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Carbon transfers in tropical stream water in a volcanic context: examples of a hot spot island (Reunion Island) and two subduction arc islands (Guadeloupe and Martinique, French Lesser Antilles)

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At long-time scales, the global cycle of CO_2 is controlled by chemical denudation of rocks. One way to evaluate the CO_2 consumption rate by chemical weathering is to consider bicarbonate concentrations. However, transfers of carbon in rivers are poorly constrained both for the sources of carbon and processes that may affect dissolved inorganic carbon (DIC), for example CO_2 degassing, carbonate precipitation or dissolution, photosynthesis, organic matter decay.

In order to better investigate the carbon behaviour in rivers, we have used $\delta^{13}C_{DIC}$ as a source and processes tracer. Because basaltic areas have high chemical weathering rates comparatively to other silicate places, we have focus our study on basaltic/andesitic-like single-lithology areas with no sedimentary carbonates (Guadeloupe and Martinique Islands, and Reunion Island). These tropical islands have important rainfall, thick soils and sharp relief, which induced high weathering rates (Rad et al, 2005). Main streams, vegetation and soil solutions were sampled.

The $\delta^{13}C_{DIC}$ of the sampled streams ranges from –19.6 ‰ to -5.2 ‰, with DIC ranging from 110 to 2540 μM. In absence of carbonate rocks, potential sources of carbon in these streams are atmospheric CO_2 ($\delta^{13}C_{CO2}$= -7.7 ‰), organic matter ($\delta^{13}C_{OM}$ = -29 ‰), and magmatic CO_2 ($\delta^{13}C_{CO2}$= -3.5 ‰). The Reunion Island data show a quite different $\delta^{13}C_{DIC}$ vs. DIC trend from that of the Antilles Islands. The Reunion trend can be mainly explained by a mixing between soil solutions (carbon from

organic matter) and magmatic CO_2. This influence of magmatic contribution is confirmed by major elements like Mg/Na vs. Ca/Na (Louvat, 1997 and Rad et al., 2005), and the $\delta^{13}C_{DIC}$ vs DIC allows us to estimate the different contributions of magmatic/organic sources in absence of other processes. Moreover, a variable degassing of dissolved CO_2 from waters is likely to occur in addition of mixing, more in Lesser Antilles than in Reunion Island (profile of river shows lower $\delta^{13}C_{DIC}$atthe source of the river). This behaviour of DIC should be considered for recalculation of CO_2 consumption rate by chemical weathering.

References:

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