Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.31733

H- and O-isotope composition of the Plio-Quaternary Gölcük Volcanism (SW Anatolia): Insights into Magmatic Evolution, Fractional Crystallization, and Mantle-Crust Interactions

EFE AKKAŞ[1,2], CHRIS HARRIS[2], H. EVREN ÇUBUKÇU[1], LUTFIYE AKIN[1] AND CANER DIKER[1]

[1]Hacettepe University, Department of Geological Engineering, Beytepe, 06800 Ankara, Türkiye.
[2]University of Cape Town, Department of Geological Science, Rondebosch 7700, Cape Town, South Africa.

The Plio-Quaternary Gölcük (Isparta) maar volcanism is key to understand mantle-crust interactions in SW Anatolia (Türkiye). Extensive $\delta^{18}O$ and δD data were obtained on early-formed minerals, glass, and hydrous phases from sub-/crystalline magmatic rock fragments and host volcanic products. These data constrain magmatic processes, crystallization conditions, and the isotope composition of the mantle source and provide petrological insights into the pre-eruptive formation of heterogenous crystal-melt assemblage during volcanic evolution. A broad range in $\delta^{18}O$ values (4.75–7.72‰) in minerals and glasses is consistent with mineral magma O-isotope equilibrium between 700–1250°C. Relatively higher $\delta^{18}O$ values for most of the common crystallizing phases in the host volcanic rocks (e.g., feldspar: 5.82–11.18‰, amphibole: 5.14–6.53‰, phlogopite: 5.32–6.98‰) compared to those in cumulates (e.g., feldspar: 5.57–7.62‰, amphibole: 4.75–5.26‰, phlogopite: 4.84–5.7‰) are consistent with crustal assimilation accompanying fractional crystallization. The δD versus H_2O (wt. %) for the hydrous crystallizing phases suggest magma degassing during ascent. Equilibrium mineral–mineral $\delta^{18}O$ pairs affirm the existence of a common magma reservoir feeding for both cumulates and host volcanic rocks. Calculated liquid line of descent trajectories of magma $\delta^{18}O$ values assuming mean bulk-rock compositions of the cumulates as bulk crystallizing phases closely align with observed glass $\delta^{18}O$ values of the host rocks. All of these findings highlight the dominant impact of fractional crystallization on the “pristine” mantle-derived magmas (mean magma, 5.78 ± 0.52 $\delta^{18}O$, 1σ). As well as the influence of crustal contamination interplay in shaping the formation of most evolved host volcanic rocks (mean magma, 7.36 ± 1.49 $\delta^{18}O$, 1σ). The study outcomes refine the understanding of Anatolian volcanism by demonstrating that fractional crystallization, crustal assimilation, and magma degassing significantly modify mantle-derived magmas, providing detailed isotopic data for tracking magma evolution from mantle to crust. This study was supported within the scope of the TÜBİTAK BİDEB 2219 International Postdoctoral Research Fellowship Program and Scientific Research Projects Coordination Unit of Hacettepe University under the project numbers 1059B192301145 and FYL-2015-6983, respectively.