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Location and source of magmatic fluid inputs in reservoirs beneath stratovolcanoes from the Central Volcanic Zone: The case of Lascar and Lastarria explosive eruptions

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Lascar (5,592 m.a.s.l.) and Lastarria (5,697 m.a.s.l.) are stratovolcanoes from the Central Volcanic Zone; (16°S - 28°S). Irrespective of the similar explosive eruptive style, their complex feeding structures and the origin of their magmatic volatiles is unclear. In addition, both volcanoes are located at the edge of the Andean subduction zone, above ~40–71 km of rigid continental crust¹²³. Magma reservoir location and fluids source characterization are investigated for the 1989–1993 explosive eruptive cycle of Lascar and compared with several Holocene eruptive sequences from Lastarria⁴⁵⁶. The geochemistry of noble gases in fluid inclusions (FI) trapped in olivine and pyroxene crystals separated from rocks is investigated. Those data are integrated with the composition of minerals so that a series of mineral-liquid matching compositions are used to estimate depth conditions of crystallizing magmas. The ⁴⁰Ar/³⁶Ar ratios (300–310 and 302–308) and ⁴He/²⁰Ne ratios (5.6–204 and 1.0–55.4) from Lascar and Lastarria FI, respectively, indicate some degree of air contamination, which is probably a mantle feature related to atmospheric volatiles recycling from the slab. The ³He/⁴He ratios in FI from Lascar (6.91–7.12 Ra) are constant, while those from Lastarria (5.31–8.01 Ra) are more variable. The ³He/⁴He measured in olivine-hosted FI from Lascar is between 6.9 and 7.3, falling at the lower limit of MORB range (8±1 Ra). These values are comparable to those in fumaroles, indicating that the latter is representative of the magmatic source. Instead, FI in pyroxene show lower ratios (5.2–5.4 Ra) indicating shallower crystallization than olivine, and the entrapment of fluids contaminated by radiogenic ⁴He. In Lastarria volcano, olivine FI yields 8.0 Ra, within MORB, while pyroxenes vary between 5.3 and 6.6 Ra, suggesting shallow contamination as observed for Lascar pyroxenes. Fumaroles from Lastarria vary in the same range of pyroxene, indicating that they represent shallow and contaminated magma bodies. Major explosive events were fed by heterogeneous noble gas signatures in Lastarria's magma fluids for at least 3 stage depth ponding zones (one shallow ~1–6 km and two variable intermediate depth zones at ~12–20 and 20–30 km), while Lascar show at least two ponding zones (secondary reservoir at ~2 km and main storage at ~11.5 km). ¹Thorpe *et al.* (1982); ²Winter (2001); ³Gardeweg *et al.* (2011); ⁴Matthew *et al.* (1999); ⁵Mamani *et al.* (2010); ⁶Naranjo (2010)