

## Non-matrix-matched calibration of femtosecond LA-ICP-MS applied to geochemical and environmental analysis

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Limitations with respect to measurement accuracy of LA-(MC)-ICP-MS, in particular for volatile and siderophile/chalcophile elements, are caused by matrix related effects. We have therefore investigated elemental fractionation [1] and mass-load-induced matrix effects [2] with a new 200 nm femtosecond laser (NWRFemto200) and two nanosecond lasers (193 nm excimer, 213 nm Nd:YAG) using reference materials with different matrices (silicate, geological, carbonate, phosphate) [3]. In all cases, the fractionation factors and element/Ca ratios obtained from fs LA are more uniform than those obtained from ns LA; this is especially apparent for the volatile elements Rb, Zn and Pb. Our experiments demonstrate that no significant matrix dependency could be observed with the 200 nm fs laser. Therefore, a non-matrix-matched calibration for the analysis of quite different matrices can be performed using certified NIST or other reference glasses for calibration. To test this calibration procedure, we have determined the mass fractions of 47 trace elements in 22 international reference materials with quite different matrices. Within overall analytical uncertainties of several percent the data agree with available reference values.

We have also applied fs LA for the line-scan analysis of small amounts of dust samples, where samples are extremely heterogeneous and ablated material is about 1  $\mu$ g. Especially promising are the low detection limits allowing the determination of femtogram amounts of trace elements [4]. Because of the low test portion masses and the heterogeneity of the samples, uncertainties are about 15 – 25 %.

[1] Fryer *et al* (1995) *Can. Min.* **33**, 303-312 [2] Krosiakova and Günther (2007) *JAAS* **22**, 51-62 [3] Jochum *et al* (2014) *GGR*, *subm.* [4] Macholdt *et al* (2014), *in prep.*