Lithium Quantification in Geological Samples using Sci-Trace/M-Trace LIBS Technology

Challenges

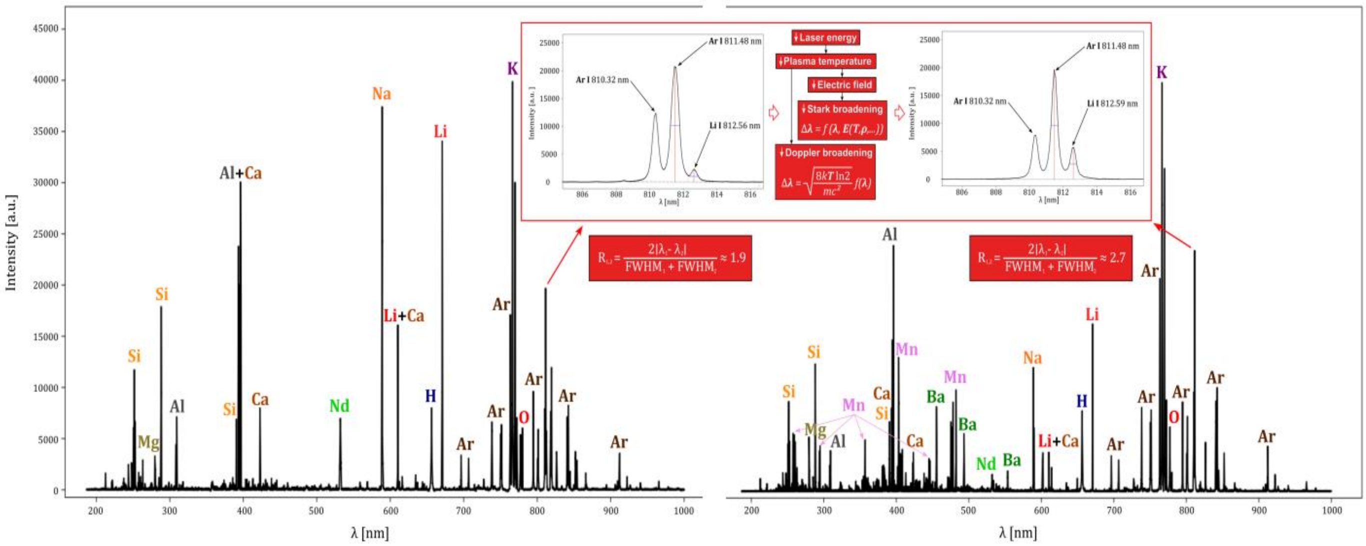
Lithium mining is difficult due to a combination of geological, environmental, technical, regulatory, and social factors. Addressing these challenges is crucial, particularly as **lithium** is a key component in the production of batteries for electric vehicles and energy storage systems, which are essential for the transition to renewable energy. As the demand for **lithium** continues to grow, finding sustainable and ethical mining practices becomes a critical duty for the industry, to minimize environmental and social impacts.

Solution

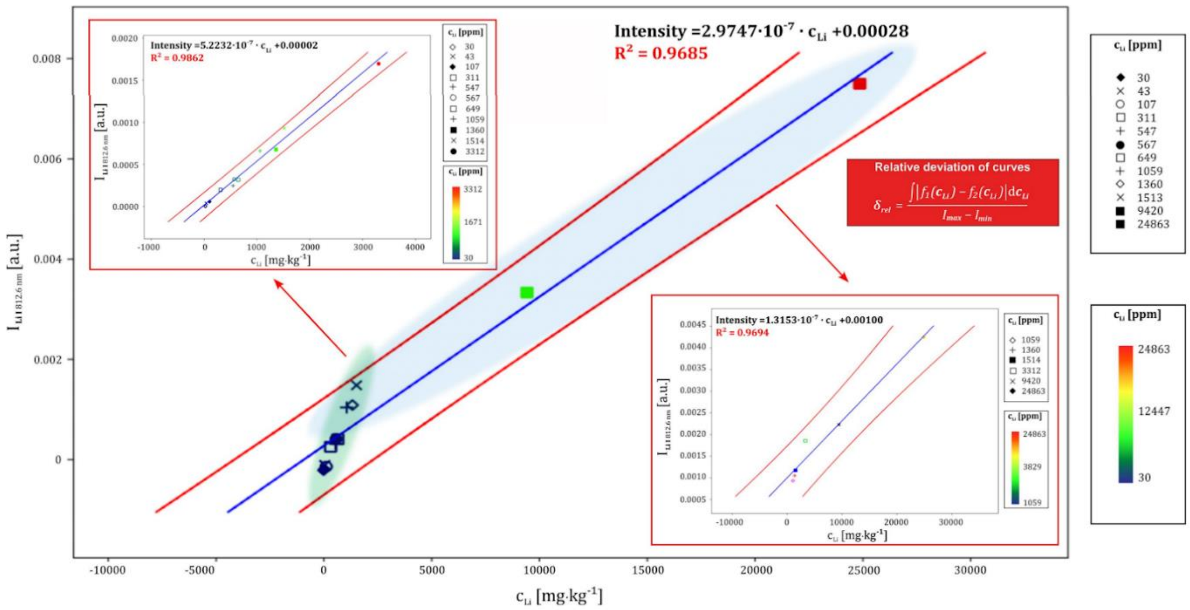
LIBS is being implemented in industrial applications, where it can provide important advantages over other techniques. It is a fast analytical technique that provides near real-time analysis. **LIBS** can quickly determine lithium content in ore samples, making it suitable for high-throughput mining operations where timely information is crucial. This information is essential for assessing the economic viability of a mining site and extraction process. Miners can use **LIBS** to determine which ore bodies contain higher lithium concentrations, focusing their efforts on the most promising areas. **LIBS** contributes to process optimization, quality control, environmental compliance, and efficient resource management in the **lithium** industry, ultimately enhancing the overall efficiency and sustainability of **lithium** production.

Results

- Measurement was performed on two datasets with different geological matrices using our **Sci-Trace LIBS instrument**.
- **Dataset A**: Li-bearing granites with Li-rich micas (concentration range from 30 to 24 863 mg·kg^{-1}).
- **Dataset B**: Li-rich minerals of rhyolite occurrence with MnO mineral varieties (concentration range from 4 mg·kg^{-1} to 814 mg·kg^{-1}).
- The spectrum excerpt highlights the region of interest around the lithium peak with greater detail. **Li 812.6 nm** gives best results - Li I 610.4 nm interference with Ca, Li I 670.8 nm becomes easily saturated.
- Decrease in laser energy leads to **higher resolution** (suppression of Stark effect and Doppler broadening).
- Using a different calibration curve for different concentration regions **increases the accuracy of the prediction.**



LIBS spectrum of Li-bearing granite samples (Dataset A)   *LIBS spectrum of Li-minerals of rhyolite occurrence samples (Dataset B)*



Calibration curve of lithium samples showing the split into two concentration ranges.

LIBS Principles

Laser Induced Breakdown Spectroscopy (LIBS) is an optical emission tool for the quick characterization of chemical elements in a broad range of materials, including biological, geological, and ceramic materials. A highly energetic laser pulse is directed at the target sample (Figure 1), resulting in the creation of an expanding microplasma upon impact. This microplasma emits luminous species that provide valuable information about the material composition and the sample environment.

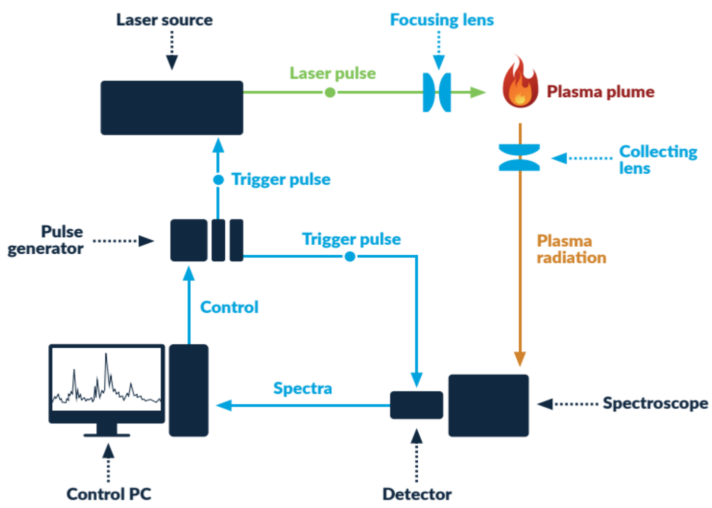


Figure 1: Sci-Trace LIBS set-up scheme