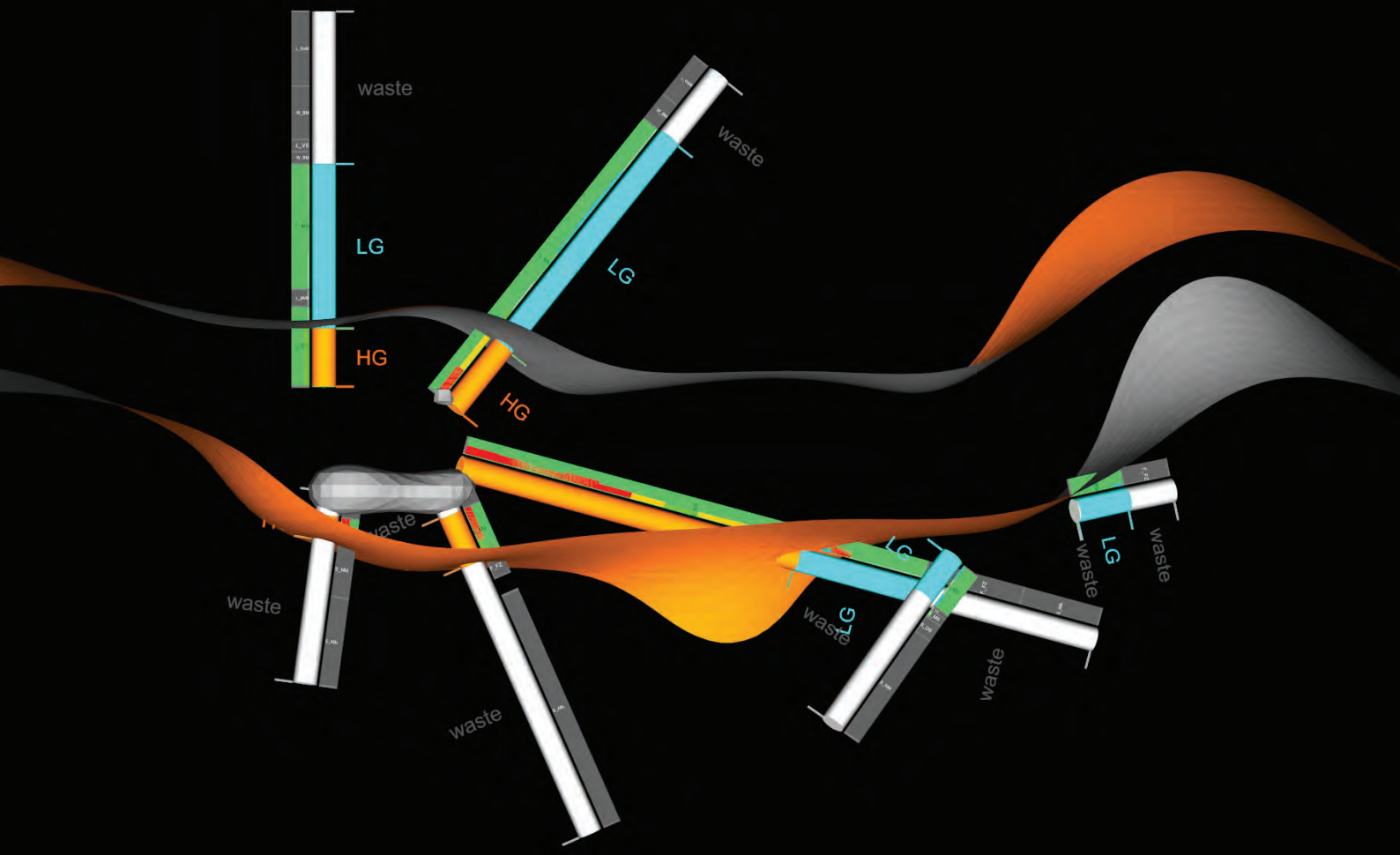
MAPTEK™

Forge

September 2021 Newsletter



In this issue

Welcome to our Forge newsletter September 2021

During 2021 Maptek turned 40. As we approach the end of our milestone year, we're refining our long-term technology strategies through collaboration with customers to meet immediate needs and to anticipate industry futures.

The transition to renewable energy will require technologies that drive deeper integration between processes and operations, and harness AI and machine learning to ease bottlenecks. Aligning with social and environmental considerations continues to be a high priority for our customers.

In this issue we outline how Cornish Lithium is embracing new technologies to responsibly source the raw materials to meet the demand for low carbon technologies.

Sibanye-Stillwater in Montana is discovering the benefits of data driven modelling for planning and forecasting in a production environment.

Exploring different approaches to allow profitable mining while minimising the operational footprint is covered in a recap of Bara Consulting's talk at Maptek Connect 2021.

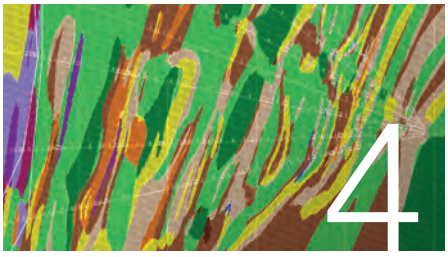
Anglo American is targeting innovation to bring blast design deeper into the upstream planning process in their continuous improvement journey.

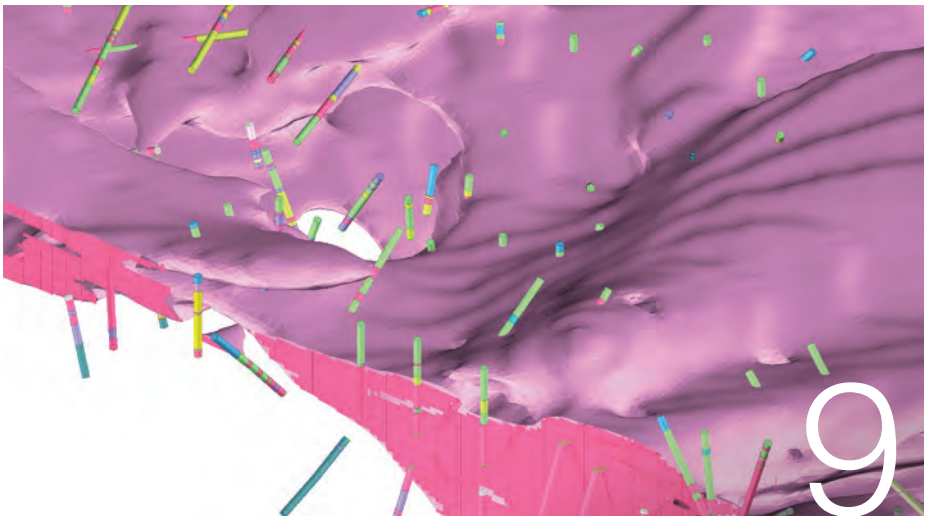
Maptek has joined other forward-thinking companies in supporting research into eco efficient mining by incorporating comminution outcomes into mine planning from the outset.

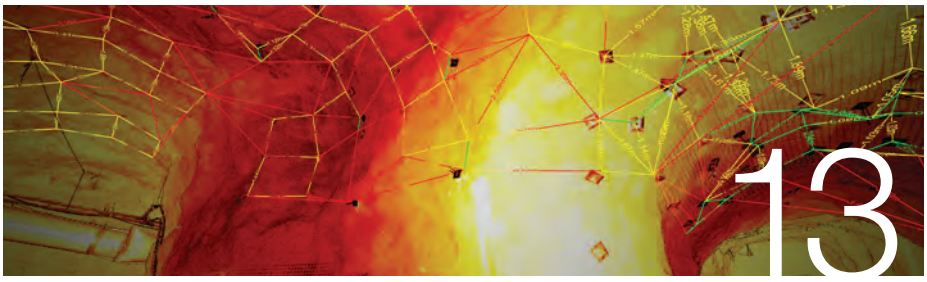
This month we launch Vulcan GeologyCore, which introduces a novel approach to geological modelling, just one of multiple technologies that will enable miners to make better decisions.

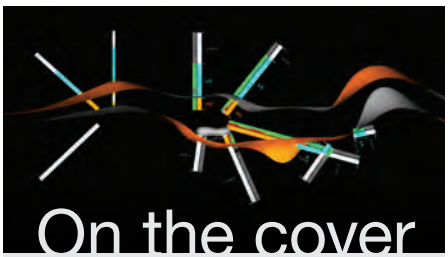
We hope you enjoy this issue and welcome your feedback.

Eduardo Coloma
CEO









Vulcan GeologyCore automates the geological workflow from drillhole database to geological model

Contact us: forge@maptek.com

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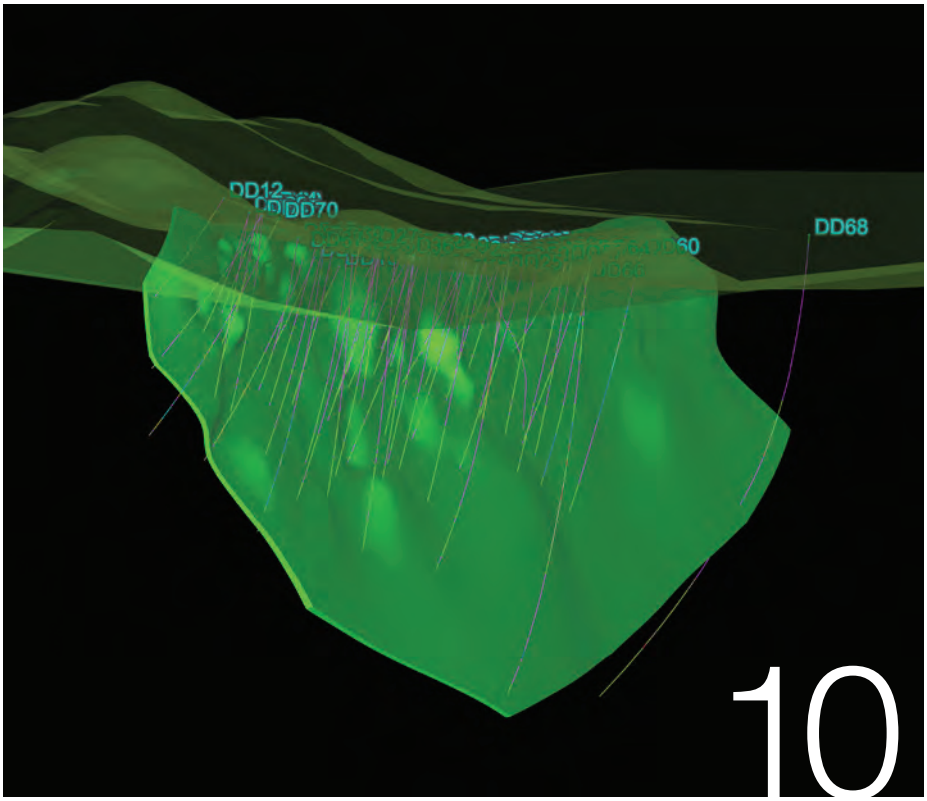
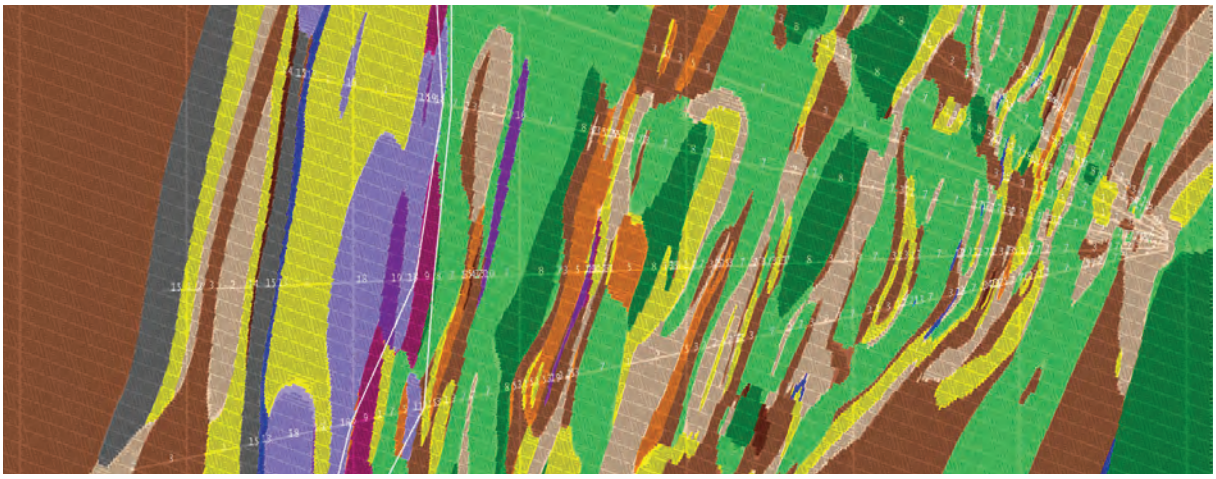


Data driven modelling

Machine learning can change the way an operating mine uses geological and geotechnical models to keep information up to date in a production environment.



DomainMCF model where block size is based on the smallest Sibanye-Stillwater mining unit

A trial of Maptek™ DomainMCF to accelerate ground control model creation has opened the door for Sibanye-Stillwater to apply machine learning to other aspects of its operations.

DomainMCF is a simple application capable of absorbing very large datasets. Once the machine learning model has been trained on a dataset, it can generate a predicted domain block model very quickly. Geologists have more time to look for significant features and trends that may impact safety, productivity and profitability.

> DomainMCF allows a more timely and practical use of the valuable investment in data collection and storage.

Stillwater and East Boulder are shallow to intermediate level underground PGM (platinum group metals) mines in south-central Montana. The two principal mining methods are mechanised ramp and fill, and sub-level extraction by longhole open stoping with hydraulic backfilling. Efforts to expand the production output are ongoing.

During 2020, Maptek began working with Sibanye-Stillwater to evaluate whether DomainMCF was a good fit for their geological modelling work. The focus for experienced Senior Rock Mechanics Engineer, Gretchen Moore was harnessing data for ground control risk evaluation and predictive modelling.

The Stillwater igneous complex has been recognised as a metalliferous resource since the late 1800s. Copper, nickel and chromium were identified in surface outcrops and the chromium was mined as a strategic resource in the 1930s.

The platinum group orebody lies within a horizon referred to as the J-M Reef, a world class stratiform magmatic reef-type deposit.

Drilling and modelling

Production definition diamond drilling programs involve primary axis drifts being driven 200 to 300 feet south of and in parallel to the J-M reef. These drifts are 300 to 400 feet apart vertically, and are driven out in front of the area of high concentration of existing diamond drillhole information.

At every 600 to 1200 feet of primary drift, Sibanye-Stillwater performs campaign diamond drilling of the reef, which targets a 50-foot spaced grid through the narrow deposit.

Holes are logged in their entirety for lithology, structure, alteration and mineralisation, and selectively for geotechnical data within about 30 feet north and south of the mineralised zone.

'Drilling scheduled during 2020 involved the geologists logging upwards of 800,000 feet of diamond drill core – to say this is a lot of data is an understatement', said Moore.

The development geologists traditionally digitise 2D cross-section interpretations. This group is also responsible for designing drill programs, logging and interpretation.

Reserve and resource geologists update interpretations of the mineralised zone, creating the minimum mining model that is used to design stoping areas and calculate reserves.

The geotechnical model is built using composited geotechnical or lithological data to predict the anticipated ground types and the ground support required in all development and production headings.

'Historically, ground-type models were only built in the areas we planned to mine, and it was fairly labour intensive using the ore triangulation that the geologists build for reserve modelling,' Moore said.

The main purpose of the machine learning trial was to estimate the geotechnical variables into a block model. Where the geotechnical data is not collected, gaps are left in the ground-type model.

Value in use

Moore researched software to expand the use of geotechnical models and saw the potential value in Maptek DomainMCF.

'It's not just faster block modelling – updating models in minutes, not days – it also enables us to include the latest information in planning and forecasting,' Moore said.

Sibanye-Stillwater data exists in a standardised format, so little data manipulation was required for a successful test modelling run.

Data input into DomainMCF consisted of text lithology logging presented as a numeric rock code, representing the 21 lithological units to be modelled. The first test model took 2 hours and 15 minutes to generate.

The geologists were excited to see how DomainMCF modelled the thin problematic rock types and structures that are important for predicting ground control conditions in the mine.

> The development geology team soon realised they could spend more time on doing actual geological interpretation and structural modelling rather than on the manual drafting process.

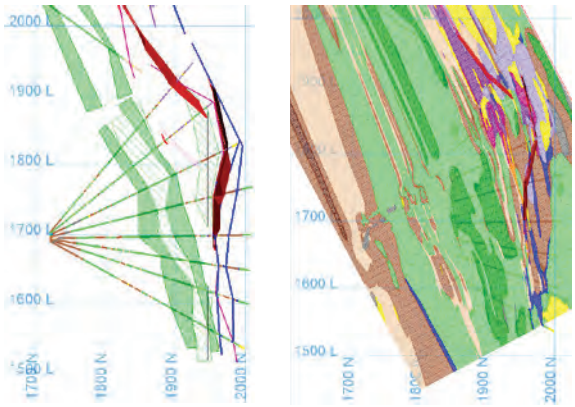
DomainMCF was then tested on the mineralised domain, for comparison with the current explicit modelling workflow. The resource geology team will supervise ongoing reconciliation and proving tests during 2021 and 2022.

For the Geotechnical Ground Control models, the DomainMCF test models showed significant improvements in accuracy, time to delivery and effectiveness, to guide geologists and mine planners in ground support requirements.

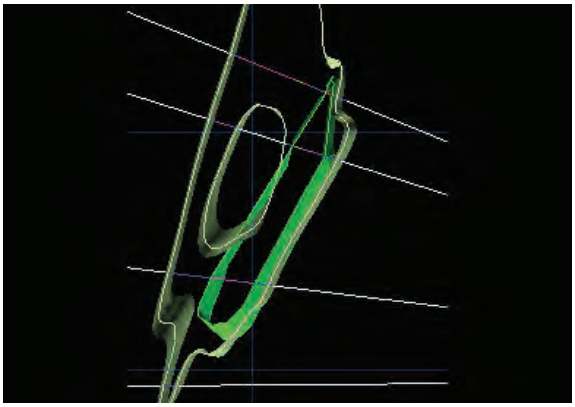
DomainMCF software usage costs are based solely on the actual compute time it takes to generate the geological domain models. Maptek worked with Sibanye-Stillwater staff to extrapolate the expected computing time from early demonstration models, creating a budget usage estimate for the entire mine.

When considering the ease of use for DomainMCF, Moore stated that, 'Input and setup are quick, and once we dialled in some of the sensitivities, I could set a model up to run in less than an hour. The level of detail is far greater than could ever be achieved through manual digitisation efforts in any kind of a timely fashion.'

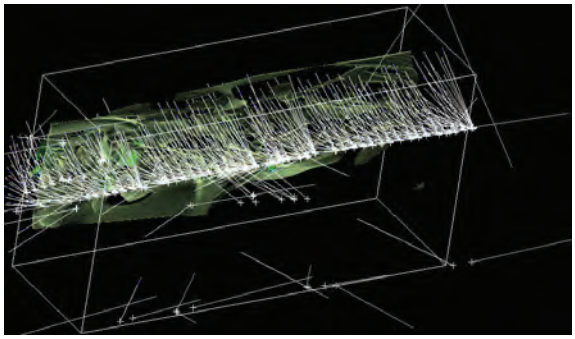
Sibanye-Stillwater geologists and engineers are keen to see the application and impact to short- and mid-term planning activities as testing and increased utilisation of the DomainMCF models progress.



Digitised cross-section (L) and DomainMCF version (R)



Cross-section showing the DomainMCF mineralised zone and wireframes built by Sibanye-Stillwater geologists



View looking north of the DomainMCF modelled mineralised zone

Thanks to
Gretchen Moore
Senior Rock Mechanics Engineer
Sibanye-Stillwater, Stillwater Mine

Edited excerpt from Maptek Connect presentation, May 2021

The green industrial revolution

The transition to renewable energy will see demand for lithium rise dramatically. Cornish Lithium is using new technologies to extract mineral resources in a responsible way.

The mining industry has an important part to play in the transition to renewable energy. To meet the demand for low carbon technologies such as wind turbines and batteries for electric vehicles, production of the raw materials must increase dramatically. Lithium is one mineral in high demand.

> The World Bank has forecast a 965% increase in lithium demand from 2017 production levels by 2050.

Most of the world's lithium is either produced in South America by solar evaporation from salt deposits or Western Australia from open pit mining of hard rock deposits.

Lithium in Cornwall

Cornish Lithium is a company focused on the responsible extraction of lithium, exploring in lithium-enriched geothermal waters and granites in the southwest of England, aiming to extract mineral resources in an environmentally responsible way.

The region is underlain by a massive lithium-rich granite, formed about 290 to 270 million years ago. Certain pockets in the 60,000km^3 of granite are more lithium-enriched. The granite has a higher heat flow than any other parts of the UK, with potential for geothermal energy.

Cornwall is cut by many geological faults and mineralisation is associated with the granite intrusions. The county has historically been a major producer of copper and tin, with more than 3000 named mines. Stock prices collapsed before the minerals ran out, and the last tin mine closed in 1998. However, there is still potential for tin, copper, tungsten and other technology metals.

Engine houses are dotted around the landscape because the miners needed to pump water out to artificially lower the water table so they could mine deeper. Much of this water was called 'hot springs' – upwelling warm waters that travelled into the mine through permeable geological faults. These geothermal waters were sampled as far back as 1864 and found to be enriched in lithium.

Today, Cornish Lithium is focused on exploring for lithium and other battery metals in the region.

The company is looking at four main settings and the potential for production from shallow geothermal water (1-2km depth). Although the geothermal water is much hotter at 5km, this is very expensive to drill, requiring a more powerful drilling rig as used by oil and gas companies.

Affordable and clean energy is a really key goal, requiring industry, innovation and climate action alongside responsible consumption and production.

> Mining undertaken responsibly has the opportunity to contribute positively to sustainable development goals.

Cornwall has an amazing mining history and a wealth of subsurface information from old mine plans and sections. Some are 200 years old and hand painted on vellum, and cannot be scanned.

Cornish Lithium employs two full-time digital archivists to capture 2D information, which is brought into GIS software. Then 3D modelling software transposes the images into a virtual 3D space, allowing all the information to be traced.

This historical data can be amalgamated with satellite imagery and remote sensing data from aerial and drone surveys, which show these large geological structures, and can be traced through the cliffs and out to sea.

A 3D digital model of the subsurface can therefore be built without needing extensive drilling, which allows Cornish Lithium to target specific geological structures with confidence.

Hard rock project

China clay has also been mined for 250 years in central Cornwall. The reduction in demand for china clay in recent years has left a lot of infrastructure for potential reuse.

Cornish Lithium has completed its second drilling campaign, focused on a disused china clay pit at Trelavour Downs, adjacent to the site of a lithium mine active during World War II, which can be repurposed to produce lithium, fitting into the circular economy.

01 Engine houses dotting the Cornwall coast are evidence of earlier mining

02 Cornish Lithium is exploring for lithium in a disused clay pit at Trelavour Downs

03 Test site for extracting lithium-enriched geothermal waters from hot granite rocks

The company hopes to have a JORC compliant resource in the autumn, with testing on how to extract lithium and associated by-products from the mica minerals.

Cornish Lithium will use a new extraction technology developed by Australian company Lepidico.

Currently, most of the world's production of lithium from hard rock sources involves roasting to extremely high temperatures to crack the mineral structure and leach lithium out. The innovative new process extracts lithium from the mica minerals without any roasting. This has a much lower carbon impact and is more environmentally responsible.

Geothermal waters

United Downs is the company's flagship test site for lithium-enriched geothermal waters.

To date Cornish Lithium has drilled two experimental boreholes to depths of approximately 1000m in the area where lithium was first discovered in 1864 in these upwelling warm waters.

The United Downs Geothermal Test Site has proven that it is feasible to pump these circulating warm waters within the permeable geological structures and extract lithium from them.

The waters at the design project are less salty than sea water, but contain significantly lower levels of deleterious elements than the South American deposits.

Cornish Lithium will extract the lithium from the water, while also seeking to commercialise the geothermal energy.

> The process could ultimately be a low carbon or even net zero carbon way of producing lithium.

Recent progress has been made in new technologies that can extract lithium directly from waters – a suite of 'direct lithium extraction' technologies.

Highly selective membranes or ion absorption beads can be used to selectively remove just the lithium compounds from the water. These are concentrated into lithium chloride, which can be further processed to generate a battery grade lithium hydroxide.

Cornish Lithium is excited about the potential for its pilot lithium extraction plant, which is currently being built with government funding.

'Water is pumped from a borehole to the surface and heat energy is extracted. A pass into the lithium pilot plant extracts the lithium compounds and then you can re-inject it back to depth where it will heat up and hopefully recharge the lithium again,' said Crane.

'It's crucial to decarbonise and combat climate change. Energy transition will be mineral intensive, and the mining industry has a huge task ahead. We must embrace new technologies to help explore for lithium and other battery metals, and do it responsibly. That's why 3D digital modelling is so important, to get as much data as possible from all the information available,' concluded Crane.

New extraction technologies can also help unlock mineral deposits that have previously been thought unconventional, or to help deal with falling head grades in copper and tin mines around the world. All geoscientists have a responsibility to play a key role in this energy transition.

Thanks to
Lucy Crane
Senior Geologist, Cornish Lithium

Edited excerpt from Maptek Connect presentation, May 2021

Supporting sustainable mining

Maptek believes that greater efficiency, productivity and sustainability can be achieved throughout the mining life cycle by building these aims into a mine's operating model.

Coalition for Eco Efficient Comminution (CEEC) is a global initiative, providing access to current technical scientific papers and field studies for the global mining industry. CEEC promotes awareness of the most outstanding and high impact eco-efficient technologies for sustainable, efficient, lower footprint mining.

Maptek™ has joined other forward-thinking companies wanting to make a difference to sustainable mining by supporting the work of the not-for-profit Coalition for Eco Efficient Comminution (CEEC).

CEEC was established by a group of mining industry leaders who recognised the need for a platform providing effective communication around the latest technical findings on efficient comminution practices.

Extensive research and engineering design studies have established that a range of improved blasting, crushing and grinding techniques can lower project costs and improve energy efficiency.

CEEC objectives to drive efficiency, productivity and sustainability throughout the whole mining life cycle are well aligned with Maptek aspirations. Maptek focuses on providing tools for integrated decision support to help make operations safer and more efficient.

Integrating comminution outcomes into mine planning from the outset addresses considerations around environmental, social and governance (ESG) factors, which investors increasingly look to include in their analysis of material risks and growth opportunities.

‘Building eco efficiency and sustainability into a mine's operating model is more than possible, and we aim to contribute our expertise through support of CEEC,’ says Maptek CEO, Eduardo Coloma.

‘We believe the aims can be best achieved by considering comminution outcomes from the earliest stages of mining.’

Decision support

Maptek develops solutions that are easy to use, and works collaboratively with customers, technology partners and industry.

Multi-objective optimisation is an effective technique that Maptek employs to develop new decision-support solutions.

'We turn data into knowledge at every stage of the mining life cycle,' says Coloma.

> Ultimately, fully integrating that knowledge will change the way mining is done, forever.

Maptek considers that incorporating solar and wind energy usage in mine scheduling tools will help mines optimise energy consumption and reduce operating costs.

Blast design and fragmentation is another focus area. Creating a single design is traditionally highly engineering intensive.

The trend towards remote operating centres sees a shift away from onsite, reactive design efforts. The Maptek blast optimisation solution automates repetitive elements of the drill & blast design process.

Multi-objective optimisation references empirical models of fragmentation, vibration and fly rock, with powder factor and cost incorporated as objectives or constraints.

This holistic approach allows blast designs to be completed earlier as part of an integrated proactive short-term or medium-term planning process.

Maptek fragmentation solutions provide accurate analytics that can drive improved productivity and performance.

Fragmentation has a significant effect on blasting costs, schedule conformance, dig rates and crusher performance. Tracking fragmentation metrics on a blast by blast basis helps engineers analyse blast design parameters and manage the impacts on mining.

'Understanding our customers and their operations ensures we maximise our contribution by creating solutions to revolutionise mining,' concluded Coloma.

Through accelerating information, knowledge and technology transfer, CEEC can help miners lower processing costs and raise shareholder value.

Answering the geology challenge

Vulcan GeologyCore takes modelling outcomes to new heights, raising the bar for industry in handling data validation and drillhole correlation before modelling starts.

Making geological modelling simple is the premise of Maptek™ Vulcan™ GeologyCore. The new application frees up geologists to do more analysis on their resource data by removing time-consuming manual validation, chart creation and database manipulation.

Even with the latest computing technology, resource modelling can prove a challenge. Data validation remains a bottleneck in the workflow. How much data is enough and does the model accurately represent all the data?

Geologists can be confident that with Vulcan GeologyCore, drillhole and other data is clean, accurately correlated and in a valid format before modelling. The novel approach introduces a repeatable and non-destructive workflow.

Maptek Technical Lead, Richard Jackson knows the frustration of running complex tasks overnight, only to find next morning that a data error had stopped the process. Valuable time must be spent finding the issue and cleansing data before initiating another modelling pass.

‘As a geologist, I judge the impact of Vulcan GeologyCore from the belief that my time is better spent making decisions about geology, rather than setting up specifications!’ said Jackson.

An intuitive ribbon streamlines the process from importing and validating drillhole data, through defining geological domains, to generating the model.

Geologists can choose modelling techniques such as cloud-based machine learning with DomainMCF alongside conventional approaches such as vein and implicit modelling.

There is no doubt that interpretation can be highly subjective. Three geologists will have three different opinions. DomainMCF provides an unbiased approach to modelling.

> Vulcan GeologyCore paves the way towards updating resource models daily or multiple times a day, instead of quarterly or yearly.

Users can easily experiment with changes to domains and see the immediate effect on the model, without actually modifying the original data until they are satisfied.

‘One of my goals is to make and validate grade control models in less time than it takes me to finish my coffee,’ joked Jackson. ‘I'd like to link the models automatically to downstream processes like optimisation and scheduling.’

Vulcan users will be familiar with the logic and data routines in Vulcan GeologyCore. Drillhole and other data is managed in Vulcan, then opened in Vulcan GeologyCore for validation, domain definition and model generation. The user returns to Vulcan for grade modelling and advanced statistical analysis.

Early access customers and participants in the recent Maptek Geology Challenge were able to try the new workflow for themselves, reporting time savings and speed as the standout benefits.

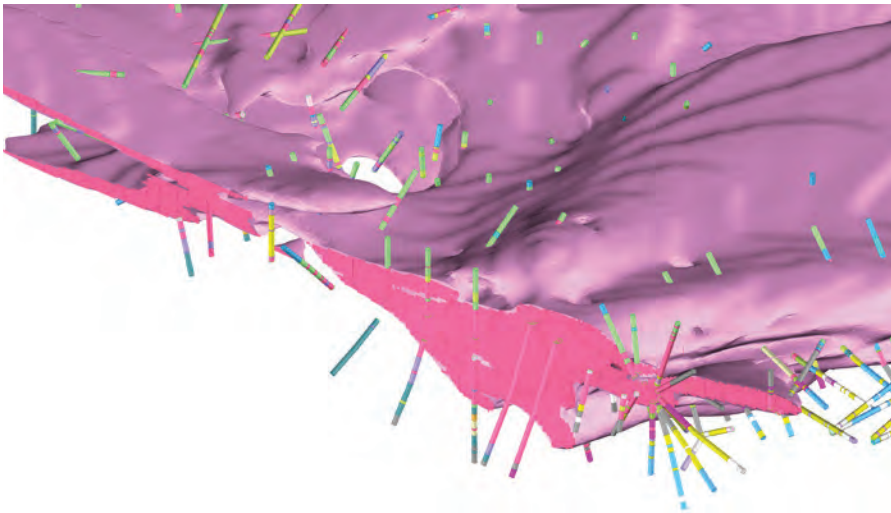
'It was really convenient to load all the drillhole data into Vulcan GeologyCore. Using the lithology targeting tools we could change our parameters on the fly to see how they corresponded with sub-mine units,' said one of the winners.

Jackson is also keen to apply Vulcan GeologyCore and DomainMCF in combination with Maptek drillhole planning tools to optimise and de-risk a deposit.

‘Maybe I am taking this dream too far but I know I don’t want to go back to the old way of doing things!' concluded Jackson.

Vulcan GeologyCore entitlements will be included in Vulcan GeoModeller and GeoStatModeller bundles, and will be offered as a subscription for customers wishing to access it as a standalone.

Adding DomainMCF to Vulcan GeologyCore takes advantage of machine learning for fast, accurate domain modelling.



Mining narrow vein orebodies

New exploration and resource estimation tools designed for narrow vein deposits have created opportunities for low volume projects to thrive.

Bara Consulting Principal Mining Engineer Clive Brown believes a resurgence in small mines has been driven by evolving attitudes, technology and techniques.

'In the last few decades most mining companies have found it easier to finance bigger projects, and particularly the major mining companies have chased larger deposits,' Brown said.

Many smaller narrow vein deposits that have been discovered are also available for development. Several factors have made mining these deposits more attractive using narrow vein underground methods.

The fact that many jurisdictions adopt a 'use it or lose it' policy means companies cannot indefinitely hold on to properties they are not developing. The deposits become available for junior project developers and mining companies that are more suited to low volume operations.

Environmental pressures on mining and the high cost of building, maintaining and rehabilitating large infrastructure footprints motivate the 'tread lightly' approach of smaller operations.

The availability of exploration and resource estimation tools specifically designed for narrow vein deposits, and a range of smaller underground mining equipment, gives mining engineers flexibility in choosing the best approach.

Processing and tailings storage facility technologies that have developed around low volume operations are directly applicable to narrow vein mining, and novel mining methods will play a part in the future of the practice.

Selection of development fleet and excavation dimensions can have a significant effect on project capital and operating costs.

Smaller equipment and narrow vein specific methods allow mechanised mining to be selective and cost-effective. A low volume approach can significantly change project metrics and viability.

Realising value

A gold project in East Africa, initially owned by a major gold company that completed a scoping study and found it to be unattractive, became more viable when its new owners considered a different approach.

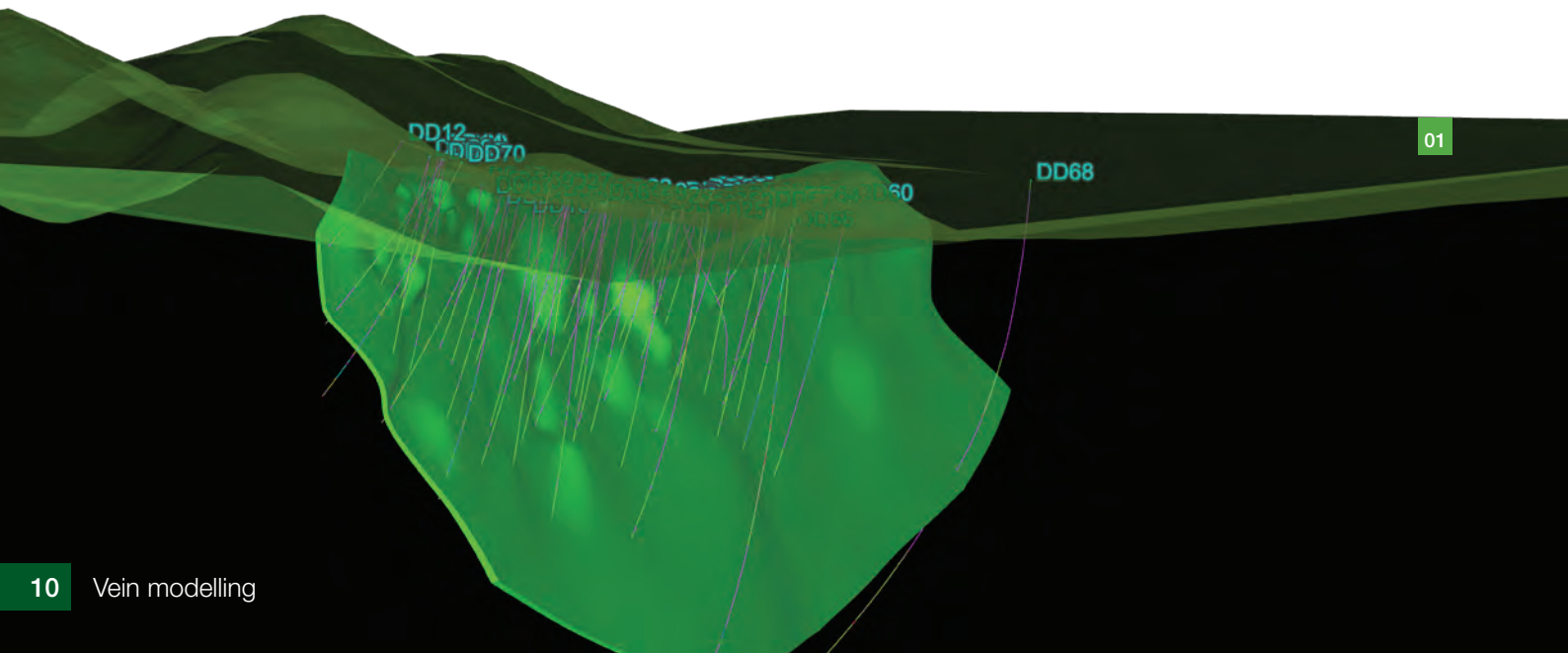
In the initial scoping study the resource grade of 12.1g/t gold was diluted to a run of mine grade of 5.8g/t.

Mechanised open stoping was initially assumed, with large access excavations accommodating 50t trucks and a minimum mining width of 2.5m. A mining inventory of 4.95Mt at 5.8g/t Au was proposed and the production rate was scheduled at 490,000tpa.

Bara Consulting worked on a revised study commissioned by the new owners and traded off the mining equipment fleet and size, selecting a smaller suite which could work in a 4m x 4m access ramp and drives.

Allocating smaller equipment reduced the minimum mining width to 1.5m. The mine was replanned and scheduled, resulting in a mining inventory of 3.16Mt at 7.9g/t Au scheduled at 400,000tpa.

The NPV of the project increased from US$8M to US$106M and operating costs dropped from US$1215 to US$612 per oz.



Complex geology

Narrow vein deposits generally exhibit complex geology, being associated with mineral veins or shear zones and featuring variations in continuity, dip, strike, width or mineralogy, which affects metallurgy downstream.

The veins are composite, so the grade of mineralisation is restricted into zones. Branches, intersections or braided zones, known as horsetailing, are common features and it is important to define the high grade ore shoots.

Data is traditionally collected through mapping, geophysics and geochemistry, trenching, drilling and sampling. This helps develop a picture of the deposit through longitudinal and horizontal sections.

These sections are used to interpret the orebody behaviour and are digitised before wireframes are generated. This repetitive and time-consuming process limits the time geologists have to solve problems and understand the geology.

Solids are created with straight lines between data points, resulting in unrealistic models inclined to be chunky and angular and not a true reflection of a deposit.

Maptek software and workflows can overcome these issues, providing a truer picture of narrow vein orebodies and releasing geologists to work on fundamental geology and analysis.

A comprehensive from–to dataset is added to a database, and mapping strings from geophysics, underground or surface mapping can supplement the information.

A dedicated Maptek narrow vein modelling tool generates a first pass model. This improves geological understanding and informs drilling and mapping targets. The new data is then fed through the narrow vein tool to quickly generate the resource model.

Automating a proven process with the narrow vein tool improves accuracy, allowing geologists to focus on other tasks such as monitoring drilling, logging core and investigating unexpected results.

> Results are delivered faster to management, investors and the market.

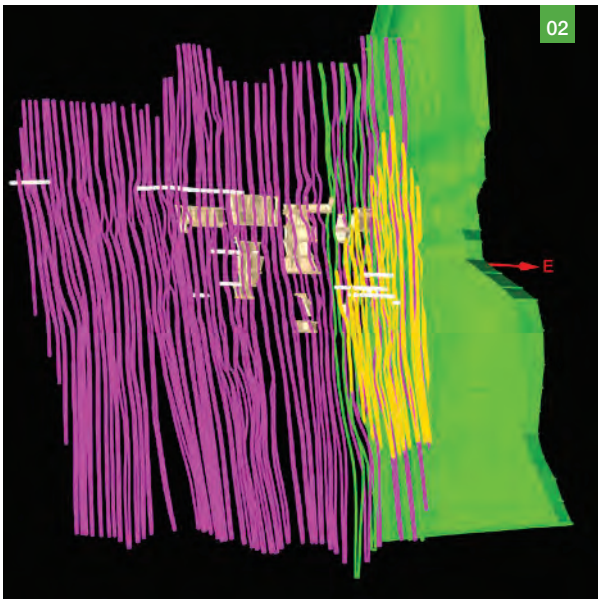
The fact that deposits remain that have been ignored by the major miners means smaller operations can capitalise.

'Bigger is not always better. The future is bright for smaller volume quality orebodies if they are well planned and well managed,' Brown concluded.

As more successful projects of this kind come online, the value of narrow vein specific exploration resource modelling tools and mining equipment will be reinforced.

Thanks to
Clive Brown
Principal Mining Engineer
Bara Consulting

Edited excerpt from Maptek Connect presentation, May 2021



01 Orebody and drillholes in relation to surface topography

02 Section view of a narrow vein deposit exhibiting braided sinuous ore zones

03 Changing parameters increases NPV and lowers operating costs

Continuous improvement in drill & blast

Drill & blast is the cornerstone for safe and efficient mining operations. Anglo American is significantly improving processes in a rolling implementation of Maptek™ BlastLogic™.

Anglo American commenced implementation of Maptek™ BlastLogic™ in 2017 to deliver the digitisation of critical drill & blast information. The goal was to transform inconsistent practices into an integrated function underpinning safety and value protection.

Dr Alan Tordoir, Lead Drill & Blast Group Mining Technical & Sustainability for Anglo American, oversees drill & blast for 20 surface and 12 underground operations. He benchmarked the original rollout at six open pit sites, which has enabled streamlined uptake at a total of 15 global locations so far.

'It's a really exciting time to be in the industry, with a lot of new technologies and processes emerging,' said Dr Tordoir.

> Turning data into proactive decision-making information is key to success.

Traditional paper-based drill & blast is inefficient, complicated by multiple platforms contributing to design, hole placement and tie-up. Data transfer between stages leads to further communication challenges between field and office.

BlastLogic stores a single source of truth for all processes. The outcome is a significant increase in downstream productivity and better management of explosive risks.

Anglo American has also found that design and execution teams have been brought closer together, and providing the data in a timely manner allows every level of the organisation to make proactive decisions.

Technical and Innovation May 2021 update from Anglo American stated:

'In blasting practices, the company reported a 50% improvement in drill & blast execution vs plan, which was enabled via real-time, in-field digital platforms.'

Change management

However good a new system is, the changeover phase can be disruptive. Maptek supports customers through BlastLogic configuration, training and implementation, aiming for minimal disruption to the production environment.

Dr Tordoir paid particular attention to proving the benefits during the Anglo American rollout, mapping out the process and troubleshooting at the original sites so that replication was easy for subsequent sites.

Benchmarked data was made universally available, so that teams could track their adoption trajectory curve. When an operation can see how others have overcome initial problems, uptake is faster.

Maptek has found that other customers have a similar change management experience. Recent graduates may be initially more comfortable with new systems, but longer-term players soon recognise the benefits of digital processes and quickly absorb them into a new integrated workflow.

Anglo American found continuous improvement is much easier when multiple sites are sharing the same system. Operations can learn from each other, and can see what good practice looks like. The KPI data showed how some sites were performing better than others.

Having a unified platform for design work enables consistent training and upscaling. This ensures that engineers are performing at the required level to deliver fit-for-purpose designs that promote safe and efficient operations.

'Improvement is a never-ending journey,' concluded Dr Tordoir.

Automation advances

Upcoming releases will introduce a drilling data entry on the blast loading tablets for sites with contractor drill rigs, so that all the drilling and charging data is captured for analysis.

Automation of the blast design process is an exciting innovation by Maptek to advance analysis of the interaction of different factors as part of blast design.

Engineers can then better understand how they can trade off objectives to determine the value that can be gained by small incremental design changes.

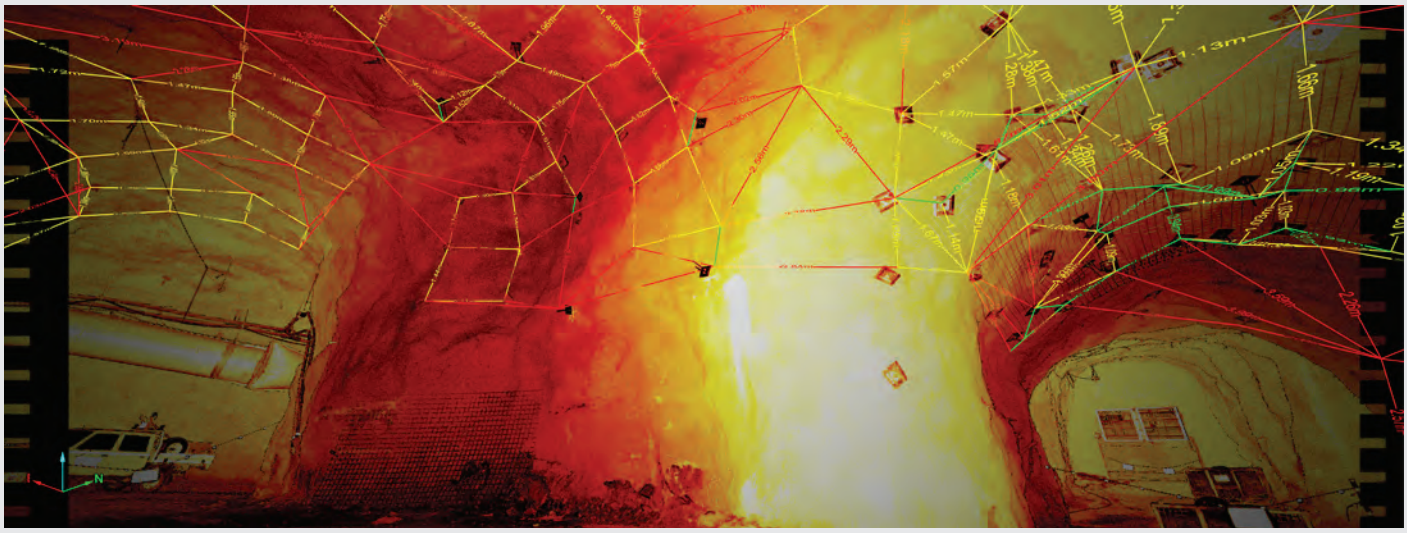
The future will also bring blast design deeper into the upstream planning process and broader cross-operation scenario design.

Dr Tordoir looks forward to a continuing partnership with Maptek to integrate technology solutions, to improve the downstream feedback loop and to empower engineers.

Thanks to
Dr Alan Tordoir
Lead Drill & Blast Group Mining Technical & Sustainability, Anglo American

Rock bolt 3D visualisation and analysis

A new tool applies laser scan data to reconcile rock bolt distribution and effectiveness, improving safety in underground environments.



A new tool that automates the spatial distribution and analysis of rock bolt effectiveness will be available to Maptek™ customers later in 2021.

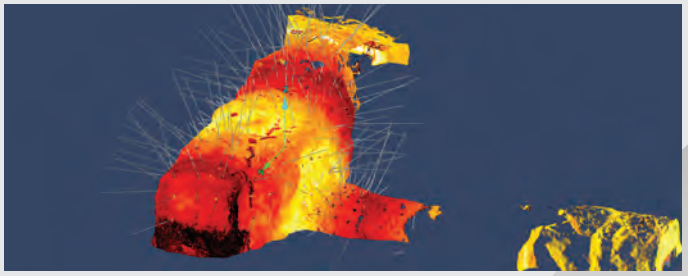
The rock bolt solution includes extraction, analysis and reporting options for evaluating the stability of structures and surrounding rock mass to maintain safe working conditions underground.

> Support and reinforcement of rock structures is a safety priority for underground mining operations and civil tunnelling projects.

Rock bolts are installed in mines and tunnels to support exposed structures and prevent rock collapse. Current practice involves personnel visually inspecting the placement, distribution and condition of rock bolts to assess their effectiveness.

The new Maptek approach automatically identifies and counts the bolts on the laser scan, removing the need for manual or digitised recording.

Rock bolt assessment is easier, faster and safer. Underground operations can determine whether the location of planned or installed bolts is correct and take remedial action as required.



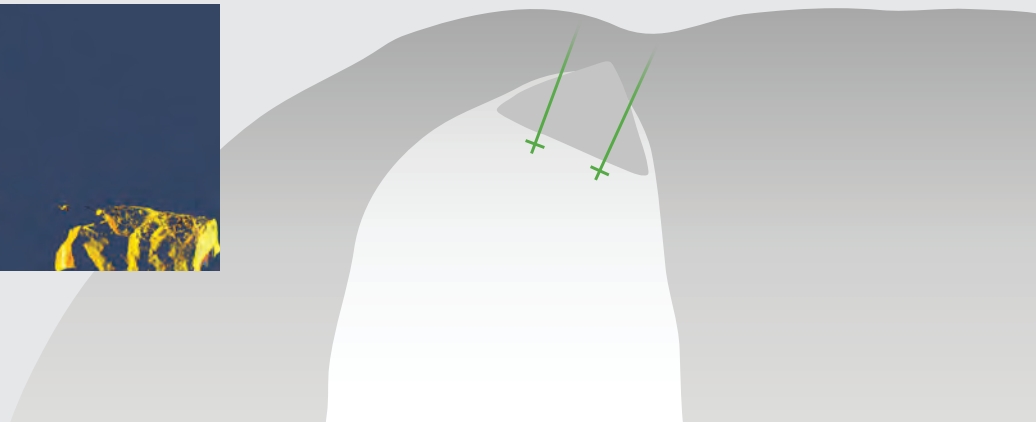
Benefits

- Improve underground safety through understanding rock mass support requirements
- Design placement of rock bolts to prevent key block failures and meet site safety regulations
- Accurately represent rock bolt location for more efficient design and reduce costs related to surplus placement
- Confirm placement of rock bolt patterns through 3D visualisation and reconcile payment for installation contractors
- Reporting and visualisation features support better decisions by surveyors, geotechnical engineers and mine management

Rock bolt analysis is run on point clouds captured by Maptek laser scanners. The Maptek SR3 system is ideal for underground survey applications and can be deployed to capture rock bolt data weekly or monthly, depending on the extent of underground headings and installation areas.

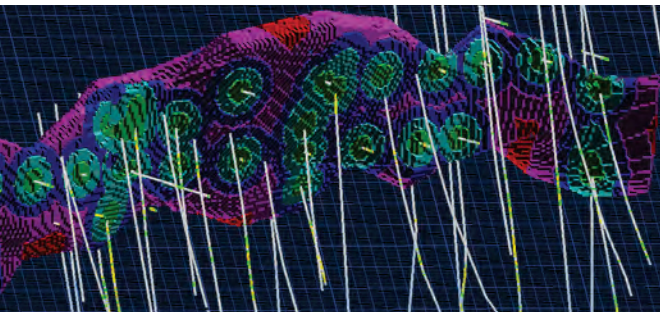
Future development includes incorporating output from SLAM (Simultaneous Localisation and Mapping) data sources.

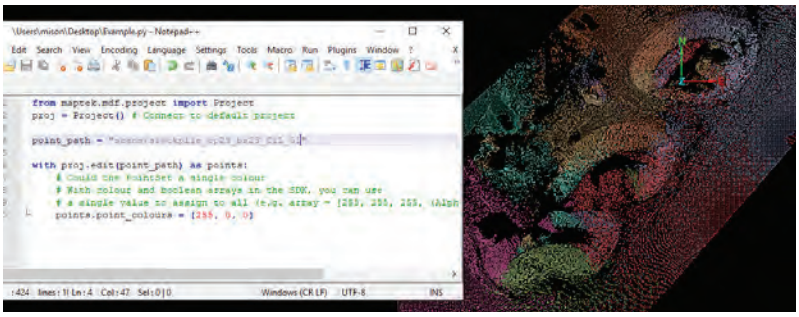
Rock bolt analysis will be available by subscription for PointStudio and PointViewer licences.



Leveraging the power of Python

Users can leverage the power of scripting with support for Python libraries or tools broadening the opportunities to extend the value in use of Maptek™ applications.





Python training is giving mining professionals a firm foundation to automate tasks and streamline software use. Uptake of Python usage has risen globally and Maptek™ offers in-person and online scripting courses.

Geologists, surveyors and engineers have gained exposure to the potential the scripting solution offers for value-adding to Maptek™ Vulcan™. The training covers block models, triangulations, sample databases and design databases.

Python is easy to learn and easy to use. It can help Vulcan users interrogate, analyse and extend the value of project data, and create custom solutions.

Software Engineer Mick Hannebery delivers Python training from the Maptek office in Perth, Western Australia.

'Python is a dynamically typed language that lets you do things that stricter languages won't allow – it's forgiving and flexible,' said Hannebery.

Python is popular in a range of disciplines such as education, business and mining. A large library of modules covers many tasks, including statistics, analysis and graphs, and skills are transferable across many industries.

A key time-saving advantage of Python is the availability of ancillary libraries that contain pre-written code for creating new scripts.

Python integration was introduced in Vulcan 11 and the libraries for Vulcan 2020 and 2021 are now more extensive and compatible with newer versions of Python.

'Vulcan is a giant, it's organic, and Python doesn't cover everything. Typically Python will let you tap into something that's already been created in Vulcan and then analyse it more deeply,' Hannebery said.

Python discussions are shared by developers all over the world, and online access to well-vetted libraries flattens the learning curve for new users.

> You don't need to be a software engineer to take advantage of Python capabilities, you just need the right mindset.

Hannebery enjoys teaching Python and seeing people become good at it and enjoying it too.

'Geologists are curious people and tend to like using Python to learn more about their deposits,' said Hannebery.

A simple example is a process in Vulcan that works on a single triangulation. With Python, users can create a loop to apply that process to all the triangulations, scaling up their work.

Users can record macros to replay actions selected in Vulcan and add the macro to the script. They can also define a step to run a Python script within the Workflow Editor on the Maptek Workbench.

Significant productivity gains are found through automating interrogation of large files and datasets, and thereby avoiding manual data entry.

'Essentially, Python is a way of speeding up your processes – you'll soon get back the time you invest,' concluded Hannebery.

Maptek has developed integrated Python libraries for automating tasks in Vulcan and Maptek™ PointStudio™, with other applications to follow.

The commitment to making Python a first class citizen in Maptek software will allow users to extract even more value, expand capabilities, bridge integrations and work on automation projects across mining solutions.

University partnerships in Chile

A combination of theoretical knowledge and practical skills in the application of world-leading software is essential for future mining professionals.

University of Talca

Last semester Maptek software was used by 25 students from the Civil and Mining Engineering faculty of the University of Talca, Chile. This semester 46 students will take the Reserve Evaluation and Open Pit Mining modules.

The teaching takes a two-pronged approach, with the 4th and 5th year students first learning the theoretical concepts related to data analysis, geological modelling, resource and reserve estimation and mine design, and other topics related to developing a mining project.

In the practical aspect, students apply their acquired knowledge to develop a project and solve problems that arise. They are given a database and relevant information, and are guided by a teacher throughout the process.

Finally, students present their results to peers and teachers. The feedback reinforces the theoretical and practical learning.

The immediate benefit is that students have access to software that is widely used in the mining industry. At the university stage, it is beneficial to learn software skills, and how to apply theoretical knowledge to real projects.

When they enter the professional world, they are then more prepared to tackle a project using familiar software and not have to start from scratch.

The partnership allows the university to deliver more instructive classes where students are taught concepts and apply the knowledge in the same course, making the learning more meaningful.

'We are very happy with this partnership. In addition to the opportunity for students to use the software, it has allowed us to place students in professional practice at Maptek. The training for teachers has enriched the development of their classes. We look forward to continuing these activities,' said Francisco Rivas, Director of the Faculty of Civil and Mining Engineering, University of Talca.

O'Higgins University

Students enrolled in Geological Civil Engineering at the Bernardo O'Higgins University in Chile are benefiting from a partnership with Maptek.

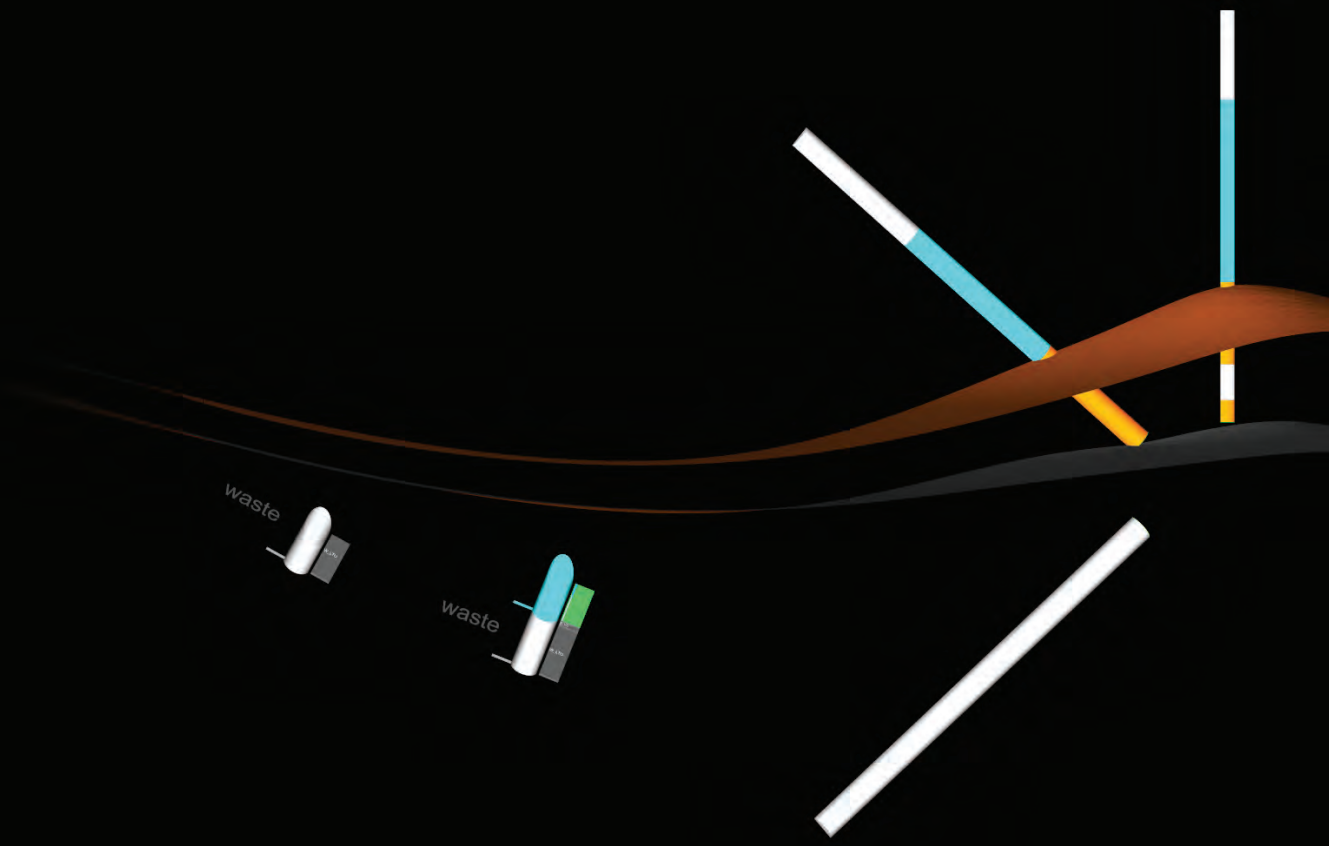
The Resource Modelling and Assessment course has a mining focus and Maptek expertise is welcomed.

Access to Maptek Vulcan software gives the students practice in a modelling and mine planning solution that is used in the mining industry both nationally and worldwide.

The opportunity to address real problems in a more integrated way gives 4th year students a firmer pathway to careers in the mining industry.

'We appreciate Maptek's input to our faculty – without this support the focus of the subject would be more limited,' said Laura Piñero, Head of the Geological Civil Engineering school at O'Higgins University.

Photographs courtesy of the University of Talca show student activities during 2019



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