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Deep mantle recycling of atmospheric Neon: evidence from Terceira lavas (Azores hotspot)

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The huge amount of crustal materials recycled back to the mantle has influenced significantly the composition of this reservoir throughout the Earth's history. However, subduction zones have been considered a barrier impeding the recycling of noble gases to the mantle. In this perspective the atmospheric component commonly present in oceanic basalts is usually interpreted as a consequence of magma contamination by air or seawater during magma ascent/emplacement. This is, for example, the interpretation given to linear trends obtained in the three-Ne isotopic diagram. Nevertheless, it has been recently claimed for the role of deep recycling of atmospheric components to the composition of magmatic noble gases [1,2,3].

Terceira island (Azores) give us additional evidence for atmospheric signatures of magmas imprinted by recycling processes. The analysis of inclusions trapped in olivines from the Santa Bárbara volcanic system invariably revealed Ne isotopic compositions similar to air. From barometric studies, olivine crystallization depths are estimated to have occurred deeper than the Moho ([U+F0BB] 12 km) precluding the existence of direct atmospheric contamination on the magma sampled by melt inclusions. Alternatively we argue for a recycled origin of atmospheric Ne in these lavas characterized by a HIMU character (206Pb/204Pb up to 20.02) [4] and consequently having a composition reflecting a relatively ancient event of oceanic crust recycling. Interestingly, the trend observed in the three-Ne isotopic diagram for some of the Fissural volcanic system lavas reflect the contribution of a reservoir characterized by low time-integrated (U+Th)/ 22Ne reflecting a deep origin for the Azores mantle plume [(21Ne/22Ne)corr = 0.052]. We propose that these lavas come from ancient recycled mantle lithosphere with only a minor contribution from the overlying altered oceanic crust, thus making possible the identification of the lower mantle signal. This hypothesis is supported by the low radiogenic Os ratios determined in Fissural lavas from Terceira [5].

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