Calcium isotope evidence for end-Triassic ocean acidification

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The end-Triassic mass extinction preferentially affected heavily calcified marine animals, suggesting ocean acidification was an important kill mechanism. Carbon isotope fluctuations across the Triassic-Jurassic boundary and into the Lower Jurassic are consistent with input of volcanic CO_2 from the Central Atlantic Magmatic Province (CAMP) as an underlying driver. However, changes in δ13C cannot be uniquely attributed to volcanic carbon release, and the ocean acidification scenario has yet to be tested using other geochemical proxies. Here we present a high-resolution calcium isotope record from marine carbonate sediments spanning the Triassic-Jurassic boundary in two stratigraphic sections from the Lombardy Basin of the southern Alps. We observe two decreases of more than 0.3‰ in $\delta^{44/40}Ca$ within the lowermost Hettangian followed by a steady return to Upper Triassic baseline values. Calcium isotope ratios are not significantly correlated with the abundance of trace elements (Sr, Mg, Mn) or other isotope ratios ($\delta^{13}C$, $\delta^{18}O$), indicating that diagenetic or mineralogic control is unlikely. A coupled numerical model of global carbon and calcium cycles shows that the $\delta^{13}C$ and $\delta^{44/40}Ca$ records can be interpreted to reflect the input of more than 40,000 Gt of carbon during emplacement of CAMP and a consequent short-term reduction in calcium carbonate burial driven by acidification.