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## Development of chlorine stable isotopes as a new tool to unravel the variations of hydrothermal activity on volcanoes: application to la Soufrière de Guadeloupe

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Closed conduits volcanoes (*i.e.,* most andesitic arc volcanoes) emit gases with different chemical compositions compared to open conduits volcanoes (*i.e.*, most basaltic volcanoes). Noticeably, when compared to pure magmatic gas compositions emitted by open eruptive vents, fumarolic gases from closed conduits volcanoes have water contents that are significantly higher (>95% versus 60-80%), as well as $SO_2$ and HCl contents that are significantly decreased due to their entrapment by waters (resulting from their high solubility in $H_2O$). These differences result from the interaction with waters and rocks of the magmatic gases through their pathways to the surface in volcanic closed conduits, the so-called scrubbing effect. However, despite its crucial role on interpreting the chemical composition of volcanic gas emissions worldwide, it is still difficult to quantify the effect of scrubbing on the respective volatile species involved.

Chlorine is moderately soluble in magmas, highly soluble in waters and, unlike most other volatiles, is considered chemically non-reactive. Such combination of geochemical features can be used to characterize the origin of magmas, their differentiation and degassing (like usually done using major volatile compositions), but also, most uniquely, Cl can be used to inimitably trace interactions between gases and aqueous fluids. Importantly, considering current knowledge on chlorine isotopes systematics, large Cl isotope fractionations should only occur during evaporation, boiling and/or vapour condensation in volcanic systems.

This thesis aims to use for the first time chlorine isotope compositions ($\delta^{37}Cl$) to quantify the amount of primary emitted HCl that have been scrubbed by subsurface waters, and to possibly extrapolate to other volatiles that are more routinely measured in volcanology. By applying this new methodology to current and historical fumarolic samples of La Soufrière de Guadeloupe volcano (NaOH Giggenbach bottles, condensates from 1998 to present), we anticipate that the spatiotemporal $\delta^{37}Cl$ variations will help to precise the hydrothermal and magmatic activity of this volcano through time. Preliminary data show that the two sampled fumaroles, Napoléon Nord and Cratère Sud Centre, seem to have systematically different $\delta^{37}Cl$ values of about +1 and +8‰ (n=10), suggesting that condensation-revolatilization processes occur with variable intensities on these two fumaroles. We will present experimental data to help quantifying the effects of these processes.