Journal of Asian Earth Sciences 229 (2022) 105184

Contents lists available at ScienceDirect

Journal of Asian Earth Sciences

journal homepage: www.elsevier.com/locate/jseaes

The late Holocene hydroclimate variability in the Northwest Himalaya: Sedimentary clues from the Wular Lake, Kashmir Valley

Aasif Mohmad Lone [a], Satinder Pal Singh [a,*], Rayees Ahmad Shah [b], Hema Achyuthan [c], Nafees Ahmad [a], Abul Qasim [a], Gyana Ranjan Tripathy [d], Anupam Samanta [d], Pankaj Kumar [e]

[a] Department of Earth and Environmental Sciences, Indian Institute of Science Education and Research, Bhopal 462066, Madhya Pradesh, India
[b] Geosciences Division, Physical Research Laboratory, Ahmedabad 380009, Gujarat, India
[c] Institute for Ocean Management, Anna University, Chennai 600025, India
[d] Department of Earth and Climate Sciences, Indian Institute of Science Education and Research, Pune 411008, Maharashtra, India
[e] Inter-University Accelerator Center (IUAC), New Delhi 110067, India

ARTICLE INFO

Keywords:
Late Holocene
Paleo-monsoon
Himalaya
Hydroclimate
Western disturbances
Geochemistry

ABSTRACT

This study focuses on the immensely debated pre-instrumental centennial–millennial scaled forcing of the late Holocene hydroclimate variability in the Northwest Himalaya (NWH). The Wular Lake is ideally situated close to the modern intertropical convergence zone (ITCZ) in the NWH and fed by the Jhelum River draining the vast Kashmir Valley, which receives seasonal precipitations from the Indian Summer Monsoon (ISM) and Western Disturbances (WD). In this study, size segregated lithic fractions (sand, silt, and clay) and elemental concentrations (TOC, TN, Ba, Al, Mn, and Fe) have been measured in the ^{14}C-AMS dated NWC sediment core collected from this lake. The continuous NWC sedimentary records reveal temporal environmental changes (water level, organic detritus supply, and redox conditions) in this open mega-lake system suggesting prevailed hydroclimate variations in the valley during the late Holocene. The captured hydroclimate variations are a wetter phase (~4.2–3.4 cal kyr BP) followed by relatively drier conditions and extreme drought before the wet Little Ice Age (LIA). The plausible forcing seems to be the latitudinal ITCZ migration regulated seasonal precipitations from the tropical/subtropical moisture sources. The ISM to WD moisture turnover dominated winter over summer precipitations in the valley during the former warm and wet phase but unequivocally reflected during the cold and wet LIA. Additional hydroclimate control comes from permafrost ice melting episodes of a few centuries duration during high solar activity events (sunspot number $\geq$50). A comparison with the regional studies further indicates that NWC records capture hydroclimate signatures widespread in the NWH.

1. Introduction

Asian monsoon region seasonally receives precipitation from tropical (Indian Summer Monsoon, ISM & East Asian Monsoon, EAM) and subtropical (Western Disturbances, WD) moisture sources (Dimri et al., 2015; Singh et al., 2020). The evolution of these precipitation drivers on a tectonic–orbital time scale is generally linked to the Himalayan-uplift/erosion (Clift et al., 2010; Clift and Webb, 2019; Meyers et al., 1998; Raymo and Ruddiman, 1992), the Northern Hemisphere glaciation (Raymo, 1994), and solar insolation responding to Milankovitch cycles (Liu et al., 2009; Meyers, 2003). Whereas, the short-term Asian hydroclimate variability is evident from regional multiproxy records (Agnihotri et al., 2002; Bird et al., 2014; Kathayat et al., 2018; Managave et al., 2020; Meyers and Lallier-vergés, 1999; Phartiyal et al., 2020; Prasad et al., 2014; Sarkar et al., 2000; Shah et al., 2020). The decadal–centennial components of this short term variability are generally linked to solar activity (Agnihotri et al., 2002; Dixit, 2020; Gupta et al., 2005; Meyers, 2003) and/or meteorological/oceanic teleconnections with El Niño–Southern Oscillation (Bird et al., 2017; Dutt et al., 2018) and North Atlantic Oscillation (Bird et al., 2014; Gupta et al., 2003; Sarkar et al., 2000). However, there is no consensus on the short-term hydroclimate variability resulting from feedback mechanisms of high-altitude glacial ice cover and temperature alterations (Babeesh et al., 2019; Dimri et al., 2015; Joshi et al., 2021; Sharma et al., 2019). Anthropogenic forcing of agrarian land-use practices by ancient civilizations might also have impacted the late Holocene hydroclimate and/

* Corresponding author.
E-mail address: satinder@iiserb.ac.in (S.P. Singh).

https://doi.org/10.1016/j.jseaes.2022.105184
Received 17 August 2021; Received in revised form 2 March 2022; Accepted 9 March 2022
Available online 12 March 2022
1367-9120/

Shah
Rayees