

The mantle source and melting conditions below the Revillagigedo Islands, Mexico, based on olivine-hosted melt inclusions: Melting a deep mantle plume?

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The volcanically active Revillagigedo Islands Socorro and San Benedicto are located on the abandoned Mathematician Ridge (3.5 Ma) in the Eastern Pacific off the west coast of Mexico. The alkaline geochemistry of the volcanics and the anomalously high magmatic volumes suggest these islands represent a hotspot locality, but the presence of a deep mantle plume has not been confirmed. Here we present new combined major- and trace element data and Sr-Nd-Pb isotopic compositions on bulk rocks and olivine-hosted melt inclusions to infer the source and melting conditions at this unique tectonic setting. We find that olivine compositions ($\text{Fo}_{76}\text{-Fo}_{86}$) are more primitive than their host lavas and are of antecrystic nature. Alkaline bulk rocks define trends on diagrams of MgO versus SiO_2 , CaO, Al_2O_3 , and K_2O that suggest fractional crystallization of olivine, pyroxene, plagioclase (+/- apatite and spinel). Broad trends between depleted OIB type isotopic compositions and trace element ratios reflect concurrent melting and mixing of melts from a two-component source. The relatively depleted isotopic compositions fit with oceanic basalts from a broad equatorial region including Galapagos, Easter and 'EMORB' East Pacific Rise and Mid-Atlantic Ridge samples. Melt inclusion compositions are significantly more mafic compared to the bulk lavas and do not follow fractional crystallisation trends. The large compositional variability of the melt inclusions suggests that they derive from a locally heterogeneous source, representing mixtures between a relatively depleted parental melt with low- K_2O (<0.1 wt %), Na_2O , TiO_2 , P_2O_5 , Cl and La/Sm, Ba/La, (La-Nb-Th)/Yb ratios and an enriched or high- K_2O parental melt (>1.5 wt.%) with the opposite characteristics. Based on the composition of the melt inclusions we derive temperatures and pressures of melting between 1420 –1490 °C and 21 and 30 kbar, which are elevated compared to MORB. The highest P-T conditions are recorded in the enriched K_2O melts. The seismic structure of the mantle and transition zone discontinuities will be studied and linked to a plate reconstruction, to determine if the melting conditions reflect the presence of a deep seated mantle plume, or not.