# Ankaramitic lavas from El Hierro island: insights from petrography

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## INTRODUCTION

The term ankaramite was firstly defined by Lacroix (1916) in their type locality of Ankaramy, at Ampasindava, Madagascar. According to the actual definition of the IUGS (Le Maitre et al., 1989), an ankaramite is a porphyritic melanocratic basanite with abundant phenocrysts of pyroxene and olivine. Ankaramites can be formed as cumulates during the crystallisation of clinopyroxenes at high temperatures. To better understand the term cumulate, it must be taken into account the separation of the minerals of the liquid that can be due to a density difference in which those with density ≥2.9 tend to accumulate at the base of the magmatic reservoir. Consequently, cumulates are rocks mostly composed by the aggregation of large minerals (Bardintzeff, 1992).

The island of El Hierro, the smallest and westernmost of the Canaries, is the less studied whilst most volcanically active island from the Archipelago. The presence of ankaramitic lavas has been reported in the three armed-rift zones of the island that control, together with the occurrence of giant landslides, its structure and morphology (e.g. Pellicer, 1979; Hernández-Pacheco, 1982; Weis et al., 2016). However, both the formation mechanisms and the eruption triggering factors of this kind of rocks are only directly addressed by Longpré et al. (2009). Thus, the origin and presence of ankaramitic lavas in El Hierro are still subject to open debate.

In this work, we present a preliminary study on the petrographic features from 6 ankaramitic lava samples collected in the NW rift of El Hierro, erupted during the recent rift volcanism stage of the island (< 145ka). Our aim is to contribute and to set the basis for future and more detailed studies regarding ankaramitic lavas at El Hierro.

## RESULTS

Ankaramitic lavas from El Hierro island are vesicular and show aphanitic porphyritic textures with a microlitic pilotaxic groundmass. Independent from the age and sample locality, all investigated rocks show the same macrocrysts assemblage of olivine + clinopyroxene; most commonly occur as isolated crystals although glomerophyric aggregates are also widespread. These macrocrysts are immersed in a microcrystalline matrix composed of plagioclase microliths and minor olivine, clinopyroxene and Fe-Ti oxides microcrysts.

We will focus our research on olivine and clinopyroxene petrographic features since ankaramitic rocks are defined by their high content and large size of these minerals macrocrysts. The olivine macrocrysts modal abundance ranges from 5 to 25 vol.% with a maximum size of 6.2mm. They occur as euhedral, nonspongy crystals, or more often as subhedral, nonspongy crystals with embayed rims and/or cores (Fig. 1A).

The clinopyroxene macrocrysts modal abundance ranges from 20 to 50 vol.% with a maximum size of 7.2mm. They occur as subhedral, nonspongy or slightly spongy crystals with embayed rims, or more often as euhedral, nonspongy or slightly to strongly spongy crystals (Fig. 1B). Three types of zoning patterns can be recognized: (1) normal or reverse, (2) oscillatory, and (3) sector zoning. Normally or reverse zoned clinopyroxenes show, under plane polarized light (PPL), ochre cores surrounded by brownish rims. Oscillatory zoning displays multiple compositional variations in thin layers, parallel to crystallographic planes, crisscrossed or anastomosed (Shore & Fowler, 1996) (Fig. 1C).

Sector zoning (also known as hourglass zoning) develops as a consequence of specific crystal faces growth with different composition from the adjacent ones (Hollister & Gancarz, 1971) (Fig. 1D).

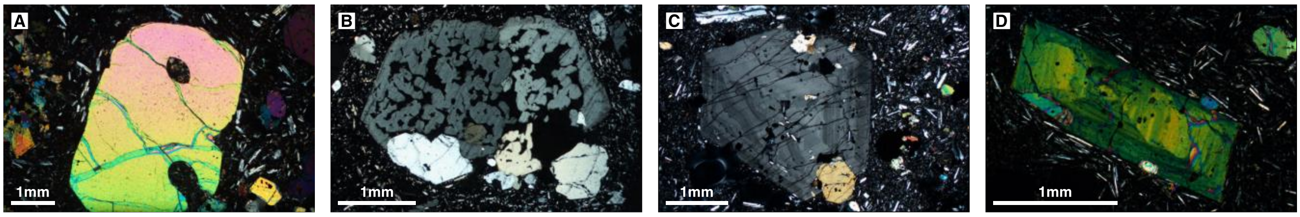


***Fig 1**. Microphotographs of El Hierro ankaramitic lavas under cross-polarized light (XPL): A) Subhedral olivine with embayed rim; B) Euhedral clinopyroxene with strongly spongy core; C) Euhedral, oscillatory zoned clinopyroxene; D) Euhedral, hourglass zoned clinopyroxene. Note that eventually, isolated clinopyroxene macrocrysts can present both oscillatory and sector zonning (D).*

## DISCUSSION AND FINAL REMARKS

Several of the macrocrysts features described, such as olivine embayed rims or clinopyroxene spongy cores and their complex zoning patterns can be interpreted either as: (1) a result of magma mixing processes, where pronounced changes in the magma chemistry cause disequilibrium reactions between mineral and host melt (Stroncik et al., 2009); or (2) as a consequence of an initial rapid, dendritic growth followed by a slow, near-equilibrium growth that partially infills the cavities with different clinopyroxene composition (Welsch et al., 2016). Therefore, if the latter hypothesis is considered, the cavities in the clinopyroxene cores would not be the product of partial dissolution (e.g. caused by magma mixing) but a result of the initial growth stage.

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