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S—Se—Te systematics in La Réunion hotspot lavas and peridotites

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This work investigates the distribution of S and highly chalcophile elements Se and Te in La Reunion island lavas and mantle rocks. The sample set includes 2 peridotites (wehrlites) and 23 cogenetic lavas covering a wide range of degassing (sub-marine and sub-aerial) and crystallization (basalt to trachyte) extents. Whole rock concentrations of S, Se and Te were determined by isotope dilution using ^{34}S, ^{77}Se and ^{125}Te enriched spikes: sulfur was measured by high-resolution ICPMS without chemical separation, while Se and Te were purified and measured by hydride generation quadrupole ICPMS. Repeated analysis of BHVO-2 yielded S = 184 ± 7ppm (1SD, n=8), Se = 170 ± 11 ppb (1SD, n=15) and Te = 14.5 ± 0.8 ppb (1SD, n=11).

The peridotites have 264-358 ppm S, 18.9- 35.9 ppb Se, 2.7-3.1 ppb Te and Se/Te between 6.1 and 13.2 within the range of mantle lherzolites. Sulfur and Se contents of submarine lavas decrease linearly from 632 ppm and 125 ppb at MgO=10.9 wt% to 119 ppm and 51 ppb at MgO=5.1 wt%, respectively. In the same sample suite, Te concentrations (3.7-22.8 ppb) show an opposite trend, resulting in a factor of ten decrease of Se/Te (from 26 to 2.2) during magma differentiation. Subaerial lavas are generally depleted in S and Te, but not in Se, relative to submarine lavas. Se/Te of subaerial basalts raises up to 189 and decreases markedly during magma differentiation down to 3.5 in trachyte.

S-Se-Te are dominantly controlled by degassing processes in La Réunion lavas, unlike less volatile Cu, which records sulfide saturation. The contrasted distribution of Te between submarine and subaerial lavas is consistent with Te accumulation in the former and extensive Te degassing in the latter. The elevated Se/Te ratios of subaerial basalts might be due to extensive outgassing of Te_2 or H_2Te in reducing conditions possibly favored by SO_2 degassing. Extensive outgassing of tellurium in reducing conditions could explain the contrasted Se/Te signatures of hotspot and arc volcanic gases [1,2].

[1] Edmonds, Mather & Liu (2018) Nature Geoscience 11, 790–794.

[2] Zelenski et al. (2021) Geochimica et Cosmochimica Acta 295, 112–134