A comparison of elemental fractionation in silicate glasses by nanosecond and femtosecond laser ablation ICP-MS

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The laser induced elemental fractionations of 58 selected elements in silicate glass NIST SRM 610 were investigated using 193 nm ArF excimer laser and 266 nm femtosecond laser ablation systems coupled to inductively coupled plasma mass spectrometry (LA-ICP-MS). The results of this study highlighted some special fractionation behavior for 266 nm fs-LA-ICP-MS. Compared to 193 nm ArF excimer laser ablation system, the observed laser-induced elemental fractionation of B, P, Zn, Ga, Ge, As, Mo, Ag, Sn, Sb, W, Pb and Bi in NIST610 were much smaller than those obtained for 266 nm fs-laser ablation at the small spot size of 16 μm-32 μm. Contrary to those observed in 193 nm ArF excimer laser ablation system, the calculated elemental fractionation indexes for these elements were positively correlated to the crater size for 266 nm femtosecond laser ablation system. In addition, it was shown that the reduced elemental fractionation was obtained by applying high laser fluence at small pit or with low laser fluence at large crater size. The experimental data reveals that no-homogeneous energy distribution in the femtosecond laser beam may partly account for this phenomenon. The much less laser-induced elemental fractionation in fs-LA-ICP-MS in comparison with 193 nm LA-ICP-MS makes it more suitable for the analysis of silicate materials at a high spatial resolution. In this work, 58 elements in MPI-DING glasses, USGS basaltic reference glasses, and the synthetic NIST glasses were determined at a high spatial resolution of 24μm by fs-LA-ICP-MS. Most of the determined values were found to be in excellent agreement with the reference values, with the relative error less than 10%.