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Understanding the eruptive dynamics of 2010-2011 Planchón-Peteroa unrest period through volcanic fluid sampling

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Planchón-Peteroa (35.240°S, 70.570°W, 3603 m a.s.l.) is a composite stratovolcano located in the Transitional Southern Volcanic Zone at the border between Argentina and Chile. From January 2010 up to July 2011, PP entered in an eruptive cycle characterized by phreatic and phreatomagmatic eruptions with a VEI ≤2. Even though different authors reported geophysical, petrological and glaciovolcanic evidences about the 2010-2011 unrest episode (e.g., Pritchard et al. 2013, Aguilera et al. 2012; Naranjo 2012, Liaudat et al 2013), no consensus on the mechanisms triggering this eruptive cycle, the fluid sources involved, and the possible dynamic interaction between those sources during the cycle have been achieved. In order to unveil the dynamics of the 2010-2011 unrest period, this study presents chemical and isotopic ($\delta^{18}O–H_2O$, $\delta D–H_2O$, $\delta^{13}C–CO_2$, $^{3}He/^{4}He$, $^{40}Ar/^{36}Ar$ and $\delta^{15}N–N_2$) data of gas discharges collected during five sampling campaigns (February 2010 to March 2015) from the fumaroles located at the PP summit.

Our results shows that in 2012, the acidic gas species contents of the fumaroles from the PP summit showed a huge increase (SO_2>CO_2) with respect to the 2010-2011 period, whereas the typical hydrothermal compounds (e.g. CH_4 and light hydrocarbons) decreases. This compositional change could be interprated as a pulse of magmatic fluids, but the temporal evolution of the $\delta^{18}O$-H_2O, δD-H_2O, R/R_a and $\delta^{13}C–CO_2$ values suggest, in stead, an enhanced fluid contribution from a shallow source. In 2014-2015, the dominant hydrothermal signature characterizing the 2010-2011 samples was almost completely restored. The temporary decoupling of the chemical and isotopic parameters can only be reconciled when two sources of magmatic fluids are proposed: a basaltic batch, controlling the fumarolic chemistry in 2010-2011 and 2014-2015, and a dacitic batch whose contribution to the fumarolic fluid emissions achieved its maximum in 2012. Given this, we conclude that the eruptive period 2010- 2011 of PP is related to the increasing of heat and mass transfer from shallow hydrothermal-deep magmatic sources favoured by the formation and/or reactivation of cracks produced by the Maule earthquake (27th February 2010). The disturbance created by the volcanic events and the associated seismic activity (both related to the Maule earthquake), could have reactivated a relatively "old" (i.e., highly degassed) dacitic body that in 2012 imposed over that of basaltic composition.