Recycled nitrogen fixed in arc lavas

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The study of nitrogen recycling efficiency in the arc has been focused on the comparison between the input from the subducting slab and the output by volcanic degassing. Although arc vocanic rocks have been demonstrated to retain a variety of recyled slab components, the recycled nitrogen fixed in arc volcanic rocks has not been assessed yet. Here, we examined the fixed nitrogen in the rocks from Kick'em Jenny (KEJ), a submarine arc volcano in the southern Lesser Antilles, which has very little crustal assimilation during magma ascending.

The results show that the KEJ volcanic rocks contain 6-26 ppm (with one sample containing 230 ppm) fixed nitrogen with a $\delta^{15}N$ range between -1.7‰ and +8.9‰. A negative trend between nitrogen concentrations and $\delta^{15}N$ values was observed and can be explained by surface nitrogen contamintion (from sediments and/or organisms) on a magmatic nitrogen source with low nitrogen concentration (~2 ppm) but a high $\delta^{15}N$ value greater than +6‰. This magmatic value is distinct to the mantle value (-5‰) but consistent with slightly elevated value of the subducting slab (+5.6‰ for seafloor sediments and +3.3‰ for AOC from DSDP Leg 78 Site 543) as a result of metamorphic devolatilization. Thus, the high $\delta^{15}N$ value of the magmatic endmember in the studied samples implies that recycled slab nitrogen overwhelmed the mantle nitrogen in the KEJ magma source.

Notwithstanding that large amount of recycled nitrogen would be emitted as N_2 in the arc by volcanic degassing, our results show that significant amount of recycled nitrogen can be fixed in the volcanic rock body and has not been revealed. This omissive reservoir needs be considered to refine the modeling of nitrogen cycling across subduction zones.