The boron isotopic composition of diatom opal

GAVIN L. FOSTER¹, HANNAH K. DONALD¹, NICO FRÖHBERG¹, ALEX J. POULTON², C.MARK MOORE¹, GEORGE E.A. SWANN³

¹Ocean and Earth Science, University of Southampton,
Southampton, UK SO14 3ZH
²The Lyell Centre, Heriot-Watt University, Edinburgh, UK
EH14 4AS
³School of Geography, University of Nottingham,
Nottingham, UK NG7 2RD

The boron isotopic composition of marine calcium carbonates is a well-known proxy for ocean pH [1], with applications for marine foraminifera ranging from reconstructing atmospheric CO₂ in the past to tracing the nature and magnitude of ocean:atmosphere exchange of CO₂ [1]. The high latitude oceans are key in this regard, being areas of substantive carbon and heat exchange. However, calcareous microplankton are rare in deep sea sediments south of 50° in the Southern Ocean and north of 40° in the North Pacific. Instead, these sediments contain abundant siliceous microfossils (e.g. diatoms, sponges, radiolarians), necessitating the development of opal-based proxies to reconstruct the past behaviour of these key oceanographic regions.

Here, we apply the boron isotope pH proxy to diatom opal for the first time. We will present δ¹¹B and B/Si data from two sample sets. The first is for the diatom Thalassiosira weissflogii cultured under controlled conditions with variable pH (7.48, 7.83, 8.25, 8.53), and the second sample set consists of sedimentary diatom opal belonging to the genus Coscinodiscus from ODP Site 882 in the North Pacific. These samples originate from 2.52 to 2.85 Ma, and include the period of intensification of Northern Hemisphere Glaciation [2]. We will present and discuss the pH-δ¹¹B and pH-B/Si relationships in the T. weissflogii cultures and apply this understanding to interpret the sedimentary record of Coscinodiscus. Both sample sets illustrate the differences in boron systematics between carbonates and opal, but also highlight the potential of δ¹¹B and B/Si in diatom opal as a means to reconstruct the ocean carbonate system in regions devoid of preserved calcareous microplankton.