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ERUPTIVE ACTIVITY FROM LASCAR VOLCANO (2003 – 2005)

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1. INTRODUCTION

Lascar Volcano has been a constant study case due an its very high activity, reflected by its high eruptive rate (2.5 and 0.8 eruptions/year considering eruptive plumes higher than 5,000 and 1,000 m above crater, respectively). Diverse efforts have been made it to understand its eruptive behaviour, being only a very short eruptive period related to growth–and–collapse dome between 1986–1994 characterized (Matthews *et al.*, 1997). However, the eruptive behaviour before and after of this period is not clear. Is considered that the understanding of process that trigger the eruptions can help to determine the eruptive behaviour of a particular volcano, therefore, in this work are presented field, satellite, air fall deposits and gas data from 2003–2005 eruptive period, with the objective to characterize this eruptive period and to determine the process that have triggered the eruptions.

2. GEOLOGICAL SETTING AND ERUPTIVE HISTORY

Lascar is a composite volcano, located 270 km NE to Antofagasta city and 70 km SE to San Pedro de Atacama town. Its height is 5,592 m a. s. l. and is formed by 5 NE–SW trending aligned craters, being actually active the central crater, with 800 m of diameter and 400 m of profundity

(Aguilera *et al.*, 2003). Lascar volcano is formed principally by Pleistocene–Holocene andesitic to dacitic lava flows and pyroclastic rocks.

Its normal activity is characterized by a permanent gas emissions, interrupted by occasional large eruptions with eruptive columns >5,000 m above crater (principally vulcanian eruptions) and more frequent small to moderate eruptions (eruptive columns between 500 and 5,000 m above crater). Main eruptions have occurred in September 1986, February 1990, April and December 1993, July 1995 (Matthews *et al.*, 1997) and July 2000 (Aguilera *et al.*, 2003). However, the most important eruption took place in 19–20 April 1993, when a subplinian eruption generated an eruptive plume that reached up 25 km of height and pyroclastic flows that extended up 7.5 km from central active crater (Gardeweg and Medina, 1994).

3. DECEMBER 2003 ACTIVITY

In 9 December 2003 at ~21:00 UTC time, small grey eruptive plumes were emitted reaching an altitude between 400 and 500 m above crater, being rapidly dispersed to SE. This activity continued during 10 December (GVN 29:01).

4. MAY 2005 ACTIVITY

In 4 May 2005 at ~6:39 UTC time an eruptive plume was emitted. According to information gave by inhabitants from Talabre town (located 17 km W to volcano), there were no eruption noises or seismic activity related. Very fine ash fall was reported in the city of Salta (285 km SSE of volcano) at 8:45 UTC time (GVN 30:05) and province of Chaco (1,100 km SE of volcano), both in Argentina, being the last place the farthest point where was registered ash fall (GVN 30:04). According to numerical model of temperatures and wind measurements made it by Servicio Metereológico Nacional (Argentina), the eruptive column reached up a height between 10 and 11 km above crater and was dispersed to SE (GVN 30:05; Viramonte *et al.*, 2006a, b).

Ash samples collection was carried out during 2.5 hours, measuring an ash fall rate of 0.4 $gm^{-2}h^{-1}$. Petrographical analysis of ash samples indicate the presence of no juvenile fragments, corresponding to fragments of ancient domes composed by andesitic lithic fragments, broken crystals of two pyroxenes (hyperstene and augite) and plagioclase and very scarce glass shards. Crystals of secondary gypsum piles up these fragments and material hydrothermaly altered, indicating a relative

long–time vapour phase (fumaroles) alteration. Granulometric analysis shows a strong mode at 3–4 phi size (0.125–0.0625 mm), smaller than grain size distribution from September 1986 and April 1993 eruptions with strong modes at 2–3 phi size (0.25–0.125 mm) (Glaze *et al.*, 1989; Viramonte *et al.*, 1994), reflecting a greater fragmentation during May 2005 eruption.

Analysis of satellite data from GOES images sequence indicate that the eruption began ~6:39 UTC time, being the first evidence a little thermal anomaly composed by 4 satured pixels. At 7:09 UTC time, a prominent thermal anomaly composed by 28 satured pixels and SE dispersed eruptive plume of ~20 km of length were detected. Between 8:39 and 10:10 UTC time a detached plume from volcano was affected by a strong dispersion and great loss of area, coinciding with the period in which passes over Salta city and the ash fall over the city, suggesting that most of ash fall occurred during this period. After 13:39 UTC time, the plume had been completely dispersed. The mean velocity of eruptive plume was 168 km/h and its maximum area of ~5,723 km^2. Minimal volume erupted was 2.86 x 10^6 m^3 considering an ash fall deposit of 0.5 mm. This volume is equivalent to equal side cube of 141.97 meters. If are considered as end members the diameters of active crater and the crater floor, 800 and 110 meters respectively (Aguilera *et al.*, 2003), the volumes erupted are equal to cylinder of 5.69 and 301.11 meters of profundity, respectively. This volume is very small compared with volumes erupted in September 1986 and July 2000 vulcanian eruptions, with 50 x 10^6 and 36 x 10^6 m^3, respectively (Glaze *et al.*, 1989; Aguilera, 2004).

During the field campaign carried out in May 25 were reported three new low temperature fumaroles (30–76ºC) a few meters from S border of central crater, and absence of new bombs and ash around volcano area. Gas chemistry analysis from new fumaroles indicate that they are more enriched in H_2O, H_2S and $(H_2 + HCl)/S_{total}$ ratio compared with fumaroles sampled during 2002 in central active crater (Tassi *et al.*, 2004; GVN 28:03).

5. CONCLUSIONS

4 May 2005 eruption correspond to freato–vulcanian eruption caused by a mixing of two process, the income of water in volcanic system and prolonged obstruction period of degasification ways. Evidences for first process are supported principally by: 1) a strong enrichment of water and $(H_2 + HCl)/S_{total}$ ratio in new fumaroles appeared after the eruption; 2) presence of secondary

gypsum; 3) high fragmentation during eruption indicated by grain size distribution. Evidence for second process are: 1) absence of juvenile fragments in the ash fall deposits; 2) prolonged period (~5 years) without big eruptions (the last one in July 2000) and occurrence of only 4 minor explosive events during this period. Possible magmatic component cannot be ruled out, principally by presence of high contents of acid gases in peripheral–low temperatures fumaroles, suggesting a direct connection of these fumaroles with central feeder conduit.

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