B and O isotopes as tracers of serpentinization along fossil oceanic detachments, Troodos ophiolite, Cyprus

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Serpentine lubricated detachment faults strike parallel to two segments of a paleo spreading center that are separated by the Arakapas transform in the Troodos ophiolite, Cyprus. To the north of the transform, serpentinite faulted against gabbro shows bimodal spatial distribution and covariance of B-O isotope ratios. These data indicate overprinting of fault localized, 'high temperature' oceanic serpentinization ($\delta^{18}O$=4 to 6‰; $\delta^{11}B$=-3 to 3‰) by widespread late hydration at lower temperatures, forming abundant chrysotile veins ($\delta^{18}O$=10 to 12‰; $\delta^{11}B$=7 to 13‰). At the Limassol Forest complex, south of the transform, extensive talc-amphibole-chlorite metasomatic zones and rodingitized gabbro boudins occur within strongly foliated serpentinite shear-zones separating an ultramafic section from sheeted dykes. $\delta^{18}O$ values of serpentine from shear-zones in the Limassol Forest have a narrow range and are invariably lower than mantle values(1 to 5.7‰; n=26), consistent with serpentinization during seafloor spreading. $\delta^{11}B$ (Srp) values are more scattered (5 to 27‰) and weakly correlate with boron contents (2 to 60 ppm), which might be accounted for by increase in pH of water as serpentinization progressed.

Absence of the lower crustal section above the mantle and injection of gabbroic magma followed by localized serpentinization, metasomatism and deformation along this discontinuity are major characteristics of oceanic detachments. Isotope systematics strongly resemble those of serpentine recovered from modern oceanic core complexes such as the Atlantis Massif. The mantle sequence of the Limassol Forest is thus suggested to have been exhumed at the footwall of an oceanic core complex. This scenario sheds light on the location of the spreading axis south of the transform and explains the highly complicated structure of the fossil ridge-transform intersection of the Limassol Forest.

Origins of anomalous ridge magmatism near Jan Mayen

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The sustained volcanism at Jan Mayen Island, located immediately south of a major fracture zone (the Jan Mayen Fracture Zone) and adjacent to two slow-spreading mid-ocean ridges (the Kolbeinsey and Mohns Ridges), has been variably ascribed to a small, isolated plume, to material siphoned northward off the larger Icelandic plume, to convection-driven edge effects along a major compositional mantle discontinuity, and to the presence of highly fusable, wet, old, garnet-bearing material derived from veins or pockets of rift-faulted or delaminated Greenland sub-continental lithospheric mantle. The compositions of volcanic rocks from both Jan Mayen Island and the immediately adjacent segments of the Mohns and Kolbeinsey Ridges likewise support the long-term presence of mantle rocks enriched in incompatible elements. While the most recent work on long-lived radiogenic isotope compositions of Jan Mayen Island magmas has supported a complex model invoking several of the above scenarios of melting, no high-resolution sampling and analysis existed for the adjacent ridge segments.

We present geochemical data for new, precisely bathymetrically located volcanic samples from the Northern Kolbeinsey and Southern Mohns segments. Preliminary geochemical and bathymetric findings suggest that both segments host long-lived, localized sources of increased magma flux associated with the most geochemically enriched melt compositions hosted by those ridge segments, which decrease in indicators of geochemical enrichment with distance from Jan Mayen Island. The surface expressions of this high magma supply include large volcanic edifices straddling the axial valleys and walls, as well as evidence for ridge axis relocations in the direction of Jan Mayen Island. This supports a sustained point source of geochemically enriched magmatic activity beneath the region, consistent with a deep-seated mantle plume.

We further provide new U-series isotopic data for all three geographic areas, which place constraints on mantle source compositions and upwelling rates beneath the region.

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