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Recent plate re-organization at the Azores Triple Junction: Evidence from combined geochemical and geochronological data on Faial, S. Jorge and Terceira volcanic islands

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The study of volcanism near unstable plate triple junctions (TJs) offers a unique opportunity to investigate the interactions between mantle dynamics and lithospheric deformation in relation to short-term plate reconfiguration. From combined geochronological and geochemical analyses on Terceira, S. Jorge and Faial volcanic islands, we evidence contrasted modes of melt generation near the Azores Triple Junction during the last 1.3 Myr. The oldest lavas (N800 ka) erupted along N150 elongated volcanic systems in S. Jorge and Faial have homogeneous isotopic compositions which partly overlap the compositional field of MORBs from the adjacent Mid-Atlantic Ridge (MAR). In contrast, the younger lavas (b750 ka) erupted along the N110 main structural direction on the three islands are significantly more enriched in LILE and LREE, and have more variable and generally more radiogenic Sr, Pb, Nd and Hf isotopic ratios. Altogether, our data do not support the presence of an active mantle plume under the central Azores. Instead, they suggest that magma generation results from decompression melting of a heterogeneously fertilized mantle (fossil plume?). The higher geochemical heterogeneity of the lavas erupted during the last 750 kyr likely reflects low-degree partial melting promoted by recent reactivation of pre-existing MAR Fracture Zones. We propose that the sub-aerial volcanism over the last 1.3 Myr in the central Azores records a sudden change in the conditions of melt generation, due to a major reconfiguration in regional deformation associated with the recent reorganization of the Eurasia Nubia plate boundary.

1. Introduction

The evolution of triple junctions (TJs) is a topic of major interest for plate tectonics and geodynamic reconstructions (e.g. Georgen and Lin, 2002; Georgen and Sankar, 2010). In oceanic settings, plate reconfiguration is generally inferred from available magnetic anomaly patterns of the seafloor. However, the mechanisms and the time over which a plate boundary changes its location remain poorly understood, especially in areas where oceanic spreading occurs at very slow rates (e.g. Vogt and Jung, 2004). The study of volcanism occurring close to such TJs offers a unique alternative to overtake these limitations and to constrain the interactions between mantle dynamics, regional deformation, melt production and migration in relation to plate boundary reconfiguration over short geological periods (~1 2 Myr). The Azores volcanic province in the North Atlantic is a target of particular interest for such purpose. The Azores archipelago comprises nine volcanic islands built during the Quaternary (except the easternmost Santa Maria Island) over an oceanic plateau encompassing the present-day TJ between America, Eurasia and Nubia lithospheric plates (Fig. 1). The origin of the volcanism in the Azores has long been attributed to plume ridge interactions (e.g. Cannat et al., 1999; Lourenço et al., 1998; Luís et al., 1994; Schilling, 1975; Searle, 1980; Vogt and Jung, 2004; White et al., 1976). The Azores plateau, especially, is generally interpreted as a large igneous province (LIP), formed during a plume-derived episode of enhanced melt production centered on the Mid-Atlantic Ridge (MAR) between 20 and 7 Ma ago (e.g. Cannat et al., 1999; Gente et al., 2003). The plateau roughly has a triangular shape, and is delimited in the south by the prominent East Azores Fracture Zone (EAFZ), a presently inactive transform zone interpreted as the fossil eastern branch of the Azores Triple Junction (ATJ). During the last few Myr, the plate boundary between Eurasia and Nubia has jumped to the Terceira Rift (TR), considered an active hyper-slow spreading oceanic rift (e.g. Vogt and Jung, 2004). The

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