



Drill core scanning for Rare Earth Elements using Laser-induced Fluorescence spectroscopy

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We present Laser-induced Fluorescence (LIF) spectroscopy of Rare Earth Elements (REEs) in minerals as a noninvasive analysis method that can be applied for drill core scanning in order to acquire valuable information about the REE content in rocks omitting extensive chemical analysis. Due to the REE's exclusive f-orbital electronic transitions sharp lines in emission spectra provide distinct features for REE detection. Those features are characteristic for each individual REE and therefore provide an excellent opportunity for identification. Besides the emission of REEs the optical excitation is characteristic as well. The latter enables selective optical excitation of specific REEs leaving others untouched. Considering both, emission and excitation properties, we are able to develop LIF setups aiming to detect and distinguish REEs in natural samples.

According to optical excitation properties of REEs we investigate the respective appropriate excitation energy, sufficient light intensity as well as beam geometry with respect to the surrounding matrix. As light sources we use Lasers, LEDs and Laser diodes of monochromatic light in the UV/VIS region. These are a 325/442 nm HeCd Laser, a 405 nm Laser diode, a 365 nm as well as a 470 nm LED and a 532 nm Nd:YAG Laser. In order to provide a reasonable detection speed we develop linear-light excitation concepts enabling to operate in continuous line scan mode, which can cover the surface of drill cores in one operation. Beam shaping is essentially arranged using spherical and cylindrical lenses.

With our LIF setup we primarily investigate apatite containing rock samples from Siilinjärvi-Finland and Namibia as well as artificial Smithsonian REE-phosphate standards for data validation. We detect REE emission in the VIS/IR region using CCD as well as sCMOS cameras. As initial results we can show line scan emission spectra covering a sample surface width of 4 - 6 cm depending on the respective light source. Scanning the same rock sample under different excitation conditions delivers diverse emission features that can be assigned to specific REEs.