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Debris avalanches at Oldoinyo Lengai (Tanzania): morphological evidence, collapse mechanisms and hazard assessment

M. Kervyn (1), J. Klaudius (2), J. Keller (2), E. Mbede (3), P. Jacobs (1), G.G.J. Ernst (1)

(1) Mercator & Ortelius Research Center for Eruption Dynamics, Geology Dept, Ghent University, Belgium, (2) IMPG, Albert Ludwigs-University of Freiburg, Germany, (3) Department of Geology, University of Daar-es-Salaam, Tanzania
(Matthieu.KervynDeMeerendre@UGent.be)

Evidence for collapse scars and debris avalanches were collected in the field and subsequently fully documented and mapped using a combination of remote sensing data including airphotos, SRTM DEM, ASTER and Landsat imagery. One debris avalanche estimated at $\sim 5\text{km}^3$ in volume affected the Northern flank of Lengai and flowed northward at least 24 km, to the Southern shore of Lake Natron. This collapse, estimated to have occurred at ~ 10.000 B.P, affected more than 10% of the volcano volume. The collapse scar is a major unconformity in the volcano stratigraphy and corresponds to a transition from phonolite to nephelinite magma composition, accompanied by a Northward shift of the feeding conduit. Remarkable linear alignments of individual hummocks are observed within the debris avalanche field and indicate flow direction. Evidence for at least two additional sector collapses affecting the N and E flanks of Oldoinyo Lengai are also documented. Of much smaller scale ($\sim 0.1-0.2\text{ km}^3$), these most recent and shallow landslides are attributed to the unstable growth of the summit part of the volcano. Lengai data is consistent with the greatest collapses occurring in the direction of the greatest height difference and least buttressing. Volcano-scale collapses and debris avalanches are amongst the most hazardous volcanic phenomena. The potential for a future sector collapse at Lengai is also evaluated using RS data and field observations. The Oldoinyo Lengai region is important for the local already-threatened Masai herders and is an important focus for eco-tourism. The findings highlight the need to routinely monitor ground deformation and seismic activity

at Oldoinyo Lengai to anticipate volcano collapse and/or an explosive eruption that could harm local people, unique ecosystems, international air traffic or developing eco-tourism.