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The recovery of the biological pump across the K/Pg boundary in the GSSP of El Kef, Tunisia

JOEP VAN DIJK[1,2], JULIO SEPÚLVEDA[1], LAIA ALEGRET[3], HEATHER BIRCH[4], TIMOTHY BRALOWER[5], HEATHER JONES[5,6], MICHAEL J HENEHAN[7], PINCELLI M. HULL[8], MOHAMED HEDI NEGRA[9], ANDY RIDGEWELL[10], URSULA ROEHL[6], JOHAN VELLEKOOP[11,12], THOMAS WESTERHOLD[6], JESSICA WHITESIDE[13], ELISE B WILKES[14] AND RICHARD ZEEBE[15]

[1]University of Colorado Boulder
[2]Utrecht University
[3]University of Zaragoza
[4]University of Bristol
[5]Pennsylvania State University
[6]University of Bremen
[7]GFZ German Research Centre for Geosciences
[8]Yale University
[9]Tunis El Manar University
[10]University of California - Riverside
[11]Vrije Universiteit Brussel
[12]Department of Geology
[13]University of Southampton
[14]Caltech
[15]University of Hawaii at Manoa

Presenting Author: joep.von.dijk@gmail.com

Earth's most recent mass extinction at the Cretaceous/Paleogene (K/Pg) boundary provides insight into the resilience of marine ecosystems to environmental perturbations resulting from a bolide impact. Mass extinctions among marine calcareous nannoplankton heavily disrupted the marine food web, resulting in a severe weakening of the ocean's biological pump. The timing and heterogeneous nature of the recovery of the biological pump remain poorly resolved in the neritic-bathyal zone in the aftermath of the impact. Here, we address the evolution of the biological pump across the K/Pg at the Global Boundary Stratotype Section (GSSP) at El Kef, Tunisia using high-resolution compound-specific carbon isotope records ($\delta^{13}C_{biomarker}$) of non-calcareous marine phototrophs from an outer shelf to upper bathyal setting of the southwestern Tethys Ocean. We use $\delta^{13}C_{biomarker}$ to reconstruct changes in isotopic fractionation (ε_p), which is a function of the physiology and geometry of marine phototrophic cells, their rate of carbon fixation, and the concentration and isotopic composition of aqueous CO_2. We then use our ε_p record to constrain the recovery of the biological pump in this region while considering the composition of marine phytoplankton, the composition and the $\delta^{13}C$ of the benthic foraminifera assemblage, a state-of-the-art physiological model for ε_p, and carbon cycle simulations using cGENIE. Our results indicate that the recovery of the biological pump at this shallow setting likely outpaced the recovery in the open ocean. This is in agreement with the selective extinctions among phytoplankton at the K/Pg, with most survivors that would later repopulate open-ocean sites being adapted to neritic environments.