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Laser-induced fluorescence mapping: a new spectroscopic technique for detection of Rare Earth Elements in rock samples

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With the recently intensified development in key technologies for renewable energy, electric mobility as well as computer and telecommunication systems, the robust detection and characterization of rare earth elements (REE) simultaneously gained in importance. REE identification is essential not only for securing a continuous supply from new or re-evaluated mineral deposits, but also for the future recycling of today's high-tech products and plants. Up to now, hyperspectral absorption as well as laser-induced fluorescence (LIF) spectroscopy have proven to be capable of REE detection in different materials [1, 2]. While absorption spectroscopy has been successfully used for identification of REE-bearing mineral phases in complex natural samples, but still show some ambiguities. In contrast, existing studies in LIF spectroscopy often focus on synthetic crystals and single REE standards. Recently, we could prove the benefit of combining both techniques in the case of REE identification in various minerals [3].
Within this contribution, we employ both methods for the qualitative and quantitative characterization of REEs in complex rocks, and discuss their suitability for applications in the mining industry. We present detailed 2D-LIF maps of REE-bearing rock pieces and compare them to hyperspectral absorption images. Validation of these results involves the use of mineral liberation analysis (MLA). By the combination of the aforementioned techniques we are able to identify and locate several REEs (e. g. Nd, Eu, Dy, Sm, Er) precisely within the host rock matrix. Furthermore, we could prove similar pattern between 2D LIF REE emissions, REE absorption and host mineralogy as inferred by MLA mineral distribution. This approach sets the basis for LIF-based mapping as a new technique for non-invasive REE detection.