Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.10038

A high-Ni isotopically enriched endmember in Canary Islands lavas

ROBERT WILLIAM NICKLAS[1] AND PROF. JAMES M.D. DAY[2]

[1]University of California, San Diego
[2]Scripps Institution of Oceanography
Presenting Author: rwnicklas@ucsd.edu

Nickel concentrations in olivine grains have been used to quantify the presence of olivine-free pyroxenite in the mantle source regions of basaltic lavas [1,2]. Nickel is compatible in residual olivine during mantle melting and melting lacking residual olivine is predicted to form lavas enriched in Ni that then crystallize Ni-rich olivine. Calcium behaves in the opposite manner, being retained by residual pyroxene and thus depleted in olivine formed from pyroxenite-derived melts. The diagnostic ability of Ni and Ca in olivine to constrain pyroxenite sources has been questioned however [3], as Ni and Ca partitioning into olivine is pressure dependent and "pyroxenite-rich" magmas may simply represent high pressure peridotite partial melts.

The Canary Islands are an ocean island basalt (OIB) province hosting a variety of isotopic endmembers including HIMU [4], and EM [5]. Previous authors have shown that Canary lavas with higher inferred pyroxenite in their source regions have more depleted (radiogenic Nd, unradiogenic Pb and Sr) isotopic compositions, contrary to expectations as both the "pyroxenite" and enriched isotopic signatures likely represent recycled materials [6]. To clarify this relationship, new LA-ICP-MS data are presented for 357 olivine grains from Canary Island lavas for which isotopic data, including $^{187}Os/^{188}Os$, have been reported [7]. The parameter "X_{Px}" (= (0.001341 × (Ni) × (FeO/MgO))-0.437) [2] was used to express Ni enrichment at a given Fo number. Average X_{Px} ranges from 0.33±0.09 to 0.72±0.14 (2SD) and is negatively correlated with isotopic signatures suggesting a Ni-rich endmember associated with unradiogenic Os. Calcium in olivine is negatively correlated with Ni in olivine, and positively with X_{Px}. We examine the robustness of the Ni-rich endmember as being pyroxenite, and whether partial melting of peridotite at high pressure might also be a viable formation mechanism. Finally, it is shown that LA-ICP-MS analyses can accurately constrain olivine major element compositions when compared to electron microprobe data.

[1] Sobolev *et al.* (2007) Science; [2] Sobolev *et al.* (2008) Science; [3] Matzen *et al.* (2017) Nat. Geosci; [4] Day *et al.* (2010) GCA; [5] Hoernle *et al.* (1991) EPSL; [6] Gurenko *et al.* (2011) EPSL; [7] Day et al. (2009) Geology