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A reconstruction of fire and vegetation in Cantabria, northern Iberian Peninsula throughout the Holocene using a multi-proxy approach

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Abstract

Sedimentary palaeofire records are critical to our understanding of past ecology, fire, climate, and human-land relationships in postglacial quaternary environments. This data provides insights into the favourable environmental (e.g., flora and vegetation) and climate (e.g., hydrological) conditions that impact fire propagation, intensity, and frequency.

Here we present a study of a multi-proxy approach to reconstruct fires in Cantabria throughout the Holocene from a peat record site (Ríofrío peatbog, Vega de Liébana, Cantabria in the northern Iberian Peninsula, 43.037°N, 4.697 W°, 1740 MASL). Besides contributing valuable palaeoecological knowledge, our work will fill in research gaps of postglacial quaternary environmental history of the Iberian peninsula's mountain regions (Ruiz-Fernandez et al., 2016) and validate charcoal classification methods.

Macroscopic and microscopic charcoal concentrations in peat records are established palaeofire proxies. During a fire, charcoal particles undergo primary deposition via aeolian fallout, with the size decreasing over distance (Whitlock & Larsen, 2005). The concentration and deposition rate of particulate charcoal, through counting and size classification, can signal the timing, intensity, patterns, and proximity of the fires to the deposition site. The morphology (i.e., qualitative particle identity classification) and morphometry of the particles (i.e., length:width ratio calculations) provide information on the kind of flora that burned (Enache and Cumming 2006; Mustaphi and Pisaric, 2014; Umbanhowar and Mcgrath, 1998).

As such, we have combined these approaches: at a 1 cm resolution, we applied the 27

classifications method from Mustaphi and Pisaric (2014) and placed them into size classes; we also determined the length:width ratios and organic matter content (loss on ignition, LOI). Additionally, we looked at pollen and non-pollen palynomorphs (NPP) to further interpret and validate signals of past climate, dominant burned flora, and surrounding vegetation.

From this multi-proxy data, aside from a fire reconstruction, we will distinguish periods of open versus forested vegetation (i.e. maintenance fires versus newly burned from charcoal and pollen data; Fyfe et al., 2003; Pérez-Obiol et al., 2012; Rodríguez-González et al., 2023). The study allows us to validate secondary charcoal deposition through erosion proxies (i.e., NPP). Organic matter data (i.e., LOI) could provide us with indirect connections between fire dynamics and large-scale climate processes (i.e., flooding, Ishii et al., 2017).

Keywords: fire, palaeoclimate, particulate charcoal, landscape

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