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Volcano morphology and eruptive hazard of the Virunga Volcanic Province: Combining colonial-time reports, satellite images and new field observations in a conflict zone

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Within the Western branch of the East-African Rift Valley lies the Virunga Volcanic Province (VVP), shared by DRCongo, Rwanda and Uganda. A spatio-temporal assessment of the volcanic hazards presented by the eight central volcanoes is essential in this region characterized by recurrent military conflicts and a high population density of ~one million people in the cities of Goma and Gisenyi. We have created a volcano-structural map for the VVP using colonial-time reports and maps, recent satellite images (SPOT, Pléiades) and a newly-created 5 m resolution digital elevation model (TanDEM-X), completed with limited field observations. Mapped eruptive vents-and-fissures served as input to an eruptive vent density map using QVAST (Bartolini et al., Nat. Haz. Earth Syst. Sci. 2013). This map was then combined with the fragments of eruptive history of the Virunga volcanoes, described in colonial-time reports and scientific literature, and new 14C-ages of palaeosols above or below volcanic cone deposits. Contrasts in erosive grade and relative age were

estimated for the central volcanoes and their parasite cones through a set of morphometric parameters calculated from the DEM. Although the reconstructed eruptive history for the whole VVP remains incomplete, we propose a spatio-temporal assessment of future eruptive susceptibility. Volcanic features are generally concentrated along major topographic lineaments, potentially controlled by palaeo- and neo-tectonic structures. Combining the morphometric data, the available ages and the volcanic susceptibility map, the eruptive hazard appears low to non-existent for the eastern-most volcanoes, and medium on the long term for the central volcanoes, with a focus on Karisimbi volcano. A 1957 lava flow, at 'Mugogo' ~10 km north of Visoke volcano, is reportedly the only historic activity outside the rift valley. Finally, the western-most Nyiragongo and Nyamulagira volcanoes show abundant historic effusive activity, especially for the latter providing sufficient temporal constraints for quantitative eruptive susceptibility estimations.

Keywords : volcano-structure, eruptive vent density, eruption susceptibility