DIM ESEE-2 innovation in process-oriented orebody characterization

19th – 21st October 2022

Dubrovnik, Croatia // hybrid mode (online participation enabled)

Supported by

eit RawMaterials ACADEMY

Co-funded by the European Union

➜ WHAT IS DIM ESEE-2?

DIM ESEE v.2: Implementing innovations is a lifelong learning project focused on rising innovativeness among raw materials professionals in the region of Eastern and Southeastern Europe (ESEE), and is based on positive results and success of previous DIM ESEE school (2016-2020).

The aim is to enhance entrepreneurial and innovative capacity of the region's higher education institutions' graduates and alumni by organizing the following topics:

- Innovation in process-oriented orebody characterization (19th - 21st October 2022),
- Innovation in extraction (18th - 20th October 2023), and
- Innovation in ore processing (16th - 18th October 2024).

➜ DIM ESEE 2022: Innovation in process-oriented orebody characterization

This course will focus on the most recent technological innovations contributing to a better understanding of a mineral resource from in situ and online measurements down to microanalytical techniques for automated mineralogy. It will introduce principles of geometallurgy and show how process-oriented ore characterization allows to predict process performance and its environmental impact.

Day 1. Sensing and modelling the ore deposit
Digital perspectives in the mining industry | Introduction to Geometallurgy | Principles of geological imaging and online vision | Automated analytical core logging system.

Day 2. Tracking the fine particles and minerals
Sample prep for quantitative mineralogy | SEM-based automated mapping | MicroLIBS for elemental mapping | Reconciliation of analytical data.

Day 3. Process simulations and lifecycle assessment
Minerals and process simulation | Introduction to LCA for mineral processing operations.

➜ WHO CAN APPLY?

Raw materials professionals with good command of English language and basic knowledge related to annual school topic, working in one of the following fields: Geology, Geological engineering, Mineral Processing, Mining Engineering, Applied Earth Sciences and similar.

We particularly encourage applications of professionals from the following countries: Armenia, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Georgia, Greece, Hungary, Italy, Kosovo, Latvia, Lithuania, Malta, Moldova, Montenegro, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Turkey, Ukraine.

Participation fee covering accommodation, meals and all workshop activities:
400,00 € + VAT 25%

Fee for online participation (payments by 1st September)
100,00 € + VAT

Apply here!

FIND OUT MORE
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Joint project of

University of Zagreb FACULTY OF MINING, GEOLOGY AND PETROLEUM ENGINEERING
National Technical University of Athens
TUKE
LIÈGE université
ZAG

Prof. Eric Pirard

Head of Minerals Engineering, Materials and Environment department

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Eric PIRARD is "ingenieur geologue" and professor of georesources @ULiege. Specialised in developing computer-assisted imaging techniques in geology, particle science and geometallurgy, he is heading a group of about 30 researchers (GeMMe) active in:
- process oriented mineralogical mapping
- vision and smart sorting technologies
- geological remote sensing
- energy-efficient fragmentation and pre-processing
- bio/hydrometallurgical processing

This group is a core-partner of several major EU and regional projects aiming at characterizing and recovering metals from challenging ores and complex end-of-life products.
Eric Pirard is the academic coordinator of the European Master in Resources Engineering (EMerald) a labelled master program part of the EITRawMaterials Academy.

Lecture D1U1: Digital perspectives in the mining industry

Digitization is not new in the mineral industry where resource modelling and online control have been pioneering technologies. Despite this and despite a very harsh and challenging environment, a lot of opportunities still exist to develop more digital tools at all stages from exploration down to mineral processing. This introductory talk will emphasize the role of cameras and sensors and introduce the upcoming lectures.

On schedule: Wednesday, 19th October 2022, 10:30 – 11:15

Lecture D1U3: Principles of geological imaging and online vision

The aim of geological imaging is to obtain roxels or in other words digital equivalents of „rock-elements“ . In order to achieve this, cameras have to be operated like spectrophotometers and spatial informations have to be carefully registered. With the help of classification and advanced learning algorithms it is possible to come closer to fully automated mineralogy and automated rock identification eventually offering opportunities for quality control monitoring and even smart sorting of mineralized materials. This lecture will review some of the most common geological imaging principles from microscopy to online vision and from core-scanning to remote sensing.

On schedule: Wednesday, 19th October 2022, 13:15 – 14:15

Lecture D2U1: Spatial sampling and stereology

Stereology is the science of studying solids. In mathematics it is also known as a series of tools to estimate 3D properties from 2D or even 1D observations. This is exactly what we need when exploring a 3D orebody with drill cores or when

observing 2D sections under the microscope. A good understanding of basic sampling principles is therefore essential to optimize the estimation process. This lecture will insist on some good practices to sample ores and particulate materials, it will also demonstrate how to develop unbiased sample preparation and correctly estimate confidence intervals.

On schedule: Thursday, 20th October 2022, 09:00 – 10:00

Lecture D2U6: Mineralogical reconciliation of ore sample analyses

Bulk chemical analyses (ex. ICP) and semi-quantitive mineralogical analyses (ex. XRD) are standard technologies that provide unique insights into ore samples, concentrates, tailings, etc. Due to different sampling protocols, limits of detection and accuracies the results provided by these techniques are often difficult to reconcile... even more so, when automated mineralogy results are provided by electron microscopes. This workshop will demonstrate how to properly reconciliate elemental and mineralogical data and try to yield the best possible estimate for a given sample. Cross-validation or reconciliation should be part of any serious study in ore characterization.

On schedule: Thursday, 20th October 2022, 15:15 – 16:00

Ir. Milkias Zerai Semereab

PhD candidate | Geo-Resources Engineer | Raw Materials | Minerals & Metals | Circular Economy | GeoStatistics

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Milkias Z. SEMEREAB is a Geo-Resource Engineer and PhD candidate with a master from Erasmus Mundus in Resources Engineering (Emerald). He aims at keeping a holistic view of the entire raw materials value chain and circular economy while pursuing a deeper expertise in spectral Geo-Sciences and sensor based Geo-Resources characterization, spatial data analysis as well as Geostatistics.

He is currently enrolled as PhD at university of Liege and has a research role at GeMMe; a research group at University of Liège that specializes in multi-sensor geo-imaging, development of vision-based characterization and sorting, mineral processing and recycling. Both his PhD and research works focus mainly on the applications of machine learning/deep learning models for multi-sensor data fusion (Hyperspectral, XRF, Raman, LIBS) at a scale of drill core scanning.

Lecture D1U4: Advanced rock imaging principles

With the emergence of digital rock imaging using cameras and sensors (such as digital RGB, hyperspectral, LIBS, XRF, XRT, Raman etc.), diverse data sets are being acquired at multi-scale (from sattelite borne down to microscope). However, the acquired 'raw' and 'big' data often comes with a challenge of processing and transforming it into meaningful 'smart' data insights such as geological, mineralogical, chemical and geotechnical features. One of the leading techniques to handle such task in rock imaging is the application of machine learning algorithms.

In this lecture we will present three types of machine learning frameworks which are developed for multisensory analytical core-scanning prototype (called ANCORELOG). The first framework is based on 'supervised machine learning classification' for fusion of SWIR hyperspectral and high-resolution SEM images with the objective to produce drill-core mineral mapping. The second framework will discuss 'deep learning neural network models' that take SWIR, XRF and Raman data as input and provides us labels of drill core domains as output. The final framework will focus on the application of transfer learning (pre-trained on very big datasets) into our specific needs to exploit the proven state-of-the-art CNN architectures such as GoogLeNet and ResNet that are now commonly used in numerous applications of RGB images classification, segmentation and computer vision.

On schedule: Wednesday, 20th October 2022, 14:15 – 15:15 (with Pierre Barnabe)

Ir. Pierre Barnabe

R&D, Project management, Software development, data analysis, machine learning

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I'm an engineer from the University of Liège. I started my career in the field of mining and geology, and, throughout my first job experiences, I've had the chance to get to know various aspects of the industry – such as mining exploitation as a planning engineer, geophysical and bathymetric surveying, site investigation - as well as discovering a bit of the world.

I've then had the great opportunity to lead an applied research project at the University of Liège, for which I had to diversify my skills and get into software development (C++, Python, Matlab), get familiar with several high-end technologies (hyperspectral vision, multi-energy X-Ray transmission, laser-induced breakdown spectroscopy), and deal with programmable logic controllers and delta-robots.

I've actually been very lucky as, until now, my work has always been a pure example of continuous learning, allowing me to know myself better and to realize how enthusiastic I am about computer science, technologies, machine learning and automation.

Lecture D1U4: Advanced rock imaging principles

With the emergence of digital rock imaging using cameras and sensors (such as digital RGB, hyperspectral, LIBS, XRF, XRT, Raman etc.), diverse data sets are being acquired at multi-scale (from sattelite borne down to microscope). However, the acquired 'raw' and 'big' data often comes with a challenge of processing and transforming it into meaningful 'smart' data insights such as geological, mineralogical, chemical and geotechnical features. One of the leading techniques to handle such task in rock imaging is the application of machine learning algorithms.

In this lecture we will present three types of machine learning frameworks which are developed for multisensory analytical core-scanning prototype (called ANCORELOG). The first framework is based on 'supervised machine learning classification' for fusion of SWIR hyperspectral and high-resolution SEM images with the objective to produce drill-core mineral mapping. The second framework will discuss 'deep learning neural network models' that take SWIR, XRF and Raman data as input and provides us labels of drill core domains as output. The final framework will focus on the application of transfer learning (pre-trained on very big datasets) into our specific needs to exploit the proven state-of-the-art CNN architectures such as GoogLeNet and ResNet that are now commonly used in numerous applications of RGB images classification, segmentation and computer vision.

On schedule: Wednesday, 20th October 2022, 14:15 – 15:15 (with Milkias Semereab)

Dr. Alan R Butcher

Professor of Geomaterials & Applied Mineralogy at Geological Survey of Finland (GTK) / Geologian tutkimuskeskus (GTK)

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Alan R Butcher is both a generalist and a specialist geologist, with a keen interest in rocks of commercial importance. His lack of a single-track specialism has enabled him over the years to develop topical trends in Geoscience, including: layered intrusions as natural laboratories for studying magmatic processes and the enrichment of base and precious metals, including the platinum-group elements (1980's); and the development of new Automated Mineralogy technologies for unparalleled micron-scale mapping of earth and planetary materials (from ore bodies, to hydrocarbon reservoirs, soils, dust, and even extra-terrestrial samples, during the 1990's-2000's). He is currently leading research at the Geological Survey of Finland (GTK) into the geology, geometallurgy and new uses of minerals for the modern world, using a novel multi-scale, multi-modal, multi-dimensional, & multi-skilled approach. He is also specifically involved in the characterization and efficient processing of newly discovered battery mineral deposits in Finland, as part of the Nation's drive to attain carbon neutrality by 2035

Lecture D1U2: Introduction to process-oriented orebody characterization

This lecture will cover some of the most important aspects of ore deposit characterization that control the efficient and effective processing of natural ores. We will cover the concept of upscaling and down scaling of geological observations. Then we move onto how geologists make the measurements, the types of technology involved, and how the information is interpreted. Mineralogy within a textural context is the key enabler to unlock the secrets of ore bodies. Several case studies will be presented that demonstrate the real world application of this approach

On schedule: Wednesday, 19th October 2022, 11:15 – 12:15

Dr. Marcos de Paiva Bueno

Founder & CEO at Geopyörä Oy

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With more than 15 years of work and research experience in the fields of mining and mineral processing engineering, Dr. Bueno has an in-depth knowledge on the design and optimisation of comminution circuits as well as geometallurgy. He completed a PhD degree at the University of Queensland, specialising in multi-component autogenous and semi-autogenous grinding. He has carried out extensive comminution circuit surveys as well as pilot plant campaigns both in Australia and internationally. Working as a senior process engineer for Ausenco, he has been involved in technical and engineering studies related to most key mining commodities. More recently, as a senior researcher and lecturer at the University of Oulu, he developed the Geopyörä breakage test with financial support from Business Finland.

Demo D1U6: Rock breakage characterisation testing

Dr Bueno will first provide an overview of the most commoly used rock breakage characterisation methods and their application. Then he will present his recent developed double wheel breakage test (Geopyora), describing its fundamentals and advantages in relation with other tests.

On schedule: Wednesday, 19th October 2022, 15:30 – 16:15

Carlos García Piña

Geologist at DMT GmbH & Co. KG

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Carlos García Piña has an educational background in structural geology. He joined the company DMT (Germany) in 2002 and dedicated his first years to consultancy in structural geology in the field of hydrocarbon exploration, mainly in the Arabic countries, but also in mineral exploration projects worldwide.

Currently he is in charge of R&D projects dedicated to automatization and digitalization in the mining sector. As part of that, he is leading two major international technological development projects funded by the European Union (https://eitrawmaterials.eu/project/ancorelog/) with the aim of automatizing drill core logging.

Demo D1U5: The Ancorelog - advanced core logging system

During economic downturn, junior exploration companies tend to spend funding on proven assets rather than on early-stage exploration. Major exploration companies opt to increase the value of their mines. Additionally, the decreasing trend of new major ore discoveries and increasing risk in early stage exploration leads to new challanges in risk mitigation. Generating high value information in early exploration stages supports decision making and identification of risks. The lecture will focus on the opportunities in sensor based drill core logging and its contribution to project risk mitigation.

On schedule: Wednesday, 19th October 2022, 15:30 – 16:15

Ir. Arpit Singh Parmar

Chief Operating Officer

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Arpit Singh Parmar is a geometallurgical engineer and currently works in the capacity of COO at Metheore in Belgium (providing image-based online size measurement solutions). He holds an M.Sc. in Mining Engineering and a Bachelor's in Mineral Processing. He has seven years of work experience in multiple functions: operations management, strategic business consulting and academic research. His areas of interest are digitalisation and image-based applications for material characterisation in the mining industry.

Lecture D1U7: LaserSieve - Online sizing of agregates and comminuted material

This lecture will comprise the fundamentals of online vision applications and their evolution in the mineral industry in the context of real-time material measurements for size analysis. The technology will be discussed in a broader perspective in comparison to classical measurement practices (sampling & sieving) and its potential.

Finally, some industrial case studies will also be presented with an online vision product "LaserSieve" from Metheore.

The students will benefit in terms of understanding the principles of image analysis and their applications to the mining industry, especially towards digitalisation and automation.

On schedule: Wednesday, 19th October 2022, 17:30 – 18:15

Dr. Hassan Bouzahzah

Sr. researcher in applied mineralogy and Acid Mine Drainage

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Hassan Bouzahzah completed a PhD in Environmental Sciences at the University of Quebec in Abitibi-Témiscaminque (Canada). He has over 15 years professional experience during which he has acquired a strong experience in mineral characterization using various techniques ranging from optical microscopy, X-ray diffraction, and especially those including micro-beam analysis (energy and wavelength dispersive spectroscopy, SIMS and laser ablation). Since 2016, he is working at the University of Liège where he is in charge of the Automated mineralogy system providing services for mineral processing and acid mine drainage prediction. Current research interests include automated mineralogical analysis and applications for ore deposit regarding mineral recovery, sample preparation for SEM observations, and acid mine drainage prediction.

Lecture D2U2: Sample preparation for quantitative mineralogy

The mining industry uses mineralogy to understand and improve mineral processing, ore recoveries, and tailings characterization for their valorization and environmental management. Characterization of the mining samples often analysed as mineral powder is mainly performed by microscopic observation that needs sample impregnation within Epoxy resin, i.e. polished block (PB) preparation. During the hardening of the "Epoxy-hardener-powder" mix, a differential settlement of minerals happens governed by particle size and specific gravity of minerals. The coarser and heavy particles accumulate at the bottom of the PB which is the analysis surface and often biases the results when fine and lighter particles remain floating in the resin and rarely appear on the observation surface. This phenomenon is well known in literature and is recognized to seriously affect the representativeness of the surface submitted to microscopic analyses on powder samples, particularly those using automated mineralogy. In this communication, an innovative preparation method of PB is presented allowing a complete elimination of differential particle segregation as well as touching grains. Another feature of this preparation method is to make the Epoxy electrically conducting which avoid the carbon coating for SEM observations. The communication also covers the PB preparation for graphite observation under SEM by doping the resin by iodine to better contrast it with the graphite.

On schedule: Thursday, 20th October 2022, 10:00 – 10:45

Lecture D2U7: Mineralogical data reconciliation, case study

Mineral characterization in earth sciences, ore processing and mine environment is usually achieved through X-ray diffraction, microscopy and sometimes by modal calculation based on chemical assay. The automated mineralogy based on SEM-EDS micro-analysis has strongly developed in the last three decades and also become widely used in mineral characterization offering a wide suite of information (modal mineralogy, textural quantification, chemical assay, etc). The data obtained by each characterization technique, whether chemical, mineralogical or by microscopy, are often divergent and cannot be used without a cross interpretation of the results requiring data reconciliation. The objective of this communication is to reconciliate the data obtained from different chemical and mineralogical characterization techniques through an exercise using the element to mineral conversion.

On schedule: Thursday, 20th October 2022, 16:00– 16:45

Dr. Rich Taylor

Geoscience Applications Development

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Rich completed a PhD in Experimental Petrology at the University of Edinburgh in 2009, before moving to Curtin University in Western Australia as a SIMS laboratory specialist. He subsequently held research positions in the School of Earth and Planetary Sciences at Curtin studying geochemistry and geochronology, specialising in imaging and microanalysis. In 2017 he moved to the University of Cambridge to study magnetic inclusions in Earth's oldest materials using novel microscopy techniques. In 2019 Rich moved to Zeiss based in Cambourne, UK to take on the global Geosciences Applications Development role.

Lecture D2U3: SEM-based Automated Mineralogy

The phrase 'automated mineralogy' has been synonymous with the use of Scanning Electron Microscopes (SEM) for decades. The classification of minerals using SEM-based Energy Dispersive Spectroscopy (EDS) chemical measurements has been the only method for rapid, automated phase ID in microscopy.

Now, non-destructive X-ray microscopy techniques and deep learning algorithms to execute automated mineralogy using Mineralogic 3D software. Mineral classification and particle identification are performed alongside customisable data outputs including true grain size/shape and mineral association measurements.

Three immediate benefits:

1. Streamlined sample preparation with no polished mounts
2. Reduce sample runs by eliminating stereological assumptions
3. Non-destructive for precious samples or correlative workflows

The capabilities of the X-Ray Microscope (XRM) and Computed Tomography (µCT) are at the forefront of lab-based, non-destructive imaging. These 3D microscopy capabilities now feature 3 key enhancements enabling quantitative analytical applications.

1. Advanced machine learning for noise reduction and speed
2. Diffraction Contrast Tomography for crystal orientation analysis
3. Calibrated phase identification for automated mineralogy

Mineralogic 3D automatically classifies the mineralogy of the sample based on attenuation measurements. This unique capability can be combined with morphological measurements to create a full description of the sample with none of the stereological restrictions of SEM-based analysis.

Mineralogic 3D is capable of analysing whole rock samples, loose particle fractions, or intricate structures in full with no sample damage and minimal preparation.

Quantitative outputs of structure and mineral identification are ideal in the classification of heavy mineral in ore body research and industry workflows. But the ability to do this non-destructively using X-ray tomogrpahy is also perfect for precious samples such as meteorites & sample-return missions, museum specimens, and fossil samples – particularly those still embedded in host rock.

On schedule: Thursday, 20th October 2022, 10:45 – 12:00

Dr. Andrew Menzies

Sr. Application Scientist Geology and Mining at Bruker Nano Analytics

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Andrew Menzies holds a Doctorate of Geochemistry from University of Cape Town (South Africa) and a Bachelors of Science and Bachelors of Commerce from University of Auckland (New Zealand). He has over 25 years professional experience working as a geologist involved in numerous projects around the world ranging from grassroots exploration, follow-up reconnaissance exploration, target evaluation, laboratory analysis, and consulting and project management. During this time he has used various analytical techniques and managed analytical laboratories including, especially those including micro-beam analysis. In addition, the laboratories achieved ISO accreditation and he holds an ISO certificate of competence as an analytical signatory. He is registered as a certified professional with the South African Council for Natural Scientific Professions (SACNASP). He has work in industry, as a academic professor of geochemistry at Universidad Católica del Norte, (Antofagasta, Chile), and is currently working for Bruker Nano Analytics based in Berlin, Germany. Current research interests include ore deposit mineralogy (epithermal, porphyry, exotic-Cu, REE); mantle geochemistry and the origin of diamonds; automated mineralogical analysis and applications, both SEM and microXRF based, and analytical standards preparation and evaluation.

Lecture D2U4: MicroXRF for Mineralogical Mapping

Micro-X-ray fluorescence (micro-XRF) is a spatially-resolved version of traditional X-ray fluorescence analysis (XRF). In recent years a series of technological developments, from excitation sources, to enhanced detection possibilities and signal processing capabilities and algorithms, have allowed improvement in the performance of the technique, consequently making micro-XRF useful as a standard geological analytical tool. Specifically, these technological developments include improving (minimizing) beam size, improving X-ray source options and capabilities, applying numerous types of filters, and next generation SD detectors with high signal throughput and energy resolution. The small beam and localized measurement position can be used in single point mode, or in scanning mode for a line scan or area map. This position-tagged style of spectroscopy then allows for the creation of element distribution maps, as well as for other complex post-processing procedures, including mineralogical analysis. Some of the main advantages of micro-XRF analysis are the ability to perform large area maps on a variety of sample types, non-destructive analysis, minimal sample preparation (no carbon coating or polishing required), small spot analysis, fast measurements with major, minor and trace element sensitivity, and ability to process results for quantification and / or mineralogy. Examples of all these benefits will be shown from the geological and mining sciences, especially in the context of field samples and drill-core analysis.

On schedule: Thursday, 20th October 2022, 13:00 – 14:00

Christian Burlet

Geologist

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Christian Burlet obtained his Master in Geology in 2002 from University of Liège (Belgium). In 2007, he started working for the Geological Survey of Belgium (GSB-RBINS) on a Belgium-Africa cooperation project, where he worked in applied mineralogy, developing Raman spectroscopy of unstructured Cu, Co and Mn oxidized ores. During the last 5 years, he has been working for several raw materials related EU projects (FP7 and H2020). He currently coordinates the selective mining work package of the ROBOMINERS H2020 project and works on the LIBS-Screen BRAIN (Belspo) project, developing laser-based spectroscopy tools for fast CRM screening in mining operations. He is a member of the EuroGeoSurveys Minerals and Raw Materials Expert Group. Christian Burlet is also regularly working on archaeometry projects, using quasi non-destructive analytical techniques on paleontological and archaeological material.

Lecture D2U5: MicroLIBS for Elemental Mapping

LIBS (Laser-Induced Breakdown Spectroscopy) is becoming a technology of choice for exploring and recycling Critical Raw Materials and monitoring the environment of sites associated with the Raw Materials economy. This elemental analystical technique is complementary to XRF and its use in industry is growing very fast.

This lecture wil be devoted to the recent optimizations and applications of LIBS techniques for multiscale detection and characterisation of Critical Raw Material (CRM), with an emphasis on the recent development of high-resolution elemental mapping. This type of LIBS elemental mapping is sometimes refered as micro - LIBS because of the small size of the ablation craters (typically a few microns diameter) obtained by low power diode-pumped lasers, with excellent beam quality and focusability. New compact instrumentation using microscopy optics, high resolution displacement stages and compact spectrometers are now producting rapid high-resolution elemental images of ore samples slabs, cores and cuttings of to assist in CRM screening and automated mineralogy processes.

On schedule: Thursday, 20th October 2022, 14:00 – 15:00

Dr. Jussi Liipo

Director, Geometallurgy & Mineralogy

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Dr. Jussi Liipo, Director, Geometallurgy & Mineralogy, MAusIMM (CP). Jussi is a process mineralogist with 25 years of experience in the mining and metals industry. He holds a Ph.D. degree on Geology and Mineralogy from the University of Oulu, Finland, and is a Member of the Australasian Institute of Mining and Metallurgy and Chartered Professional under the discipline of geology.

Lecture D3U1: Impact of mineralogy on process performance

The world's demand for metals is increasing and ore deposits available for mining and processing are getting lower grade and more complex, that require tailored solutions to reach optimal metallurgical results. Process mineralogical studies are providing the critical information that stands between failure or collapse and survival or success of some mining operations. In this lecture, selected case studies are used to demonstrate the value of the process mineralogy combined with sophisticated modelling and simulation tools being used to provide the platform for innovative technology development.

On schedule: Friday, 21st October 2022, 09:00 – 10:30

Dr. Sandra Belboom

Reasearch Engineer at University of Liège and Maitre Assistant à HELMo

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Dr. Sandra Belboom got her chemical engineering degree from the University of Liège (BE) and her PhD from the same university, specializing in the development of methodologies to guide environment-friendly choices in process industries.

As a professor at HELMO, University College, her teaching and research activities are dedicated to sustainability with a special focus on LifeCycle Analysis (LCA) applied to the energy and raw materials sectors with the aim to provide global answers to environmental challenges.

Lecture D3U2: Introduction to LCA for mineral processing operations

This lecture will present the basis of the Life Cycle Assessment methodology as an environmental method to be applied to assess the sustainability of a process. This lecture aims to provide a good understanding of this method within the mineral field.

On schedule: Friday, 21st October 2022, 10:45 – 12:15