Titanium Isotopic Compositions of Rocks from the Aegean Arc

NICOLAS D. GREBER1,2*, NICOLAS DAUPHAS1, MATOUŠ P. PTÁČEK1, LORENZ GEFELER3, THOMAS PETTKE3

1Origins Laboratory, Department of the Geophysical Sciences and Enrico Fermi Institute, The University of Chicago, 5734 South Ellis Avenue, Chicago, IL 60615, USA
2Department of Earth Sciences, University of Geneva, Rue des Maraîchers 13, 1205 Geneva, Switzerland
3Institute of Geological Sciences, University of Bern, Baltzerstrasse 3, 3012 Bern, Switzerland
*corresponding author: nicolas.greber@unige.ch

Published Ti isotopic compositions (expressed as δ49Ti; the deviation in ‰ of the 49Ti/47Ti ratio relative the OL-Ti standard [1]) of terrestrial rocks follow a well defined positive correlation with bulk rock SiO2 concentrations and range between -0.05 to +0.55 ‰ [1]. This correlation has been interpreted to result from the preferential incorporation of light Ti isotopes in Fe-Ti-oxides during fractional crystallization, leaving behind a melt enriched in heavy Ti isotopes [1]. The correlation between δ49Ti and bulk rock SiO2 is linear until a SiO2 concentration of around 68wt%. To better understand the mechanisms relevant for Ti isotope fractionation in magmatic systems, we present new Ti isotope measurements of co-genetic xenoliths from the Kos Plateau Tuff (KPT) in eastern Greece. We measured the δ49Ti values of two rhyolites, three andesites, an olivine basalt, and a hornblende cumulate.

Similar to previously published data, a positive trend between δ49Ti and SiO2 content is observed in the KPT samples, ranging from -0.06 ± 0.035‰ in the magmatic hornblende cumulate to +0.66 ± 0.035‰ in the strongly differentiated rhyolites. The new data also confirm that at SiO2 concentrations above 68 wt%, the δ49Ti-SiO2 trend changes slope and becomes steeper. Modelling results suggest that either (i) more extensive crystallization of mineral phases with light δ49Ti occurred at SiO2 concentrations above around 68 wt%, resulting in a steeper increase in the δ49Ti with SiO2, or (ii) the analyzed intermediate rocks are the result of magma mixing between a rhyolitic and a basaltic melt.

Further modelling and analyses of mineral separates will help to better constrain the mechanisms responsible for the fractionation of Ti isotopes in magmatic systems.