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UV-Femtosecond LA-LIBS for Microanalysis of Lithium in Geological Materials

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Femtosecond laser ablation laser-induced breakdown spectroscopy (fs-LA-LIBS) is a powerful tool for geological analysis, enabling rapid multi-elemental detection with minimal matrix effects and sample damage [1]. The intense, stable plasma generated by fs-LA-LIBS enables high spatial resolution and reproducibility of plasma conditions, making it an emerging technique for precise elemental analysis [2]. Previous work has demonstrated sensitive detection of light elements such as Li, B, and Be, which are challenging to quantify over a wide range of concentrations by other techniques [3]. In this contribution, we have tested and applied analytical strategies for quantification and mapping of lithium and other elements by fs-LA-LIBS.

Experiments were conducted using an Applied Spectra J-200 tandem LA-LIBS instrument, equipped with 343 nm femtosecond laser source, and coupled with an Agilent 8900 ICP-MS-MS. Protocols have been developed for simultaneous analysis of major and minor elements such as Si, Al, and Li by LIBS, with high-sensitivity trace element analyses by LA-ICP-MS. We have developed and tested a linear calibration approach for the quantification of Li at concentrations spanning from single ppm to weight %, along with high spatial resolution mapping of elemental distributions in complex geological samples. These include lithium-bearing pyroxene (spodumene), a range of micas and certified reference geological glasses, providing a comprehensive geochemical characterization. Fs-LA-LIBS emerges as a robust tool for integrated and rapid lithium microanalysis in complex geological matrices, with implications for geochemical and industrial research.

Keywords: fs-LA-LIBS, lithium quantification, microanalysis, laser ablation, geochemical analysis, critical minerals, spatial mapping.

UV-Femtosecond LA-LIBS for Microanalysis of Lithium in Geological Materials

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