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Tin isotopes in lavas from the Sunda arc, Indonesia

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Subduction zones are major sites for the global element cycling between crust and mantle via arc magmatism. Tin isotopes in erupting lavas have the potential to trace deep arc processes because of its potential sensitivity to the salinity of fluids, the large spectrum of isotopes, and its isotope fractionation between multiple valence states, the isotopically heavier Sn^{4+} and isotopically lighter Sn^{2+}, at temperatures relevant to arc magmatism [1] [2].

Tin isotope compositions were determined in twenty-eight arc rocks from Java and Bali of the Sunda arc, Indonesian, using a ^{117}Sn-^{122}Sn double spike technique. These samples vary in compositions from basalt and basaltic andesite to andesite and dacite, and also silica-under saturated leucitite and tephrite. Data from previous studies of these samples suggested that they were significantly affected by subducted continental material and/or by crustal assimilation with high La/Sm, and also by deep fluids evidenced through elevated Ba/Th [3].

The basalts and basaltic andesites of our samples share similar Sn isotope compositions with an average $\delta^{124/116}Sn$ of 0.67±0.10 ‰ (relative to NIST 3161a Monash, 2 s.e.), while andesites and dacite are generally lighter (average $\delta^{124/116}Sn$ = 0.44±0.10 and 0.27±0.11 ‰, respectively). These samples show a positive trend between $\delta^{124/116}Sn$ and MgO concentration, suggesting Sn isotope fractionation during differentiation with heavier Sn isotopes being removed by crystal fractionation. This can be interpreted by the different combability of isotopically heavier Sn^{4+} and lighter Sn^{2+} in early crystallizing phases. Silica undersaturated leucitites and tephrites, however, are overall isotopically lighter relative to basalts, for a given degree of fractionation, suggesting isotopically lighter arc sources. $\delta^{124/116}Sn$ among all the samples show a negative trend with La/Sm ratio, and a positive one with Ba/Th ratio, indicating contributions of both sediments and fluids to Sunda arc lava sources. Our results indicate that Sn isotopes bear strong potential to trace compositional differences in the source of arc lavas.

[1] Polyakov et al. (2005). Geochim. Cosmochim. Acta, 69(23), 5531–5536.

[2] Roskosz et al. (2020). Geochim. Cosmochim. Acta, 268, 42–55.

[3] Whitford (1975), The Australian National University.