Mira Geoscience
...modelling the earth

eNewsletter Q4-2018

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In this issue:

Don't miss out!

Here is a quick glance at our Upcoming Events Calendar:

» **December 3-5** Saskatchewan Geological Open House in Saskatoon, Canada

» **January 28-31** AME RoundUp 2019 in Vancouver, Canada

» **February 20-21** 4D Subsurface Modelling in London, UK

» **March 3-6** PDAC2019 in Toronto, Canada

» **March 1-2**, Jean-Philippe Paiement, our Director of Global Consulting, along with Guy Desharnais, Martin Blouin, Antoine Cate and Erwan Gloaguen will host a two day Short Course at PDAC2019 - Concepts and application of machine learning to mining geoscience. This workshop will introduce the participants to the applications and evaluation of machine learning in mining geoscience...

…more details on our Upcoming Events page

Welcome to the 2018, Q4 eNewsletter. In this edition, we report on Ero Copper's Curaçá Valley copper mine/project area in Brazil. We sat down and discussed the 3D interpretation and modelling process of Alberton-Mathinna "Gold Corridor" with Mark Duffett and Daniel Bombardiere from Mineral Resources Tasmania. On the software side, we have been busy with new releases of GOCAD® Mining Suite, Geoscience ANALYST, and VP Suite. We also give you more details on the upcoming version 3.0 of Geoscience INTEGRATOR and how it is the missing AI link for exploration. Finally, we cover the tips of the month, as well as some news and upcoming events.

Maximizing value: 3D data integration and interpretation

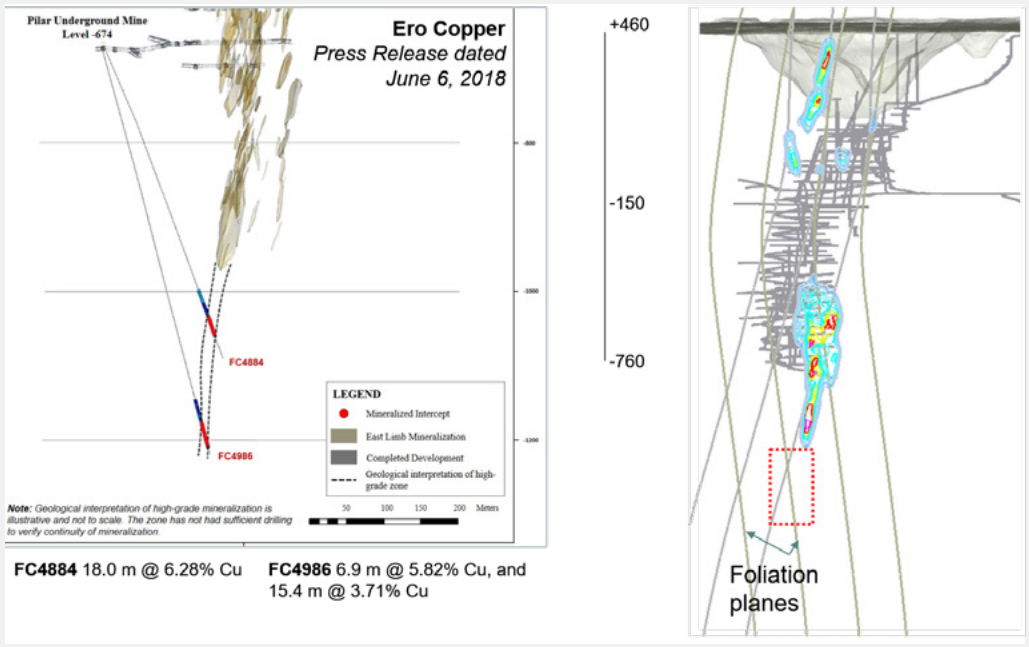
One of the main challenges in exploration is increasing our subsurface knowledge. Add to this the desire to reduce exploration risks and maximize success of discovering new resources. Nowadays scientists work with a wide range of raw and processed data, geological interpretations, and concepts. New technologies for 3D data integration and interpretation are essential, but the approach is not simple. In some instances, you have mountains of historical data that need to be brought in a real 3D interpretation environment, while in others, you have very little geological data making geophysical modelling essential to test geological hypothesis. Increasing knowledge demands effort and resources.

Two years ago, Mira Geoscience started working with Ero Copper Corp on the Curaçá Valley project by providing an integrated approach supported by geological understanding. From observation to computation, we helped in the creation and delivery of meaningful, client-driven integrated 3D models that served as the basis for decision making and discoveries.

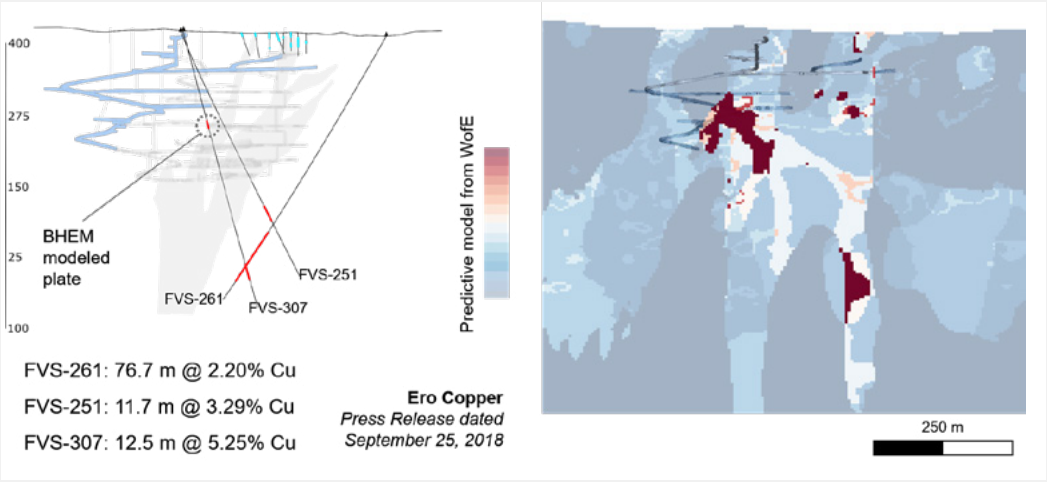
CASE STUDY: Ero Copper Corp on the Curaçá Valley Project

The Curaçá Valley project is a great example of adapting an exploration approach to the different types of data available. It all started with data management. We compiled historical geological, geophysical and geochemical data in GOCAD Mining Suite. This was followed by a thorough QA/QC of the geoscientific database. Finally, 2D surface data were brought into a 3D modelling environment, allowing the creation of 3D models.

Caraíba (Pilar mine) area is a near mine exploration project rich in data. New findings at depth called for a re-evaluation of the historical synform model. The deposit is now considered related to a steeply-dipping intrusion. Using structural field interpolations, in GOCAD Mining Suite – Sparse, a new model of the foliation families was created using historical structural data. The predictive model pointed to a high mineral potential zone near the contact between two foliation planes. This model was confirmed by the finding of a new mineralization intercept almost 500 m below the mine infrastructure.



Caraíba - new mineralization intercept almost 500 m below the mine



Vermelhos – new satellite mineralization

Due to the lack of geological data at depth in the **Vermelhos project area**, we applied the classical data-driven approach of Weights-of-Evidence using 3D properties (mostly geophysics) as predictors in GOCAD Mining Suite – Targeting Workflow. The near surface main mineralized area was used as training data in order to find similar signatures elsewhere in the volume of interest. The predictive model indicated mineralization 200 m below the main mineralized area. In parallel to this, an ongoing review of historical electromagnetic (EM) surveys determined that the mineralization produced moderate, but appreciable conductive responses. A systematic Borehole EM program and interpretation of this data through plate modelling pointed to satellite mineralization. Both the predictive and BHEM targets were confirmed by drilling.

The success we had in broadening our knowledge made us confident in using similar workflows, processes and techniques at depth and larger scale throughout the Curaçá Valley. With modelling results indicating that a Vermelhos-type mineralization could be detected at roughly 200m depth, a state-of-the-art airborne EM program was designed as the next phase of exploration.

Scott Napier, P.Geo - Senior Geophysicist with Mira Geoscience

Scott leads this project with James Reid, Glenn Pears, Thomas Campagne, Pablo Letelier, and Jean-Philippe Paiement. Scott brings general expertise in geophysical inversion, along with extensive borehole, ground, marine, and airborne EM interpretation and processing experience. He has worked in Canada and internationally on oil and gas, uranium, and base metal exploration teams, with a track record of proven discovery.

In the news:

Smarter, cheaper, faster
CIM Magazine

"The development of long-term hazard monitoring systems is critical as mine companies turn to deeper deposits, said **Mira Geoscience** president **John McGaughey**, because "with increased depth comes increased rock stress." He added that while some pillars of ground control, such as mine design and support design, are "reasonably well understood," hazard monitoring is "an area that is crying out for innovation…"

Tower Resources Intersects 288 metres grading 0.26% Copper Equivalent (CuEq) including 53 metres grading 0.48% CuEq at Rabbit North
Resource World Magazine

"Crossrange, in cooperation with **Mira Geoscience Ltd**., performed 3D modelling and interpretation of geophysical data encompassing the Rabbit North property. Future exploration activities at Rabbit will include the completion of deep 3D direct current resistivity and induced polarization (DCIP) surveys followed by target refinement and diamond drilling."

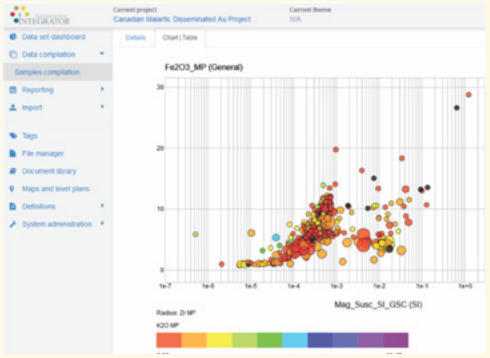
Geophysics in the Surveys – Mineral Resources Tasmania: 3D geophysical model launch
Preview Magazine

"It is being distributed principally as a **Geoscience Analyst** (free viewer) project, which permits user import of other spatial data from their own sources, and is also available from MRT in native modelling software formats [**GOCAD Mining Suite**]."

What's new

Geoscience INTEGRATOR, the missing AI link for exploration

Did you know that the upcoming release of Geoscience INTEGRATOR 3.0 has been greatly adapted to also serve the exploration side of the mining industry? This unique web-based data management system is designed to quantitatively integrate 3D and 4D mineral exploration data sets and interpretation. It is the industry's first multi-disciplinary, 4D data management framework and, as such, delivers the platform required by computational systems such as AI, that aim to answer questions that only quantitative data integration can answer. Most importantly, the system provides a "data fusion" capability specifically aimed at mining industry problems. This is game-changing technology for the industry, providing a sound, robust solution to the once-intractable problem of integrating highly disparate data across space and time.



Create metadata fields.

About version 3.0 release

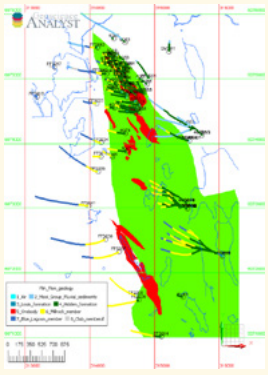
With this version you will be able to create your own metadata fields and search for data sets using keywords, dates, tags, file names, metadata values, or even draw a 3D box via Geoscience ANALYST to see all the data sets belonging to an area of interest. Additionally, 2D map views are now supported to facilitate analysis on topographic and geological maps, or other required map-based visualizations of models and data. Enhancements were made to the creation of input files for machine learning. Other updates include new exploration and mining themes, and access to layer names within DXF and DWG files.

Details about the product available here »

Geoscience ANALYST version 2.70 release

In this new version, 2D map views are now supported to better display mine level plans, topographic and geological maps, or other required map-based visualizations of models and data. 3D objects may be displayed in the 2D Viewport, in which they appear projected onto the map view. This version also features a new query panel that connects to Geoscience INTEGRATOR v.3.0 to allow you to find and display data sets intersecting a user-defined volume of interest or matching selected metadata values. Low and high clipping value within the Data Colours panel can now display data outside the defined range. Other updates include access to text and label layers within AutoCad files as well as new ESRI shapefile types.

More information about the product available here »



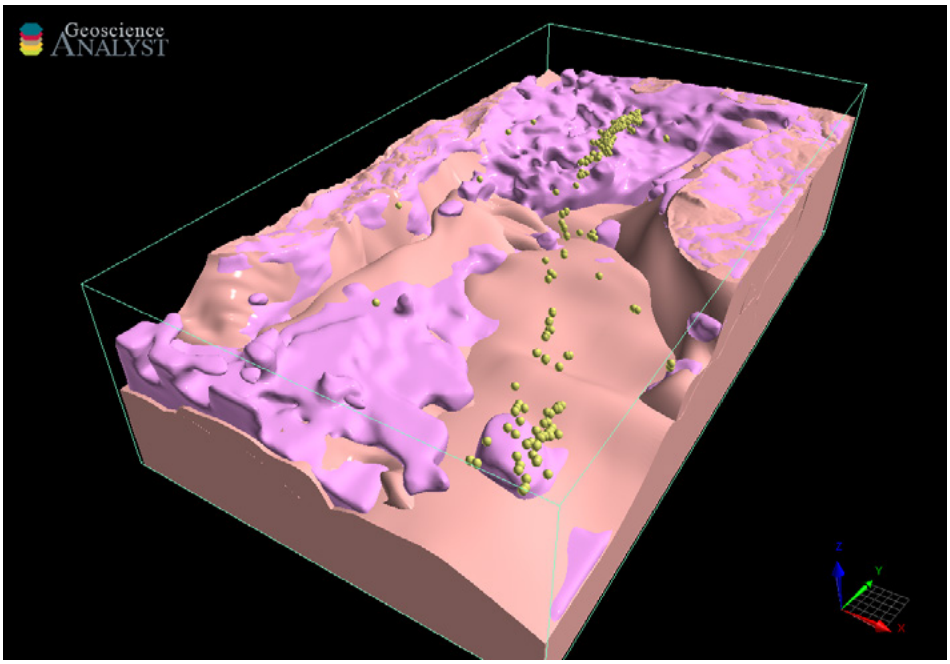
3D model projected in map view. Ore body displayed on top.

Q&A The construction of plausible geological models

The 3D interpretation and modelling process is of a cyclical nature; where testing geological ideas with potential fields forward modelling and using inversions to update parts of a geological model is crucial. We had a chat with Dr. Mark Duffett and Daniel Bombardieri from Mineral Resources Tasmania (MRT) on the importance that cross-validation between geological ideas and geophysical data had when developing the 3D model of Alberton-Mathinna "Gold Corridor", northeast Tasmania. They also shared how GOCAD Mining Suite (GMS) and its Potential Fields Module (VPmg) was integral to coming up with a plausible model. Here is an excerpt:

Q: Can you provide more details about the workflow you used?

Daniel: Initially, due to complexity of Tasmanian geology, we constructed our [geological] model explicitly. Using [the Potential Fields Module], we start with forward modelling to determine how reasonable our reference geological model is. We then conduct homogeneous inversions to get a handle on bulk rock property information, and a series of geometry inversions producing calculated magnetic and gravity responses which agree with observations. This process is iterative. We follow a workflow, but this will vary depending on what we're trying to achieve. If new geological information becomes available, we test this and go through the process again with the aim of always trying to produce a reasonable geological model which satisfies the geophysics.



Courtesy of Mineral Resources Tasmania

Post inversion granitoid volume (all plutons, pink) with superposed magnetic plutons from initial modelling (salmon) and historic gold occurrences plotted at the ground surface (yellow spheres). Granitoid below gold deposit points is generally 1-3 km.

Q: Did the forward modelling and inversion results push against the geology hypothesis?

Daniel: In the case of the Alberton–Mathinna 3D model we were fortunate to have a granitoid model produced from previous 2D forward modelling attempts. We used this granitoid surface as a reference with the aim of slightly varying the geometry. Remember, current generation software allows us to truly model in the 3D domain, and at higher resolutions, compared to previous generation software. So yes, GMS and its potential fields module allowed us to produce a more detailed granite surface.

Mark: What we've largely come up with so far is: there's been more second order and adding details to the existing 3D model of previous work; and that itself, there is value in that. The [cyclical nature of the workflow] did test and challenge the interpretations, but it's not like we are coming into virgin territories here.

Q: Can you describe how GMS was valuable for dealing with sparse data?

Daniel: I think that one of the key abilities of GMS and the [Potential Fields Module] is its ability to deal with sparse data. This is why we use it. Mostly we just have cross sections with very limited drillhole control. Validating the geological model using geophysics… I think is the only way you can actually handle sparse data. That's why GOCAD and VPmg are important tools to use in this regard.

Mark: Referring to sparse data was in the sense of having very little drilling control, particularly deep drilling control.

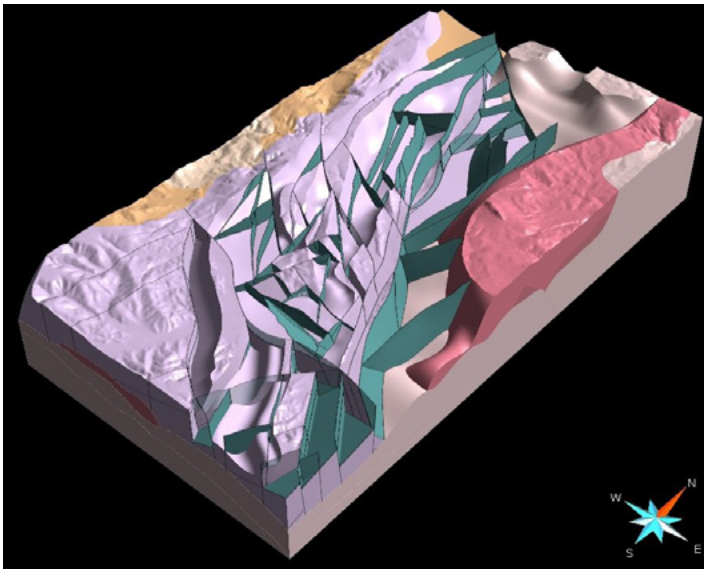
Q: What were the key revelations or realizations regarding the geology model? and Has the modelling heightened prospectivity of the area?

Mark: The homogeneous unit inversion was quite critical in characterizing the bulk signature of the geological domains. It highlights a definite need to subdivide the intrusive granite in some areas. This was not identified previously and the economic and exploration significance of this needs to be investigated. The modelling also impacted the geometry of the granitoid volume which leads to the generation of new exploration targets.

The plan going forward is to bring 3D modelling generally in sync with our traditional Geological Survey mapping and map updates. In these areas it is virgin terrain and there is an expectation of more insight from the process of 3D modelling.

Q: Has using GMS facilitated those findings?

Mark: The whole exercise got value in seeing geological concepts that work and don't work when tested as 3D. Insight start to come even before the geophysical modelling starts. It allows the construction of plausible geological model for which concepts on single cross-section would not have been tenable.



Courtesy of Mineral Resources Tasmania

Geological volumes, with one country rock unit (Sideling Sandstone) removed to reveal 3D fault surfaces.

Daniel: Yes, it's important to remember that geology is 3D in nature and GMS coupled with its VPmg potential field module was crucial in creating the new Alberton-Mathinna 3D model and providing new insights into the geometry of geological objects at depth.

Mark Duffett

After studies at the Universities of Adelaide and Tasmania, Mark Duffett has worked at Charles Darwin University, the Northern Territory Geological Survey and the University of Tasmania on projects ranging from saltwater crocodile nesting habitat to regional potential field acquisition and interpretation in the African Copperbelt. Since 2009 he has been Senior Geophysicist at Mineral Resources Tasmania, the state's geological survey.

Daniel Bombardieri

After completing a PhD in physics at the University of Tasmania in 2008, Daniel Bombardieri was employed as a geophysicist with Mineral Resources Tasmania to develop high precision three dimensional geological models and validating these against existing magnetic and gravity observations using 3D potential field inversion codes. (e.g., GOCAD® and GeomodellerTM inversion codes.)

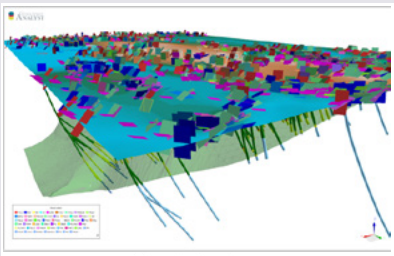
Geoscience ANALYST:

November's tip

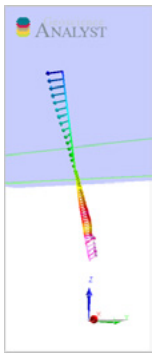
In case you missed them, our monthly software tips delivered to you.

GOCAD Mining Suite – find out from what commands an object was created or see which commands were run on it. History.

Geoscience ANALYST – Data grouping orientations, because sometimes we need to know in which direction things are going.



Structural geology



Borehole EM

Geoscience INTEGRATOR – To maximize results, tag your data.

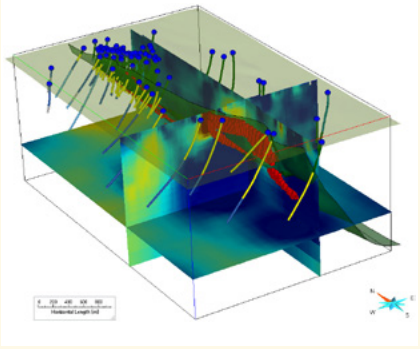
To receive full tip or to view previous ones, visit our site. »

What's new

GOCAD Mining Suite version 17 update2 release

Released this October, this version will definitely improve your modelling experience. The focus is on user experience and stability. We have introduced mining categories and classifications to the Assign Data to Geologic Features window, such as: Fault, Geochemical Data, Airborne or Ground Geophysical Data, Geotechnical Data or Mining Infrastructure. The Potential Fields Module now performs a check between newly imported VPmg model files and previously imported ones to create new property display templates when necessary. With the introduction of the support of rotated models in VPmg v9.2, GOCAD Mining Suite now supports the import of these models to both Grid objects and Surfaces. Models that are rotated from a N-S orientation can now be exported directly from rotated Voxet models within GOCAD Mining Suite. The Targeting Workflow now allows you to select a user-defined region to take advantage of the method's ability to deal with missing information, and to generate targets even where data may not be present in the entire volume. SKUA-GOCAD 17 support packs 1, 2, 3, 4, and 5 have been included in our installer, along with other updates and upgrades.

Details about the product available here »



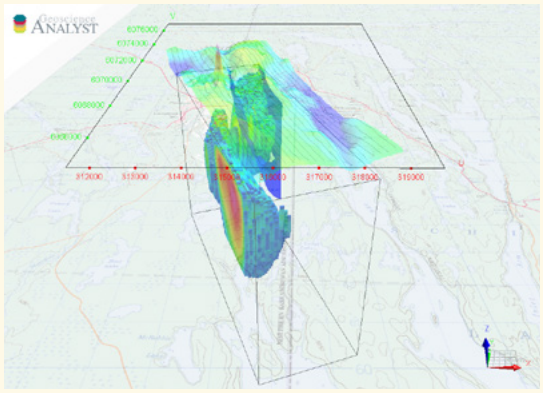
Magnetic inversion with orebody regions and drillholes displaying simplified geology.

VP Suite's VPmg version 9.2, VPem1D version 4.2 and VPutility version 1.1 releases

Released this November, VPmg 9.2 allows the user to rotate the model, instead of the data, so the inversion result is in its "true" location. Geosoft XYZ files can now be given as data files. Further robustness is added to the half-space optimization for susceptibility.

Faster total magnetic gradient and magnetic amplitude inversion and inversion solver. VPem1D 4.2 introduces a new feature: a best-fitting half-space calculation and checks for zero conductivity. VPutility 1.1 facilitates the creation of rotated models. Other updates and upgrades include unlimited number of geological units. Fixes were made to improve your modelling and inversion experience..

More information about VP Suite available here »



VP Suite heterogeneous inversion model rotated at -20 degrees along the data.