USE OF LASER-INDUCED BREAKDOWN SPECTROSCOPY (LIBS) AS A TOOL FOR THE QUANTITATIVE DETERMINATION OF LITHIUM IN GRANITE ROCK-FORMING MINERALS

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Introduction

There is a high global demand for lithium resources. From a geochemical perspective, the lithium-bearing minerals such as spodumene, lepidolite or petalite crystallize in the late-magmatic/pegmatitic period, producing granitic pegmatites. One such granitoid massif, about 1 km below the present surface in SE Hungary is located in the Battonya Unit. Here, the granitoids typically contain quartz, feldspar and micas, like biotite and muscovite. All these phases can incorporate a significant amount of lithium, thus may become a potential target of lithium mining.

Drill samples, taken from different locations in the Battonya region, containing different minerals (e.g. feldspar, muscovite, quartz, biotite, chlorite) were used as samples during the study. The ablation behavior of the NIST glass standards were examined and these standards were tested for calibration due to their similarity in matrix composition (silicate).

Experimental

In this work, the LIBS spectra were taken by using the J200 LA-LIBS tandem spectrometer (Applied Spectra Inc., USA). The minerals were presented to the instrument in the form of micro-polished sections. For the examination of the ablation behavior of the NIST standards and the samples profilometry measurements were performed on a Veeco, Dektak 8 Advanced Development Profiler.

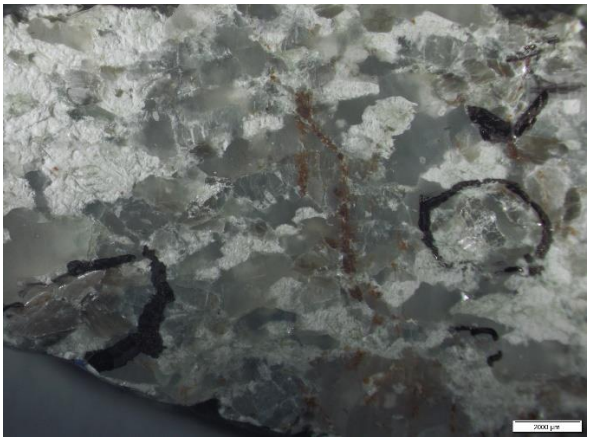

Figure 1.: Optical microscope view of one of the samples

Results and discussion

The comparison of the ablation behavior of NIST glass standards and the samples shows that the ablation craters for the NIST standards look quite similar. At the same time, the crater profiles for the sample minerals are different from each other, but generally also from the NIST standards. Biotite and quartz, both crater shapes and volumes are reasonably similar to those of the standards. For muscovite and feldspar, the matrix effect is remarkable, which may significantly influence quantitative analytical results. Normalization to the crater volume is suggested.

During the determination of Li concentration in the grains we measured all four minerals in and eight drill samples. During the measurements, at least four grains of each minerals were analyzed. Spectra were recorded from two different location in every identified mineral grains. We found that biotite, chlorite, muscovite and feldspar contain a high amount of Li (in some cases reaching 1 mg/g), whereas quartz is generally quite free from Li. An advantage of using LIBS in such prospection studies is that it can also provide a quick estimate for the average useful concentration of Li in rock samples without the need to remove the mineral grains from the rock.

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