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Differences in the BrO/SO_2 evolution in the plume of Nyiragongo and Etna

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Studies of bromine monoxide and sulphur dioxide distributions in the plume of Niyragongo have been carried out with the Multi-Axis-Differential Optical Absorption Spectroscopy (MAX-DOAS) technique several times during the last years. The data discussed here are from measurements taken in 2004 and 2007. Niyragongo shows that even if the chlorine abundance might be very low in intraplate volcanism, conclusion from these findings cannot be drawn for other halogens, e.g. bromine. This is also a hint that the potential volcanic bromine source is not only the earth crust, in particular the ocean crust, as often assumed, because Niyragongo is fed by lava originating from a depth > 150 km with nearly no crustal influences (e.g. Chakrabarti et al., 2009).
The contribution of halogens and sulphur emitted into the free troposphere by the lava lake of Niyragongo is estimated at about 1300 SO_2 t/d, 52 HCl t/d, 2.6 HBr t/d in 2007. Nyiragongo is therefore an unexpectedly large source of inorganic bromine for the free troposphere.
Although Niyragongo's plume is relatively poor in filterable chlorine it is richer in bromine than Etna and has an even higher Br/S ratio than the one of Soufriere Hills volcano, which was considered to exhibit the globally highest Br/S ratio (Gerlach, 2004). Although Nyiragongo has the highest so far measured Br/S ratio in its (young) volcanic plume, comparing the BrO/SO_2 ratios further downwind leads to the unexpected result of relatively low BrO values in the aged plume of Nyiragongo.
In this presentation we compare BrO/SO_2 ratios in aging plumes, - the activation of bromine, in the volcanic plume of Nyiragongo, DR Congo and Mt Etna, Italy. Although the Br/S ratio in the plume of Nyiragongo is generally higher than that at Etna, the highest BrO/SO_2 ratios of the plume of Nyiragongo are significantly below the ones at Mt Etna. We also show that in the plume of Nyiragongo as well as seen in data taken at Etna, the BrO/SO_2 ratio at the largest distance (oldest plume, > 40 minutes) from the emission source is considerable lower than measurements at plume ages between 10 and 40 minutes.
We will compare the data with results from a 1D numerical chemistry-transport model that has been used for the investigation of volcanic plumes in the past in order to test whether our current understanding of plume chemistry as implemented in the model is able to reproduce the measurements. We will furthermore present sensitivity studies regarding ambient factors such as humidity.