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Composition of slab-derived fluid modulated by interaction with subducted metasedimentary rocks

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Serpentinized slab interior has been proposed to be an important carrier of water to the subarc mantle. The characteristic enrichment of heavy Mg in arc magmas is commonly interpreted as a slab serpentinite derived component owing to its high Mg content and δ^{26}Mg. However, fluid-rock interaction between different lithologies within the subducting slab may drastically alter the chemical and isotopic signatures delivered to the source of arc magmas.

Here, we report Mg isotopic composition of metapelites altered to varying degrees, in contact with meta-ultramafic mélange matrix from Syros, Greece [1]. The ultramafic mélange matrix is highly enriched in light Mg (−1.02 ± 0.06‰), and the least altered metapelites have δ^{26}Mg (−0.21 ± 0 .06‰, n=2) comparable to modern subducting terrigenous sediments. The Mg isotopic composition of the altered metapelite varies systematically between these two endmembers ranging from −0.87 to −0.53 proximal to distal to the contact. Mass balance calculation suggests that while more Mg is deposited during alteration closer to the contact, the 'un-mixed' secondary Mg component is progressively more enriched in light Mg further away from the contact. Fluid-rock interaction models show that while Rayleigh fractionation during precipitation of secondary Mg-bearing minerals might have contributed, kinetic fractionation induced by diffusion is required to account for the systematic variation measured in Mg content and isotopic composition. Our study shows that while substantial Mg may be liberated during dehydration of ultramafic lithologies, interaction with Mg-poor metasedimentary rocks could alter the Mg isotopic composition of such fluid drastically or effectively hinder any serpentinite derived Mg isotopic signature to be delivered to the source of arc magmas. Although Mg isotopic composition of arc magmas cannot be interpreted as evidence, slab interior serpentinite might still be an important contributor to the water budget of arc magmatism.

[1] Breeding, C. M. *et al. (2004), Geology 32, 1041-1044.*