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A multiproxy (pollen, stable isotope, chironomid and μXRF) record for the Late Glacial to Holocene transition from Thomastown Bog, Ireland

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We present results for a 3.5 m composited and spliced palaeolake sediment core taken from Thomastown Bog (53º 39' 25.8" N, 6º 28' 24.1" W), a small basin in Co. Meath, eastern Ireland. Multiproxy investigations comprising rangefinder C-14 dates, pollen, chironomids, stable isotopes (O and C), loss-on-ignition (LOI) and new μXRF analysis (using core scanning step-lengths of 0.2 mm) have produced an ultra-high resolution record of palaeoenvironmental change, spanning the Late Glacial to Holocene transition (ca. 15000 to ca. 9000 cal. BP).

The sediment stratigraphy of the former lake is characterized by intercalated lacustrine marls and clastic silts, underlain by laminated, dark clays and capped by organic mud and peat that formed as the lake shallowed. Six local pollen assemblage zones have been recognized, spanning four distinct climatic episodes from the Late Glacial to early-Holocene. Major climate changes are dominated by the classic tripartite climate sequence for northwest Europe. XRF core scanning results show that the end of the Glacial and Younger Dryas stadial are both marked by very low Ca XRF intensities, where autochthonous Ca production had slowed or ceased, and concomitant increases in XRF intensities for allochthonous sediment indicators Fe, K and Ti. Major climate shifts appear to have initiated changes in lake sediment geochemistry in a matter of decades, and both our chironomid-based temperature reconstruction and LOI results show these changes at lower resolutions. The intervening Late Glacial interstadial shows a series of multi-centennial scale, lower amplitude phases of variability that also correspond to changes in the relative importance of autogenic carbonate production (Ca) and allogenic sediment input (Fe, K, Ti). Meanwhile, highly elevated XRF Mn intensities occur in centennial-scale episodes linked to apparent climate ameliorations. Although this marked variability may represent Mn mobilization during diagenesis, these data appear to show relatively brief episodes of soil instability and erosion that arose while the Thomastown Bog catchment slopes were adjusting to new climatological conditions.

Using stable isotope curves for calibration, we show that the ultra-high resolution climate and environmental changes revealed by μXRF scanning correspond exceptionally well with the latest regional climate models from Greenland ice cores. Millennial to sub-centennial adjustments in lake sediment chemistry reflect the combined effects of regional climatic change and nested local geomorphic (catchment and internal lake) variability, that emphasizes the importance of underlying climate forcing on geomorphic adjustment during this period of rapid environmental change.