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Enhanced reverse weathering in the End Permian and the Early Triassic Ocean

XIAO-MING LIU[1], CHENG CAO[2], CLEMENT BATAILLE[3], HAIJUN SONG[4], MATTREW SALTZMAN[5], HUAICHUN WU[4], KATE TIERNEY[6], CHRISTOPH KORTE[7] AND ZHAOFENG ZHANG[8]

[1]University of North Carolina at Chapel Hill
[2]Nanjing University
[3]University of Ottawa
[4]China University of Geosciences
[5]Ohio State Unviersity
[6]University of Iowa
[7]IGN, University of Copenhagen
[8]Chengdu University of Technology

Presenting Author: xiaomliu@unc.edu

Chemical weathering and reverse weathering are two critical processes controlling biogeochemical cycles. Geochemical and stratigraphic records suggest that these processes might have varied considerably during the Permian to Early Triassic period influencing biogeochemical cycles during this critical interval of Earth's history. Here we present newly derived seawater lithium and strontium isotope records of bulk carbonates and fossil brachiopods spanning the Permian to Early Triassic period (300 Ma to 247 Ma). The lithium isotope composition of seawater remained constant for most of the Permian until a sharp decrease in the Changhsingian (~ 254 – 252 Ma), reaching a minimum value of around 5‰ near the Permian-Triassic boundary (PTB, ~ 251.92 Ma). This decline occurred several million years prior to the PTB but low seawater Li isotope values (~10‰) persisted throughout the Early Triassic. Based on steady-state box modeling of the marine Li isotope budget, changes in the fluxes and isotopic composition of Li inputs alone (i.e., chemical weathering and hydrothermal) are unable to explain the abrupt decline in seawater Li isotopes. Rather, increased reverse weathering in the ocean is required to initiate the quick drawdown and maintain low Li isotopic values in the End Permian and Early Triassic (253-247 Ma).