Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.15852

Architecture of the Lesser Antilles arc illustrated by melt inclusions

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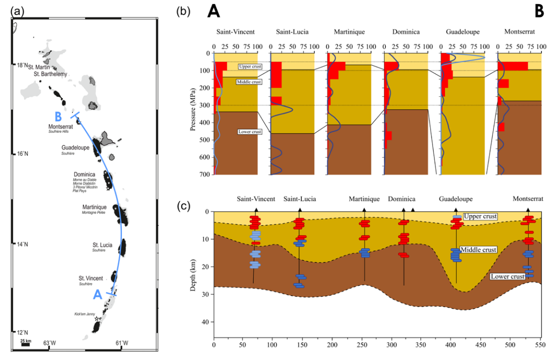

Volatiles are an essential aspect of subduction zones and constraining their cycling through subduction zones is of prime importance to better understand the genesis, transport, storage and eruption of arc magmas. Here we performed an along-arc investigation of the chemical composition of melt inclusions trapped in minerals representative of ten volcanic centers and 23 key explosive eruptions along the presently active Lesser Antilles arc, from Montserrat in the North to St. Vincent in the South. We use the melt inclusion compositions to reconstruct pre-eruptive conditions, that highlight how the magma plumbing system is organized. All major and selected trace elements and volatiles (H_2O, CO_2, S, halogens (F, Cl, Br)) have been measured on the same melt inclusions when possible. Eruptions dominantly involved andesitic to dacitic magmas (Montserrat, Guadeloupe, Dominica, Martinique, St. Lucia) and basaltic andesite magmas from St. Vincent.

Melt inclusions have been used as pressure probes for magmas, for inferring crustal equilibration pressures. We shed light on the systematic occurrence and lateral complexity of a vertical transcrustal magmatic systems feeding active volcanoes. The geochemical view of the architecture of the plumbing system and in particular the Moho's depth is more variable than the view obtained by seismic data along the Lesser Antilles arc. We propose that the discontinuity between the upper and the middle crust is a major magma ponding zone beneath most of the Lesser Antilles islands and that the crustal structure thus imparts a control on the geochemical signature of arc lavas.

Volatile contents are variable for MIs across the arc: the highest
H_2O (<8 wt%), Cl (up to 3800 ppm) and Br (up to 20 ppm) concentrations occur in MIs from Dominica. But there is no systematic correlation between MI volatile content and position along the arc. Halogen Cl/F and Cl/Br ratios vary from one island to another, even between the different eruptions, but without any along arc zoning, indicating that halogen fractionation occurred by fluid transfer (variable assimilation rate of fluids derived from seawater) or by heterogeneities of mantle origin inherited from the initial differentiation of the mantle.