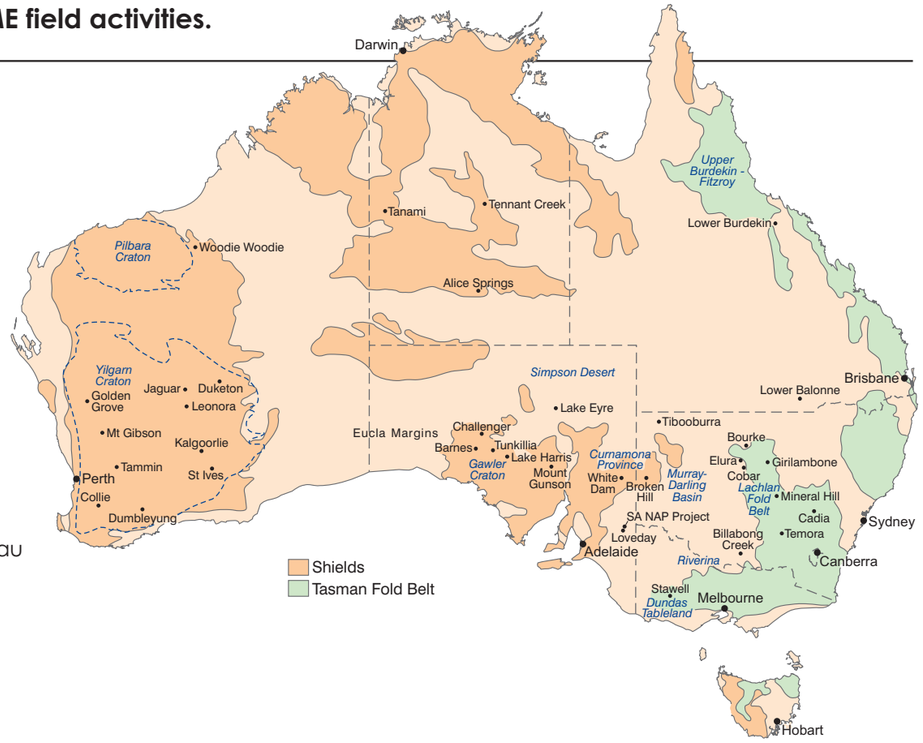
PROGRAM 2

MINERAL EXPLORATION IN AREAS OF COVER

CRC LEME operates out of three key nodes: Perth, Adelaide and Canberra.

Location of CRC LEME field activities.



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

Your organisation can benefit from CRC LEME expertise.

http://crcleme.org.au

APPLYING REGOLITH SCIENCE TO THE MINERAL EXPLORATION CHALLENGES FACING AUSTRALIA

Focus:

LEME Program 2 is using the Centre's expertise in regolith geoscience to understand the mechanisms by which surface expression of mineralisation can form in a variety of Australian environments. In areas of transported cover, geochemical anomalies can form above and be related to buried mineralisation. However, many bear no relationship to underlying bedrock and can mislead explorers.

Once the mechanisms of metal migration from mineralised source to surface are fully understood, the Centre aims to develop effective and reliable geochemical exploration techniques that will enable explorers to make decisions on what techniques are suitable for a given mineralisation style in certain regolith environments.

Program 2 aims to:

- Investigate the role and timescale of biological, mineralogical, chemical, hydrochemical and gaseous processes, and their significance for exploration through sediments.
- Establish and understand the three-dimensional geochemical 'footprint' these processes may produce.
- Determine the role of microbes in gas generation and biotransformation of elements.
- Investigate the effect of regolith properties (e.g., pH, organic matter, mineralogy, particle size, permeability, fracturing, depth) on metal migration.
- Design and conduct experiments to verify the existence of specific metal-migration mechanisms.
- Identify chemical and biological markers for use as exploration tools to distinguish real from false geochemical anomalies.

Expertise

Program 2 seeks innovative solutions for mineral exploration by linking up unrelated scientific discplines such as geology, soil science, microbiology, plant biology and ecology. Through its Core Parties, LEME has access to high quality researchers from a wide variety of disciplines including soil science, botany, plant physiology, molecular biology, microbiology, geochemistry, hydrogeochemistry and regolith geology.

Under the supervision of LEME staff, some Program research is undertaken as Honours and postgraduate projects, ensuring the wide range of expertise is past on to the next generation of scientists.

Access to technology

LEME researchers, through it Core Parties, have access to state of art technology such as X-Ray Fluorescence Spectroscopy (XRF), Nuclear Microprobe, Synchrotron, Nanosims, Scanning Electron Microscopy (SEM), Atomic Absorption Spectro-photometry, Inductively Coupled Plasma Mass Spectroscopy (ICPMS), Electron Microprobe, Transmission Electron Microscopy (TEM), Denaturing Gradient Gel Electrophoresis (DGGE), UV-Vis Spectrophotometry and ASD. These technologies provide high-quality data to support the scientific investigations required to observe and understand metal transportation processes through transported cover.

Produced by CRC LEME Visual Resources Unit
LEMEb005-06

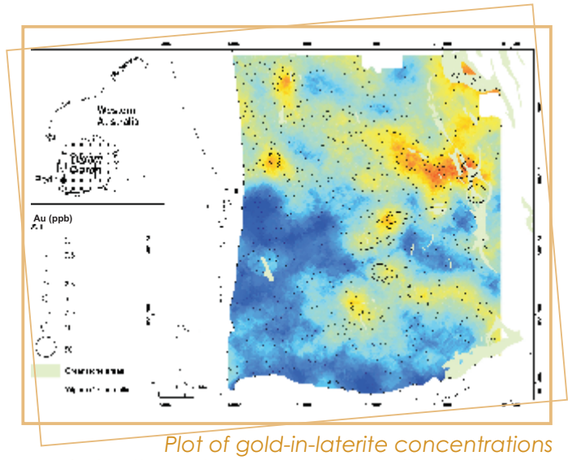
Milestones

- Improved scientific understanding of the mechanisms responsible for metal migration through transported cover.
- Guidelines for assessment of which transported regolith environments where metal dispersion is possible and what sample media and techniques are needed for detection.
- Development of cost-effective, reliable and practical exploration techniques such as phyto-exploration and hydrogeochemistry with a higher rate of success. Preliminary results in both phytoexploration and hydrogeochemistry show promise.
- Acquisition of mineralogical data through new regolith spectroscopic technology has provided the basis for effective logging of regolith materials.
- New regolith models have established mineral relationships between the bedrock and near surface geochemistry.

Current Projects

Western Yilgarn Geochemical Laterite Map

Through the sampling of laterite, this project aims to create a geochemical atlas for the Western Yilgarn Craton of Western Australia. Already, mineral explorers have shown great interest in the new regional geochemical trends and provinces identified by research associated with the atlas. The project is a collaboration between LEME, the Geological Survey of Western Australia with funding from the Minerals and Energy Research Institute of Western Australia (MERIWA).



Plot of gold-in-laterite concentrations in South Western Australia (SW Yilgarn Craton).

Predictive Geochemistry in Areas of Transported Overburden (AMIRA P778)

In collaboration with BHP Billiton, Cameco Corporation, Teck Cominco, Independence Gold, SGS Minerals, Barrick Gold, Inco, Newmont, Codelco, Rio Tinto and CVRD, the AMIRA P778 Project is determining the mechanisms responsible for geochemical anomaly formation in transported overburden in a variety of Australian environments and a selected field site in Chile.

Once this initial goal has been achieved, the project's secondary aim is to develop effective and reliable geochemical exploration techniques. Research efforts in the past two years have seen crucial breakthroughs in understanding the critical role that plants, microbes, mineralogy and groundwater play in element cycling and surface geochemical anomaly formation.

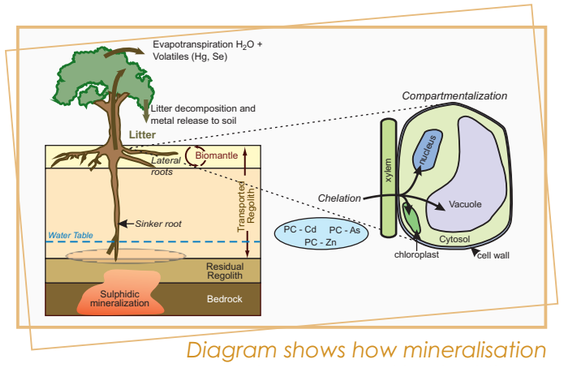


Diagram shows how mineralisation can be expressed in plant tissue.

Gold Geochemistry and Mobility

This project is determining new thermodynamic properties for gold complexes such as chlorides, bromides, iodides and thiosulphates and measuring the solubility of a zinc mineral called hemimorphite (hydrated zinc silicate). The hemimorphite study includes assessing the zinc dispersion halo around the Reliance Deposit, South Australia. Program 2 has also established an experimental facility to study copper, zinc, salt and other metal mobility in regolith.

Ni Hydrogeochemistry-PGE

This project is investigating the characteristics of Platinum Group Elements (PGE) in regolith formed over nickel-sulfide deposits. By studying these elements, the project aims to develop an efficient surface geochemical exploration method for detecting nickel and PGE deposits.

Uranium in WA Wheatbelt Waters

The Uranium in WA Wheatbelt Waters Project is investigating a series of uranium anomalies identified by a LEME Program 3 study in 2006 that examined management options for acid, saline waters in the Western Australian Wheatbelt.

In collaboration with junior explorer Mindax Ltd, LEME is undertaking an in-fill sampling program around the anomalies. In addition, a uranium-thorium isotope analyses is being undertaken to assess the technique's ability to define potential areas of economic uranium mineralisation.

Hydrogeochemistry for Mineral Exploration Under Cover

Involving a series of activities, ranging from self-contained sub-projects to one-on-one projects with industry partners, workshops, presentations at meetings and publications, this umbrella project is promoting the use of groundwater geochemistry as a mineral exploration technique.

Objective Logging of Regolith

Using CSIRO-developed HyChips technology, the Objective Logging of Regolith Project is developing a practical method to rapidly characterise regolith samples from core, drill chips, or pulps. The project's aim is to provide the exploration industry with a meaningful objective tool for quick regolith material analysis that will aid geological, geophysical, geotechnical and geochemical interpretation.

CSIRO's HyLogger using HyChips technology to quickly determine regolith mineralogy.

Metal Migration: Tracing, Timing and Modelling

A fundamental mineralogical and geochemical study for Program 2, this project is looking at metal dispersion in deeply weathered *in-situ* and transported regolith environments.

The project is also developing a new understanding of solid gold grain provenance in both environments and determining the role of secondary minerals as hosts for gold and other associated metals through the use of electronic optical techniques such as Synchrotron, Nanosims, Electron Microprobe and Laser Ablation.

Mineral Mapping, South Australia

Through its Core Party, Primary Industry and Resources South Australia, this project uses spectroscopic geology at all scales, including HyChips technology, to differentiate regolith mineral assemblages associated with mineralisation from regional regolith materials. Important aspects of this project include demonstration of new equipment and techniques for remote sensing dataset analysis such as HyMap, Hyperion and ASTER.

Drill rig sampling regolith.