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Plume composition and volatile flux from Nyamulagira volcano

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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). The activity is characterized by frequent eruptions (on average, one eruption every 2–4 years) which occur both from the summit crater and from the flanks (31 flank eruptions over the last 110 years). Due to the peculiar low viscosity of its lava and its location in the floor of the rift, Nyamulagira morphology is characterized by a wide lava field that covers over 1100 km2 and contains more than 100 flank cones. Indeed, Nyamulagira is a SiO_2- undersaturated and alkali-rich basaltic shield volcano with a 3058 m high summit caldera with an extension of about 2 km in diameter.
In November 2014 a field expedition was carried out at Nyamulagira volcano and we report here the first assessment of the plume composition and volatile flux from Nyamulagira volcano. Helicopter flights and field observations allowed us to recognize the presence of lava fountains inside an about 350-meter wide pit crater. The lava fountains originated from an extended area of about 20 to 40 m2, in the northeast sector of the central caldera. A second smaller source, close to the previous described one, was clearly visible with vigorous spattering activity. There was no evidence of a lave lake but the persistence of intense activity and the geometry of the bottom of the caldera might evolve in a new lava lake. Using a variety of in situ and remote sensing techniques, we determined the bulk plume concentrations of major volatiles, halogens and trace elements. We deployed a portable MultiGAS station at the rim of Nyamulagira crater, measuring (at 0.5 Hz for about 3 hours) the concentrations of major volcanogenic gas species in the plume (H_2O, CO_2, SO_2, H2S). Simultaneously, scanning differential optical absorption spectroscopy instruments were applied inside the crater as well as downwind the volcano and active alkaline traps (Raschig-Tube and Drechsel bottle) were exposed. The alkaline solution traps acidic species (CO_2, SO_2, H2S, HCl, HF, HBr, HI) due to the acid-base reactions. Moreover, filter packs technique have also been used to collect both the volatile phase of the plume (sulphur and halogen species) and the particulate phase (major and trace metals) emitted from the volcano. These new results will add to our lacking knowledge of volcanic degassing in VVP, and will increase constraints on the abundances and origins of volatiles from the mantle source which feeds volcanism in the western branch of the EARS.