A deep time perspective on ocean pH

S. A. KASEMANN[1*], R. WOOD[2], F. OHNEMÜLLER[13], M. O. CLARKSON[24], T. M. LENTON[5] AND A. R. PRAVE[6]

[1]Department of Geosciences & MARUM-Center for Environmental Sciences, University of Bremen, 28334 Bremen, Germany ([*]skasemann@marum.de)
[2]School of GeoSciences, University of Edinburgh, UK (Rachel.Wood@ed.ac.uk)
[3]Forschungsgemeinschaft Kalk und Mörtel e.V., Köln, Germany (frank.ohnemueller@kalk.de)
[4]Department of Chemistry, University of Otago, New Zealand (matthew.clarkson@otago.ac.nz)
[5]College of Life and Environmental Sciences, University of Exeter, UK (T.M.Lenton@exeter.ac.uk)
[6]Deaprtment of Earth and Environmental Sciences, University of St Andrews, UK (ap13@st-andrews.ac.uk)

Ocean pH is a critical variable in Earth's climate system: it influences the stability and production of carbonate minerals and the availability of nutrients, hence impacts on marine ecosystems. Further, ocean pH is linked to atmospheric carbon dioxide concentrations and can inform on pCO_2 fluctuations in Earth history. Detailed reconstruction of past ocean pH has therefore become a key objective of various (palae)oceanographic studies.

Boron isotopes locked in marine carbonate rocks provide a measure of ocean pH and are frequently utilised to identify fluctuation in ocean acidity and to reconstruct atmospheric CO_2 concentration. Particular attention has been given to rapid and transient acidification events in the Cenozoic as potential analogues for present and future environmental perturbations. Based on these data ocean pH was never more than 0.6 units lower than today and short-term oscillations were at maximum 0.3 pH units.

Deeper in time reconstructing both the short- and long-term history of ocean pH becomes challenging, particularly during times of extreme environmental and ecological changes. At present, pH proxy data are few and most information is based on computed ocean-pH models. With our new B isotope compilation, we will illustrate that before the Cenozoic, the Earth was marked by substantially larger, short- and long-term fluctuations in ocean pH, often linked closely to extreme ecological changes. Our record will start in the Cryogenian, at the end of the Sturtian glaciation c. 660 Myr ago, cover the Ediacaran and transition into the Cambrian, and provide a glimpse at the Permian and Triassic.