Quantifying Magma Recharge and Assimilation at Parinacota volcano, Northern Chile (52 Ka-recent)

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Parinacota volcano of northern Chile is a dormant basaltic andesitic to rhyolitic stratovolcano whose eruptive history spans from 163 ka to recent. New thermodynamic models constrain and quantify recharge, assimilation and fractional crystallization (RAFC) processes for the Old Cone (OC; 52-20 ka; 56-66 wt.% SiO_2) and Healing Flows (HF; >8 ka-recent; 58-64 wt.% SiO_2) eruptive stages. The Magma Chamber Simulator (MCS; Bohrson *et al*., 2014) was used to produce over 200 RFC and RAFC models with variable pressure, fO_2 and resident/recharge magma and wallrock masses, temperatures, and compositions. Best fit MCS results, determined by comparing model results with observed major and trace element and $^{87}Sr/^{86}Sr$ data of whole-rocks and mineral phases, suggest that magma is stored at relatively shallow depths (~7-11 km) in crust that is ~70 km-thick. A Rhyolite Domes (RD; 47-40 ka; 74 wt.% SiO_2) lava serves as the resident magma in model runs for the subsequent OC stage, and lavas from the youngest eruptive stage, the Ajata Flows (10-3 ka, Upper Ajata; 53 wt.% SiO_2; Lower Ajata; 57 wt.% SiO_2), represent mafic recharge into the system. Modeling indicates a recharge mass to initial magma mass ratio of ~5:1 and near-liquidus recharge magma temperatures to form the most mafic OC compositions. Linearity of OC major and trace element trends suggests little fractionation occurs after mixing. Thus, mixing to eruption timescales are likely short because significant magma cooling is precluded. During the HF stage, frequent recharge events accompany more extensive fractionation; there is little input from rhyolitic magma that was present during the OC stage. Assimilation of Belen metamorphic basement is possible for both OC and HF, but modeling indicates that the contribution from assimilation is less important than that of mixing. MCS results, such as those presented here that define magma recharge rates, may be applied to actively monitored volcanoes where geophysical data provide constraints on rates of magma influx. Such integration promises to enhance understanding of magma storage conditions of potentially hazardous volcanoes that are dominated by magma recharge.