Carbon recycling efficiency in the Lesser Antilles

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Among the world major convergent margins, the Lesser Antilles is unique in extremely low convergence rate (2-4 mm/year) and not too old oceanic crust (80 to 105 Ma [1]). Such a setting may facilitate partial melting of subducted sediments in the arc depths and promote return of slab volatile components back to the surface via arc volcanism. A number of volatile components, such as noble gases and CO_2, released by the Lesser Antilles arc volcanoes indeed contain significant slab contributions [2-4]. One remaining question is how efficient the slab volatiles can be recycled through the arc or how much the slab volatiles can survive arc magmatism and be further subducted to deeper mantle.

As a first step to address this question, here, we constrain the input fluxes of sedimentary carbon (C) and nitrogen (N) based on the analyses of C and N concentrations and isotope compositions of drill core samples from DSDP Sites 543 and 144 entering the middle and southern Lesser Antilles trenches, respectively. The results indicate that the subducting sediments contribute 3.7-7.4×10^6 g·yr^{-1}·km^{-1} organic C with weight average $\delta^{13}C$ value of -24.4‰, 1.9-3.8×10^7 g·yr^{-1}·km^{-1} inorganic C (as carbonate) with weight average $\delta^{13}C$ value of 2.0‰, and 3.7-7.4×10^6 g·yr^{-1}·km^{-1} fixed N with weight average $\delta^{15}N$ value of 5.4‰. These result in an input of 5.7-11.4×10^9 g·yr^{-1} total C with weight average $\delta^{13}C$ value of -2.3‰ into the 250 km middle Lesser Antilles subduction zone (from Guadeloupe to Martinique), which is currently the most volcanically active part in the Lesser Antilles. So far, C output flux has only been determined for Guadeloupe with an estimate of 1.2×10^9 g·yr^{-1} [4], in which ~70% is from slab based on C isotope compositions. Accordingly, the recycled C in Guadeloupe accounts for 9-18% of the total C input by sediments. This number would decrease significantly if take into account the inorganic C in oceanic crust, which is currently under investigation. The C output flux in another active volcano, Dominica, is not available yet but another important component to be determined for a better constraint on the C recycling efficiency in the middle Lesser Antilles.

[1 Carpentier, M., et al. (2008) *Earth Planet. Sci. Lett.* **272**, 199-211; [2] Van Soest, M.C., et al. (1998) *Geochim. Cosmochim. Acta* **62**, 3323-3335; [3] Ruzié, L., et al. (2013) *Chem. Geol.* **359**, 70-80; [4] Allard, P., et al. (2014) *Chem. Geol.* **384**, 76-93.