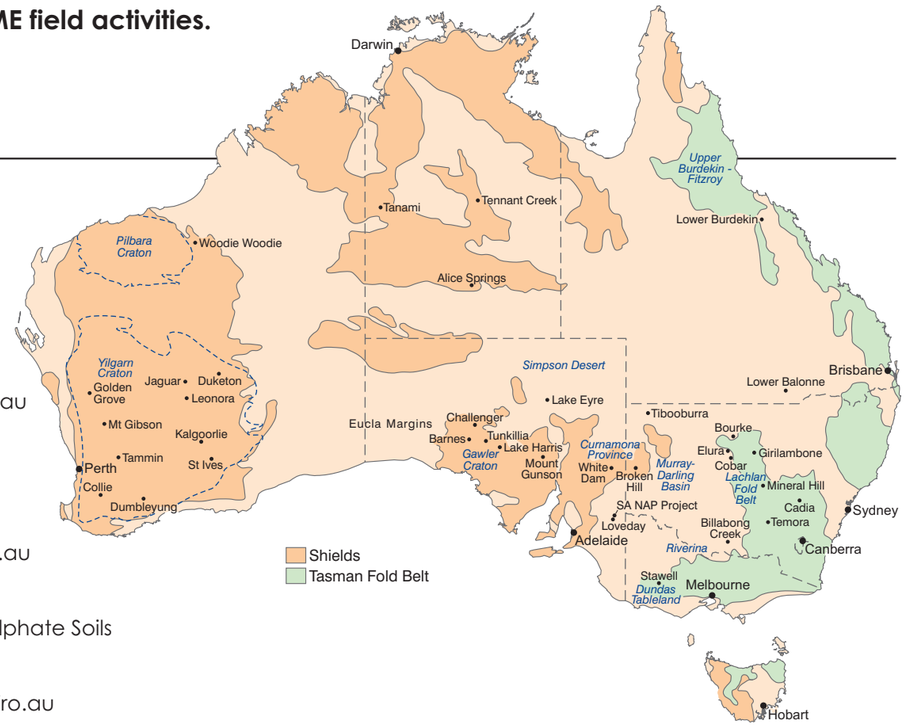
# PROGRAM 3
# ENVIRONMENTAL APPLICATIONS OF REGOLITH GEOSCIENCE

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

**Location of CRC LEME field activities.**





For further information about CRC LEME contact:

Greg Lawrence
Communications Officer
Tel: (08) 6436 8786
Fax: (08) 6436 8560
Email: gregory.lawrence@csiro.au

Dr Paul Shand
Program 3 Team Leader
Tel: (08) 8303 8513
Fax: (08) 8303 8550
Email: paul.shand@csiro.au

Dr Rob Fitzpatrick
National Atlas of Acid Sulphate Soils
Tel: (08) 8303 8511
Fax: (08) 8303 8550
Email: rob.fitzpatrick@csiro.au

Or visit our website at: http://crcleme.org.au

**CRC LEME Head Office** postal: c/- CSIRO Exploration & Mining PO Box 1130 Bentley WA 6102
phone: (08) 6436 8695 fax: (08) 6436 8560
email: crcleme-hq@csiro.au web: http://crcleme.org.au


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 GEOSCIENCE TO THE ENVIRONMENTAL CHALLENGES FACING AUSTRALIA*

**Focus:**

CRC LEME Program 3 utilises the Centre's multidisciplinary regolith geoscience expertise to undertake specialised research into major national resource management problems including inland and floodplain Acid Sulfate Soils (ASS), acid groundwater and drainage geochemistry. It addresses the National Research Priority of 'overcoming soil loss, salinity and sodicity.'

Acid Sulfate Soils (ASS) occur naturally in both coastal (tidal) and inland or upland (freshwater) settings where oxygen is lacking. In saturated oxygen-poor soils or sediments where organic matter is allowed to accumulate, bacteria breaks down organic matter and reduces the dissolved sulfate to form iron sulfides, commonly pyrite and iron monosulfides.

While under water or when buried beneath the surface, these pyrite layers or sulfidic materials are harmless. When sulfidic material is exposed to air - through excavation or drainage - the iron pyrite is transformed to sulfuric acid by oxidation. This acid, together with associated toxic elements, can kill plants and animals, damage buildings and infrastructure, as well as contaminate water and associated aquiculture such as oyster farming.

Through its Core Parties, and collaborations with external organisations, LEME is developing new risk assessment techniques and environmental management strategies for ASS and acid drainage.

Program 3 aims to:

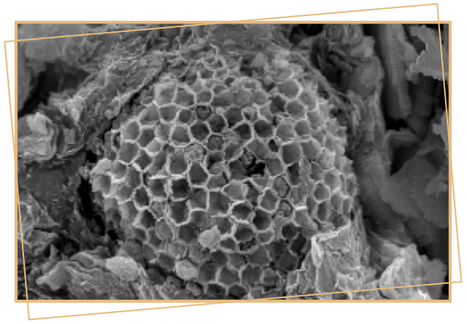
- Determine how ASS form in inland Australia and their relationship to metal mobilisation and other environmental impacts.
- Understand the processes of acid generation in groundwater in the natural or pre-disturbed regolith and beneath areas of land-use change.
- Better understand the biological processes within sulfidic environments.

**Expertise:**

Through its core parties, LEME has access to qualified staff who are internationally recognised experts in a range of disciplines including hydrology, hydrogeochemistry, plant geochemistry, microbial biogeochemistry, microbial molecular biology, mineralogy, pedology and geophysics. This is complemented by a large number of research students, many linked with industry or end-users.

**Access to technology:**

LEME researchers, through the core parties, have access to state of art technologies such as Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM), X-Ray Fluorescence Spectroscopy (XRF) and the Proton Miniprobe (PIXI). Standard analytical methodologies have been developed to deal with high salinity water samples (up to four times seawater).



*SEM image shows the mineral Jarosite in Loveday Basin ASS, South Australia.*

These techniques are providing new data to support the high quality scientific investigations required to underpin policy management in ASS affected areas.


Produced by CRC LEME Visual Resources Unit
LEMEb002-06

**Milestones**

- Discovery of trace element, metal and metaloid concentrations in drains, lakes and bores from the Western Australian wheatbelt orders of magnitude above current Australian water guidelines. Mineral explorers have shown interest in the anomalously high concentrations of uranium and gold.
- Following a submission by LEME, inland ASS have been recognised as a 'Significant Geohazard to the Environments of the World' by an international working group of the International Union of Geological Sciences.
- Significantly improved understanding of the chemical, physical and biological processes at work within ASS forming environments of the Lower Murray River Floodplains of Southern Australia.
- Development of an online, pictorial database to assist environmental managers in the identification of critical soil indicators and land use options.

**Current Projects**

**Western Australian Wheatbelt Drainage - Acidic Groundwater: Geochemical Risk Assessment and Evaluation of Management Options**

LEME is undertaking a geochemical risk assessment and evaluation of deep open drains installed in the West Australian Wheatbelt as a salinity management option.

*Acidic saline drain, Western Australia.*

A collaboration between LEME, WA Department of Water's Engineering Evaluation Initiative and the West Australian Department of Agriculture and Food, the project aims to:

- Understand the processes of groundwater acidification in natural and cleared landscapes
- Forecast the impacts of engineering drainage on the transport and transformation of trace elements in undrained and drained areas.
- Assess and devise feasible management options.

**Loveday Basin Draw Down Project**

Overseen by Centre Core Party CSIRO Land and Water, in collaboration with the South Australian Department of Water, Land and Biodiversity Conservation, this project is developing tools to enable the effective environmental management of the Loveday Basin, located on Lower Murray Basin Floodplain. Part of the project includes an evaluation of the environmental impacts resulting from reflooding the basin.

*The Loveday Basin, South Australia.*

LEME is contributing to the rehabilitation model of the Loveday Basin by:

- Reconstructing historical water, salt and sulfur balances for the wetland between 1970 and 2000, when the wetland was being used as a disposal basin.
- Monitoring surface water quality to follow the impacts of water level variations.
- Reviewing mechanisms responsible for noxious smells in sulphur-rich wetlands.
- Monitoring water quality during reflooding of the Basin in 2006.

**Loveday Basin Acid Sulfate Soil Geomicrobiology**

CRC LEME, through the Australian National University (ANU), is investigating the role of microbial processes in the recycling of sulphur, iron and other metals in the Loveday Basin to determine physical, chemical and biological controls.

*Loveday Basin's wet-dry zone.*

**Inland Acid Sulfate Soils: Distribution and Regolith Processes**

This project is developing new mineralogical, geochemical and geophysical techniques to improve the analysis and prediction of ASS in a variety of inland environments.

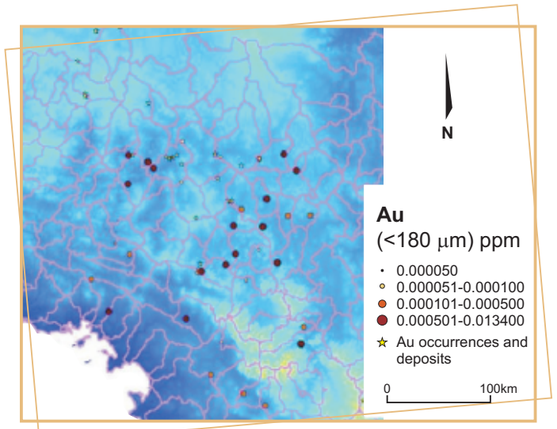
LEME has contributed to the national understanding of Inland Acid Sulfate Soils though the development of:

- New and more accurate soil-landscape process models of inland ASS at 30 pilot regions/catchments from the Mt Lofty Ranges in South Australia, the West Australian Wheatbelt and the Dundas Tableland of Victoria. The models can be used by natural resource managers to predict how soil-water-landscape properties can respond to land-use change.
- The Atlas of Australian Acid Sulfate Soils (Stages 2 and 3) incorporating a database of representative soil-regolith case studies from 30 pilot regions/ catchments across Australia.
- Quantitative mineralogical and geochemical techniques to improve reliability, accuracy and speed of analysis of inland ASS.
- Improved geophysical and geochemical field methods to characterise, map (spatially model) and predict various inland ASS environments.


*Disturbance of potential ASS may impact on vegetation, soil structure and cause the release of heavy metals to the environment.*

**Low-density Geochemical Surveys**

A study to assess the potential of low density geochemical surveys to characterise patterns in regolith chemistry is being led by Geoscience Australia (GA). Pilot studies have shown that such surveys are useful in both environmental and mineral exploration applications.




*A low-density geochemical survey plot showing gold-in-regolith concentrations over the Gawler Craton, South Australia.*