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Reconstruction of the sulfur cycle in the Earth mantle: isotopic signatures of subduction-unrelated and subduction-related ophiolitic rocks

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Sulfur (S) is one of the key volatiles in Earth's chemical cycles as it affects biological, climate, ore-deposits, and redox processes. It is recycled into the mantle at subduction zones but speciation, flux, and isotope composition and fractionation processes occurring in the mantle are poorly constrained. Ophiolites could provide information about S contents and isotopic features in subduction-unrelated and subduction-related geodynamic settings. Using an elemental analyzer coupled with a mass spectrometer (EA-IRMS) we measured the whole rock S contents and the relative isotopic ratio ($^{34}S/^{32}S$) of subduction-unrelated and subduction-related ophiolitic basalts from different locations and geodynamic settings. We analyzed samples well constrained from a petrological and geochemical point of view in previous studies (Moberly et al., 2006; Saccani et al., 2011; Brombin et al., 2022); they are: Mid-Ocean Ridge Basalts (MORBs) from Corsica, Romania, Albania, and North Macedonia; ii) Island Arc Tholeiites (IAT) from Albania and Greece; iii) Calc-Alkaline Basalts (CAB) from Greece, Romania, North Macedonia, and Iran. Results show that the S contents range from 200 and 300 ppm and the isotopic signatures are similar in rocks with the same geochemical affinity. Only MORBs preserved the typical S signature of the Earth mantle (i.e., from –2‰ to 0‰), whereas the subduction-related magmatic rocks (i.e., IATs and CABs) show positive S isotopic values, probably due to the contamination of i) ^{34}S-enriched contribution from subducting sediments or ii) fluids released by serpentinized rocks of the subducting slab. Therefore, this work allowed us to define: i) the S isotope compositions in both subduction-unrelated and subduction-related magmatic rocks; ii) the possible causes which modify the original S signature. This research is therefore essential to understand the global S cycle.

References

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