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Thermodynamic modeling of the magmatic processes controlling the evolution of El Negrillar monogenetic field (Central Andes, Chile)

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El Negrillar (EN) is a monogenetic volcanic field located in the Central Volcanic Zone, within the southern portion of the Andean Altiplano-Puna plateau (15°S–28°S). This volcanic field presents the largest magma volume emitted within the monogenetic centers of the Central Andes in the last 1 Ma (~6.8 km^3;[1]; [2]), as well as the largest concentrations of eruptive centers, with 51 small eruptive centers and 98 eruptive phases distributed in the Northern, Central and Southern clusters (NEN, CEN, and SEN, respectively). The lava flows range in composition from basaltic andesite to trachyandesite/trachyte compositions. Major elements chemical characterization shows the existence of a south to north evolutionary local trend within EN [2].

A major element thermodynamic modeling using Rhyolite-MELTS 1.2.0 was carried out to establish and quantify the magmatic processes involved in the evolution of EN lavas. The results indicate that from the most primitive sample located in the SEN (55.63 wt.% SiO_2; 5.93 wt.% MgO; $^{87}Sr/^{86}Sr$= 0.706544; $^{143}Nd/^{144}Nd$= 0.512465) it is possible to reproduce all the compositional variety of the EN through repeated and similar fractional crystallization paths, considering the existence of certain degree of crustal assimilation in all the magmas. The volcanostratigraphy of the eruptive centers does not point to a single geochemical evolution trend, and therefore, it is inferred that recharge events of similar parental magmas occurred during the formation of the monogenetic field. The conditions that characterize the emplacement are: 300MPa-225MPa as initial-final pressures, 1135°C-950°C as initial-final temperatures, an initial H_2O content of 2.95 wt.%, dP= 2, dT= 5, and QFM buffer. In addition, we are currently pursuing a study of the mineral chemistry of the EN volcanic products to define the textural and chemical composition of the mineral assemblage and estimate the pre-eruptive conditions of the volcanic field plumbing system.

[1] Loaiza et al. (in prep).

[2] Parra-Encalada et al. (2022). Journal of Volcanology and Geothermal Research, 426, 107541.