Role of the Overriding Plate in Arc Magma Evolution

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The systematics of ^{10}Be global magmatic variations are incontrovertible evidence for the critical role of sedimentary components of the subducted lithosphere in arc magma genesis. More generally, distinctive trace element fractionations (high U/Nb, low Ce/Pb) only found in supra-subduction zone magma types, coupled with regional variations correlative with distinctive subducted litholgies and isotopic trends (particularly Pb) are all attributed to dominance of “fluid”-residual slab fractionations in establishing the *subduction zone signature* of arc magmas. However, there is also unequivocal evidence that the overriding plate can be an important component in establishing this signature. For example, the early claim that high Ni and Cr of andesites from Papua precluded a fractional crystallisation derivation from similarly endowed basalts [1] was subsequently demonstrated to result from crustal contamination of andesite by harzburgite of the Papuan Ultramafic Belt [2]. Even erstwhile primary/primitive peridotite-xenolith-bearing alkali basalts of Grenada in the Lesser Antilles contain crustal xenocrysts of quartz [3]. Contamination in these cases is spectacularly obvious, may be subtle and ubiquitous in others, but clearly cannot be ignored. Specific studies have “isolated the variable” by study of along-strike overriding plate contrasts in the Japan-Kurile arc system; in the case of Honshu, clear-cut variation in Pb isotopic systematics are coincident with lithosphere-penetrating, terrane-bounding faults [4]. In this case, the notion that all of the Pb contributing to low Ce/Pb of the Honshu magmas is overwhelmingly from the subducting Pacific Plate is clearly erroneous. One of the intriguing aspects of the Japan case is whether the locus of geochemical imprint is strictly confined to the overriding plate, or whether some conversion of lithosphere to advecting wedge asthenosphere is occurring during evolution of the Japanese arc system.

References

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