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2020

DOI (link to publisher)
10.46427/gold2020.1357

document version
Publisher's PDF, also known as Version of record

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Unspecified

Coupled trace element and Sr-Nd-(Pb) isotopes in olivine-hosted melt inclusions from the Mariana arc

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The Mariana arc forms part of the 2500 km Izu–Bonin–Mariana arc system caused by westward subduction of the Pacific Plate beneath the Philippine Sea Plate over the last ~45 Myr. The magmatism produced in this comparatively simple arc setting records a moderate flux of fluids and sediments from the downgoing plate, however, the low MgO (< 6 wt.%) of the lavas imply that magma mixing, crystal fractionation and crustal assimilation mask the primitive melt compositions. Olivine-hosted melt inclusions (MIs), in contrast, provide access to melt trapped deep in the magmatic plumbing system allowing more precise determination of the nature and quantity of recycled components.

Here we analyse coupled trace element and Sr-Nd(-Pb) isotope compositions of olivine-hosted MIs in five samples from four islands within the Central Island province: Agrigan (AGR2, AGR6), Pagan (PAG3), Guguan (GUG6) and Sarigan (SAG1). Bulk rock MgO contents range from 4 to 5.7 wt.% [1]. We specifically target melt inclusions in olivine phenocrysts with the highest fortsterite content (Fo = Mg/(Mg+Fe)*100): AGR: 80-86; PAG: 76-81; GUG: 76-88; SAG: 84-88 mol%.

Trace element contents and ratios of the selected MIs record marked differences between islands and show larger variability compared to published bulk rock and MI compositions [2]. Ba/La and Th/Nb or La/Sm ratios – indicators of slab fluids versus sediment melts, respectively – confirm that Guguan inclusions are dominated by a fluid component whereas Agrigan and Sarigan reflect a larger sediment contribution. Pagan inclusions show intermediate compositions and a restricted range indicating the influence of both fluids and sediments.

Sr-Nd-(Pb) isotope compositions of individual and pooled melt inclusions will be determined by wet chemistry and TIMS techniques using 10^{13} Ω amplifier technology [3] to further identify and quantify the recycled components.

[1] Elliott et al. (1997). Journal of Geophysical Research, 102: 14991-15019. [2] Kent & Elliott (2002). Chemical Geology, 183: 263-286. [3] Koornneef et al. (2019). Nature Communications 10, 3237