Geophysical Research Abstracts
Vol. 21, EGU2019-6234, 2019
EGU General Assembly 2019

Speleothem Biomarker Evidence for Vegetation and Bacterial Responses to Holocene Climate Change

James Bendle (1), Canfa Wang (2), Sarah Greene (1), Michael Griffiths (3), Junhua Huang (2), Heiko Moossen (4), Hongbin Zhang (2), Kate Newton (1), and Shucheng Xie (2)

(1) University of Birmingham, School of Geography, Earth and Environmental Science, Birmingham, United Kingdom (j.bendle@bham.ac.uk), (2) China University of Geosciences, Wuhan, China (wangcf@cug.edu.cn), (3) William Paterson University, Department of Environmental Science, Little Silver, United States, (4) Max Planck Institute for Biogeochemistry, Jena, Germany

Stalagmites have become a key archive in Quaternary palaeoclimatic reconstruction due to their ability to yield continuous and undisturbed records, precise and absolute chronologies, and their global terrestrial distribution. Oxygen isotopes are effectively the master proxy for speleothem analysis, but inherently encode a mix of climatic signals. Thus it is tricky to deconvolve the temperature and precipitation signal from speleothems. Bacterial derived 3-hydroxy fatty acids (3-OH-FAs) have potential as independent temperature and pH proxies. By applying the 3-OH-FA based temperature proxy RAN15 and the pH proxy RIAN to the HS4 stalagmite from central China, we recently reconstruct Holocene temperature and hydrological changes, respectively.

Now we address the issue of how terrestrial carbon storage feeds back on warm climate states, which is critical for improving global warming projections. Soils may act as a positive feedback on climate if warming increases soil carbon decomposition rates. Conversely, if increases in net primary production (NPP) exceed increases in decomposition, the climate feedback will be negative. Here we present new constraints on the response of terrestrial carbon cycle feedbacks, especially soil respiration, during earlier warm episodes of the early Holocene Climate Optimum (HCO) and Medieval Warm Period (MWP), which have hitherto been poorly constrained due to a lack of proxies (and thus available data). We utilize the first palaeoclimatic application of compound-specific δ13C measurements on n-fatty acid biomarkers extracted from a stalagmite. We resolve a proportional increase in C3 plants in the catchment area during these warmer/wetter intervals. Moreover, we find that heterotrophic soil respiration was highly substrate selective, indicating that NPP outpaced decomposition and the catchment behaved as a carbon sink. Thus, we provide the first palaeoclimate evidence that subtropical mineral soils in warmer/wetter climates can act as a negative climate feedback.