October 3

Opening Address

Towards Integrated Interpretation

John McGaughey
CEO/CTO Mira Geoscience

"Integrated Interpretation" is the interpretive process by which an earth model that is consistent with data and geological reasoning—a Common Earth Model—is created. It supersedes 3D geological modelling and geophysical inversion, each of which are tools used in the integrated interpretation process. It is essential to utilize Integrated Interpretation anywhere, at any scale, where the earth model matters for business or scientific reasons. Deep search, exploration under cover, data-rich brownfields and data-poor regional exploration all demand it as a best practice for interpreting the geometry of structure and contacts. It is prerequisite to employment of quantitative methods, from geophysical interpretation of alteration signatures to targeting with machine learning. The process is conceptually simple: create a 3D geological model and test it conceptually and numerically against all available data. Iteratively modify it until it is validated. Doing so requires a workflow that includes rapid model geometry construction and editing, rapid geophysical forward modelling, and inversion of geophysical data for both structural geometry and physical property heterogeneity. Development and delivery of Integrated Interpretation has been the essence of our vision. It can now be deployed routinely, providing the foundation of our work in mineral exploration and mining.

Keynote Address

Integrated geoscience – past, present and future from 2D to 3D

Jim Franklin
President, Franklin Geosciences Ltd

A quantitative method for assessing the potential for discovery of resources has been developed, based on expert-defined mineral deposit models and "as is" digital geological maps. Each criterion used to establish prospectively is derived from genetic models and identified in the digital map data. The prospectivity for VMS and magmatic Ni-Cu types, both with genetically validated identifiable attributes, and orogenic gold deposits, with less well-proven attributes, were tested. A quantitative value for each attribute is determined using a "decay of favourability" function, using the distance from any map pixel to the presence of each criterion. These values are combined into one function for each pixel and contoured, producing a prospectivity index map.

Data Management Session

The Integra « Gold Rush Challenge »: Impacts from hard data management through resulting exploration targets ranking

Francine Fallara
Senior Geologist, InnovExplo Inc.

The Integra «Gold Rush Challenge» implemented one of the largest organized crowd sourcing analytical challenge ever created in the mining industry. Open to worldwide individuals and organizations, to rapidly increase the probability in discovering the next major gold deposit within the Sigma-Lamaque gold properties in Val-d'Or, Québec.

The resulting « Top 21 » exploration targets analysis to help prioritize future exploration programs was achieved using the GOCAD platform within a 3D integrated geological map model. InnovExplo major mandate is summarized as: 1) Historical Hard Data Compilation and Management, 2) Resulting Targets Validation and Ranking, 3) Resulting Targets Querying.

The future value of this 3D integrated geological map model is directly based on how a multi-disciplinary team of geologists, geophysicists, geochemists, engineers, metallurgists and environmental specialists will use it and make it evolve through ongoing exploration programs.

Data Analytics—Real value being delivered for the mining industry

Damien Duff
Vice President Geoscience and Geotechnical R&D, Centre for Excellence in Mining Innovation (CEMI)

"Data is the new gold", or so goes the axiom, but is it entirely true? Likely only partially. This presentation will suggest that the real value is "added value" through the use of modern data analysis and management tools. Whether we're dealing with complex geotechnical, geoscience or even mine site energy audit datasets, it can be demonstrated that modern data analytical techniques extract heretofore unimagined value from them and, furthermore, that these approaches are getting better at doing that almost by the day. Examples will be presented from projects currently being managed by CEMI. The new Mining Observatory Data Control Centre (MODCC), a data analytics facility, will also be discussed.

Managing data for Integrated Interpretation with Geoscience INTEGRATOR

James Purchase
Product Development Manager, Mira Geoscience

After several years of development, Geoscience INTEGRATOR sees its first deployments coincide with Earth Modelling 2016. Initially developed for the Centre for Excellence in Mining Innovation (CEMI) as a 4D data management system to support multi-disciplinary interpretation of time-based underground mining data, it has been extended through CMIC "Footprints" project research to provide a multi-institution, multi-project mineral exploration data management system. The system combines a file and document management system with record level contextual data query, reporting, and powerful 3D visualization. New this year is a powerful capacity to manage and integrate geochemistry, mineralogy, and petrophysics. The future of geoscience data integration will require the assembly of huge amounts of data into structured inputs that retain links to all relevant metadata for interpretation. Geoscience INTEGRATOR has been designed specifically for that purpose, supporting large-scale data integration and visualization for both mineral exploration and geotechnical hazard assessment.

3D Modelling Session

Probabilistic 3D modelling in regards with big data mining and risk mitigation

Jean-Philippe Paiement
Geology Project Manager, SGS Canada Inc.

The mining industry relies on geological modelling from early exploration phases to resource estimation and mining, however, most of these models use a deterministic approach and expert knowledge from a single individual. The deterministic approach makes it difficult to quantify the risk associated with the geological uncertainty. Recently, SGS Geostat has applied existing geostatistic techniques and new algorithms in order to create 3D probabilistic geological models. This approach not only creates different iterations of probable geological models, but also quantifies the interpolation/extrapolation errors for a given density of information. Combined with machine learning algorithms, these estimated geological errors will highlight the inherent risk associated with the foundation of all mining project: the geology.

3D igneous rock modelling using potential data and machine learning

Gyesoon Park
Director / Principal Researcher, KIGAM-Mineral Resources Technology Research Department

To verify and analyze the related igneous rocks is one of the important research topics in mining area. But it is not easy to analyze the 3D distribution of igneous rocks because of lack of surface information to analyze the genesis and shape patterns of igneous rocks. To overcome this limit, we newly proposed the 3D igneous rocks modelling method using integration of surface geological map and gravity and magnetic data sets based on the probability approach. For this, structure analysis and neural network methods were used to figure out the 3D distribution of igneous rocks. The proposed method was applied to 3D related igneous rocks analysis of southern Taebeaksan mineralization belt, which is highest mining potential area in Korea. As a result, the 3D related igneous rocks were quantitatively estimated by probability values and matched very well with the surface geological information. The newly proposed method could be effectively adopted and applied to imaging the various underground structures.

Regional targeting using Geoscience ANALYST for rapid 3D modelling in the Irish Midlands MVT District

Alan King
Geophysical Consultant, Geoscience North

The presentation is a summary of a regional targeting exercise using Geoscience ANALYST for rapid 3D modelling in the Irish Midlands MVT District. The main purpose of this review was to use the available geophysical and other data to identify basement structures that may provide control on the exploration target - Irish type Zn-Pb deposits. A review of existing geophysical data on and around a large property, located mainly in Count Galway Ireland, was carried out. The geophysical data sets were integrated in 2D (ARGIS and Geosoft Oasis Montaj) and 3D (Geoscience ANALYST) with geological, geochemical and drilling data provided by the company or in the public domain.

Centralized 3D modelling services at K+S

Joachim Plümacher
Senior Geologist, K+S Aktiengesellschaft

K+S is an international resources company mining and processing raw materials in Europe, North America and South America for more than 125 years. K+S is the world's largest salt producer and one of the top potash providers worldwide with more than 14,000 employees.

Geological modelling at K+S supports exploration and production activities as well as security and environmental issues.

K+S has founded a central service unit for modelling providing standards and support. Robust data management and well organized model management have turned out to be the key elements for gaining the expected benefits.

Integrated earth model interpretation with GOCAD Mining Suite

Jennifer Levett
Product Development Manager, Mira Geoscience

Getting earth models right is important—business decisions having profound economic consequence are made every day on the basis of them. Away from dense drilling, models are only as good as the geological concepts and sparse data that underlie them. Demonstrable, quantitative consistency with the multi-disciplinary data from which earth models are constructed should be a required validity check. With our October release, GOCAD Mining Suite continues its evolution in support of the vision of fully integrated interpretation, providing the tools that allow us to create and verify models that are quantitatively consistent with geological, geophysical, geochemical, and petrophysical data. Version 15.5 provides enhanced tools for working with geological, geophysical, and geochemical data within a single integrated platform. Our geologically-based geophysical modelling and inversion has been upgraded (to VPmg 8.1 for potential fields and VPem1D 3.1 for electromagnetics). We now connect to the most recent version of partner software, including version 5.0 of UBC-GIF geophysical software and ioGAS 6.2 geochemistry software. GOCAD Mining Suite version 15.5, with its full range of implicit and explicit geological modelling tools, geophysical forward modelling and inversion tools, geostatistics and geochemical analysis tools, makes the industry's only fully integrated 3D interpretation technology platform even better.

Partnership address - Paradigm Overview

Matt Williams
Global Account Manager

October 4

Keynote Address

Metal Earth - a fully integrated 3D study of our Earth

Harold Gibson
Director, Mineral Exploration Research Centre - Department of Earth Sciences, Laurentian University

A significant impediment to exploration success is how to identify small areas of metal endowment from vast areas that are geologically similar, but less endowed. Current models do not provide a means to identify metal endowed areas, as metal endowment is related to differences in the evolution and interplay of large tectonic elements including deep crustal structures, fluid (magma/heat) pathways, and connection and interaction with the mantle. Metal Earth's research will be at the scale of ore systems, where metals are sourced, mobilized, transported, concentrated and preserved. Ore systems and, for the first time, less endowed "equivalents" will be "imaged" at full crust-mantle scale to identify – fingerprint - the key measurable geological, geochemical and geophysical attributes, and processes responsible for metal endowment.

Integrated Interpretation Session

Exploration data integration: High impact solutions for exploration companies

Jenna McKenzie
Principal Consultant, Ronacher McKenzie Geoscience

We live in the digital age, with abundant data instantly accessible. Exploration companies expend much time, energy and money to collect data on their properties, but this data loses its usefulness when stored in a computer folder, or worse tucked away in a desk drawer.

The goal of this talk is to highlight the effectiveness of compiling all exploration data in 3D, for analysis, integration and interpretation. A selection of case studies will be reviewed to demonstrate the value of this approach, ultimatiely making targeting more efficient and increasing the odds of discovery.

3D quantitative mineral potential targeting in the Kristineberg mining area, Sweden

Tobias Hermansson
Structural Geology Specialist, Boliden Mines

The Kristineberg mining camp is situated in the western part of the Palaeoproterozoic Skellefte District, northern Sweden. The roughly 100 km2 area hosts one active VHMS mine (the Kristineberg mine - 29.1 Mt), and several smaller abandoned mines and deposits. Exploration has been active in the region for 100 years and the potential to find new ore zones at surface is regarded as limited. Consequently, focus has been shifted towards finding blind deposits at depth. Recently, Common Earth Modelling has been applied to the area, on a semi-regional scale, to make better use of the immense amount of legacy data, increase the understanding of the geology in 3D, and perform quantitative mineral potential targeting.

Geological model validation and update using gravity data at Kinnegad, Ireland, and application to Irish-type carbonate hosted Pb-Zn exploration

Scott Napier
Senior Consultant at Mira Geoscience

Teck Ireland Ltd performed an integrated interpretation of geology, 2D seismic and limited drilling to build a 3D structural model of their Kinnegad project area (located 30km to the SW of the Tara Zn-Pb mine at Navan, Ireland). Teck had collected a ground gravity dataset which was used to qualitatively guide the structural interpretation. This project was aimed at using the gravity data, quantitatively, in a model verification process to query the validity of the contacts interpreted in the existing structural model. The detailed gravity modelling work demonstrates that value of the quantitative model verification approach at a number of levels, including results that improve the interpretive value of gravity data, aid in structural interpretation, and provide indications of areas of increased confidence and decreased confidence in the existing model. Ultimately the modelling provides results directly applicable to future exploration targeting.

Analysis Session

Structural restauration of key exploration formations at Kinnegad, Ireland: 3D strain predictors

Pablo Mejia-Herrera
Consultant at Mira Geoscience

A wide variety of metal deposits results from the circulation of mineralizing fluids through fault systems. Those discontinuities are related to high secondary permeability in the rockmass that drives the migration of metals and their deposition. The strain analysis makes possible to infer the places with high probability to find a fault system and hence a mineralized location linked to those discontinuities. The inferred faults system is obtained using GeoChron, wich is based on a type of 3D Wheeler technique which maps the present versus depositional time models applying a curvilinear coordinate system. We modelled the horizons related the Kinnegad mineralized system and obtained a set of potential faulted zones based on high strain areas.

HyperCube: Geodata integration and analysis, from regional to local scale

Clément Dombrowski - Project geologist, and Réjean Girard - CEO
IOS Services Géoscientifiques inc

IOS, in partnership with BearingPoint, incorporated HyperCube® artificial intelligence software into georeference data analysis protocol to predict mineral occurrence and solve complex multivariable issues. HyperCube® enables the integration of incomplete or asymmetrical data from which a series of comprehensive multi-variable rules can be scripted to build robust predictive map. At regional scale, the orogenic gold potential was evaluated for the James Bay area, which compared advantageously to former WoE prediction. At local scale, geochemical surveys over Northern Abitibi clay belt were processed, which returned non-intuitive but robustly replicated multi-elements associations over deposits buried under 30-60 metres of overburden. The authors consider that such rules generation process can be efficient to define exploration parameters.

Predicting ore location in 3D with machine-learning: the Sigma-Lamaque mine

Antoine Caté
PhD Student, INRS-ETE

Artificial intelligence and machine learning are used in countless environments to interpret data and improve processes. In mining exploration, huge amounts of 3D data is collected from various sources (geology, geophysics, geochemistry, rock properties). Machine learning is the perfect tool to integrate this data and get the best of it. However, careful data integration and modelling is necessary to obtain reliable results. The advantages and limitations of machine learning for mineral potential predictivity in 3D are presented through the example of the Sigma-Lamaque mine and other sites. A series of best practices for data integration are proposed.

The evolution of earth model analysis with Geoscience ANALYST

John McGaughey
CEO/CTO, Mira Geoscience

Our free 3D visualization and collaboration platform has been out for nearly a year and is now being actively used by well over a thousand explorationists, consultants, academics, and government organizations around the world. Our October release of version 2.3 introduces major enhancements to the free platform as well as the addition of new low-cost, added value features. We have completely revamped the original project data file, replacing it with a powerful and flexible database based on the publicly available HDF5 format, as well as enhancing import/export, visualization, and other functionality. Our new low-cost paid modules take the user from what is already the industry's most powerful, free, and connected 3D visualization and collaboration environment to a rich set of features for analyzing and acting on earth models. "Geoscience ANALYST Pro" provides the ability to create new objects, edit objects, edit data tables, digitize, transfer data between objects, de-survey drillholes, and more. "Drillhole Designer" provides a full-featured drillhole design capability. "ioGAS Live Link" provides a direct, live connection to ioGAS, featuring...

powerful visual attributes, stereonet and gridding utilities. With the October release, Geoscience ANALYST establishes itself as the inexpensive, go-to platform specifically designed for the multitude of geoscientists and managers who want to make everyday business decisions with earth models, not necessarily make the earth models themselves.

New GOCAD Mining Suite Bundles – Joint Paradigm-Mira Geoscience offering

John McGaughey
CEO/CTO, Mira Geoscience

Paradigm and Mira Geoscience are introducing new, attractively priced software bundles specifically designed for the newly pressing demands of integrated interpretation in mining. We have given a lot of thought to combining the best of our technology in optimal user-centred configurations that empower you to rapidly construct and validate earth models consistent with your geological, geophysical, and geochemical data. From basic 3D model construction and editing, to the industry's best implicit structural modelling, to a full range of geophysical modelling and interpretation tools, this new offering is designed to set the standard in multi-disciplinary integrated interpretation for years to come!

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