EGU2020-10651
https://doi.org/10.5194/egusphere-egu2020-10651
EGU General Assembly 2020

Measurements of HCl in the volcanic plumes of Calbuco (2015) and Raikoke (2019)

Lieven Clarisse[1], Alexandre Deguine[1], Tim Hultberg[2], Nicolas Theys[3], Simon Carn[4], Karen Fontijn[5], Luna Decoster[1], Juliette Hadji-Lazaro[6], Daniel Hurtmans[1], Claude Camy-Peyret[7], Cathy Clerbaux[1,6], and Pierre-François Coheur[1]

[1]Université libre de Bruxelles (ULB), Spectroscopy, Quantum Chemistry and Atmospheric Remote Sensing (SQUARES) Brussels, Belgium

[2]European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), Darmstadt, Germany

[3]Royal Belgian Institute for Space Aeronomy (BIRA-IASB), Brussels, Belgium

[4]Department of Geological and Mining Engineering and Sciences, Michigan Technological University, Houghton, MI, United States

[5]Université libre de Bruxelles (ULB), Department of Geosciences, Environment and Society Brussels, Belgium

[6]LATMOS/IPSL, Sorbonne Université, UVSQ, CNRS, Paris, France

[7]Sorbonne Université, UPMC · Institut Pierre-Simon Laplace (IPSL), Paris, France

Hydrogen Chloride (HCl) is an important but still poorly understood magmatic volatile species. Degassed HCl and ratios with other volatiles can be used to monitor, understand and forecast volcanic activity. As the dominant chlorine reservoir species in the stratosphere, and a source of reactive halogens, HCl also plays an important role in the depletion of ozone. The contribution of volcanic HCl to the stratospheric budget is however somewhat debated, but it is generally accepted that scavenging by hydrometeors is a dominant process. Unlike the less soluble SO_2, this prevents the majority of volcanically emitted HCl from reaching the stratosphere. Currently HCl measurements have only been reported from limb sounders (MLS and ACE-FTS in particular), but given their viewing geometry, their vertical sensitivity is limited to the upper troposphere/lower stratosphere. In the past ten years, MLS was able to measure traces of HCl in a number of large volcanic plumes such as those originating from Sarychev Peak, Nabro and Calbuco.

Here, we report the first measurements from IASI of HCl in volcanic plumes. We provide unambiguous spectroscopic identification of HCl in the 2670-2760 cm^{-1} spectral region in several IASI observed spectra. A survey of 12 years of IASI data was carried out, and revealed several large plumes of volcanic HCl. We show two notably large plumes of HCl identified in the eruptions of Calbuco (2015) and Raikoke (2019). For these two eruptions, we show that HCl is detected in the lower altitude plumes emitted towards the end of the eruptions (and not in the main, higher-altitude and SO_2-rich plumes). This finding could be a result of the greater scavenging of HCl relative to SO_2 in rapidly rising plumes, but could also be related to particular degassing mechanics of different volatile components in the erupted melt. First quantitative estimates indicate that for the analysed plumes, the HCl/SO_2 molar ratios exceed one, which is much higher than the typical ratios measured by MLS (typically below 0.05) and also higher than reported from petrological

data or in situ measurements (typically in the range 0.1-0.3).