Ca isotope constraints on Early Triassic marine carbonate chemistry

K. V. LAU1*, K. MAHER1, D. ALTINER2, S. BROWN3, D. J. DEPAOLO3, A. EISENHAUER4, A. B. JOST1, B. M. KELLEY1, L. R. KUMP5, D. J. LEHRMANN6, A. PAYTAN7, J. C. SILVA-TAMAYO8, M. YU9 AND J. L. PAYNE1

1Department of Geological Sciences, Stanford University, Stanford, CA 94305, USA (*kvau@stanford.edu)
2Department of Geological Engineering, Middle East Technical University, 06531, Ankara, Turkey
3Department of Earth and Planetary Science, University of California, Berkeley, CA 94720, USA
4GEOMAR, Helmholtz Centre for Ocean Research Kiel, 24148 Kiel, Germany
5Department of Geosciences, The Pennsylvania State University, University Park, PA 16802, USA
6Geosciences Department, Trinity University, San Antonio, TX 78212, USA
7Institute of Marine Sciences, University of California, Santa Cruz, CA 95064 USA
8Department of Earth and Atmospheric Sciences, University of Houston, Houston, TX 77204, USA
9College of Resource and Environment Engineering, Guizhou University, Caijaguan, Guiyang 550003, Guizhou, China

Perturbed global C cycle dynamics characterized the five million years following the end-Permian mass extinction, coincident with reduced biodiversity and expansive anoxic conditions. Early Triassic δ13C exhibits multiple negative (down to -2‰) and positive (up to 8‰) excursions, which could have resulted from volcanism, acidification, or changes in organic carbon burial, carbonate precipitation, or mineralogy. Because the Ca cycle is linked to carbonate chemistry through CaCO3 acidification/dissolution and burial, Ca isotopes can help constrain C cycle behavior. We present δ44/40Ca data measured in Upper Permian–Upper Triassic limestones from south China and Turkey. By measuring δ44/40Ca in two stratigraphic sections located across the Tethys, we can determine whether the data represent global conditions or have undergone local effects, such as diagenesis. At the extinction horizon, a 0.5‰ negative excursion is observed at both sections, followed by a positive excursion of ~0.7‰. In Turkey, this positive excursion is concurrent with the large positive δ13C excursion at the Induan-Olenekian boundary (~251.22 Ma), whereas a 0.6‰ negative δ44/40Ca excursion occurs in south China. Records stabilize by the Spathian (~250 Ma). Using a coupled C and Ca model, we test different local and global controls on δ44/40Ca and δ13C to identify conditions that explain the observed isotopic excursions in multiple elements.