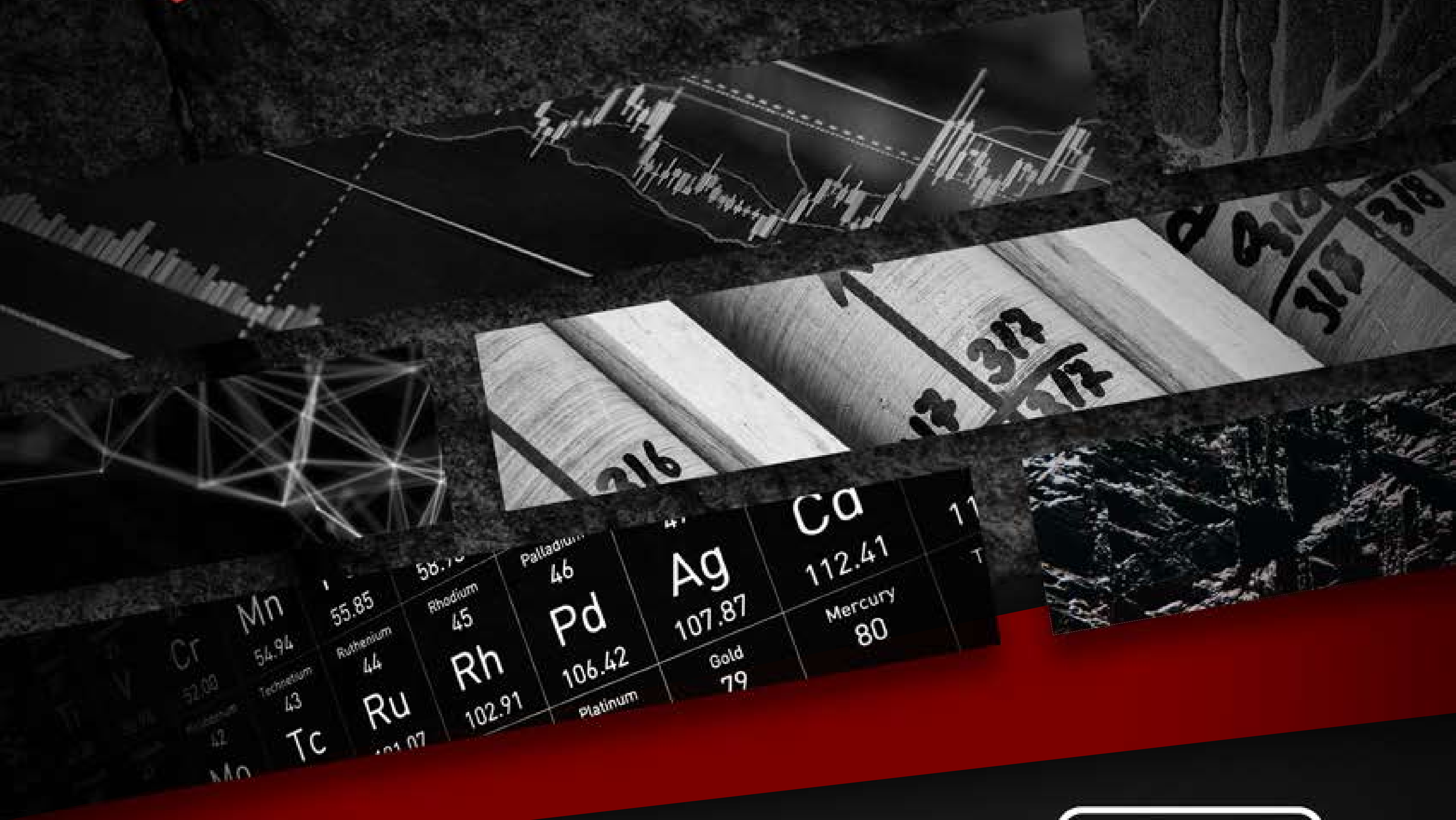
ELEMISSION

LIBS TECHNOLOGY



APPLICATION NOTE

79
Au
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OPTIMIZING GOLD DEPOSIT EXPLORATION THROUGH RAPID ELEMENTAL AND MINERALOGICAL CHARACTERIZATION USING ECORE

ECORE

Optimizing gold deposit exploration through rapid elemental and mineralogical characterization using ECORE

Importance of Gold Exploration

Gold exploration and production remains as a critical industry, driven by its economic importance (mining market valued at $215.4 billion USD in 2024) and growing technological demand. Gold is consistently considered to be a trusted store of value, providing stability to financial markets, especially during periods of inflation or economic uncertainty. At the same time, technological advancements in the electronics, renewable energy, and aerospace industries have increased the demand for gold due to its superior conductivity, resistance to corrosion, and exceptional durability. The gold mining industry faces increasing challenges in sustaining production growth due to the diminishing availability of accessible gold deposits. The implementation of innovative technologies is essential to improve the discovery of new deposits and to optimize the recovery and production of existing deposits.

ECORE Technology

Figure 1: ELEMISSION's ECORE Mobile laboratory, a LIBS-based core scanner mounted in a container for rapid onsite analysis of drill core.

ECORE (Figure 1) utilizes Laser Induced Breakdown Spectroscopy (LIBS), interchangeably referred to as Laser Ablation Atomic Emission Spectroscopy (LA-AES). LIBS/LA-AES is a spectroscopic technique that utilizes laser ablation to excite elements in a material. Our ECORE technology employs this method while acquiring spectral data while scanning of drill core surfaces. With each laser pulse, a plasma is created, and as the plasma cools, the emitted light is captured by a spectrometer. This process generates a characteristic spectrum of each material ablated along the surface containing elements that are present in the material.

In this application note, we demonstrate how ECORE technology significantly accelerates gold deposit exploration by rapidly providing critical elemental and mineralogical information, greatly enhancing ore body knowledge.

APPLICATION: Distinguishing arsenopyrite from arsenic-bearing pyrite

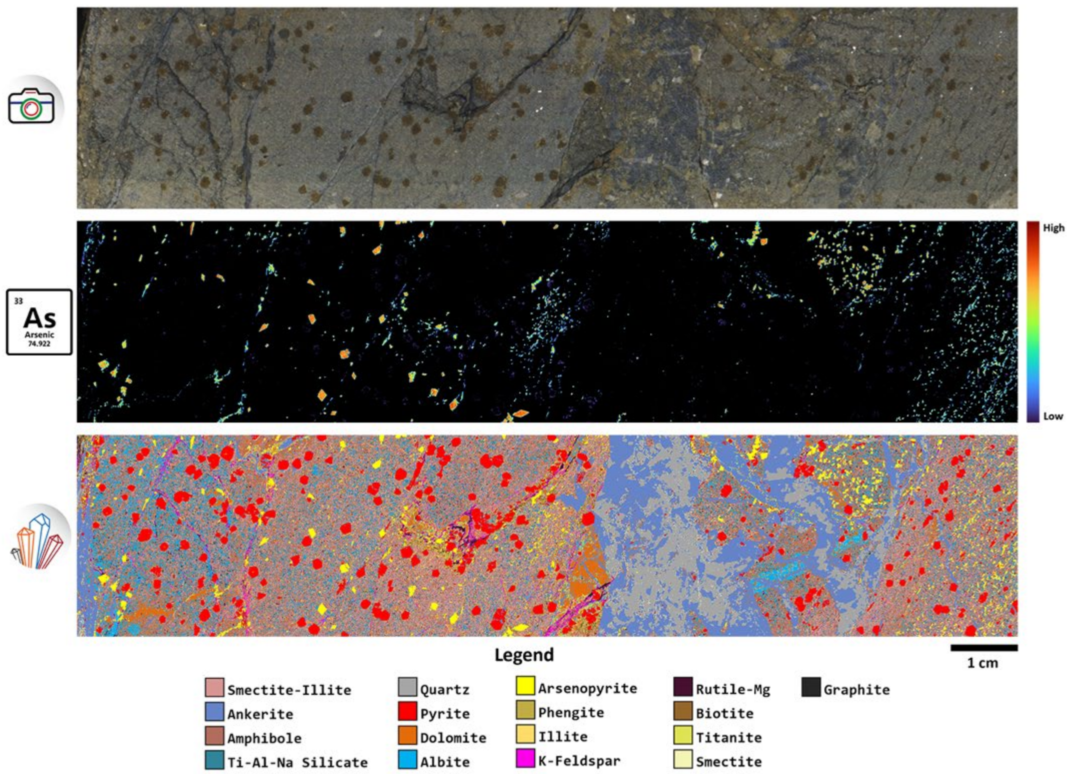

Figure 2: A photograph, a mono-elemental arsenic (As) map, and a mineralogical map generated by ELEMISSION's Smart Automated Mineralogy (SAM) algorithm of a section of drill core from an orogenic gold deposit. Arsenopyrite can be differentiated from As-bearing pyrite and non-As-bearing pyrite.

For many gold deposit types, the presence of arsenic-bearing minerals is known to be associated with gold mineralization. Properly constraining the deportment of arsenic within a deposit can, therefore, provide invaluable insight into understanding controls on gold mineralization to facilitate decision-making and generate future drilling targets.

The orogenic gold deposit shown whose drill core is shown in Figure 2, has gold mineralization that is almost exclusively refractory and is associated with disseminated sulfide mineralization and related hydrothermal alteration. In general, gold particles are primarily trapped within fine-grained arsenopyrite or arsenic-rich pyrite crystals. Higher concentrations of arsenic are typically associated with higher gold concentrations.

The selectivity and sensitivity of ECORE technology allow users to distinguish between arsenopyrite, As-bearing pyrite, and non-As-bearing pyrite. Using a combination of mineralogical and elemental mapping, the distribution of arsenic throughout the core can be observed, and subsequently, mineralogical, textural, and chemical affinities between As-bearing pyrite and non-As-bearing pyrite can be established.

The textural and chemical characteristics of these minerals can be used to better understand the implications concerning the mechanisms and timing of gold deposition. Access to detailed mineralogy promotes easy and accurate deposit characterization and identification of alteration assemblages, allowing for informed decisions to be made for future exploration.

APPLICATION: Differentiating between carbonate types during exploration for quartz-carbonate vein-hosted gold deposits

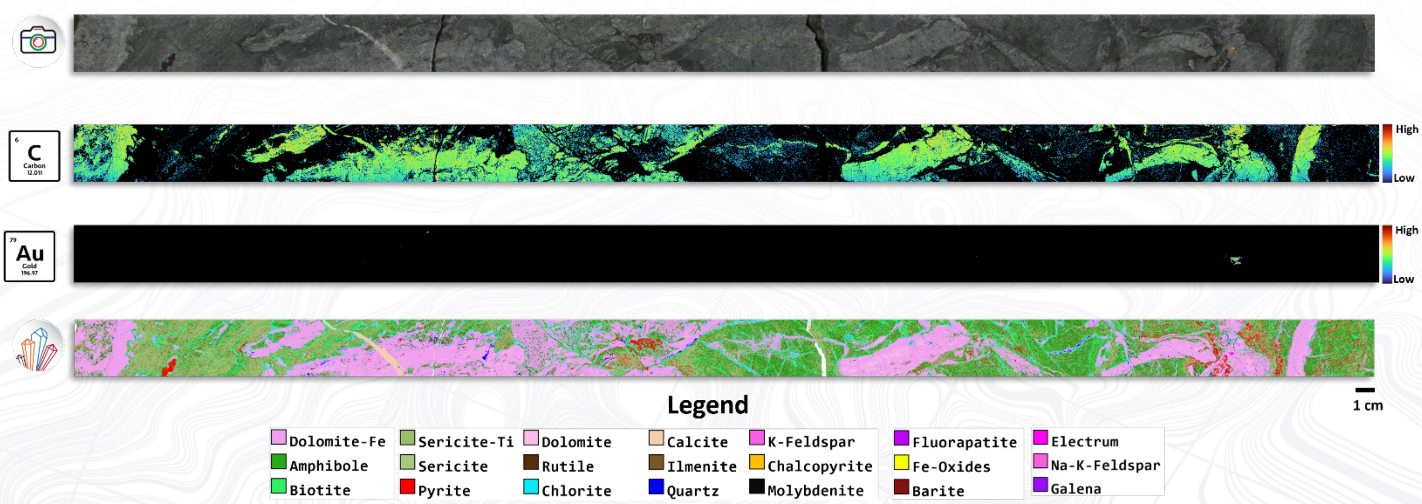

Figure 3: A photograph, an elemental carbon (C) map, an elemental gold (Au) map, and a SAM image of a quartz-carbonate vein-hosted gold deposit drill core sample. Carbon-rich minerals and gold distribution can be clearly differentiated and visualized, along with their associated alteration minerals.

Quartz-carbonate vein-hosted gold deposits typically exhibit mineralization closely associated with distinctive carbonate alteration assemblages, primarily comprising calcite and dolomite. Accurate identification and characterization of these carbonate minerals and related alteration phases is critical, as their presence and distribution often directly correlate with gold grades and the potential for economically viable mineralization.

In the example shown in Figure 3, gold mineralization is closely linked to quartz-carbonate veins and surrounding altered wall rocks, where gold particles occur both as free gold and in association with carbonate and sulfide minerals. Higher gold concentrations often correlate spatially with specific carbonate minerals, indicating a strong relationship between carbonate alteration assemblages and gold deposition.

ELEMISSION's proprietary software for producing elemental and mineralogical (SAM) maps allows precise differentiation between carbon-rich minerals, gold occurrences, and other alteration minerals. Elemental maps, particularly those illustrating carbon and gold distributions, clearly shows spatial distribution and textural relationships of these minerals within the vein system.

Detailed mineralogical mapping and elemental analysis facilitate understanding of alteration zoning and its relationship to gold distribution. This enhanced characterization of carbonate alteration assemblages provides critical insights into the mineralizing processes, improves geological interpretations, and supports targeted exploration and resource delineation.

APPLICATION: Identifying base metal sulfide zonation as a vector for gold in VMS deposits

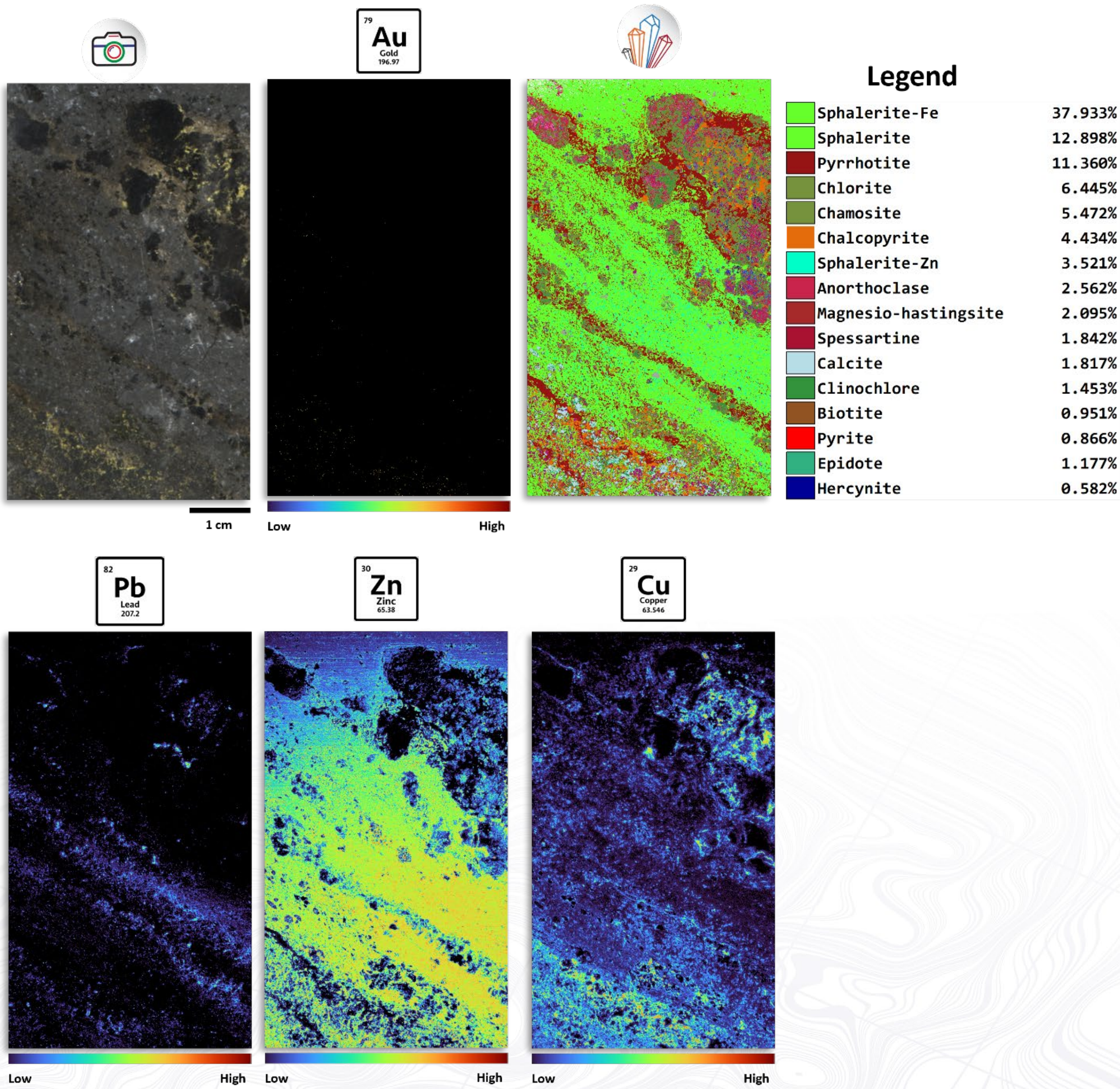

Figure 4: A photograph, elemental, maps, and a SAM image of a thin section offcut from a VMS deposit showing the association of base-metals to the gold present.

Base-metal sulfide zoning is particularly important in volcanogenic massive sulfide (VMS) deposits, where minerals such as chalcopyrite (Cu), sphalerite (Zn), and galena (Pb) commonly occur. Accurately mapping and differentiating these base-metal sulfides through elemental and mineralogical mapping provides key insights into hydrothermal fluid pathways and depositional environments associated with VMS systems. Understanding sulfide zoning patterns enables exploration teams to effectively vector toward high-grade gold and polymetallic enrichment zones, enhancing exploration targeting, resource delineation, and overall exploration success in VMS deposits. Figure 4 shows a thin section offcut from a gold-bearing VMS deposit where copper, zinc, and lead-bearing minerals are able to be identified and their association with gold. This capability significantly enhances the understanding of mineral associations and zoning patterns, particularly critical in VMS deposits where the spatial relationships of copper, zinc, and lead minerals to gold occurrences can provide key insights into depositional mechanisms and exploration targeting. Detailed elemental mapping facilitates accurate interpretations of ore-forming processes and supports strategic exploration decisions by clearly delineating zones with the highest potential for economic mineralization.

Conclusion

Gold exploration and production remain critical, driven by gold's economic significance and growing technological demand. The challenges posed by declining gold yields from accessible deposits require innovative technologies to effectively guide exploration and enhance production outcomes.

This application note demonstrates how ELEMISSION's ECORE technology significantly improves gold exploration by providing detailed mineralogical and elemental mapping capabilities. By accurately distinguishing arsenopyrite from arsenic-bearing pyrite, differentiating carbonate types within quartz-carbonate vein-hosted gold deposits, and clearly identifying base-metal sulfide zoning in VMS deposits, ECORE technology delivers precise geological insights crucial for exploration success.

The integration of elemental and mineralogical mapping through ECORE enables exploration teams to effectively target high-grade gold zones, refine geological interpretations, and make informed strategic decisions. The capacity to accurately identify and characterize mineral associations, alteration assemblages, and sulfide zoning significantly reduces exploration risk and enhances the probability of discovering economically viable gold deposits. Thus, the application of ECORE technology represents an important advancement toward sustainable, efficient, and successful gold exploration.

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