Global activities

Maptek user forums, tradeshows and masterclasses were held around the globe in recent months. See our 2016 calendar for details of events where you can find out more about our technology.

Forge
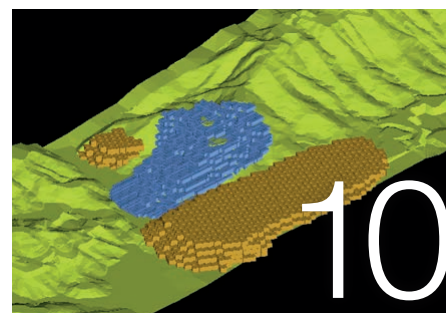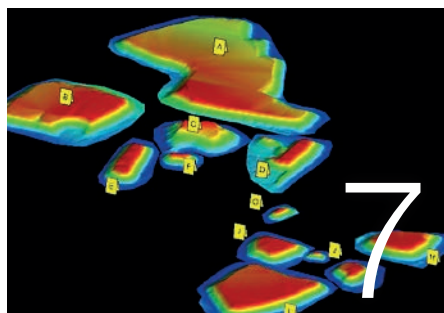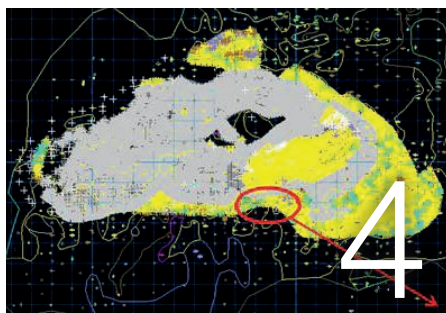
In this issue

Innovation is the foundation of all Maptek solutions. In this issue customers report on how innovation improves workflow and optimises use of technical data.

New Vulcan implicit modelling tools have been used to create a geological model for guiding short term planning at the Teck Quebrada Blanca Mine.

Klondex Mines customised Vulcan tools in an innovative approach to modelling of a narrow vein gold deposit, to guide short term planning.

Fast, accurate survey benefits mine operations and consultants alike. I-Site Drive continuous scan acquisition saves money and improves operator safety.

Product updates include new functionality in Vulcan, BlastLogic and Evolution. We hope you enjoy this issue, and welcome feedback at forge@maptek.com

Contents

On the cover

Vulcan 10 will be launched within the new Maptek Workbench. The release includes two new options inspired by the Klondex case study, Vein Modeller (for multiple veins) and Model Vein Surface (for single veins) with any Vulcan GeoModeller bundle.

Vulcan 10 preview

Maptek™ Vulcan™ 10 introduces the Maptek Workbench and includes new tools for conducting grade control and creating scheduling blocks.

Workbench

Maptek™ Vulcan™ 10 will be delivered within the Maptek Workbench, introducing a new architectural backbone for all Maptek products. Improved workflows and data sharing, the ability to establish user roles and permissions, and access to additional applications will complement the new functionality in Vulcan 10.

Workbench project leader Peter Odins said, 'The new interface is incredibly flexible, particularly for users working in a multi-screen environment. Any window can be detached from the Workbench and moved with associated icons to your desired working location.'
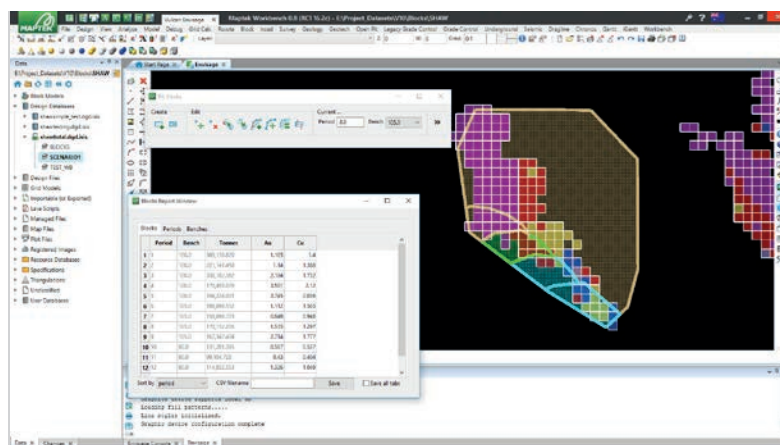
'A tabbed approach allows easy access to everyday apps such as csv, t-shell and text editors to support design and modelling tasks,' he continued.

'Dock two applications, such as an Envisage design window and the Isis database, side by side, and interactively interrogate drillholes. Changes are recorded in a log that creates a session audit trail.'

The Workbench interface is customisable from the very first screen, and includes tips and tricks and inbuilt help.

> Vulcan 10 in the Workbench introduces a new option for defining workflows that jump between different menus.

The command list can incorporate any application within Vulcan or run from Vulcan, in a single workflow. Users can add pauses, tips and prompts. This is extremely helpful for training new staff and documenting standard approaches to shared tasks. Users can still set up hotkeys, history lists and custom toolbars for their preferred mode of working with Vulcan.

New functionality in the Vulcan Explorer allows users to easily manage working files through searches and thumbnail views. This saves time when working with hundreds of thousands of files.

'The release reflects our global user base, with multi-language support in the Workbench interface and Vulcan 10 that goes beyond translated menu options to layer names and plot file output,' added Odins.

This release includes a free trial of up to 12 months of core drillhole viewing and exploration tools in Maptek Eureka for Vulcan Modeller users. Companies will be able to sign up online and match Vulcan licences to Eureka usage.

The Workbench provides access to licence configuration and operating system details to help guide technical support, as well as a memory performance dashboard.

The Workbench enables Maptek to leverage a flexible environment for development and testing, allowing new functionality to be delivered in a more versatile way. It will be progressively rolled out for Maptek I-Site, BlastLogic, PerfectDig, Sentry and Evolution.

'Looking ahead to Workbench 2, we foresee applications launched as functionality windows much like Vulcan users now view the Envisage design window. The command list workflow tool will incorporate functionality from across Maptek solutions with the ultimate aim of a single platform,' added Odins.

'True integration will be achieved when our users can build the ideal product for their tasks, enable licences online through the Workbench and work with a single data format.'

Feedback from the global beta program has been positive, with Vulcan users enjoying the modern approach to working with spatial design data. Maptek welcomes comments on the new interface at solutions@maptek.com
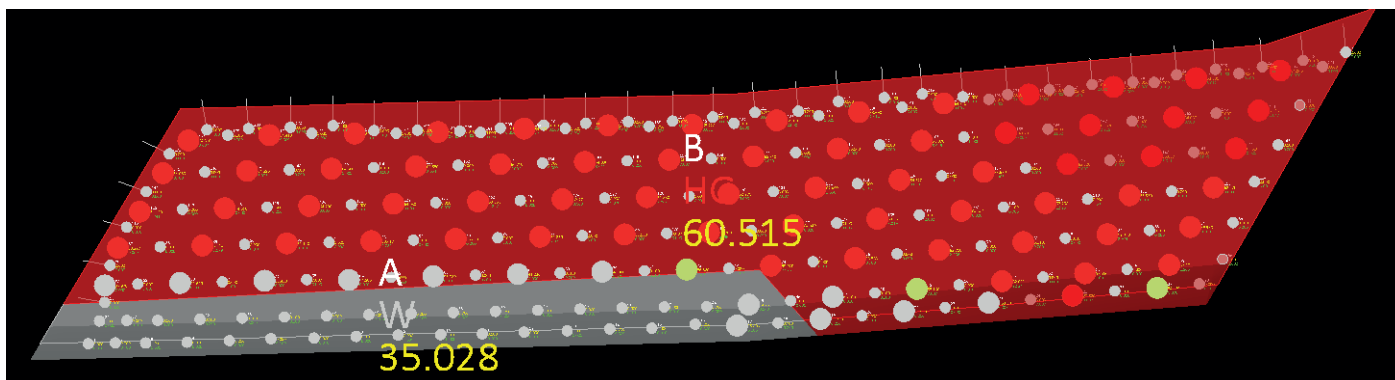
Grade Control

Revamped tools in Vulcan 10 will make the grade control process more robust, streamlining data management and workflow. Grade control is the first application written in the new Maptek Workbench framework.

Improvements focus on setup and maintainability of the grade control database. New menu modality greys out toolbar menus and icons to direct users through the grade control process. Automatic bench plan output extracts grade blocks and labels them with required attributes.

Validation checks ensure that data types are not mixed. Errors in specification file setup are flagged, and subsequent menu items remain disabled until the issues are resolved.

Key setup fields are automatically pre-populated from the source database. In the calculation rules phase the data type is explicitly enforced to clearly indicate how values are calculated. Grade block logs record how each grade block was calculated, enabling better auditing. Users will find it easy to set up and edit scripts to run conditions with pre-defined syntax, attributes and variables.

Blast solids can be generated from surfaces or levels if blast solids are not provided with grade control output.

Audit trails show changes through log files which record the last user to create, modify or delete blast files, block boundaries, block out and reconciliation files, and record weight assignment rules used to calculate block out values. Other upgrades include:

> Separate rule configuration and display avoids change to assignment rules without due process.

> Using the drillhole database as the source is no longer required in Isis database setup.

> Display of plotted data is improved.

Cutting blocks

Vulcan 10 introduces a new tool to create scheduling blocks by interactively cutting bench polygons into period-based cut polygons. Target tonnage is reserved against a block model as cuts are made.

The reserves are defined by a schedule of cut polygons, then accumulated and sub-totalled by bench, material type, grade and period in a report displayed as tabbed views. Each schedule reserve view can be exported to csv for inclusion in formatted Microsoft® Excel reports.

The optimised targeting algorithm makes this an ideal tool for short term planning.

The graphical approach allows users to show the mining blocks for the next few periods through a set of user-definable visual attributes. Cut block polygons can be interactively modified, and shared point-pairs moved as one to maintain common block boundaries.

Easy specification setup and parameter recall are features of the new tool. Benches can be automatically defined from design layers, and the option works with polygons and triangulations.

Flexible and custom views of generated bench cut polygons allow display of scheduled cuts on benches above and below, as well as periods forward and back for instant recognition of the scheduled mining sequence.

The new cutting blocks option uses Vulcan templated attributes to store metadata (block, waste tonnage) with scheduling objects for easily labelling of cut polygons by bench.

Usability and onscreen validation are key features. When merging or moving points the changes appear in real time and are reflected instantly in reserves and reported breakdown.

This new Vulcan tool saves time and improves productivity for short term planning. It can also be applied to long term planning exercises.

More information on other new tools coming in Vulcan 10 can be found at www.maptek.com/vulcan10

Automatic solids modelling

Maptek™ Vulcan™ Implicit Modelling tools were used to create a valid geological model for short term planning at Quebrada Blanca Mine in Chile.

The Teck Quebrada Blanca open pit copper mine is 4400m above sea level, 240km southeast of Iquique in the Tarapaca region of Chile. Teck has 13 mines in Canada, the US, Chile and Peru, and actively explores for copper, zinc and gold across the globe.

The challenge

Teck needed to quickly and easily generate a geological model of the supergene zone for short term planning. Staff understood the geology of the deposit extremely well, but were less experienced in technical modelling.

Maptek™ was asked to provide expertise in mapping and geological interpretation, with particular attention to lithological concepts and structural controls. The data to model included bench maps, blastholes, reverse circulation (RC) and diamond drillholes (DDH).

Maptek realised not all of this geological data had been used in the October 2013 long term model. Quebrada Blanca had a conceptual model of the hypogene area of the deposit, which differed in some respects from the supergene zone.
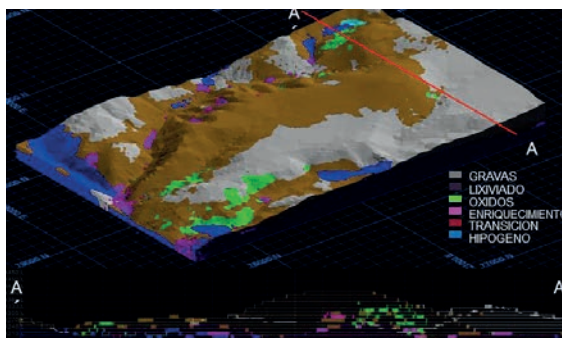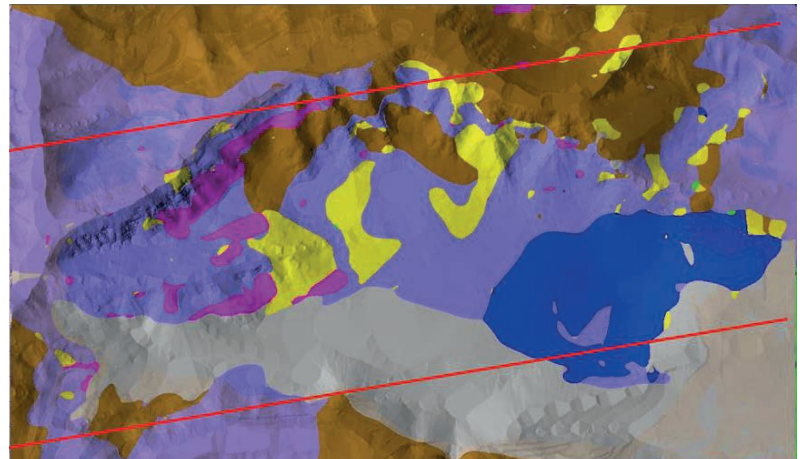
Solid model showing lithology and cross-section lines

Maptek™ Vulcan™ has several tools for manually building solid models. The aim was to test the new implicit modelling tools in Vulcan 10 to automatically produce solid models directly from the database.

The project focused on the life-of-mine supergene interpretation phase with a medium term block model. The user-defined variables were lithology, alteration and mineralised zones.

Initially, only blasthole data was used for the geological interpretation. Not all holes were fully mapped so DDH and RC drilling data was included, along with the blastholes and structural information.
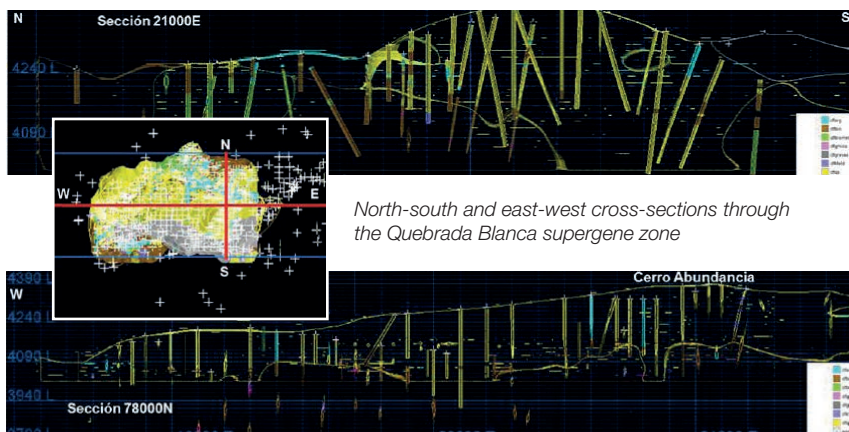
Considerations in the interpretation included mapped structures and the effects of mapping carried out in different periods. Blastholes and drillholes were displayed differently to weight data for ranking the interpretation.

Interpreting polygons

The interpreted polygons were checked for closure, repeated points and dimensions before viewing a preliminary 3D layout of the units. Continuity of the interpreted bodies could be reviewed before a final comparison and validation of the solids was obtained with implicit modelling.

A Vulcan script was used to create synthetic holes, by compositing where samples or composites accurately reflected the shape of the interpreted polygons. The synthetic database inherits the smoothness of the contacts between the interpreted polygons, and a low smoothing level was chosen to accurately represent the data.

The monthly block model for Quebrada Blanca was the basis for modelling. Between 4 and 16 samples were used to provide a more reliable estimate within the mesh composites and result in smoother edged solids.

GRAVAS
LIXIVIADO
OXIDOS
ENRIQUECIMIENTO
TRANSICION
HIPOGENO

Geological model of the mineralised area

North-south and east-west cross-sections through the Quebrada Blanca supergene zone

A simple variogram and a spherical model were selected. The orientation of the units was already implicit in the interpretation. The horizontal search radius was set at 80m, covering the maximum distance between the composites. No estimate was created in areas of sparse data. A vertical radius of 15m was set to coincide with the interpreted spacing of the plans.

Solid modelling with the implicit drillhole database did not require prior interpretation. It did require a drillhole database with previously reviewed sections and compositing data, as well as the definition of preferential directions of ellipsoids for model calculation.

Users could compare the overall consistency between the estimation direct from the drillhole database and that modelled on the interpretations.

Implicit modelling enabled delivery of a block model for resource modelling, featuring valid closed surfaces that honoured all geological contacts.

The modelling process is fully automated in Vulcan 10 using existing databases as inputs.

Advantages

Using Vulcan allowed Quebrada Blanca to produce a model and block solids to confidently prepare realistic resource estimates. Explicit control is provided through polygons. Sections and/or plans can be used in conjunction with the drilling database.

Vulcan produces consistent multi-domain models without crossovers, and with 100% shared boundaries. The 3D solids are generated in minutes and are easy to use, auditable and reproducible. Errors arising from file manipulation are avoided. The speed leads to higher productivity, with more alternatives generated in less time.

Dynamic previews allow Vulcan users to respond quickly to changes, gaining total control over the process. Implicit modelling incorporates geostatistical tools, including ordinary kriging and locally varying anisotropy to accurately account for trends.

A more accurate model of the resource improves planning and thus production at Quebrada Blanca.

Vulcan 10 implicit modelling

'Our world class Vulcan Implicit Modelling integrates block and automatic solids aspects of 3D modelling in a single tool. Users can combine various methods in a hybrid approach which best suits their deposit and achieves desired planning outcomes,' commented General Manager Maptek South America Marcelo Arancibia.

Defining a geological structure from drillhole data requires many possible alternatives to be evaluated in a short time. Uncertainty modelling allows multiple models of an orebody to be automatically generated from the same drillhole data.

Adding financial information to these scenarios gives greater confidence in assessing the viability of mining and promotes better decisions.

A new radial basis function (RBF) option complements the existing geostatistical estimation technique for implicit modelling.

Implicit modelling allows quick and easy assessment and adjustment of potential models before building. Importantly, the risk can be easily analysed. With integrated RBF, faulting and uncertainty modelling in a single workflow, engineers and geologists can tailor a best fit modelling approach for each scenario.

Implicit modelling using either RBF or the geostatistical technique takes greater advantage of shared structural trends for related domains. Vulcan 10 offers an enhanced smoothing method that still honours the drillhole data. Users can also leverage existing anisotropies.

New methods to create local anisotropies for implicit modelling, grade estimation or simulation allow grade estimation to match the complex folded structures identified through geological modelling.
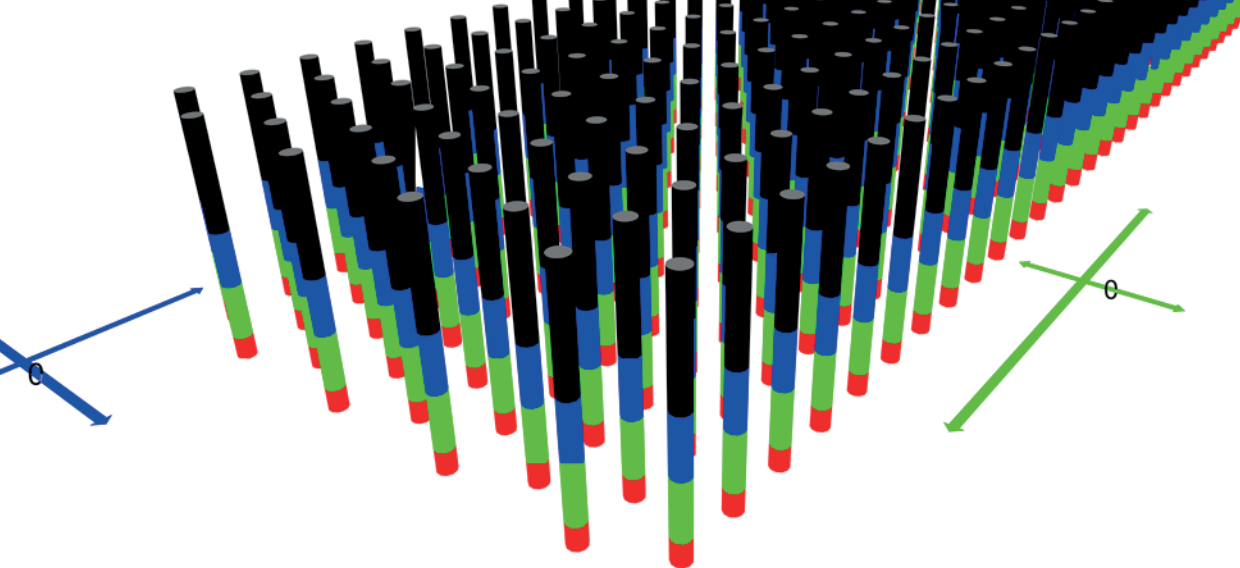
New electronic timing tools

Electronic tie-up tools will be the headline feature of Maptek™ BlastLogic™ 2.1 when it is released later in 2016.

Maptek™ will be introducing electronic timing in BlastLogic™ blast accuracy and management system. Electronic timing systems are fast becoming the industry standard for mines with complex blasting requirements.

Electronics can improve fragmentation and reduce environmental impacts of blasting without compromising quality. New possibilities are opened for multi-layer blasting techniques such as through-seam coal blasting, which can have several timing sequences in one blast.

Alongside the benefits that come with electronic timing, there are also some risks. Electronic timing systems are able to improve results due to flexibility and virtually limitless timing combinations. However, this flexibility can lead to mistakes and can be counterproductive if rigorous controls and checks are not in place.

New features in BlastLogic 2.1 streamline design and modelling to help get the most out of the electronic approach. BlastLogic includes new ways to design and manipulate hole by hole timing as well as a time saving autofill feature for duplicating a row design across multiple rows.

Animations of wave propagation guide final blast designs

Relationship based timing speeds up the design process by maintaining complex timing sequences even when plans change.

These relationships apply to multi-horizon timing sequences as well. For example, a through-seam blast may require a unique timing sequence in one coal horizon, and a completely different sequence in another. BlastLogic allows users to connect sequences so that when one changes, the others are automatically updated, reducing mistakes and saving time.

Once the blast design is complete, advanced modelling tools identify issues and high risk scenarios. Multi-horizon timing contour and timing envelope options help control blasts.

The ability to rapidly prototype several alternatives at once allows users to quickly find the most appropriate design.

Wave propagation animation and peak particle velocity maps ensure mines remain environmentally compliant.

The new electronic timing tools are integrated with industry recognised third party timing systems, and work hand in hand with BlastLogic inventory management and tracking components.

The addition of electronic tie-up to existing pyrotechnic tie-up functionality in BlastLogic is an important factor in ensuring the system offers a complete solution across the drill and blast process.
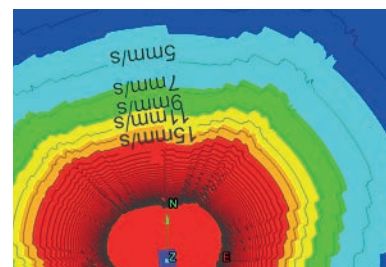
Blast modelling helps identify risk

I-Site drives cost-effective survey

Three companies based in Denver, Colorado experienced the benefits of using Maptek™ I-Site™ Drive for stockpile surveys and topographic updates.

Maptek™ I-Site™ Drive allows continuous acquisition of laser scans with an I-Site 8820 or 8200 laser scanner mounted on a moving vehicle. Mining, quarry and civil operations can efficiently survey stockpiles, highwalls and haul roads, cutting survey time by more than 50%.

The Inertial Navigation System in the dedicated vehicle mount allows the data to be acquired continuously.

> Workflows are tailored to suit common site survey practice. Surveying from the safety of a vehicle minimises disruption to operations and reduces risk to operators.

After seeing demonstrations of Maptek technology, companies based in Denver, Colorado took advantage of consulting services using I-Site Drive to generate stockpile volumes and topographic models.

American Environmental Consulting (AEC), which runs waste management facilities in Colorado and Nebraska, heard about Maptek through a talk at the Solid Waste Association of North America.

AEC hired Maptek to scan and create a topographic model about a year ago, and recently wanted a current topographic model to calculate the quantity of material that had been added to the landfill. The difference in volumes was easily calculated by comparing surfaces between laser scans, and AEC can rely on the accuracy of the results for calculating revenue.

An aggregate company which specialises in construction materials for residential, commercial and municipal projects wanted to obtain stockpile volumes at different locations.

In addition, a utility provider engaged Maptek consulting services to obtain a current topographic model for a leased site.

I-Site Drive delivers a denser data string, captured from a safe distance in less time. Collecting more data, at the required or better accuracy, and at a faster rate reduces the cost to the client, and allows consultants to be more productive.

I-Site Drive data is imported into I-Site Studio already registered into real world coordinates along with any stationary scans conducted with Drive. This shortens processing time dramatically. Volumes, surfaces, contours and other client requirements are generated much faster.

> Smart I-Site software registration and visualisation tools reduce time to output survey deliverables.

Existing survey methods were unable to create the topographic models required by these companies. Laser scanning with I-Site Drive fulfills survey requirements and saves time and money.
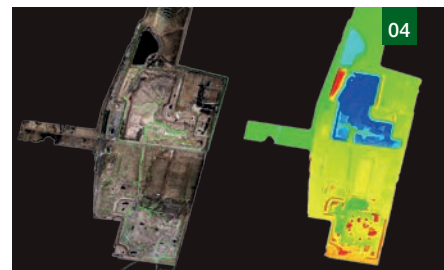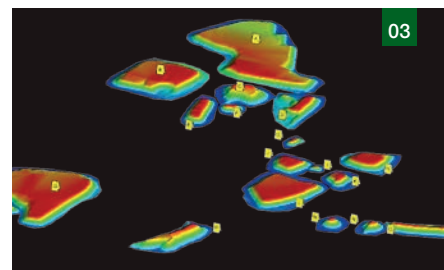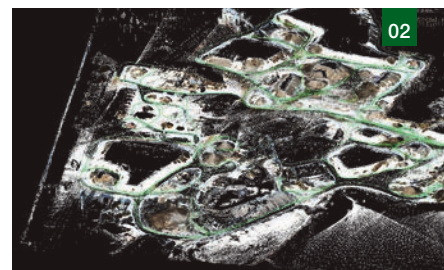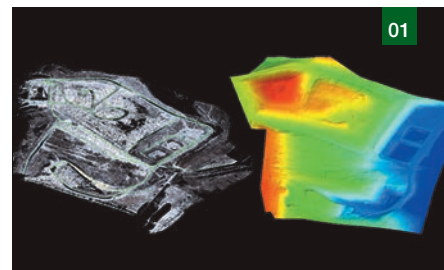
01 Point cloud of waste facility showing route taken with I-Site Drive and modelled surface with intensity readings
02 Aggregate site point cloud and tracks
03 Stockpile models generated with the new volume report tool in I-Site Studio 6
*04 Topographic survey capture and modelled surface*

Narrow vein underground mining

Klondex Mines customised the Maptek™ Vulcan™ toolbox, using Lava scripting to create a short term modelling process for narrow vein mining, freeing up time for other work.

Klondex Mines Ltd specialises in narrow vein gold and silver deposits. It operates the Midas Mine and an ongoing bulk sampling program at the high grade Fire Creek project in Nevada. Klondex recently purchased the Rice Lake Mine in Manitoba.

In the highly dynamic environment of narrow vein mining, vein characteristics and grade can change rapidly. Local resource models rapidly become outdated as information is collected from drifting along veins. Short term modelling requires vein models to be rebuilt regularly. Monthly rebuilds fit the reconciliation and short term planning cycles, and lead to better quality resource models and long term planning.

Customising the Maptek™ Vulcan™ toolbox by linking tools into scripted workflows allows repetitive actions to be run autonomously. Lava allows panels to be written to collect the required input and provide a user friendly application.
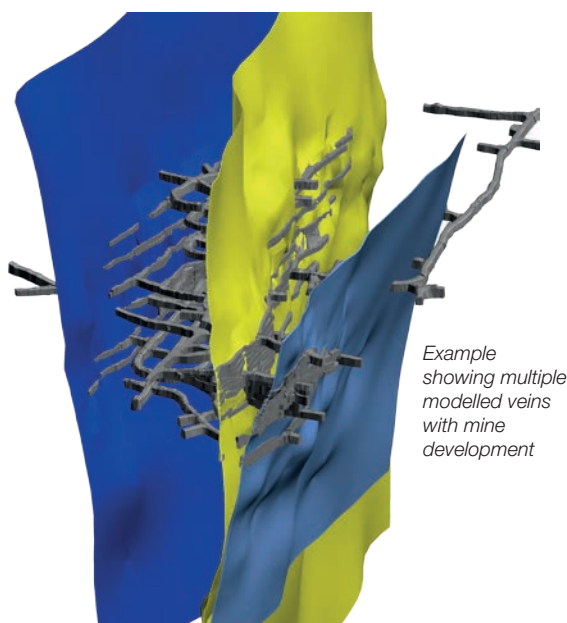
Example showing multiple modelled veins with mine development

Background

Because veins are continuous, narrow and planar it has been difficult and time consuming to create valid final solid interpretations using traditional section-based approaches.

In addition to their planar nature, vein sets may merge and split along strike, as their development is controlled by the structural framework of their environment. In this way, vein modelling is analogous to coal seam modelling. The Vulcan GridCalc menu has extensive coal modelling options using grid modelling.

Grid modelling is a form of implicit modelling, where a grid of points is interpolated to represent an attribute of interest. Benefits of the approach in vein modelling include:

> Grid nodes between surfaces align, enabling grid maths to calculate additional attributes such as the thickness of the vein in any location and to ensure nodes do not overlap.

> Grid nodes can be extrapolated outside the actual data extents to project veins along strike or down dip.

> Grids can be output to triangulations that honour both the grid nodes and the original input vein intercepts.

The complication is that grids are modelled in plan view, which works for sub-horizontal coal deposits, but not for sub-vertical veins. The solution is to use the overall dip and dip direction of the vein to rotate the input data to a sub-horizontal plane prior to modelling. Once rotated, this data can be modelled with grids and the output triangulation rotated back

to its original position. In this way, the data can be aligned to the vein orientation so the user may vary the extrapolation distance along strike and/or down dip.

Workflow

The short term modelling workflow simplifies the process from drillhole and underground channel information to a final block model that represents the vein and its spatial grade distribution, ready to be used in mine planning. The steps are as follows:

> Extract hanging wall and footwall points from drillholes and channels for the vein to be modelled.

> Rotate data to a sub-horizontal plane and model hanging wall and footwall surfaces.

> Build the vein solid and rotate data back to its original position.

> Create a block model to represent the vein solid.

> Estimate grades of economic metals into the blocks and assign confidence levels.

> Run dilution calculations to identify economic material based on minimum mining width and dilution expectations.

Using this workflow, models for active veins can be updated monthly to align with reconciliation reporting and short term planning.

Lava scripts

Lava scripts step users through this process, starting with a specification file for settings that are to remain constant throughout the entire workflow. These settings include colours for hanging wall and footwall, dip direction and dip angle of the vein, and drillhole and channel databases to use.

Gold equivalence blocks and samples showing only blocks defined as ore once dilution calculations are taken into account

User input is kept to the minimum needed to make a difference to the result, such as how far outside the data to extrapolate the models. Positive feedback is provided in the form of panels signifying completion of the running of scripts. Through Lava scripting, modelling settings and other metadata can easily be saved with the triangulations through triangulation attributes.

Lava scripting can access all Vulcan data formats such as grids, block models and Isis databases. The block model can be built without user input as the grids are interrogated for their locations and extents, supplying the required information to build the final block model on the fly.

> The Lava script does the hard work. Users spend more time validating and improving models.

The Lava scripts are set up to be adaptable to all Klondex sites. Some settings that could have been hard coded are left open for users to specify, e.g. database field names, so that the process can be transferred to a new site.

While the process uses 50% coal tools, the Lava panel terminology is specific to vein modelling. Lava scripting enables creation of tools that are specific to the work.

The entire process is quick and simple. Users can go from a set of drillholes with some coded veins through to a first pass analysis of defined ore zones or areas identified for further drilling in less than an hour. Manually, this might involve 100 or more steps and would take many hours.
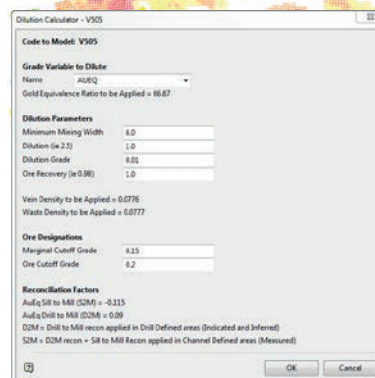
Additional functionality

Typically, in high grade epithermal vein deposits, drilling may under-represent the high grade ore shoots and hence the metal attained once silling has been undertaken. This can lead to areas not being mined that may in fact be economic if silling were undertaken.

The workflow enables drillhole data and underground channel sample datasets to be easily turned on or off, so models can be created to represent both pre-mining and post-mining results. Understanding the historical performance of ore shoots and the factors that affected their mining performance can aid future planning and analysis of ore shoots that are currently only drill defined.

As infill drilling is undertaken, the metal and economic zones of an ore shoot may change significantly. The scripted workflow enables new drilling to be quickly incorporated in updated models. This allows the results of drilling programs to be measured and aids planning of new infill programs.

A block model without waste blocks is quicker to create and much smaller than a full block model. It can be useful in the early stages of planning to identify diluted ore and waste zones. However, waste blocks are needed for short term planning and for Stope Optimiser output, where the reporting of diluted tonnage and grade from many triangulations is critical.

The ability to run dilution calculations directly on the output block models enables geologists to quickly answer the questions of 'where is the economic mineralisation' and 'what material is marginal' with the current assumptions. This functionality acts as an early stage planning tool prior to the use of Stope Optimiser at the engineering stage.

Vulcan Lava script panel for dilution calculations, providing a simple interface for user settings

> Lava scripting simplifies the process to the key steps, so users validate the results of each step before they move to the next.

Outcomes

Klondex combined tools from different menu options into a standardised workflow, simplifying what would otherwise be a complex task. Block modelling and triangulation naming is standardised, so when geologists pass models on to the engineers they know exactly what they will be working with.

Site geologists are able to concentrate on the real inputs required and spend more time validating the results, rather than just concentrating on generating the vein triangulation. By adding the tools to build block models, perform estimates, and run dilution calculations, site personnel take greater ownership of the results and how they affect short term planning. Importantly, they also have the appropriate tools and more time to allow them to identify new opportunities.

Interactive and optimised backfilling

Maptek™ Evolution has provided a rehabilitation proof of concept to define sequencing for multiple pits at a coal operation.

It is universally acknowledged that rehabilitation has a major impact on productivity and operational costs. Detailed and interactive material movement planning is required to ensure an optimal rehabilitation sequence for improving the land reforming process. Maptek™ Evolution optimises the rehabilitation phase to reduce rehandling costs.

Strategic scheduling

Evolution allows for strategic placement of material from the pit to the mining void, enabling optimisation of material handling through 'smart' backfilling. The benefit of Evolution is the support for dynamic and interactive rehabilitation scheduling.

Production scheduling and backfilling are scheduled at the same time. This ensures the consideration of key impacts between the two operations, leading to delivery of a robust and accurate mining schedule.

Rehabilitation is an integral part of mine planning and needs to be scheduled concurrently with a production schedule to account for any changes within that schedule. Rehabilitation is therefore not done on the 'back end', and forms part of the schedule.

When rehabilitation is undertaken in isolation, it is usually after a production schedule is completed. This incurs a knock-on effect to the production schedule which must be adjusted for viewing a holistic mine schedule.

With Evolution, displaying material movement on a block by block basis enables powerful visual analysis of the mining schedule.

> Value is added to the project by saving costs through strategic material placement during life-of-mine planning.

A scheduling scoping study on a mine in Africa started with a pit design of each strip with access ramps on either side. A haulage network was then built to establish all possible routes for minimising haulage costs. Several operational factors were considered:

> Shortest haulage network (following in and ex-pit ramps)
> Horizontal versus vertical dumping cost ratio
> Swell factors to account for adjusted volumes
> Void volume available as mining takes places

The optimal haul destination was achieved for each individual block, as well as optimised material placement within the pit.

Evolution 4.5

Improved interoperability for haul network generation coming in Evolution 4.5 allows users to drag and drop a haul network created in Maptek™ Vulcan™ into Evolution to automatically configure the schedule network. Multiple digger fleets can also be allocated.

Evolution 4.5 includes a new graphics environment, providing superior visualisation and easy manipulation of very large models.

New **Evolution Strategy** options allow users to track and report multiple elements and contaminants per process and/or destination. Stockpiles can be modelled with tonnage and grade items.

Setting part or all of the cut-off grade policy before optimisation means the optimisation process determines the best extraction sequence.

New options in **Evolution Origin** allow users to set maximum constraints per stage, group or period for manipulating sequences through the model. Specifying multiple truck types to work in a mining area permits mining different material types with different equipment.

Improved charting and export of schedules, and support for imperial and metric units are included in the new version due for release shortly.

For more information on Evolution email solutions@maptek.com
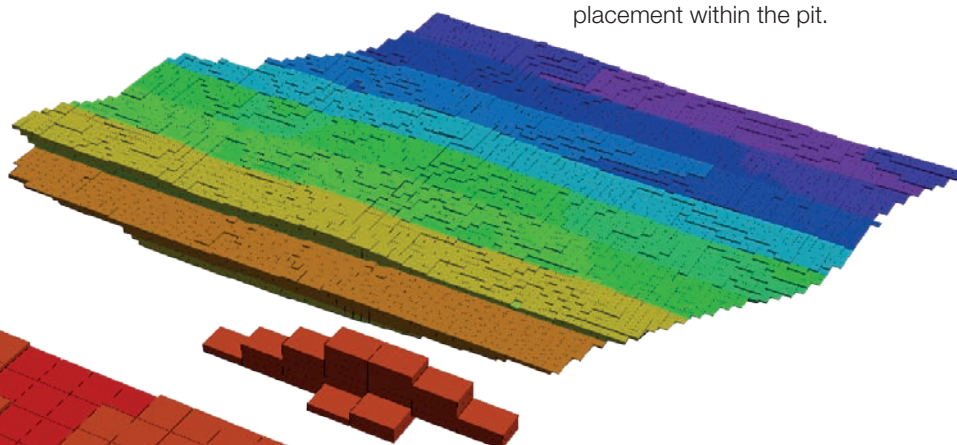
Strategic design of final landforms

3d-DigPlus animation software from Earth Technologies helps operations reduce costs by considering rehabilitation as an integral part of life-of-mine planning.

Once a mine site has reached full term it is expected that all material is returned to its original state. Understanding the way landforms are defined is key to achieving conformance to rehabilitation guidelines.

There is no industry recognised approach to final landform design. An engineer will typically gravitate towards an angular straight line design. Landform construction is generally done in levels or lifts with each dump lift building on the previous one.

These landforms are often constrained within a nominated mine planning dump footprint in which trucks are able to dump waste. The material in the lifts rills down at an angle of repose, which is usually well above rehabilitation slope requirements. Realistically, a fully constructed landform will not look natural or meet sustainable final landform slope requirements.

This approach lacks foresight and proper planning strategies. The default is to keep constructing a landform as material becomes available without consideration of the end result.

Incorporating progressive rehabilitation into everyday operations using existing fleet capacity for landform construction brings a significant and easily identifiable cost saving.

Mobilising additional equipment dedicated to rehabilitation efforts is expensive. Historically the design of final landform construction, cut and fill balances, material identification and placement has been a time intensive process.

Calculating final landforms based on target slope angles was traditionally done on a range of cross-sections. This method can be highly inaccurate and making material balance 100% is near impossible and very subjective. It becomes difficult to understand cut and fill requirements for final landforms and increases the margin for error in calculating rehabilitation costs.

Mine planning technology is evolving to a more all-round approach to life-of-mine (LOM) planning. Engineering design of 'natural' final landforms through 3d-DigPlus reshaping methods is delivering results.

The ability to generate rolling natural landform shapes with rapid turnaround for testing multiple scenarios is incredibly valuable to LOM planning. Industry wants an easily auditable and reproducible reshaping process to increase the accuracy of data.

3d-DigPlus allows for calculation of necessary push directions, distances and associated volumes to achieve a desired final landform. This is key to quantifying costs of landform construction and maintenance and identifying savings.

Different regulatory guidelines for mine closure and final landform rehabilitation nationwide lead to inconsistent approaches to rehabilitation. New strategies are redefining guidelines based on key premises:

> Soil characterisation is unique at each site.
> Stable final landform slope targets are based on site specific soil erodibility curves.
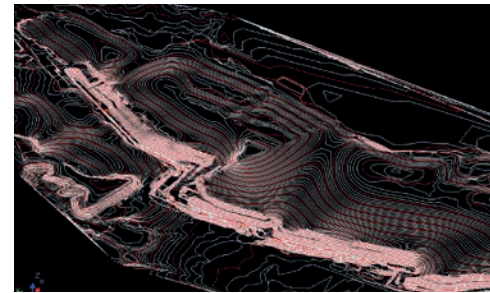
Rolling natural final landforms generated in 3d-DigPlus (above) and push distance arcs indicating material movement directions (below)

Understanding target slope criteria through soil characterisation is key to understanding associated costs, as is a collaborative upfront approach to LOM planning using new technology.

3d-DigPlus is one of the best and most accurate tools available for controlling landform target slopes and generating meaningful results. The principle is simple: start with the end in mind.

Thanks to Sara Wodyk
Landform Planning Specialist
Raine & Associates, Brisbane

3d-Dig software allows full 3D simulation across excavation, dump and machine performance. The tools are ideal for dragline, truck and shovel, and dozer movements for coal and iron ore strip mining operations. 3d-DigPlus is now available from Maptek. Email solutions@maptek.com

University partnerships

Universities across the world benefit from relationships with industry. Maptek invests in the next generation of engineers and geologists by providing software and training tailored to the needs of both research and the mining industry.
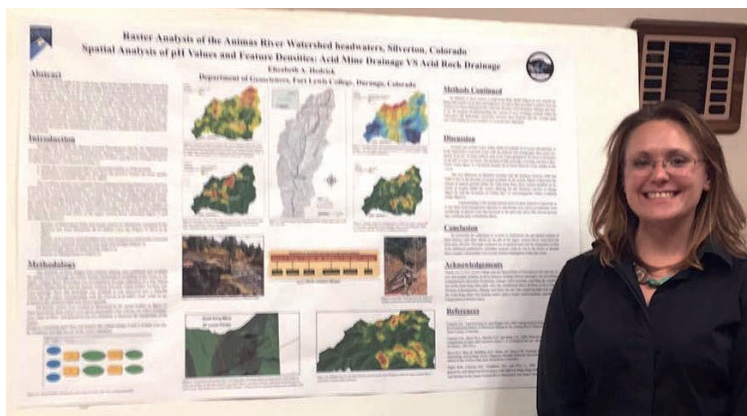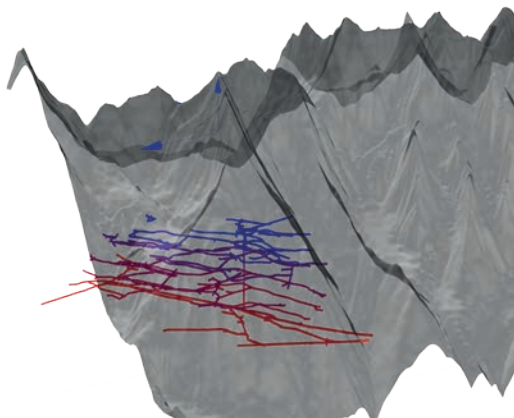
Fort Lewis College

The Department of Geosciences at Fort Lewis College encourages students to learn Vulcan software to develop their skills for careers.

Geology major Anastasia Hedrick used the Maptek university program and training sponsorship to learn Vulcan software as a tool to compile and model geological data for her senior thesis.

She also used Vulcan to increase her understanding of the dynamics of the 2015 Gold King Mine waste water spill in Colorado, a widely publicised environmental event.

The relationship between historic mining districts, the geology that drove their development, and the hydrological connections between them is very complex.

'Using Vulcan, I was able to provide a hypothetical visual projection to assist in understanding and explaining the complex dynamics leading to the spill. This project allowed me to develop strategies and refine the skills which provided a gateway into my thesis.'

With support from Maptek Anastasia developed a database and the framework for a speculative 3D model of the underground workings of the Gold King Mine to serve as a template for future work.

Vulcan's ability to import spatially referenced data from programs such as ESRI's ArcMap enabled incorporation of existing surface data as shape files from the USGS.

Faults and fractures were registered to a surface and projected through the highwall data, based on speculative depths and orientations derived from existing publications.

Integration of this data and 3D modelling allowed her to develop possible groundwater flow paths and hydrological connections between the Gold King Mine and another historic mine.

Anastasia was also able to illustrate the power of Vulcan to her student peers. Maptek North America regional University Coordinator, Maureen Moore helped set up a custom introductory Vulcan course for 18 classmates. These students have since been empowered to pursue additional training through Maptek programs.

Polytechnic University of Catalonia

Students using Vulcan at Polytechnic University of Catalonia (UPC) in Barcelona, Spain gain skills to manage, optimise and improve the efficiency of the different stages of a mining operation.

Founded in 1971, UPC is the largest engineering university in Catalonia, with more than 25 schools, 30,000 students and 2500 professors and researchers. UPC has a high number of international PhD and Masters degree students, through bilateral agreements with several top-ranked European universities.

Vulcan is mainly used in the Masters level Mining Engineering degree where around 20 students become familiar with geological tools in the Modelling and Assessment of Geological Resources subject, and open pit and underground mine planning tools in the Mining Technology I subject. Undergraduate students are also given an overview of the software in practical exercises during their degree.

UPC appreciates the contact with a technology company focused on state of the art mining, and the opportunity to learn software which is one of the most widely used products in the mining industry. Feedback from research and educational institutions is welcomed by Maptek.
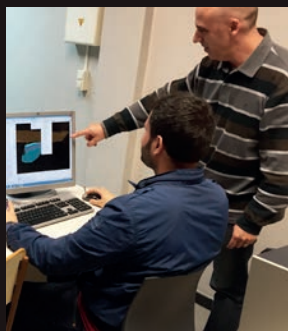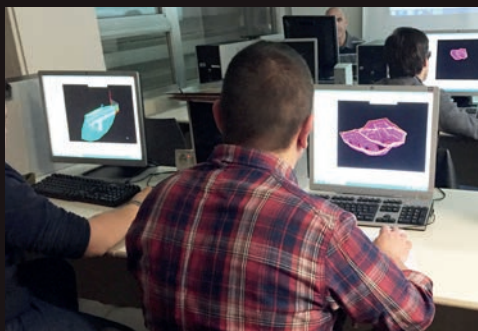
Maptek Calendar

2016

April 5-7
Discoveries 2016
Hermosillo, Sonora, México - Booth 34

April 13-15
XI Conferencia Internacional de Minería
Chihuahua, México - Booth 167

April 25-29
Expomin 2016
Santiago, Chile - Booth 811-2, USA Pavilion

April 26-28
Mining World Russia 2016
Moscow, Russia

May 1-4
CIM, Vancouver, Canada

May 10-12
MundoGeo Connect 2016, Sao Paulo, Brazil

May 17-18
12th International Gold & Silver Symposium
Lima, Peru

June 9-10
Elko Mining Expo, Nevada

June 15-17
GeoMet 2016, Third AusIMM International
Geometallurgy Conference
Perth, Western Australia

June 16-18
Euromine Expo 2016, Skelleftea, Sweden

August 17-20
México Minergy 2016
Cancun, México - Booth 240

August 24-27
5th Congress - Tendencias de Actividad
Minera en México
Durango, México - Booth 14

September 6-8
First Asia Pacific Slope Stability in Mining
Conference
Brisbane, Queensland

September 14-16
ExpoMina Peru 2016, Lima, Peru

September 16-18
International Mine Surveyors Conference
Brisbane, Queensland
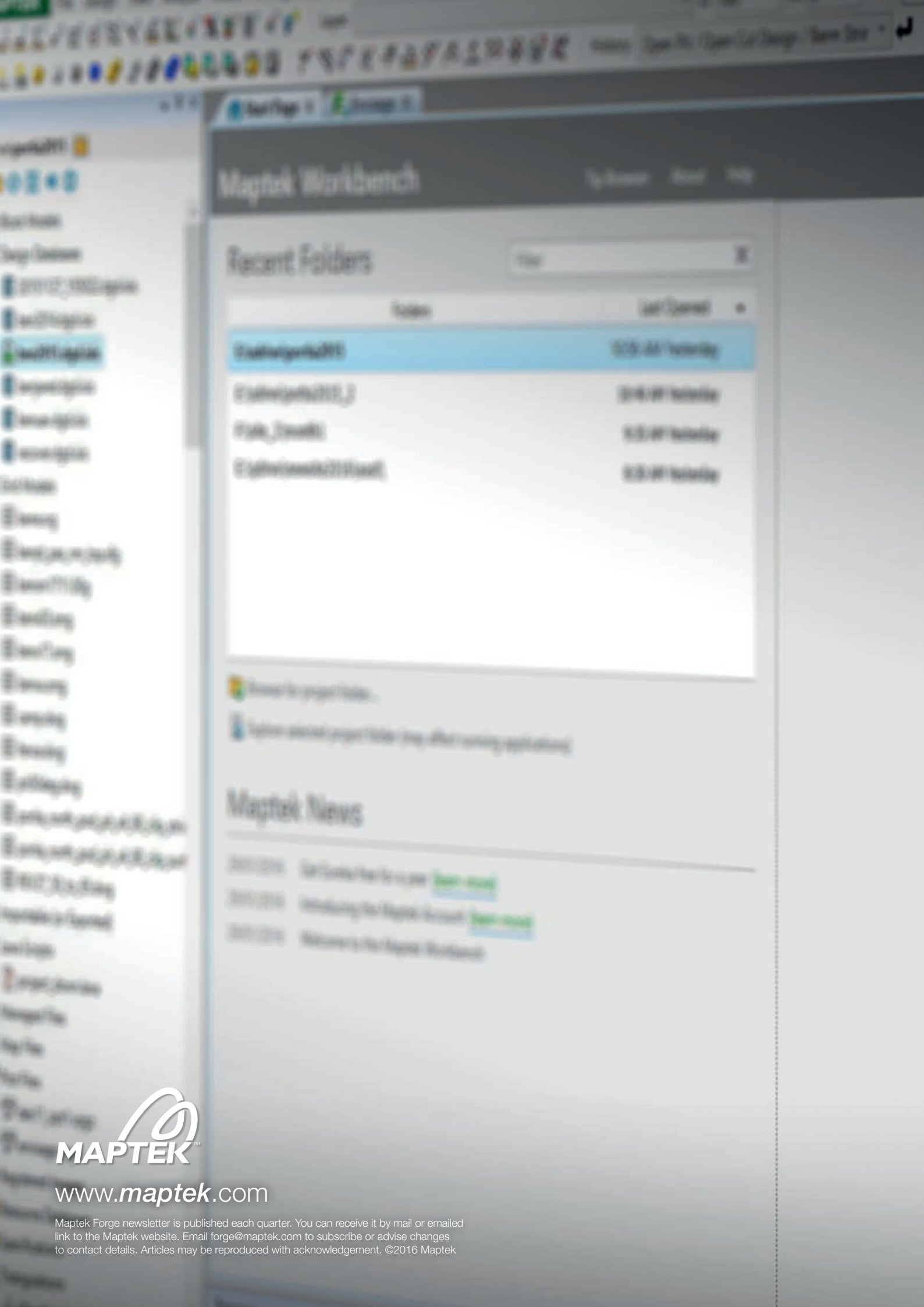
September 26-28
MINExpo 2016, Las Vegas, Nevada

October 16-19
XVIII Geology Congress, Lima, Peru

October 25-28
XII Seminario Internacional de Minería Sonora
Hermosillo, Sonora, México - Booth 285

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