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LAJIAL

The Holocene volcanism of El Hierro, Canary Islands

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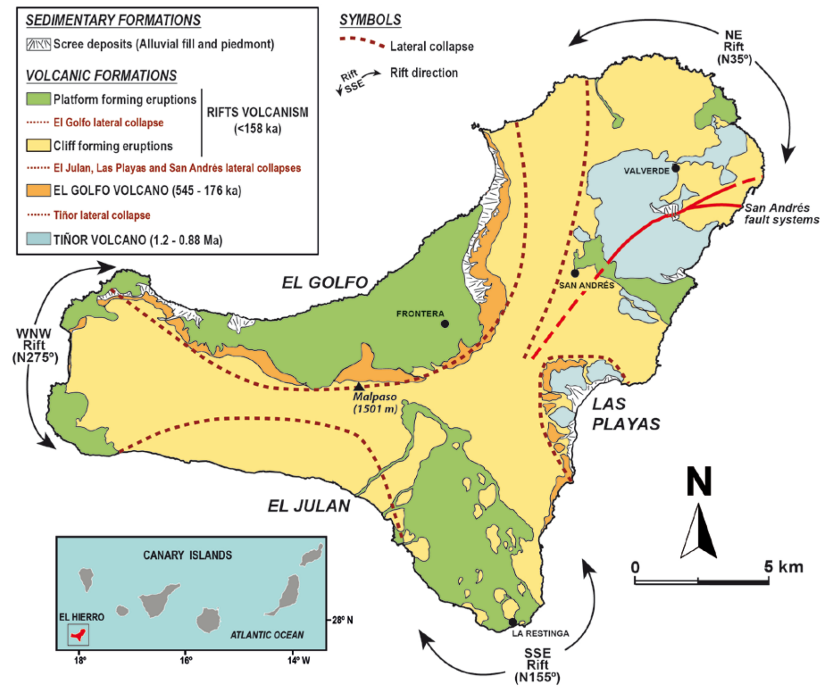
Introduction

The Project LAJIAL combines methodologies of geological mapping, geomorphology, GIS, chronostratigraphy, paleomagnetism, petrology and geochemistry to solve the Holocene eruptive recurrence rate in El Hierro, and to constrain the rift model of intraplate ocean volcanic islands.

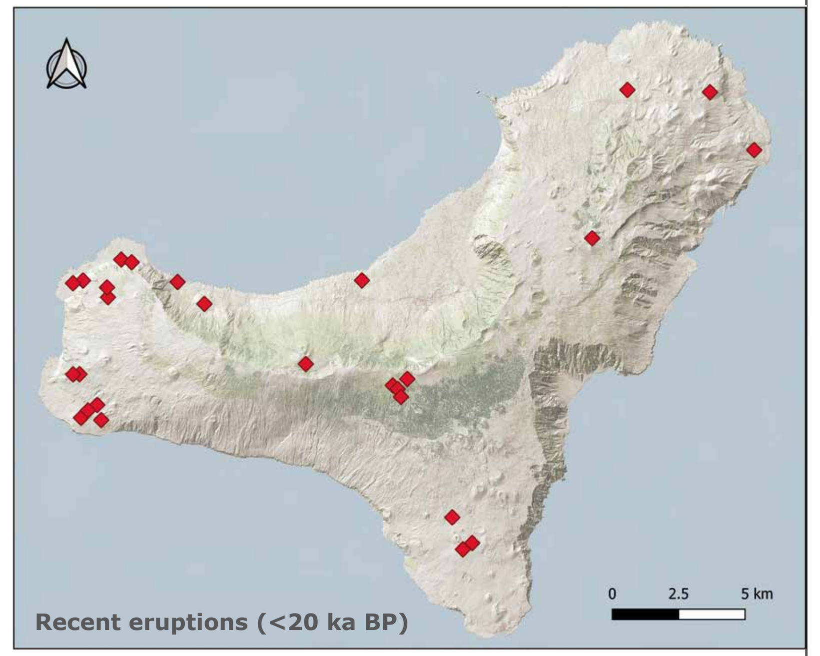


Simplified geological map of El Hierro island (modified from Carracedo et al., 2001)

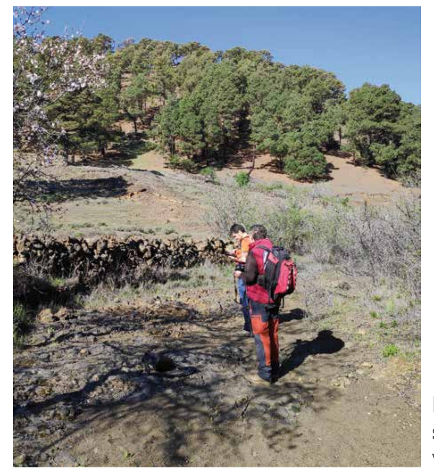
Background

An eruption is treated as recent in El Hierro if their lava flows arrive to coastal platforms, which are considered after the last glacial maximum (~20 ka BP) (Rodriguez-Gonzalez et al., 2011). In addition, there are some apparently recent volcanic edifices far from the coast. More than thirty subaerial eruptions are studied as recent and are the aim of the Project LAJIAL.


Lava flow of recent eruption (<20 ka BP) arriving to a coastal platform


Recent eruptions (<20 ka BP)

Field work

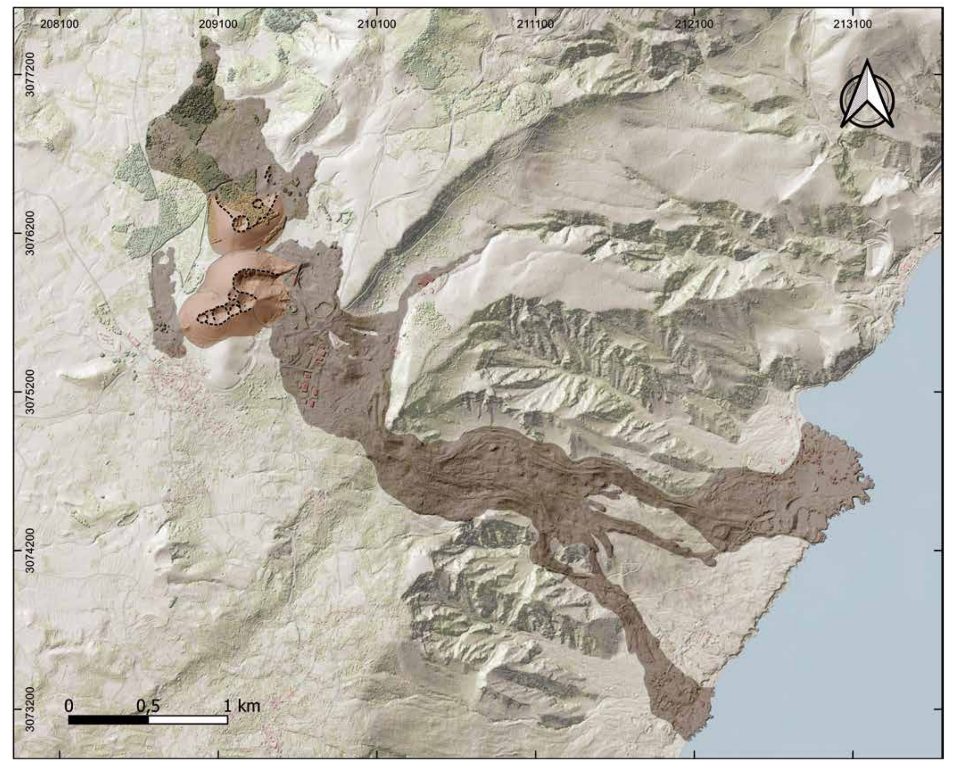



Sampling was performed for dating (^{14}C, ^{40}Ar-^{39}Ar and paleomagnetism), petrology and geochemistry during fieldwork in all potentially Holocene eruptions.

By using GeoPads in the field, tablets equipped with FieldMove software, it was possible to integrate mapping, note taking, and visualization applications.

Results

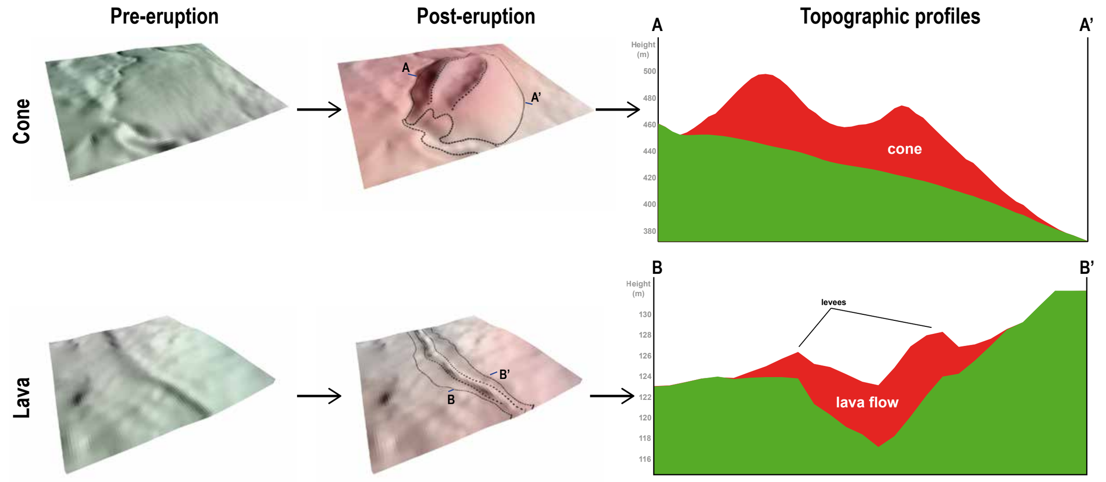
Geological mapping


Detailed mapping of studied eruptions was carried out identifying its main volcanic units (cone, lava flow and pyroclastic fall deposits). This example corresponds to the eruption of Montaña Chamuscada.

Geochronology

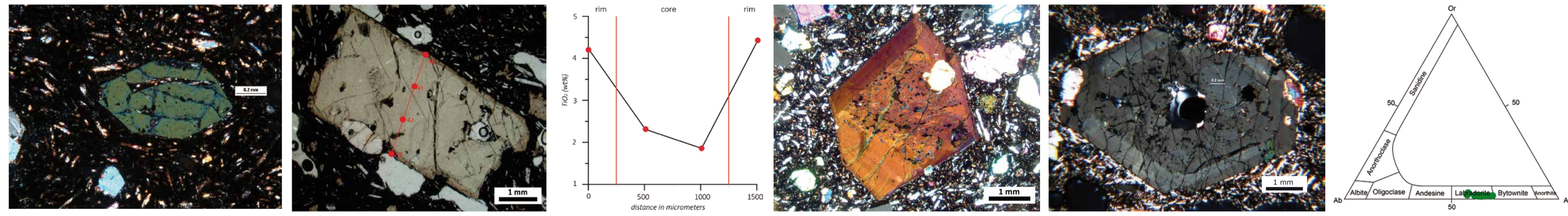
Montaña Chamuscada is the youngest dated subaerial eruption (2.5 ka, Carracedo et al., 2001).

Eruption modelling



Field work-based geomorphological reconstruction of Montaña Aguarijo eruption

Mineral chemistry



Forsterite (Fo) in olivine 74-84 % Fo, 0.07-0.31 % NiO

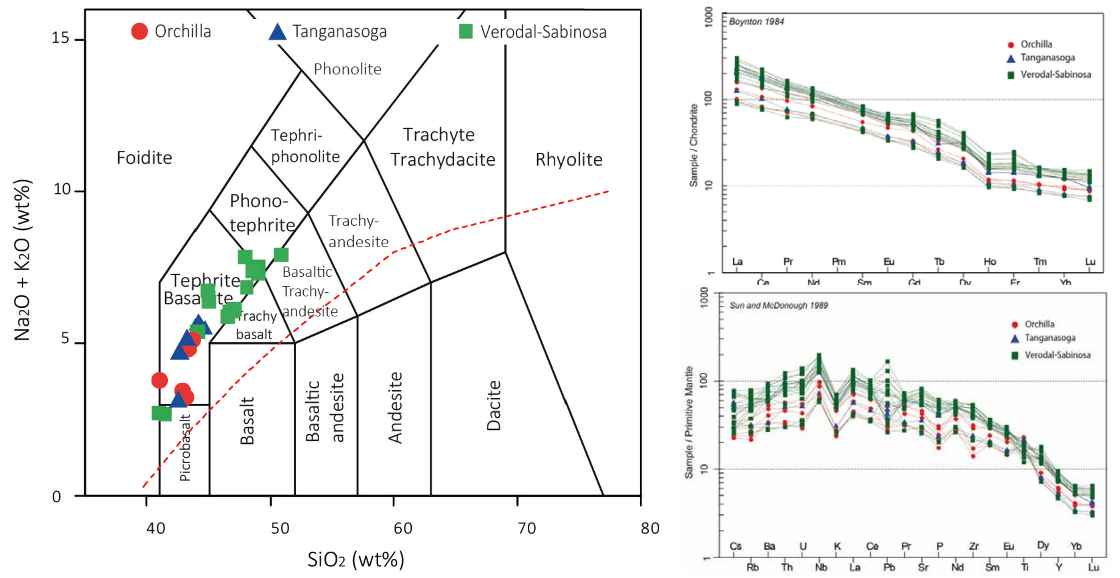
Clinopyroxene normal zoning

Clinopyroxene complex zoning

Plagioclase

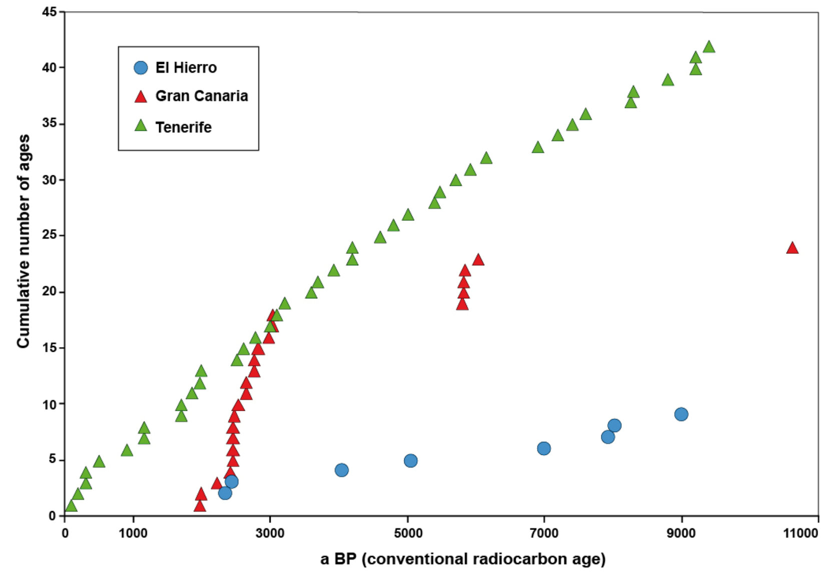
Porhyritic lavas with clinopyroxene and olivine, and minor plagioclase phenocrysts in a plagioclase-rich groundmass. Some of them are ankaramitic lavas with clinopyroxene and olivine crystals up to 5 mm. Clinopyroxenes show complex growth history (cores with disequilibrium textures mantled by rims with oscillatory zoning).

Whole-rock chemistry

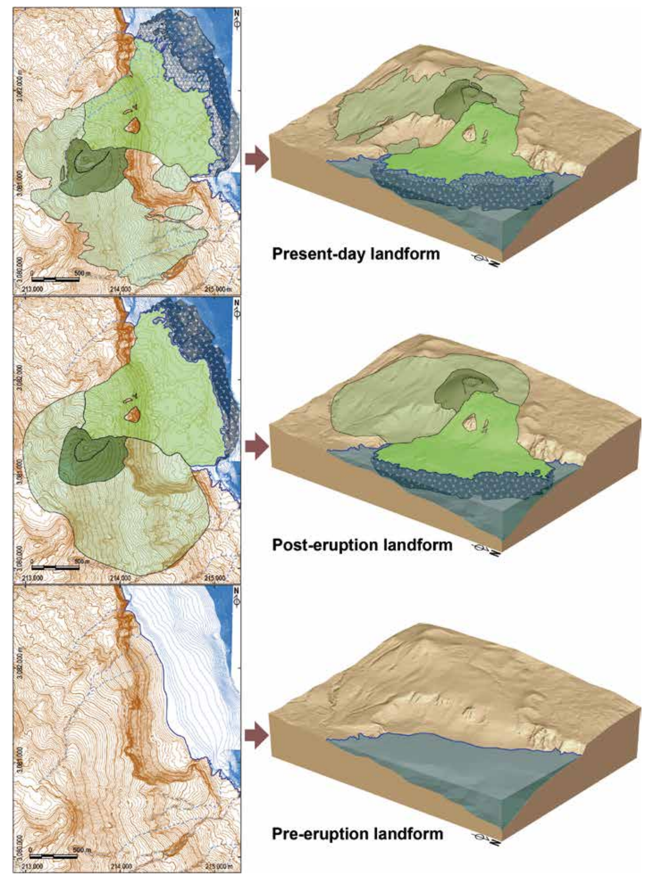


Lava flows compositions follow an alkaline trend in the Total Alkali Silica (TAS) diagram of Le Bas et al. (1986), REE and multi-element diagrams show typical ocean island basalt (OIB) patterns.

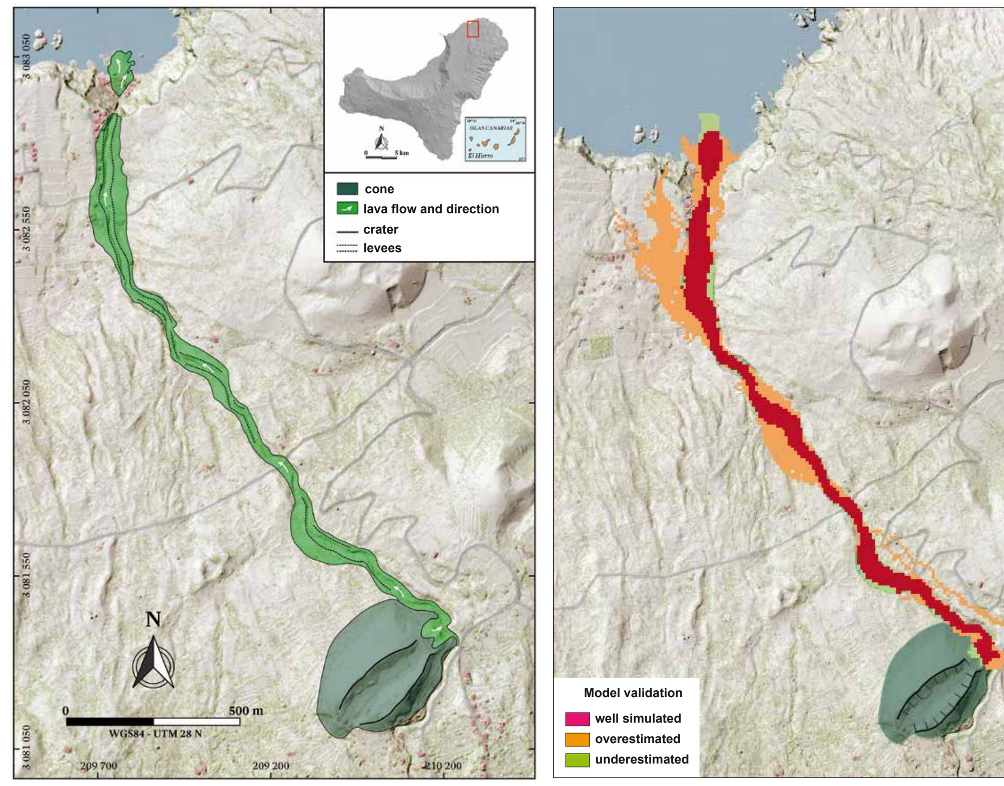
Eruptive rate (preliminary)



Temporal distribution of Tenerife, Gran Canaria and El Hierro eruptions during the last 11 ka (Tenerife data from Carracedo et al., 2007; Gran Canaria data from Rodriguez-Gonzalez et al., 2009; El Hierro data from Guillou et al., 1996; Perez-Torrado et al., 2011, 2012; Rodriguez-Gonzalez et al., 2011; Becerril et al., 2016).



Geomorphological reconstruction allows to obtain relief information on the stages of pre-eruption (before the eruption modifies the landscape) and post-eruption (just at the end of the eruption, therefore, without being affected by erosion).



Lava flow simulation of Montaña Aguarijo eruption Q-LavHA code probabilistic method L_{max}

Conclusions

- The Holocene subaerial volcanism of El Hierro generates fields of monogenetic volcanoes linked to the three rift systems of the island. Its eruptive mechanisms are typically Strombolian although there are also phreato-Strombolian events.
- A detailed and individualized cartography of all the subaerial Holocene eruptions of the island will be available for the first time.
- Major, trace elements and Sr and Nd isotope ratios evidence the compositional variation of the Holocene magmas and are consistent with an ocean island basalt (OIB) pattern.
- Major and trace elements trends as well as normal zoning in clinopyroxenes evidence fractional crystallization. Clinopyroxene cores with spongy cellular / sieve textures indicate other magmatic processes, such as magma mixing/mingling or assimilation.
- Geomorphological reconstructions, morphometric modelling and lava flows simulation of Holocene eruptions allow constraining the characteristics of future volcanic hazards in El Hierro.

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