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IRISH ASSOCIATION FOR ECONOMIC GEOLOGY

IAEG & GRINDING SOLUTIONS
Present a 1 day seminar

CHARACTERISATION FOR RESOURCE DEVELOPMENT

Wednesday 9th October 2019

Radisson Blu Hotel, Dublin Airport, Corballis, Dublin, Ireland

INTRODUCTION

On behalf of the IAEG, it gives me great pleasure to welcome you all to this geometallurgy seminar 'Characterisation for Resource Development'.

In recent years we have seen an increasing development of geometallurgy as a discipline within the mineral industry where it is now considered a core component in project evaluation processes and project design to return optimal value throughout the life cycle of mineral projects.
This seminar brings together a wide range of technical expertise to introduce the concept of geometallurgy, how it is best incorporated to projects and emphasise the importance of orebody characterisation from the earliest stage to enable a better economic evaluation allowing improved project design and mine operation planning.

I wish to extend my gratitude to Grinding Solutions who have been instrumental in putting this seminar together. Their professionalism, expertise and enthusiasm to impart their knowledge has been a pleasure to work with. I would also like to extend my gratitude to all the presenters at this seminar and their companies for providing their time and expertise to share with us all today.
I am confident that this seminar will be of huge benefit to all associated with the mineral sector and everybody will leave with an increased understanding of the important role geometallury has within mineral projects.

Kieran Parker

IAEG President

THE BASIS FOR DEVELOPING THE GEOMETALLURGICAL MODEL

The mining industry generally sees the evaluation of lower grade, and more heterogeneous and complex deposits. In this context, geometallurgy seeks to integrate geoscientific disciplines with minerals and mining engineering. It aims to understand orebody variability, underpinned by characterisation data such as mineralogy, geochemistry, grade and physical rock properties obtained from spatially distributed samples.

Geometallurgy is an important addition to any project evaluation or mining operation. As a discipline, it seeks to maximise the Net Present Value of an orebody, while minimising technical and operational risk. It also aims to promote sustainable development by ensuring that all stages of extraction are performed in an optimal manner from a technical, environmental and social perspective. Geometallurgical practice improves stakeholder collaboration and communication, creating an environment for knowledge sharing and improved data acquisition. The end result, is the integration of data into 3D models to optimise mine planning and scheduling. These aspects create better business optimisation, utilisation of staff and targeted and realistic key performance indicators.

The objective of this seminar is to introduce attendees to the concept of geometallurgy and emphasise the importance of early stage ore/waste characterisation programmes.

Agenda

9:00 - 9:30 **REGISTRATION / COFFEE / NETWORKING**

9:30 - 9:40 **INTRODUCTION**
Kieran Parker, IAEG &
Nick Wilshaw, Grinding Solutions

9:40 - 10:10 **CHARACTERISATION FOR RESOURCE DEVELOPMENT**
Nick Wilshaw, Grinding Solutions

10:10 - 10:40 **IMPORTANCE OF SAMPLING**
Klaas van der Wielen, Grinding Solutions

10:40 - 11:10 **BREAK**

11:10 - 11:40 **AGILE EXPLORATION SUPPORTING EARLY STAGE GEOMET: WORKING TOGETHER IN A REAL-TIME DATA ECOSYSTEM?**
James Cleverly, Imdex

11:40 - 12:10 **USING PORTABLE XRF (PXRF) AND PORTABLE XRD (PXRD) FOR RAPID UNDERSTANDING OF YOUR MINERAL DEPOSIT**
Todd Houlahan, Olympus

12:0 - 12:40 **MAXIMISING THE VALUE OF MINERALOGICAL STUDIES**
James Strongman, Petrolab

12:40 - 1:30 **LUNCH BREAK**

13:30 - 14:00 **GEOMETALLURGICAL PROBLEM SOLVING AND MAPPING OF COMMINUTION ORE CHARACTERIZATION**
Simon Michaux, GTK

14:00 - 14:30 **TESTWORK FOR METALLURGICAL & WASTE CHARACTERISATION**
Phil Hingston, Grinding Solutions

14:30 - 15:00 **BREAK**

15:00 - 15:30 **GEO-METALLURGICAL BLOCK MODELLING - MAKING THE MOST OF YOUR DATA TO MAXIMISE PROJECT ECONOMICS**
James McFarlane, Mining Plus

15:30 - 16:00 **IRISH CASE STUDY ***
Neil O 'Carroll

16:00 - 16:05 **SUMMARY OF THE GEOMET APPROACH**
Nick Wilshaw, Grinding Solutions

16:05 - 16:10 **CLOSING**
Kieran Parker, IAEG

16:10 **SUNDOWNER TO FOLLOW EVENT CLOSE**

* Abstract

There is now a greater economic pressure on mineral resource recovery due to fewer resources, lower metal grades and poly metallic ores. Now more than ever before is there need for clear lines of communication between both geological and mineral processing departments.

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Keynote
Nick Wilshaw, Managing Director, Grinding Solutions, UK

Title
Geometallurgy - a route to unlocking deposit value

Abstract
Geometallurgy is an important addition to any evaluation project or mining operation. As an integrated approach, it unlocks value by establishing 3D models which enable NPV optimisation and more effective orebody management, while minimising technical and operational risk. Critically, through spatial identification of variability, it allows the development of strategies to mitigate the risks related to variability. Geometallurgy promotes sustainable development when all stages of extraction are performed in an optimal manner from a technical, environmental, and social perspective. To achieve these goals, development of innovative technologies and approaches along the entire mine value chain are being established. Geometallurgy has been shown to intensify collaboration among operational stakeholders, creating an environment for sharing orebody knowledge and improving data acquisition and interpretation, leading to the integration of such data and knowledge into mine planning and scheduling. These aspects create better business optimisation and utilisation of staff, and lead to operations that are more resilient to both technical and non-technical variability. Geometallurgy encompasses activities that utilise improved understanding of the properties of ore and waste, which impact positively or negatively on the value of the product, concentrate, or metal. Properties not only include those that impact on processing efficiency, but also those of materials which will impact on other actions such as blasting and waste management. Companies that embrace the geometallurgical approach from an early exploration stage through to feasibility will benefit from increased NPV and shareholder value.

Profile
Nick Wilshaw has over 30 years' experience in the global minerals industry, graduating from the Camborne School of Mines with a BSc in Mineral Processing and an MSc in Mineral Processing from Queens University, Canada. Nick's professional career spans all areas of industrial & metalliferous minerals processing and oil field related minerals and applications. His experience ranges from R&D, product development, production and product marketing through to plant specification design & commissioning. Nick is a member of IOM3 and as a Director of CEEC he also provides advice on market analysis and mining investment.

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Grinding Solutions
Klaas van der Wielen, Senior Metallurgist

Title
Importance of sampling

Abstract
When developing a process flowsheet, the risks in achieving positive financial outcomes are minimised by ensuring representative metallurgical samples and quality testwork. Poor metallurgical sampling leads to grade and recovery underperformance. Typical sampling-related issues include: poor liaison between geologists and metallurgists during programme design; poor domain interpretation; too few metallurgical samples collected and tested; unrepresentative sample composites and sub-samples; poor laboratory practice; and a lack of documentation and QAQC. This paper presents a case study based on an underground gold operation, where poor metallurgical sampling led to disruption over four years and is estimated to have cost the company around US$115M in lost revenue and US$7.5M in corrective expenditure. After an initial characterisation programme, a metallurgical variability mini-bulk sampling and testwork phase was undertaken which aimed to quantify gold grade and recovery variability. This was followed by a pilot programme, progressing to trial mining and production.

Profile
Grinding Solutions place our clients at the forefront of what we do. Our ethos is to reduce mining and processing costs as well as the environmental impact whilst maximising value for our clients.
We offer a wide range of mineral processing testing and consultancy services from our 1,500m2 laboratory facility based in Cornwall, UK. We are industry experts and world leaders in fine grinding and have in recent years been applying our innovative and consultative approach to areas including process mineralogy, flotation and gravity separation.

We can provide metallurgical consultancy and testwork from Scoping/PEA, to PFS and DFS on exploration projects as well as plant audits and optimisation services for operating mines.

Helping our clients increase their profitability and environmental credentials by driving down costs, reducing energy consumption and increasing grade and recovery is at the core of what we do.

REAL-TIME SUBSURFACE SOLUTIONS

IMDEX

Dr James Cleverley, Global Product Manager – Geosciences

Title

Agile exploration supporting early stage Geomet: Working together in a real-time data ecosystem?

Abstract

The process of Ore Discovery, and the delivery of a reportable resource, is traditionally driven by waterfall processes. Each step in the process is sequential, with long delays waiting for data and information to decide on the best action. In many cases the decision about what to do next is made long after the drilling or sampling program has finished, or, without reliable information to support the decision. Technology now exists that can be used to change the drilling to decision paradigm, with connected sensor-based data and analytics delivering information that can support geoscience decisions. The quality of early project stage geoscience data is increasing, and with better techniques to turn this into information how do we bridge the industry divide between ore discovery, resource definition and extraction plan?

In this talk I will cover emerging tools and workflows that bring technology, data and analytics together to allow a change in the way rapid decisions can be made – during drilling and mining, by geologists and metallurgists. These agile processes will mean geometallurgical information can be determined much earlier in the project lifecycle and yet this requires a change in behaviours around data access and information models.

I will illustrate how traditional data like portable XRF can be better fed into rapid resource assessment, and non-traditional techniques like natural gamma can provide extra information that may not have been considered before.

Profile

IMDEX is a global mining equipment, technology and services – or METS – company. Our IMDEX solution sets improve the process of identifying and extracting what is below the earth's surface for drilling contractors and resource companies – we let clients know where it is and what it is, now.

Our company delivers these solution sets, which include: Drilling Optimisation; Downhole Navigation; Structural Geology; In-Field Geoanalysis; and Driller Operable Geophysics, to the global minerals industry and targeted non-mining applications via our leading REFLEX and AMC brands.

Olympus

Todd Houlahan, Director, International Mining and EMEA ANI Sales Specialist Analytical Instruments (ANI)

Title

Using portable XRF (pXRF) and portable XRD (pXRD) for rapid understanding of your mineral deposit

Abstract

The talk will discuss real examples using pXRF and pXRD in exploration and mining scenarios where customers have used these technologies to gain better understanding of specific aspects of their mineral deposit.

Profile

Olympus provides an industry-leading portfolio of X-ray Fluorescence (XRF) and X-ray Diffraction (XRD) Analyzers for a range of applications in mineral exploration, underground and open cut mining, mineral processing, commercial and on-site laboratories and for environmental remediation projects. Our focus on long term partnerships in the minerals industry, field experience and emphasis on best practice, ensures we enable our customers to achieve fit-for-purpose, decision-quality data. Our revolutionary Vanta significantly advances handheld XRF technology via its key features of Ruggedness, Connectivity, Stability and Precision.

Petrolab
Mineralogy · Petrography

Petrolab

James Strongman, Director
James Strongman Director and Principal Mineralogist at Petrolab Limited and has been working in the field of Process mineralogy for the last 18 years

Title

Maximising the value of mineralogical studies

Abstract

Mineralogy provides a fundamental dataset and common language through all stages of a deposit's life cycle from early stage exploration through to development, extraction and finally remediation. The advancement of process mineralogy, both in terms of speed of analysis and resolution, but also the ability to correlate data from multiple sources and data sets, means that Petrolab now has the ability to really increase the integration and value of mineralogical analysis. Once minerals of interest have been identified, a more focused approach can be taken to measure the key metrics for that mineral and therefore build an improved understanding of value and risk for the deposit's lifecycle. This is achieved through utilising a "best tool for the job" approach to the mineralogy toolkit and further to that, to use it more efficiently to generate robust and targeted datasets. The generation of data is only part of the story and making the data accessible and easy to integrate with deposit models and plant databases is crucial to extracting and utilising the mineralogical metrics. This talk will cover some of the developments Petrolab and its partners have made in this field.

Profile

Petrolab provides technical support services to the mining, minerals processing and materials industries worldwide and has been operating for over 20 years

Specialists in the mineralogical investigation of rocks, mineral resources and manufactured inorganic materials by microscopic analysis. High quality interpretative reports help clients evaluate the potential of their mineral resources and solve materials related problems.

We have close links with the high concentration of local companies offering world class expertise in the mining and minerals processing industries. Please contact us to discuss your requirements and for a specific quotations.

GTK

Dr Simon Michaux

Title

Geometallurgical problem solving and mapping of comminution ore characterization

Abstract

Geometallurgy is a comparatively new discipline in mining that involves the fundamental integration of multiple conventional technical areas of the industry, where the outcome is a genuinely new methodology. It can be a daunting prospect to be tasked with designing and justifying a comprehensive geometallurgical program. The task could be starting a program from scratch or collating existing information to re-analyse as a pre-cursor to a program extension.

Commonly it is seen as purely the relationship between metallurgical testing and process mineralogy, although this is not incorrect, it is only part of the whole program. The discipline covers many areas across the Mine-Value-Chain. Geometallurgy is an appreciation of the prediction of rock behaviour, being subject to an engineering outcome; this is in context of the engineering processes.

There are many valid definitions and approaches to this methodology. In this presentation, comminution and rock breakage behavior is examined.

Profile

The Geological Survey of Finland (GTK) is an internationally recognized geological survey. Established in 1885, GTK is an internationally oriented governmental sector research institute under the Ministry of Employment and the Economy. As a key player in Finnish and EU mineral policy, GTK provides basic geological knowledge to decision makers and adds value to business industrial development. As a scientific service GTK provides responsible for national geological information service and maintain geological databases.

High-level scientific knowledge is a key asset for GTK and a cornerstone of strategic change. It is based on our ability to deliver new scientific results, innovation and demanding customer solutions. It is also a prerequisite for public awareness in the scientific community and in society at large, and a key factor in networking with centers of excellence and seeking competitive research funding.
The most important measure of the quality of scientific research is the publication of research results and the attention they receive in the scientific community. Research results are of scientific importance only when they are published. GTK owns a unique Pilot Plant that can operate at industrial scales, which also has supporting state-of-the-art chemical, mineralogical and metallurgical analysis capabilities on site in Outokumpu. This pilot plant can handle samples up to several hundred tonnes in size.

The Geological Survey of Finland (GTK) provides solutions for more sustainable growth. Geologically, we create success for our customers and stakeholders. We are a European leader in geological resources and their sustainable use. For the good of our country. For Earth and for Us.

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Grinding Solutions
Phil Hingston, Technical Manager

Title
Testwork for metallurgical & waste characterisation

Abstract
Given the high costs of exploration drilling, availability of sample for metallurgical testing, especially in the early stages of a project, can be minimal. That said, establishing appropriate links between metallurgy and geology as early as possible can help direct further exploration efforts to get the best understanding of deposit variability as soon as possible and provide savings for the duration of the exploration project. Early stage characterisation enables the progressive implementation of the geometallurgical approach to life of mine optimisation.

Grinding Solutions have a number of innovative tools available that can help provide indications of the metallurgy of a deposit based purely on thin sections and other data available from geological investigations. Amongst these tools are methods to aid sampling accuracy, image-based simulation of mineral liberation to determine target grind size without having to do any physical grinding, and use of process mineralogical data to establish theoretical and realistic grade and recovery targets.
This presentation will showcase some of the key metallurgical simulation tools relevant to the exploration market, and highlight the value they can add through case-studies.

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Mining Plus

James McFarlane, Principal Geology Consultant

Title

Geo-Metallurgical Block Modelling -
Making the most of your data to maximise project economics

Abstract

Geo-metallurgy is a rapidly emerging cornerstone of mining projects, as a proven way to reduce project risk by developing a higher resolution appreciation of the critical relationship between deposit geology and metallurgical variability. While undertaking geo-metallurgical or detailed ore variability studies is becoming more commonplace, the data gathered is rarely harnessed for its full potential, often being treated as a standalone dataset and not being fully integrated into the mine plan.

The crucial aspect to consider when planning, undertaking and developing these programs is the ability to integrate the data within the geological block model – and this should be the ultimate goal of the programs being undertaken.
Examples are shown whereby key metallurgical attributes, once defined spatially, can take advantage of modern mining software to be integrated into scheduling, allowing dynamic prediction of performance over the life of mine, improving both production and budget forecasting. Further, it is illustrated how in more complex deposits exhibiting multiple payable and/or deleterious elements, it is possible to re-define what is 'ore' in terms of monetary value. This presents a range of opportunities to run an operation in terms of dollars and not grades; keeping the focus on maximising project economics.

Profile

Why
We have a passion for our great industry, the inspiring people within it and the amazing projects we get to work on. Our Vision is to develop a high performance culture and be known as the best professional mining experts on the planet.

Who
Our team of 150 + full-time expert mining professionals, operate as one team from 12 offices in 6 countries around the globe. An affiliation of the Byrnecut Group (family), Mining Plus are corporate and contractor specialists in all mining and part of an organization employing more than 4,000 people worldwide.

What
Our clients come to us as investors, mining companies, mine services and exploration groups from all over the world, to partner with us, our excellence in service delivery and our commitment to making a project happen.

Our core capabilities centre around Geology, Geotechnical Engineering and Mining Engineering, in an end-to-end delivery scope for all hard rock mineral commodities across a project, enhanced by strategic alliances in other core disciplines.

The perfect scenario is for us to go from project conceptual stage (Define – Corporate), right through feasibility study work (Plan – Consulting) to project delivery (Operate – Contracting). We have a unique ability to integrate seamlessly with customer's project teams to deliver results with the flexibility of working remotely or mobilising to site.

We work by our Company values of: • Action • Accountability • Diligence. We live by our internal values of: • Get it right the first time • Own it as if it is our own • Go the extra mile

PERTH / KALGOORLIE / ADELAIDE / MELBOURNE / BRISBANE / LIMA / VANCOUVER / TORONTO / BRISTOL / DENVER / ULAANBAATAR / NEWCASTLE