding of how anomalies relate to the 4D regolith framework will allow geochemistry to be used predictively. It will discriminate the null case (not tested) from the negative case (nothing there).

We will also undertake bottom-up studies at known sites of basement mineralisation, in order to study the nature of hydrothermal alteration zones in the regolith, and how it can be distinguished from weathering effects.

We will seek industry support for this work.

6.3. Develop techniques to interpret regolith architecture

We will use satellite (hyperspectral), airborne and ground geophysical systems (magnetic, gravity, electromagnetic, electrokinetic, ground penetrating radar), and innovative borehole logging techniques, to look within and through the regolith. This will be done in key areas of interest to stakeholders, preferably where good geospatial datasets already exist. We will develop 3D mapping techniques by the acquisition and interpretation of new, high resolution geophysical data, especially in areas of previous drilling. New generation 3D regolith models can then be established, enabling a better understanding of interaction between groundwater and regolith architecture. The application of this technology to regolith-based ore deposits will be promoted. Furthermore, the relationship of regolith and groundwater will be integrated with natural resource management (NRM) studies.

Some industry funding will be sought for this work.

6.4. Use regolith knowledge to enhance mineral prospectivity in geological regions

Integrated regional studies in covered areas are required to enhance mineral prospectivity of geological regions, and to stimulate exploration. Local studies will be extrapolated regionally. This will be achieved by detailed and regional scale studies that characterise the regolith, image its 3D distribution, date key regolith-forming events, place element mobility (metals and salts) into 4D models, and interpret geophysical and geochemical surveys in the context of these models. The focus will be on mineral fields with further exploration potential.

This work will be funded directly by the Core Parties, augmented by industry funds.

6.5. Develop methods to map and predict salinity with outcomes linked to mitigation and remediation

The factors that make it difficult for mineral explorers to use geophysical methods in regolith, such as high electrical conductivity caused by saline groundwater, can be used to map salinity. This research theme will provide salt location maps; new models of landscape evolution and sediment deposition as three dimensional frameworks for salt stores and conduits; and interpretations of all spatial data sets including geophysics. This will enable extrapolation from sites to regions; and provide data at a scale suitable for salinity intervention strategies. There is a requirement for a regional focus on the Murray Darling Basin, but not to the exclusion of other agricultural regions and rangelands.

The essential outcomes of National Action Plans on salinity are catchment management programs that command the confidence of stakeholders, substantially improve river and groundwater quality, and provide guidance for land use re-design. Using multi-disciplinary regolith knowledge, LEME will provide key outputs such as:

- 3D salinity occurrence maps for catchment planning,
- management options for engineering interventions,
- regional assessment of groundwater and surface water resources,
- landscape re-design and targeting of revegetation options,
- monitoring networks to measure the success of the various plans.

This new work by LEME will be done in collaboration with many relevant agencies, and in most instances funded through the various State National Action Plans for Salinity and Water Quality. It will therefore require a complementary salinity strategic plan.

7. EDUCATIONAND TRAINING

Education and training are vital to create the expertise to sustain strategic goals in the longer term. Our objective is to be recognised as an Australia-wide, world-class provider of quality graduates and researchers to satisfy the growing demand for specialist regolith geoscientists and environmental scientists in Australia.

Strategies to achieve this include:

- Provide funds, scientific supervision and institutional support for graduates by granting, on a competitive basis, scholarships in regolith geoscience at the BSc(Hons) and PhD levels. Our quantitative measure is to provide at least 60 new PhD graduates, and 60 Honours graduates over the life of LEME
- Provide workshops, seminars and training courses on regolith geoscience and related disciplines, directed at industry, government and institutional professionals.
- In cooperation with industry and other agencies, contribute regolith content to university courses.

8. PROMOTION AND COMMUNICATION

LEME aims to promote and communicate regolith knowledge so that it is recognised by stakeholders and decision makers as having an important role in land-use and land-management issues. Actions to achieve this will include:

- Use the internet, specifically the LEME website, to transfer knowledge and to release interim findings to all interested parties, including LEME researchers.
- Release technical reports, scientific communications and products through the LEME publication outlets, in accordance with milestones and commitments set out in project schedules.
- Compile plain-English position papers on matters of community and political interest.
- Seek opportunities to sponsor multi-disciplinary scientific and technical conferences.

The Centre will fund these activities.

9. BUSINESS AND MANAGEMENT PRIORITIES

The Governing Board and the Executive Committee will manage the business of LEME adopting best practices in accordance with the letter and spirit of the Commonwealth Agreement and the Centre Agreement, under which LEME operates. The following strategies will ensure this.

- Instil an awareness of safety in the office and field, so as to achieve a Lost Time Frequency Rate of zero.
- Manage resources according to best financial practices.
- Prioritise the work program to ensure timely delivery of products and knowledge of practical value to stakeholders.
- By generative and review processes at the Executive level, and in consultation with stakeholders and Advisory Councils, develop and manage a research portfolio that accords with research objectives.
- Provide benefits to core participants as near as practically possible in accordance with equity, bearing in mind that different projects taken up by different participants will have different demands on LEME resources.
- Grow and diversify external revenues from contract research by promoting to stakeholders the practical benefits of regolith-based knowledge.
- Ignite the creativity of LEME staff and students by encouraging and supporting an element of pure research.
- Facilitate and encourage collaborative research with other CRCs and other scientific or engineering agencies with related objectives.

10. CULTURE.

LEME will aim to develop and deliver multi-disciplinary and multi-party research that addresses stakeholder needs, consistent with the collaborative spirit of a cooperative research centre. In planning and executing its research, governance and educational priorities, LEME will act as a cohesive entity in the best interests of the joint venture, whilst still recognising the needs for equitable returns for individual parties.

11. INDICATORS OF SUCCESS

Key indicators of success in meeting the objectives of the Strategic Plan are listed below. Some are numerical targets. Others are qualitative, but are assessable by such measures as feedback from stakeholders and uptake of knowledge.

- A Lost Time Injury Frequency Rate (an industry standard measure) of zero throughout the life of LEME.
- Acknowledgement that regolith-based techniques contributed significantly to mineral discovery. This is measured by way of specific examples.
- Acknowledgement that regolith knowledge contributes to remediation of dryland salinity problems. This can be measured by instances of uptake of LEME developed techniques by agencies involved in catchment management.
- Increase in mineral exploration expenditure in areas of Australia where LEME has conducted regolith research.
- Establishment of business enterprises of international capability in regolith mapping, salinity assessment, and mitigation advice.
- LEME and its core participants are preferred providers of regolith expertise within Australia. Scientists trained by LEME are sought for employment in the Australian and overseas minerals and land management sectors: the benchmark is more than 70% of LEME students working in regolith-related jobs within one year of graduation.
- Graduate at least 60 new PhD graduates and 60 Honours students throughout the life of LEME.
- Our scientists are invited to present their work at national and international conferences, and to deliver keynote papers.
- Scientific outputs (refereed papers and book chapters, monographs, conference publications, technical reports, short course notes, maps) that total an average of three outputs per full-time-equivalent employee per year.
- Incorporation of regolith science as a significant component of all undergraduate geoscience and environmental science courses in Australian universities.

12. RESOURCES

LEME will have an average of 75 full-time-employee equivalents. These employees will have specialist skills in research and teaching, regolith geology, mineral deposit geology, geomorphology, geochemistry, geophysics, hydrogeology, hydrology, sedimentology, isotope geochemistry, geochronology, microbiology, geo-botany, bio-geochemistry, computation science, GIS and soil science.

Over the life of LEME it will have access to resources in excess of AUD$135 million. This is made up of $94M in in-kind support, $20M from the Australian Government CRC Program, and $21M in additional cash contributions. Of this, an estimated $11M will come from external sources. These external sources include State Government bodies dealing with money from the National Action Plan for Salinity, and the minerals industry through one-on-one and multi-client research studies.

13. THE FUTURE OF LEME

LEME runs from July 2001 to June 2008. In addition to developing and extending its core competencies, LEME needs to develop strategic alliances with stakeholders and other agencies to ensure the application of regolith knowledge in a post-LEME era. Three future business models are possible:

- Extend and permeate the capability of regolith science into all relevant agencies and companies, for them to progress and apply regolith knowledge.
- Preserve business units capable of providing regolith content to land management requirements on a commercial basis, nationally and world wide.
- Continue cooperative research arrangements between core parties and users without Australian Government funding.

These are not necessarily mutually exclusive models. LEME will lay the foundations so that informed judgements can be made (by the end of Year 4) on how best to develop and manage a wind-up strategy.