

The role of ultramafic veins in mafic alkaline magmatism: Contrary evidence from continental intra-plate settings

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Continental and oceanic mafic alkaline magmas have comparable major and trace element compositions that point towards similar P-T and volatile conditions during partial melting of their upper mantle source regions. While it is now widely accepted that OIB source regions must contain small amounts of recycled mafic components that contribute disproportionately to the magmatism, the geochemical and isotopic heterogeneity of equivalent magmas beneath continental interiors are more commonly explained by the contribution of partial melts of ultramafic veins at the base of the lithosphere. Vein-style metasomatism has also been suggested to explain the isotopic heterogeneity observed in OIBs formed on thick oceanic lithosphere, such that recycling of oceanic crust may not be the dominant source of mantle heterogeneity [1].

We analysed a suite of Mesozoic primitive mafic alkaline basalts and Permian alkaline lamprophyres from southern Sweden (Baltic Shield) for their major and trace element, and Sr-Nd-Hf-Pb isotope compositions. Although the Mesozoic alkaline basalts exhibit trace element features typically ascribed to melting of hydrous potassic phases within the mantle lithosphere, relatively homogeneous, moderately depleted radiogenic isotope compositions argue against derivation from old vein-metasomatized lithosphere. Isotopic modelling of hydrous metasomatic veins (represented by the Permian lamprophyres) potentially introduced to the lithospheric mantle beneath the Baltic Shield during Permo-Carboniferous plume magmatism suggests that such vein material, if it persisted to the Mesozoic, did not play a role in later mafic alkaline magmatism. In contrast, our data show that low-volume alkaline basaltic magmas beneath a thick continental lid 'oversampled' recycled oceanic crust from an otherwise highly depleted convecting upper mantle, similar to OIBs and E-MORBs.

[1] Pilet *et al.* (2008). *Science* **320**, 916 – 919.

Wintertime nitrate isotope dynamics in the Atlantic Sector of the Southern Ocean

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We provide the first data on the wintertime patterns of seawater nitrate isotopes (¹⁵N/¹⁴N and ¹⁸O/¹⁶O) for the region south of Africa. Water column profile and underway surface samples collected in July 2012 span a range of latitudes from the subtropics to 57.8°S, just beyond the Antarctic winter sea-ice edge (56.7°S). The data are used in the context of simple models of nitrate consumption (including the Rayleigh model) to estimate the isotope effect (the degree of isotope discrimination) associated with the assimilation of nitrate by phytoplankton. Within the Antarctic, application of the Rayleigh model to depth profile N isotope data yields lower isotope effect estimates than are derived from the spatial variations within the mixed layer (the latter yielding isotope effect estimates near the commonly observed value of 5‰). The data from the Subantarctic Zone, both profiles and surface variations, also yield markedly low estimates for the assimilation isotope effect when analysed with the Rayleigh model. Similar behaviour observed in the N and O isotopes of nitrate suggest that the isotope effect is underestimated by the Rayleigh model due to mixing of waters across a wide range of nitrate concentrations in this more northern domain of the Southern Ocean. The nitrate N-to-O isotope relationship (i.e. Δ(15-18), defined as δ¹⁵N-δ¹⁸O) is remarkably uniform across the entire sampled Southern Ocean surface; however, there is a measurable Δ(15-18) difference between the surface mixed layer and the underlying deep water. The significance of these observations will be presented.