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Plume composition changes during the birth of a new lava lake - Nyamulagira volcano, DR Congo

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Nyamulagira, in the Virunga Volcanic Province (VVP), Democratic Republic of Congo, is one of the most active volcanoes in Africa. The volcano is located about 25 km north-northwest of Lake Kivu in the Western Branch of the East African Rift System (EARS) with a distance of only 15 km to Nyiragongo, which is well known for its decades-old active lava lake. Nyamulagira is a shield volcano with a 3058 m high and ∼2000 m wide summit caldera. The volcano is characterized by frequent eruptions, which occur both from the summit crater and from the flanks (31 flank eruptions over the last 110 years). Due to the low viscosity lava, although significantly higher than the one of Nyiragongo, wide lava fields cover over 1100 km2 and lava flows often reach > 20 km length. More than 100 flank cones can be counted around the summit crater. A part from its frequent eruptions Nyamulagira had a long period of lava lake activity in the past, at least from 1912 to 1938.
During the past decades, gas emissions from Nyamulagira have been only reported during eruptions. This changed in 2012, however, when Nyamulagira began emitting a persistent gas plume above its crater. By the end of 2014, and beginning in 2015, a lava lake was born, a feature that—as of the time of this writing—is still growing.
To date, very little is known about gas emissions of Nyamulagira volcano with the only exception for SO_2. Very few studies have been conducted regarding the volatile chemistry of Nyamulagira. We try to fill this gap by reporting gas composition measurements of Nyamulagira's volcanic plume during the birth of the lava lake, and in the first year of the lake's activity. Two field surveys have been carried out, the first one on November 1st, 2014 and the second one October 13th – 15th, 2015. Applying the broad toolbox of volcanic gas composition measurement techniques offered us the opportunity to characterize Nyamulagira's plume in excruciating detail. Nyamulagira is known to be a significant emitter of SO_2 but shows, perhaps counterintuitively, low CO_2/SO_2 ratios (min. CO_2/SO_2 below 0.4). In contrast to Nyiragongo the H_2O contribution to the volatile budget of Nyamulagira is high (> 92 % of total gas emissions in 2014). We further determined that molar plume gas ratios of Cl/S, F/S and Br/S all decreased by a factor of two or even more between 2014 and 2015.
We will discuss the changes of plume composition in the light of the visually observed evolution of the lava lake and an interpretation on the volcanic system is attempted.