Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.20815

The petrology and Re-Os isotope geochemistry of young arc-derived pyroxenites from the Andean Northern Volcanic Zone

MAURICIO IBANEZ-MEJIA[1], LISA ZIEMAN[1], ALAN ROONEY[2], PATRICIA KANG[1], PORFIRIO I ASCENCIO[1], ALEISHA JOHNSON[1], ELIAS M BLOCH[3] AND NATALIA PARDO-VILLAVECES[4]

[1]University of Arizona
[2]Yale University
[3]University of Lausanne
[4]Universidad de Los Andes

Presenting Author: ibanezm@arizona.edu

The Northern Volcanic Zone (NVZ) in the Andes is a continental magmatic arc currently emplaced in >50 km-thick continental crust. In southern Colombia, a mid-Pleistocene eruption exhumed a variety of mafic/ultramafic xenoliths derived from the arc lower-crust and the sub-arc mantle wedge, providing a unique opportunity to study petrologic processes taking place in an active continental subduction system and at the roots of the archetypal Andean arc.

The base of the NVZ crust consists of an ~8-14 km–thick layer of gravitationally-unstable material, predominantly consisting of garnet pyroxenites, hornblendites, and amphibole-bearing pyroxenites. Despite the high temperature (~1250 ˚C) and large density inversion at the lithosphere-asthenosphere boundary calculated from mineral chemistry, the root appears to remain mostly attached to the base of the arc crust, defying rapid removal expectations from Rayleigh-Taylor instability timescale calculations. Although a few of our garnet pyroxenites plot close to the garnet-pyroxene join of a CMAS pseudo-ternary projection, the majority of samples project towards the silica-deficient side of this divide, and none towards the silica-rich side. This observation is in agreement with their lack of quartz and the common presence, but variable proportions of, Fe-Ti oxides and amphibole. These observations rule out their origin through accretion of oceanic material against the continental margin and also their formation as highly refractory residues produced from extensive partial melt extraction in the lower arc crust. Conversely, our results support the origin of all studied pyroxenite samples equilibrated within lithospheric P-T conditions as crystal-cumulates from high-pressure fractional crystallization of hydrous magmas. Furthermore, Re-Os isotopic analyses of these lithospheric clinopyroxenites yield low Os contents and high Re/Os and ^{187}Os values, which demonstrate their crustal nature. Other UHP garnet websterites also found in this locality have high Os contents and depleted mantle–like ^{187}Os values, indicative of a metasomatic origin within the mantle wedge. Altogether, our observations indicate that any partial melts extracted from these arc-derived garnet pyroxenites would be alkalic in nature and highly radiogenic in ^{187}Os, and thus would impart a distinct chemical signature to peridotite-sourced magmas akin to those observed in some OIB regions.