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Hirondelle Basin and Dom João de Castro Seamount in the light of the Azores isotopic zoo (Sr-Nd-Pb-Hf)

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The Azores Archipelago is located at the triple junction between the Eurasia, Nubia and American Plates, and is presently under the influence of the long-lived Azores plume, which also generated the Azores Platform, and affected the processes in the Mid-Atlantic Ridge between the Hayes and the Maxwell Fracture Zones (Ribeiro et al., 2017). The volcanism at the islands and the plateau is affected by a complex tectonic setting, related to the presence of major structures such as the Terceira Rift, extending from São Miguel to Graciosa islands and including Dom João de Castro Bank (DJC, top at 12 m depth) and Hirondelle Basin (circa 3200 m depth). Isotopically, the Azores are renowned for their large isotope inter- and intra-islands variability on several isotopic spaces, resulting in multiple linear trends, which have been interpreted as mixing lines.

Here we present new isotopic (Sr-Nd-Pb-Hf) and geochemical data (whole rock and olivine-hosted melt inclusions) collected on two contiguous sites at the SW-slope of Hirondelle Basin (by dredging and with the ROV Luso) between 3200 and 3000m, and on two sites at DJC NE-flank (recovered with the ROV Luso) at 1170m and 750m, during the preparatory work for the Portuguese Extension of the Continental Shelf Submission. The selected samples for this study show the least evidence of seawater alteration (LOI<2%). Olivine-hosted melt inclusions from DJC and Hirondelle, analyzed using LA-ICP-MS, fall in the same trend determined from whole-rock analyses. Hirondelle and DJC lavas are alkaline (Y/Nb<1) and have comparable Ni and Mg# contents (90-350 ppm and 41-72%, respectively). Hirondelle is more enriched in most incompatible trace elements (e.g. LILE, HFSE and REE) and has higher trace element ratios than DJC.

At odds with the results obtained by Beguelin et al. (2017), new isotopic data on DJC ($^{87}Sr/^{86}Sr \approx 0.70332$, Nd≈5.5, Hf≈7.6, 206Pb/204Pb≈19.82, 207Pb/204Pb≈15.59, 208Pb/204Pb≈39.37) falls within the Azores isotopic signature observed for the central island group, showing that this seamount is also characterized by significant heterogeneity. However, for Hirondelle data two distinct isotopic signatures are observed, one similar to DJC but with slightly lower Pb and Hf isotopic ratios (Hf≈6.3, 206Pb/204Pb≈19.5, 207Pb/204Pb≈15.56, 208Pb/204Pb≈39.1) and another displaying an extreme composition for most isotopic systems: Hf≈1.0, 207Pb/204Pb≈15.47 and 208Pb/204Pb≈38.51.

This allows to attribute to the hypothetical DJC end-member an hypothetical lower radiogenic Hf and 208Pb/204Pb signature. Our data emphasize the role of small-scale mantle heterogeneities in the variability of the Azores lavas. Apart from giving information on the Azores mantle source evolution, these data are also important to constrain processes of magma mixing and migration in the context of this particular tectonic setting.

Béguelin, et al. (2017), Geoch. et Cosmoch, Acta; Ribeiro et al. (2017), Lithos.