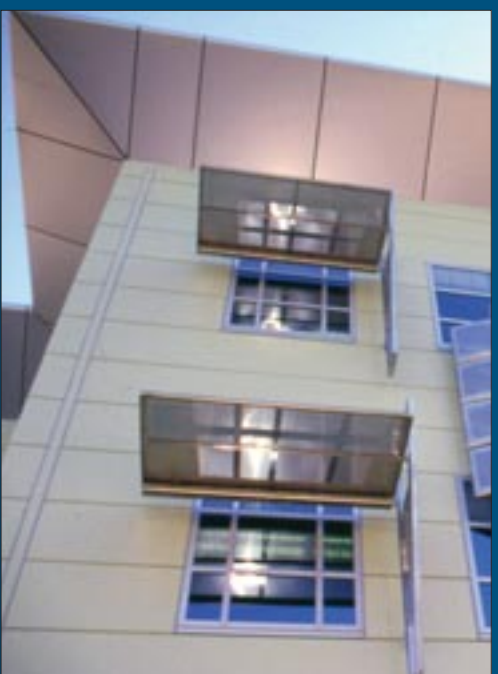
QCAT

Annual Report

QUEENSLAND CENTRE FOR ADVANCED TECHNOLOGIES 2001/2002

CSIRO



QCAT

Mission

The Queensland Centre for Advanced Technologies (QCAT) 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 and Infrastructure Technology

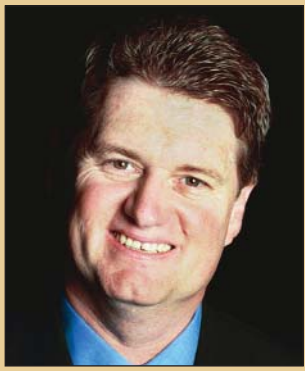
Cooperative Research Centres for:

Coal in Sustainable Development
Cast Metals Manufacturing (CAST)

Commercial Occupants

Advanced Mining Technologies Pty Ltd
Alcan
Applied Mining Technologies
Australian Centre for Mining
Environmental Research Limited (ACMER)
Coal Recovery Australia
CRC for Coal in Sustainable Development
Cutting Edge Technology Pty Ltd
Geotek Solutions
Instinct Television
Jenkins-Kwan Technology Pty. Ltd
Liquatech Turbine Company

FOREWORD



Mining technology, services and equipment are vital to the long-term viability of the Australian minerals industry, which is a major player in the $200 billion per year international resources sector and a principal source of Australian export revenue.

Technology plays a key role in the industry's sustainable development through providing safer, more efficient and cost-effective mining strategies. Innovative research and practical technologies are the foundations on which Australia established its leadership in the global resources sector.

These are also the pillars on which the Queensland Centre for Advanced Technologies (QCAT) was established. Set up as a joint venture between the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Queensland State Government, the Centre delivers world-class research and engineering to the Australian exploration, mining, minerals processing and manufacturing industries.

The benefits of continuing investment in QCAT by both Commonwealth and Queensland Governments have been highlighted again this year by the leading edge technologies and high value products and processes delivered to industry.

QCAT and its unique mix of people and disciplines deliver the mining science that helps keep Australian resource industries ahead of the game.

Hon Peter McGauran MP
Minister for Science

EXECUTIVE MANAGER'S REPORT

The past year has been another year of growth and consolidation for QCAT.

Across 2001-2002 QCAT attracted 61 projects with an expenditure of more than $100,000. The total value of the projects was $25.8 million. As at June 2002, 263 people worked at the Centre.

CSIRO continues to consolidate its leadership role at the hub of science and industry, attracting an impressive group of research and industry organisations to the QCAT site.

In June 2002 the Cooperative Research Centre for Coal in Sustainable Development opened its headquarters at QCAT. The Centre consists of 18 participating organisations, coming from the black coal producing industry, government departments, universities and CSIRO. Its vision is to optimise the contribution of coal to a sustainable future and it will invest $61 million over a seven-year period in pursuit of this.

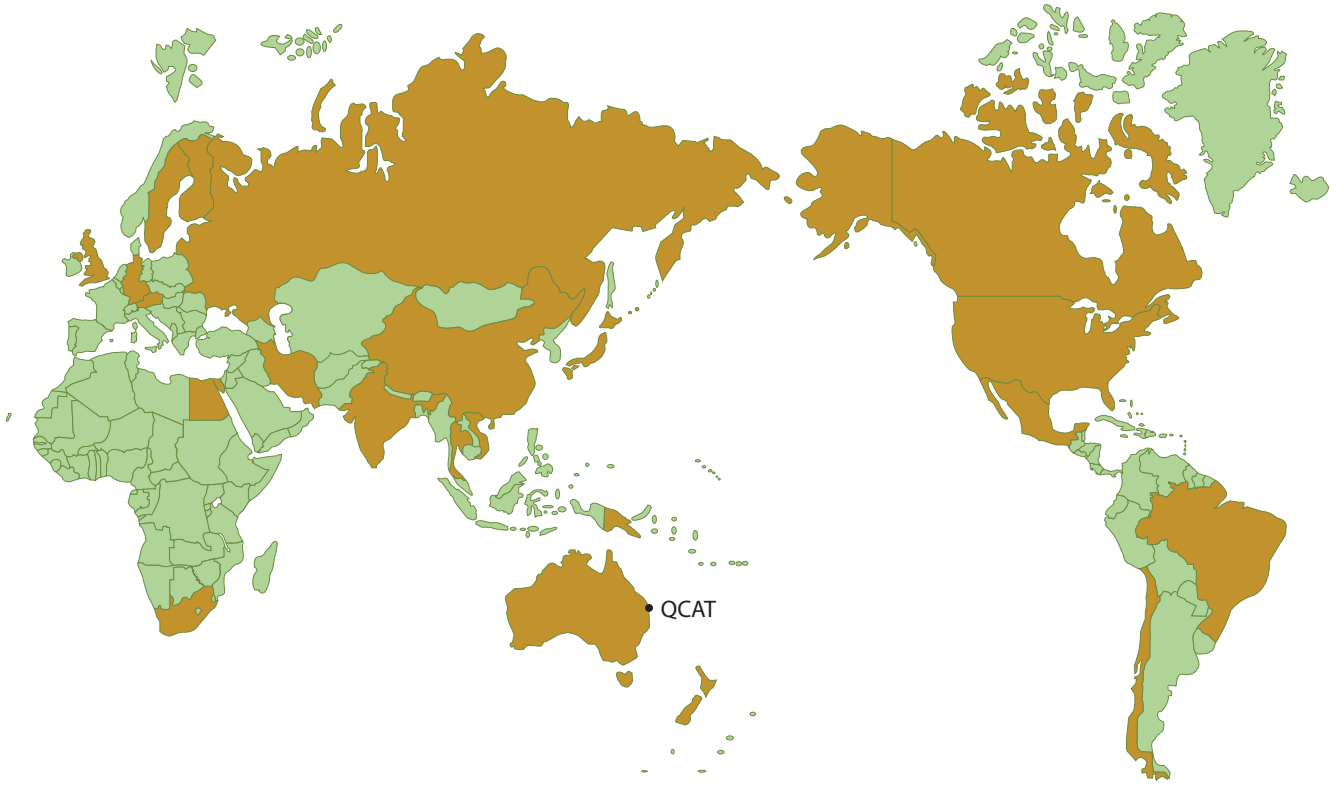
During the year QCAT continued work on a range of innovative and challenging projects in collaboration with industry partners, from assisting the discovery of new world-class mineral deposits that will improve Australia's economic performance, through to procedures to make mining cheaper and safer, and ensuring the continued improvement in environmental performance of the industry.

Although QCAT research focuses strongly on the needs of Queensland industry it is increasingly the subject of considerable international interest. The site is regularly visited by government delegations, trade missions, diplomats and Australian business leaders.

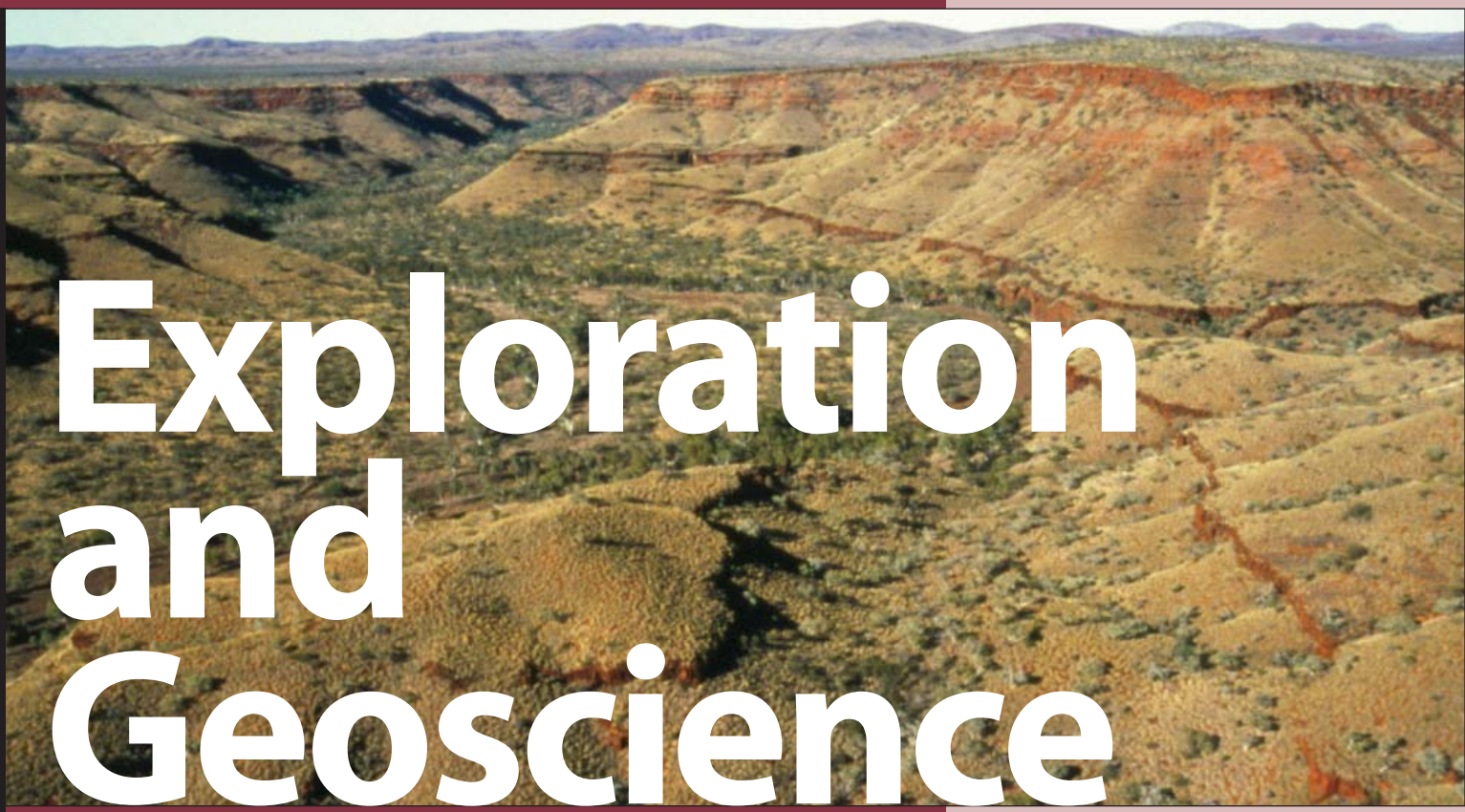
The model of QCAT as a multi-disciplinary site combining industry and science is working. QCAT is a world-class facility, providing real, on-going benefits to the mining, energy and manufacturing sectors.

Dr John Read
Executive Manager
Queensland Centre for Advanced Technologies

INTERNATIONAL INTERACTIONS

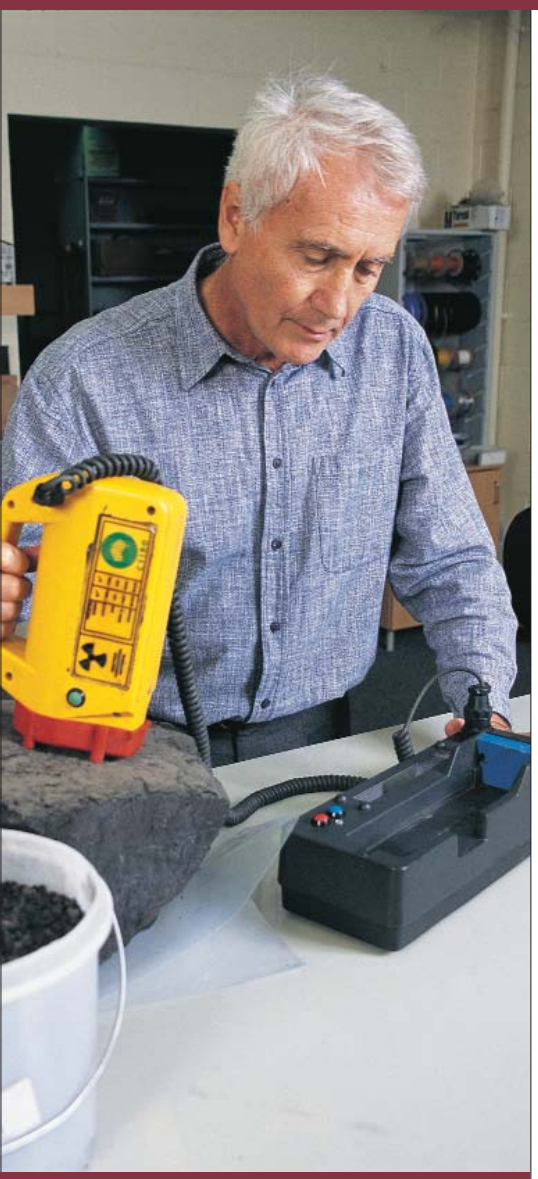


The geosciences are crucial to the wellbeing and future growth of the mining industry. Exploration activities have already found trillions of dollars worth of resources in Australia. Most of the easy surface finds have been made, but we literally have barely begun to scratch the surface. What we find beneath the surface will far outweigh discoveries made so far. Mining activities rely on a comprehensive understanding of the 3D geological picture and ongoing improvements in safety, reliability and cost effectiveness are dependant on improved geological risk management.



Exploration and Geoscience

MINING GEOSCIENCE



Mining geoscience helps piece together the jigsaw puzzle that leads to the effective delineation, assessment, design, extraction and rehabilitation of coal and mineral resources. Its primary focus is the development, demonstration and transfer of new techniques and technologies to assist all areas of the mining industry.

In 2001/02 researchers completed work on the Bowen Basin Supermodel 2000 - a comprehensive three-dimensional study of the geological history of the coal measures in the premier coal producing region of Australia. The Supermodel team integrated survey and minesite data to delineate coal resources and trace the origin of faults, dykes, sills and sandstone channels likely to pose safety hazards and halt production.

Researchers also completed a coal petrography project using reflectogram technology aimed at quantitative coal grain analysis for enhanced coal characterisation. Study continued on investigations into the fundamental causes and potential solutions to the problematic unloading of 'sticky' coal at ports. Coal transported long distances by rail often becomes 'sticky' and difficult to unload. CSIRO researchers are working with the mining industry, coal ports and Queensland Rail to find a solution to the problem.

Spectrometric nuclear logging research continued and several key projects were completed, notably the project evaluating prompt gamma neutron activation analysis (PGNAA) techniques for estimation of sulphur in coal. The SIROLOG system is now able to deliver a comprehensive set of petrophysical and elemental data including ash, density, Fe, Si, Al, Ca and S in coal and overburden. Several projects to demonstrate and evaluate this technique in metalliferous applications were also successfully completed.

Theoretical and applied research in the field of microseismicity associated with mining continued apace throughout the year. Several projects recording and evaluating microseismic events at underground coal mines in Australia and overseas were completed; at Moranbah North mine seismicity linked to fault reactivation associated with longwall mining was categorised and in China an underground installation of microseismic equipment was successfully deployed.

Collaboration with overseas organisations and agencies in Europe, Asia and the Americas continued in 2001/02, with numerous projects involving geological assessment and visualisation, microseismics and spectrometric nuclear logging.

GRAVITY

Research into developing systems to detect the presence of significant ore bodies from the air is one of the largest projects at QCAT. It involves scientists from both CSIRO Exploration and Mining, and CSIRO Manufacturing and Infrastructure Technology.

Airborne exploration has previously been based on combining methods of magnetics, electromagnetics, natural gamma spectrometry and thermal infrared surface spectrometry. CSIRO scientists played an important role in developing all of these technologies. Work at QCAT is now aiming at developing a second-generation airborne measurement system for detecting buried orebodies and geological structures based on gravity measurements. A prototype has already been tested and the group will now focus its efforts on developing techniques for measuring and interpreting airborne gravity gradiometry. The project is on track to produce a second-generation airborne measurement system by mid 2004.

Mining is Queensland's largest export industry. In 1999-2000 alone, mining exports totalled $6.1 billion dollars or 36.6% of total Queensland exports. The sector is currently responsible for around 16,000 direct and 64,000 indirect Queensland jobs. Mining has evolved into an extremely sophisticated, 21st century industry and Australia is a global leader in developing new technologies. Australia also supports a mining technology services industry of $3.1 billion. The mining and services technology is science-based, backed by know-how built on vast experience. Modern computer and communication technology is used throughout for mathmatical modeling, mine design and control and optimisation of all process stages.

Mining

CSIRO Exploration and Mining and CSIRO Manufacturing and Infrastructure Technology work together to provide applied technology solutions to major issues confronting the coal and metalliferous mining industries.

COAL MINING

Queensland is the largest single seaborne coal exporting province in the world, shipping 104.79 million tonnes in 1999-2000. Queensland has coal reserves for several hundred years – a wonderful resource that can provide energy in many forms for centuries if the industry can adapt to the changing needs and demands of contemporary society.

QCAT scientists and engineers have made significant inroads unto developing safer and more efficient approaches to coal mining. Major new research has begun at QCAT into longwall automation and communication risk mapping systems. Further research into optimising mine design, lowering pit costs and reducing geotechnical risk in mining operations has also been undertaken.

The ACARP longwall automation project started in July 2001. The project involves developing automation techniques that allow for a longwall face that will operate automatically within pre-defined parameters to enhance health and safety and production consistency, lowering operating costs and improving the return on capital.

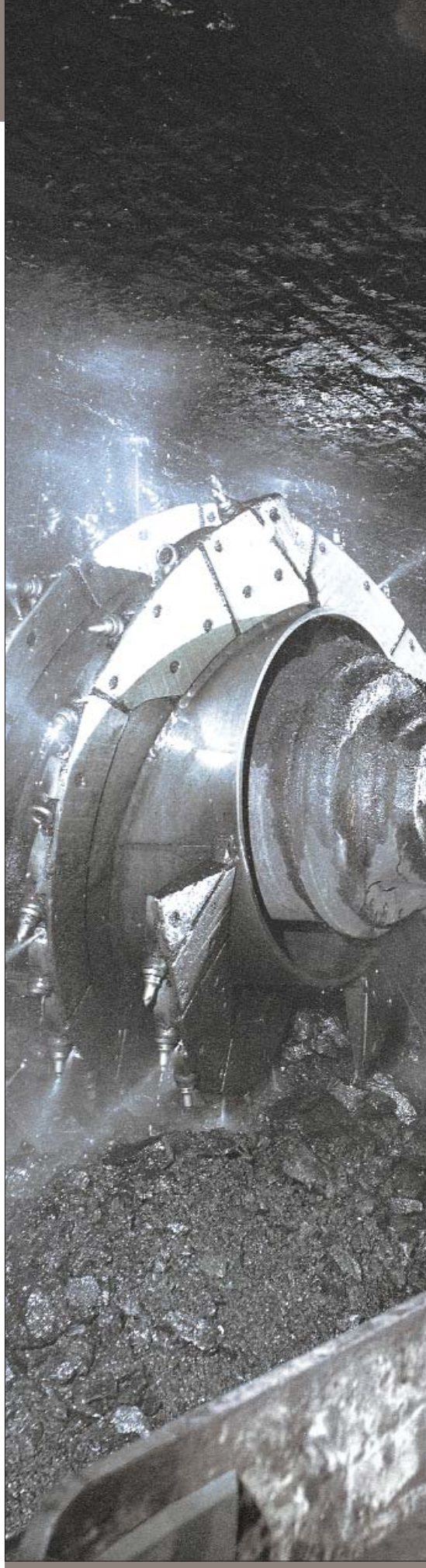
The Rapid Roadway Development Project has completed construction of the autonomous conveying-bolting module (ACBM), which is being prepared for underground trials. The system will improve the productivity and safety for building access roadways in longwall operations.

In 2001/02 a number of other new projects were initiated. A project to better control gas in underground coal mines will significantly improve their safety and viability. The team is developing a wide range of tools and methods for managing gas in coal mines, with a particular emphasis on industry applications and utilisation.

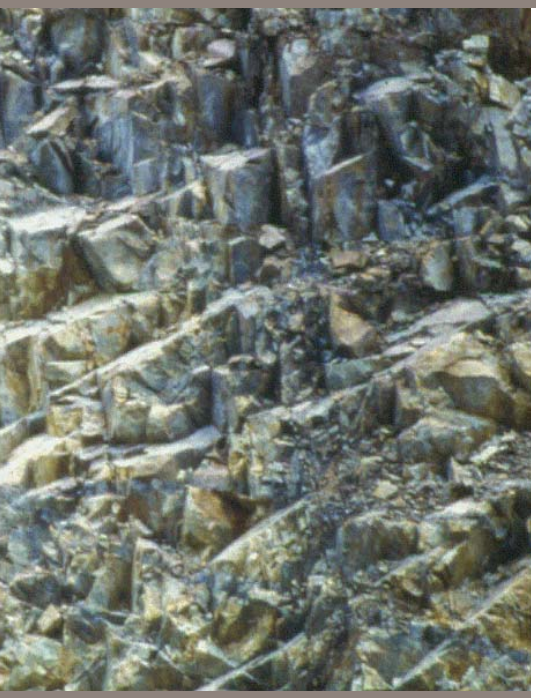
Work began in April 2002 to develop a comprehensive low cost 'quantitative 3D highwall risk mapping system' that will enable rapid visual 3-D characterisation of rock-faces into risk domains.

Research into developing a new communication and risk management system for mine ventilation, strata control and emergency response began in May 2002, in conjunction with industry partners JCOAL and Anglo Coal. The system – to be demonstrated in three examples at a test mine - allows for real time risk analysis.

Work also started in May 2002 on producing new drilling equipment for enhanced coal seam methane recovery.



METALLIFEROUS MINING



Queensland has a wealth of mineral bodies with nearly 30 different mineral commodities ranging from bauxite to zinc mined in the state.

Metalliferous mining research at QCAT includes work in rock cutting, geomechanics, automation and new mining techniques. These activities involve staff from CSIRO Manufacturing and Infrastructure Technology and CSIRO Exploration and Mining.

Several new projects were initiated in 2001/2002 and substantial progress was made on projects already underway. Two prototype automated underground loader systems were established – one at Olympic Dam and one at Northparkes Mine. Both systems are performing well in trials.

Negotiations are also underway with collaborative partners to fully develop and commercially implement the Remote Ore Extraction System project. The future development and implementation of this system could for the first time allow remote control of the complete cycle of drilling, blasting and recovering the ore.

The Vertical Opening Inspection System equipment and software being developed will allow stabilised images of shafts and open stopes to be assessed and monitored for safety and operation purposes.

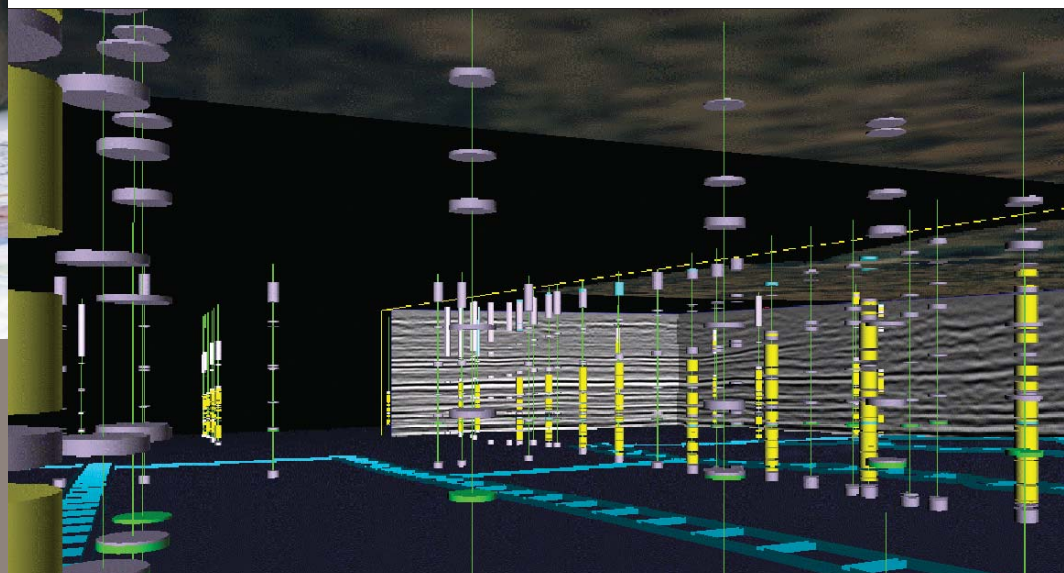
Development of the SMART*CUT technology continued, with CSIRO actively exploring commercial opportunities to take the technology to the market. This will provide long-lasting cutting material for retro-fit to existing mining machines that will make rock-cutting in hard-rock mines feasible.

Work is continuing at QCAT to develop three-dimensional imaging systems primarily for applications in the mining and construction industries.

These systems allow miners, engineers and others to 'see inside' the ground by providing real time computer models of ore bodies and other areas of interest. It can improve safety and productivity and is used in applications such as the analysis of rock mass structure for geological and geotechnical assessment. The ability to deliver

MINING SUPPORT

improvements in mine design, safety and productivity means that these systems will become an integral part of mining and construction. They can also be used in the automation of mining equipment. Even the most remote minesite can feed data into the model at QCAT and receive back an updated model of their mine via the web.



Innovative and effective processing of Australia's mineral wealth is essential to the industry. Researchers at QCAT are conducting research and development to assist the industry in Australia and overseas.

Processing

IRON-ORE PROCESSING

Australia's iron ore industry is facing major challenges from the continuous pressure on commodity prices, increasingly stringent environmental regulations, and the need to reduce capital and operating costs. New orebodies are being mined to expand production capacity and to replace orebodies that are being depleted. New products are being introduced to the market as the push for further downstream processing continues.

QCAT-based researchers with CSIRO Minerals assist the industry to meet these challenges by developing better methods for ore characterisation, beneficiation and agglomeration.

Sintering and pelletising research continued in 2001/02 using QCAT's state-of-the-art sintering facility. Upgrade work on a smaller sintering facility also took place. The improved smaller-scale sinter rig allows for more cost-effective evaluation of new orebodies by mining companies. In addition, a pilot-scale pelletising facility has been installed at QCAT and is currently being commissioned.

Research work also focused on optimising the design and operational efficiency of equipment and plants, and improving the capability of sinter plants in coping with increasingly stringent regulations on dust emissions. Research into reducing emissions at source is aimed at significantly reducing or eliminating expenditure on expensive gas cleaning systems.

QEMSCAN

Based on a LEO scanning electron microscope, QemSCAN improves the ability of miners and mineral processors to optimise their operations. Using CSIRO's QEM*SEM technology, it provides rapid mineralogical analysis that can identify problems not easily detected using traditional chemical assays. This is particularly important with lower grade ores and ore bodies that are processed to yield multiple products.

In 2001/02 five QemSCAN systems were sold around the world. They went to Anglo Platinum in South Africa, Phelps Dodge in the United States of America, CVRD in Brazil, IMPRC in Iran and Rio Tinto in Melbourne.

The purchase by Rio Tinto was their second system. The group will develop and further commercialise the technology. It also provides a mineralogical consultative service to the Australian and international mining, mineral and exploration industries.

COAL PROCESSING

QCAT-based researchers from CSIRO Energy Technology's Coal Preparation Group are working with the coal industry to improve the quality and cost attractiveness of Australian coal on international markets.

Supported by the Australian Coal Association Research Program (ACARP), and the coal producers themselves, the group is developing an intelligent plant system using hardware and software that will allow a processing plant to know its current operational performance in real time and how it compares to optimal standards. This will improve efficiencies and long-term operating costs in coal production plants

Researchers are also attempting to identify factors controlling the efficiency of fluid recovery, partition curves and magnetite recovery.

Work also began in July 2001 on exploring the potential of Electrical Impedance Spectroscopy (EIS) as a new tool for monitoring unit operations in coal preparation plants, and new capabilities for optimising plant performance.

The manufacturing industry contributes over $10 billion to Australia's export earnings. Work conducted at QCAT benefits the manufacturing industry by supporting and anticipating industry needs and by providing the resource and knowledge bases for technological advance.

Manufacturing

CASTING & ALLOYS

Research and development at QCAT by CSIRO Manufacturing and Infrastructure Technology scientists looks at productivity, performance and quality concerns in the die casting, automotive and mining industries.

The research focus at QCAT is on developing leading edge technologies for casting magnesium and producing magnesium alloys.

Magnesium has a density of about 65% that of aluminium and 25% that of cast iron, which makes it a very lightweight metal with significant advantages for use in engine components. Because traditional magnesium alloys do not have the strength to function at high temperatures or under the stresses required of modern automotive engines, QCAT scientists are focusing on strengthening the alloys so they can be used in ordinary car engines. Their ultimate aim is to provide lightweight metals with sufficient strength to meet industry needs. The value to Australia if the world's car manufacturers switched to magnesium engine blocks would be immense.

In conjunction with the University of Queensland, the Cooperative Research Centre for Cast Metals Manufacturing (CAST), a German foundry, and the Australian Magnesium Corporation, the scientists have developed alloy additions and heat treatment schedules, and cast a prototype lightweight engine block. Bench trials started in late 2001.

During the year, the group conducted successful trials on their cover-gas melt protection system for the United Kingdom's Magnesium Elektron.

The group has also produced a database of fatigue properties for a range of sand cast and high pressure die cast alloys, and a quality control document indicating acceptable defect sizes for the foundry industry.

Researchers are continuing to develop methods for measuring and improving the refining of magnesium, and to reduce its impact on the environment.

Further enhancing their association with the Australian Magnesium Corporation, CSIRO scientists continued working this year on developing magnesium casting, melt protection and refining technologies to assist in magnesium production at the corporation's Stanwell Magnesium Smelter.

Research into coal utilisation at QCAT includes assessing gasification and the performance of coal when it combusts. The ultimate goal is to improve efficiencies and reduce emissions.

Energy

COAL UTILISATION

As part of the CRC for Coal in Sustainable Development, CSIRO Energy Technology is conducting research using an advanced gasification facility at QCAT. The gasification facility is used to evaluate the performance of Australian coals at the high temperature, high-pressure conditions of advanced power generation processes. It provides ready access to the detailed technical information required to introduce and support coals in new domestic and international markets, based on high efficiency coal utilisation processes.

Ongoing research at QCAT looks to define suitable coal test procedures and equipment for the evaluation of Australian coals for utilisation in entrained flow Integrated Gasification Combined Cycle (IGCC) power generation. The aim is to provide technical data and expertise to assist the Australian electricity industry to reduce the risks in selection and implementation of advanced power generation technologies.

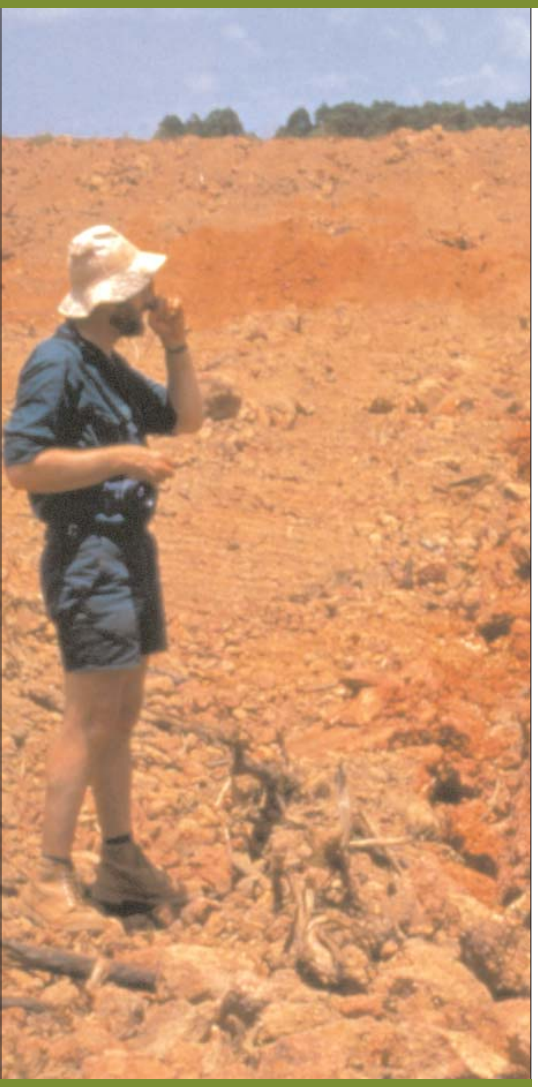
The work is designed to make QCAT a recognised centre of excellence with the necessary facilities and expertise for the evaluation of coals for advanced technologies. It will also provide technical data to support coal selection and marketing in emerging high efficiency power generation technologies.

Technical capabilities and facilities are also being established to evaluate fuel and energy strategies to help develop and implement sustainable energy conversion technologies.

The Australian minerals industry is critical to the country's economic and social well-being. Without a viable minerals industry we cannot maintain the social, economic and environmental processes that underpin sustainable development. The industry's long-term future however rests not only on how it responds to this century's economic challenges, but also how it responds to the challenges of sustainable development. Research at QCAT provides the industry with strategies and technologies for developing sound sustainability practices - minimising the effect of mining on the environment, and rehabilitating the landscape.

Environment

MINE SITE REHABILITATION



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

ACMER is based at QCAT and pursues its role through research, technology transfer, advisory services and facilitation of stakeholder forums. It also provides significant training to people working in the field.

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

In 2001/02, ACMER undertook a number of new research projects, two of which involved CSIRO.

In partnership with CSIRO and Environment Australia, ACMER produced the Practical Guide to the Application of the Australian and New Zealand Guidelines for Fresh and Marine Water Quality, giving the minerals industry a guide to enable it to effectively manage water quality.

CSIRO and ANSTO collaborated with ACMER to determine the reasons for the deterioration of the Rum Jungle uranium mine waste rock dump cover.

During the year, ACMER conducted the Fourth Australian Workshop on Native Seed Biology for Revegetation and a major workshop on the new ANZECC/ARMCANZ Water Quality Guidelines, in addition to seven short courses on a range of topics. ACMER also facilitated a major workshop in Indonesia to identify strategies to enhance Indonesia's capabilities in mining environmental management.

SUSTAINABLE MINING

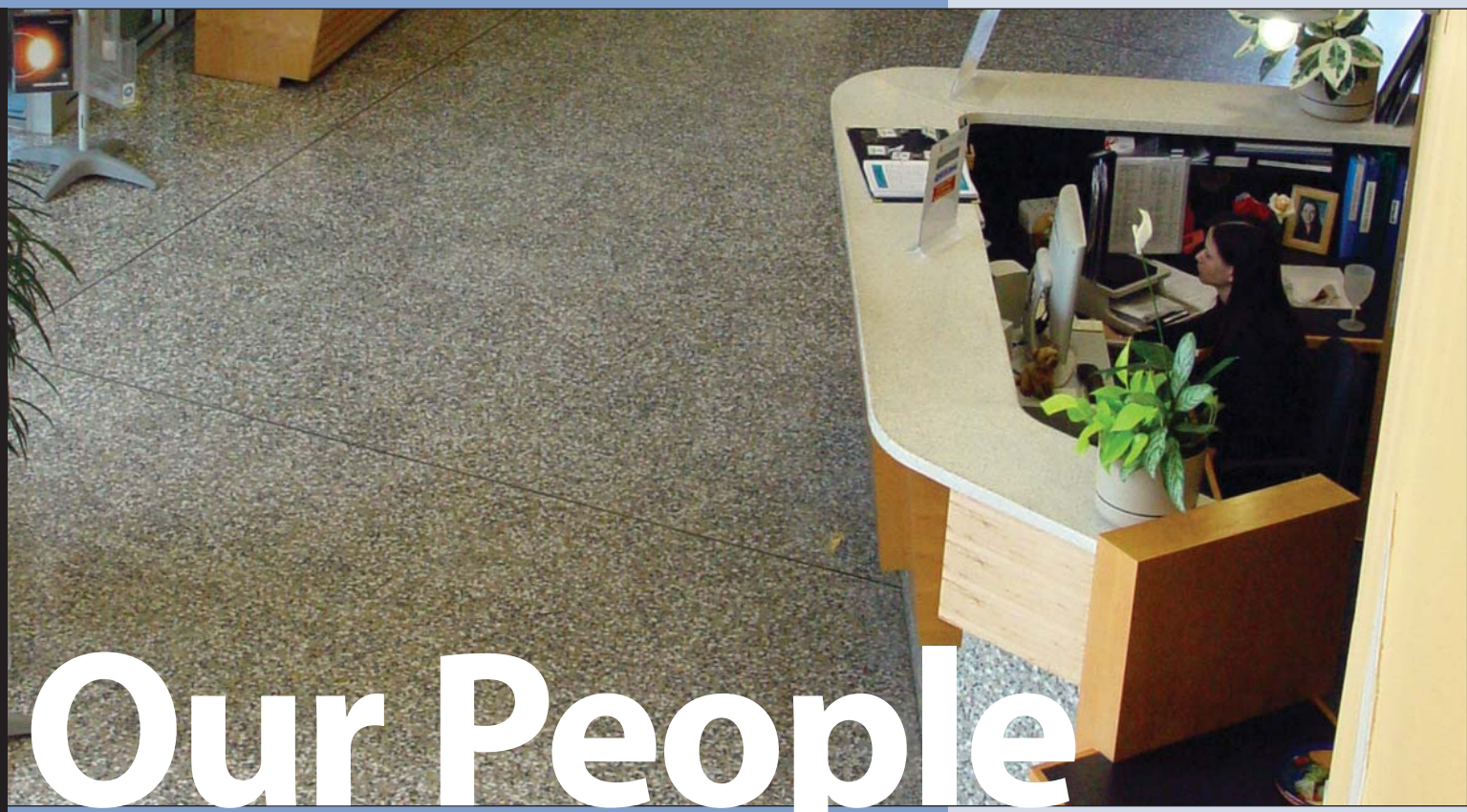
Research at QCAT into sustainable mining focuses on issues that assist mineral and energy companies to protect and enhance their operations – safety and health, environmental management and social integration.

Social management uses technology to address specific hazards in mines associated with vehicles, ventilation, explosions, fires, strata instability and emergencies. It also works with safety management systems that deliver safer conditions in operations. Environmental management concentrates on greenhouse gas mitigation, and has evolved from investigation of greenhouse gas sources to mitigation technologies. It also looks at the environmental aspects of post-mining land use. Social integration looks at better resource use and social issues in mining dominated communities.

During 2001-2002 much of the work at QCAT has concentrated on greenhouse gas mitigation. This focuses on the mitigation of fugitive gases that either come from the coal or are generated by spontaneous combustion of coal in mine wastes.

Work also continued on developing new cleaner forms of energy from coal based on underground coal gasification. Underground coal gasification works by using various grades of coal (including some grades that can't be used otherwise) to make liquid fuels to power Australia. This can be the basis of new synthetic liquid fuels and chemical industries for Australia, with net greenhouse gas benefits.

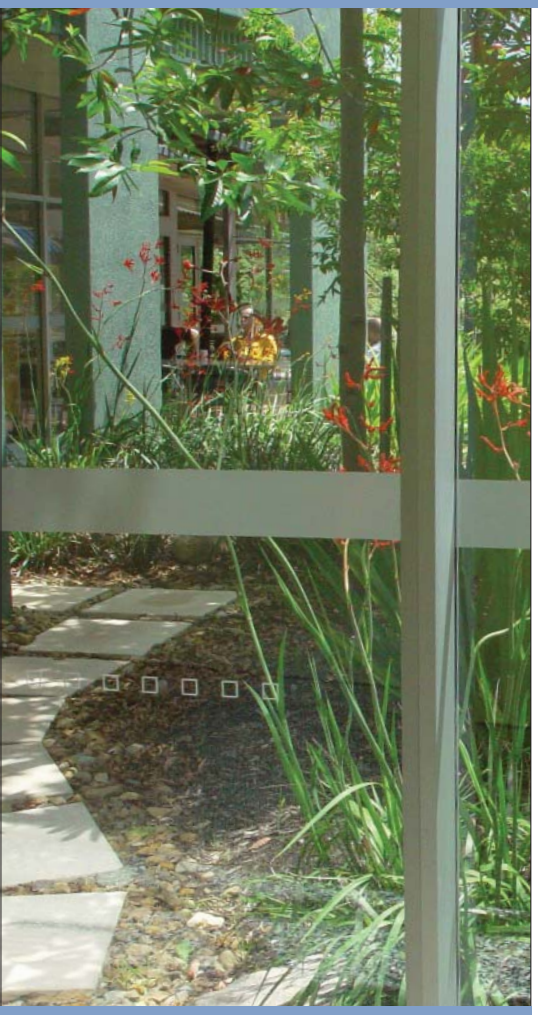
Behind the innovative science and technology researched and developed at QCAT is a dedicated team of staff employed in a wide range of professions.



Our People

- **Commercial occupants**
- **Site conservation**
- **Research and support**
- **Awards**

COMMERCIAL OCCUPANTS



As part of the mission to establish QCAT as a centre for excellence in the mining, manufacturing and energy industries, the site has a purpose-built centre for commercial occupants.

QCAT hosts a number of commercial tenants. Most are housed in the purpose-built Technology Transfer Centre. The Centre, which opened in 2000 as part of QCAT's Stage 2 expansion, provides commercial space for technology-based companies. It provides them with the opportunity to set up with like-minded companies and develop synergistic relationships with CSIRO.

Work conducted by some of QCAT's commercial occupants includes developing high accuracy navigation systems, engineering geology, television production, environmental research, coal research, design and manufacture of underground auger mining systems, and the development of new power generation technologies.

CURRENT COMMERCIAL OCCUPANTS:

Advanced Mining Technologies Pty Ltd

Alcan

Applied Mining Technologies

Australian Centre for Mining Environmental Research Limited (ACMER)

Coal Recovery Australia

CRC for Coal in Sustainable Development

Cutting Edge Technology Pty Ltd

Geotek Solutions

Instinct Television

Jenkins-Kwan Technology Pty. Ltd

Liquatech Turbine Company

SITE CONSERVATION

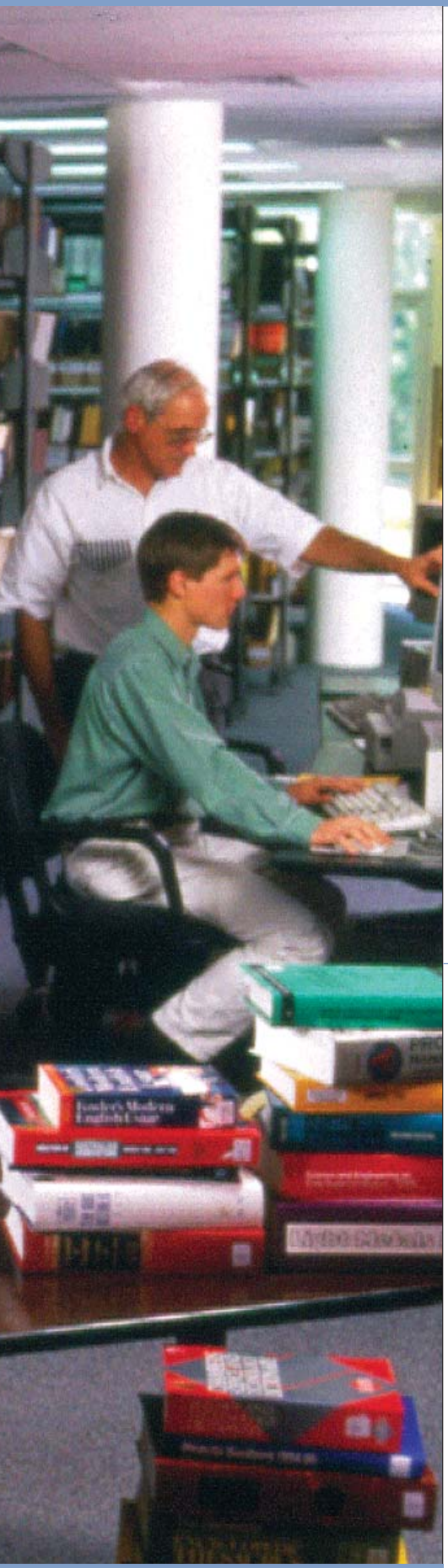
QCAT prides itself on its commitment to the environment. As part of that commitment, a number of staff have worked to preserve a creek running through the site.

The creek is surrounded by original vine forest that is uncommon in the area.

It is also rich in local flora and fauna, providing an ideal wildlife corridor from the Brisbane River to Brisbane's Forest Park.

Staff have conducted scores of working bees to clear out weeds and plant more than 280 native trees. It is now listed as a Land for Wildlife project.

RESEARCH AND SUPPORT



In 2001-2002 QCAT attracted 61 research and development projects with a budget of more than $100,000. The total value of these projects was $25.8 million. Working on these projects and other enterprises are scientists, engineers, programmers, and technical and research support staff.

In line with its mission to create a competitive advantage for Australia's mining, energy and manufacturing industries, the majority of the 263 CSIRO staff working at the Centre were engaged in research and development activities.

Alongside those people are a range of personnel providing support, production and logistics.

The Information Resources Group provides competitive and comprehensive information technology and knowledge management support services through three specialised units – Computer Support, Records Management and the Library.

The Computer Support Group manages an extensive, flexible and secure computing and telecommunications network. Records Management is responsible for site knowledge management, and consolidating and maintaining individual and project files. The Library provides traditional information services while also delivering tailored data to researchers' desktops and personalised training and other research services.

Human Resources, Finances and Site Services staff deliver other specialised services in support of QCAT's primary objective - high quality scientific and industrial research.

Specialised design and construction work is carried out by a comprehensively equipped engineering workshop.

AWARDS

A number of QCAT staff were acknowledged with awards for their efforts during the year.

Dr Rao Balusu won the *Australian Coal Association Research Program (ACARP) Research Excellence Award* for his work on optimisation of inertisation practice, (underground category). Dr Balusu and his team won the *Iki Award (Japan)* for work on mine gas control.

The Coal Mine Geology and Minescale Geophysics groups won the *Leichhardt Award* for original contributions to the advancement of coal geology in Queensland.

Mr Graham O'Brien and Mr Barry Jenkins, (Jenkins-Kwan Technology), won the *Australian Coal Association Research Program (ACARP) Research Excellence Award* for the development of automated full phase maceral reflectograms and for the coal grain analysis project, (coal utilisation category).

Dr Cliff Mallett won the *Iki Award (Japan)* for contributions over the years in building collaboration between Japanese and Australian scientific institutions such as CSIRO and the Japan Coal Energy Centre, mining companies and government.

STEERING COMMITTEE

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

Dr J R Read
Executive Manager
QCAT

Ms Mary Worthy
Acting Executive Director
Minerals and Petroleum Division
Department of Natural Resources and Mines

Prof David Siddle
Deputy Vice-Chancellor (Research)
The University of Queensland

Mr David Whiting
Director, Queensland
Australian Industry Group

Mr Brian Anker
Director, Emerging Industries Branch
Department of State Development – DSD

Ms Amanda Wilson
Qld Department of State Development

Prof Neil Phillips
Chief, CSIRO Exploration & Mining

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CSIRO
Energy Technology

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