

## **Finding Toba: Traces in a Borneo Stalagmite**

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While there is no doubt surrounding the magnitude of the 74 ka Toba super-eruption, its global and regional impact on climate, terrestrial ecosystems, and prehistoric humans remains a topic of heated debate. Notably, both Chinese and Borneo stalagmite low-resolution oxygen isotope records, proxies for monsoon strength and West Pacific tropical convection, respectively, reveal the start of an ~300yr shift to a 1000yr-long dry period coincident with the Toba eruption. It is therefore conceivable that the eruption played a role, whether direct or indirect, in shaping global-scale climate over the following several centuries, not decades, which is in stark contrast to the suggested climate effect provided by climate models. Here our objective is to leverage the application of multiple micro-analytical techniques on several tropical Mulu stalagmites (northern Borneo) to (i) establish a new tropical volcanic archive, (ii) investigate the number and timing of eruption signatures associated with the 74 ka Toba super-eruption, and (iii) determine if heightened sulfur concentrations are coincident with these signatures. We present an assemblage of new CLFM, EPMA, SIMS, and synchrotron radiation XRF and XAS data on a collection of Mulu stalagmites that precipitated through the Toba eruption. The analyses support our hypothesis that traces of the Toba eruption are preserved in Mulu stalagmites, a site 1100 miles east of the Toba caldera. Notably, in at least one stalagmite we see a significant and anomalous 100- $\mu\text{m}$  thick lamina with elevated S, Mn, Fe, Zn, Br, Rb, and Sr content preceding the  $\delta^{18}\text{O}$  transition. In another sample, two  $\delta^{18}\text{O}$  excursions of  $\pm 2\text{-}3\text{‰}$  over 6-10 SIMS spot intervals (30-60 $\mu\text{m}$ , or ~10-20 yrs) are near the start and middle of the ~300yr low-resolution  $\delta^{18}\text{O}$  transition. We discuss theories on the relative timing of suggested ash and climate signatures within multiple stalagmites.