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Peat sequence diatoms from Kedarnath, Central Himalaya, used to reconstruct mid-late Holocene hydroclimatic conditions

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ABSTRACT

Diatoms preserved in peat can preserve valuable evidence of palaeoenvironmental changes due to their sensitivity to climatic changes and their crucial role in high productivity and nutrient cycling. We present total diatom concentrations and diatom community composition preserved in a high-altitude peat deposit located in the headwaters of the Mandakini River, Central Himalaya, India, to reconstruct the hydroclimatic conditions which prevailed during the mid-late Holocene. Since diatom productivity is associated with water table height/ elevation, the high diatom concentrations during ~5656–5307 cal yr BP, ~4310–4264 cal yr BP, ~3515–3024 cal yr BP and ~ 1679–988 cal yr BP are inferred to have been periods of relatively high water table, denoting improved hydrological conditions. Conversely, low concentrations of diatoms occurred during ~8077–5866 cal yr BP, ~5263–4332 cal yr BP, ~4241–3570 cal yr BP, ~2970–1715 cal yr BP, and ~ 697–370 cal yr BP. The temporal changes in the diatom suggest stressed hydrological conditions. The water table fluctuations inferred from diatom concentration variability show a positive correlation with the Indian summer monsoon (ISM) intensity and a negative correlation with the westerlies. The observed low concentrations of diatoms was associated with the relatively dry climatic conditions, which is detrimental to the peat environment and therefore suggests the need for *in-situ* data monitoring for the Indian peat deposits. As dry conditions can result in the deterioration of peat deposits, which may prove a significant source of atmospheric carbon dioxide in a changing climate, their conservation strategies will help limit carbon emissions.

1. Introduction

Peat deposits play a crucial role in global climate through carbon sequestration despite covering an area of only 3% of Earth's land area (Gallego-Sala et al., 2018; Xu et al., 2018; Yu, 2012). Therefore, peat deposits are thought to be responsible for cooling at times during the Holocene (Frolking et al., 2006; IPCC Climate Change, 2013; Loisel et al., 2021). However, such positive feedback is suggested for pristine peat deposits, which efficiently absorb carbon from the atmosphere (Gallego-Sala et al., 2018).

Peat deposits respond sensitively to changing water table levels that modulate moisture availability for plant productivity and drives peat sustenance and carbon burial (Charman et al., 2012; Hargan et al., 2015a; Loisel et al., 2012; Treat et al., 2019). Among the multiple drivers of peat degradation during the Holocene, temporal fluctuations of climatically induced water table levels are considered to be one of the most important factors in tropical regions (Cobb et al., 2017; Dargie et al., 2017; Loisel et al., 2021; Lund et al., 2012).

Among plants, diatoms are abundant and diverse in peat and play an important role in nutrient cycling and the food web (Gaiser and Rühland, 2010; Kokfelt et al., 2009; Rühland et al., 2000). Diatoms are unicellular, eukaryotic algae that have long been used to decipher changes in aquatic environments (Battarbee, 2000). Although diatom-based transfer functions have been widely used to reconstruct various climatic, chemical, and hydrological variables in lakes (Smol and Cumming, 2000), diatoms have rarely been used in peats for reconstructing environmental changes (Gaiser and Rühland, 2010) but is recently gaining momentum. Diatoms have been used to reconstruct the relative changes in the water table levels and to track the health and pattern of peat degradation (Carballeira and Pontevedra-Pombal, 2020; Chen et al., 2020; Li et al., 2020).

The species-specific habitat variations of diatoms preserved in peat

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