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# Melt Generation and Differentiation for Central Atlantic OIB

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Central Atlantic Ocean Island Basalts (OIB) from the Azores, Canaries and Cape Verde have been the subject of detailed U-Th-Ra isotope studies, with over 150 mass spectrometric analyses now available. These islands are all characterised by relatively low buoyancy fluxes compared with Hawaii and Iceland. In the Azores ($^{230}$Th/$^{238}$U) ranges from 1.28 to 1.08, decreasing with increasing $^{87}$Sr/$^{86}$Sr (0.7035-0.7050) and so in part they reflect differences in source compositions (Turner et al., 1997). Nonetheless, the higher ($^{230}$Th/$^{238}$U) values (ave. 1.24 ±0.04) are in the plume-derived basalts (La/Yb = 11-17), closest to the Mid-Atlantic Ridge (MAR), and these are similar to those reported from the adjacent MAR of 1.25 ±0.04 (Bourdon et al., 1996). The recent, less evolved historic lavas from Cape Verde, and Lanzarote and Tenerife in the Canaries have ($^{230}$Th/$^{238}$U) = 1.46-1.13 (ave. 1.21 ±0.07), 1.44-1.04 (ave. 1.17 ±0.09, Thomas et al., 1999) and 1.51-1.09 (ave. 1.29 ±0.12) respectively. La/Yb ratios range from 11 to 38, and there is no general relation between U-Th disequilibria and La/Yb, proximity to the MAR, or the age and thickness of the oceanic lithosphere. In contrast, ($^{230}$Th/$^{238}$U) for Hawaiian OIB = 1.29-1.01, ($^{230}$Th/$^{238}$U) increases with increasing silica undersaturation and La/Yb, and many of the lower ($^{230}$Th/$^{238}$U) values are in rocks with low La/Yb = 4.5-6.5 (Sims et al., 1999).

The increase of ($^{230}$Th/$^{238}$U) with decreasing degrees of melting in the Hawaii OIB has been linked to variable mantle upwelling rates across the mantle plume, with lower melt rates and degrees of melting towards the margins of the plume (Sims et al., 1999). There is a small increase in ($^{230}$Th/$^{238}$U) with increasing La/Yb between the youngest 1730-1736 and the 1824 rocks on Lanzarote, but the shift in ($^{230}$Th/$^{238}$U) (1.15-1.20) is very much less than on Hawaii. In contrast, some of the higher ($^{230}$Th/$^{238}$U) values in the Atlantic basalts are in the plume-derived Azores OIB, and MORB from the adjacent MAR, whilst the higher La/Yb rocks from Lanzarote and Cape Verde tend to have lower ($^{230}$Th/$^{238}$U). Such shifts to lower ($^{230}$Th/$^{238}$U) with increasing La/Yb in the Central Atlantic OIB appear to be primarily due to changes in source regions, which locally affect the processes of partial melting. In the Azores ($^{226}$Ra/$^{230}$Th) = 0.8-2.1, and the lower values are in rocks from Sao Miguel which have low ($^{230}$Th/$^{238}$U) and have been attributed to enriched source regions with higher volatile contents that resulted in higher rates of melting (Turner et al., 1997). Similar low ($^{230}$Th/$^{238}$U) in the high-MgO 1730-36 rocks on Lanzarote have been modelled by dynamic melting in a low buoyancy plume with long matrix transfer times of up to 800 ky and a relatively constant upwelling rate (unlike Hawaii). There is a striking increase in ($^{226}$Ra/$^{230}$Th), ranging from 1.34-1.59, with increasing rather than decreasing degrees of melting. This may in large part reflect the time scales of melt extraction under such ocean islands, consistent with models in which smaller degree melts are extracted from greater depths in the melt column, and take longer to reach the surface. The dunite xenoliths from the 1730-36 eruption on Lanzarote have high ($^{230}$Th/$^{238}$U) (1.61-1.65) relative to their host rocks (1.05-1.44), inferring a rapid ascent from the mantle.

On Tenerife the time scales of differentiation from basanite to phonolite in the Teide-Pico Complex is ~200,000 years, highlighting how the amounts and time scales of differentiation are very different in areas of low magma supply. Finally, the low ($^{230}$Th/$^{238}$U) in the Cape Verde, relative to the MAR, is attributed to the greater involvement of lithosphere source regions which in turns modify the processes of partial melting. Overall, there is a negative array between Ce/Yb and $SiO_2$ highlighting the general link between the depths and degrees of melting in Atlantic OIB, and evidence for greater mean depths of melting under thicker oceanic lithosphere. However, for OIB associated with low buoyancy plumes the primary controls on ($^{230}$Th/$^{238}$U) appear to be source composition and the depths of melt extraction.

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