A Permo-Triassic Ca isotope record from Meishan, China

JIUYUAN WANG[1*], ANDREW D. JACOBSON[1], HUA ZHANG[2], JAHANDAR RAMEZANI[3], BRADLEY B. SAGEMAN[1], MATTHEW T. HURTGEN[1], SAMUEL A. BOWRING[3] AND SHU-ZHONG SHEN[2]

[1] Earth and Plantary Sciences, Northwestern University, Evanston, IL, 60208, USA (*correspondence: jwang@earth.northwestern.edu)

[2] State Key Laboratory of Paleobiology and Stratigraphy, Nanjing Institute of Geology and Palaeontology, Nanjing, Jiangsu 210008 (hzhang@nigpas.ac.cn)

[3] Earth, Atmospheric, and Planetary Sciences, MIT, Cambridge, MA, 02139 USA (ramezani@mit.edu)

The end-Permian mass extinction (ca. 252.2 Ma) represents the most devastating loss of biodiversity in both terrestrial and oceanic environments during the Phanerozoic. Multiple lines of paleobiological, sedimentary, and geochemical evidence indicate a significant perturbation to the global C cycle, likely induced by CO_2 emissions during eruption of the Siberian Traps large igneous province. Given that the C and Ca cycles intersect through chemical weathering and carbonate precipitation, the isotopic analysis of Ca ($\delta^{44/40}Ca$) preserved in marine carbonate rocks deposited during this time may offer insight into the causes and consequences of the mass extinction. Here, we report a high-precision ($2\sigma_{SD}=\pm0.04‰$), high spatial resolution (~1 cm) $\delta^{44/40}Ca$ record for the end-Permian from Meishan, Zhejiang Province, China. Following the mass extinction in bed 25, $\delta^{44/40}Ca$ values (reported relative to seawater) in bed 26 remain unchanged around –1.25‰ and then decrease to –1.45‰ before increasing to –1.05‰ in bed 27, which straddles the Permian-Triassic boundary. $\delta^{44/40}Ca$ values in bed 27 oscillate but remain elevated before decreasing to –1.25‰ in bed 29. $\delta^{44/40}Ca$ values show no obvious correlations with other parameters, such as wt% $CaCO_3$, $\delta^{13}C$, Ca/Mg, and Ca/Sr. Challenges exist to invoke enhanced delivery of terrestrially-derived Ca, given the short amount of time that the data represent (~60 kyr or less) combined with the overall positive direction of the excursion. We are presently considering two hypotheses to explain the Meishan Ca isotope record. One involves changes in the magnitude of the carbonate fractionation factor due to transient ocean acidification and global warming. The second pertains to carbonate depositional changes in the aftermath of the extinction due an “alkalinity overshoot.” Additional measurements and model calculations are underway to help refine and improve these preliminary interpretations.