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Luminescence dating of young volcanic eruptions

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Reliable chronologies of volcanic eruptions are vital for hazard analysis, but da-ting of Holocene and Late Pleistocene volcanism poses a major challenge. Estab-lished techniques such as 40Ar/39Ar are often problematic due to the long half-life of 40K or the absence of datable materials. In this context, luminescence dating is a promising alternative.
Luminescence signal resetting during volcanic activity can be caused by heat (lava, contact to lava), light (disintegration of ejecta) or (temperature-assisted) pres-sure in the course of phreatomagmatic explosions. While volcanogenic minerals forming volcanic rocks are less suitable for luminescence dating due to anomalous fading, the signal of volcanogenically heated or fragmented country rock also relates to the time of eruption and further provides more accurate results, due to the pres-ence of minerals like quartz.
This contribution aims to illustrate the potential of this latter approach by pre-senting two case studies. The first refers to two Late Pleistocene scoria cones in the Westeifel Volcanic Field (WEVF), Germany, of which the Wartgesberg locality was dated by 40Ar/39Ar and 14C, while the closeby Facher Höhe is chronologically poorly constrained [1]. The former locality allows testing the accuracy of various lumines-cence techniques (TL, OSL, IRSL) applied to quartz and polymineral separates against independent age control. The other study site is the monogenetic Lake Nyos Maar, which is part of the Cameroon Volcanic Line (CVL). Previous dating efforts of the last explosive activity are inconsistent and yielded age estimates ranging from 400 a (14C) to >350 ka (K-Ar) [2].
Our results demonstrate that multiple luminescence methods (TL, OSL) yield equally valid age estimates averaging to 33.6 ± 2.4 ka for the Wartgesberg site, which is in good agreement with 40Ar/39Ar and 14C results. The Facher Höhe, how-ever, is much younger than previously assumed with an average TL age of 15.5 ± 1.1 ka. This southeastern part of the WEVF thus hosts many of the most recent eruption sites, which has important implications for modelling the causes and timing of Eifel volcanism and assessment of future eruption locations. Luminescence stud-ies for the Nyos Maar suggest that the phreatomagmatic explosion has completely reset the inherited TL signal and an average maximum age of 12.3 ± 1.5 ka roughly fits with U-series age estimates [2], indicating that TL is a viable tool for completing the fragmentary chronostratigraphic record of the CVL.

References

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