

SPECIAL COLLECTION: GLASSES, MELTS, AND FLUIDS, AS TOOLS FOR UNDERSTANDING VOLCANIC PROCESSES AND HAZARDS

Spatio-temporal constraints on magma storage and ascent conditions in a transtensional tectonic setting: The case of the Terceira Island (Azores)†

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ABSTRACT

The mafic magmatism of the last 50 ka on Terceira Island, Azores archipelago, occurred along three segments of the fissure zone that crosses the island. The two subaerial segments developed with different trends over pre-existing, quiescent or extinct, central volcanoes. The Serreta submarine ridge is the offshore segment of the fissure zone that erupted recently in 1998–2001. The combined study of CO₂+H₂O fluid inclusions hosted in mafic minerals and rock geochemistry of the magmas, reveals different storage and ascent conditions among the fissure zone segments. The maximum pressure of fluid trapping for all the fissure systems occurred at the Moho Transition Zone, between 498 and 575 MPa (20.3–21 km deep). At this depth interval all magmas stagnated for some time, before ascending toward the surface, experiencing fractional crystallization and degassing. Magmas of the southeastern and Serreta segments of the fissure zone ascended rapidly through the crust without further stops. Those of the central segment experienced a multi-step ascent, with fluid trapping at 406 and 209 MPa (16.5–8.5 km deep) and associated geochemical evolution toward trachybasalt.

The magma ascent below the different segments of the fissure zone varies from almost isochoric at the submarine segment, associated with minimum re-equilibration of the inclusions, to polybaric slow ascent at the central segment, associated to almost complete re-equilibration of the inclusions. Variable degrees of re-equilibration and multi-step ascent may be linked to both the presence of pre-existing intracrustal crystallized bodies of more evolved composition and the stress field acting on this area. The latter responds to the local and shallow conditions related to the presence of older central volcanoes and to the main regional spreading direction of the Terceira Rift, which at regional scale, is approximately orthogonal to the fissure zone axis.

Keywords: Magma ponding, fissure zones, fluid inclusions, re-equilibration, olivine, Azores