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The Nsenga Tephra eruption of the Ngozi caldera, SW Tanzania

Peeters, G.-J.[1], Lenhardt, N.[1], Fontijn, K.[2] and Macheyeki, A.S.[3,4]

[1] Department of Geology, University of Pretoria, South Africa (gertjanpeeters@gmail.com)
[2] Department of Earth Sciences, University of Oxford, United Kingdom
[3] Geological Survey of Tanzania, Ministry of Energy and Minerals, Tanzania
[4] Ministry of Natural Resources, Kigali, Rwanda

Ngozi is a 3-km-wide caldera that is located in the Rungwe Volcanic Province (RVP) alongside the stratovolcano Rungwe and the composite volcano Kyejo. The RVP is the southernmost volcanic province of the East African Rift System and volcanism in this region started approximately 8.6 My ago [1]. Ngozi and Rungwe have both experienced multiple major explosive eruptions during the last ca. 12 ky, such as the 4 ka Rungwe Pumice eruption [2]. Kyejo has been built up by mainly effusive to low explosive eruptions, such as the 1800 AD Sarabwe tephrite flow eruption which was the last and only historically documented eruption in RVP [3]. A stratigraphical study of Ngozi's deposits has revealed seven ignimbrite-producing eruptions in the Holocene with a trend towards increasing influence of external water in the youngest eruptions. Even though these eruptions had various eruption mechanisms, Ngozi consistently produced white coloured, aphyric to very crystal-poor pumices with a trachytic composition. We present a detailed reconstruction of the third youngest eruption of Ngozi: the Nsenga Tephra eruption.

Figure 1: Representative picture of the Nsenga Tephra deposits. Hammer for scale.

The deposits of the Nsenga Tephra eruption have been recognized at all sides of the caldera and can be divided into two parts. The lower part primarily comprises a massive, poorly sorted, ash-rich, lapilli-poor lapilli tuff with intermittent lithic-rich, cross-stratified layers and moderately sorted pumice-rich layers. The second part is entirely made up of a thick fallout deposit (a thickness of 2 m at 12 km distance) that shows little to no grading and is poor in lithics and free crystals. Some pumices have aphyric to porphyritic enclaves. The lithic population is made up of grey trachytic lava and syenite clasts.

The Nsenga Tephra eruption was dated to approximately 5 ka BP by ^{14}C dating of the underlying paleosol. The onset of the eruption was dominated by pyroclastic density currents (PDCs) with the development of a partly stable eruption column during short intervals. This initial chaotic eruption column behaviour evolved into stable eruption column conditions that continued until the end of the eruption. The tephra dispersal model of Carey and Sparks [4] suggests a maximum column height of 23

km with a maximum wind speed of 12 m/s to the NWW during the second phase. The estimated minimum erupted volume of the Nsenga Tephra eruption is 3.4 km^3, comprising 0.5 km^3 of PDC deposits and 2.9 km^3 fallout deposits. The Nsenga Eruption was therefore of Plinian intensity and we assign it a VEI (Volcanic Explosivity Index) of 5. The bulk chemical composition of the pumice clasts is trachytic and does not significantly change with stratigraphic height suggesting a relatively homogeneous magma.

References:

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