

## **Singular blow-up in the end-Permian carbon cycle**

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About 252 million years ago, as the Permian period gave way to the Triassic, roughly 90% of all living species disappeared from the fossil record. This event, the most severe extinction in Earth history, was accompanied by a rapid ( $\sim 10,000$  year) change in the carbon isotopic composition of seawater. By transforming these chemical changes to physical fluxes, we show that the isotopic event is consistent with an incipient singularity in the growth of the oceans' reservoir of dissolved inorganic carbon. The singular influx of  $\text{CO}_2$  indicates a fundamental nonlinearity in the carbon cycle that, in principle, allows prediction of the extinction event about 100 Kyr in advance. Its identification also suggests that any hypothesis for the extinction's cause should predict such a blow-up. One popular hypothesis suggests that the extinction is caused by Siberian trap volcanism. If Siberian volcanism is indeed the cause, then our findings suggest that it must have led to the progressively rapid combustion, over a period of 100 Kyr, of at least 10 Gt of isotopically light organic carbon (e.g., coal). As an alternative, we identify a biological mechanism that naturally leads to a singular flux of  $\text{CO}_2$  and discuss its relevance to observations.