SciAps ApNotes
MAY 2016

Lithium Analysis in Geological Materials Using Hand Held Laser Induced Breakdown Spectroscopy [LIBS]

Overview

The analysis of Lithium in a range of geological samples using field portable equipment is now possible using the SciAps Z range of Hand Held LIBS [HHLIBS] analyzers. The Z is the world's ONLY Hand Held LIBS-based analyzer capable of performing geochemical sample analysis, and offers a fast, accurate, and highly portable technique for elemental detection particularly for low atomic number elements (Li, Be, B, Na and others) that cannot be measured by other field portable techniques.

As with field portable XRF [fpXRF], the Z allows analysis of transition and heavy metals, and greatly improved performance for low-atomic number elements – without the same regulatory challenges of x-ray devices. In addition to this, the Z can detect and measure very light elements not possible with fpXRF such as Li, Be, C, B, and Na, and also measure Mg, Si and Al at much lower detection limits compared to fpXRF.

SciAps Z can be used to generate both quantitative multi-element analysis of samples as well as elemental distribution maps to better understand the distribution of important elements within specific minerals in a geological sample.

The SciAps Z HHLIBS is particularly suited for in-field analysis of Lithium containing samples down to single digit ppm concentrations. The analyzer provides a way to determine Lithium concentrations in the field without relying solely on conventional laboratory analysis.

Background

Lithium production is possible from 3 main natural sources:

- Salt lake deposits and their associated brines.
- Hard rock pegmatite deposits rich in Lithium bearing minerals such as Spodumene, Lepidolite and Zinwaldite.
- Sedimentary deposits with Lithium rich clays such as Hectorite and newly identified silicate mineral Jadarite.

Historically, the majority of production has come from the first source above. However, increasing demand for lithium batteries is currently driving extensive exploration. New processing technologies yielding economic extraction of lithium suitable for batteries from previously sub-economic deposits are now being developed.

Data

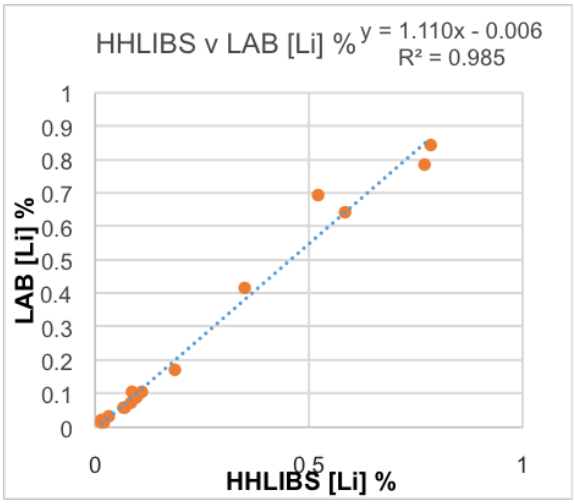


Fig. 1.

The excellent correlation between laboratory and field measurements of Li is shown in Figure 1. Field samples were pressed with a simple field pressed (5-10 ton) in a metal holder and presented to the analyzer for 3 second tests. To reduce the effects of sample non-homogeneity, several spots were tested and averaged, making the total test time approximately 10-15 seconds. Several geological reference samples were first used to build the lithium calibration on the Z-300 LIBS analyzer. The resulting data shows good agreement with the laboratory results, with detection limits in the 10 ppm range.

The SciAps Z includes desktop/laptop Profile Builder software. This software provides users full capability to create their own calibrations, choose different lines, overlay spectra for comparison and perform various pre-processing steps.

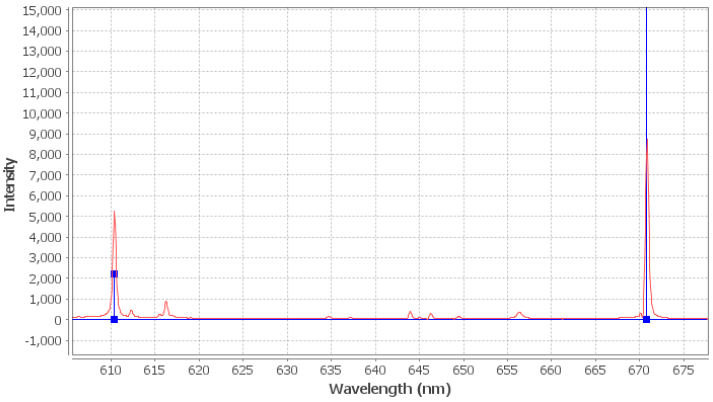


Fig. 3.

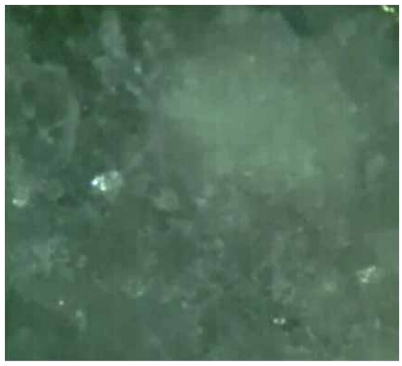
Elemental Mapping
Another Advantage of LIBZ Technology

Another unique feature to the Z is the ability to perform elemental mapping on rocks and cores. The Z includes an integrated camera/video, and utilizes a 2-D rastered laser. Using the SciAps GeoChem Pro Application operators can map elemental distribution within up to a 2 mm x 2 mm area allowing important deductions to be made about mineral chemistry. Implications of changes to mineral chemistry as a vectoring tool for targeting mineralization is also possible.

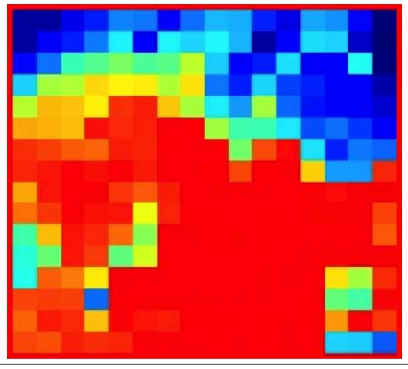
Consider the image of the rock being tested in Figure 2. The image of the rock sample is shown in Fig. 2a. This is the image as it appears on the Z's display via the analyzer's integrated camera. The bottom 2/3rd section of this portion of the rock is suspected Lepidolite. Figure 2b shows the elemental heat map of lithium produced by the Z's Geochem Pro software app. The heat map confirms the high Li concentration in this section of the rock.

Fig. 2.

a.



b.



The Z-200 vs Z-300

The SciAps Z is offered in 2 spectrometer and 3 spectrometer configurations (Z-200 and Z-300). The respective wavelength ranges are 190 nm – 615 nm and 190 nm – 950 nm. The Z-300 therefore includes the ability to measure the additional elemental emissions for H, O, N, Cl, Br, F, K, Rb, Ce and S. In fact the Z-300 has the spectral range to measure any element in the periodic table.

For the lithium application, the Z-300 can measure both prominent lithium emissions at 610.386 nm and 670.809 nm, as shown in the spectrum in Figure 3. The 670 nm line is about 5X more sensitive, and for low concentration measurements (< 100 ppm) is the recommended line. The SciAps calibration software supports multiple lines for applications where users desire to measure both high and low concentrations.

Conclusion

The SciAps Z range of Hand Held LIBS analyzers are effective tools for the in-field analysis of Lithium in a range of geological materials. Using the quantitative GeoChem Application, high levels of accuracy and limits of detection of 10 ppm are possible. Using the qualitative GeoChem Pro Application relative elemental distribution maps and associated mineral chemistry can be studied.

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