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Eruptive and depositional characteristics of the Loolmurwak and Eledoi maar volcanoes, Lake Natron – Engaruka monogenetic volcanic field, northern Tanzania

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The Eledoi and Loolmurwak maars form two of the largest craters within the Lake Natron - Engaruka monogenetic volcanic field (northern Tanzania), an area consisting of approximately 200 vents scattered between four large central volcanoes. We here describe depositional characteristics of the two maars, as observed in the field, and present preliminary findings on the petrographic textures which can provide insights into the eruption dynamics.

Most maar volcanoes are considered to be the result of explosive phreatomagmatic volcanic eruptions (in which ascending magma interacts with external water). However, our field observations indicate that neither Loolmurwak nor Eledoi provides clear evidence of wet eruption or deposition. The overall arid climate in the area, in combination with the higher elevation of these maars with respect to their surroundings, makes the availability of external water, necessary to drive a phreatomagmatic eruption, questionable. Features indicative of phreatomagmatism, such as accretionary lapilli, vesiculated tuffs or plastering against objects, were not observed. Rather, most observations points toward dry eruption modes for these eruptions. The ejecta ring of Eledoi is strongly asymmetrical, with the finer deposit fractions concentrated on its NW side, suggesting a dry eruption column that allowed effective eolian segregation of differently sized pyroclasts during deposition. Subspherical melt blobs, cored with single olivine, clinopyroxene and phlogopite crystals that reach up to 11 cm in diameter, occur abundantly at Loolmurwak. Many of these melt blobs show slight flattening parallel to the bedding plane, which indicates that they were emplaced as molten droplets. The abundance of large phlogopite phenocrysts in the Loolmurwak deposits points towards a volatile-rich magma. The occurrence of mantle xenoliths, 20-30 cm in diameter, implies that the magma traveled from the upper mantle to the surface in less than two days. The rapid ascent rate (0.80–0.95 ms-1), is similar to those previously estimated for kimberlitic magmas.

Preliminary petrographic results (using both optical microscopy and Scanning Electron Microscopy) show that, just as observed on a slightly larger scale in the field, olivine, pyroxene and phlogopite crystals encased in a fine crystalline matrix commonly occur on a (sub)mm-scale. The matrix of these melt droplets consists of the same three phases as well as melilite and opaque minerals. Phlogopite edges are commonly degraded, which suggests that the stability of this phase decreased as the magma ascended, which may have released additional volatiles that enhanced the explosivity of the eruption.

The rapid ascent rates calculated for the involved magmas and the exsolution of abundant volatiles during decompression, in combination with depositional characteristics, indicate that the fragmentation and depositional mechanisms were similar to those recorded for many “dry” volcanic eruptions. Moreover, the pyroclasts in these melilititic Tanzanian maars exhibit strong resemblance to the vent-facies of kimberlites. As these are usually sparse or missing in kimberlite deposits, a more detailed study of pyroclast textures, mineralogy and chemistry of the Eledoi and Loolmurwak deposits may provide valuable new insights into kimberlite emplacement processes.