Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.19835

Single-microfossil carbon isotope analyses show consistently ^{13}C-depleted microbial mat-builders throughout the Proterozoic

HEDA AGIĆ[1], SUSANNAH PORTER[2], PHOEBE COHEN[3] AND CHRISTOPHER JUNIUM[4]

[1]Durham University
[2]University of California Santa Barbara
[3]Williams College
[4]Syracuse University

Presenting Author: heda.agic@durham.ac.uk

Proterozoic rocks record significant fluctuations in isotopic composition of sedimentary carbon, and are generally ^{13}C-depleted relative to the Phanerozoic. One possibility is that greater contributions of ^{13}C-depleted organic matter (OM) from widespread benthic microbial mats during the Proterozoic. Here we test this hypothesis by measuring the organic carbon isotopic composition of mat-builder microfossils.

Mat-building prokaryotes are a common component of Proterozoic organic-walled microfossil (OWM) assemblages. Abundant and widespread form-species include filamentous *Siphonophycus* and *Polytrichoides*, and colonial *Synsphaeridium*, long interpreted to be cyanobacterial based on similarity to extant microorganisms. We measured the C-isotopic composition of a broad array of individual OWM from multiple Proterozoic units, using nano-EA-IRMS. This approach provides a window into short-term environmental variability and reveals palaeoecological information about Proterozoic life. Studied assemblages derive from the Paleoproterozoic Changcheng Group (China), the end-Mesoproterozoic lower Bylot Supergroup (Canada), the Tonian Chuar Group (USA), and the Ediacaran Pertatataka Formation (Australia). In general, within-sample $\delta^{13}C_{OWM}$ showed a wide range, in some cases with spreads >15‰. The most consistent values among OWM were of filamentous and cell-aggregate mat-builder taxa, which averaged -29.3‰ (N=10) in the Changcheng, -30.5‰ (N=20) in the Bylot, -27.8‰ (N=45) in the Chuar, and -29.9‰ (N=9) in the Pertatataka assemblage. Mat-builders were on average more depleted than the average assemblage $\delta^{13}C_{OWM}$ within a single sample by 3.7‰ in the Changcheng, 4.8‰ in the Bylot, 3.5‰ in the Chuar, and 2.5‰ in the Pertatataka. Additionally, mat-builders were more depleted than bulk $\delta^{13}C_{org}$ in 37 of 43 samples, including in the strata recording a positive C-isotope excursion in the Chuar Group where $\delta^{13}C_{org}$ averaged at -18.3‰.

We suggest that consistently low δ^{13}C values of OM in the Proterozic were derived from widespread microbial mats that produced a higher proportion of OM than other OWM, including planktonic taxa.