Technology Note

ZEISS Mineralogic Mining

Ore Process Optimization

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Improvement of processes is ever more important in mining. From exploration to production small improvements in efficiency can have large impacts on profitability. The increasing complexity of mined ore bodies, combined with the requirement to reduce operational costs and risks, requires the practical application of mineralogical knowledge in exploration and in the optimization of how an ore is mined and processed.

Introduction

The mineralogical characterization of ores provides insights into their processing requirements that extend to the environmental management of the tailings. Process circuit efficiency is affected by feed variability, insufficient mineral liberation, and the distribution of deleterious minerals and elements. Early knowledge of the metallurgical response of an ore facilitates improvements in grinding and in the use of reagents for flotation and leaching, thus leading to improved yields.

Automation

Use of the scanning electron microscope (SEM) to characterize ores provides process mineralogists and metallurgists with invaluable information for the optimization of processes. Manually obtaining relevant information such as mineral coatings that may interfere with flotation, mineral liberation and associations, elemental distribution, mineralogical or processing reasons for low recovery etc. can be time consuming. For this reason, automated SEM methods for mineralogical characterization have been devised. Typically these methods rely on qualitative analyses of the samples using EDS or BSD grey levels to classify the phases present.
The non-quantitative nature of the analyses means that other techniques, such as electron microprobe analysis (EMPA), must be used in conjunction with the SEM to obtain quantitative information of the sample. This is particularly time consuming if the ore body is unknown. To overcome this limitation, Mineralogic Mining provides quantitative analysis of the mineralogy of any ore or ore-derived processed material. This allows for the full quantitative evaluation of a resource to be performed automatically by the SEM, thus limiting the use of EMPA to the detection of trace elements.

Mineralogic Quantitative Analysis

Quantitative analysis provides ease of identification and accuracy of classification. Knowledge of the proportion of elements present allows detailed studies to be performed. Variability in elemental concentrations are easily and accurately mapped and vital calculations can be performed without reliance on other analytical techniques. Furthermore, the quantitative nature of the analysis means that mineral classifications may be refined with the use of chemical ratios. The availability of quantitative analysis improves accuracy in the classification of phases that are difficult or impossible to separate by qualitative methods e.g. Ti – bearing phases, Fe and Mn tantalites, clay minerals.

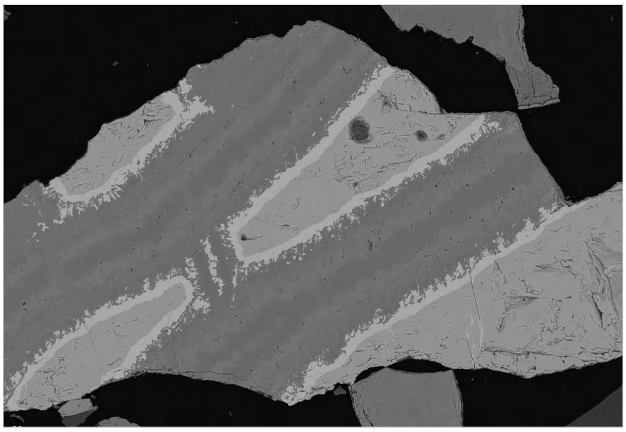

Figure 1a *Image of copper-gold ore acquired using backscatter detection with ZEISS Mineralogic Mining*

Mineral Discrimination

Consideration has been given to the distinct analytical requirements of specific ores (e.g. iron, molybdenum, gold). Flexibility is inbuilt so that the most pertinent analytical parameters for any analysis (e.g. grey-level thresholds, working distance, acceleration voltage, probe current etc.) may be adjusted to enhance detection, resolution and classi-fication. Enhanced conditions mean improved detection and differentiation of often difficult to differentiate phases using grey-levels alone, such as, hematite and magnetite.

Further mineral information discrimination is possible as Mineralogic Mining automatically separates touching particles, thus ensuring that the reported liberation values are accurate and no post processing of the data is required.

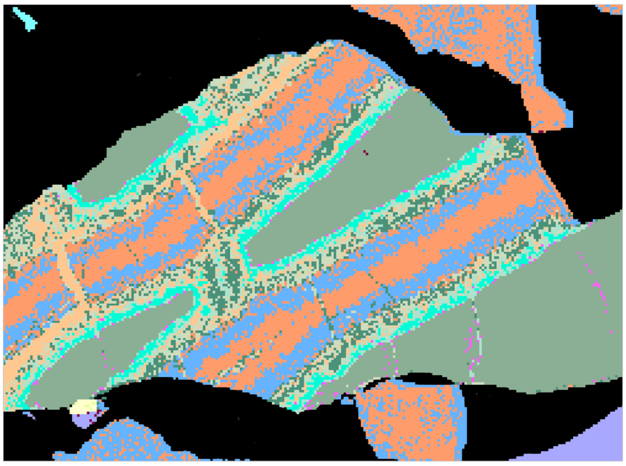

Figure 1b *Mineral classification of figure 1a using ZEISS Mineralogic Mining fitted with an EDS detector to show each mineral type by color: hematite (orange) and magnetite (blue).*

In-Line Data Processing

The ability to perform quantitative chemical analysis of samples allows for the measurement of key values and statistics to be performed in-line as the analysis is progressing. In this way, data such as elemental assays and distribution, measured mass per cent per mineral, mineral associations and the presence of penalty phases is provided immediately at the end of each analysis, without the need for further processing.

Conclusion

Mineralogic Mining takes advantage of quantitative mineral classification to optimize mineral identification and significantly simplify the characterization of unknown ores. Mineralogic Mining provides the mineralogist with greater analysis flexibility and simpler workflows in the characterization of ores and the optimization of processing circuits.

Configuration

Mineralogic Mining is compatible with conventional and field emission scanning electron microscopes from ZEISS. Configure your system with up to 4 EDS detectors and enhance your workflow with SmartBrowse, a contextualized image browsing tool that presents an overview of the analyzed sample as well as detailed queries of the images.

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