Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.36973

Chemistry of olivine and spinel in mafic volcanic rocks from the Central Southern Volcanic Zone of the Andean arc (Chile): constraints on the mantle source

ISALINE T. COLLIN[1], JACQUELINE E. VANDER AUWERA[1], YISHEN ZHANG[2], TONIN BECHON[3], PAUL FUGMANN[1] AND EDUARDO MORGADO[4]

[1]University of Liege
[2]Rice University
[3]University of French Polynesia
[4]Universidad Mayor

The composition of liquidus phases in mantle-derived melts provide key constraints about the mantle sources and their melting conditions. In basalts, primitive olivine and Cr-spinel are the earliest crystallizing phases and coexist over a narrow temperature interval. Their compositions thus record the geochemical signature of the near primary magmas and provide insight into the initial conditions of magmatic differentiation (T, H_2O, fO_2). Because of its thin continental crust, the Central Southern Volcanic Zone of the Andean arc (CSVZ, Chile) is an ideal target and a true natural laboratory to address these questions. In this work, we analyzed 150 olivine-Cr spinel pairs from samples collected in four different arc front stratovolcanoes (Osorno, La Picada, Villarrica, Mocho-Choshuenco) and two of their associated Small Eruptive Centers (Cordón Cenizos, San Jorge). We calculated the crystallization temperatures with the empirical thermometer of [1], which considers the Al exchange between the two phases and the spinel Cr#, as well as with the three updated equations by [2], two of which incorporate subsolidus re-equilibration, which in our case tends to result in underestimated temperatures. When considering the highest temperature obtained in each sample for each equation (Osorno: 1131-1255°C, La Picada: 1060-1280°C, Villarrica: 1102-1197°C, Mocho-Choshuenco: 1070-1157°C, Cordón Cenizos: 1031-1133°C, San Jorge: 1177-1283°C), results usually overlap when errors are considered and are close to the temperatures derived from petrological data. The H_2O content of the parental magma calculated with the [3] regression, based on the K_dCa(Ol/l), gives H_2O contents (2-5 wt.% H_2O) that are usually higher than those derived from petrological data. We estimated the fO_2 with the model of [4] based on the olivine-spinel-liquid peritectic reaction as FMQ +0.29 to NNO +0.38). Because the melting depth and degrees are similar for the different edifices, the olivine Ni content (707 – 2794 ppm) cannot be controlled by the variation of the K_dNi(Ol/l) but is indicative of a peridotitic mantle source.

[1] Coogan, L. A., et al. (2014). *Chemical Geology*,*368*.
[2] Zhang, Y., et al. (2023). *Journal of Petrology*,*64*(11).
[3] Gavrilenko, M., et al. (2016). *Journal of Petrology*,*57*(9).
[4] Bell, A. S., et al. (2025). *American Mineralogist*,*10*(1).