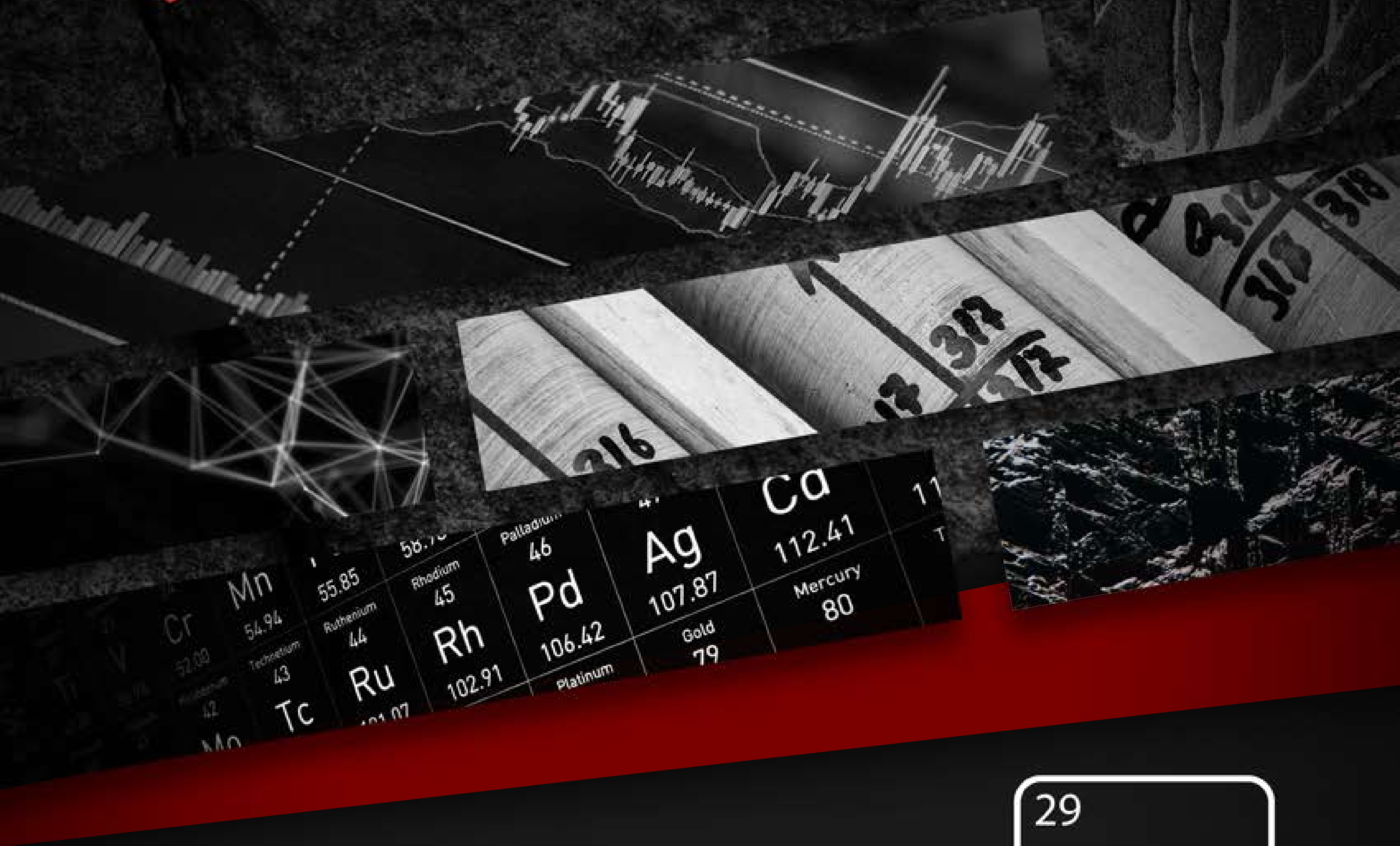
ELEMISSION

LIBS TECHNOLOGY



APPLICATION NOTE

29
Cu
63.546

STREAMLINING COPPER EXPLORATION AND PRODUCTION WITH ECORE

ECORE

Streamlining copper exploration and production with ECORE

Importance of copper as a critical metal

With the rising demand of copper driven by clean energy initiatives and anticipated supply shortages, mining companies must shift toward more sustainable and efficient operations. Increased copper production is required to meet global demands for renewable energy technologies and electric vehicles. For example, a typical megawatt (MW) wind turbine may require 4.7 tonnes of copper while a photovoltaic cell consists of around 1% copper. Similarly, the production of EVs requires significantly more copper, as they use 1.7 to 11 times more than conventional cars.

Copper is used in rechargeable batteries, electric motors, electric wiring and conductors, charging stations, and in supporting infrastructure that is necessary for connecting renewable energy sources to the main electric grid. It is forecasted by 2050 global copper demands will increase to ~29 Mt from values in 2019. This increase in copper demand means that technologies involved in the exploration and production of copper must be optimized through the utilization of emerging and innovative technologies to ensure that global demands are met.

ECORE Technology

ECORE 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 the ability for ECORE to increase efficiency of exploration on production of copper in various copper-bearing deposit types by providing rapid chemical assays and automated mineralogy along with valuable information for optimizing comminution during production.

APPLICATION: Drill Core Analysis

Porphyry copper deposits are one of the most significant sources of copper in the world, and also serve as an important source of molybdenum, gold, and silver. These deposits form in magmatic-hydrothermal systems where metal-rich fluids interact with host rocks, resulting in large-scale mineralization. One of the defining characteristics of these deposits is their distinctive zoning pattern. As hydrothermal fluids migrate outwards from the mineralization center, they create alteration haloes with distinct mineralogical and geochemical signatures. These zones serve as useful indicator for exploration geologists as vectors towards ore bodies.

1. Elemental Mapping

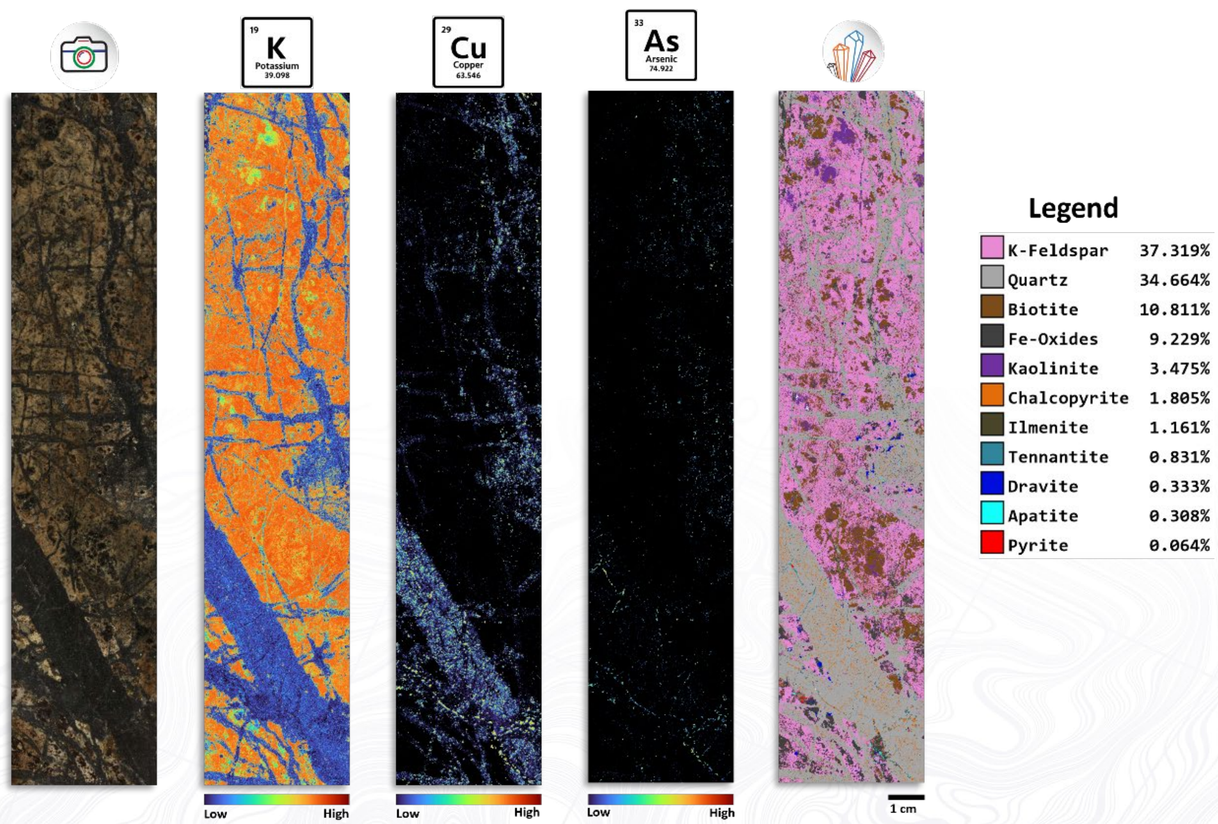


Figure 1: A photograph, elemental maps, and mineral map of a segment of porphyry copper drill core.

Identifying and mapping the distribution of pathfinder elements (Figure 1) is an important component of porphyry copper deposit exploration. These elements help define geochemical footprints that allow for more effective and precise targeting.

The use of LIBS technology means that users can have real-time access to all elements from the periodic table (from H to U). This wide elemental range also encompasses all critical pathfinder elements essential for effective porphyry copper exploration. Elemental mapping also means that spatial and textural information is preserved. Combined with ELEMISSION's proprietary Smart Automated Mineralogy (SAM) mineral map generator algorithm which takes advantage of the specificity of LIBS spectra, users can easily understand which minerals host each element of interest.

2. Automated Mineralogy and Chemical Assays

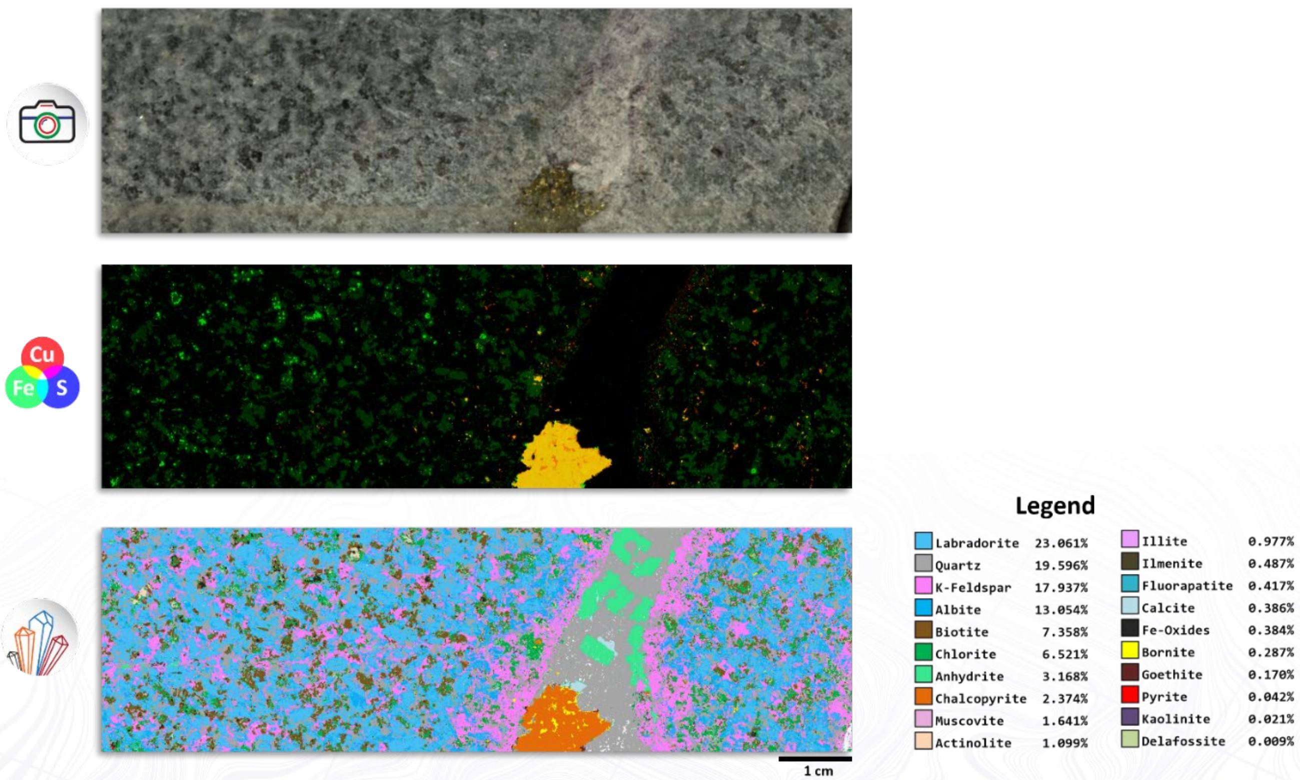


Figure 2: Smart Automated Mineralogy (SAM) map of identified minerals in a section of porphyry copper drill core.

ELEMISSION's SAM learning algorithm allows for the automated and precise creation of mineralogical maps. This algorithm consistently recognizes the unique mineralogy present in various deposit types. This is particularly useful in the case of porphyry copper deposits, where the identification and characterization of key alteration minerals such as chlorite, epidote, and sericite are crucial for enhanced ore body knowledge. Having a better understating of mineralogical textures and mineral associations is invaluable for accurate logging, targeting, and decision making. Figure 2 displays a high-resolution SAM image of a section of drill core from a porphyry copper deposit, while also showing modal mineralogy. The usefulness of the specificity of LIBS spectra and access to the entire periodic table is again highlighted where even minerals with the same elements but variable composition such as bornite and chalcopyrite are able to be distinguished from one another.

APPLICATION: Rock Chip and Powder Analysis

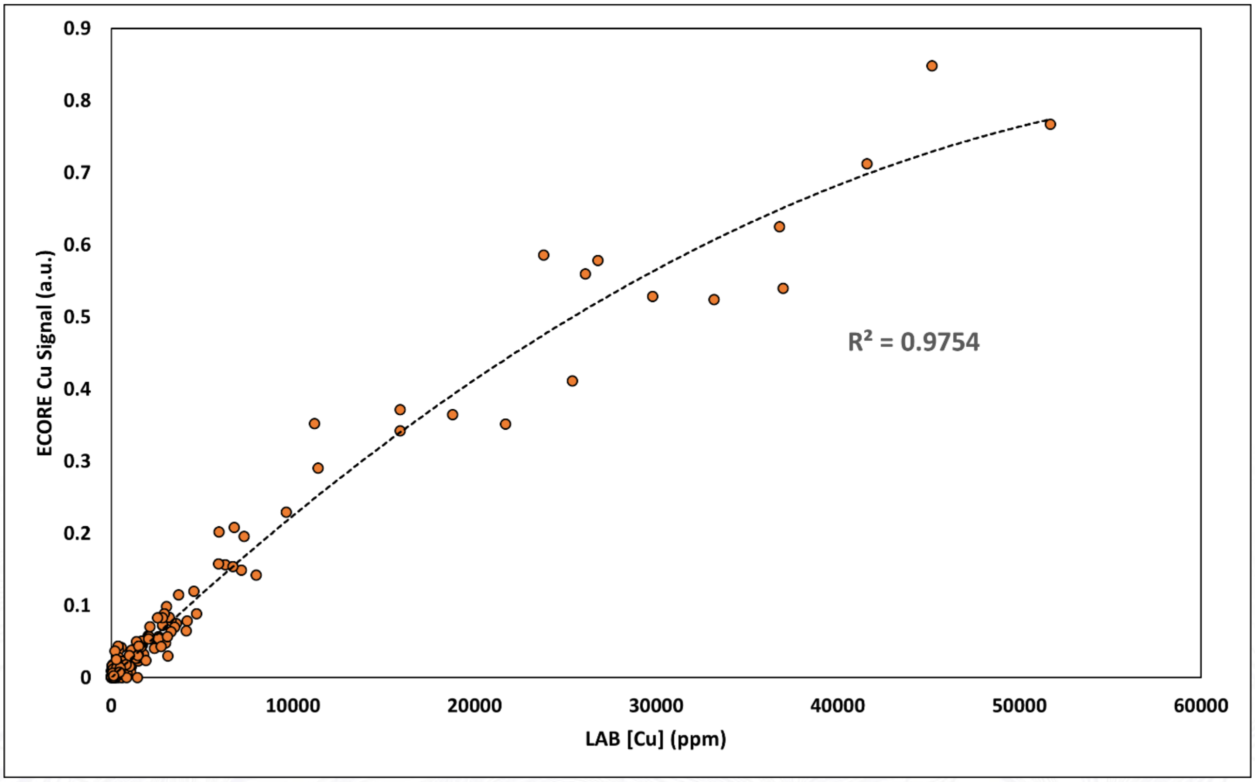


Figure 3: Comparison of Cu signal (a.u.) detected by ECORE to lab Cu concentration (ppm) obtained from halved drill core samples from a VMS deposit showing a strong correlation between traditional laboratory assays (ICP-AES) and those from ECORE.

Using ECORE technology, chemical assays can also be provided in real time. Figure 3 shows chemical assays taken at approximately 1-meter intervals over 400 m of drill core from a VMS deposit. The Cu signal detected by ECORE is compared to assays obtained by a standard laboratory method (ICP-AES, 4 acids) The R^2 value (0.975) and reveals a very strong correlation between the two methods and demonstrate that ECORE technology is equally effective and reliable when compared to traditional laboratory methods. Immediate access to quantitative chemical data, generated as a function of depth in intervals of the user's choice, is invaluable for expediting decision-making processes.

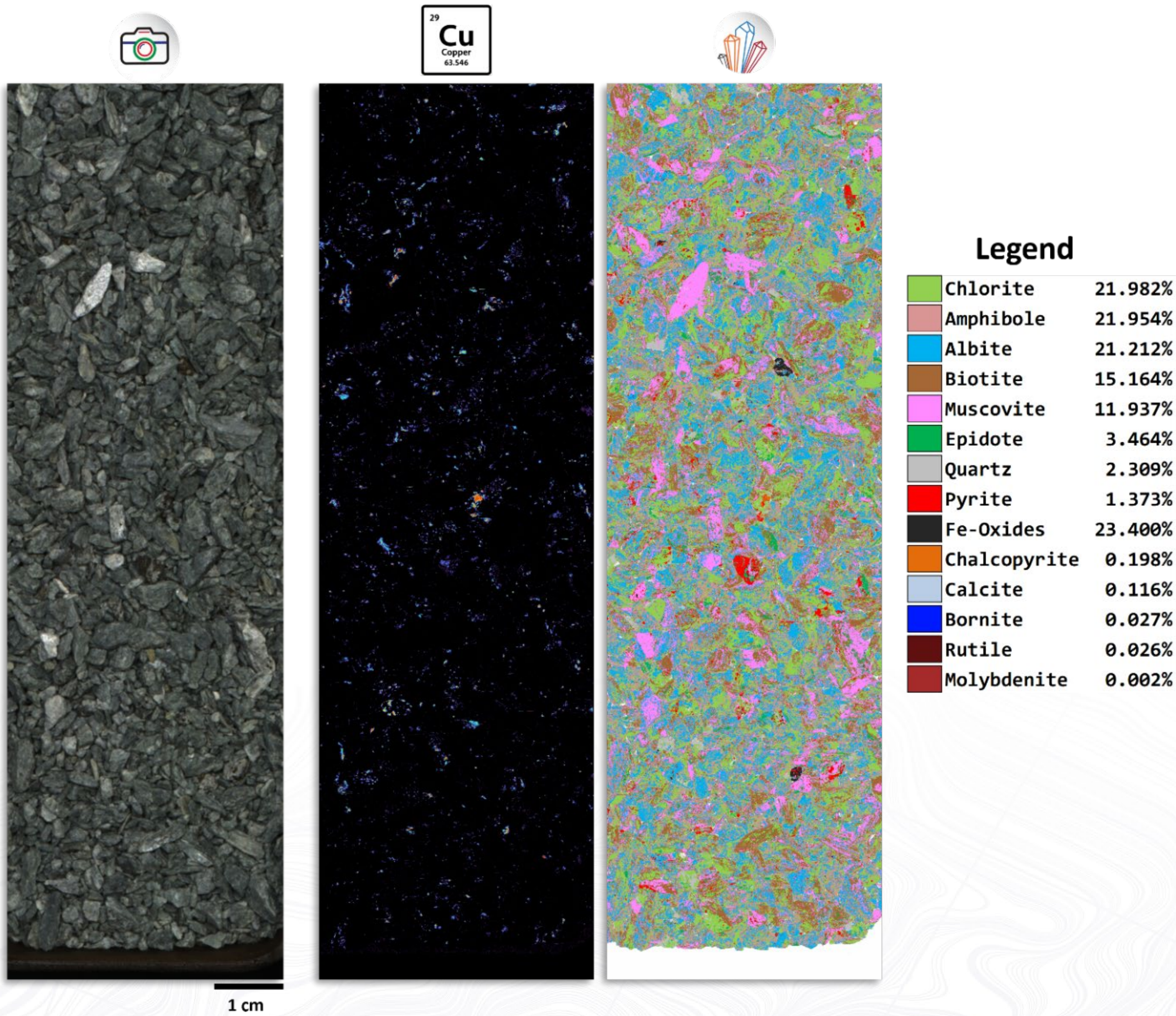


Figure 4. Rock chips obtained from a hydrothermal gold-copper deposit showing a photograph, Cu elemental map, and a SAM image.

ECORE technology demonstrates versatility by extending its analytical capabilities beyond intact drill core. It is able to easily analyze rock chips, crushed core, and pressed powder samples. Figure 4 showcases stacked elemental and mineralogical maps for rock chips from a hydrothermal gold-copper deposit. This is particularly useful during comminution and crushing studies, quality control processes during production, tailing assessments, and more. As shown in Figure 5, real-time chemical assays can also be performed on chips, crushed core, and pressed powders.

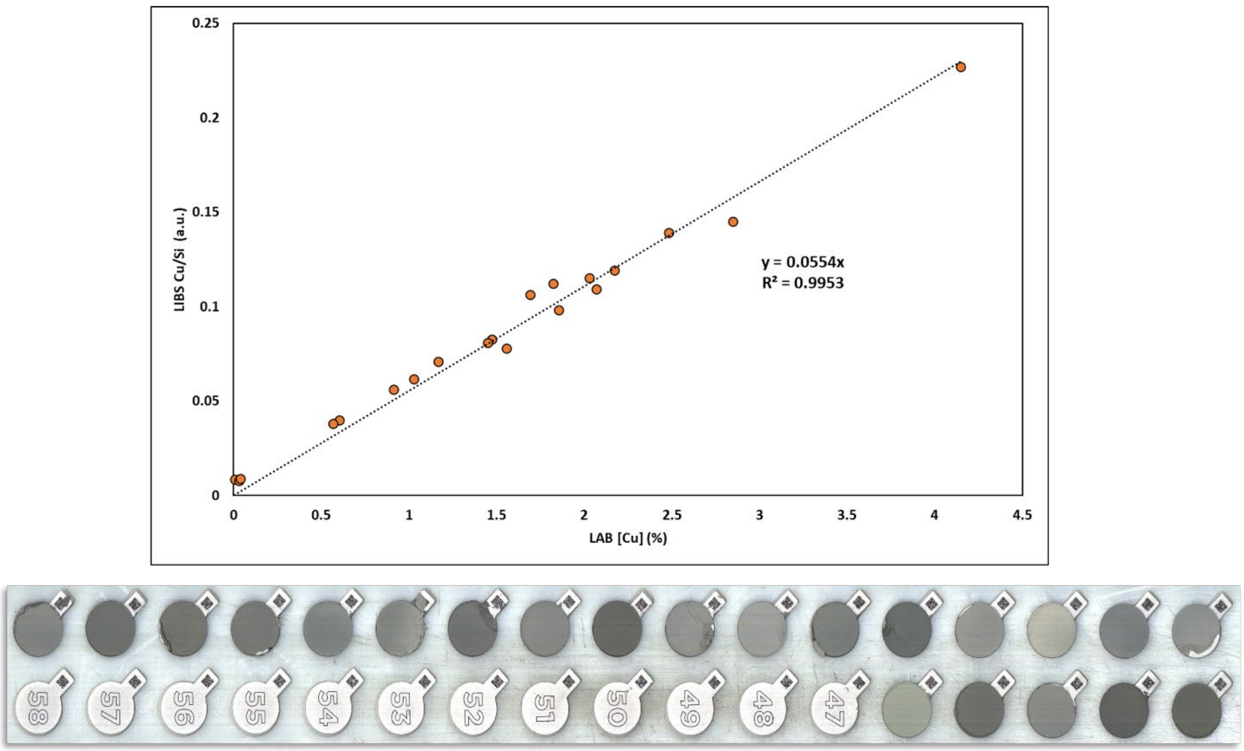


Figure 5. Comparison of copper concentrations (ppm) to the Cu/Si (a.u.) signal detected by LIBS for 22 pressed powder samples from a hydrothermal gold-copper deposit.

Conclusion

The increasing global demand for copper, driven by renewable energy initiatives and the production of green energy technologies underscores the urgent need for advanced exploration and production technologies. ECORE technology significantly enhances the efficiency, accuracy, and effectiveness of copper exploration by providing rapid and reliable chemical assays, detailed elemental mapping, and automated mineralogical analysis. By providing immediate access to quantitative chemical data and precise mineralogical identification and quantification directly on drill core and other sample types, ECORE enables faster, more informed decision-making, significantly reducing delays that are typically associated with traditional laboratory assays. This technology not only streamlines the exploration process but also contributes directly to optimizing production strategies and improving overall economic outcome in the copper mining industry.

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