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Tracking abrupt climate shifts with stable isotopes in lacustrine sediments: geochemical evidence for dynamic temperature, precipitation and seasonality regimes during the last deglaciation (8 to 15ka BP)

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The interval between the Last Glacial Maximum (L.G.M.) and the stabilisation of climatic conditions during the Holocene (ca 8ka BP) is well-known to have been punctuated with abrupt climatic shifts on a range of time scales. This is clearly seen in the oxygen and deuterium isotope signal of the Greenland ice core records (e.g. NGRIP). How the magnitude and duration of these events translates across a region, such as western Europe, is however, unclear, primarily because many traditional proxies do not respond rapidly enough to provide a clear expression of abrupt climatic events. In this paper we present a range of new oxygen and carbon isotopic records, and a review of existing datasets, from lacustrine carbonate sequences spanning the interval 8 to 15ka BP. These records lie on W-E and N-S transects across the British Isles allowing the spatial variability of the structure and magnitude of abrupt climatic events to be investigated. The oxygen isotopic signal is primarily driven by temperature and indicates that the climatic structure of abrupt events in this time interval, the Lateglacial interstadial for example, is highly variable over relatively small distances. Records from the east of Britain suggest patterns of warming and cooling in the Lateglacial interstadial comparable to that observable in Greenland (e.g. a temperature maximum occurring early in the interstadial), whilst record in the west provide evidence for more subdued climatic oscillations with peak temperatures occurring late in the interstadial. Spatial variability in the isotopic expression of abrupt climatic events allows the role of different factors; i.e. the position of the polar front, the influence of the thermohaline conveyer and the influence of maritime versus continental climates, to be investigated. This work also indicates that a major depletion event occurs in the δ18O value of lake carbonates during the early Holocene which effects all currently known sequences. This depletion event cannot be explained by temperature shifts and indicates a major re-arrangement in the atmospheric isotopic system of western Europe during the early part of the Holocene. Potential causes of this event are proposed and its implication for understanding the climate dynamics of western Europe since the L.G.M. are discussed.