An ecological rise of marine eukaryotes in the Tonian enabled by nutrient availability

Shuhai Xiao*†[1], Junyao Kang[2], Benjamin C. Gill[1], Qing Tang[3], Susannah M. Porter[4], Leigh A. Riedman[4], Gordon D. Love[5], Ke Pang[6], Bin Wan[6], Carol M. Dehler[7], Karl E. Karlstrom[8], Hong Hua[9], Chuanming Zhou[6], and Xunlai Yuan[6]

[1]Department of Geosciences, Virginia Tech, Blacksburg – VA 24061, United States
[2]Department of Geosciences, Virginia Tech, Blacksburg – VA 24061, United States
[3]School of Earth Sciences and Engineering, Nanjing University, Nanjing 210023 – China
[4]Department of Earth Science, University of California, Santa Barbara, CA 93106 – United States
[5]Department of Earth and Planetary Sciences, University of California, Riverside, CA 92521 – United States
[6]Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing 210008 – China
[7]Department of Geology, Utah State University, Logan, UT 84322 – United States
[8]Department of Earth Planetary Sciences, University of New Mexico, Albuquerque, NM 87131 – United States
[9]Department of Geology, Northwest University, Xi'an 710069 – China

Abstract

The diversification and ecological rise of marine eukaryotes is an impactful evolutionary event that transformed the Earth system. When did it occur? What were the driving forces? What were its impacts on the Earth system? Increasing paleontological and geochemical evidence indicates that the ecological expansion of marine eukaryotes occurred in the Tonian Period, earlier than previously thought. Further, emerging geochemical data indicate that increasing availability of marine nutrients (particularly phosphate and nitrate) may have enabled the ecological rise of photosynthetic eukaryotes, which in turn opened ecological opportunities for the diversification of eukaryotes overall. The transition from a prokaryote-dominated to a eukaryote-dominated marine ecosystem, particularly in terms of export bioproduction and global carbon cycles, had profound impact on the Earth system and in the long run may have contributed to snowball Earth glaciations in the following Cryogenian Period.

Keywords: Tonian, eukaryotes, nutrient availability, photosynthesis, nitrogen, phosphorus

*Speaker
†Corresponding author: xiao@vt.edu