

## MLA installed base continues to expand

The past three years has seen significant expansion in the installed base of MLA systems.

At the end of 2002 there were six systems installed. Based on current orders, the installed base at the end of 2005 will be twenty three.

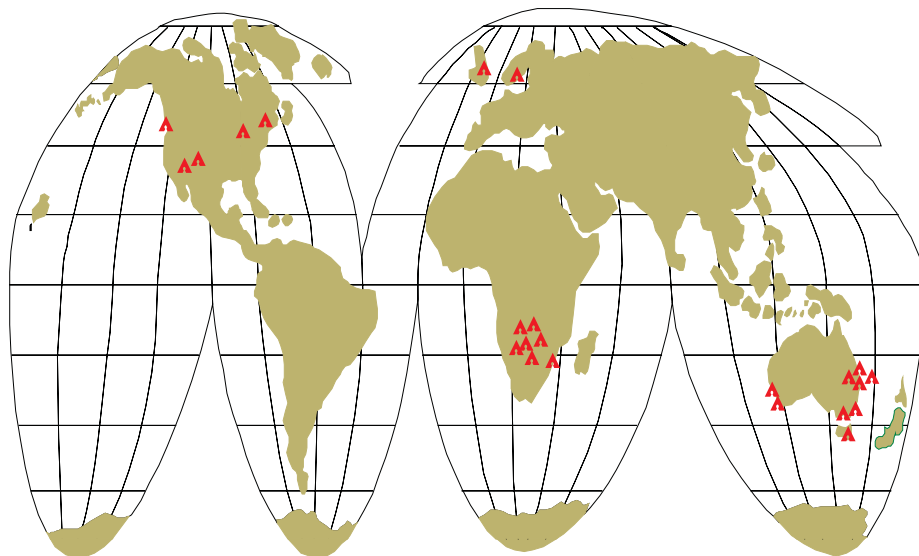
JKTech Managing Director Dr Geoff Gault said that he was pleased with the growth in the number of systems, particularly in geographic terms: "In those three years, installations have been undertaken in South Africa, Canada, USA, United Kingdom, Australia - and very soon - Finland."

Dr Gault said the support for the MLA technology from major international mining companies, from universities and from other mineral testing facilities has been tremendous.

MLA installations undertaken in the first half of 2005 have been at the University of Nottingham in the UK, at the University of Tasmania in Australia, and at the Memorial University of Newfoundland in Canada.

Installations in the second half of 2005 have been carried out at Kennecott Utah Copper in the USA and at BHP Billiton's Nickel West Perth office - formerly WMC Resources. Richards Bay Minerals in South Africa and the Geological Survey of Finland are scheduled for October.

When the 2005 orders are delivered and all the twenty-three units are in place, JKTech will have a significant worldwide installed base of quantitative mineralogy systems.



▲ North America:

Teck Cominco, Trail, British Columbia  
Inco, Toronto  
Memorial University of Newfoundland  
Kennecott, Utah Copper Corporation, Utah  
Newmont, Denver

▲ Europe:

Geological Survey of Finland,  
Outokumpu, Finland  
University of Nottingham, UK

▲ Australia:

JKTech, Brisbane (4 units)  
Rio Tinto, Bundoora  
BHP Billiton, Newcastle  
BHP Billiton Nickel West, Perth (2 units)  
University of Tasmania, Hobart

▲ South Africa:

Anglo Platinum (5 units) Johannesburg  
Mintek, Johannesburg  
Richards Bay Minerals

## New MLAs add strength to JKMRC program



Team members gather around the third MLA Unit, installed at the JK Centre in July 2005. From back left are Will Futcher, Esther Soden, Sharon Malit, Priyanthi Hapugoda, Debra Burrows, Timon Missen, Jieshi Tong, Kai Riilioja, Khoi Nguyen, and seated from left are Ying Gu, Kurt Moeller and Eugene Louwrens.

JKTech's third MLA system was commissioned in July 2005 in response to an increased demand for client sample processing and analysis through the JKMineralogy service which has doubled since 2004. This system was installed in support of the on-going strategic relationship with FEI Company and the Australian representative nanoTechnology Systems Pty Ltd.

By the end of 2005, a fourth MLA system will be installed at the JK Centre in preparation for an intense JKMRC research program based around MLA technology in 2006, together with the development activities and training needs for the MLA system.

Among the planned projects is the integration of the JK's award winning flotation optimisation methodology into the MLA framework for flotation plant diagnostic work.

Mineral flotation specialists such as former Rio Tinto senior researcher Dr Elaine Wightman recently joined the flotation research team. Elaine and others in the flotation group, together with Cathy Evans in the AMIRA GEM<sup>III</sup> project, are likely to play a leading role in MLA-oriented research. Clearly the JKMRC is strengthening its research capability around the MLA, and the addition of new MLA systems at the JKCentre in 2005 adds to that strength.

## Nitro-free first for Canadian university

A university-based research group funded via Canadian miner Inco has become the first recipient of a liquid nitrogen-free detector on an MLA unit.

The Inco Innovation Centre at the Memorial University of Newfoundland in St Johns can claim a world first at the successful commissioning of the detector, assisted by



The Roentec silicon drift detector is a new and important attachment, pictured at the right of this scanning electron microscope, negating the need for liquid nitrogen to operate the MLA system.

MLA Group Manager Dr Ying Gu and the group's senior MLA technologist Kurt Moeller.

Until the commissioning of the MUN detector in mid-2005 there had not been a commercial MLA system anywhere in the world that didn't use liquid nitrogen.

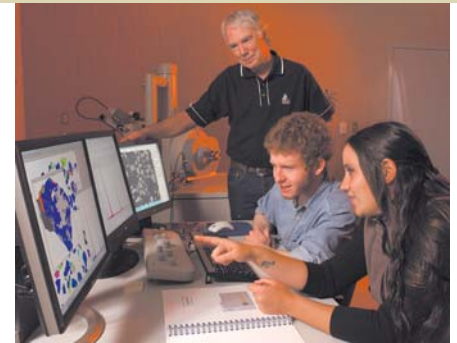
According to JKTech Managing Director Dr Geoff Gault, this development is a major step forward in MLA technology offering the prospect of increased portability of the system for remote location applications as well as the benefits of lower operating costs and ease of operation.

"You don't have to buy liquid nitrogen to operate this MLA," he said. "As well as being much less of a hassle, the major advantage for such on-site systems is that you don't need to rely on shipping and storing liquid nitrogen."

MLA group manager Dr Ying Gu said the detector was made by Roentec in Germany.

Lower maintenance, lower cost and increased speed are all benefits of Roentec's silicon drift detector when compared with the more conventional silicon lithium detector, which requires the use of liquid nitrogen in its operation.

Dr Gu said he had fielded many enquiries about the detector from operations looking to take their mineral analysis function to



Memorial University of Newfoundland claim a world first with the successful commissioning of a liquid nitrogen free silicon drift detector on their MLA Unit. Pictured standing is MUN's MLA Laboratory Coordinator Michael Shaffer with graduate students from MUN.

remote locations where transportation and storage of liquid nitrogen would be a potential burden.

"Liquid nitrogen free MLA detection could prove very popular in remote mining operations," Dr Gu said.

The project commenced at MUN's request in early 2004 after they approached JKTech to consider looking at the possibility of adapting the silicon drift detector to an MLA unit.

Dr Gu pointed out that SEMs in other industries have used similar detectors, but this was the first time a detector without the need for liquid nitrogen had been applied to the MLA.

## Retrofit market takes off

With the worldwide interest in MLA technology growing steadily, but not all operations readily able to buy the full kit of equipment, JKTech is taking the initiative to have MLA software and accessories retrofitted into existing scanning electron microscopes (SEM).

The first retrofitting exercise occurred at Inco in Toronto during 2004, where everyone concerned was very impressed by the ease of the retrofit.

In the Inco example, the eight-year-old SEM predated the advent of MLA technology by a few years.

MLA Group Manager Dr Ying Gu said MLA retrofitting made it easier for new users to take on the technology without a huge expense to start with.

At Inco, Dr Gu made a routine installation of the MLA software, with a few minor adjustments, and the SEM was running in MLA-mode almost immediately.

"This was an enormous result achieved in a very short time," he said.

The MLA allows for sample processing to be automated, rather than using the manual orientation processes of a standard scanning electron microscope.

Dr Gu said MLA software was adaptable to all major SEMs in use, anywhere in the world.

"Standard MLA hardware incorporates the FEI Quanta series SEMs. Retrofitting will give users of other makes entry into automated mineral liberation analysis," he said.

Inco Technical Services Research Mineralogist Dr Fred Ford said the decision to retrofit Inco's existing JEOL6400 scanning electron microscope was made for two reasons.

"The first was to gain access to MLA technology and the second was to gain maximum benefit

from existing equipment," Dr Ford said.

"Our retrofit was completed over a one-week period, and having twenty years experience with SEM technology, I secretly anticipated some major challenges - however the installation was relatively uneventful."

Dr Ford said the team encountered one major software issue, which was quickly resolved overnight by the programmers at JKTech.

"By the end of the week, we had most major measurement modes functioning."

Dr Ford and the Inco team immediately put their new MLA tool to the test with an 'aggressive' commissioning study.

"We decided to undertake a complete mineralogical survey of Clarabelle Mill, the main Sudbury concentrator," he said.

"The results from this survey are some of the finest mineralogical data I have ever laid eyes on, and I have used several systems to date."

The Inco team say they are now doing more liberation work than ever before.

# Shiny future for world coal with Australian-based systems integration

Two of the world's most advanced mineral analysis systems are about to be merged, potentially influencing the way in which the global multi-billion dollar coal mining industry will assess its product for sale and export.

By the end of the decade after an extensive research program and followed by industry trials and uptake, coal could be assessed using the most advanced analytical technology yet seen.

The ramifications and value of an Australian Coal Association Research Program (ACARP) project involving the University of Queensland's JK Centre and industry consultants Jenkins-Kwan Technology can't be understated, as work begins on the integration of two of the mining industry's most sophisticated mineral analysis systems - MLA and MACE<sup>®</sup>300.



MLA Group Manager Dr Ying Gu, left, with the Directors of Jenkins-Kwan Technology Pty Ltd Barry Jenkins and Henrietta Kwan discussing the integration of the MLA with MACE for 3-D coal analysis.

The ACARP project "Integration of Light and Electron Microscope Coal Petrography Methods" will take coal analysis to a new level producing technology with greater capabilities than any current system operating in the world.

A large part of the research and development will be done at JKTech in Brisbane using a newly commissioned Mineral Liberation Analyser (MLA), which is the third unit of its type brought into service at the JK Centre.

The MLA analyzes inorganic components of a coal sample while the Minerals and Coal Evaluation System - MACE<sup>®</sup>300 - analyzes the organic components. The strengths of the two systems will be brought together using image fusion technology.

Leading the project is ex-CSIRO researcher Dr Barry Jenkins, principal of Jenkins-Kwan Technology Pty Ltd who specialises in automated light microscopy, a key feature of the MACE<sup>®</sup>300 system.

"Our light microscopy methods can analyse the organic constituents of coal in great detail, but we can't do a comprehensive analysis of the minerals present," Dr Jenkins said.

The ACARP-sponsored project essentially represents the coal industry's desire to merge the MLA and MACE systems into one which will then provide a world-first system for analysing coal and coal products.

The Jenkins-Kwan Technology system was originally designed to automate the manual coal petrography tests applied to export sales of coal and meets the required international standards set for petrographer accreditation.

Dr Jenkins said the accreditation process, controlled by the International Committee for Coal and Organic Petrology (ICCP), provided his company Jenkins-Kwan Technology with a valuable opportunity to compare MACE results with those of the world's best coal industry petrographers. It also pointed to ways for continuous improvement of the system.

"Many new capabilities have been added to the system which can now perform a range of unique tasks for industrial, consulting and research activities," he said.

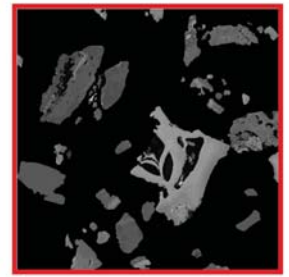
Coal has a very low atomic number so electron microscopy - as used by the MLA - is not ideal on its own for analysing coal and its constituents.

"But with MACE, the MLA potentially becomes a powerful analytical tool for coal," Dr Jenkins said.

MACE essentially creates characterised particle images based on the reflectance and texture of organic materials. In the case of thermal and coking coals, the reflectance rating of Vitrinite, the most important organic constituent, gives a measure of coal rank. A combination of coal rank, maceral abundances and texture measures may be related to a wide range of coal properties which determine its quality. Reflectance is also a key factor in optimising blends for cokemaking.

However MACE as a light-based microscopy system cannot distinguish very small particles and it cannot assess the mineral composition of these particles. Coal particles can contain a vast variety of very fine mineral grains that therefore go undetected.

The MLA system will enable more detailed analysis of very fine particles such as those found in flotation feeds and pulverised fuel, based on its ability to image particles at sub-micron resolutions and provide mineral chemistry information.

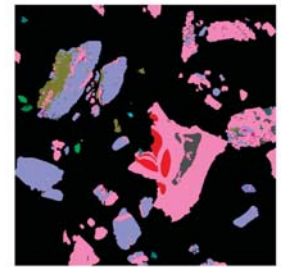


REFLECTED-LIGHT IMAGE



X-RAY MAP

- Vitrinite
- Inertinite
- Voids
- Beudantite
- Orthoclase
- Fe\_Oxide
- Chlorite
- Apatite
- Clay\_1
- Albite
- Pyrite



COMBINED ORGANIC AND MINERAL MAPS

*This series of images illustrates how a reflected light image produced by MACE, at the top, combines with the centre image of an MLA-generated X-ray map, to produce potentially the most accurate image yet obtainable of an organic-mineral map of coal, pictured bottom.*

The fusion of MACE and MLA particle images will allow analysis of raw and processed coals on a grain-by-grain basis with both minerals and the organic components characterised accurately.

The ability to analyse density and ash on a grain-by-grain basis has a major significance for developers of models for coal utilisation, process optimisation and performance.

What the industry will be waiting to see is how the two images or 'data sets' will be put together to make one composite image of every grain in the coal sample.

Once this is achieved the new data derived from joining the two systems will be unique and provide a revolutionary tool for performing tasks like flotation diagnostics and fly ash analysis.

Dr Jenkins said he was looking forward to working with JKTech over the next few years to develop and commercialise the system.

## Measurement, processing and presentation - advances come in threes

The MLA system continues to undergo enhancements, from increasing its operating efficiency through to improved presentation and reporting of data for researchers and industry clients.

JKTech Software Engineer Dr Jieshi Tong has been steadily working on improving the measurement program function of the MLA. This work involves more flexible sample measurement control, integration with existing tools for image-capture, setting parameters, and on-call reports on measurement progress where a user may receive notification at any time of what stage a sample is at during automated mineral liberation analysis. This is particularly useful for samples being analysed unattended or overnight.

The latest version of the MLA's processing program is also due for release after much hard work by Software Engineer Kai Riihioja. Currently there are five tools used to handle the processing of MLA data. The new processing program will package the handling of raw data into final results through a process requiring just two tools - classification and processing.

The way the MLA is viewed by the end user of the system is through its Data Presentation Package. The MLA Group has just released DPP V2. Combining images with statistical data is one of the important features of DPP V3, currently under development by Programmer Timon Missen. Ideally this will enable data to be turned into information related to particular processing plants, allowing plant operating decisions to be made in much faster time.

In a separate exercise, Senior Programmer Dr Khoi Nguyen is improving the segmentation and x-ray analysis features of the MLA.



A third MLA unit, pictured, is now in operation at JKTech

## Inaugural MLA User Group meeting held at JK Centre

The JK Centre in Australia played host to a global gathering of MLA users early in 2005 with a primary objective of forming the first official MLA user group.

JKMineralogy Manager Mr Eugene Louwrens said that as there were so many new users it was a good opportunity for people from around Australia and the world to get together.

"It also gave MLA users an idea of what other people were doing on the technical side, and I'm sure much was learned from this exercise," Mr Louwrens said.

"JKTech as the technology supplier was actively seeking guidance on the future direction of MLA development from users, meaning that JKTech and the JKMRC are not solely responsible for setting the R & D agenda for mineral liberation analysis."

Mr Louwrens said the User Group meeting held in Brisbane had shown there was a spirit of close cooperation between JKTech as the supplier and the users from industry.

"We were able to get an idea of what they want and what we - JKTech - can do for them."

The MLA user group's inaugural chairperson is Teck Cominco Senior Process Mineralogist Nichola McKay.



A new Quanta 600 MLA was recently installed at BHP Billiton Nickel West's Perth laboratory. From left are Steven Luitjens, Miree Leslie and Karen Tabb.

## 2005-2006 JK User Group - open letter from Nichola McKay

I was pleased to be elected Chairperson of the new MLA User Group at the first User Group Meeting in February 2005 at the JK Centre in Brisbane. At the time of the meeting, Teck Cominco had been in possession of our MLA for approximately 18 months and put it through its paces on a variety of ore and metallurgical products and a variety of mineral assemblages including lead, zinc, copper, silver and gold. The first User Group Meeting was excellent and the newly expanded MLA design team provided us with a detailed update and a template for our choices in moving forward with MLA development. A quick survey was held at that time to identify our common development needs; however, as many of the Users were not in attendance the survey was only a snapshot.

My role as Chairperson, as I see it, is to coordinate communication over the next twelve months between the MLA Users and the MLA design team, ensure that the MLA development is progressing in the direction desired by the Users and to plan the 2006 User Group Meeting.

Immediately following the February meeting I re-submitted the Development Survey by e-mail and collated the results based on excellent feedback from all Users. These needs have been the basis for our forward movement.

One of the features that will guide future MLA development is the new science of Geometallurgy. This is a direction of study of great interest to many Users and the mining industry in general, and coordinates nicely with the new AMIRA P843 GEM<sup>III</sup> project.

Since the February meeting, Ying Gu and Deborah Burrows have provided periodic updates to me and to the User Group. I have proposed - with no objections - that the 2006 User Group meeting be held in Canada, as there are now so many Users in the northern hemisphere, and that it be coordinated with the annual January Canadian Mineral Processors meeting in Ottawa, so bring your woollies!



Nichola McKay, inaugural MLA User Group Chairperson