Mechanisms controlling explosive-effusive transition of Teide-Pico Viejo complex dome eruptions

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INTRODUCTION AND OBJECTIVES

- The geological record allows us to evaluate the eruptive sequences and the eruptions’ explosivity index.

- This is vital for a correct hazard assessment, especially in volcanic systems with high return period.

DOMES Eruptions

Volatile zoning?

Magma ascent rate?

Degassing?

New magma influx?

Pre-eruptive conditions changes?

Objectives

- Identify the pre-eruptive parameters that control the explosive-effusive transitions in Teide dome eruptions.

- Evaluate the presence of halogen volatiles in Tenerife felsic magmas.

METHODOLOGY

1) Petrographic characterization of samples from the effusive (lava flows) and the explosive (pumice) phases of Pico Cabezas dome eruption, using both petrographic and scanning electron microscopes.

2) Geochemical analysis using an electron microprobe (major elements) and micro-X-ray fluorescence (for Br quantification).

3) Pre-eruptive parameters: geothermobarometer [2] and geochronometer [3]. These use the chemical composition of minerals (clinopyroxene and feldspar, respectively) and the magma in equilibrium.

4) Comparison with experimental petrological data [4-6].

RESULTS: GEOCHEMISTRY

Feldspar

- Continuous evolution from olivine-rich (less evolved magmas) to sanidine compositions (more evolved magmas).

- Less fractionated feldspars (low or negative fractionation index “log(Or/An)” are also slightly enriched in iron.

Clinopyroxenes

- Ca-rich clinopyroxenes: diopsides and some augites.

- Zonations have only been found in the explosive phase, with cores enriched in Fe, Na, and Mn.

- Typically associated with Fe-Ti oxides: magnetite and ilmenite.

DISCUSSION AND CONCLUSIONS

P-T: low accuracy due to the difficulty obtaining the exact composition of the magma in equilibrium.

Model: magma chamber at 1kbar, chemical and thermally zoned. Zoning in minerals indicate self-mixing processes. Ca-rich rims in feldspars suggest underplating and injection of a mafic magma short time prior to eruption. This injection probably triggered the eruption.

1st phase: Explosive (pumices). Related to the upper cupola of the chamber with less temperature and higher volatile content. It was triggered by an increase in temperature and energy after a mafic injection.

Collapse of the eruptive column because of energy loss and formation of a PDC into the low valley.

2nd phase: Effusive (lava flow). Related to the magma stored in the main body of the magma chamber.

From Cl and Br measured in the explosive phase and the distribution coefficient between magma and fluid phase we estimate 244.6 Tm of CI and 9.9 Tm of Br released to the atmosphere in this eruption.

CONCLUSIONS

- Pico Cabezas eruption: magma chamber at ±0.5 kbar chemically and thermally zoned.

- The pre-eruptive parameters that controls the explosive-effusive transition are the temperature and the volatile content.

- The release of high amounts of CI and especially, Br, may lead to a local destruction of the stratospheric ozone layer.

- Phreatomagmatic dome eruptions in Tenerife should be taken into account for improving the hazard assessment of the island, with special focus on Icod valley.

BIBLIOGRAPHY


EGU2020: Sharing Geoscience Online