Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.17945

Phase equilibria point to cold and shallow depth conditions for magma storage at La Palma 2021 eruption

JOAN ANDÚJAR[1], BRUNO SCAILLET[2], RAMÓN CASILLAS[3], IDA DI CARLO[4], ANETA SLODCZYK[5], DILETTA FRASCERRA[6], CARMELA FEDERICA FARANDA, PHD[7], MRS. MARÍA JIMÉNEZ MEJÍAS, PHD[3], ELENA NÚÑEZ-GUERRERO[5], STAVROS MELETLIDIS[8], STEPHANE SCAILLET[5] AND EXPERIMENTAL STUDENT GROUP FROM ORLÉANS-OLOT 2021-2022 COURSE[5]

[1]Institut des Sciences de la Terre d'Orléans (ISTO), CNRS
[2]Institut des Sciences de la Terre d'Orléans (ISTO), Université d'Orléans, CNRS, BRGM
[3]Universidad de La Laguna (ULL)
[4]Institut des Sciences de la Terre d'Orléans
[5]Institut des Sciences de la Terre d'Orléans (ISTO), CNRS, Univ. Orléans, BRGM
[6]Institut des Sciences de la Terre d'Orléans (ISTO),Universite d'Orleans, CRNS, BRGM
[7]Univ. Orléans, CNRS, BRGM, ISTO
[8]Instituto Geográfico Nacional (IGN)

Presenting Author: juan.andujar@cnrs-orleans.fr

The Tajogaite 2021 eruption at La Palma emitted a variety of magmas with contrasted mineralogy and composition[1], this diversity potentially reflects the ponding of magmas at one and/or two seismically well-defined depths at ~10 and ~30 km[2]. Hence, the short-term temporal evolution of the emitted products gives a unique opportunity to test the capability of available petrological methods to 1) constrain the pre-eruptive conditions of the emitted magmas and 2) capture the structure and evolution of the plumbing system related to this event. Application of available geothermometric tools as well as field measurements imply a T=1150°C for the whole set of emitted magmas and crystallization depths ≥ 15-30 km according to mineral and fluid barometers[1,3,4,5,6]. These suggest that the petrological features of the magmas were mostly acquired in the deep hot mantle rather than at shallow crustal levels.

Within the framework of the experimental course held in Orléans with Latino-American and French students, we performed a set of crystallization experiments at variable temperatures (1150-900ºC) and H_2O-CO_2 ratios to check these model estimates. Pressure was fixed at 300 MPa (10 km depth), in accord with seismic constraints, so as to capture the potential fingerprint (if any) left by the storage of the magmas at this depth. Experiments were performed on 3 representative samples covering the first month of the eruption and characterized by a mineralogy and petrology evolving from amphibole-bearing (tephrite) towards an amphibole-free and olivine+clinopyroxene dominated assemblage (basanite). The presence of amphibole in our experiments sets a maximum T for the opening phase at ≤ 1065ºC, this progressively increased to higher values along with increasing Mg# of the magma during the eruption. Yet, the coexistence of Ol+Cpx in the most primitive products is found experimentally only at T < 1150ºC. Our results thus indicate that the first erupted Tajogaite magmas were likely stored at a depth of 10 km and at temperatures 100ºC lower than those inferred so far.

[1]Day et al. 2022 EPSL, [2]Del Fresno et al. 2023 NC ,[3]Romero et al. JVGR , [4]Dayton et al 2023 SA [5]Castro and Feisel 2022,NC [6]Carracedo et al.2022.,GT.