QUEENSLAND CENTRE FOR ADVANCED TECHNOLOGIES

ANNUAL REPORT 2000/2001

vision mission

vision mission

The Queensland Centre for Advanced Technologies will be recognised for the excellence of its contribution to the mining, energy and manufacturing industries.

To generate products and processes of high value to Australia's mineral and energy resources and manufacturing industries with particular focus on those resources and industries located in Queensland.

The Queensland Centre for Advanced Technologies (QCAT) is a world class facility for research and development in all aspects of the mining, energy and manufacturing industries with the goal of increasing the international competitiveness and efficiency of Queensland's and Australia's resource based and related industries.

QCAT is a joint venture between the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the State Government of Queensland. The establishment of the Centre flows from an agreement between the Commonwealth and Queensland Governments to expand and diversify the research and development activities undertaken by CSIRO in Queensland.

Government Occupants

CSIRO:
Exploration and Mining
Minerals
Energy Technology
Manufacturing Science and Technology

Cooperative Research Centres for:
Coal in Sustainable Development
Cast Metals Manufacturing (CAST)

Commercial Occupants:
Australian Centre for Mining Environmental Research Limited (ACMER)
Cutting Edge Technology Pty Ltd
GeoTek Solutions Pty Ltd
Reservoir Solutions Pty Ltd
Hydrobiology Pty Ltd
Applied Mining Technologies Pty Ltd

occupants

CONTENTS

Foreword

Mining technology, services and equipment are one of Australia's rapidly growing export industries. In 2000, this progressive industry generated exports of approximately $1.5 billion.

Queensland is an important producer of mining technology and processed mineral exports. The State contains some of the world's largest base metal mines with many giant mineral deposits currently being exploited.

The Queensland Centre for Advanced Technologies (QCAT) was established through an agreement between the Queensland and Commonwealth Governments to expand and diversify the research and development activities undertaken by CSIRO in Queensland. The continuing investment made by the Queensland and Commonwealth Governments and CSIRO into facilities such as QCAT has ensured the diversification of mining related research and development activities in Queensland and Australia.

Through their outstanding science and innovative new developments, QCAT staff are providing world class technologies that play a fundamental role in maintaining Queensland and Australia as one of the key centres of the world minerals, energy and manufacturing industries.

These advances in technology are also helping to cement Queensland's reputation as the Smart State.

Hon Stephen Robertson MP
Minister for Natural Resources and Minister for Mines

EXECUTIVE MANAGER

The past year has seen some exciting changes for QCAT and CSIRO. The completion of Stage II has enabled us to ramp up our research activities in a number of areas by providing a much better balance between laboratory, office and large process bay accommodation. Minerals have commissioned a new state-of-the-art pilot scale sintering facility and are currently installing a new sintering/pelletising facility. The Automation Group have utilised their new facilities to increase their testing of autonomous underground vehicles, with the LHD automation project being able to move from research to technology transfer. The construction of the Waste Coal and Waste Gas Mitigation Research Facility has accelerated the development of this new technology involving the catalytic combustion of coal waste and fugitive methane emissions from coal mines. The profile of QCAT has also been enhanced with the construction of the Technology Transfer Centre. This new facility has enabled the headquarters of the Co-operative Research Centre for Coal in Sustainable Development to re-locate from Newcastle, with occupancy expected in December 2001. Facilities for undertaking bench-scale evaluation of the fundamental aspects of coal and char activity under high pressure conditions will be re-located from North Ryde in 2002.

An original contribution to the advancement of coal geology in Queensland by the Coal Geology and Minescale Geophysics Groups was recognized when they received the inaugural coal industry Bowen Basin Geology Group Leichhardt Award for 2001. Their work on developing the CSIRO "Virtual Mine" concept supports the assessment, prediction and communication of mining conditions in open cut and underground coal mines. Additionally, the Coal Processing Group has developed the concept of the intelligent plant and is receiving solid industry support in a number of projects involving the development of new sensing/monitoring devices. And in manufacturing, a prototype lightweight automotive engine block utilising magnesium alloys has been cast and bench trials have commenced. The project, carried out through the CRC for Cast Metals Manufacturing with the University of Queensland, the Australian Magnesium Corporation and a German foundry offers enormous potential for weight savings in vehicle components.

For CSIRO as a whole, the appointment of Dr Geoff Garrett as Chief Executive of CSIRO has ushered in a new look at CSIRO's performance as a research business. His visit to QCAT in February 2001 was highlighted by his forceful opinions on how CSIRO should communicate with the outside world. That QCAT is addressing these issues successfully is amply demonstrated by the solid industry support for all of its projects, and also by a successful industry breakfast held at QCAT in May when Queensland Government Natural Resources and Mines Minister Stephen Robertson and CSIRO Board member Norbury Rogers addressed over 40 delegates. Minister Robertson described QCAT as a successful example of the Queensland Government's "Smart State" initiative, whilst Norbury Rogers highlighted the many ways in which QCAT is fulfilling our Chief Executive's call to "add value and to benefit all those people outside ourselves - government, business (large and small), sister organisations and the community at large".

Dr John Read
Executive Manager
Queensland Centre
for Advanced
Technologies


fruit
EXPLORATION

gravity

This is the largest single project within Exploration and Mining on the QCAT site. Emerging from five years of CSIRO funded research, and involving scientists from both Exploration and Mining and Manufacturing Science and Technology, it aims to provide its industry partners with a second generation airborne measurement system by late 2003. CSIRO Exploration and Mining, AngloGold Australasia, Anglo American and De Beers announced in November 2000 that they had signed a collaborative agreement to develop an airborne gravity gradiometer suitable for detection of buried orebodies and geological structures. The new contract was for AU$7.4M with AU$6.4M being provided by the industry partners and

find it

AU$1M from CSIRO. "Anglo American, De Beers and AngloGold have a long and successful track record of high powered Research and Development and a continued commitment to leading edge technologies to ensure their competitive advantage in minerals prospecting" said Eddie Kostlin, then Vice-President: Geophysics at Anglo American. "The investment is seen as part of our recent commitment to the exploration and mining industry in Australia," said Mr Kostlin.

The gradiometer application has demanded the extension of the technology previously developed for precise measurements of deformation in the earth that are associated with earthquake processes. In the gradiometer, movements smaller than one hundred millionth of a millimetre are measured. A prototype instrument has been constructed and will be tested on airborne platforms in the second half of 2002.

Airborne gravity represents the remaining geophysical observational window for exploration and geological mapping. To this time, airborne exploration has been based on combinations of observations of magnetics, electromagnetics, natural gamma spectrometry and thermal infrared surface spectrometry. CSIRO has played an important role in the development of all of these technologies, and expects to do the same in measurement and interpretation of airborne gravity gradiometry.

Ultimately, the system will provide the industry with enhanced mapping of the geological structures as part of CSIRO's Glass Earth Initiative which aims to visualise the structure and mineralogy of the first kilometre or so of the earth's surface. The new technology will also be used in other nano-technology applications.

The key targets for the Minescale Geophysics Group are the development, demonstration and transfer of new techniques/technologies to assist the mining industry (coal, metalliferous and industrial minerals). Accurate deposit delineation together with ore and rock mass characterisation are essential for maximising the recovery of reserves and for minimising dilution. Geophysical data acquisition systems will be crucial for controlling next generation mining systems. By monitoring real time progression of the mining operation, they contribute to safety in mining by enabling increased automation, and by better monitoring the stability and ground response to mining.

- Microseismic measurement and interpretation of induced failure mechanisms at Australian longwall coal mines continues to enhance the understanding of stress failures associated with longwall mining, goaf generation and gas emission. A significant breakthrough has been achieved in the real-time display and visualisation of microseismicity and event location. The system has now been used in thirteen Australian mining environments and in three sites in China.
- A new generation miniaturized borehole tensor strainmeter has been developed. This instrument is a slimline mining version of the acclaimed Gladwin Tensor Strain Meter system used in tectonic arrays in California since 1983. It directly and precisely measures in-situ rock mass deformation, providing stable and accurate measurements over long time periods. Dr Gladwin is currently serving as chairman of the Strain Instrumentation Program for the Plate Boundary Program, which is a component of the $300M US Earthscope Initiative for Tectonic studies of the Western USA.
- Geophysical techniques for seafloor exploration/evaluation of hydrothermal base and precious metal mineralisation have been demonstrated in the Manus Basin off the coast of Papua New Guinea. These included new applications at depths of more than 1500 m of sonic scanners, magnetic field gradient measurements and resistivity measurements of ocean floor materials in moderately conducting seawater. These Geophysical techniques will play a crucial role in evaluating the potential of seabed mineral resources in the future. The work was performed from the Research Vessel CSIRO Franklin.
- Demonstration projects in support of commercialisation of the SIROLOG spectrometric borehole logging technology continue in Australia and offshore. Projects have been undertaken in Tasmania, Western Australia, NSW, Queensland and Chile in coal, iron ore, nickel, copper, base metals and phosphate commodities.
- The first of the new generation miniaturised borehole tensor strainmeters was installed for Allied Bellambie Collieries, adjacent to the Cataract Reservoir dam wall in NSW. The instrument forms part of an array monitoring the effects of longwall mining on the integrity of the dam wall.

geophysics

MINE

MINING

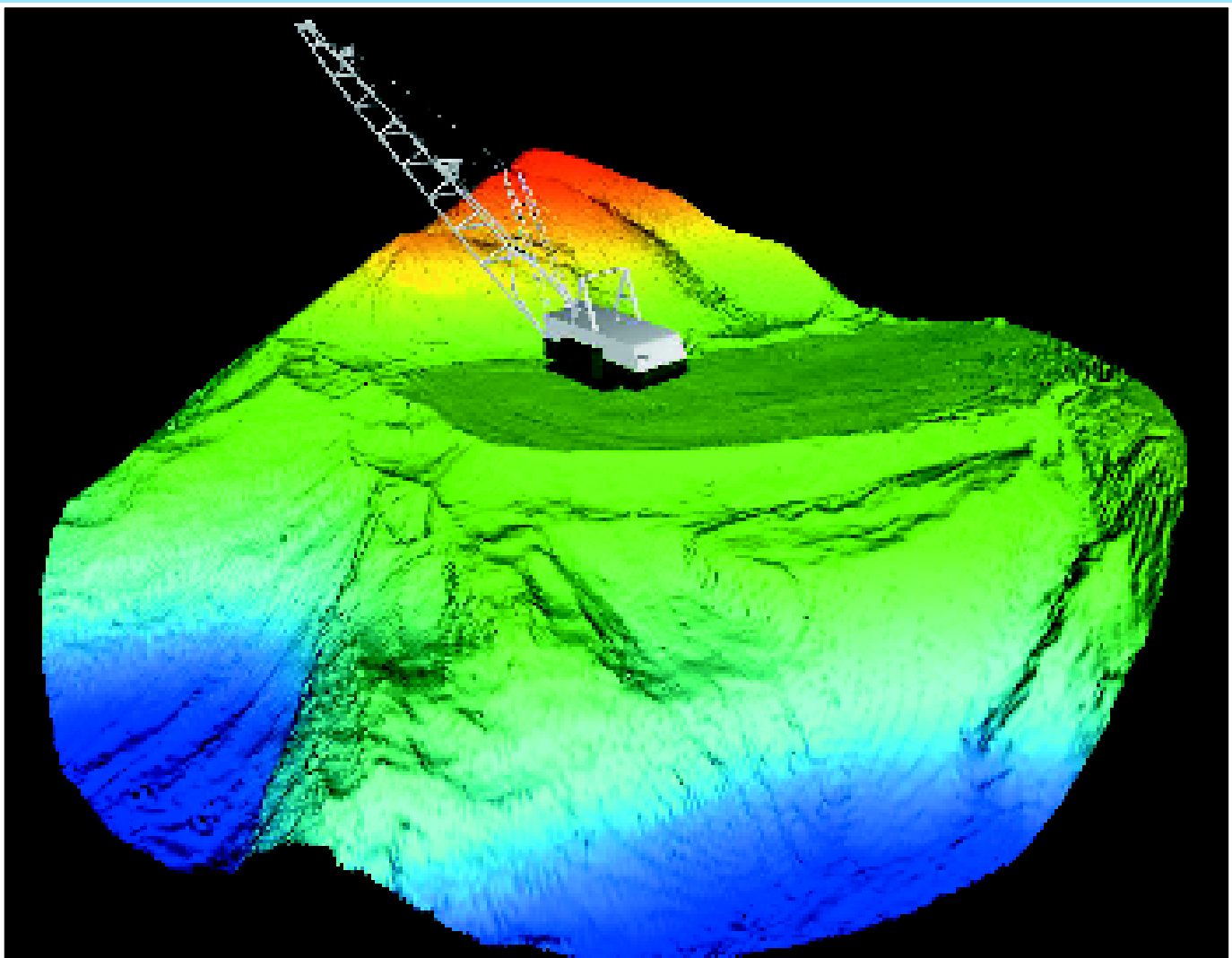
coal mining

Research and development in coal mining is focussed on multidisciplinary areas, which effectively use fundamental science to deliver applied approaches to the coal industry. Several groups in CSIRO Exploration & Mining and Manufacturing Science & Technology are working together with external groups to deliver applied technology solutions to major industry issues. These range from optimising mine design, lowering pit costs, enhancing reserve estimation and increasing recovery to reducing geotechnical risk in mining operations and dragline swing automation. A team approach is crucial, as industry problems require the integration of disparate disciplines. External recognition of a successful team approach is the awarding of the inaugural coal industry Bowen Basin Geology Group Leichhardt Award for 2001 to the Coal Mine Geology and Minescale Geophysics Groups for their original contribution to the advancement of coal geology in Queensland.

Investigations into improved techniques of thick seam mining are underway. These are focusing on top coal caving (TCC), as practiced in China, and on hydraulic mining. A relationship agreement has been signed with the YanKuang group to assist in the introduction of TCC techniques into Australia. Both methods have the potential to access several billion tonnes of prime Australian coal that cannot be accessed with conventional mining methods.

Development of the geological "supermodel" has already shown benefits to several mining operations. This Australian Coal Association Research Program supported project joins data from eleven mines and prospects, and has helped to better characterise regional sedimentological and structural controls on mining conditions. The model assists in the prediction of deleterious ground conditions, thus reducing safety risks and increasing mine productivity, and has been used for targeting commercial coal seam methane. A JCOAL sponsored gas project at a Hunter valley mine successfully assisted the mine to improve its gas capture by more than 250%. This research is contributing to safety goals and minimising lost production from shutdown due to gas problems.

Techniques developed in past highwall mining projects are now moving underground. Span and pillar stability tools are now being applied to proposed augering layouts and place changing for underground mines.



A CSIRO/JCOAL project "Rapid Roadway Development" has successfully demonstrated the world's first autonomous feed and bolting system. The system will be utilised in a new Autonomous Conveying and Bolting Module (ACBM) to be trialled in early 2002. The system will have up to 400 roof-bolts and 200 rib-bolts live on the machine.

An interactive, 3D computer visualisation technique which utilises current internet based technologies to integrate drilling, 3D-seismic, geology, and other data creates the CSIRO 'Virtual Mine'. This technique supports the assessment, prediction and communication of mining conditions and geological disturbance of coal in opencut and underground mines and has been well received by two major coal companies. Its effective intercontinental use was successfully demonstrated in the collaborative CSIRO/Anglo American "Cerrejon Opencut Mine" project. Effective communications of exploration and mine data were achieved between participants in Australia, Africa and the South American based mine site. Requests for technology licensing are being addressed following this success.

A joint CSIRO/Julius Kruttschnitt Centre project has resulted in a pit to port fragmentation model for coal. Improved practices as a result of the utilisation of the model may improve coal recovery by several percentage points and result in significant improvements in site profitability.

CSIRO, in conjunction with the Cooperative Research Centre for Mining Technology and Equipment (CMTE), was awarded the Longwall Automation Landmark Project, which is an initiative of the Australian Coal Association (ACA) through ACARP. The aim of the project is to develop face equipment that will reliably carry out the routine functions of cutting and loading coal without human intervention. The three year initial stage of the project began in July 2001.

Better prediction of coal performance for the power and steel industries has been delivered through another ACARP supported project that employs inexpensive technology for automated characterisation of coal maceral composition and thermal maturity. The full phase maceral reflectogram technology has been licensed to Jenkins-Kwan Technology for commercialisation.

A collaborative project with Queensland Rail and CSIRO Energy Technology is investigating methods to mitigate delays and reduce costs at the port for unloading problem coals that do not flow freely from rail wagons.

CSIRO in collaboration with the JKMRC successfully ran a Workshop-"Innovative technologies for assessment, prediction and monitoring of ground and material behaviour during mining", in Johannesburg, South Africa.

Production testing of the dragline swing automation system is underway at Callide Coalfield's Boundary Hill Pit and automation trials have commenced. The primary goal of this work is to reduce the average cycle time of the machine, leading to immediate reductions in overburden removal costs. This will be achieved by reducing the time of the dominant part of the cycle --- swinging the bucket through free space. On the current testing schedule, comparative productivity figures for the swing automation system based on the analysis of Tritronics dragline monitor data will available in early 2002.

The current dragline swing automation system requires an operator to enter so-called `no-go' points into the system indicating where the bucket and boom must not travel.

The next logical step in dragline swing automation is therefore to give the machine the ability to sense its surroundings. With support from ACARP and Callide Coalfields Pty Ltd a full-scale implementation project was begun in March 2001.

Online knowledge of the local terrain and how it changes with time would allow measurement of the real productivity (volume of overburden removed) of a dragline operation, which is currently inferred from estimated weights and approximate knowledge of specific gravity of the overburden.

The system can also provide operators with much better information about the location of spoil, and better allow them to plan where spoil can be placed. 3D visualisations from different view points could be shown.

Pictured is a height encoded image of a DTM created over a complete 360 degree swing of the dragline.

mining support

Three dimensional imaging systems primarily for applications in the mining and construction industries are being developed. These systems can improve safety and productivity and are used in applications such as the analysis of rock mass structure for geological and geotechnical assessment.

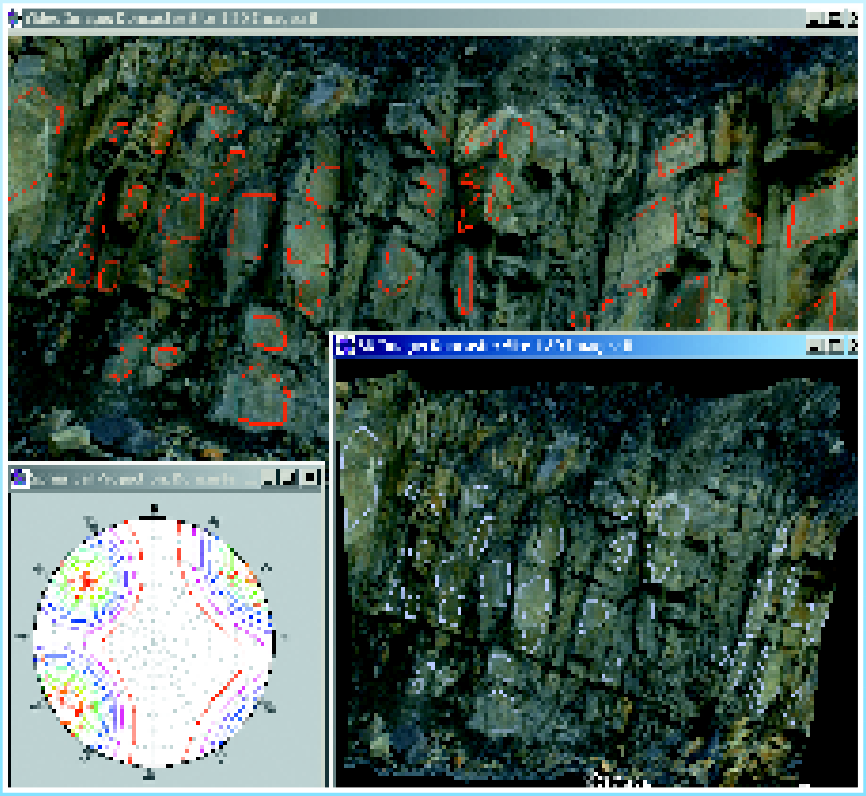
The ability to deliver improvements in mine design, safety and productivity means that these systems will become an integral part of mining and construction operations. The systems can also be used in automation of mining equipment.

To provide a 3D imaging capability the group has developed a low cost, terrestrial photogrammetry system tailored to the needs of the mining industry.

The system provides data collection and mapping requirements for:

- highwall mapping to collect geotechnical and geological data used in blast design and stability analysis;
- general mine site communication through spatially corrected digital and hardcopy image mosaics (orthomosaic); and
- data validation and interpretation through integration with other data sets in visualisation and mine planning software.

Ongoing development of the technology has included trial of a demonstration system for underground mapping. The objective is to produce an automated system to map mine infrastructure in three dimensions. The system will produce integrated visual and 3-D spatial information that will enable mine staff to "fly through" a mine layout for safety assessment, maintenance and other operational applications.



metalliferous mining

Research into metalliferous mining at QCAT includes work in rock cutting, geomechanics, automation and new mining techniques. These activities involve staff from CSIRO Manufacturing Science and Technology and CSIRO Exploration and Mining. A multidisciplinary team approach is taken. Close contacts with the industry are maintained to ensure the research is well directed. Some of the work is strategic, such as rock cutting and new mining techniques. Other work is industry-funded, such as automated vehicles.

*Rock Cutting ~ SMART*CUT*

Mechanical excavation of hard and abrasive rocks with UCS values up to 250 MPa has become a reality with the introduction of ***SMART****CUT technology. This technological revolution has come about through the use of diamond composite materials as the cutting elements in point-attach picks, drill bits and saw blades. The amazing wear resistance of thermally stable diamond composites combined with CSIRO's patented bonding process has produced tools that now offer a viable alternative to the traditional drill and blast method for metalliferous mining. The technology has wide spread industrial applications in mining, construction and materials engineering. CSIRO is actively exploring a number commercial opportunities to take the technology to the market.

Automated Underground Vehicles

The development of technology to automatically operate underground vehicles such as LHD's and haulage trucks was completed. This was a sponsored project through AMIRA. The CSIRO research team then began working with the

commercialising company, Dynamic Automation Systems to integrate the outcomes of its research into a commercial product. This has involved adaptation of the research software. The simulated minesite at QCAT was used to commission some components of the control system on an Elphinstone 2900 LHD. The team, comprising CSIRO, DAS and WMC staff successfully retrofitted the technology to the 2900 which achieved full speed operation in 3rd gear under autonomous control. Components of this prototype were then reinstalled by DAS on one of the 2900 machines at the Olympic Dam Operations for production trials.

Work began on the next phase of the development for DAS, which is to design and supply a guidance and control system. This will be used as a production-grade prototype for duplication and testing at the ODO and the Northparkes mines.

The CSIRO automation team have consolidated their expertise in guidance of high-speed underground mine vehicles and have established a research infrastructure to realistically simulate underground mining environments. Uptake of this technology will deliver improvements in safety and productivity.

Automated Explosive Placement

Work began with Orica Explosives to develop a control system for their explosive loading machines. The aim of the work is to improve the efficiency, productivity and safety of bulk explosive delivery systems. Explosives are currently pumped into drilled holes using a purpose-built vehicle. The operator needs to be close to the hole to ensure that explosives are properly delivered.

New technology will be developed through a phased programme, culminating in full autonomous operation, to remove the operator from hazardous areas. The first stage undertaken by CSIRO is to develop the equipment's boom control and sensing technologies so that the operator can remain in the safety of the vehicle cabin. The technology will automatically find the hole and manipulate the explosive placement boom and nozzle into the correct position.

Research infrastructure has been built at QCAT to simulate the mine environment for this research. Successful hole-finding techniques have been developed.

New Mining Techniques

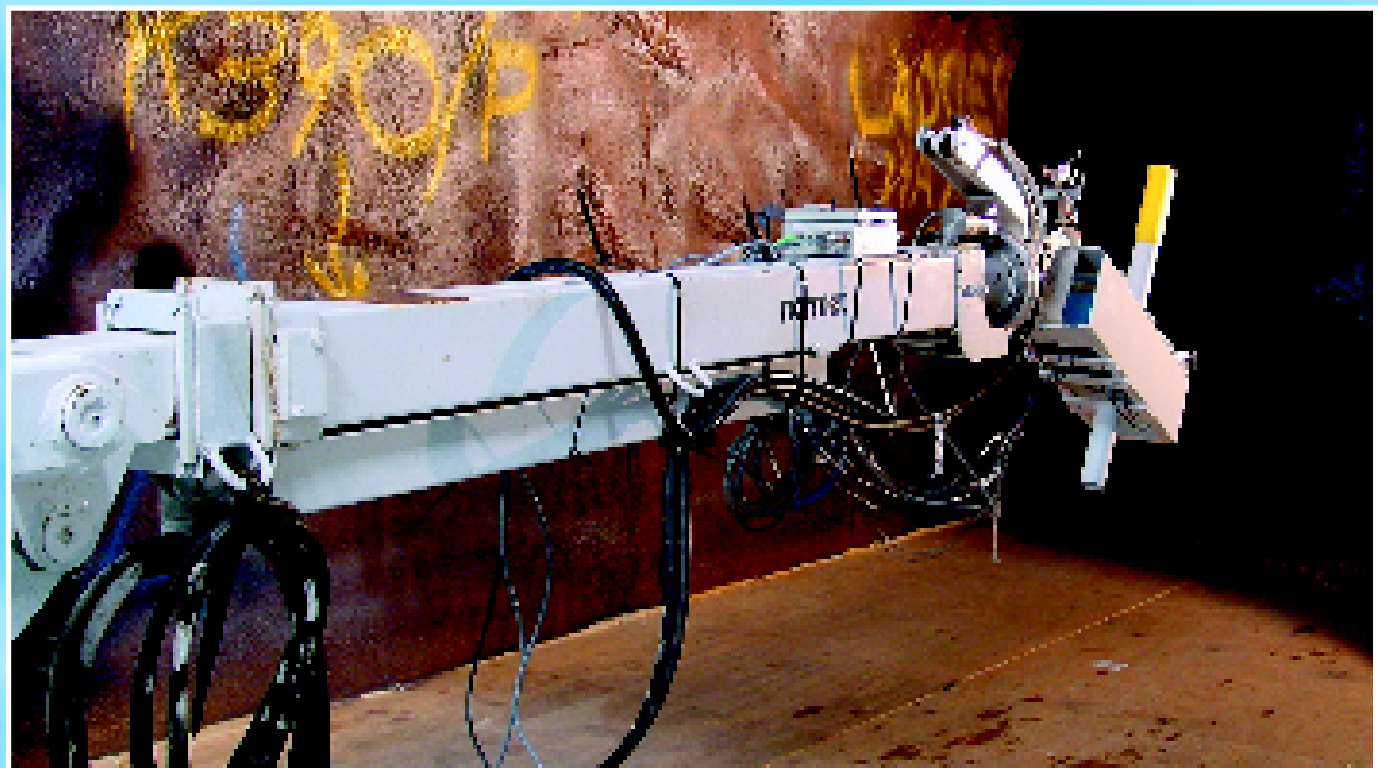
Work has begun to develop a new mining technique called Automated Horadiam that will be automated from the outset by design. A specialised mining platform will drill, survey and load explosives from a large diameter shaft drilled through the orebody. The platform will be fully automated. A preliminary feasibility study has shown that a reduction in the cost of present mining techniques between 16% and 20% is achievable. The project is being done in collaboration with the Western Australian School of Mines (Curtin) and Geographe Enterprises.

Haul Truck Scanning

Techniques and software have been developed to use scanning lasers for measurement of the volume and load distribution of material carried by haul trucks and shove buckets. This has led to the resolution of mass/volume balancing issues for sites such as the Century mine. Load distribution and volume of material are important for protection of the vehicles and for management of contracts for removal of material. The technology is in the process of commercialisation.

Orepass and Stope Survey Platform

A survey platform is being developed for inspections of ore passes, stopes and underground cavities. The work has been contracted by the Western Australian School of Mines. A market study and a business plan were prepared for WASM who will use the platform in their research and also undertake contract inspection work. The first stage will deliver a robust platform with video, odometry and broadband communications. Ultimately the research will lead to a stabilised inspection platform that can be suspended by cable into open spaces and return a range of sensor information. This will assist in the management of orepass flow, stope filling and draw control.




process
IT
PROCESSING

iron ore processing

Australia's iron ore industry is undergoing a major transformation at present, especially the development of new ore types such as Marra Mamba ores to replace the premium grade Brockman ores that are being depleted, and several companies are working on large value adding projects. The iron ore processing group at QCAT is playing a key role in a number of these projects, using its cutting-edge expertise in ore characterisation, comminution, beneficiation, agglomeration, sampling and quality control. With the completion of QCAT2, all the group's laboratory and pilot-scale equipment has now been moved into the new laboratories, which provide a much better balance between laboratory and large process bay accommodation.

The focus of the research on characterisation of iron ores is the prediction of downstream processing performance from the mineralogy and petrology of the particular ore using optical microscopy and computer-based image analysis techniques.

When required, this is backed up by complementary techniques such as electron microscopy and electron microprobe analysis at the Melbourne laboratories of CSIRO Minerals. In the long-term, it is anticipated that this approach will reduce the amount of laboratory and pilot-scale work required to develop process flowsheets for new and existing ore bodies. Development of better ISO standards for sampling and physical testing of iron ores is continuing both to improve quality control procedures and optimise the life of ore resources.

In the beneficiation area, development of a versatile hydrocyclone pilot plant for processing lower grade ore deposits has been completed and successfully used for plant design and optimisation for a number of industry clients. The fully instrumented facility can accommodate hydrocyclones up to about 250 mm in diameter and is currently being upgraded to accommodate even larger diameter hydrocyclones. A spiral separator module is also under development to enhance the other pilot-scale beneficiation facilities at QCAT.

All the group's expertise and facilities in the agglomeration of iron ores have now been consolidated at QCAT. This involved relocation of staff and equipment from North Ryde to QCAT and the subsequent closure of the North Ryde laboratory of CSIRO Minerals in August 2001. As part of this relocation, construction of a new state-of-the-art pilot scale sintering facility was completed and successfully installed and commissioned at QCAT.

The facility is well instrumented and can be operated under computer control. Because of the increasing pressure to develop more environmentally friendly agglomeration methods, the sintering facility is being fitted with emission monitoring equipment to monitor the gas and particulate emissions during sintering.

The pilot-scale sintering/pelletising facility originally at North Ryde has now been refurbished and is currently being installed at QCAT as a dedicated pelletising facility. The laboratory scale furnaces and other physical testing equipment previously at North Ryde has also been relocated and recommissioned at QCAT to support the sintering and pelletising research. Both facilities will be used in a number of ongoing research projects aimed at developing a better understanding of the sintering and pelletising properties of new ore types currently under evaluation and improving the productivity of existing sinter and pellet plants.

process IT

non-ferrous processing

Major changes have occurred in the scope of non-ferrous mineral processing research at QCAT over the last year. With the industry drivers being advanced grinding technologies to both improve throughput and reduce energy consumption and improved ore characterisation methods, the focus is now largely on the continued development of new techniques for SAG mill monitoring and control using surface vibrations, on sales of QemSCAN machines around the world and on the provision of a QemSCAN Bureau service. CSIRO Minerals' research staff are at the cutting edge in these areas and have received substantial acclaim for their development of QemSCAN.

The development of new technologies for monitoring and controlling SAG (and AG) mills is a substantial international AMIRA project, sponsored by Anglo Platinum (South Africa), Codelco/IMM (Chile), MIM, Minera Los Pelambres (Chile), Ok Tedi Mining (PNG), Pasminco, Phelps Dodge (USA), RioTinto and WMC, with access to pilot-scale SAG mills being provided by Mintek in South Africa.

The basis of the technology is understanding the relationship between surface vibrations and conditions within the mill. The surface vibrations are measured directly with accelerometers mounted on the mill shell, and changes in the vibration signal indicate changes in the charge motion and provide a warning of the onset of undesirable operating conditions. Initial trials of the technology on the SAG mill at the Ernest Henry operations in Queensland provided exciting results.

The CSIRO QEM*SEM technology continues to be marketed as QemSCAN. In the last year, two systems have been sold, one to Phelps Dodge in the USA, the other to Anglo Platinum in South Africa. A further order has been received from the Mineral Processing Research Centre in Iran with installation scheduled for early 2002. Recent collaborative research with the Petroleum Industry has successfully demonstrated the application of QemSCAN technology in the quantification of stratigraphy from drill cuttings in exploration and production oil and gas wells. A major feasibility study has been completed in collaboration with Camborne School of Mines (UK), to assess the suitability of QemSCAN for the environmental waste characterisation industries. Coal, coke and fly-ash characterisation has continued in collaboration with the CRC for Coal in Sustainable Development, with encouraging results. The group continues to work with CSIRO to effectively commercialise and fully develop the QEM*SEM technology, and provides a mineralogical consultative service to the Australian and International mining, mineral and exploration industries.

coal processing

CSIRO Energy Technology has a major component of its Coal Preparation Group based at QCAT. This group is strongly focussed on addressing the issues associated with preparing Australian coals for sale on the international market.

The Coal Preparation Group is developing methods for improving the quality of and cost of Australian product coals, and a number of projects have been developed which address key components in the research priority areas. The strength of this linkage has been demonstrated by the significant level of financial support for these projects from the industry research program, ACARP, and directly from coal producers.

- The concept of the Intelligent plant has been developed and a number of projects involving the development of new sensing/monitoring devices are now receiving industry support. This development is an outcome of the rapid improvement in the capability of digital electronics and computing and the decreasing cost of this type of equipment.
- The theme of high capacity unit operations continues to develop with significant effort being undertaken to understand the physics controlling the performance of Banana screens. These screens have allowed the capacity of preparation plants to be increased and it is important that their full potential is realised.
- A number of projects have been accepted for the XIV International Coal Preparation Conference in Johannesburg, March 2002.
- Presentations on the outcomes of three projects were given at ACARP organised symposiums in Emerald (Qld) and Singleton (NSW) in October 2001.

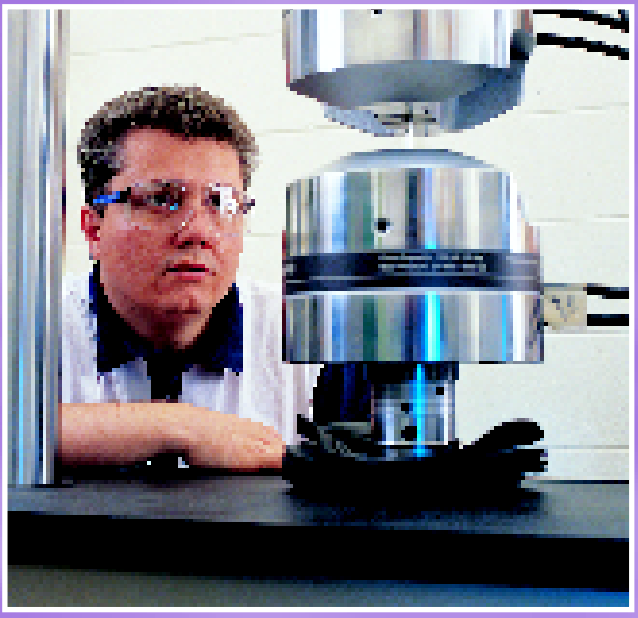
process


MAKE IT
MANUFACTURING

casting & alloys

CSIRO Manufacturing Science and Technology scientists undertake research in casting technology and in alloy design concentrating on the "light metals" – aluminium and magnesium.

This research is carried out at CSIRO laboratories in Melbourne, Adelaide and Brisbane. Here at QCAT we have 6 full-time staff working in the areas of Process Technology and Alloy Performance and we have developed leading edge technologies for casting magnesium and for producing magnesium alloys. Capability in numerical modelling of casting is of world standard with work being undertaken for Australian foundries in addition to supporting internal projects. Work on mechanical properties of both aluminium and magnesium alloys is being used to support Australian foundries, notably those supplying castings to the automotive industry.



Developing magnesium alloys for a lightweight automotive engine block

The density of magnesium is about 65% that of aluminium and about 25% that of cast iron. Accordingly, magnesium offers a huge potential for weight savings in components. However, traditional magnesium alloys are unable to operate at the temperatures and stresses required of modern automotive engines. In this project (carried out through the Cooperative Research Centre for Cast Metals Manufacturing with the University of Queensland, the Australian Magnesium Corporation and a German foundry) alloy additions and heat-treatment schedules have been developed that have resulted in satisfactory mechanical properties. A prototype engine block has now been cast and bench trials were started in late 2001.

Developing methods for measuring magnesium metal quality

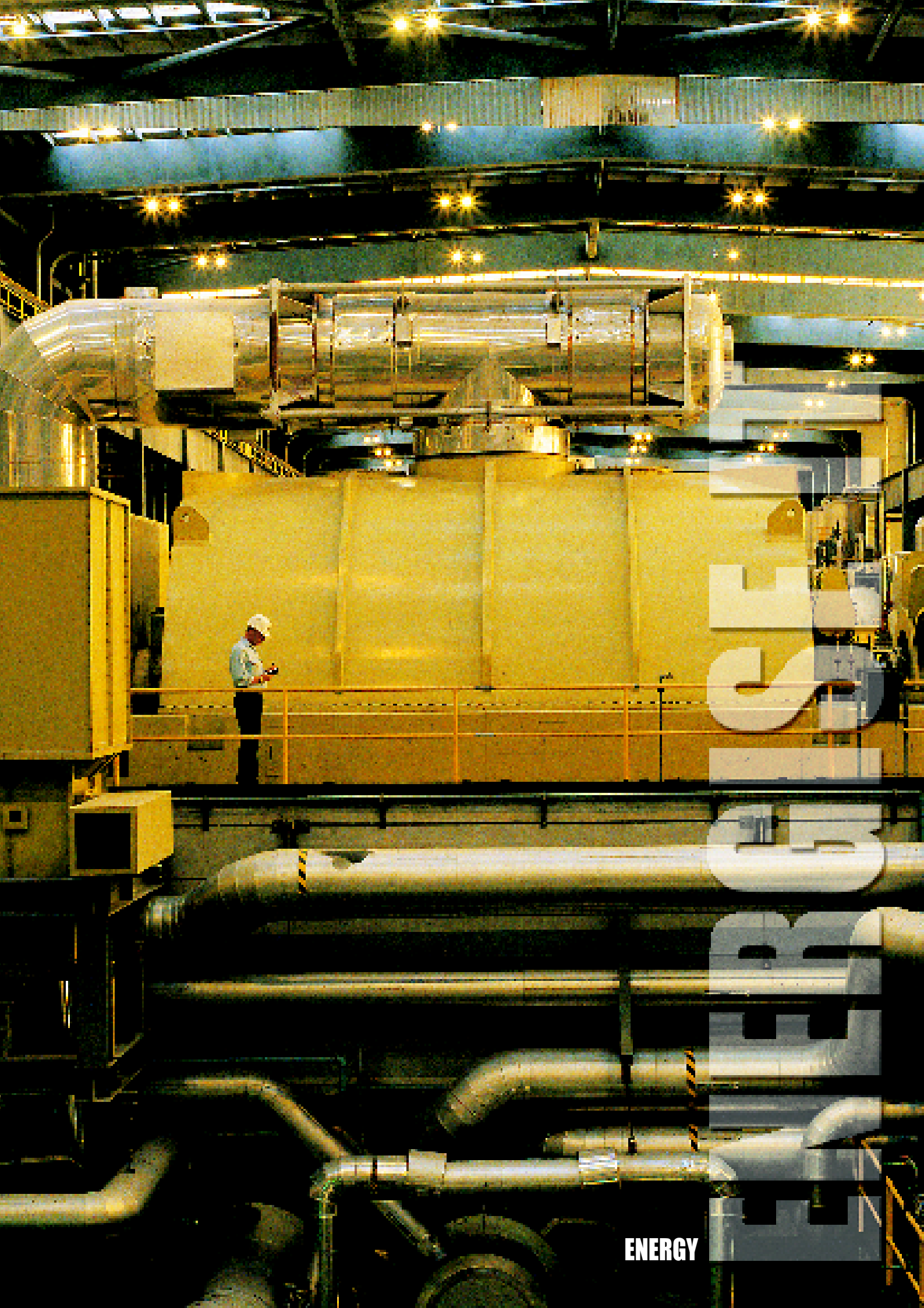
The existing refining process for molten magnesium metal allows non-metallic inclusions to sink under gravity, settling to form a sludge at the bottom of the crucible. The process is time consuming, typically taking up to 8 hours per batch. Moreover, no industry-wide method for measuring the non-metallic inclusion content of magnesium exists, so no universally accepted end-point for the refining process exists. This project, funded by the Cooperative Research Centre for Cast Metals Manufacturing, seeks to develop methods for metal quality measurement and also to develop faster and more effective refining procedures. Considerable success has been achieved in developing filter materials and a process for pumping the metal through them. The methods have application in recycling magnesium scrap.

Increasing greenhouse gas savings through the use of alternative melt protection for molten magnesium

Molten magnesium burns rapidly in air. The standard method to prevent burning is to use a dilute mixture of sulphur hexafluoride as a cover gas. This gas reacts with the metal surface and slows the oxidation reaction. However, sulphur hexafluoride is an especially effective greenhouse gas, being over 22,000 times more potent than carbon dioxide. The use of this gas in magnesium processing is estimated to produce 0.1% of the total global greenhouse gas emissions. This project, involving CSIRO and University of Queensland researchers, is funded by the Cooperative Research Centre for Cast Metals Manufacturing, and it has identified a promising alternative to sulphur hexafluoride for this application. The gas, well-known as a refrigerant in automotive air conditioning systems, is more effective than sulphur hexafluoride and is only one-third the cost. Trials of the gas in die-casting applications have shown greenhouse gas savings of almost 99% and a cover gas cost saving of almost 90%. If adopted in a 100,000 tpa magnesium smelter (the size of that proposed by the Australian Magnesium Corporation), the greenhouse gas savings would be of the order of 1 million tonnes per year of carbon dioxide equivalent, equal to the effect of taking more than 200,000 cars off the road.

Reducing the heat-treatment cycle time for aluminium castings

Aluminium castings are heat-treated in a two-step process – a high temperature (540°C) stage followed by a low temperature (170°C) stage. Current industry specifications require the time at 540°C to be at least 8 hours. However, research evidence accumulated by CSIRO and other groups suggests that the time could be reduced by at least a factor of two with no adverse effects on mechanical properties (strength, ductility and fatigue resistance). A Victorian foundry that supplies the automotive industry made available production castings and these were heat-treated at 540°C for 8 and 4 hours. Mechanical testing, supported by metallurgical examination and a rigorous statistical analysis, showed that the shorter time was indeed adequate. The foundry is now modifying one of its production lines to take advantage of the savings in time and fuel.


ENERGY

coal utilisation

As part of the CRC for Black Coal Utilisation (now the CRC for Coal in Sustainable Development), CSIRO Energy Technology has established an advanced gasification research facility at QCAT to evaluate the performance of Australian coals in advanced power generation technologies. The focus of the work is on the performance of Australian coals in Integrated Gasification Combined Cycle (IGCC) technologies. These technologies have the potential to significantly reduce emissions and enhance the efficiency of large-scale power generation from coal. Gasification technologies also offer the potential for development of future energy conversion technologies with greatly reduced, and ultimately zero, greenhouse gas emissions. The research is aimed at supporting future export markets of Australian coal into these new technologies to provide technical data necessary to assess and adapt these technologies for use in the Australian power generation industry.

ACARP have provided funding to the CRC for Coal in Sustainable Development to perform an assessment of the gasification performance of a wide range of Australian coals using the facility. A second ACARP/CRC funded project is also being conducted to provide more detailed examinations of promising Australian coals in order to define appropriate coal test procedures and to determine optimum operating conditions for different coal types. A suite of 14 Australian coals are being examined and their gasification performance is being correlated with other relevant parameters such as ash and slag behaviour. Bench-scale evaluation of fundamental aspects of coal and char reactivity under high pressure conditions are also being performed at CSIRO Energy Technology's North Ryde laboratories. These facilities will be relocated to QCAT during 2002 and will form an integrated component of the coal gasification research program.

The CRC for Coal and Sustainable Development began in July 2001. This CRC represents a development of the CRC for Black Coal Utilisation and will continue to work closely with the Australian coal industry and the major coal utilisation industries – electricity generation and metallurgical processing – to help maximise the value of Australian coal resources and to enhance the efficiency and environmental performance of coal based energy systems. The headquarters of the Centre will be located at QCAT and will provide a major focus for advanced coal utilisation research at the site.


ENVIRONMENT
protect IT

sustainable mining

The highest standards in safety, environmental management and social responsibility are crucial to the long-term viability and acceptability of the mining industry. The Sustainable Mining Group is currently working to assist the industry in improving its safety and environmental performance through its research in mine gas control, heavy vehicle collision avoidance, greenhouse gas characterisation and mitigation and new environmentally acceptable resource recovery methods. The Group works closely with other researchers within CSIRO Exploration and Mining and CSIRO Energy Technology, and with commercial partners to bring research developments to market.

An RF tagging system to reduce the risk of collisions in open cut mines has now been developed into a commercial product. This has eliminated the need for reversing alarms on large mining equipment and is improving safety. New Doppler radar technology has been developed and demonstrated at Bengalla Mine.

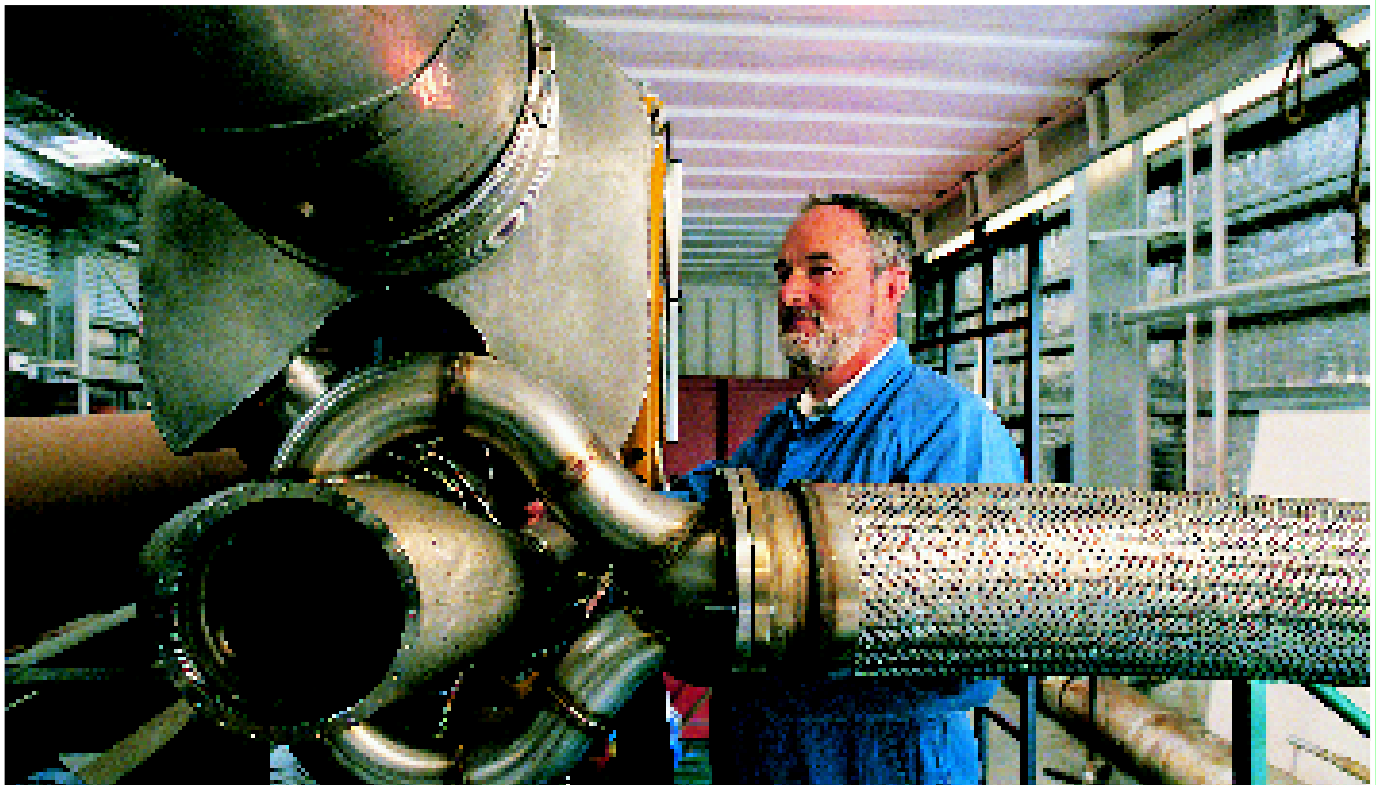
Studies at Dartbrook Mine have developed computational fluid dynamic models of goaf gas flow, which have been verified by tracer gas testing. This is the first work of its type in Australia and is a cooperative venture with the Japan Coal Energy Centre, Dartbrook Mine and ACARP. This work has now been extended to other mines with new applications such as improved inertisation practice.

The methane emitted from coal mines has a global warming potential approximately 21 times that of carbon dioxide on a hundred year comparison. Utilisation of this valuable resource results in a seven-fold reduction of its impact on the environment. New technologies involving catalytic combustion of fugitive emissions from coal mines are being developed. Combined with new thermal storage techniques, which reduce the effect of variability of the gas supply, these systems promise to significantly reduce Australia's greenhouse gas emissions from coal mines. The reduction of greenhouse gas emissions from mines is essential to the ongoing sustainability of the mining industry, which is under increasing pressure to develop its resource with minimal environmental impact.

Advances have been made in the understanding of underground coal gasification (UCG) technology through modelling of the combustion behaviour. UCG promises to deliver efficient energy production with minimal environmental impact and improved safety levels in mining.

Characterisation of coal mine gas resources in the Bowen Basin by the Group, have demonstrated the feasibility of using this resource as an environmentally responsible alternative for energy production in Qld. The success of this project has prompted requests for further resource assessments in other Australian coal basins.

Goaf gas modelling and implementation of the results at Dartbrook Mine has increased the efficiency of goaf gas drainage by 40%. This has allowed the mine to reach ventilation specifications required by regulators and to control heatings in the goaf. Trials are currently underway at Newlands mine on improved inertisation practice developed using these models. As a result of the collision avoidance system project, Bengalla Mine have adopted the use of high resolution colour cameras on their haul trucks. The camera systems alone have provided a tremendous safety and operational improvement. An RF tagging system has been commercialised and is now available. The system was recently released internationally at the NIOSH National Mining Exhibition in the USA.



The Australian Centre for Mining Environmental Research Limited (ACMER) is an incorporated research institution comprising five of the major groups in Australia carrying out environmental research for the mining industry; CSIRO; University of Queensland (Centre for Mined Land Rehabilitation); Australian Nuclear Science and Technology Organisation (Environment Division); Curtin University of Technology (Mulga Research Centre and the Mine Rehabilitation Group); and the University of Western Australia (Centre for Land Rehabilitation); and five of Australia's major mining companies; Anglo Coal Australia Pty Ltd; BHP Billiton; Placer Dome Asia Pacific Limited; Rio Tinto; and WMC Resources Ltd.

The vision of ACMER is to be an internationally recognised centre of excellence supporting continual improvement in environmental performance in the minerals industry for the benefit of all stakeholders.

The vision is being pursued by:

- working with industry, government, researchers and the community to define key environmental issues facing the minerals industry from exploration through to mine closure.

mine site rehabilitation

- focusing the collective skills of research organisations to produce effective technical solutions to key environmental issues identified by industry and relevant stakeholder groups.
- ensuring effective national and international transfer of research outcomes and key environmental technologies through advisory services, the conduct of short courses and workshops and the production of research reports, workshop proceedings, manuals and handbooks.

Major research programs of the Centre include waste rock dump stability, final void use, acid mine drainage, tailings disposal and remediation, and ecosystem reconstruction.

Outcomes of these programs include:

- Documentation of the effects of subsidence of Central Queensland agricultural land resulting from longwall mining on crop yields;
- Identification of the factors affecting the seed dormancy of key native plant species used in revegetation programs across Australia and development of methods to break the dormancy;
- Publication of a national database (Floradata) on the collection, storage, germination, propagation and field establishment of seed of Australian plants for use by mining companies and community groups in revegetation programs.

During 2000/2001, the Centre conducted Short Courses (SC) and Workshops (W) which were attended by mining industry, government, research and consulting personnel.

Topics included:

- Reporting of Emissions for NPI by the Minerals Industry (SC) (Brisbane);
- Erosion and Sediment Control for Mining and Quarrying Operations (SC) (Adelaide);
- Landform Design for Stability (W) (Adelaide);
- Community Consultation Processes for the Minerals and Energy Industries (W) (Perth);
- Managing Environmental Impacts of Mineral Processing at Mine Sites, Refineries and Smelters (W) (Perth);
- Mine-Site Water Management and Treatment: Implementation of the New ANZECC/ARMCANZ Guidelines (W) (Hobart);
- Water Management (SC) (Hobart); and
- Water Quality and the Introduction of the New ANZECC Water Quality Guidelines (SC) (Yeppoon).

In addition, with assistance from the Commonwealth Department of Industry, Science and Resources, the Centre conducted a program to assist small-medium miners and quarry operators in improving their environmental performance. Courses on water quality management, erosion control and landform stability, and noise and air quality management were presented at Penrith and Glasshouse Mountains.

Cutting Edge Technology Pty Ltd

Cutting Edge Technology Pty. Ltd. (CET) have continued to transform the nature of their business through the year 2000/1, moving from a technical consultancy providing a combination of geotechnical and mining equipment solutions to the industry, to a joint venture partner in a mining company.

CET consulted to the design, manufacture and commissioning of the BryDet BUA 600 the world's most powerful underground auger at that time with full field trials beginning in March 2000. CET has energetically built upon the foundation established in South Africa with their collaboration in both surface and underground auger mining operations.

In January 2000 they were awarded a grant under the Commonwealth Government's START scheme, their second grant under the scheme and a unique achievement. The grant was awarded for the design, manufacture, proving and commercialisation of an underground auger mining system built in Australia and suited to local mining conditions.

CET was joined in this venture partner by the international investment bankers, Babcock and Brown, to help fund the multi-million dollar underground auger program. CET also established a joint venture mining company with SBD Services, a Queensland based contract service provider to the underground coal mining industry. The SBD Mining JV draws together the innovation and auger mining expertise of CET and couples it with the highly developed project management and practical mining skills of SBD Services.

The first Australian underground auger unit, RDAMS, is currently at an advanced stage of manufacture and due for completion in December 2001.

SBD Mining expect to conduct initial surface trials in December moving to full underground trials in January 2002. The RDAMS concept has been well received by industry and holds the key to tremendous potential benefits for the Australian underground coal mining industry and CET are committed to realising that potential.

For further information contact Mr Bret Leisemann at cet@cetpl.com or phone +61 7 3720 1555.

COMMERCIAL OCCUPANTS

Applied Mining Technologies

Applied Mining Technologies (AMT) is a technology transfer company specialising in the application and development of high accuracy navigation systems, automated mining methods, and communications systems for the Australian and international coal mining industry. It has taken a leading role in the application of inertial navigation technology to underground mining automation.

This technology is at the heart of our newly released Highwall Mining Guidance System and has gained the support of Australian and international mining and equipment manufacturing companies. This system is now considered essential for safe and efficient deep-penetration highwall mining.

As part of ongoing product development, the AMT guidance system is being further enhanced to provide an integrated guidance, communications and control system for highwall and other underground mining applications.

For further information contact Dr David Reid at info@appliedminingtech.com or phone +61 7 3378 8375.

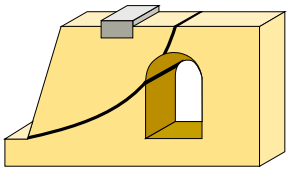
Hydrobiology Pty Ltd

Hydrobiology Pty Ltd has been recently formed to combine the operations of Fluvial Research and R&D Environmental Pty Ltd. Hydrobiology Pty Ltd provides environmental consultancy services, principally in the physical and biological processes of rivers, estuaries and coastal waters. The directors, Dr Ross Smith and Dr Andy Markham, have a combined experience of almost 40 years, and have studied the impacts of a wide range of stressors of river systems. The principal office has been at QCAT since February 2001.

Once trading, the company was immediately commissioned by Brisbane City Council to undertake an ecological health assessment of the Willawong Remediation Site in Brisbane, by the Queensland Department of Natural Resources and Mines for a river processes study of the Logan River and its tributaries and by Canadian Consultants Lorax Environmental to undertake components of a mine closure plan for PT Newmont Minahasa Raya, Indonesia. Other overseas work-in-progress continues for established clients at Minesites in Papua New Guinea, Indonesia and the Philippines, while a number of smaller stream health assessments have been conducted within the Brisbane Metropolitan Area.

For further information contact Dr Ross Smith at rews@hydrobiology.com.au or phone +61 7 3878 9479.

Hydrobiology Pty Ltd
Aquatic Environmental Services



GeoTek Solutions Pty Ltd

GeoTek Solutions Pty Ltd (GTS) is a geotechnical and engineering geology consultancy that has been based at QCAT since 1999. GTS located at QCAT to build a synergistic relationship with the CSIRO and other like-minded commercial groups.

This year, GTS has been active in assessing the stability of spoil dumps for a number of existing and proposed mines in the Bowen Basin. Problems like floor heave associated with dump instability have been examined. Our fundamental knowledge of coal dump spoil stability is underpinned by the major research programs carried out by CSIRO in the 1970s. GeoTek Solutions has also been part of a large project to develop rehabilitation strategies for a major mine site in the Philippines.

This project has required GTS to work with another QCAT tenant, Hydrobiology P/L, and CSIRO, for the lead consultant Maunsell Philippines Inc. GTS, Cutting Edge Technology P/L and CSIRO have continued their collaboration this year, to better understand the geomechanics of underground auger mining. Other work carried out by GTS during the year has included projects with mining contractors, AusIndustry, Queensland Main Roads and CSIRO Exploration and Mining.

GeoTek Solutions integrates geology and engineering to create client focussed solutions to mining and civil engineering with a particular emphasis on terrain and slope stability analysis and characterisation. GTS has had extensive experience in the tropics including the Philippines, Papua New Guinea, the Solomon Islands and Fiji.

For further information see www.geoteksolutions.com, email gts@geoteksolutions.com or phone +61 7 3720 1792.

COMMERCIAL OCCUPANTS

Reservoir Solutions Pty Ltd

Over the last year, Reservoir Solutions Pty Ltd has continued to carry out petrographic studies for some of Australia's major oil and gas explorers, and is now firmly established as one of the main providers in Australia of specialised services relating to the petrographic analyses of hydrocarbon reservoir and seal rocks. Results of such analyses can assist in the interpretation and calibration of wireline logs and can also be used to better predict sandstone porosity and permeability and seal integrity in undrilled areas.

Core samples have come from such diverse sedimentary basins as the Carnarvon Basin (NW Shelf), Otway Basin (Bass Strait), Cooper Basin (SW Qld) and Bowen Basin (east central Qld).

Work this year also included the petrographic analysis of coals from the Walloon Coal Measures, which was carried out in collaboration with the Coal Mine Geology Group, CSIRO Exploration and Mining. This work provided information on coal macroporosity characteristics and on the frequency of mineralised and unmineralised fractures that would have a bearing on coal seam permeability for coal bed methane production.

Over the next year, it is likely that the company will continue to receive a constant stream of freshly drilled core samples from some of Australia's most important hydrocarbon provinces.

For further information contact Dr Julian Baker at J.Baker@uq.net.au or phone +61 7 3367 8391

People, facilities and finance

Consistent with its mission to create a competitive advantage for Australia's resource and manufacturing industries, QCAT employs research scientists, programmers, engineers, technicians and support staff. QCAT's staff work in environmentally friendly and state of the art facilities, and conduct their activities in close partnership and consultation with industrial, academic and government groups.

Integrated and intuitive knowledge management is an essential pre-requisite to success. As an internationally respected centre for innovative research and development, QCAT has been instrumental in demonstrating a new way forward for CSIRO research collaboration in a rapidly changing political and technological climate. The Information Resources Group provides the competitive IT and knowledge management support services integral to maintaining this advantage. It accomplishes this through the work of three specialized units – Computer Support, Records Management and the Library.

The Computer Support Group administers an extensive, flexible and secure computing and telecommunications network, while Records Management is responsible for site knowledge management, consolidating and maintaining individual and project files.

The Library delivers tailored information solutions to the researcher's desktop, as well as providing personalized training and research services (http://www.cat.csiro.au/qcat/services/library/about.htm).

Human Resources, Finance, and Site Services Staff deliver other specialised services in support of our objective of delivering high quality scientific and industrial research. These highly valued support staff ensure that the people, resources and facilities are managed in order to enable all staff to fulfil their potential.

The design and construction of specialised prototypes is carried out by a comprehensively equipped engineering workshop. An example of their work is an automated system for collecting multiple simultaneous samples of a hot caustic solution from the hydrocyclone rig.

people &

people &

AWARDS AND ACHIEVEMENTS

Dr Nigel Ricketts, of CSIRO Manufacturing Science and Technology, was one of 17 members of the Magmetal Team that received a CSIRO Medal in December 2000. The medal's citation stated that the award was for the development and commercialisation of the Australian Magnesium Process, from its inception in the early 1990s to the successful production of magnesium and magnesium alloys from the AMC Demonstration Plant. The team lead by Dr Ricketts at QCAT has successfully developed a range of molten metal handling technologies that are used by AMC.

Ian Hutchinson of CSIRO Exploration and Mining was a member of a team which received the Award for Technology Transfer from the Cooperative Research Centres' Association. The award was announced on May 15, 2001 at the CRCs' Association Conference. The technology relates to a self-advancing fluid drilling system which can be used in a variety of mining applications. It has the ability to develop tight-radius bends at a coal seam horizon from a vertical hole.

Thressa Rowlands of CSIRO Minerals was part of a team which received one of the CSIRO Minerals Innovation Awards for 2000 for their work on "A Novel Low Frequency Microwave Moisture Analyser." The team developed a low frequency analyser which uses low-cost, high performance hardware originally developed for the mobile telephone industry to improve the measurement of the moisture content of materials. The last stages of development have been supported by Australian Coal Research (ACR) and Blair Athol Coal Pty Ltd, and the first two units will be installed at the Dalrymple Bay Coal Terminal to analyse 30 million tonne/annum of out-loaded coal. A further two units are planned to be installed on the in-loading coal conveyors in 2001.

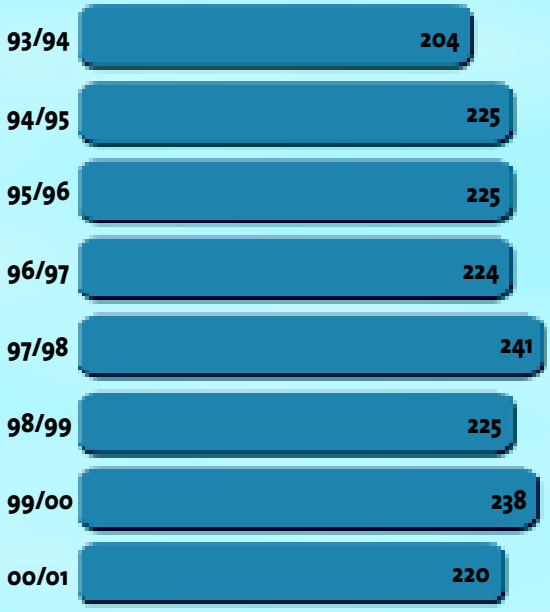
Dr Cliff Mallett of CSIRO Exploration and Mining recently became the first Australian to receive the prestigious Iki Award for distinguished service to the coal industry. The award was made in acknowledgement of his contribution over the years in building collaboration between Japanese and Australian scientific institutions such as CSIRO and the Japan Coal Energy Centre (JCOAL), mining companies and government. Under his leadership, collaborative research projects worth $40 million were established, involving research bodies in both countries. The award recognises a 25-year collaboration in energy research which has brought benefits to both countries, and transferred a significant amount of Japanese R & D activity to Australia.

The recipient of the QCAT Work Achievement Award was Kyle Roggenkamp, for his outstanding contribution to the Centre's public affairs and communications activities during the Stage II construction project. The QCAT Staff Services Award went to Adrian Burger, Andrew Castelden, Andrew Taylor, Steve Reeves, Craig Korn, Daniel Henderson, Douglas Nemeth, John Atkinson, Norm O'Neil and Stephen Peck. These dedicated staff members, in their own time, organised materials and constructed a boardwalk and bridge connecting the eastern carpark with the main site. The completed project significantly enhances staff access to the carpark, and is an excellent example of staff members' contribution to the well-being and morale of their colleagues.

Work at extremely close tolerances was also demonstrated in the Gravity Gradiometry project.

Commissioning of the enhanced facilities delivered through the Stage II expansion is complete, with project staff heavily involved in utilising them. Commercial tenancies for the Technology Transfer Centre are increasing, with plans nearing completion for the re-location of the Secretariat of the CRC for Coal in Sustainable Development. Another recent arrival is Advanced Mining Technologies.

In 2000/2001, QCAT performed 60 research projects with individual budgets over $100K each. The total value of research expenditure exceeded $27M, of which 61% was funded from CSIRO and 39% from government, CRC grants and industry funding.

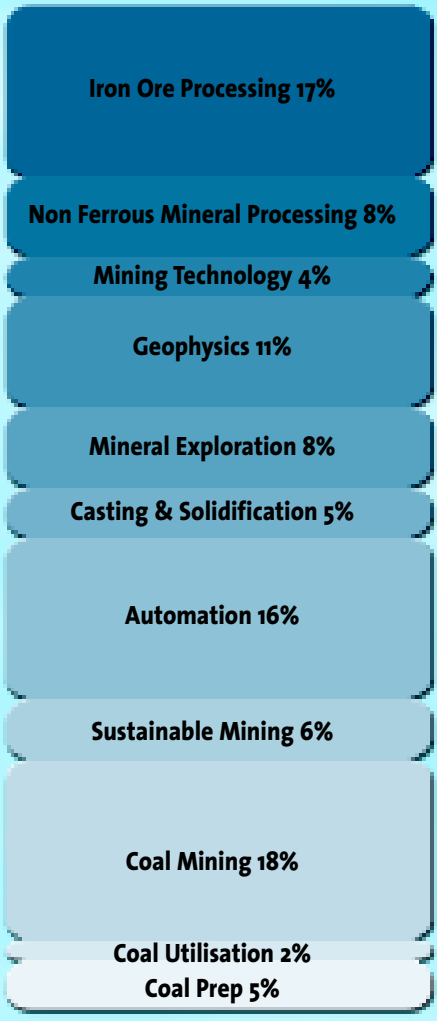


CSIRO QCAT Total Staff Numbers

money

money

CSIRO QCAT Total Research Expenditure



Expenditure by Research Area as a % of Total CSIRO QCAT Budget

CSIRO QCAT Expenditure Breakdown

STEERING COMMITTEE

Dr John G Reid - Chairman
Director
Reid Resource Consulting Pty Ltd

Dr J R Read
Executive Manager
QCAT

Mr D Mason
Acting Executive Director
Minerals and Petroleum Division
Department of Natural Resources
and Mines

Associate Professor D Siddle
Pro-Vice-Chancellor, Research
The University of Queensland

Mr D Whiting
Director, Queensland
Australian Industry Group

Mr B Anker
Director, Emerging Industries Branch
Department of State Development

Professor N Phillips
Chief
CSIRO Exploration & Mining

INTERESTS

Interactions with Industry
ACARP
ACIRL
Advanced Mining Technologies
Applied Mining Technologies
Alcoa
Alpha Geoscience
AMIRA
Anaspec (Sth Africa)
Anglo
Anglo Platinum (Sth Africa)
Aro Mining
Aro Mining
Arup Geotechnics
Auslog Pty Ltd
Auspace
Austrade
Australian Magnesium Corporation
BAE Systems
Basin Minerals
BHP Billiton
BHP Cannington
BHP Coal
BHP Minerals
Boeing
Capricorn Coal
Carbotech-Fosroc-GmbH
Cemex (Mexico)
Central Colliery
Cobra Resources
CODELCO (Chile)
Comalco
De Beers (Sth Africa)

Diamond Composite P/L
Digital
DSTO
Dragline Technologies
Ernest Henry Mining
ETRS
Falconbridge (Canada)
Fractal Graphics
Geological Survey of Norway
German Creek Mines
Glencore
Haheito Coal Mine
Hamersley Iron
Hamersley Pacific (Hong Kong)
Hewlett Packard Honeywell
Hicom International
Hope Downs
ICI Explosives
IM2 (Chile)
Iranian Mineral Processing Research Centre (Iran)
Iscor South Africa
JCOAL
Jorgonson Geological Services
Kalgoorlie Consolidated Gold Mines
Kirktrac
Koolyanobbing Iron
Liquatech
Ludowici Mineral Processing Equipment
Mantek (South Africa)
McArthur River Mining
MIM Exploration
MIM Process Technologies
Mincom
Minserve
Mintek (Sth Africa)
Minera Los Pelambres (Chile)
Mt Gibson Iron
Newport Capital Group
North Limited
Northparkes Mines
Oakleigh Coal Mines
Ok Tedi Mining Ltd
OneSteel
Pacific Coal
Pasminco
Phelps Dodge (USA)
Platinum Australia
Portman Mining
Queensland Metals Corp.
Queensland Rail
Rio Tinto
Robe River Mining
Santos
Scintrex (Canada)
Scitec
SDS Digger Tools
Southern Cross Resources
Stanwell Corporation Limited
Storagetek
Straits Resources
Taiheto (Japan)
Tambruk (Finland)
Tamrock
Tarong Coal
Temco
TSM Resources
UNISEED
Virtuozo Systems
WMC
World Geoscience

Interactions with Education
Australian Academy of Science
Bremer TAFE
Camborne School of Mines
Changsha Institute of Mining
China University of Mining Technology
Deakin University
Falconbridge Technology Centre (Canada)
Griffith University
James Cook University
Julius Kruttschnitt Minerals Research Centre
Kedron State High School
Kyoto University
Monash University
Noranda Technology Centre
University of Nottingham
Queensland University of Technology Physical Sciences
Queensland University of Technology Space Centre
The University of Queensland
University of Adelaide
University of Auckland
University of Chile
University of Liverpool
University of Lulea
University of Newcastle
University of Sydney
University of Western Sydney
University of Utah

Interactions with Government
Queensland Department of State Development
Ministry of International Trade & Industry (Coal Industry Division Tokyo)
Queensland Department of Natural Resources & Mines
Queensland Department of Public Works & Housing
Primary Industries & Resources, South Australia
Geological Survey of Western Australia
Western Australia Department of Commerce & Trade

EXPLORATION AND MINING

- Airborne Gravity Gradiometry
- Geophysical Imaging Techniques
- Nuclear Logging Technologies
- Mine Design
- Open Cut Extension
- Inertisation Practice
- 3D CFD Mine Ventilation Modelling
- Collision Avoidance
- Mine Gas Control
- 3D Photogrammetry
- Location & Monitoring Personnel Monitors
- Automated Underground Haulage
- Strain & Deformation Monitoring
- Microseismic Monitoring
- Top Coal Caving
- Longwall Automation

ENERGY TECHNOLOGY

- Monitoring/Control of Slurry Flows in Coal Preparation Plants
- TurboFlotation
- Size Classification
- Centrifuging Coarse Coal
- Gasification Performance of Australian Coals

MINERALS

- Prediction of Downstream Processing Performance
- Standards Development
- Maximising Lump Production
- Hydrocyclone Classification and Dewatering
- Spiral Separation
- Sustainable Raw Material Preparation
- Integration of Compact and Pot-grate Sintering
- Characterisation of Iron Ores

research projects

research projects

- Gas Control in Coal
- Mine Greenhouse Gas Measurement & Reduction
- Span Stability
- Roadway Development
- Longwall Support Characterisation
- 3D Geological & Geotechnical Modelling
- Highwall Mining - Geotechnics
- Sirojoint/Sirofrag
- Rock Cutting Techniques
- Coal Geology Modelling
- Coal Quality Services & Modelling
- Coal Strength & Fragmentation Modelling
- Mine Scale 3D & 4D Visualisation
- Borehole Logging
- Ground Penetrating Radar
- NUMBAT

- Characterisation of Commercial Manganese Ores
- Beneficiation of Iron Ores
- Sintering of Iron Ores
- Sintering of Magnetite Concentrates
- Agglomeration of Iron Ores
- SAG Mill Monitoring using Surface Vibrations
- HPGR and Fine Grinding of Ores
- QEM*SEM Bureau and Consulting
- QemSCAN Sales

MANUFACTURING SCIENCE AND TECHNOLOGY

- Computer Simulation of Casting
- Squeeze & Semisolid Casting
- Magnesium Production Technologies
- Automation

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