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Report
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AN ULTRA-HIGH-RESOLUTION ISOTOPIC ANALYSIS OF THE MARKS TEY ABRUPT CLIMATE EVENT, MIS 11C

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Background and Rationale

Stable isotopes in lacustrine environments are widely used as tracers of past climate (e.g., Holmes *et al*., 2010). They are particularly useful in studying abrupt climate events (ACEs) given their rapid response to changing climate. The impact of ACEs can be seen within a human lifetime and may have severe economic and societal consequences (Alley *et al*., 2003). The Marks Tey, Essex, core contains an annually laminated record of an ACE during MIS 11c, the best available in a pre-Holocene interglacial (Tye *et al*., 2016). Subsequently, this site presents a unique opportunity to understand the dynamics of ACEs without anthropogenic input. A low-resolution oxygen isotope record at this site exists shows a link between vegetational and isotopic changes (fig.1); thus, infers a climatic response (Tye *et al*., 2016).

The tephra layer identified at this site links this event to a reduction in sea surface temperature in marine core ODP 980, allowing for North Atlantic Ocean dynamics to be confidently correlated to ultra-high-resolution terrestrial changes for the first time in MIS 11c (Candy *et al*., 2021, fig.1). This project aims to utilise oxygen isotopes from individual calcite laminations drilled from sediment blocks (e.g., Mangli *et al*., 2010) as a palaeoclimatic proxy by producing a minimum decadal resolution across ~ 2300 varve years and increase resolution to 5 years during the ecological event to fully extract the climate signal from the background noise across the depth interval. This will permit (1) a robust analysis of the structure of this ACE and any cyclicity within; (2) a detailed comparison to the 8.2 ka event, of which it is often seen as an analogue for (Koutsodendris *et al*., 2012).

Results and significance

Preliminary results indicate that the Non-Arboreal Pollen (NAP) phase at Marks Tey is the final oscillation of a period of a millennial-scale reduction in isotopic values spanning ~ 1500-2000 years. Within this, there are two distinct isotopic events separated by a centennial-scale increase in values (Oxygen Events (OE) 1 and 2). The NAP phase (here referred to as OE 2c) is part of a 3-step reduction in isotopic values within OE 2. OE 1 is ~ 400 years in length, whilst OE2 is ~ 865 years (averaged between 30/100-year smoothing), giving an overall length of ~ 1250 years. The temperature decline experienced between the onset and trough of OEs 1 and 2 is ~ 3.64 and 4.25 °C respectively, or ~ 5°C from the onset of OE 1 to the trough of OE 2c (averaged between 30/100-year smoothing). Both the duration and absolute reduction in temperatures exceed that of Western Europe during the 8.2 ka event (~300 years, ~1°C), indicating that this event is not an 8.2 ka analogue. Indeed, there is greater similarity to the Younger Dryas (~ 1200 years, 6°C temperature decline). Significantly, this is not something experienced at any point in the current warm phase and may relate to the substantial levels of ice loss in MIS 11c, which is yet to occur in the Holocene.

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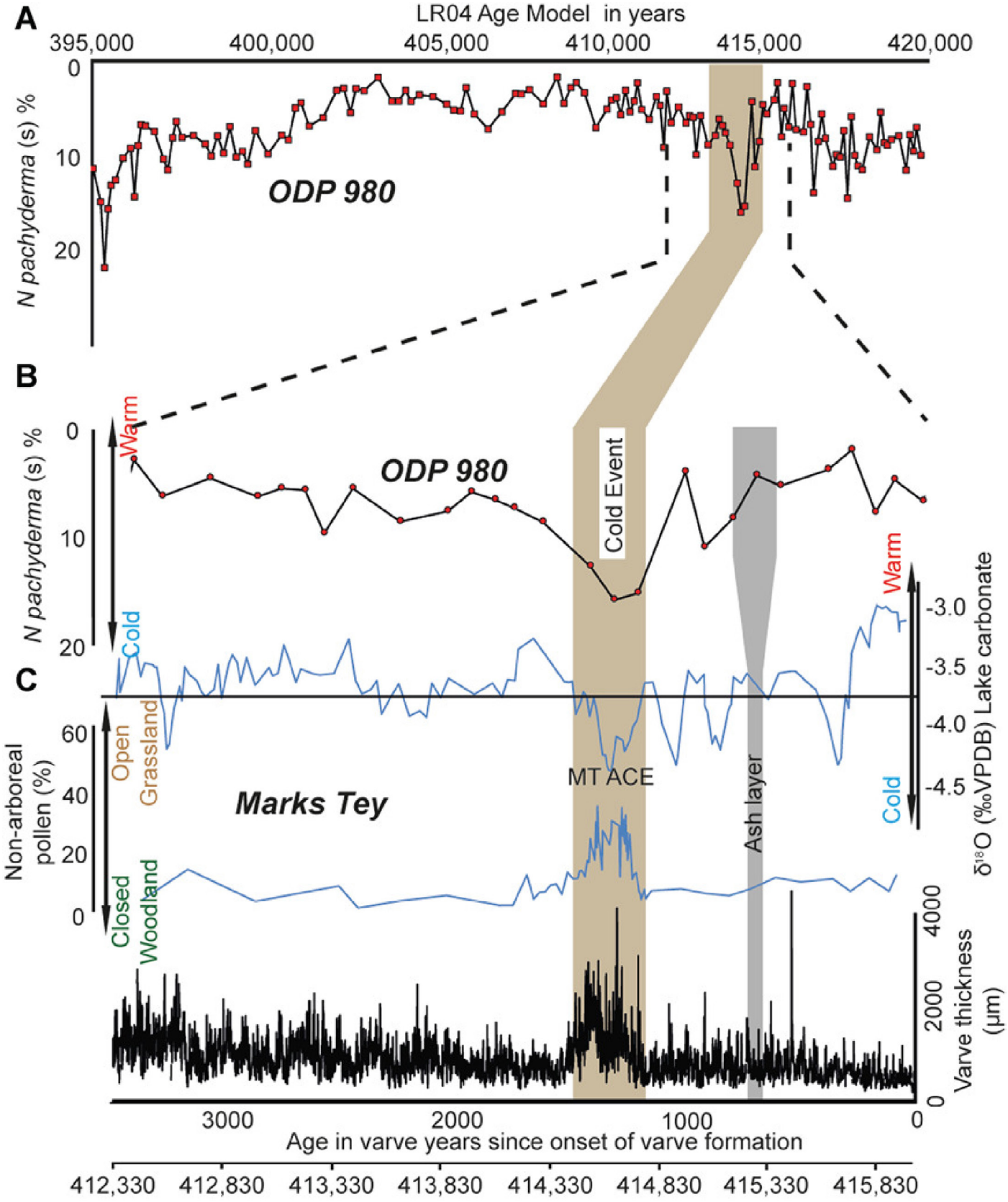

Figure 1. The correlation of key environmental proxies from Marks Tey (C, oxygen isotopes, non-arboreal pollen and varve thickness) with the N.pachyderma (s) (A and B) of ODP 980 (McManus *et al*., 1999 but using the timescale of Lisiecki and Raymo, 2005) on the basis of the co-located tephra layer. Both B and C are plotted on independent timescales but are aligned on the basis of the tephra layer. Taken from Candy *et al*., (2021).

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