Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.23531

Boron-based insights into late Cretaceous climate and carbon cycle: Updates from the PETRARCH project

MICHAEL J. HENEHAN, SOPHIE WESTACOTT, BERNÁT HESZLER, EMMELINE GRAY AND ELLIE CHAMBERS

University of Bristol

Presenting Author: Michael.Henehan@bristol.ac.uk

While our understanding of Cenozoic CO_2 has greatly improved over the past 10 years thanks in part to advances in the boron isotope-pH proxy [see e.g. 1,2], the Cretaceous period remains an uncharted frontier for boron-based CO_2 reconstructions. While there are challenges associated with the extension of our records into the Mesozoic, the Cretaceous poses major questions that would greatly benefit from the attention of boron isotope geochemists. In particular, the late Cretaceous saw the warmest greenhouse temperatures of the past 100 Myr. Understanding what CO_2 levels are needed to drive these extreme temperatures, and how CO_2 is cycled in hothouse worlds, are pressing priorities in the face of current anthropogenic climate change [e.g. 3]. Not only this, but this time period witnessed intervals of prolonged, sometimes global marine anoxia in the form of the Cretaceous Ocean Anoxic Events (OAEs), and the role for CO_2 in predisposing the Earth system to anoxia, or tipping Earth into an OAE, is still not well understood. Here I present progress from the PETRARCH project (www.petrarch-project.science), which aims to address these open questions. This includes efforts to extend the boron isotope-pH proxy to radiolarian silica, through laboratory culturing and open-ocean sampling, to allow us to apply boron isotope approaches to time intervals and sediments where planktic foraminifera are not preserved. In combination with our multi-species planktic foraminiferal boron isotope records, this work allows us to place better quantitative constraints on climate forcing from CO_2 through the late Cretaceous. Synthesising these geochemical insights with Earth system modelling, we aim to shed new light on the role of elevated CO_2 in driving marine anoxia.

[1] Rae et al. (2021), *Ann. Rev. Earth Planet. Sci.* 49, 609-641.
[2] Hönisch et al. (2023), *Science* 382(6675), eadi5177.
[3] Tierney et al. (2020), *Science* 370(6517), aay3701.