Drying and dying of a subducted slab: Li and B isotopes in Western Anatolia Cenozoic Volcanism

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The transfer of the light elements Li and B from solid to fluid phases is accompanied by isotopic fractionation, with the heavier isotopes (^{7}Li and ^{11}B) concentrated in fluid phases. In the context of subduction, low-temperature fluids released from slabs are strongly enriched in both ^{7}Li and ^{11}B, and progressive dehydration of slabs releases fluids with lower and lower δ^{7}Li and δ^{11}B. Interestingly, Li isotopes in most arc lavas show modest variation and are similar to MORB values, while δ^{11}B shows remarkable variability.

Western Anatolia orogenic magmatism took place during the Neogene in an extensional but subduction-related context and shifted over time from calc-alcaline to shoshonitic to ultrapotassic in character. From Late Miocene onward OIB-type magmas occurred, and the transition from orogenic to intraplate products is marked by eruptions of mildly alkaline K-rich basalts. Values of δ^{7}Li for calc-alkaline lavas vary widely (from +8 to -4 ‰) while younger ultrapotassic lavas show overall lighter δ^{7}Li, partially overlapping the values of calc-alkaline rocks (+3 to -7 ‰). The variations observed in the calc-alkaline/U-K association are positively correlated with δ^{11}B (varying between 0 and -15‰) and with ^{87}Sr/^{86}Sr (0.70866-0.70720). These data fit a model in which both Li and B isotopes are fractionated during progressive slab dehydration, and the geodynamic setting of the study area leads to melting of a supra-slab mantle that records this ^{7}Li depletion. In this model, U-K magmatism originates via melting a mantle metasomatized by residual fluids coming from a dying slab. Pleistocene OIB-type Na-alkali basalts are characterized by δ^{7}Li $\approx$ +3 ‰ and δ^{11}B $\approx$ -2 ‰. Late Miocene potassic basalts have comparable δ^{7}Li, but their δ^{11}B varies from -13 to -4 ‰. The B isotope systematics of these lavas have been explained via melting of sub-slab mantle modified by small amounts of residual slab derived fluids [1]. The decoupling of B and Li isotopes in K-basalts may result from markedly different B and Li mantle contents. The mantle is essentially bereft of B (<<0.1 ppm), but contains significant Li (1-2 ppm), so that small slab fluid additions cannot shift Li isotopic compositions, but will significantly modify δ^{11}B.

References

[1] Tonarini S., Agostini S., Innocenti F., and Manetti P. (2005) *Terra Nova* **17,** 259-264.