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Halogen content in Lesser Antilles arc volcanic rocks : exploring subduction recycling

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Halogens (F, Cl, Br and I) are strongly reactive volatile elements which can be used as tracers of igneous processes, through mantle melting, magma differentiation and degassing or crustal material recycling into mantle at subduction zones. Cl, Br and I are higly incompatible during partial melting or fractional cristallization and strongly depleted in melts by H_2O degassing, which means that no Cl-Br-I fractionation is expected through magmatic differenciation [current thesis]. Thus, Cl/Br/I ratios in lavas reflect the halogen content of their mantle sources. Whereas these ratios seemed quite constant (e.g. Cl/Br =300 as seawater), recent works suggest significant variations in arc volcanism [1,2].
In this work we provide high-precision halogen measurements in volcanic rocks from the recent activity of the Lesser Antilles arc (Montserrat, Martinique, Guadeloupe, Dominique). Halogen contents of powdered samples were determined through extraction in solution by pyrohydrolysis and analysed by Ion Chromatography for F and Cl and high performance ICP-MS (Agilent 8800 Tripe Quad) for Cl, Br and I [3,4]. We show that lavas - and mantle sources - display significant vraiations in Cl/Br/I ratios along the Lesser Antilles arc. These variations are compared with Pb, Nd and Sr isotopes and fluid-mobile elements (Ba, U, Sr, Pb etc.) compositions which vary along the arc from a nothern ordinary arc compositions to a southern ‘crustal-like’ composition [5,6]. These characteristics are attributed to subducted sediments recycling into the mantle wedge, whose contribution vary along the arc from north to south [7,8]. The proportion of added sediments is also related to the distance to the trench as sediment melting and slab dehydration may occur depending on the slab depth [9].
Further Cl-Br-I in situ measurements by LA-ICP-MS in Lesser Antilles arc lavas melt inclusions will be performed, in order to provide better constraints on the deep halogen recycling cycle from crust to mantle.

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