Technical revolution

Mining technology has come a long way since the days of hand-dug pits and horse-driven whirms. These days a good geologist will not only have a hand-lens, hammer and compass-clinometer in the tool kit, but a computer with 3D modelling software as well. In the following pages, Mining Journal takes a look at some of the latest innovations in exploration technology and mining software. Below, Features Editor Michelle Giglio looks at what is driving the development of technology today – and what will influence future advancements.

**HOW TIMES HAVE CHANGED**

NEWMONT Mining Corp geologist Loren Ligocki tells Mining Journal how the sector has evolved. "Modern mining is considered to be a sophisticated industry. It has evolved immensely from pencil and paper to various technologies enhancing our business on a daily basis. Advances in technology such as satellite communications, high-precision 3D imaging and use of robotics have sped up data collection, cut costs and improved worker conditions. Computers are more prevalent today and used for a wider range of jobs. Mining technology, its efficiencies and automation have decreased human oversight from just ten years ago, causing a decrease in labour needs. "Technology has increased hazard awareness and consequently improved mine safety. GPS-guided loaders and shovels are able to track historic underground workings as the machine moves, making the mining of open pits far safer. Using new survey tools to map pit high walls from a distance allows for a safer environment than having a geologist stand next to raveling pit walls to take geologic measurements."

"The economic downturn has changed everyone’s focus… Mining companies are looking to derive more value from their investments”

Marc Bese, Gemcom

**INVESTING IN HIGH-QUALITY DATA**

Mr McLennan, who is CSIRO director of business development and commercialisation at the Australian national science agency, also cites a changing skills base and greater safety requirements as factors that are pushing companies to operate faster, leaner and more precisely.

"However, major developments have occurred on the back of ever-increasing ready access to greater quantities of high-quality data that allows for greater and faster decision making,” Mr McLennan says. "Relatively cheap, high-quality data forms the basis of many advances in material analysis, sensing and ultimately machine or system control.”

Maptek chief executive Barry Henderson says early mining technology saw applications developed to tackle individual tasks. "Processing speed was slow, output files were massive and hardware was definitely not portable,” he says. "Now mining professionals expect desktop computing speed on handheld or suggested devices in the field, with easy-to-use application interfaces and integration across the mining lifecycle.”

Mr Henderson says that globalisation has been a major factor in the evolution of technology. "The globalisation of mining has driven the development of systems where a whole lot of information from disparate operations can be merged into one model, so operations can see a single impact of their business in one scenario.”

And it has made exploration and development more targeted, saving time and money. "Investigating scenarios on the computer minimises the risk of exploring or digging in the wrong place, which can be expensive!” he says.

Technology also allows geologists to work with confidence, says Newmont Mining Corp’s Loren Ligocki: “New modelling software has allowed me to evaluate projects much faster than before and with greater confidence. The evaluation can be done with fewer people, generating more realistic geologic models and consequently better economic models. I feel this improves our company by allowing us to select projects which fit best within our profile.”

**VIABILITY IS KEY**

Inevitably, viability is becoming the key issue for companies, says Mr McLennan. The global financial crisis has put even more pressure on companies to cut costs but still deliver the goods, making technology paramount.

"The development of technologies and broader innovation processes are key to the mining industry maintaining its viability,” Mr McLennan says.

"The economic downturn has changed the focus of companies. “Until the economic downturn, mining companies pushed as hard as they could to get as much throughput from their operations,” says Mr Bese, who is Gemcom’s marketing communications manager. "It was all about getting material out of the ground. Prices were high, which offset costs, meaning that efficiency concerns were secondary. "The economic downturn has changed everyone’s focus, as has consolidation in the industry. Mining companies are looking to derive more value from their investments. Technology that helps control costs and drive productivity will play an even more central role than it has today."

It’s a feeling echoed by Maptek’s Mr Henderson: “Recently, the needs of our customers have changed from expansion in an aggressive environment to looking at..."
saving costs where they can, or looking at increasing productivity and efficiency.”

Mr Henderson says Maptek products help companies to collect and analyse accurate spatial data in order to understand their deposits. “If you consider that a deviation of a minor percentage on a calculation can result in a million dollar difference, the repercussions are felt throughout the value chain.

“Everything depends on the reliability of the information that is captured on the mine site. Everything that has been extracted has to be transported, so it’s very important to eliminate inaccuracy.”

In such a competitive environment, survival and success means a company must “develop new and more effective ways to find, mine, process and rehabilitate the environment to the satisfaction of all stakeholders,” Mr McLennan says. “Companies that can do this really well will have a greater capacity to secure funding from investors and support from local stakeholders and therefore become viable commercial entities. For example, companies that can operate in the bottom quartile of the cost curve (and meet their safety and environment objectives) are far more likely to attract and retain investors than those further up the cost curve.

“This is very pertinent in today’s environment where the current financial situation has a strong focus on cost cutting and efficiency. As prices fall, it is critical to be able to absorb that reduction and remain viable. Technology and smart processes are key to that.”

FUTURE TECHNOLOGY NEEDS

So what does the future hold? Most companies have extensive research and development departments that are constantly refining existing products and testing boundaries for new ones. With some current mineral reserves on track for exhaustion in the next few decades – such as silver (16 years), lead (22 years) and nickel (41 years) – the struggle to find the next big deposit is ongoing (Mining Environmental Management, July 2008).

Greg Hollyer of Quantec Geoscience says that as near-surface or “easier” deposits become depleted and harder to find, future technological advancements will be increasingly focused on deeper imaging technologies. In addition, Mr Hollyer, who is manager, mining sales and marketing at the Canadian company, says that because economics dictates that it is more profitable to extract all the ore on a deposit, this will spur the development of deep imaging technologies and methodologies.

“Mining technology will ultimately look like a powerful toolset of deep-imaging technologies capable of reliable geologic mapping and drill targeting to depth.”

Mr McLennan says two important areas will be geophysical tools and systems to see farther into the Earth’s crust. “Better identification of the ore deposited or mineralisation at depth will clearly also extend the potential life of a mine by being able to better locate and plan for extensions to orebodies,” he says. “New processing technologies and processes are also important in enabling mines to extend production from what may be a primary ore type into lower-grade, potentially more metallurgically-complex zones.”

Gemcom’s Mr Bese says that mining industry demographics will also be a harbinger of change: “With fewer skilled workers available to replace those leaving the industry, mining software will have to allow knowledge and best practices to be shared across organisations.”

The industry is beginning to see examples of collaborative work: for example, Geosoft and ESRI recently joined forces to create next generation GIS solutions for exploration industries and the geosciences sector (see page 18).

Newmont’s Mr Ligocki says the mining industry needs to look beyond itself and gain inspiration from the colleague industries of oil and gas – and even transportation. He calls for more “cooperative effort between those within our own industry and a sharing of technology between industries.” He adds: “I feel the mining industry has made strides to utilise new technology, but can still adapt to what has already been developed elsewhere.”
Foreign recognition translates into exports

Richard Roberts looks at the global successes of mining technology and service provider association Austmine in spreading Australian technology.

Innovative and leading-edge Australian mining practices have long been acknowledged by miners in other countries, but now more than ever this recognition is translating into rising export sales for many Australian-based mining technology and service (MTS) providers. At the tail end of a mining investment boom that has pitched Australian MTS companies into offshore markets through globalisation, demand for technology to plug skills and machine-utilisation gaps, and regulatory pressures, the sector is tipped to maintain growth through its broader exposure to international markets, including developing markets such as those in Russia, China, India, Brazil, the Middle East and parts of Africa.

“Ask the moment the Australian MTS sector brings about A$3.6 billion (US$2.8 billion) worth of revenue to Australia per annum;” said the chairman of Austmine, Alan Broome. “We’re working on growing that to A$6 billion around 2010-2011. We believe that by 2030 we’ll be looking at in excess of A$20 billion of exports provided that the global mining industry maintains its focus on the lowest cost of production and getting that product to the market, and assuming the market stands up.”

Austmine, a self-funded association representing and promoting Australia’s MTS sector, works with Austrade and other Australian and state government organisations to develop and promote the sector’s export capability, develop existing and new export markets, and facilitate networking between members.

“If we can get the global mining industry to understand how Australian technology can help deliver into the global marketplace and improve things like keeping production costs at a minimum, and make sure they can maintain the momentum in a difficult market circumstance we will have succeeded, and Australia will benefit,” Mr Broome said.

Executive director Robert Trzebski said Austmine was stepping up a successful 2008 campaign to boost awareness of the range and calibre of Australian mining technologies and services in Latin America, where more than a dozen Australian MTS companies participated in a trade mission to Chile and Brazil. Return visits to Chile and Brazil are being organised for this year, with work also underway to bring Austmine’s delegation into direct contact with mining companies and organisations in Mexico, Peru and Colombia.

The biennial Austmine conference, to be held in Adelaide on 10-11 November, 2009 will also bring representatives of Brazil’s biggest mining company Vale SA, Chile’s Codelco, and other South American and international miners to Australia for a comprehensive update on Australian mining technical innovations and application reviews.

CHIEF OPERATING OFFICER

Our Client, a major and long established heavy mineral sands producer, with mines in Africa, has an immediate opening for a Chief Operating Officer.

The position

This position would suit a Mining Engineer, Geologist, or Metallurgist with previous experience at senior levels in a publicly listed mining company. In particular, hands on experience in the coordination of mine expansion, exploration, mergers/acquisitions, and the preparation of accurate budgets and forecasts, will be highly regarded. Knowledge of the regulatory requirements of a publicly listed company will also be favourably viewed. The chosen candidate will be expected to undertake frequent travel and will be based at the company’s head office in Africa. The position will interface very closely with the Mines General Manager, as well as with the groups Chief Financial Officer and reports to the Chief Executive Officer.

Candidate Qualifications

Expressions of interest are sought from senior industry professionals with at least 15 years of relevant experience in the mining industry and ideally with some experience gained from coordinating operations within Africa.

Please send C.V. to: jobs01@mining-journal.com, quoting reference T1 or post to Aspermont UK Ltd (Box 01), Albert House, 1 Singer Street, London EC2A 4BQ, UK
Our company started in 1986 as a ground geophysical services company focusing on the mineral exploration industry. Since then, the company has grown from a few employees to several hundred – making Quantec one of the largest ground geophysical groups globally. In addition to helping companies discover numerous orebodies, the company has expanded into the geothermal exploration, and oil and gas exploration sectors. The company’s key technologies have also developed. Today, the company has several core technologies, including Titan 24 Deep Earth Imaging and Spartan Magnetotellurics, in addition to the conventional geophysics technologies on which Quantec was founded.

QUANTEC PRODUCTS SEE DEEP
Our products are unique because they see deep. No other services partner can offer the depth of investigation of Titan 24 which acquires induced polarisation and resistivity data to 750m, and magnetotelluric data to virtually unlimited depth. With Titan 24, explorers can image alteration, structure, geology and economic targets more effectively than ever before. The Spartan MT technology is also distinct in that it sees deep, and can be applied in many different earth science investigations.

Before Titan 24 and Spartan MT, no one could prospect to the depths of exploration of these systems (with the exception of expensive seismic surveys). Now, these two systems bring the possibility of exploring to depth into the mainstream of exploration. Many of the existing near-surface deposits have already been found, making the implementation of deep techniques an absolute necessity for continuing economic growth and development in mining.

HELPING TO FIND THE BIG ONE EARLY
Titan 24 and Spartan MT make exploration easier as it enables explorers to find the big one early and maximise the value of their exploration drilling by identifying targets rapidly and to depth. And recently, the results of a Titan 24 survey helped junior mining company Copper Mountain Mining Corp raise almost C$29 million (US$26 million) in financing – demonstrating the economic value of a Titan 24 survey above and beyond the acquisition and interpretation of data itself.

COMMITMENT TO R&D
This technology is valuable not only to Quantec’s business but to the industry as a whole, enabling companies to rapidly and quickly scour ground in either grassroots or near mine/minesite applications. The company sees itself as leaders in deep exploration, a belief it upholds every day through careful attention to data quality and safe operating practices on the numerous deep-imaging projects completed around the world during the past eight years.

Quantec has a research and development team dedicated to the development of the company’s flagship deep-imaging services, including Titan 24 and Spartan MT. We are leaders in development in a number of areas with patents pending on a variety of technologies. Quantec prides itself on its R&D efforts and leadership in deep exploration technologies.
Exploration workflows in GIS

GIS plays a crucial role in exploration technology. Carmela Burns reports on how Geosoft and ESRI have built next-generation GIS solutions for exploration industries and the geosciences sector.

**Geographic Information System (GIS)** has always had a role to play in the search for mineral deposits – and use of GIS in the exploration industry is increasing. One key reason is because there are more tools available to help explorers work effectively within the GIS environment, conducting advanced geospatial analysis, and creating accurate, quality results.

The questions posed by resource exploration and the answers offered by GIS are a natural fit. Exploration teams need to integrate and make sense of reams of geological, geochemical and geological information in order to find ore bodies. GIS supports this complex workflow by managing and analysing the data and displaying it in a spatial context.

As GIS becomes more mainstream in all aspects of life – from the ever-changing political wall maps used by CNN to depict US election results, to Google Map applications that can track a runner’s training routes – geoscientists are becoming more comfortable weaving geospatial technology into their workday.

The real breakthrough, however, has been adding and improving exploration workflow support for geologists and specialists working with large and multidisciplinary exploration datasets.

US-based ESRI launched what it calls the “first modern GIS” – ArcGIS – in 1982. Geoff Wade, ESRI’s natural resource industries manager, says: “I think one of the most critical aspects in the recent uptake (of GIS) is direct workflow support. But to support the most complex of specialist workflows, GIS really needs to be in the hands of a specialist solution builder.”

For this reason, ESRI joined forces with Canada’s Geosoft – which provides software and solutions for earth mapping and exploration – to build next-generation GIS solutions for exploration industries and the geosciences sector.

“Our global partnership with Geosoft has been essential in fulfilling the specific needs of explorers working within ArcGIS,” Mr Wade says.

Louis Racic, Geosoft’s director of desktop applications, explains how the companies developed Geosoft/ArcGIS exploration workflow solutions. “We identified several explorer challenges, from basic format incompatibility issues, to a lack of advanced tools for visualising and interpreting earth datasets (geology, geochemistry, and geophysics) inside GIS systems,” he says. “And we set out to create a whole solution for explorers that would bridge these gaps.”

From an inter-operability standpoint, Geosoft has made it a development priority to support all of the leading GIS data formats, and other common data formats, says Mr Racic. “There is nothing more frustrating than spending time fiddling with incompatible data formats. Our goal is to eliminate the need to convert data formats entirely, and free up time for the exploration team to collaborate in an integrated environment.”

Geosoft chose to extend its exploration workflows to the ESRI ArcGIS environment to meet customer demand for simpler and more seamless solutions that met their exploration project needs.

“ESRI technology easily scales to the growing data and spatial challenges that exploration organisations are facing,” says Mr Racic. “And we’ve also seen strong adoption of ArcGIS within global, government geological surveys and the academic geoscience sector.”

One result has been strong market demand for Geosoft ArcGIS exploration workflow solutions. “Our Target for ArcGIS extension software was our highest growth product last year, and we were taking orders for the new Geochemistry for ArcGIS before its release to the market,” said Mr Racic. “We’re seeing strong interest in the Geochemistry extension from the government sector as well as the exploration industry.”

Geosoft has advanced its exploration strategy in GIS with the recent release of a Geochemistry for ArcGIS extension that extends the explorer’s tool kit by providing the ability to analyse geochemical data within the ArcGIS environment, according to Mr Racic. And it provides a powerful exploration workflow solution that’s not currently available in the market.

Geochemical investigations require the ability to process and analyse all components of geochemical sampling in context with the geology and geophysics. With the tools available within Geochemistry for ArcGIS, explorers can effectively extract knowledge from their data by examining multivariate relationships, uncovering underlying structures and identifying outliers and anomalies, and can present results by easily creating informative, visually impactful maps.

Using Geochemistry for ArcGIS, explorers can simplify their geochemistry quality control process and maintain data in an ESRI file geodatabase using a data model optimised for geochemical data. They can select and subset data interactively from maps based on lithology and regions to enhance data display; create advanced geochemical maps within the ESRI ArcGIS Desktop environment; and analyse multi-element geochemistry using a variety of tools including: interactive multiple histogram plots, Pearson’s correlation reports, scatter plots, probability ternary plots, box plots, to identify outliers and define populations.

ESRI’s Mr Wade recommends a gradual adoption of GIS by the exploration department, but one that is incorporated by every member of the interdisciplinary team. “We find it particularly effective if several members of the project team embrace the technology at the same time, thereby supporting each other in the education process and gaining extra benefit from data sharing, improved workflow support and an improved communication capability,” he says.

In addition to workflow support, effective integration of GIS within your exploration organisation is also an important consideration. “Technology aside, if you start with a good understanding of your people’s data requirements and project workflows, than you are more likely to achieve the results you need,” says Mr Racic.

There is no doubt that explorers today, both junior and major, are operating in a rapidly changing exploration environment that is increasingly reliant on data and applications available through the Internet. There’s more digital data to make sense of, greater integration and interpretation challenges and larger drilling projects to manage.

For many, the choice is clear: retrofit to deal with the new complexities of exploration and take advantage of all the rich, digital data and applications coming online, or risk being left behind, and missing out on future opportunities.

**Technology can turn a mineral deposit in the Nevada desert into a multi-layered 3D model**
Buster Hunsaker tells Carmela Burns how being faster and more efficient in how he uses technology for geological insight and project management has given him an edge in the Nevada goldfields

AS A well-established consulting geologist working in the middle of the Nevada goldfields, Buster Hunsaker has adopted software and GIS as a critical part of his exploration tool kit – both in the field and in the office. Being faster and more efficient in using technology for geological insight and project management has given him an edge in what can be a competitive business, especially during cyclical downturns in the mining industry such as the one we are experiencing today. More importantly, it’s enabled him to produce better results for his customers.

“Our expertise in GIS has opened a lot of doors for us,” says Mr Hunsaker, whose company Hunsaker Inc specialises in early-stage gold exploration projects. “As a consultant, bringing both our experience and technology to bear on projects is a tremendous advantage. We see a real gap in the application of technology to exploration. There are not as many senior people applying it as there should be.”

The Carlin gold belt in north-central Nevada is one of the richest in the world. Mr Hunsaker estimates that about 8% of global gold production comes from deposits within a 100km of his headquarters in Elko. Because the state has been so intensively mined and explored over the years, there is a rich store of available data, including a comprehensive sub-surface database.

“That’s where the application of digital technology comes in handy. Without the tools to process and make sense of it, all that data would be mindboggling at best and virtually useless at worst.”

Using ESRI’s ArcView to visualise geographic data in combination with Geosoft’s Target for ArcGIS to manage drill projects, Mr Hunsaker is able to integrate volumes of old and new data, both public and private, to highlight areas with mineral potential, work within different scales, and generate 3D renderings of the information.

“There are a lot of new geological concepts coming out in Nevada,” he says. “We can take the new geologic maps and apply existing data to them and it gives us new ways to interpret the existing data.”

Through Mr Hunsaker’s experience with GIS for years, many mining companies are just beginning to see the value of integrating geological, geochemical and geophysical data from government geologic surveys – which are increasingly publishing data in ESRI formats – with their own exploration data as part of their workflow.

The most obvious advantages are efficiencies in project and data management, time savings, increased productivity and better decision making.

The introduction of extensions for GIS, such as Geosoft’s Target for ArcGIS, has made the suite of spatial analysis tools even more powerful by providing the ability to visualise sub-surface geological data within a GIS environment.

“We wouldn’t consider doing something without the third dimension if we have drill data available,” says Mr Hunsaker, “and Target provides the ability to handle that third dimension quickly and easily. That’s both the geophysics as well as the drillhole data.

“Having the 3D perspective also means we’re quite comfortable bringing in a lot of data because we’re confident we can handle it and it won’t overwhelm us.”

Mr Hunsaker’s adoption of GIS for mineral exploration began 12 years ago when he was looking for an efficient way to track federal mining claims. A colleague directed him to ArcView and there has been no looking back.

“ArcView’s ability to handle large amounts of data led us to expand from land title data to all kinds of geologic data,” he says.

As Mr Hunsaker’s experience with GIS grew, he was able to take the mostly raster data available in Nevada and convert them into GIS format. (Raster data store values in a grid, and are used for items such as aerial photographs and scanned maps.) That gives him another edge over the competition. “From a business viewpoint, it has become a good income stream for us,” he says.

Another unique aspect of Mr Hunsaker’s approach to exploration is the use of ESRI’s ArcPad, a software program that allows data capture in the field on ultra-rugged field computers or handheld devices. The software is commonly used in urban areas where there is easy access to mobile phone networks, but is just beginning to enter the mineral exploration industry.

Using ArcPad has allowed Mr Hunsaker to generate data in GIS format while he is in the field, resulting in an instant compatibility between field and office that would not be possible were he still using a notebook to scribble observations about outcrops and other geological information.

In the historic gold mining district of Wonder, Nevada, for instance, Mr Hunsaker used ESRI’s ArcMap to convert 34 years of data generated by his client and a century of archival data into a standard GIS coordinate system. He then took the sub-surface data – including results from more than 100 boreholes and applied Geosoft’s Target for ArcGIS to generate cross-sections. He is adding even more value to the historic data by using ArcPad to complete additional surface mapping in the field, creating another layer of digital information that can be used to explore the district.

“The ArcMap model and the Geosoft extension allowed me to generate sections that have the latest mapping from ArcPad windowed in the plan portion, straight out of the field,” he says. “As important as it is today, adapting technology to exploration will be even more essential in the future.”

“We are generating massive amounts of data, all of it digital and most in GIS format. You need technology to effectively explore all this new data and fit it in to your projects,” says Mr Hunsaker. “The new technology that’s coming on stream, like Geosoft DAP and Dapple, is phenomenal. You can take an AirCard even in an area where you have limited coverage, and you can take a cell connection with your tablet computer and access these data sets.”

“Don’t even think about the old tools. Think about the new tools that are coming on board. You need to become really efficient with data.”

Carmela Burns is editor of Earth Explorer (www.earthexplorer.com), Geosoft’s magazine and online news site covering the earth sciences and exploration.
Datamine provides bespoke solutions

UK-based Datamine Software offers solutions from exploration to mine design, tailoring its software to meet clients’ demands

Datamine’s continued success is proof that strong links with end-users gives a distinct edge when developing for the mining industry. Prevalent mergers and acquisitions are testament that for any software provider to survive, let alone flourish in this environment, it must deliver archetypal business benefits and measurable value and nurture genuinely bespoke solutions on a customer-by-customer basis. Today, converting resource to reserve is as much about reacting to specific needs by deploying software quickly and successfully as it is about delivering technical solutions.

Simon Blake, general manager of Datamine Software Ltd, is clear about how Datamine positions itself: “Datamine is expanding its level of service. In the past, a ‘shrink-wrapped’ software approach, adopting the ‘sell-and-train’ methodology, may have sufficed, but the market now demands an integral relationship between provider and client, and it is imperative that we can provide individual clients with a tailored solution to implement robust operational improvement without delay.”

Datamine’s Exploration solution supports exploration planning with 2D and 3D tools to place strategic holes. Remote handheld drill log data collection as well as remote mapped geology enforces compliance with regulatory and corporate resource measurement standards (e.g., JORC and NSI-43-101). Visualisation of drillhole and sections for preliminary geological assessment is performed according to one of Datamine’s valued ethics: “accurate, clear and accessible information at all times.” This is especially pertinent when discussing another key category of Datamine software – Geological Interpretation.

Datamine Studio 3 heads up the Geological Interpretation solution, and is supported by a plethora of other applications, such as Downhole Explorer, Sirovision, Mining Power Pack, Mineable Reserves Optimizer and Mineable Shape Optimizer. Tools are delivered to visualise, model, review, analyse and manipulate all types of geological data to provide the best possible geological interpretation. Data formats are largely irrelevant due to the provision of a wide-ranging Data Source Drivers facility.

Advanced graphical and modelling facilities for deconstructing complex geological structures exist to permit kriging of the mineralisation in the original physical form. Conditional simulation then facilitates mine planning based on corporate risk strategies. Throughout the process, it is the same master data set that is developed, providing true collaboration and continuity between geology, production and planning departments.

With data transferable between all core Datamine products, team collaboration is not only supported, but encouraged, particularly when supported by Datamine’s MineTrust delivery environment for protected data sharing an easier corporate analysis.

CASE STUDY: VASTAN LIGNITE MINE

GIPCL’s Vastan lignite mine uses Datamine software both for mine planning and operations monitoring. The GIPCL – Gujarat Industries Power Co Ltd – mine is located in India’s Gujarat state. Operational mine planning relies on factors such as control over slope angles, minimising overburden removal and ensuring consistent exposure of lignite. Over-stripping results in a huge cost burden and under-stripping can lead to inconsistency of supplies.

Before mining starts, the operator prepares a mine plan and mine project report. The plan uses data generated by initial exploration drilling on a relatively wide grid to control exploration costs. Normally, detailed exploration is undertaken only once extraction has begun, when this expenditure can be more easily supported.

Mine planning has to accommodate in-operation issues quickly to ensure that the data models in use are relevant. Datamine is used at Vastan Mine for the medium-term planning, including overall management of the geological model and all subsequent reserve estimations. It is also used for lignite quality mapping and face advance planning.

Pre-production drilling data is used to update the mining loss model, held in Datamine Studio. The goal is to refine the estimate of reserves by planned removal of overburden, and provide facilities to ensure accurate and appropriate 3D data sets throughout the life of the mine. The result is more accurate control of the power station operation. The resulting mining plan is adjusted in a more appropriate manner than before, with the extensive 3D modelling capabilities of Studio simplifying the incorporation and clear display of alternative models and thus facilitating more informed operational decisions.
Creating a more accurate model

The use of Leapfrog has made it easier for mining experts and scientists to visualise in three dimensions trends and structures that are not mappable with other software.

CASE STUDY: GEOSCOTT EXPLORATION CONSULTANTS INC AND LEAPFROG

Bill Scott, former GeoScott president, talks to Mining Journal about his company’s use of Leapfrog software.

“FOR several years GeoScott has been developing an approach to carrying out three-dimensional resistivity and induced polarisation (IP) surveys. Until we started using Leapfrog, we were limited to providing results as a series of horizontal and vertical sections, which were difficult to use. Since acquiring a Leapfrog licence, we have been very pleased at the ease with which it allows our 3D models to be visualised. I cannot think of another geophysical program which is as easy to learn, yet offers such useful features.

“Three dimensional induced polarisation became practical only with the advent of 3D inversion programs, about six or seven years ago. Before that induced polarisation and resistivity surveys were done only in 2D. In complex situations 2D surveys do not necessarily explain the subsurface geometry very well.

“The illustration (left) is a model generated with Leapfrog. Without the 3D representation, the model character was very difficult to understand. The approach we use call Stereo IP. induced polarisation is a geophysical method used to prospect for disseminated sulphides. We make 3D measurements of resistivity and induced polarisation in the field, and then invert them with another program (Res3Dinv, from Geotomo Software, handled in Canada by Terraplus Inc in Toronto) to generate a 3D distribution of values of resistivity and induced polarisation effects. We work with an induced polarisation quantity called chargeability. The model shows high-chargeability values in red, and high resistivity values in grey. The source of the sulphides reflected by the high-chargeability areas appears to be a silicic alteration which results in high resistivity values as well.

“When we started doing Stereo IP we had only horizontal and vertical sections generated by Res3Dinv, which are output as page-sized bitmaps. In a complex situation, I find it very difficult to visualise the spatial relationships from the sections. Before we went to Leapfrog, we looked at several other 3D display programs, but none of them combined the ease of model construction with the availability of a free viewer we could give to the client.”

CASE STUDY: DR JAMES CLEVERLY, SENIOR GEOCHEMIST WITH CSIRO EXPLORATION AND MINING

JAMES Cleverly of Australia’s national scientific research organisation, CSIRO (Commonwealth Scientific and Industrial Research Organisation), uses Leapfrog to process HyLogger spectral data and visualise geophysical, geochemical and geological data. Dr Cleverly says Leapfrog makes the generation of precise targets possible.

“Implicit modelling promises to revolutionise the way in which models are constructed and updated,” he says. “This is because the rules for creating the models are contained in processing parameters that don’t require updating when new data is added. This allows models to be updated without manual intervention. Implicit modelling is data driven and so requires the data to be clean and consistent. This is an area where the geologist has a critical role. Leapfrog provides tools that allow validation and cleaning to be performed in an interactive visual environment and that means the geologist can quickly make changes to rationalise logged codes.

“The new tools require a mind shift but are fundamentally easier to use and more productive than the traditional CAD-based systems.”

Left: CSIRO’s longwall automation technology is an example of how productivity and safety can be increased in coal mines.

Above: Modelling allows geologists to visualise mineral deposits in three dimensions.

Source: CSIRO
Mark Bese, Gemcom marketing communications manager, talks to Mining Journal about how the Canadian-based company’s software has revolutionised mining tasks

Gemcom InSite manages the processes that drive operational performance through the mining value chain

MINING SOfTwARE: GEMCOM SOfTwARE INTERNATIONAL INC

A gem of a software

Mining Journal presents a back-to-basics seminar

Three mining experts deliver a comprehensive but straightforward (no jargon) explanation of what the global mining industry is, and how it works.

The event is aimed at people working on the periphery of the industry (the financial community, lawyers, service providers, etc) who would benefit from an overview of mining, and be in a better position to develop business opportunities as a result.

“We all have knowledge gaps, and our ‘Mining in a Day’ seminar will help fill many of them,” said Chris Hinde, the editorial director of Mining Journal.

Seminar agenda:

**9.00AM: INTRODUCTION**
- Overview of the mining and metals industry, with a schematic of the participants

**9.20AM: GEOLOGY**
- Elements/minerals/metals; periodic table; grades
- General geology; rock types; earth processes
- Ore deposit types; classification; distribution

**11.50AM: MINING**
- Surface mining operations
- Underground mining operations

**2.05PM: PROCESSING**
- The main metallurgical processes
- The beneficiation of ore

**3.20PM: INFLUENCES ON MINING**
- Economic factors
- The marketplace
MANAGING COSTS AND EFFICIENCIES
In the industry today there is a critical need to control costs and drive increased efficiencies at mining operations. Our Gemcom InSite solution focuses on operational performance management to address these concerns. InSite manages the processes that drive operational performance through the mining value chain. By improving productivity, reducing production losses and controlling costs, InSite helps to increase profitability. InSite consolidates and validates information from operational systems in near real time, enabling you to make timely decisions in response to changing conditions.

Very deep, powerful analytics are at the heart of what InSite provides because just having data does not make it valuable. It’s how the relationships between the data can be drawn that makes it powerful. What sets InSite apart is that it has been designed for mining, incorporating an architecture that is able to accurately mirror how mining businesses function.

GEM HELPS CONSOLIDATE DATA
Data management is another critical area that we address with our solutions. Industry regulations are becoming more stringent, requiring that data used in production reports come from sources that can be validated. Rather than having multiple versions of data residing on various laptop and desktop computers, consolidating the data in a central database presents one version for all to use.

Mining companies are also consolidating and are seeking to drive additional efficiencies from their properties. To achieve this they are seeking to use more of their operational data to find areas for improvement in production processes, starting right at geology and all the way through the mining and follow-on production processes. Lamgold Corp uses our Gemcom GEMS software with Microsoft SQL Server to enable its staff to collaborate. lamgold senior mine geologist Eric Ramsey says GEMS is the single most critical tool onsite. “It is our main data repository for the entire Rosebel mining project,” he says.

NO MORE NEED FOR MANUAL TASKS
Prior to the development of exploration and mine planning software, geological modelling and mine design tasks were done manually. Today, Gemcom software in areas such as production scheduling is replacing manual processes driven by spreadsheets. Our Gemcom Whittle software has helped companies improve economics by running hundreds of different ‘what-if’ scenarios based on different physical mining constraints and economic factors – something that was not possible previously.

Canada’s Teck Resources Ltd uses Whittle to calculate the size of pits for resource estimates, determine mineable pit outlines and develop strategic mine production schedules. Bruce Butcher, director of mine engineering, says: “Whittle is an essential component in the mine engineers’ tool kit to provide fast, accurate results. If we did not have Whittle we could not determine the value of a resource in a timely manner.”

Patagonia Gold S.A.
the Argentine exploration company
subsidiary of AIM listed Patagonia Gold plc
is seeking a qualified and experienced
PROJECT DEVELOPMENT ENGINEER
We are looking for a qualified Mining Engineer with project development experience in Gold mining from scoping through permitting to production.

Experience in Heap Leach processing would be an advantage.

Candidates must have the following essential requirements:

- University degree.
- A minimum of five years of proven experience in management of mineral project developments, with solid knowledge of gold and silver epithermal systems.
- Experience in EPCM of mining projects as well as management and supervision of personnel, contractors, logistics and administration, including mine safety and environmental associated matters.
- Proven experience with metallurgy, mine, civil and mechanical construction engineering as well as mine data handling and software, including GIS (Mapinfo) and interpretation of geological, geochemical and drill information.
- Spoken and written English and Spanish

Remuneration will be to industry standards commensurate with experience. Housing assistance, vehicle, and contributions to a pension scheme will be provided.

Stock options and a bonus scheme will be applicable given company success.

If you have the qualifications, this is your opportunity to join a highly professional team. Please submit your complete resume, including references and requested remuneration, to the following email: cv@patagoniagold.com

May 29, 2009