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The use of luminescence for dating young volcanic eruptions

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Reliable chronologies of volcanic eruptions are vital for hazard analysis, but dating of Holocene and Late Pleistocene volcanism poses a major challenge. Established techniques such as $^{40}Ar/^{39}Ar$ are often problematic due to the long half-life of ^{40}K or the absence of datable materials. In this context, luminescence dating methods are an alternative since they are applicable to Earth's most common minerals and to a range of different datable events.

Luminescence signal resetting during volcanic activity can be caused by heat (lava, contact to lava), light (disintegration of ejecta) or (temperature-assisted) pressure in the course of phreatomagmatic explosions. While volcanogenic minerals assembling basalt or other volcanic rocks are less suitable for luminescence dating due to so-called anomalous fading, the signal of volcanogenically heated or fragmented country rock actually relates to the time of eruption as well and further provides reproducible results.

This contribution aims to illustrate the potential of this latter approach by presenting 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 $^{40}Ar/^{39}Ar$ and ^{14}C, while the closeby Facher Höhe is chronologically poorly constrained (Mertz et al. 2015; pers comm. Luise Eichhorn, 2016). The former locality allows testing the accuracy of various luminescence techniques (thermoluminescence, TL, optically stimulated luminescence, OSL, infrared stimulated luminescence, IRSL) applied to quartz and feldspar against independent age control. The other study site is the monogenetic Lake Nyos Maar as part of the Cameroon Volcanic Line, having killed 1,700 people in 1986 following the release of large amounts of CO_2. Previous dating efforts of the last explosive activity are inconsistent and yielded age estimates ranging from 400 a (^{14}C) to >350 ka (K-Ar) (Aka et al. 2008).

Our results demonstrate that multiple luminescence methods (TL, OSL) yield equally valid age estimates averaging to 33.6 $\pm$ 2.4 ka for the Wartgesberg site, in good agreement with $^{40}Ar/^{39}Ar$ and ^{14}C results. The Facher Höhe, however, is much younger than previously expected with an average TL age of 15.5 $\pm$ 1.1 ka. This southeastern part of the WEVF thus hosts many of the most recent eruption sites, which has important implications for studying the causes of Eifel volcanism but also for assessing future eruption locations. Preliminary findings suggest that the phreatomagmatic explosion of the Nyos Maar was capable of completely resetting the inherited luminescence signal and indicate a significant overestimation by K-Ar.

References

Aka, F.T., Yokoyama, T., Kusakabe, M., Nakamura, E., Tanyileke, G., Ateba, B., Ngako, V., Nnange, J., Hell, J., 2008. U-series dating of Lake Nyos maar basalts, Cameroon (West Africa): Implications for potential hazards on the Lake Nyos dam. Journal of Volcanology and Geothermal Research 176, 212-224.

Mertz, D.F., Löhnertz, W., Nomade, S., Pereira, A., Prelevic, D., Renne, P.R., 2015. Temporal–spatial evolution of low-SiO_2 volcanism in the Pleistocene West Eifel volcanic field (West Germany) and relationship to upwelling asthenosphere. Journal of Geodynamics 88, 59-79.