# Controls on the He-C systematics of the Izu-Bonin-Marianas (IBM) subduction zone

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We report He-$CO_2$ isotopic and relative abundance characteristics of geothermal fluids (geothermal wells, fumaroles, hot springs) collected from the IBM subduction zone. South of the Ogasawara Plateau, we sampled the islands of Uracas, Agrigan, Pagan and Alamagan in the Mariana Arc whereas north of the plateau we sampled the volcanoes Oshima, Niijima, Shikinajima, Hachijojima and Aogashima in the Izu Islands.

Of 29 localities sampled along the strike of the arc, a total of 10 Izu and 2 Marianas have $^3He/^4He$ > 5-6 $R_A$ (where $R_A$ = air $^3He/^4He$) and thus are free of major air or crustal contamination. The 2 Mariana localities have near identical $CO_2/^3He$ (1.5 x $10^{10}$) and $\delta^{13}C$ (-0.5‰) values and are similar to other arc volcanoes worldwide [1]. Adopting endmember He-C compositions of [2] then ~87% of the $CO_2$ in the southern IBM is slab-derived. In contrast, $CO_2/^3He$ values for the Izu Islands are unusual: 7 out of 10 locations have values < $10^{10}$. Furthermore, $\delta^{13}C$ values are highly variable (-2 to +2 ‰). In this region, carbonate-rich guyots are less common than in the southern IBM and chert and pelagic clays dominate [3]. Assuming elemental fractionation associated with degassing is negligible, the data preclude simple modeling of slab-derived $CO_2$ contributions with fixed endmember compositions. However, the subducting slab remains the principal source of $CO_2$ for all reasonable ranges in endmember compositions.

The IBM results, together with data from other subduction zones (e.g. Central America, Philippines), allow first-order deductions to be made on the relative effects of various subduction zone forcing functions. Sediment composition appears to be the dominant control on output volatile characteristics as opposed to slab dip (length of melting column), thermal structure of down-going plate or thickness of over-riding crust. Significantly, the He-C systematics are immune to the presence of sediment fluid vs. melt involvement in the source [4].

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[3] Stern et al., Geophys. Monograph (2003)
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