

# Eruptive activity of Peteroa Volcano for period 2010-2011, Southern Volcanic Zone, Chile

Felipe Aguilera<sup>\*1</sup>, Jorge Romero<sup>1,2</sup>, Francisco Gutierrez<sup>3</sup>, Mariano Augusto<sup>4</sup>, Ornella Saltori<sup>1</sup>, Oscar Benavente<sup>3</sup>, Alberto Caselli<sup>4</sup>, Marcela Pizarro<sup>1</sup>

<sup>1</sup> Departamento de Geología, Universidad de Atacama, Chile

<sup>2</sup> Geohiggins, Museo Regional de Rancagua, Chile

<sup>3</sup> Departamento de Geología, Universidad de Chile, Chile

<sup>4</sup> Departamento de Ciencias Geológicas, Universidad de Buenos Aires, Argentina

\*E-mail: [felipe.aguilera@uda.cl](mailto:felipe.aguilera@uda.cl)

**Abstract.** Peteroa corresponds to a composite stratovolcano located in the border between Chile and Argentina (35°31'W-70°14'S-4,107 m a.s.l.) and belongs to the Planchon-Peteroa-Azufre Volcanic Complex. Peteroa started a new eruptive period (VEI 1-2) during 4 January 2010, when phreatics explosions generated white coloured column of 500 m altitude above crater. Four eruptive stages have been recognized, being the second and fourth the most intense. The main activity, occurred in its westernmost crater, is characterized by phreatic eruptions, which generated columns that reached up 1.5 km above the crater and plumes that extended by 170 km. Main plumes directions were ESE and NNW. Ash fall deposits were identified in the SE flank of the volcano, covering an area of ~200 km<sup>2</sup>, with thickness that varied from 4 m to 1 mm. Fall deposit corresponds to dark grey tephra, with grain-size varying from coarse to fine ash and constituted totally by lithics fragments. No juvenile fragments are present. Statistical analysis shows a multi modal deposit, with high contents of fine ash.

**Key Words:** Phreatic explosions, ash fall deposit, Peteroa volcano

## 1 Introduction

Planchon-Peteroa-Azufre Volcanic Complex (PPAVC) is a NE-SW volcanic chain located in the border between Chile and Argentina (35°31'W-70°14'S – 4,107 m s.n.m.) and is part of the Southern Andean Volcanic Zone (SAVZ) (Fig. 1). The actual active volcano corresponds to Peteroa, which is distinguished by its 4 km caldera-type crater that hosts 4 craters (150-500 m diameter) and a scoria cone (150 m diameter, 60 m height) (Naranjo et al., 1999). Acid lakes are hosted in 4 craters, while permanent fumarolic activity is present in 3 of them. In the areas that surround the volcano may notice an intense thermal activity with the presence of thermal springs, which often have an intense bubbling gas.

This work describes the characteristics of recent eruptive activity of Peteroa volcano (2010-2011) based on local witnesses information, visual observation of the authors, Southern Andes Volcanic Observatory (OVDAS) internal reports and webcam data, satellite and fall deposit analysis.

## 2 Geological and volcanological setting

Peteroa volcano is the youngest and smallest (<1 km<sup>3</sup>) volcano of the complex, and is formed by calc-alkaline lavas and pyroclastic units, corresponding mainly to andesites and Holocene rhyodacitic tuffs. Differently, Azufre and Planchon volcanoes are composed by basaltic to dacitic lava and pyroclastic flows (Tormey et al., 1995). PPAVC is built above an underlying basement consisting in Cretaceous marine and evaporitic sediments, formed mostly of limestone, conglomerates and sandstones, basaltic to rhyolitic lava flows and pyroclastic rocks (Tertiary) and Middle Tertiary granodiorite plutons (e.g. Haller et al., 1985; Naranjo et al., 1999). PPAVC is related genetically to strike-slip faults W-NW trend, where volcanoes are aligned (Tormey et al., 1995).

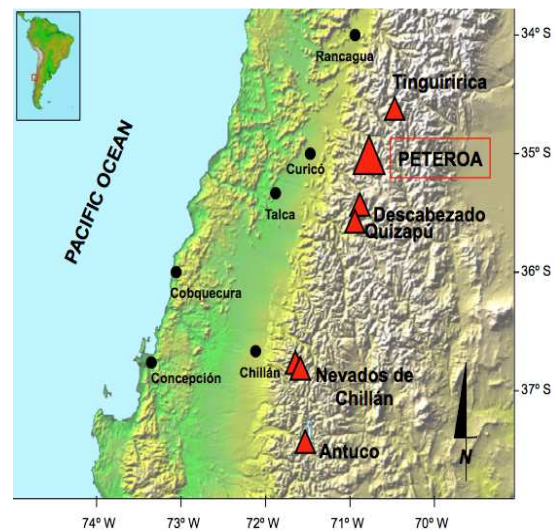


Fig 1. Location map of the study area.

## 3 Historic eruptive chronology

The historical activity is characterized by the permanent emission of gas from different fumarolic fields. However, sporadic gas column is emitted (~200 m above crater), normally during the summer, probably associated to ice melting. At least 13 historical eruptions have been observed since 1660, corresponding mainly phreatic and

phreatomagmatic, and being frequently associated to those eruptions the generation of lahars (Gonzalez-Ferran 1995). The last eruption occurred during February 1991, when a phreatomagmatic explosion generated eruptive columns between 1.000 and 2.000 m above the crater, which were dispersed to E-NE by 80 km approximately, while lahars were generated in the W side of volcano (BGVN 1991; Gonzalez-Ferran 1995; Naranjo et al 1999).

## 4. Eruptive chronology

### 4.1 Stage 1

First report of activity (SERNAMEOMIN, 2010) from Peteroa volcano indicates that a white plume ~250 m above the crater started at 4 January 2010. Phreatic explosions in the acid crater lake of the westernmost crater, that produced a ~500 m of altitude white column, was observed from the authors between 23 and 26 February 2010.

### 4.2 Stage 2

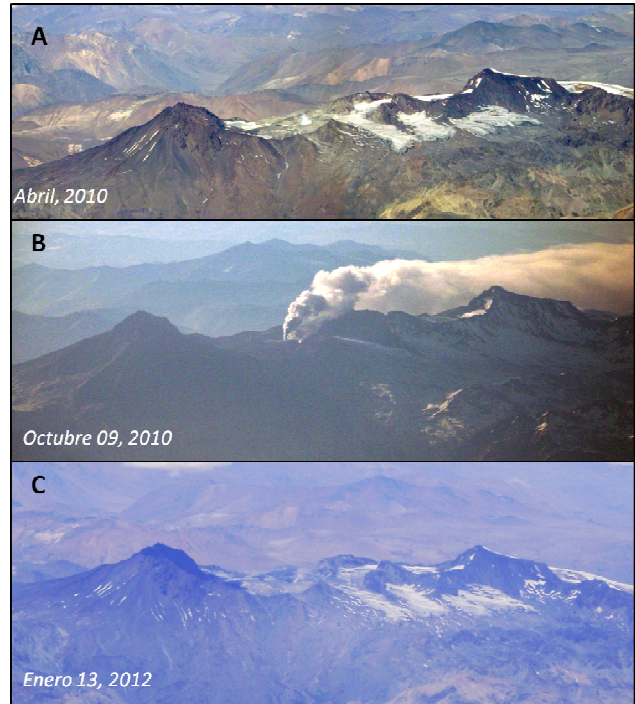
During 4 September 2010, a 1.2 km of altitude above the crater dark-grey eruptive column was emitted from the westernmost crater (SERNAMEOMIN-OVDAS, 2010a). The plume was dispersed to N by 30 km and ash fall was reported in the NW and NE flanks. Between 6 September and 10 November 2010 diverse explosions produced light to dark-grey eruptive columns, which altitude that varied from 200 to 1,500 m above the crater (Fig. 2). The plumes were dispersed mainly to ESE and NNW, reaching up 170 km of distance (Fig. 3).

### 4.3 Stage 3

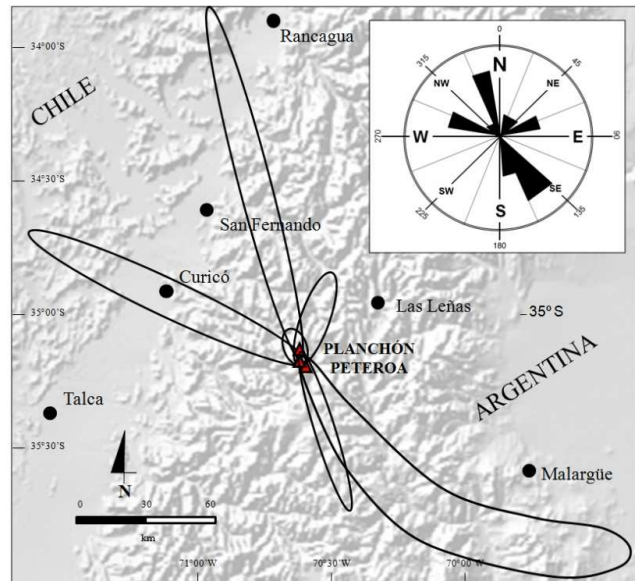
Between 11 November 2010 and first week of February 2011 were emitted steam columns with altitudes ranging 200-300 m above crater (SERNAMEOMIN-OVDAS 2010b, c and 2011a). Visual observations at the eruptive crater during November 2010 evidenced the absence of acid crater lake.

### 4.3 Stage 4

The period between second week of February and 5 May 2011, a permanent steam column was emitted, with altitude between 200 and 650 m above the crater. Visual observations during March 2011 indicate that a new acid crater lake appeared in the active crater, although littler than February 2010 lake. Explosions were observed the second week of February, 18 March, 16, 17, 18, 19, 21, 25, 26, 27, 28 and 29 April, and 5 May 2011 (SERNAMEOMIN-OVDAS, 2011b, c, d and e). Eruptive columns reached up 1.2 km above the crater, while plumes were dispersed to mainly to SE, reaching up 22 km of distance.



**Figure 2.** Peteroa volcano during pre eruptive (A), eruptive (B) and post eruptive (C) stages. View from the West. Photos by Victor Marfull and Hector Moyano.



**Figure 3.** Main directions and maximum dispersion of the eruptive plumes generated during 2010-2011 period

## 4. Fall deposit analysis

A total area of ~200 km<sup>2</sup> was covered by ash fall, being deposited mainly in the SE flank of volcano, where ~90% of ash was deposited during the second stage. Thickness of ash deposit varies from 4 m on the SE border of active crater to 1 mm, 80 km SE from Peteroa crater.

During March 2011, fall deposit was sampled on the SE border of active crater. Fall deposit corresponds to dark grey tephra, with grain-size varying from coarse to fine ash (2 to <0.075 mm) and constituted totally by lithics fragments. Lithics correspond to poorly vesicular andesitic lava (40-20% vol.), glassy lava fragments (35-10% vol.), and quartz (35-15% vol.), plagioclase (15-8% vol.) and pyroxene (2% vol.) crystals. No juvenile fragments are present in the ash fall deposit. Statistical analysis shows a multi modal deposit, with high contents of fine ash. Ash fall deposit characteristics suggest a typical phreatic eruption.

## 5. Conclusions

The new eruptive period of Peteroa volcano (January 2010-May 2011) is characterized by four stages, being the second and fourth the most intense. The activity have been characterized by occurrence of phreatic eruptions, which generated columns that reached up 1.5 km above the crater and plumes dispersed to ESE and NNW reaching up 170 km of distance over Argentina. Ash fall deposit, constituted exclusively by lithics fragments and grain-size distribution trending to fine ash is compatible with typical phreatics eruptions. Consequently, have been estimated that 2010-2011 eruptive period correspond to low magnitude event, with a VEI 1-2.

## Acknowledgments

This work has been funded by FONDECYT N° 11100372 (FA) and PBCT-PDA07 (FG) projects. The group is warmly grateful of Constanza Nicolau by her help in the ash analysis, Victor Marfull (POVI) for aerial photographs, Cristobal Bayer, Juan José Oliva, local horse riders Don Aburto and Miguel for their help during the field trip, and Gendarmería Argentina (Paso Vergara) for February 2011 eruption data.

## References

- Bulletin of Global Volcanism Program. 1991. Peteroa. Volcanic Activity Reports. BGVN 16:01. <http://www.volcano.si.edu>
- González-Ferrán, O. 1995. Volcanes de Chile. Instituto Geográfico Militar, 639 p. Santiago
- Haller, M., Nullo, F., Proserpio, C., Parica, P., Cagoni, M., Walker, J. 1985. Major element geochemistry on early Tertiary Andean volcanic (34°-36°S). Comunicaciones, Vol. 35, 97-100
- Naranjo J., Haller M., Osters H., Pesce A., Sruoga P. 1999. Geología y Peligros del Complejo Volcánico Planchon-Peteroa, Andes del Sur (35°15'S), Región del Maule, Chile- Provincia de Mendoza, Argentina. Servicio Nacional de Geología y Minería, Boletín No 52.

- SERNAGEOMIN. 2010. Actividad fumarólica en volcán Planchón. SERNAGEOMIN reporte interno
- SERNAGEOMIN-OVDAS. 2010a. Reporte Especial N° 2, Actividad volcánica Región del Maule, Grupo volcánico Planchón-Peteroa, 6 de Septiembre de 2010. Observatorio Volcánico de los Andes del Sur
- SERNAGEOMIN-OVDAS, 2010b. Reporte N° 11, Actividad volcánica REGIÓN DEL MAULE, Noviembre de 2010. Observatorio volcanológico de los Andes del Sur
- SERNAGEOMIN-OVDAS, 2010b. Reporte N° 12, Actividad volcánica REGIÓN DEL MAULE, Diciembre de 2010. Observatorio volcanológico de los Andes del Sur
- SERNAGEOMIN-OVDAS, 2011a. Reporte N° 13, Actividad volcánica REGIÓN DEL MAULE, Enero de 2011. Observatorio volcanológico de los Andes del Sur
- SERNAGEOMIN-OVDAS, 2011b. Reporte N° 14, Actividad volcánica REGIÓN DEL MAULE, Febrero de 2011. Observatorio volcanológico de los Andes del Sur
- SERNAGEOMIN-OVDAS, 2011c. Reporte N° 15, Actividad volcánica REGIÓN DEL MAULE, Marzo de 2011. Observatorio volcanológico de los Andes del Sur
- SERNAGEOMIN-OVDAS, 2011d. Reporte N° 16, Actividad volcánica REGIÓN DEL MAULE, Abril de 2011. Observatorio volcanológico de los Andes del Sur
- SERNAGEOMIN-OVDAS, 2011e. Reporte N° 17, Actividad volcánica REGIÓN DEL MAULE, Abril de 2011. Observatorio volcanológico de los Andes del Sur
- Tormey D., Frey F., López L. 1995. Geochemistry of the Active Azufre-Planchón-Peteroa Volcanic Complex, Chile (35°15'S): Evidence for Multiple Sources and Processes in a Cordilleran Arc Magmatic System. Journal of Petrology, Vol. 36: 265-298