LETTERS

Comment on “The Latest on Volcanic Eruptions and Climate”

Alan Robock (*Eos*, 94(35), 305–306, doi:10.1002/2013EO350001) nicely summarizes past volcanic eruptions and climate, but we wish to correct his assessment of our recent discovery of the Youngest Toba ash in the sediments of Lake Malawi in East Africa [Lane *et al.*, 2013].

Robock wrote that our paleoclimate record averaged several decades, which “does not support their claim that there could not have been a short-lived, catastrophic volcanic winter.” The paleoclimate record in this interval of the Malawi core is not averaged over several decades. As we reported, the sediment is faintly laminated, indicating a lack of bioturbation and anoxic conditions similar to the present-day lake. We examined sediment smear slides at a 2-millimeter (~6 year) interval surrounding the Toba horizon and observed no significant change in the fossil diatom assemblage. Our X-ray fluorescence (XRF) profiles were at a 200-micrometer (subannual) resolution. If Lake Malawi suddenly underwent a 4°C cooling over 4 years [Timmreck *et al.*, 2012], there would likely have been complete overturn of this 700-meter-deep lake if its density stratification prior to the eruption was similar to that of today.

The density shift of freshwater from 22°C to 18°C equals that from 13°C to 4°C, which can turn over Lake Superior’s entire water column in a matter of weeks. Complete overturn of Lake Malawi, which is anoxic below 200 meters, would cause massive fish kills and iron and manganese oxide precipitation because of oxygenation in the upper

water column of the reduced iron- and manganese-enriched deep water. Our XRF data provide no evidence of a major redox event (iron-titanium ratio) or an accompanying biological response (XRF incoherent-to-coherent signal strength ratio).

We stand by our interpretation: There is no evidence for a significant perturbation of the climate in the Lake Malawi basin at the time of the Youngest Toba eruption. We acknowledge the need to model Lake Malawi’s circulation under different cooling scenarios to explore the range of conditions under which overturn would occur. Hopefully, this input, along with further modeling of Toba’s impact on climate, will clarify the effects of this supereruption on our early ancestors.

References

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- Timmreck, C., H.-F. Graf, D. Zanchettin, S. Hagemann, T. Kleinen, and K. Krüger (2012), Climate response to the Toba super-eruption: Regional changes, *Quat. Int.*, *258*, 30–44, doi:10.1016/j.quaint.2011.10.008.

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