

# An increase in the extent of global anoxia at the end-Triassic inferred from uranium isotopes

ADAM B. JOST<sup>1</sup>, AVIV BACHAN<sup>1</sup>,  
BAS VAN DE SCHOOTBRUGGE<sup>2</sup>, KARRIE L. WEAVER<sup>1</sup>,  
KIMBERLY V. LAU<sup>1</sup>, KATE MAHER<sup>1</sup> AND  
JONATHAN L. PAYNE<sup>1</sup>

<sup>1</sup>Department of Geological Sciences, Stanford University,  
Stanford, CA 94305 USA

<sup>2</sup>Departement Aardwetenschappen, Universiteit Utrecht,  
Budapestiaan 4, Room Z308, 3584 CD, Utrecht,  
Netherlands

The end-Triassic extinction was likely triggered by a rapid rise in  $p\text{CO}_2$  associated with the emplacement of the Central Atlantic Magmatic Province (CAMP) ca. 201 Ma, though, due to a lack of proxy data, the proximate effects on seawater chemistry are still not well understood. Ocean acidification is perhaps the most cited proximal cause of the extinction event, but increases in the preservation of organic matter, the appearance of biomarkers for anoxygenic photosynthesis, enrichments in redox-sensitive metals, and selective loss of marine animals with poor respiratory buffering capacities suggest that shallow marine anoxia and/or euxinia may also have played a role. Many proxies exist for local anoxia at the time of deposition, but these cannot easily be used to infer global redox conditions. Uranium isotopes ( $\delta^{238}\text{U}$ ) in  $\text{CaCO}_3$  sediments deposited in oxygenated conditions have the potential to passively track seawater  $\delta^{238}\text{U}$  composition, which is sensitive to the areal extent of anoxia globally due to fractionation of  $^{238}\text{U}$  relative to  $^{235}\text{U}$  during reduction of U(VI) to U(IV) in marine sediments. To better quantify the change in the extent of ocean anoxia during the end-Triassic mass extinction, we measured  $\delta^{238}\text{U}$  in shallow marine limestones from two stratigraphic sections in the Lombardy Basin, Northern Italy spanning over 400 m. We observe a ca. 0.6‰ negative excursion in  $\delta^{238}\text{U}$  beginning in the lowermost Jurassic, coeval with the onset of the initial negative  $\delta^{13}\text{C}$  excursion and persisting for the duration of subsequent high  $\delta^{13}\text{C}$  values in the lower-mid Hettangian ca. 200 Ma. Using a numerical model of the uranium cycle, we demonstrate that this excursion is consistent with a thirty-fold increase in anoxic deposition worldwide, suggesting that anoxia was an additional stress on marine organisms at the Triassic/Jurassic boundary.