

## Effects of Louisville seamount subduction: Geochemical evidence from central Tonga-Kermadec arc volcanoes

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Alkaline Louisville seamount lavas and volcanoclastics were subducted beneath the Tonga arc since ~4 Ma, while the locus of seamount-arc intersection moved southward with time. Presently, Louisville material is subducting beneath the northern Kermadec/southern Tonga arc nearby the arc volcanoes Monowai, 'U', 'V'. Basalts recovered from all three volcanoes during the NZAPLUME III expedition show MORB-type REE patterns with enrichments of LILE and negative Nb anomalies. Lavas from Ata Island (located ~250 km N of 'V') however have higher La/Sm, Sm/Yb (and Th/Yb) than lavas from Monowai, 'U' and 'V', suggesting the input of fluid-immobile elements, such as LREE, MREE and Th from the slab into the mantle wedge beneath Ata Island. Conversely more radiogenic Sr and Pb isotopic compositions are found in lavas from volcano 'U' and 'V', consistent with input of fluid-transported Sr and Pb from subducted Louisville material beneath these volcanoes. Because dehydration of the slab requires lower temperatures than melting, we suggest that both the higher fluid-immobile, more to less incompatible element ratios (and slightly lower <sup>143</sup>Nd/<sup>144</sup>Nd) in the Ata Island lavas, and the higher Sr and Pb isotopic composition in the 'U' and 'V' lavas may reflect the influence of subducting Louisville material transported to the mantle wedge via aqueous fluids and hydrous melts and/or bulk mixing at different locations and times.

[1] Turner, S.P. *et al.* (1997) *Geochimica et Cosmochimica Acta* **61**, 4855–4884.

## A paradox between Mg and Li isotope ratios during weathering

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The sources and processes that release mineral-bound (Mg) to solute Mg during chemical weathering are surprisingly under-constrained, but are critical for a complete understanding and quantification of its global biogeochemical cycle and chemical weathering. Magnesium isotope ratios (<sup>26</sup>Mg/<sup>24</sup>Mg expressed as δ<sup>26</sup>Mg) in the river waters of the Mackenzie basin show in excess of 1‰ variability. In suspended sediments δ<sup>26</sup>Mg values show in excess of 3‰ variation and correlate with the Ca/Mg ratio, a strong indication that the rock composition is controlled by a mixture of carbonate and silicate minerals. Riverine δ<sup>26</sup>Mg values do not show the same control. Rather, they show coherent trends suggesting that Mg isotopes are more likely controlled by process-related fractionation. In particular, we highlight a linear positive covariation (R<sup>2</sup>=0.81) between Li (<sup>7</sup>Li/<sup>6</sup>Li) and Mg isotope ratios in the rivers waters of the Mackenzie Basin and in four of the world's largest rivers. This is therefore representative of the average processes occurring at a global scale. Li is not present in appreciable quantities in carbonate rocks, but Mg can be. Therefore Mg isotope ratios are not being dominated by processes linked to carbonate dissolution. Li isotopes have often been interpreted in term of process controlled fractionation linked to silicate weathering and clay and previous work has demonstrated that during weathering, Mg and Li isotopes show opposite discrimination. Waters are often enriched in the light isotope of Mg and the heavy isotope of Li compared to the rocks they drain. The data present a paradox because any covariation between <sup>7</sup>Li/<sup>6</sup>Li and <sup>26</sup>Mg/<sup>24</sup>Mg would be anticipated to show a negative slope, rather than the positive slope observed. This paradox could be very simply resolved by interpreting the isotopic compositions as mixtures of different water bodies (such as groundwaters and surface waters for example) but this is not supported by concomitant variation in Mg/Li ratios. Modelling results show that the co-variation is more likely related to fractionation linked to clays. Coupled modelling of Mg and Li enables both the fractionation factors associated with such processes to be estimated, and the proportion of Mg that is incorporated into secondary phases, enhancing our current understanding of solute Mg at spatial scales from the critical zone to the continental scale rivers.