Morphology of Lava Fountain Deposits in the Cinder Cone of La Cornudilla Volcano. Campo de Calatrava Volcanic Region (Central Spain)

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1. INTRODUCTION AND STUDY ZONE

The Campo de Calatrava Volcanic Region is located in the center of the province of Ciudad Real (Central Spain). It has an area of approximately 5,000 km^2 along which they have formed more than 300 volcanoes in a temporary space quite extensive, ranging from the 8 My to 6500 BP. The study area where this volcano is located in the southeastern sector of the volcanic region: Sierra Granátula-Valenzuela de Calatrava. Alignment is a Paleozoic mountain carved on Armorican quartzite, sandstone and shale, intensely fractured, with a maximum altitude of 865 m (Cuevas Negras volcano). About the same, different volcanoes were constructed with effusive and explosive (Strombolian and hydromagmatic) eruptions and developed the volcanoes of La Herradura, Cerro Gordo, Cuevas Negras, La Sima, Cerrillos del Sapo, La Cornudilla and maars of Varondillo and La Nava, (González, 1996).

The aim of this paper is to characterize the volcano as an example of a volcanic construction triggered by an effusive and strombo-effusive eruption in which lava fountains and spatter deposits, generated by them, played an important role (Becerra, 2007). It has been used for this purpose the typical methodology of volcanic geomorphology studies: a review of previous papers, use of spatial orthoimagery, GIS and field works for the description of the deposits and the resulting morphology.

2. DESCRIPTION OF THE VOLCANO

This volcano stands in the middle of the Paleozoic mountain, right at the intersection of two lines of fracture of E-W and N-S direction (González, 1996).

It is a volcano consisting of a cinder cone with heterometric scorias reaching an absolute height of 61 m, a mean base diameter of 290 m and an average slope of 14° (Becerra, 2007). The morphological typology, according to the classification established by Dóniz (2009) for basaltic volcanoes, is an open horseshoe volcano whose cone and crater are open towards the SW. The crater has about 90 m wide. Through the opening of the crater a final lava flow was emitted that and yet retains its original morphology. There is a small volcano (Cerro Negro) to the SE of La Cornudilla formed by spatter deposits, linked together chronologically (Fig. 1).

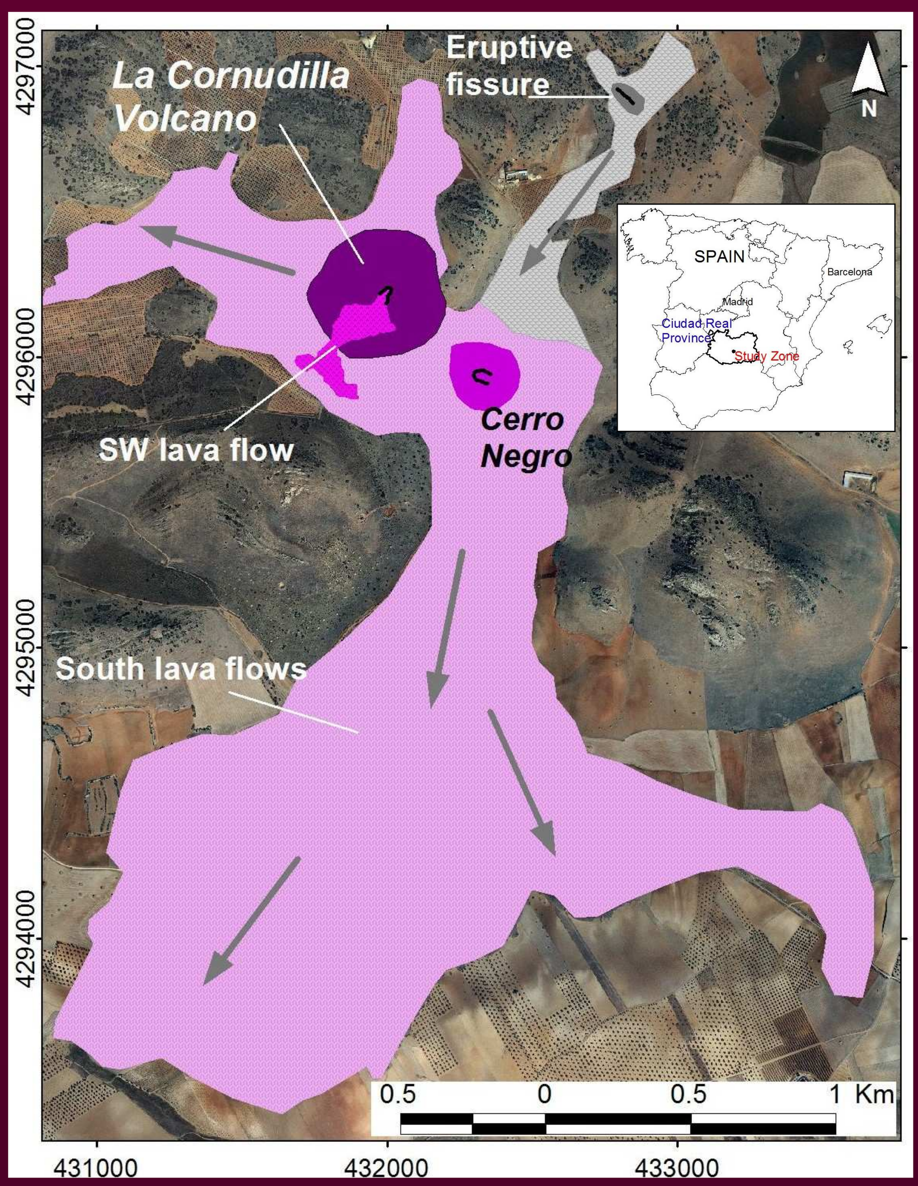

Figure 1. Geomorphologic diagram of La Cornudilla volcanic complex and study zone location.

2.1. CINDER CONE: volcanic deposits.

Eruptive processes that built La Cornudilla volcano were basically two types: effusive and strombolian, with intermediate stages, according to some of the studied deposits. Highlights the not welded fallout deposits that form the cone and spatter deposits (agglutinated scorias) which form the crater rim (Fig. 2).

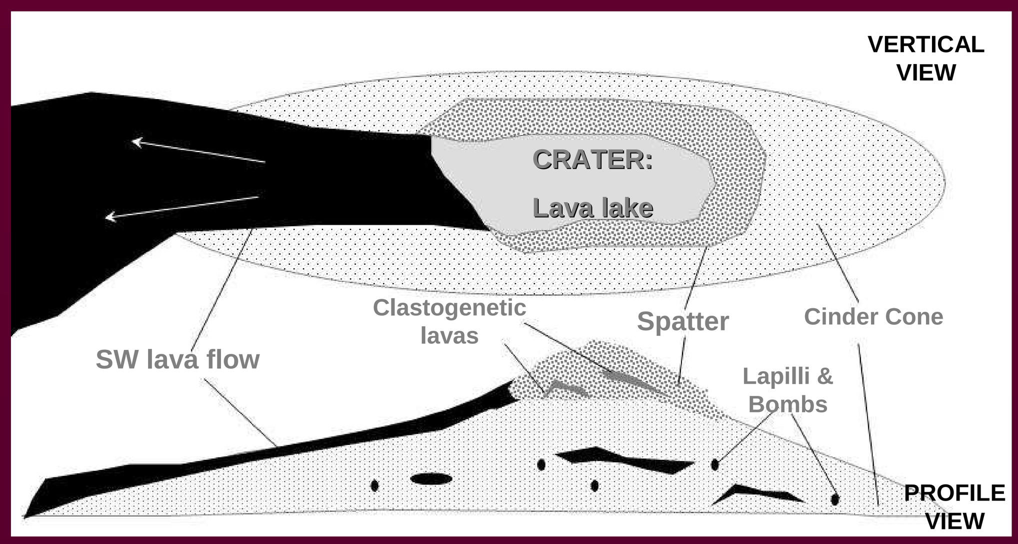

Figure 2. Sketch from vertical and profile view of the volcanic deposits structure on cinder cone and crater of La Cornudilla.

Figure 3. Not welded fall basaltic pyroclasts of the cinder cone.

The materials that form the cone of La Cornudilla are the result of the successive accumulation of basaltic pyroclastic fall of different sizes (Fig. 3), not welded or consolidated, result of low explosive eruption (strombolian and strombo-effusive pulses). We found lapilli (<5 cm), vesicular scorias (5-10 cm), shreds, plasts, bombs (10-30 cm) and interbedded lava spills, result of lower explosive pulses.

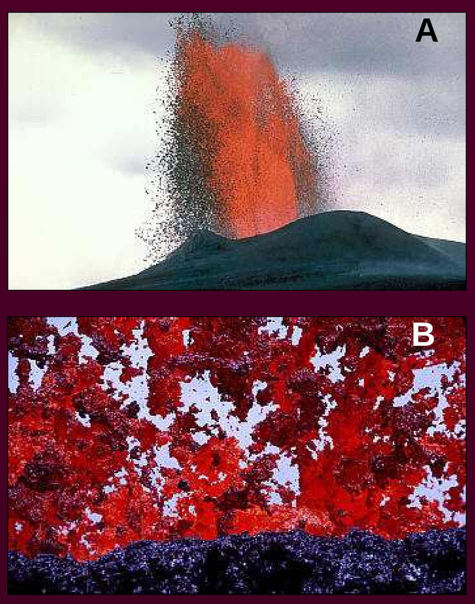

Figure 4. Typical hawaiian eruption. Pic's from *USGS (J.D. Griggs)*: **a)** Lava fountain ; **b)** Spatter.

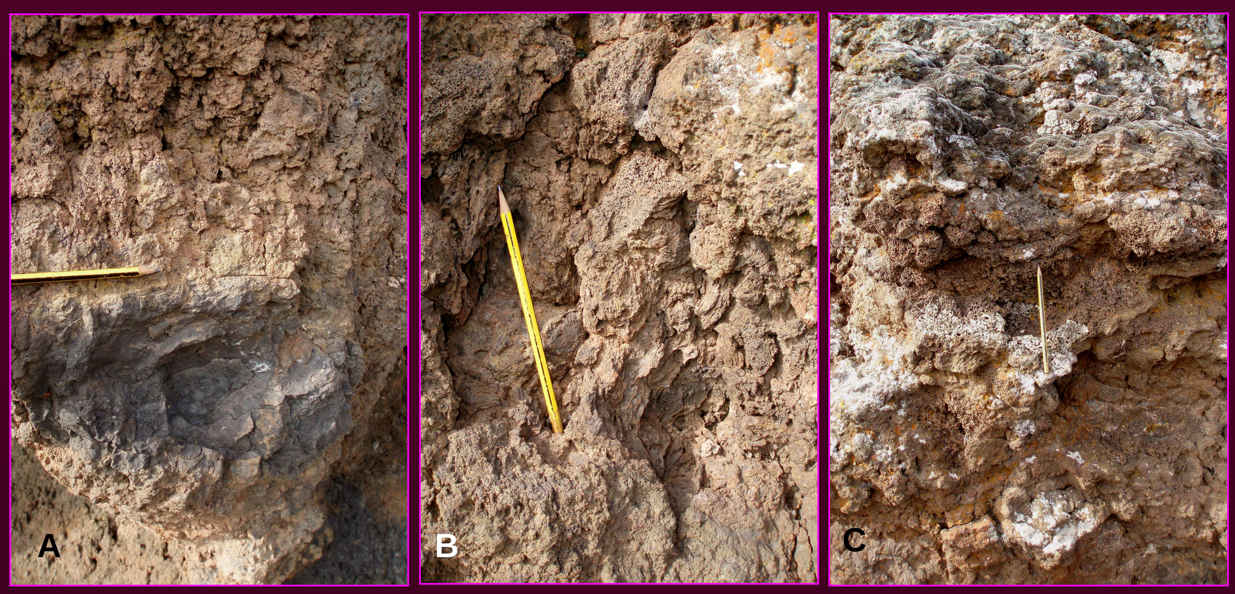

Figure 5. Welded and agglutinated scorias and spatter in the crater rim: a) Interbeded lavas; **b)** Spatter; **c)** Lava plasts.

The crater rim (volcano peak) is formed by agglutinated and strongly welded scorias (spatter), usually associated to hawaiian eruptions with fluid magmas, low gas content and high temperatures (Romero *et al.*, 2006). It is the presence of typical eruptions of lava fountains (Fig. 4) that emit high plasticity pyroclastics, that during its deposition, are welded to each other by processes of compacting, agglutination and coalescence (Sumner *et al.*, 2005).

In La Cornudilla, these deposits with about 5 m thick are composed of shreds, plasts, agglutinated scorias, very welded lapilli and lava spills – clastogenic lavas – typical materials of lava fountain processes, according to Head and Wilson (1989).

2.2. LAVA FLOWS MORPHOLOGY.

Hawaiian and strombo-effusive eruptions, determined the important issue of highly fluid lava flows that were channeled by the pre-existing valleys, filling them and change its morphology substantially. We note the existence of a large lava flow of about 3 km long, channeled through the Jabalón Valley to the South to spread in a fan shape with 2,5 km wide, stopping a few meters from the river in the depression of Granátula-Calzada.

It also highlights a lava flow emitted from SW openning of the crater (Fig. 7) that runs about 480 m bifurcated in two branches with 200 m wide, fed by a small intra-crateric lava lake derived from the last effusive vent.

Both lava flows have a pahoehoe surface morphology type (cordate and draped), still preserved in the case of the last lava flow.

Figure 6. Lava lake in the crater of La Cornudilla. Detail of pahoe-hoe lavas (right).

Figure 7. SW lava flow, latest emission.

3. CONCLUSIONS

The existence of significant eruptive processes with effusive and strombo-effusive character, and the presence of lava fountains, determined the appearance of volcanic edifices with spatter deposits, just described to date in this volcanic region.

These deposits, strongly agglutinated and welded together, have a higher resistance to erosion on the cone. This is seen as significant in the slightest erosion of the crater rim (composed mainly of spatter and agglutinated scorias and lapilli) against the further erosion of the rest of the cinder cone, whose unconsolidated material were more likely to be eroded and transported by erosive agents such as water or wind .

Lava flows also offer greater resistance to erosion and human activity on them, especially in the last lava emission to be “safe” for agricultural uses that on the rest of de cone have been carried out.

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