



PROGRAM ONE: REGOLITH GEOSCIENCE
2006- 2007 PROJECT SUMMARIES

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PREAMBLE

Objectives

- Provide the minerals industry with world-leading capabilities leading to breakthroughs in exploration in Australia's extensive areas of regolith cover
- Provide essential multi-disciplinary knowledge of Australia's regolith environments, to deliver this knowledge in readily useable forms, and ensure that it is transferred into practice in the minerals exploration industry and environmental management

Organisation

- Program Management and Communication Projects
- Regional Focus Projects
- Generic Process Projects
- Commercial Projects

Program Management and Communication Projects

- Program One Management
- Program One Communications

These projects enable

- effective Program management
- knowledge delivery
- transfer and training
- national and international recognition
- a lasting legacy

Regional Focus Projects

- Tanami
- Central Gawler
- Curnamona
- Thomson Orogen
- Eucla Margins

These projects

- have been designed and developed in close collaboration with core parties and client groups
- are multidisciplinary multiparty
- characterise the regolith and regolith forming processes in 4 dimensions (space and time)
- provide focus for generic process projects
- incorporate transfer and training strategies
- are delivering “cost enhanced, predictive methods to generate meaningful exploration targets within and under regolith”

Generic Process Projects

- Geochronology
- The formation of bauxite: macro and micro biotic influences on the solubility of alumina

These projects

- focus on poorly understood regolith forming processes
- analyse process mechanisms and controls on rates

Commercial Projects

- 1:2,500,000 Queensland Regolith Map (GA/GSQ)
- Physiographic regions (ACLEP)
- NACC Coastal

These projects

- use external funds to build fundamental datasets at a regional scale to support current and future regolith research in Australia
- ensure a lasting legacy for CRC LEME

Abbreviated title: Program One Communications

Type of project Centre (Centre or Industry/Commercial):

Program: One

Themes:

Project Leader: Lisa Worrall

Start date and duration: 1/07/05 - 30/06/08

Participants: ANU, AU, CUT, GA, PIRSA, NSW DPI

Brief project description: (in no more than 500 words address objectives, scope of work, knowledge to date, what is new, interactions with other projects)

This project contains the communications activity carried out by staff in Program One Projects. It includes all publications, presentations as well as some legacy products.

Deliverables (outputs) and expected impacts of research (outcomes):

Outputs¹

Reports

- Fieldwork completion reports
- Summary of results especially analytical results
- Synthesis reports

Oral and Poster Presentations with published abstract

Published Papers

Legacy Products

- CRC LEME Field Guide for Describing and Sampling Regolith Materials
- Explorers Guide to the Tanami
- Explorers Guide to the Central Gawler
- Explorers Guide to the Curnamona
- Explorers Guide to the Cobar- Giralambone District
- Explorers Guide to the Thomson Orogen
- The CRC LEME Atlas: A Digital Compilation of CRC LEME Regolith Maps

Outcomes

¹ A full list of proposed presentations and publications appears in Appendix 1. For the sake of brevity only a summary list of outputs appears here

- Knowledge delivery
- Transfer and training
- National and international recognition
- A lasting legacy

Milestones: *(dates of significant events marking scientific progress)*

Jul 06	AESC Melbourne
Aug 06	Goldschmidt Melbourne
Sep 06	BHEI, Broken Hill
Nov 06	Regolith Symposium Hanndorf
Mar 07	AGES Alice Springs
May 07	QLD Natural Resources Conference, Brisbane
Jun 07	Release of Explorers Guide to the Cobar Girilambone District
Jun 07	Mineral Exploration Under Cover Symposium Adelaide
Jun 07	IGES, Spain
Sep 07	5th Decennial Conference on Mineral Exploration, Toronto Canada
Nov 07	ASEG Perth
Dec 07	Release of Field Guide for Describing and Sampling Regolith Materials
Dec 07	Release of CRC LEME Atlas: A Digital Compilation of CRC LEME Regolith Maps
Feb 08	ANZGG, Queenstown
Mar 08	AGES, Alice Springs
May 08	QLD Natural Resources Conference, Brisbane
Jun 08	Release of the Explorer's Guide to the Curnamona
Jun 08	Release of the Explorer's Guide to the Thompson Orogen
Jun 08	Release of the Explorer's Guide to the Tanami
Jun 08	Mineral Exploration Under Cover Symposium Adelaide

Project name: Exploration through Cover in the Tanami

Abbreviated title: Tanami

Themes:

1. Understanding of regolith processes
2. Models of regolith landscape evolution
4. Regional mineral exploration studies
5. Making geochemistry more effective

Project Leader: Lisa Worrall

Start date and duration: 1/07/05 - 30/06/08

Participants: ANU, AU, CUT, GA, (NTGS, GSWA, Tanami Gold NL, Newmont Australia, Barrick Gold)

Brief project description:

The Tanami Region is host to a number of significant gold deposits however exploration of the region is hampered by the extensive development of regolith; comprised of both *in situ* and transported regolith materials.

Representatives of CRC LEME, GA, NTGS, GSWA and the three mining companies then operating in the Tanami (Newmont, Tanami Gold and Barrick Gold) met in Perth in November 2004 and agreed to collaborate in order to maximize the impact of regolith research on the effectiveness of mineral exploration in the Tanami. It was also agreed that this collaboration would be facilitated by CRC LEME

The objective of the Tanami collaborative regolith research program is to develop an effective means of exploring through the cover. The achievement of this objective will be measured by an increase in successful exploration activity.

The strategy to achieve this objective is progressing through three phases:

- A acquisition of data on the terrain which can be used to construct hypotheses about the processes dispersing elements and forming anomalies
- B construction of the explanatory hypotheses and
- C tests of the predictive capability of the explanatory hypotheses.

The work plan has seven elements:

- 1 mapping the character and disposition of regolith materials (including groundwater) in 3D
- 2 developing an understanding of the post-mineralisation geomorphic history of the Tanami Region
- 3 characterising contemporary dispersion processes (physical and chemical; including hydro-geochemical, biogeochemical and electro-chemical processes)
- 4 identifying palaeo-dispersion processes
- 5 developing an exploration strategy
- 6 developing and implementing an effective transfer and training strategy

- 7 tracking results and revising the recommended exploration strategy based on experience.

This project interacts closely with the Generic Process projects in Programs One and Two; especially the *Geochronology*, the *HydroMinEx* and *Gold and Metal Mobility* Projects.

Deliverables (outputs) and expected impacts of research (outcomes):

Outputs

- Reports
 - Fieldwork completion reports
 - Summary of results especially analytical results
 - Synthesis report on 4D model of regional regolith landscape evolution including recommendations about appropriate sampling media and pre competitive data acquisition
 - Explorers Guide
- Oral and Poster Presentations with published abstracts
- Published Papers

Outcomes

- Improved effectiveness of exploration through cover in the Tanami

Milestones: *(dates of significant events marking scientific progress)*

Mar 05	Reconnaissance fieldworks at the Coyote Prospect
Mar 05	Fieldwork Program Completion Report
Oct 05	Review Meeting (Ivy Camp, Granites)
Oct 05	Reconnaissance fieldwork at the Titania Prospect
Oct 05	Fieldwork Program Completion Report
Jan/Feb 06	Follow-up Fieldwork at the Coyote Prospect
Mar 06	Review Meeting (ARRC, Perth)
Mar 06	Fieldwork Program Completion Report
Jun 06	Reports on Analytical Results
Aug 06	Additional fieldwork testing the predictive capability of hypotheses developed at the Review Meetings
Sep 06	Fieldwork Program Completion Report
Nov 06	Review Meeting (Adelaide University, Adelaide)
Feb 07	Reports on Analytical Results
Mar 07	Review Meeting (AGES, Alice Springs)

Confidentiality requirements

A Memorandum of Understanding describes the nature of the collaboration between project partners on this project. Some datasets will remain confidential to their owners. All proposed publications and public presentations are to be reviewed prior to publication/presentation by the project partners.

Project name: Exploring through Cover in the Central Gawler

Abbreviated title: Central Gawler

Themes:

1. Understanding of regolith processes
2. Models of regolith landscape evolution
4. Regional mineral exploration studies
5. Making geochemistry more effective

Project Leader: J Keeling

Start date and duration: 01/07/03 – 30/06/08

Participants: PIRSA, CSIRO (E&M), AU, GA

Brief project description:

An arcuate belt of Proterozoic rocks in the central Gawler Craton has been recognised as a potential new gold province of regional significance. Deposits at Tarcoola, Boomerang, Glenloth and Earea Dam, together with new gold prospects at Tunkillia, Nuckulla Hill, Barns, Baggy Green and Weednanna outline a >500 km long arcuate belt of similar mineralisation and alteration styles. That such a regional gold system has gone largely unrecognised is due to the presence of extensive cover sediments, a gold-depleted regolith and the lack of an effective exploratory tool, until the widespread use of calcrete geochemistry in the mid-1990s.

Some companies have experienced significant success with Au-in-calcrete sampling while others have been frustrated by the difficulty in discriminating between anomalies closely associated with bedrock mineralisation and spurious anomalies associated with significant thicknesses of transported regolith. The project addresses the need for additional data on landscape history, metal mobilisation through cover and development of supplementary targeting techniques to plan effective drilling programs, in particular to test calcrete anomalies.

Since mid-2005, the central Gawler Craton has also been targeted by exploration companies for sedimentary uranium with a consequent high demand for project data on the distribution and architecture of palaeodrainage sediments in the area. An improved map showing palaeochannel sediment distribution on the Gawler Craton is now planned for 06-07 in conjunction with anticipated new data coming from company exploration drilling for uranium.

Zircon dates from the Eucla Margins project indicate that the source of heavy minerals at Jacinth deposit is dominantly from the Musgrave Ranges. It is proposed that during 2006-08, a GIS of available data including palaeodrainage and sediment cover in the area south of the Musgrave Block to the margin of the Eucla Basin will be compiled. Heavy mineral suites from Tertiary and Permian sediments will be analysed from selected drill hole samples held in PIRSA's Core Storage Facility to track heavy mineral dispersion. These data will aid models of HM distribution in marginal marine sediments of the Eucla Basin.

Deliverables (outputs) and expected impacts of research (outcomes):

Outputs

- GIS including data on
 - regolith thickness
 - regolith type
 - palaeo-drainage
 - geochemistry
- Distribution and description of sedimentary cover in the Central Gawler Craton
- Dating and evolution of the palaeodrainage system
- Dating dune and sand spread cover
- Understanding metal mobilisation through sediment and dune cover
- Prospect scale preliminary models of
 - landscape evolution (includes: regolith stratigraphy dating transported cover and reference site description and maps)
 - weathering of the primary mineral system
 - physical dispersion processes
 - hydro-geochemical dispersion processes
 - role of vegetation in cycling of Au

Outcomes anticipated include uptake of regional data products and use of identified regolith vectors to mineralisation, leading to increased and more efficient mineral exploration in the area with improved exploration success.

Milestones: *(dates of significant events marking scientific progress)*

- Dec 03: Completion of all current work on the Harris Greenstone Belt on the northern margin of the Central Gawler Gold Province (work completed and final LEME report printed and distributed. All work incorporated in the HGB GIS and data CD issued by PIRSA April 2005).
Publication AJES paper on “Evolution of beach placer shorelines and heavy mineral deposition in the eastern Eucla Basin”.
- Feb 04: complete construction of the Central Gawler Gold Province GIS, workshop the production of interim maps (Catalogue of available data compiled as a joint GA, PIRSA, CRCLEME report; initial GIS in completed; workshop of interim maps held 30 March –1 April).
- Jun 04: release GIS and interim maps, report on prospect scale process studies, review and reassess project plan in conjunction with the PIRSA/GA group reviewing the nature and timing of the mineralising systems (commitment from GA and PIRSA to funding Central Gawler projects for a further 2 years release of version 1 GIS and preliminary data issued at Gawler State of Play workshop, Adelaide 4-6 August, 2004).
- Oct 04: Field workshop of LEME participants in Central Gawler Gold projects (combined field trip, PIRSA-AU-CSIRO, held June 04 during excavation of dune at Barns).
- Release Harris Greenstone GIS on DVD
 - Report by Hou on Kingoonya Palaeochannel
- Nov 04: Announcement by Iluka of discovery of Jacinth HMS deposit, high-grade zircon. Followed in December 04 by discovery of Ambrosia, and in November 2005 by Tripitaka. Over \$4 billion in-ground value.

- May 05: Paper by Hou and Warland on “Eucla Basin - world-class palaeo-beach place province” MESA Journal 37.
- Jun 05: Exploration Through Cover Conference, Adelaide University, 24 June.
- Aug 05: LEME report Hydrogeochemistry of the Tunkillia Gold Prospect (Gray and Pirlo). CHIM trials at Challenger Gold Mine.
- Nov 05: LEME Symposium: Papers on plant biogeochemistry of Au at Barns (Lintern) and in the Wudinna area (Mayo and Hill)
- Dec 05: Papers prepared on dating dune cover and significance to landscape evolution and geochemical dispersion (Lintern, Rhodes; Sheard et al.).
- Jun 06: Completion report on regolith mapping and site studies in the Wudinna area. Final copies of regional regolith and geochemical maps output on DVD in GIS. LEME report on Boomerang Au prospect.
- July 06: Papers on CHIM results over Challenger Au Mine and source HMS Eucla Basin to be presented at AESC, Melbourne.
- Nov 06: Paper on integrated exploration strategies for gold in the Central Gawler Craton. Paper in “Exploration Geophysics” on CHIM results over Challenger Au Mine.
- Jun 07: GIS of palaeodrainage and available data on the area draining south of the Musgrave Ranges to the Eucla Basin. HM analysis of palaeodrainage.
- Dec 07: Synthesis of landscape evolution, cover distribution and metal dispersion.

Confidentiality requirements

None (except where use of company data may have a short time restriction before release)

Project name: Exploring through Cover in the Curnamona

Abbreviated title: CurnaMinEx

Type of project Centre/Industry (Centre or Industry/Commercial):

Themes:

1. Understanding regolith processes
4. Regional mineral exploration studies
5. Making geochemistry more effective
6. Geophysical mapping and modelling

Project Leader: Adrian Fabris

Start date and duration: 01/07/05 – 30/06/08

Participants: PIRSA, AU, GA, ANU. External collaborators: Dirk Kirste (Simon Fraser University, Canada), Roger Fidler (Consultant), Keith Scott, (Consultant), Professor Xianrong Luo (Guilin University China), Don Hoover (formerly USGS).

Brief project description:

This project integrates research carried out in the Curnamona Province, which includes work conducted under the LEME I Basins Program, the Western NSW Regolith Project of LEME II and current industry, government and research agency activities. We aim to develop comprehensive geochemical and geophysical exploration strategies to target specific mineral deposit types in areas of regolith cover. The primary targeted mineralisation is Cu-Au, Pb-Zn and U. The relation of these types of mineralisation to chemical and geophysical phenomena in the Curnamona is well documented. However, exploration methods are not sufficiently refined in areas of transported regolith cover to allow confidence in developing exploration strategies. We will establish the most viable exploration strategies for these conditions by first developing our understanding of the geochemical and geophysical character of the deposit types, and through that establishing the processes of dispersion most likely to result in the physico-chemical expression of the mineralisation.

This project will apply established and new (for the region) geochemical, biogeochemical and geophysical exploration techniques in areas of known mineralisation (Goulds Dam, Kalkaroo, Polygonum, Portia, McBrides Dam, Christmas Ball) to will test the viability of the various methods. In order to establish a rigorous sampling program it is our intention to address three physico-chemical components of buried mineralisation:

1. geophysical expression of mineralisation in primary/secondary form
2. geochemical expression of mineralisation in primary/secondary form
3. dispersion through cover from deposit to surface

The project consists of a series of sub-projects that address exploration methodologies at scales appropriate to District – Prospect – Target dimensions in terms of the geochemical mechanisms of formation and subsequent dispersion of mineralisation.

Sub-projects include:

- Targeted geochemistry and regolith studies **CurnaMinEx A**

- Geophysical Signatures at selected Mineral Prospects **CurnaMinEx B**
- Understanding Geochemical Signatures **CurnaMinEx C**
- 3D regolith mapping **CurnaMinEx D**

The overall impact of this project will be the enhanced ability for exploration in areas of regolith cover in Australia.

Deliverables (outputs) over total project time frame and expected impacts of research (outcomes):

Outputs

- 1) Surface regolith maps
- 2) 3D models of regolith cover of Prospects
- 3) 3D models of regolith cover of basin at regional scale
- 4) Baseline geochemical maps and databases
- 5) Interpretive reports (geochemical and geophysical)*
- 6) Analytical report for applied geochemical techniques
- 7) 3D process (reactive transport) models
- 8) Explorer's guide for the region
- 9) Abstracts, publications, presentations;

*interim and final reports

Outcomes

- 1) More effective geochemical exploration through cover using process based understanding and combined geochemical and geophysical techniques
- 2) Field testing of specific geochemical sample collection methods (CHIM, biota, partial/selective extraction, gas phase)

Milestones: *(dates of significant events marking scientific progress)*

Jul 06	Presentations at AESC
Sep 06	Interpretative report
Sep 06	China trip – CHIM development
Sep 06	BHEI conference and presentation.
Nov06	Field acquisition of additional geochemical, geophysical, hydrological data at new prospects (incl. CHIM).
Dec 06	Future direction strategy meeting
Jun 07	Interim report on analytical results and interpretations.

Confidentiality requirements:

As per contracts with clients

Project name: Exploration through cover in the Thomson Orogen

Abbreviated title: Thomson Orogen Project NSW

Type of project Centre/Industry (Centre or Industry/Commercial):

Themes:

1. Understanding regolith processes
2. Models of regolith landscape evolution
4. Regional mineral exploration studies
5. Making geochemistry more effective

Project Leader: John Greenfield

Start date and duration: 01/07/05 - 30/06/08

Participants: GA, NSW DPI, ANU, AU

Brief project description:

The Thomson Orogen, which underlies the Channel Country in northwest New South Wales, is the last major greenfields terrain in NSW. The NSW DPI hopes to make this terrain the focus of a new Exploration Initiative. The Thomson Orogen has potential for arc and ocean-crust related gold and base metal deposits while the area to the south of the Orogen may have potential for Mississippi Valley style zinc deposits. The prospective units are obscured by Eromanga Basin sediments. The basin cover presents a significant impediment to exploration.

The primary objective of this project is to develop an effective means of exploring through the cover in the Thomson Orogen. The achievement of this objective will be measured by an increase in successful exploration activity.

The strategy to achieve these objectives builds on the results of Tibooburra, Curnamona and Cobar-Giralambone Projects (these areas are also under Eromanga Basin cover and Tibooburra is on the western margin of the Thomson Orogen) and has eight elements:

- 1 Mapping the character and disposition of regolith materials in 3D
- 2 Developing an understanding of landscape history for the late Mesozoic – Cenozoic, including post-Mesozoic tectonics.
- 3 Characterising contemporary dispersion processes (physical and chemical; including biogeochemical and electro-chemical processes)
- 4 Identifying palaeo-dispersion processes
- 5 Developing an exploration strategy
- 6 Developing and implementing an effective knowledge transfer and training
- 7 Tracking results and revising strategies based on experience

This project will have close interaction with the generic process projects in Programs 1, 2 and 3, especially *Lachlan Fold Belt*, *Metal Mobility* and *Geochemical Baselines* Projects respectively.

2006-2007 Deliverables (outputs) and expected impacts of research (outcomes):

Outputs

- 1) Digital Database and GIS
Initial release in September 2005, updated in January 2006. Version 3 release due February 2007.
- 2) 4 x 1:100k Regolith Maps
Submitted to GSNSW Cartography section in March 2006, and due for publication June 2007.
- 3) LEME Reports
- 4) Publications in national and international journals
- 5) Presentations at national and international conferences
- 6) University theses

Outcomes

- 1) Development of an accurate landscape evolution model and application to mineral exploration beneath cover in the Thomson Orogen
- 2) Increase in successful exploration activity in the Thomson Orogen

Milestones: *(dates of significant events marking scientific progress)*

July	Pay for 176 biogeochem Au analyses from March 06 baseline trip (GA)
Jul 06	Tibooburra Fieldwork: Hons and PhD fieldwork, DGPS surveys (Adelaide Uni)
Aug 06	Preliminary biogeochem report (Hulme, includes contract salary)
Aug 06	Geophysical Interpretation of Thomson (NSWDPI)
Aug 06	Submit Warratta Inlier biogeochemistry assays (Adelaide Uni)
Sep 06	Prelim baseline Geochem Report (de Caritat, Lech, Hulme)
Sep 06	Finalize Warratta Inlier Regolith Landform map (Adelaide Uni)
Sep 06	Planning-progress meeting in Canberra
Sep 06	Submit New Bendigo soil and regolith samples for geochemistry assay (AU)
Sep 06	BHEI Conference (S. Hill)
Oct 06	Baseline geochem/biogeochem sampling trip (GA, AU)
Oct 06	Baseline biogeochem sample preparation
Oct 06	Baseline geochem sample preparation
Nov 06	Completion of McAvaney & Tucker Hons
Nov 06	Regolith Symposium 2006, Hahndorf
Dec 06	Baseline geochem sample submission
Mar 06	Tibooburra fieldwork (Adelaide Uni)
Jun 06	Public release of four 100k Regolith sheets
Jun 06	Geochronology analysis and results (ANU)

Confidentiality requirements

None at this stage

Cooperative Research Centre for Landscape Environments and Mineral Exploration

Project name: Eucla Margins: Placer deposit study

Abbreviated title: Eucla Margins

Type of project: Industry

Themes: Addresses Research Themes 1 & 4 - Understanding regolith processes & Regional mineral exploration studies.

Project Leader: Luisa Ruperto

Start date and duration: July 1, 2006. 12 months

Participants: Luisa Ruperto, Baohong Hou, Lindsay Collins, Lilliana Stoian, Sue Welch, Lisa Worrall, Brad Pillans.

Brief project description:

As a result of a meeting in Perth (15 Mar 2005) between Ian Warland (Senior Project Geologist - Iluka) and Mark Paine (CRC LEME) a decision was made to develop a research project focussed on the setting of Jacinth and Ambrosia deposits. The project would be in close collaboration with Iluka's exploration and resource definition activities to facilitate data transfer between the parties. Similar studies in eastern Eucla Basin (Baohong Hou 2003), Bondi Main western Victoria (Mark Paine 2005) and Capel area, Western Australia (Lindsay Collins) demonstrate proven research capacity in this regard.

The project will first concentrate on a stratigraphic framework for Jacinth and Ambrosia deposits similar to that of the Eucla Basin and Bondi Main deposits. Key research tasks include characterisation of the heavy mineral-bearing facies, documentation of mineralised dunes facies and the spatial relationships between all facies. 3D modelling of the deposit is also envisaged. Weathering overprints will be described including (if possible) the determination of hematite precipitation ages by palaeomagnetic dating. This will provide a minimum age for the deposit.

At the same time the project will focus on analysis of the heavy mineral suite using the Automatic Geological Scanning Electron Microscope (AutoGeoSEM) located at (ARRC, as demonstrated by Paine et al (2005). Results will include quantitative and qualitative data allowing definition of heavy mineral domains within selected drill holes. Element concentrations throughout selected heavy mineral grains will be mapped using the ARRC electron microprobe facilities to determine both the presence and concentration of potentially deleterious trace elements.

The proposed project will then determine the provenance of zircon (and possibly other minerals) in the deposits. This work will be undertaken with the ANU Laser Ablation Facility (U-Pb dating), with further work (U-Th-He dating) at either Curtin University or Yale. The advantage of "double dating" zircons is that crystallisation and cooling/exhumation rates can be calculated which enables more accurate determination of provenance.

Finally, all work will be synthesised, leading to a deposit model.

The principal objective of the project is to provide a better understanding of the character, geometry and age (facies interpretation) of mineralised sediments associated with the Jacinth and Ambrosia deposits. Heavy mineral suite will be characterised; heavy mineral domains established and heavy mineral provenance studies undertaken.

Deliverables (outputs) and expected impacts of research (outcomes):

- **Final synthesis report with suggestions for further work.**
- **A final project meeting where results will be presented.**
- **Scientific publications and presentations at conferences.**

Milestones: *(dates of significant events marking scientific progress)*

- **Submission of quarterly and final reports**

Confidentiality requirements: **12 months**

Project name: Geochronology and quantitative models of landscape evolution

Abbreviated title: Geochronology

Type of project Centre *(Centre or Industry/Commercial):*

Themes: 2. Models of regolith-landform evolution
4. Regional mineral exploration studies
5. Making geochemistry more effective

Project Leader: Brad Pillans

Start date and duration: 01/07/03 – 30/06/08

Participants: ANU

Brief project description:

To provide reliable numerical ages for regolith material, and to develop quantitative models of landscape evolution in regions which are important for mineral exploration and land management. Focus regions may include: Yilgarn Craton, Western NSW, Curnamona Province, Eucla margins and Northern Territory (especially Tanami region). Other focus regions may be recommended. Planned collaboration with Allan Chivas (stable isotopes; University of Wollongong), Barry Kohn (fission-track; Melbourne University) and Ken Farley (U-Th/He, CALTECH).

In past years, the project largely focussed on dating weathering imprints in regolith using paleomagnetism. Results show that there have been periods of enhanced oxidation and weathering extending back to Permo-Carboniferous times. Recently, multi-method approaches to regolith dating have been pioneered using K/Ar, U/Pb, (U-Th)/He and U-series methods in parallel with paleomagnetic dating. Opal, silcrete and iron oxides are being investigated as potential multi-method dating targets. Luminescence techniques will be used to measure rates of biological turnover in soils, and to establish the age of “parna” (aeolian dust) in a key section within the Lachlan Fold Belt, both leading to a better understanding of soil dynamics. OSL dating of sand dunes overlying mineralisation will be carried out to constrain rates of geochemical dispersion in transported cover. Further work on dating of silcrete will be undertaken by Rainer Grun (Electron Spin Resonance) and Jim Dunlap (U-Th/He).

Despite the departure of Mark Paine, we will continue to investigate the feasibility of (U-Th)/He dating of specifically selected ferruginous duricrusts at the ANU noble gas lab. Work at the Californian Institute of Technology (CALTECH) has revealed the complex nature of the helium diffusion domains within various minerals by way of proton-bombardment diffusion experiments. They have shown that goethite contains at least two helium diffusion domains, one with high helium retentivity and the other with very low retentivity which means that an age correction must be made (typically around 10%) to quantitatively account for the helium lost from the sample over time. Clearly accurate ages on goethite samples cannot be obtained without characterization of the helium diffusion domains in each sample. At present, this work can only be

done at CALTECH, and will therefore require collaboration. We are investigating the suitability of hematite and anatase for (U-Th)/He dating, which may circumvent the diffusion domain problem in goethite.

In summary, the project will continue to provide new insights into the chronology and rates of Australian regolith and landscape evolution in selected focus regions.

Deliverables (outputs) and expected impacts of research (outcomes):

Outputs

1. International Journal publications, conference presentations
2. LEME report “Regolith Dating Methods” 2nd edition

Outcomes

1. Chronologically constrained regolith landform evolution models
2. Chronologically constrained geochemical dispersion models

Milestones: *(dates of significant events marking scientific progress)*

Sep 06	New edition of handbook on “Regolith Dating Methods”
Nov 06	LEME Regolith Symposium
Mar 07	AGES conference, Alice Springs

Confidentiality requirements Nil

Project name: Macro and Micro-biotic Influences on the Solubility of Alumina and the Formation of Bauxitic Regolith

Abbreviated title: Weipa Bauxite

Type of project: Centre/Industry *(Centre or Industry/Commercial)*

Themes:

1. Understanding of regolith processes
2. Models of regolith landscape evolution

Project Leader: Tony Eggleton/Graham Taylor

Start date and duration: 01/11/04 – 31/12/07

Participants: ANU, CAMALCO

Brief project description:

Bauxite accumulations in Australia are common regolith features, extending across the whole continent. Three accumulations are mined, Weipa in Queensland, Gove in Arnhem Land and those of the Darling Ranges in W.A. The Weipa bauxite is unique in that it consists almost entirely of free-running bauxitic pisoliths with little or no matrix. Although many theories have been proposed for its formation, few answer two major questions:

- how did it form; and,
- what is its age?

Our research into the deposit has limited the possible answers to the first question to chemical and biological processes associated with high, seasonal rainfall. But such processes occur all over the tropics. Why is the bauxite at Weipa, and not everywhere? We will investigate the biochemical reactions from the activities of macro- and micro-biota to see how these influence alumina and other element solubilities.

It is known that early wet-season rains are highly acid (pH 4.5), and that at least some Weipa ground waters have this level of acidity (e.g. 4.5 to 5.5 from August 2005 to February 2006). We need to complete our investigation into how the water chemistry at the top of the water table varies seasonally, in order to understand the chemical and biochemical processes leading to the precipitation of alumina in the form of pisoliths.

The age of the bauxite is unknown, except that it must be younger than the Tertiary rocks on which it sits. Our research has shown that the present minerals equilibrate with their environment in a period measured from tens to hundreds of thousands of years, rather than millions. One recent dating of pisoliths from Arnhem Land found an age range from 100,000 to 350,000 years. We will apply the techniques of that study to Weipa, to help us to understand when the deposit formed, and by relationship to other geological information, how it formed. The presence of insect trace fossils in the bauxite suggests another way to assess the age of the deposit.

Value of the research

The Weipa bauxite can be viewed as an archetype for deep weathering such as is common over much of Australia. As such, understanding Weipa will have application to the understanding of much of the landscape and regolith processes across the continent.

Bauxite is a valuable commodity. Understanding the age and processes of formation of the Weipa bauxite will benefit mineral exploration across tropical north Australia, as well as having direct benefit to more efficient mining of the deposit itself.

Budget share

The budget of \$7,648 sought in this application is for part only of the funds necessary to prosecute the research. We seek the balance from COMALCO Ltd (\$4,000 for field support).

Deliverables (outputs) and expected impacts of research (outcomes):

Scientific papers describing the deposit and its origin
Advice to COMALCO on ore search.

Milestones: *(dates of significant events marking scientific progress)*

Sep 06	Water sampling and analysis complete
Dec 06	Termite mounds mapped
Jun 07	Papers 3 (the bauxite) and 4 (biota) complete
Dec 07	Paper 5 (origin) and Report to COMALCO complete

Confidentiality requirements

As COMALCO requires



Project name: Queensland Regolith Map

Abbreviated title: Queensland Regolith Map

Type of project: Commercial *(Centre or Industry/Commercial)*

Themes:
1. Understanding of regolith processes
2. Models of regolith landscape evolution

Project Leader: Mike Craig

Start date and duration: 01/07/06 – 30/06/08

Participants: GA, Geological Survey of Queensland (GSQ)

Brief project description:

This project provides a regional regolith-landform framework of Queensland for mineral exploration and land management and extends work carried out in conjunction with the NTGS during the period 2003-2006.

The Australian regolith is a product of weathering, erosion, deposition and chemical transformation. In tropical and arid environments of Queensland, these processes are reflected in the landforms, desert sands and loams, internal and external drainage systems, and ancient weathering surfaces that we see today through various forms of remotely sensed imagery.

A Regolith Landform Map of Australia (1:5Million) was produced in 1984. This map showed some major alluvial-colluvial systems, and some major areas of ferruginous duricrust but did not adequately address the question of the evolution of land surfaces and regolith materials. Since, there has been considerable advances in understanding regolith processes in the Cratonic regions of Australia. In addition there is now a wealth of new data provided by Second Edition geological mapping, Landsat 7, DTM and radiometric data from high-resolution airborne surveys, and drill data from mineral exploration.

A regional regolith study of Cape York Peninsula was conducted under the auspices of the Cape York Land Use Study (CYPLUS) by AGSO/CRC LEME in 1995. The study was based on detailed surface observations and regolith information including extracted from remotely sensed imagery. Local scale regolith assessments formed part of detailed studies conducted by CRC LEME as part of AMIRA project activities in the Mt Isa Region of Queensland. The Geological Survey of Queensland has also conducted some detailed local regolith-related studies that are of significance and are available to the project and will help reach the goals of this proposed project.

In 2006, CRC LEME in collaboration with the Northern Territory Geological Survey addressed the need for a wider regional regolith framework by completing the first whole of State (Northern Territory) Regolith Map and Atlas of regolith materials. This excellent regional dataset and QLD's existing detailed datasets coupled with supplementary detailed studies across Queensland could now provide an extended basis for constructing a regional regolith-landform framework for the entire "Top End" of Australia.

An understanding of the regolith is now acknowledged by industry as necessary for effective mineral exploration. The Queensland Regolith Map is the second step necessary to developing a national regional map which is in itself is fundamental to understanding

landscape evolution, extractive and placer mineral occurrences, groundwater potential, rangeland management, and environmental geoscience across Australia.

Deliverables (outputs) and expected impacts of research (outcomes):

Outputs

- Regolith-landform map (1:2.5 Million scale) of Queensland, as a companion to the recently completed Northern Territory Regolith Map.
- An Atlas of Regolith Materials of Queensland.

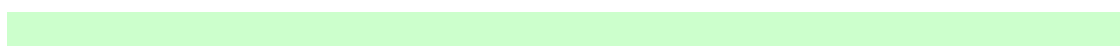
Outcomes

- Significant progress towards a national regolith map.

Milestones: *(dates of significant events marking scientific progress)*

Aug 06	Scoping document, budget and agreed work-plan.
Dec 06	Compilation of existing relevant datasets
Mar 07	Trans Qld Regolith Traverse and Selection of key areas for supplementary work
Jul 07	Major field data collection
Nov 08	Preliminary data assemblages for Map
Nov 08	Preliminary data analyses for Atlas of QLD Regolith Materials, progress presentations.
Feb 08	Draft Regional regolith-landform map
Feb 08	Draft Atlas of QLD Regolith Materials,
Apr 08	Final Drafts of outputs , Synthesis report and scientific publications in national/international journals/conference presentations.
Jun 08	Product delivery

Confidentiality requirements: None



Project name: Physiographic regions of Australia

Abbreviated title: Physiographic regions

Type of project Industry (Centre or Industry/Commercial)

Program: One

Themes:
1. Understanding of regolith processes
2. Models of regolith landscape evolution

Project Leader: Colin Pain

Start date and duration: 01/07/05 – 30/06/07

Participants: Geoscience Australia, ACLEP

Brief project description: *(in no more than 500 words address objectives, scope of work, knowledge to date, what is new, interactions with other projects)*

In 2005/2006 the Australian Collaborative Land Evaluation Program (ACLEP) provided funding to LEME for the preparation of a national map of physiographic regions. A first draft of this map will be completed by the end of June 2006. We have now approached ACLEP for further funding to enhance regolith information, and have been successful in getting \$15,000. The new objective is to assess the complexity of each physiographic region in the present coverage, and where necessary compile new more detailed line work so that each polygon has a similar level of complexity. Where appropriate we will use data from other LEME projects.

There will also be a report. The map of physiographic regions of North America (1940) was accompanied by a 520-page book. The original map of physiographic regions of Australia (1977) appeared in a 15-page chapter in a book on the geography of Australia. We envisage something in between.

The project contributes to LEME's strategic intent by providing a basis for the regional description and explanation of the Australian regolith. It also provides a firm basis on which to extrapolate results obtained from studies of detailed areas to surrounding areas at lower resolution. In particular the project will work with P4 projects in the Murray-Darling Basin.

Deliverables (outputs) and expected impacts of research (outcomes):

Outputs

1. Revised map of physiographic regions (produced in 05/06) with new more detailed line work so that each polygon has a similar level of complexity.
2. Attribute descriptions (landform, relief, and substrate materials) for the new polygons in revised map.
3. Report to accompany the new map of physiographic regions of Australia.

Outcomes

National framework which will support extrapolation between more regional (detailed) studies.

Milestones: *(dates of significant events marking scientific progress)*

Sep 06	Progress report to ACLEP
Dec 06	Progress report to LEME executive
Jun 07	Final line work and attributes for map
Jun 07	Draft of report ready for printing

Confidentiality requirements

None

Project name: Resource Assessment and Coastal Management, Northern Agricultural Region of WA

Abbreviated title: NACC Coastal Project

Type of project Industry/commercial (Centre or Industry/Commercial):

Themes:

1. Understanding of regolith processes
2. Models of regolith landscape evolution

Project Leader: Lindsay Collins

Start date and duration: 01/01/06 – 30/12/07

Participants: Curtin University of Technology, CALM (the major collaborator) and the Northern Agricultural Catchment Council

Brief project description:

The coastal zone of the Northern Agricultural Region of Western Australia contains wilderness regions, nature reserves, geological reserves, tourism nodes, resource exploration activities and minesites, estuaries and ports and harbours, and is controlled by a number of local authorities. An investment strategy being developed for the region requires, to be successful, the development of a regional GIS of the terrain which will include layers for access, tourism development, coastal landforms, land use, and conservation. Such a detailed analysis of the coastal zone will also provide opportunities for the assessment of coastal regolith evolution and the distribution of natural resources, such as mineral sands, salt and other commodities.

Deliverables (outputs) and expected impacts of research (outcomes):

This project is externally funded and driven by clients- CALM (the major collaborator) and the northern Agricultural Catchment Council. It will deliver a GIS designed to suit client needs and to serve as a decision support system for coastal management, including impact remediation, and external resources will be provided for this purpose. This will form the basis for the Agency expenditure plan. The further benefit that will be provided by LEME researchers will be applied research focused on coastal and regolith evolution, chronology and resource distribution.

Milestones: (dates of significant events marking scientific progress)

GIS segments and associated client reports will be generated quarterly. Publications will result from in tandem on ground investigations and geochronology results.

Confidentiality requirements

The GIS output will be the property of the clients but will become public information; regolith research outcomes will accrue to LEME.