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Ablation rates for geological materials

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Laser ablation ICP-MS is widely used to determine the chemical composition of solid materials. The rate at which material is ablated from a surface is important not only for depth profiling but also for the analysis of materials for which the destructive ablation of the sample has to be minimized. So far, results on the ablation depth per pulse have been published only for a limited number of materials such as bioapatite [1], metals, and silicate samples [2,3,4]. Systematic studies on a wider spectrum of sample types and relevant reference materials related to geosciences are not available.

The focus of this study is on natural and synthetic materials that are commonly used in geoscientific research, such as zircon, rutile, corundum, apatite, carbonate, and silicate reference glasses. Various operational parameters (wavelength, energy density, pulse repetition rate, ablation time, and spot size) have been applied using two different ablation systems: a 213 nm Nd:YAG and an 193 nm ArF excimer laser system. The depths of individual ablation pits resulting from different experimental set-ups were measured and converted into ablation depth per pulse. For each material tested, a non-linear correlation between energy density and depth per pulse has been observed. The results show that corundum has the lowest ablation rates for both laser systems, whereas those for speleothem calcite and the NIST SRM 61x glasses are approximately five times higher when applying identical settings. Further investigations aiming to link the determined ablation rates with optical properties such as transmission, adsorption, and reflectance, which are mainly caused by differences in crystallography and chemical composition, are in progress.

[1] Li et al. (1992) *Lasers Surg Med* **12**, 625-630. [2] Horn et al. (2001) *Appl Surf Sci* **182**, 91-102. [3] Stafe et al. (2010) *Rom Rep Phys* **62**, 758-770. [4] Marillo-Sialer et al. (2014) *J Anal At Spectrom* **29**, 981-989.