

Industry interaction



INDUSTRY INTERACTION, TECHNOLOGY TRANSFER AND COMMERCIALISATION PROGRAM

GEMOC RELIES on a vigorous interaction with the mineral exploration industry at both the research and the teaching/training levels. The research results of the Centre's work are transferred to the industry and to the scientific community by:

- collaborative industry-supported Honours, MSc and PhD projects
- short courses relevant to the industry and government sector users, designed to communicate and transfer new technologies, techniques and knowledge in the discipline areas covered by the Key Centre
- one-on-one research collaborations and shorter-term consultancies on industry problems involving national and international partners
- provision of high quality geochemical analyses with value-added interpretations to industry and government organisations, extending our industry interface
- use of AccessMQ consultancies, which employ and disseminate the technological developments carried out by the Centre
- GLITTER, an on-line data-reduction program for Laser Ablation ICPMS analysis, developed by GEMOC and CSIRO GEMOC participants, has been successfully commercialised and is available both through New Wave Research and directly from GEMOC (<http://www.es.mq.edu.au/GEMOC/>)
- collaborative relationships with technology manufacturers (more detail in the section on *Technology Development*)
 - GEMOC (Macquarie) is the Australian demonstration site for Agilent Technologies LAM-ICPMS applications
 - GEMOC (Macquarie) is an international test site for New Wave Research Lasers

SUPPORT SOURCES

GEMOC industry support includes:

- direct funding of research programs
- "in kind" funding including field support (Australia and overseas), access to proprietary databases, sample collections, digital datasets
- collaborative research programs through ARC Linkage Projects and the Macquarie University External Collaborative Grants (MUECRG) and PhD program support
- assistance in the implementation of GIS technology in postgraduate programs
- participation of industry colleagues as guest lecturers in undergraduate units
- extended visits to Macquarie by industry personnel for interaction and research

- ongoing informal provision of advice and formal input as members of the Advisory Board

ACTIVITIES IN 2005

Ten Industry Reports were completed for collaborative industry projects.

TerraneChron[®] studies (see *Research Highlights*) have been adopted by a significant segment of the global mineral exploration industry. This methodology, currently unique to GEMOC, requires the integration of data from three instruments (electron microprobe, LAM-ICPMS and LAM-MC-ICPMS) and delivers fast, cost-effective information on the tectonic history (with ages) of regional terranes.

The ARC Linkage Project titled “Global Lithosphere Architecture Mapping” (GLAM) changed partners in late 2005 following the takeover of WMC Resources by BHP-Billiton. Planning and workshop sessions at Macquarie with participants from BHP-Billiton and GEMOC, and visits by Macquarie researchers to Perth, were key activities in 2005. The project has continued with full support following the takeover of WMC by BHP-Billiton. Dr Graham Begg spent significant research time at GEMOC through 2005 as part of the close collaborative working pattern for this project.

GEMOC’s development of a method to analyse trace elements in diamond through the PhD project of Sonal Rege (see *Research Highlights*) has opened up potential further developments and applications relevant to industry, ranging from diamond fingerprinting for a range of purposes to improving the knowledge framework for diamond exploration. Rio Tinto funded a pilot project on diamond fingerprinting.

A collaborative project with Anglo American continued to investigate the isotopic composition of Cu, Fe and several other elements in sulfides and whole rocks from a major ore deposit.

A pilot study on detrital zircons from Paleozoic sediments carried out with the New South Wales Geological Survey has evolved into a continuing collaborative research relationship to apply *TerraneChron*[®] to investigations of the provenance of the Paleozoic sedimentary rocks of the western Lachlan Fold Belt and related areas.

A very successful project with WMC on Continental Flood Basalts related to Ni and PGE deposits was finalised within the original scope envisaged and resulted in a new project with BHP-Billiton commencing in 2005, exploring a novel framework for the origin of magmatic Ni-deposits.

The GLAM team.



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The alliance with PIRSA (Primary Industries and Resources, South Australia) that commenced in 2004 for *TerraneChron*[®] collaborative projects continued.

GEMOC researchers presented invited and keynote addresses at the SGA Meeting on “Mineral Deposit Research: Meeting the Global Challenge” in Beijing in August. This conference had a large industry attendance and the GEMOC work generated much discussion and interest.

Industry visitors spent varying periods at GEMOC in 2005 to discuss our research and technology development (see *visitor list, Appendix 3*). This face-to-face interaction has proved highly effective both for GEMOC researchers and industry colleagues.

DIATREEM continued to provide LAM-ICPMS analyses of garnets and chromites to the diamond-exploration industry on a routine collaborative basis.

GEMOC publications, preprints and non-proprietary reports are available on request for industry libraries.

CURRENT INDUSTRY-FUNDED COLLABORATIVE RESEARCH PROJECTS

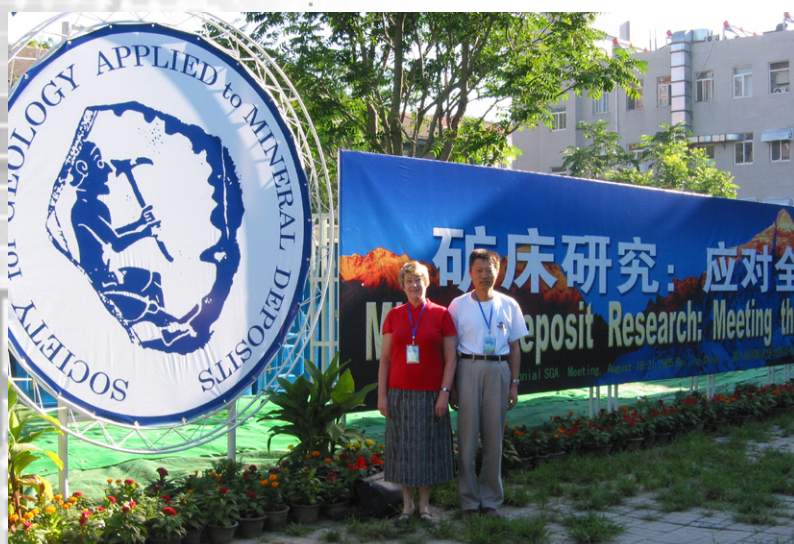
THESE ARE BRIEF DESCRIPTIONS of current GEMOC projects that have direct cash support from industry and timeframes of at least one year. Projects are both national and global.

GEMOC’s industry collaborative projects are designed to develop the strategic and applied aspects of the basic research programs based on understanding the architecture of the lithosphere and the nature of Earth’s geodynamic processes that have controlled the evolution of the lithosphere and its important discontinuities. Most of the industry collaborative projects rely on geochemical information from the Geochemical Analysis Unit in GEMOC and especially on novel methodologies developed by (and some unique to) GEMOC.

Geochemical data on crustal and mantle rocks are being integrated with tectonic analyses and large-scale datasets (including geophysical data) to understand the relationship between lithosphere domains and large-scale mineralisation.

The new methodologies of using mantle sulfides to date mantle events, and of characterising crustal terrane development using U-Pb dating and Hf isotopic compositions of zircons provide more information for integration with geophysical modelling. *TerraneChron*[®] (see *Research Highlights*) is proving an important new approach to characterising the tectonic history and crustal evolution of terranes on the scale of 10 – 100 km as well as delivering a cost-effective exploration tool to the mineral (and potentially petroleum) exploration industry.

Sue O'Reilly and Ming Zhang presented papers on GEMOC's industry-related work at the SGA meeting, Beijing 2005.



Global Lithosphere Architecture Mapping

Supported by ARC Linkage

Industry Collaborator: BHP-Billiton

Summary: Compositional domains in the subcontinental lithospheric mantle reflect the processes of continental assembly and breakup through Earth's history. Their boundaries may focus the fluid movements that produce giant ore deposits. Mapping these boundaries will provide fundamental insights into Earth processes and a basis for the targeting of mineral exploration. We will integrate mantle petrology, tectonic synthesis and geophysical analysis to produce the first maps of the architecture of the continental lithosphere, to depths of ca 250 km. These maps will provide a unique perspective on global dynamics and continental evolution, and on the relationships between lithosphere domains and large-scale mineralisation.

Lithosphere Evolution Across a Craton Margin, Southern Africa

Supported by Industry and a matching Macquarie University Collaborative Grant

Industry Collaborator: De Beers

Summary: The margins of cratonic blocks extend to 150-300 km depth, and exert a strong control on crustal tectonics. Kimberlite magmas intruded across the southern margin of the Kaapvaal Craton (S. Africa) provide detailed sampling of the lithospheric mantle. We will use these samples to map the composition and structure of the mantle in two time slices (120 Ma, 90 Ma), providing new information on how the craton margins channel fluids. Linkages between crustal tectonics and mantle events will be constrained by comparing *TerraneChron*[®] analysis of zircons from modern streams, and the kimberlites themselves, with existing Re-Os ages for mantle rocks.

Trace-element Analysis of Diamonds

Supported by Industry and a matching Macquarie University Collaborative Grant

Industry Collaborator: Rio Tinto

Summary: Diamonds contain minute amounts of trapped fluids, representing the medium from which the diamonds grew; these fluids are a unique source of information on processes in Earth's mantle. New techniques for the trace-element analysis of these fluids, developed recently in GEMOC will be further developed, and applied to the analysis of selected populations of diamonds from the Argyle mine (WA). The data will provide new insights into the genesis of diamond, with applications both to exploration models and to test the feasibility of "fingerprinting" of diamonds for exploration and forensic purposes (tracing illegal diamond sources).

Links between plume-mantle interaction, mantle sulfides and Ni-PGE endowment in Large Igneous Provinces

Supported by industry and a matching Macquarie University Collaborative grant

Industry Collaborator: BHP-Billiton

Summary: Most large Ni-PGE (Platinum Group Elements) deposits are associated with some, but not all, Large Igneous Provinces (LIP=plume-related flood basalts). Isotopic and trace-element data suggests that the magmas of “fertile” LIPs have interacted with the deep mantle roots of ancient continents. We will test the hypothesis that the Ni-PGE enrichment in some LIP magmas reflects the mobilisation of pre-existing Ni,PGE-rich sulfide phases as the magmas pass through these old, highly modified mantle roots. This model, if confirmed, will be a major advance on traditional models for Ni-PGE concentration, and will have a significant impact on exploration models.

Developing a geochronological framework for the Gawler Craton, South Australia

Supported by a matching Macquarie University Collaborative grant (2004-2005)

Industry Collaborator: PIRSA (Primary Industries and Resources, South Australia)

Summary: The aim of the project is to supply a geochronological framework for the evolution of the Gawler Craton of South Australia, by dating major Archean and Proterozoic magmatic and tectonic events across the Craton. At present, the geochronology of this large region is poorly known, and this is one main reason why the minerals industry is choosing better-known regions to explore. The development of a better geochronological base will support the industry partner’s goal of establishing an integrated tectonic model as an aid to mineral exploration, and provide new insights into crustal evolution.

Application of metal isotopes in exploration for magmatic nickel and volcanic-hosted copper deposits

Supported by a matching Macquarie University Collaborative grant (2004-2005)

Industry Collaborator: Anglo-American PLC

Summary: The major aim is to study, for the first time, the isotope geochemistry of Ni and Pd in a magmatic nickel deposit. Cu and Fe isotopic studies will also be carried out on a volcanic-hosted copper deposit. The aims are to determine whether isotopic data for commodity metals can be used to discriminate between barren and fertile host rocks and whether these isotopic ratios can provide vectors to ore within a mineralised system. The expected outcomes are development of new analytical methodologies and new isotopic exploration tools for blind ore deposits, which could be adopted by the Australian mineral exploration industry.

Improving Mineral Exploration Performance by Superior Management of Risk, Uncertainty and Value

Supported by Macquarie University Industry Collaborative Grant

Industry Sponsors: BHP Billiton, Codelco, Geoinformatics Exploration, Gold Fields, Jackaroo Drill Fund, Newmont, Placer Dome, Teck Cominco, WMC Resources.

Summary: Mineral exploration performance has deteriorated significantly over the past 15-20 years, especially with respect to the rate and cost of the large, 'greenfields' discoveries that generate so much value for the industry and underpin its future resource base. This research project is analysing past industry performance to identify opportunities for improvement, building probabilistic models of the mineral exploration business to provide a better decision framework, investigating the role of the high natural uncertainty and complexity on decision making, and developing a range of tools to improve risk and value management. The project involves collaboration between geoscientists, statisticians, psychologists and business management across the university.