



Contents lists available at ScienceDirect

Quaternary International

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

Vegetation and climate change in the temperate-subalpine belt of Himachal Pradesh since 6300 cal. yrs. BP, inferred from pollen evidence of Triloknath palaeolake

Rameshwar Bali ^{a,*}, M.S. Chauhan ^b, Amit K. Mishra ^a, S. Nawaz Ali ^{b,c}, Ajay Tomar ^a, Imran Khan ^a, Dhruv Sen Singh ^a, Purnima Srivastava ^a

^a Centre of Advanced Study in Geology, University of Lucknow, Lucknow 226007, India

^b Birbal Sahni Institute of Palaeosciences, 53 University Road, Lucknow 226007, India

^c Physical Research Laboratory, Ahmedabad 380009, India

ARTICLE INFO

Article history:

Available online xxx

Keywords:

Vegetation
Climate change
Pollen analysis
Mid-Holocene
Lahaul

ABSTRACT

Pollen records from a 2.13 m thick palaeolacustrine sediment profile from Triloknath glacier valley, Lahaul region reveal the vegetation succession and climatic variability since the Mid-Holocene. Around 6300 to 5379 cal. yrs. BP, the region supported broad-leaved birch (*Betula*) forests in which *Quercus*, *Corylus*, *Carpinus*, *Rhododendron* etc. were other major constituents. Coniferous forests in the form of pure stands of *Pinus wallichiana*, *Abies*, *Cedrus* etc. grew on the lower dry northern sunny slopes adjoining to the lake. The vegetation composition, in general, evidences that the region was under warm and moderately humid climatic conditions. The sporadically encountered pollen of aquatic plants, *Ludwigia*, *Potamogeton* etc., signals the existence of a lake of small dimension. Between 5379 and 3167 cal. yrs. BP, the broad-leaved birch forest declined, whereas coniferous forests expanded simultaneously, reflecting the deterioration of climate, which turned warm and less-humid due to weakening of SW monsoon. Later on, the diminishing of broad-leaved forests continued, however, around 3167 to 2228 cal. yrs. BP; the coniferous forests occupied most of the landscape. This significant alteration in the vegetation scenario might have occurred as a consequence of severity of climate, attributed to further weakening of SW monsoon. During the time bracket from 2228 to 962 cal. yrs. BP, the maximum expansion of broad-leaved forests and coeval improvement of coniferous forests implies that the region witnessed warm and humid conditions on account of enhanced monsoonal precipitation. Since 962 to 300 cal. yrs. BP, the warm and more humid climatic conditions prevailed in the region as manifested by the further increase in broad-leaved forests and a contemporary reduction of coniferous forests, most likely due to initiation of more active SW monsoon. Chronologically, the early part of this phase coincides with the time interval of Medieval Warm Period, which is well known globally between 950 AD and 1200 AD. A pulsatory cool climatic phase towards the termination of this phase, around 350 years ago (1650 AD), is evidenced by a sharp decline in the broad-leaved forests, which likely reflects the impact of a Little Ice Age event.

© 2016 Elsevier Ltd and INQUA. All rights reserved.

1. Introduction

Concerning the spatial and temporal vegetation succession and climatic fluctuations in the Himalayas, substantial amount of information has been generated for the Late Pleistocene and

Holocene, mainly in the temperate and subtropical belts of different sectors of the Himalaya such as Jammu and Kashmir (Singh, 1964; Vishnu-Mittre and Sharma, 1966; Singh and Agrawal, 1976; Gupta et al., 1984; Trivedi and Chauhan, 2008, 2009), Garhwal Himalaya (Chauhan et al., 1997; Chauhan and Sharma, 2000), Kumaon Himalaya (Vishnu-Mittre et al., 1967; Gupta and Khandelwal, 1982; Kotlia et al., 1997, 2000, 2010; Chauhan and Sharma, 1996a; Bali et al., 2013, 2015), Himachal Pradesh (Sharma and Singh, 1974a,b;

* Corresponding author.

E-mail address: rameshbali@rediffmail.com (R. Bali).

Sharma and Chauhan, 1988), Darjeeling (Sharma and Chauhan, 1994; Chauhan and Sharma, 1996b), Meghalaya (Basumatary et al., 2013, 2014) and Sikkim (Sharma and Chauhan, 2001).

Many such records are based on palynological studies of lake/swamp deposits supported with absolute radiocarbon dates. These studies have facilitated unfolding the sequential alterations in the vegetation scenarios and climatic variability as well as changing hydrological status of the lakes in the Himalayan regions in response to deviating trend of southwest monsoon during the Holocene time. The investigations of the lake deposits from the subtropical (600–1400 m amsl) and temperate belts (1400–3500 m amsl) have also provided some dependable insights on the long and short climatic variability since the Late Pleistocene. In addition, the pollen-based signals have also enabled to understand the various global events such as glacial and interglacial episodes, Last Glacial Maximum, deglaciation of Period of Climatic

out from Triloknath palaeolake (altitude 3457 m), located almost 1.5 km downstream of the Triloknath glacier in Lahaul region of Himachal Pradesh (Figs. 1 and 2). The pollen proxy evidence obtained through the investigation of the profile (Fig. 3), has provided very significant inferences pertaining to vegetation shifts, landscape change and depositional environment of sediments in response to climatic variability in the region since prior to Mid-Holocene in a definite time frame. The lithology of the profile varies from sub angular matrix supported layer at the base to gritty sandy, coarse to medium sand and silty layers at various levels (Table 1). Few prominent peaty bands are present within them (Figs. 2C and 3). Attempts have also been made to work out the impact of human activities in the region during the past through the retrieval of some cultural pollen taxa in the sediments.

Table 1
Lithological description of the pit profile.

Depth (from top to bottom)	Lithological description
0–32 cm	Medium Sandy layer intercalated with two thin (~1 cm thick) peat bands
32–36 cm	Gritty sandy/sandy layer
36–47 cm	Clay layer
47–51 cm	Medium Sandy layer
51–56 cm	Silty-clayey layer
56–73 cm	Gritty sandy/sandy layer
73–113 cm	Silty-clayey layer with specks of peat. Has two prominent peat bands (~2–3 cm thick)
113–139 cm	Coarse Sandy layer
139–143 cm	Medium Sandy layer
143–149 cm	Silty layer
149–153 cm	Medium Sandy layer
153–213 cm	Sub angular matrix supported layer

Optimum, Medieval Warm Period and Little Ice Age events (Bradley, 1999). However, meager efforts have been put forward on these aspects from the subalpine and alpine belts, where a large number of potential lakes/swamps of variable dimensions are present in different sectors of the Himalaya, barring a few reports from Tsokar Lake in Ladakh (Bhattacharyya, 1989; Demske et al., 2009) Rohtang Pass (Bhattacharyya, 1988); Lahaul (Rawat et al., 2015); Spiti valley (Mazari et al., 1996; Chauhan et al., 2000); Parvati Valley in Himachal Pradesh (Chauhan, 2006) and Tipra Glacier in Garhwal Himalaya (Bhattacharyya and Chauhan, 1997), based mainly on pollen and some multiproxy approaches. Recently, the isotope ($\delta^{18}\text{O}$ & $\delta^{13}\text{C}$) study on some cave deposits from Kumaun Himalaya has also emerged a valuable tool in understanding climatic changes on centennial and decadal time scales as well as the impact of global events such as MWP and LIA during the last 2 millennia or so (Kotlia et al., 2012, 2015; Sanwal et al., 2013).

However, the Lahaul region in northwest Himalaya has so far not received adequate attention concerning the palaeoclimatic reconstruction, except for some multiproxy information from Chandra peat bog (Rawat et al., 2015). Even the knowledge on this aspect is also scanty in other sectors of Himalaya. Hence, in the present study, we pursue the reconstruction of vegetation dynamic and contemporaneous climatic variability in chronological order since prior to Mid-Holocene in the region, which have been largely controlled by the deviating trend of Indian Summer Monsoon (ISM). In addition, stress has also been laid to understand the impact of some global event such as Period of Climatic Optimum (PCO), Medieval Warm Period (MWP) and Little Ice age (LIA), which are not yet precisely understood.

To resolve all these issues, a comprehensive pollen analytical investigation of a 2.13 m thick sediment profile has been carried

2. Regional settings

2.1. Study area

Triloknath is a 6.5 km long north easterly flowing valley glacier located between $32^{\circ} 39'25.51''$ to $32^{\circ} 36'19.57''$ N latitude and $76^{\circ} 39'32.71''$ to $76^{\circ} 36'09.14''$ E longitude, in fifth order South Chenab basin in Lahaul district of Himachal Pradesh, India (Fig. 1A). Landscapes formed during Quaternary were shaped mostly by the glacial and fluvial activities (Owen et al., 1996; Adams et al., 2009; Owen, 2009). Lahaul region, located at an altitude between 3500 and 5000 m a.s.l., marks the junction between the monsoon influenced southern flank of Pir Panjal and the Greater Himalaya. The area is considered to be sensitive to fluctuations in the south Asia monsoon through time and provides best chronological evidence of glaciation within the western Himalayas (Owen et al., 1997; Owen and Zhou, 2002). In Lahaul valley, climate varies altitudinally and geographically along a strong N–S gradient of precipitation, covering monsoon influenced southern slopes and passes of Pir-Panjal as well as arid valleys on the northern slopes of the Himalaya (Owen et al., 1997). Triloknath glacier falls in the Udaipur block of Lahaul and Spiti district of Himachal Pradesh. Triloknath glacier valley consists of two ice bodies that in recent past coalesced at 3900 m a.s.l. (Fig. 1B). It receives nourishment mainly through snow and ice avalanches (Swaroop et al., 2001).

2.1.1. Climate

The area is predominantly dry as it is located in the rain shadow zone of the Himalayan region. As a result the monsoon is hardly able to penetrate into this area. Maximum temperatures range between 7°C and 23°C , and the minimum temperatures vary

Download English Version:

<https://daneshyari.com/en/article/5113381>

Download Persian Version:

<https://daneshyari.com/article/5113381>

[Daneshyari.com](https://daneshyari.com)