Carbonate chemistry response of the North Atlantic mixed layer and thermocline to the Paleocene-Eocene Thermal Maximum

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With between 2,000 and 12,000 Gt of carbon released over ≤10 ka (see [1] and references therein), the Paleocene-Eocene Thermal Maximum (PETM) is regarded as the best analogue for understanding the long-term effects of present-day fossil carbon combustion (e.g. [2]). Deep ocean acidity displayed a strong response to this carbon cycle perturbation, witnessed in the substantial temporary shoaling of the Carbonate Compensation Depth (by >2 km) [3] but, as yet, no constraints exist for the response of surface water *p*H through this event. If the initial injection of carbon occurred sufficiently rapidly (relative to the mixing time of the oceans) it should have resulted in a significant drop in surface water *p*H that subsequently recovered to near pre-event values. Such a perturbation of surface water *p*H is potentially traceable by means of the boron isotopic composition (expressed in $\delta^{11}B$) of marine carbonates.

In this presentation we will investigate the upper ocean's *p*H response through the PETM with new $\delta^{11}B$ records from two species of planktic foraminifera from the North Atlantic (DSDP Site 401). We present complementary boron isotope and B/Ca records for the mixed layer (using *Morozovella subbotinae*) and the thermocline (using *Subbotina patagonica*), both sampled from the same sedimentary depths at high resolution spanning the entire event. Planktic foraminifera at Site 401 are very well preserved, implying minimal diagenetic alteration of their primary $\delta^{11}B$ and B/Ca signatures.

Through calculations assuming various seawater $\delta^{11}B$ and alkalinity configurations, we aim to provide new constraints on the evolution of surface water *p*H and atmospheric pCO_2 across the PETM to better constrain the amount of carbon released and, hence, its likely source.

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The Gulf of Mexico Pb isotope response to elevated deglacial freshwater fluxes

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The disintegration of the North American Laurentide ice sheet during progressive warming throughout the last deglaciation provides an excellent opportunity to study changes in continental surface conditions and its effect on the dissolved runoff signal. The climate in interior North America shifted from glacial conditions dominated by intense (sub-)glacial physical and significantly reduced chemical weathering rates to wetter and warmer conditions in the transition to the Holocene. Various mineral phases in freshly exposed rock substrate weather relatively quickly, resulting in increased dissolved runoff fluxes for many major and trace elements during deglacial warming (cf. [1]). For tracing ice sheet retreat, elements displaying incongruent chemical weathering behaviour are particularly useful as long as these elements have short residence time in seawater such as dissolved Pb ($\tau \sim 20$-30 years).

At the NW Atlantic Laurentian Fan and deeper Blake Ridge, two Pb isotopic data sets suggest a significant increase in riverine input from proximal North American sources eastward during and after the Younger Dryas [2, 3]. The magnitude of change between these two sites suggests a proximal-distal relationship with the source of this radiogenic Pb signal most likely being located within the Gulf of St Lawrence. Together with Laurentide ice sheet margin retreat patterns presented from interior North America, oxygen isotope records derived from the Gulf of Mexico [4] and one multi-proxy data set from the outer St. Lawrence estuary [5], these Pb isotope records suggest that the signal recorded in the NW Atlantic very likely traced a major runoff reorganisation in interior North America during the mid-Younger Dryas.

Apart from [5], the identification of increased deglacial freshwater input into NW Atlantic sites by means of surface water $\delta^{18}O$ has proven difficult if not impossible [6]. Conversely, the supposedly preceding mid-deglacial Laurentide-derived freshwater runoff into the Gulf of Mexico was clearly recorded in surface-dwelling foraminifera in the open Gulf of Mexico [4, 7]. In order to complement the existing NW Atlantic Pb isotope records, we therefore present a new authigenic Fe-Mn oxyhydroxide derived Pb isotope record from core MD02-2550 within the Orca Basin in the Northern Gulf of Mexico. This core has a well-dated deglacial section and contains oxygen isotopic and organic matter content-based evidence for enhanced freshwater runoff during this key interval [7], allowing direct comparison with the new Pb isotope records.

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