The influence of diagenesis and mineralogy on Ca isotopes in Lower-Upper Triassic carbonate rocks

K.V. LAU[1]*, K. MAHER[1], S. BROWN[2], J.C. SILVA-TAMAYO[3], A.B. JOST[4], D. ALTINER[5], D.J. DEPAOLO[2], A. EISENHAUER[6], D.J. LEHRMANN[7], A. PAYTAN[8], M. YU[9], AND J.L. PAYNE[1]

[1]Department of Geological Sciences, Stanford University (*kimberly.lau@ucr.edu)
[2]Center for Isotope Geochemistry, Lawrence Berkeley National Laboratory and UC Berkeley
[3]Department of Earth and Atmospheric Sciences, University of Houston
[4]Department of Earth, Atmospheric, and Planetary Sciences, Massachusetts Institute of Technology
[5]Department of Geological Engineering, Middle East Technical University
[6]GEOMAR, Helmholtz Centre for Ocean Research Kiel
[7]Geosciences Department, Trinity University
[8]Institute of Marine Sciences, UC Santa Cruz
[9]College of Resource and Environmental Engineering, Guizhou University

The calcium cycle is linked to the carbon cycle through the weathering and burial of carbonate rocks. As a result, calcium isotope ratios ($^{44}Ca/^{40}Ca$, or $\delta^{44/40}Ca$) can help to constrain ancient carbon cycle dynamics if Ca cycle behavior can be reconstructed. However, $\delta^{44/40}Ca$ of carbonate rocks is influenced not only by seawater but also by fractionation associated with $CaCO_3$ precipitation and by diagenesis. We investigate the controls on carbonate $\delta^{44/40}Ca$ in Upper Permian to Upper Triassic limestones (~253 to 235 Ma) from south China and Turkey. Parallel negative $\delta^{13}C$ and $\delta^{44/40}Ca$ excursions were previously identified at the end-Permian extinction horizon. We find a second negative excursion of ~0.2‰ in both south China and Turkey within Lower Triassic strata. However, this excursion is not synchronous and $\delta^{44/40}Ca$ values are different between the two sections. The excursion cannot be interpreted as secular change in the $\delta^{44/40}Ca$ of global seawater. The [Sr] and $\delta^{44/40}Ca$ data are best described statistically by a log-linear correlation that exists also in many previously published datasets. Using a model of early marine diagenetic water-rock interaction, we illustrate that this correlation can be explained by the chemical evolution of carbonate sediment samples with a range of initial calcite-to-aragonite ratios. Although these factors strongly influence carbonate $\delta^{44/40}Ca$ values, it may still be possible to infer changes in seawater $\delta^{44/40}Ca$ from carbonate rocks after controlling for recrystallization effects.