Geochemical fluxes associated to the Betic subduction (Spain): Helium isotopic analyses of mantle xenoliths

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Mantle xenoliths collected in the Iberian Peninsula provide clues on the geochemical processes induced by the Tertiary subduction that ultimately lead to Betic Cordillera. We investigated two distinct suites of mantle xenoliths collected in a) the volcano of Tallante (TL; Pliocene) within the mentioned orogenic belt and b) the Calatrava volcanic field (CLV; Miocene-Quaternary) that is located in the neighbouring foreland, providing new $^{3}He/^{4}He$ and $^{40}Ar/^{36}Ar$ data carried out on olivine and orthopyroxene crystals. As concerns the ultrafemic xenoliths from TL, ten analyses have been carried out on samples that on the basis of petrographic, geochemical and isotopic reveal a metasomatic signature induced by continental crust component recycled back in the mantle via subduction. As concerns the CLV xenoliths, six analyses have been performed on lherzolites characterized by a Fe-Ti enrichment and Sr-Nd isotopic composition resembling that of the HIMU mantle end-member; this appears to be the ubiquitous isotopic fingerprint in most of the European and Mediterranean volcanic district. The $^{40}Ar/^{36}Ar$ ratio does not display values higher than 560 in both CLV and TL, testifying that Ar isotopes has been affected by air contamination. However, TL samples despite reaching $^{40}Ar/^{36}Ar$ higher than CLV, display maximum $^{3}He/^{4}He$ (5.6 Ra) lower than that recorded in the CLV lherzolites (6.5 Ra). The $^{3}He/^{4}He$ values in the TL ultrafemic xenoliths are slightly lower than those recorded in mantle xenoliths suites from other European volcanic districts. Such low values have been observed also in samples previously assumed as unmetasomatized, possibly suggesting that the $^{3}He/^{4}He$ is a more sensitive tracer of subduction related fluids respect to the lithophile elements. The maximum $^{3}He/^{4}He$ values measured in CLV xenoliths match those reported in many other European/Mediterranean mantle xenoliths characterized by HIMU affinity; this signature is generally interpreted as the result of long-term recycling of oceanic basalts, suggesting that sublithospheric convective instabilities (triggered by the neighbouring Betic subduction) could have remobilized deep mantle domains which interacted with remnants of ancient subducted slabs.

Circulation in the North Atlantic during the Late Cretaceous based on Nd isotopes

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Nd isotopic values derived from Albian to latest Cretaceous fossil fish teeth and debris from a depth transect of four sites ranging from ~600 to 1500 m water depth on Demerara Rise in the tropical North Atlantic record the presence of an intermediate water mass characterized by very low ε_{Nd} values (-14 to -18). These values are markedly lower than contemporary values from other sites in the North Atlantic, including a deep water site in Cape Verde Basin, also located in the tropical North Atlantic. Low values at Demerara are interrupted by positive excursions of 4 and 8 ε_{Nd} units at the mid Cenomanian event and oceanic anoxic event 2 (OAE2), respectively, and there is a permanent transition to values more typical of the Cenozoic North Atlantic from the late Masstrictian into the early Danian.

We interpret the low ε_{Nd} values to represent long-term formation of locally-derived intermediate waters influenced by nonradiogenic runoff from the neighbouring Guyana Shield. Absence of this signal in Cape Verde Basin and elsewhere in the North Atlantic suggests this water mass is limited to intermediate depths and the Demerara region.

During OAE2, Nd isotopic values on Demerara Rise approach values recorded throughout the North Atlantic, suggesting a temporary shutdown of local intermediate water formation and enhanced mixing within the North Atlantic basin. A similar process could explain the mid-Cenomanian excursion, although that shift did not affect all sites. Finally, the shift during the Maastrichtian suggests local intermediate water formation ended around the time of a pulse of extinction among inoceromid bivalves, regional warming and proposed reorganization of North Atlantic circulation.