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New insights on the Si cycle and Si isotopes behaviour in the mantle from *in-situ* measurements of δ^{30}Si in olivine-hosted melt inclusions

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Silicon, a major constituent of silicate minerals, has three stable isotopes (^{28}Si, ^{29}Si and ^{30}Si), which significantly fractionate at low temperature. High-temperature processes such as mantle melting and fractional crystallization only induce small Si isotope fractionation (<0.20‰; e.g., [1]). Any variation larger than 0.2‰ in high-temperature rocks may indicate the reworking or assimilation of material altered at low temperature [2,3]. To explore the possible influence of slab recycling and/or crustal contamination on Si isotope compositions, this study presents 1- the first *in-situ* silicon isotope measurements in terrestrial olivine crystals and their hosted melt inclusions (MI) in order to determine the Si isotope compositions of the magma source, and 2- the first measured Si isotope fractionation factors between olivine and melt.

Melt inclusions and their host olivine from two N-MORB and one E-MORB samples as well as 4 arc samples have been investigated for δ^{30}Si by LA-MC-ICP-MS. The MORB MI samples have δ^{30}Si values (-0.32 ± 0.17‰, 2s) that are consistent with bulk MORB glass values (-0.27 ± 0.06‰, 2s ; [4]). The MIs from the arc samples have lower and more variable δ^{30}Si values (-0.6 ± 0.6‰, 2s) compared to the 4 bulk rocks published for modern arc settings (-0.28 ± 0.06‰, 2s; [4]). The difference between δ^{30}Si in MI from MORB and from arcs points toward the influence of a low δ^{30}Si reservoir in subduction zones (e.g., weathered crust or biological activity-derived silica).

Measured silicon isotopic fractionation between olivine and melt for the MORB samples are similar to the theoretical values for basalt at 1200°C. On the contrary, the Si isotope fractionation between olivine and melt for the arc samples is higher than predicted for calc-alkaline rocks at 1150°C [5].

These results suggest that the investigation of δ^{30}Si in melt inclusions and their host crystals can provide a better understanding of the Si isotope behavior in magmatic systems.

References:

[1] Poitrasson (2017), RiMG 82, 289-344. [2] Guitreau et al. (2022), GCA 316, 273-294. [3] Savage et al. (2011), GCA , [4] Savage et al. (2010), EPSL 295, 139-146. [5] Qin et al. (2016), CMP 171, 1-14.