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A ∼260 ka eruptive history for Kilimanjaro derived from Lake Challa sediments

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The iconic Mount Kilimanjaro is Africa's highest peak and most popular geotouristic attraction. Volcanism began here at ∼2.5 Ma with activity focussed on three laterally aligned centres, Shira, Kibo and Mawenzi, until ∼200 ka (Nonette et al., 2008). Since then Strombolian activity from as many as 250 parasitic cones on the SE flanks of the mountain has dominated the record. Fumarolic activity continues at Kilimanjaro and many of the cones are of suspected Holocene age, yet the volcanic threat that this poses to the 2.6 million people living within a 100-km radius remains unconstrained (Brown et al., 2015). Improved cataloguing of the frequency and relative size of past eruptions is essential if we are to assess the potential for, and possible impacts of, further eruptions from Kilimanjaro.

Deep lakes preserve volcanic ash (tephra) layers in their stratigraphically-resolved sediment sequences, often offering the most complete window into past explosive volcanism. The new ICDP DeepCHALLA sediment core from Lake Challa, located on the Kenya-Tanzania border and in the shadow of Kilimanjaro, provides a high-resolution palaeoenvironmental record for tropical Africa, as well as a detailed record of explosive volcanism extending to ∼260 ka. This finely laminated sediment sequence contains thirty visible tephra horizons, many of which are distinctive in terms of their physical and geochemical properties. Six of these tephra layers contain basaltic glass shards with major and minor element compositions that we confidently match to published data on the lavas from Kilimanjaro's <200-ka parasitic cones.

Here we use the Lake Challa tephrostratigraphy to infer the eruptive history of Kilimanjaro. We confirm that its latest phase of volcanism was confined to Strombolian activity. The earliest tephra layer we have sampled lies at the base of the DeepCHALLA sequence, currently dated to ∼260 ka. Five further eruptions are recorded, but activity appears to have ceased around ∼70 ka. However, future investigation of microscopic cryptotephra horizons may yield evidence of younger activity. We show the potential for lake sediments to shed light on past volcanic activity and future volcanic hazard throughout the rapidly developing East African Rift.

Brown, S. K. et al., 2015. Regional and country profiles of volcanic hazard and risk. Report IV of the GVM/IAVCEI contribution to the Global Assessment Report on Disaster Risk Reduction

Nonnotte, P., et al., (2008). New K–Ar age determinations of Kilimanjaro volcano in the North Tanzanian diverging rift, East Africa. Journal of Volcanology and Geothermal Research, 173(1), 99-112.