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Determining the volatile-rich source for Bermuda using Zn isotopes

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Observed chemical heterogeneities in the mantle are commonly attributed to the recycling of oceanic crust - including carbonate and silicate sediments - during subduction, providing an opportunity for the addition of volatiles and incompatible elements into the mantle. Recent geochemical data from the intraplate volcano of Bermuda suggest that silica undersaturated (SU) melts sampled a previously unknown mantle reservoir with significant enrichments in volatiles and incompatible elements, as well as a unique isotopic signature[1]. Bermuda records the most radiogenic $^{206}Pb/^{204}Pb$ isotopes ever documented in an ocean basin (19.9-21.7), coupled with low $^{207}Pb/^{204}Pb$ (15.5-15.6) and relatively invariant Sr, Nd, and Hf isotopes, suggesting that this source must be <650 Ma. These SU melts are interpreted to be sourced in the transition zone, tapping a young mantle reservoir that resulted from recycling and storage of incompatible elements and volatile-rich material. However, the source of this recycled volatile-rich lithology remains unknown.

Stable Zn isotopes ($\delta^{66}Zn$ as the ‰ deviation of $^{66}Zn/^{64}Zn$ from the JMC-Lyon standard) have been used to differentiate various recycled carbon-bearing lithologies in mantle-derived melts [e.g., 2, 3]. Partially melting mantle peridotites ($\delta^{66}Zn$ = 0.18 ± 0.06 ‰) can generate slight fractionation in $\delta^{66}Zn$ ($\delta^{66}Zn$ = 0.28 ± 0.04 ‰),whereas marine carbonates are isotopically heavy ($\delta^{66}Zn$ = 0.91 ± 0.24 ‰), making Zn isotope systematics well-suited to trace recycling of carbonates in the mantle.

We present new $\delta^{66}Zn$ data to help improve our understanding of the source of the Bermuda SU lavas. Bermuda SU lavas are on the high-end of Zn concentration averages reported for other OIBs ([Zn] = 122.3 ± 18.3 ppm, Zn/Feâ‹…10^4 = 13.4 ± 2.4, n = 23), and while such elevated [Zn] could suggest incorporation of carbonated eclogite in the mantle source, olivine trace element data indicate a carbonated peridotite source instead [1]. Preliminary $\delta^{66}Zn$ from Bermuda yields an average of 0.23 ± 0.07‰ (n=6), which implies that Bermuda is the result of partially melting peridotite without significant input from recycled marine carbonates..

[1] Mazza et al. (2019) *Nature* [2] Beunon et al. (2020) *Earth-Science Reviews* [3] Zhu et al. (2021) *Chemical Geology*