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High-resolution in-situ Si isotopic composition of natural zircon reference materials using UV femtosecond laser ablation MC-ICP-MS

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Silicon isotopes vary during magmatic fractionation processes [1] and Si isotope analysis of zircon can be useful to quantify these variations. To assess small-scale variation in zircon, high spatial resolution and optimal repeatability of in-situ analysis are required [2,3]. We report here high spatial resolution (37µm spotsize, <15µm depth) results from UV femtosecond laser ablation (fs-LA) coupled to multi collector inductively coupled plasma mass spectrometry (MC-ICP-MS) with comparable repeatability of ~0.1‰ (2SD). This method is specially adapted to the small size of zircon grains in magmatic intrusive and volcanic rocks and could potentially access Si isotopes zonation within zircon.

We evaluated the sustainability of five natural zircon reference materials for in situ Si isotopes analysis, namely: Mud Tank, 91500, GJ-1, Plešovice and Fish Canyon Tuff (FCT). Obtained $d^{30}Si$ values were of -0.26±0.24 ‰ (2SD, n=101) for Mud Tank which is a centimeter size monocrystal used as the primary bracketing standard; -0.23±0.11 ‰(2SD, n=27) for 91500; -0.25±0.16 ‰(2SD, n=20) for GJ-1; -0.47±0.14 ‰(2SD, n=20) for Fish Canyon Tuff zircon and -0.23±0.14 ‰(2SD, n=32) for Plešovice. The isotopic composition of Mud Tank, Plešovice and Zircon 91500 agree with results from solution nebulization (SN) MC-ICP-MS analyses as well as with data reported in the literature. The fs-LA-MC-ICP-MS method confirmed the intra-grain homogeneity of Mud Tank, 91500, FCT and Plešovice zircons which therefore can be considered as good potential reference materials for in-situ Si isotope zircon analysis. In contrast, zircon GJ-1 displays high intra-grain heterogeneity with $d^{30}Si$ variations of 0.3‰, and cannot be considered as a suitable reference material. UV Femtosecond laser ablation coupled to MC-ICP-MS is therefore a promising method for Si isotope analysis of zircon in magmatic and volcanic contexts, combining low uncertainty and high spatial resolution and reference materials are readily available.

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