Heavy oxygen recycled into lithospheric mantle

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Evidences for continental crust recyceld into the mantle are often elusive and poorly constrained. Exotic millimetre/centimetre-sized siliceous veinlets likely originated from crustal partial melts injected into the supra-subduction mantle wedge were found found in peridotite xenoliths from the Betic cordillera, SE Spain. They are made of orthopyroxene and plagioclase (± quartz ± amphibole/phlogopite), that show highest $\delta^{18}O$ values so far measured in mantle phases ($\delta^{18}O_{opx}$ = +9.8‰, $\delta^{18}O_{pl}$ = +10.6‰). These extreme oxygen isotope compositions, coupled with high $^{87}Sr/^{86}Sr$ ratios constrain the crustal nature of the veinlets.

Metasomatic reactions between peridotite and silica-rich partial melts produced chemical and modal variations in the primary mineral assemblage. As a result, mantle xenoliths were enriched in silica and replacive harzburgite were formed.

The metasomatic minerals underwent little oxygen isotope re-equilibration through diffusion with the surrounding primary mantle phases. The lack of complete isotope re-equilibration indicates that entrapment of the xenolith in the basaltic carrier (< 5 Ma) occurred shortly after the metasomatic process. It follows that mantle metasomatism continues even after the end of oceanic subduction, during continental collision.

Diffusion-based calculations of oxygen isotope variability within and among xenoliths provide insights on the extent a ^{18}O-enriched crustal signature can be preserved at mantle conditions. A “benchmark” O-isotope composition for post-orogenic magmas is derived. This can in turn be used to assess the possible occurrence of recent mantle enrichment, or the effects of assimilation of continental crust during magma ascent to the surface.