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Paleoclimatic reconstruction of the Karewa deposits of Kashmir Valley, northwest Himalaya: A review

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A B S T R A C T

Plio-Pleistocene sedimentary successions, comprised of fluvio-glacial-lacustrine sediments capped by loess, are widespread in the Kashmir Valley, NW Himalaya, India. These sediments act as a repository of climate records for the past 4.4 Ma suggesting the dominance of southwestern monsoon up to 1.95 Ma and thereafter the dominance of mid-latitude western disturbances in the region. However, the younger strata of the loess-paleosol sequences (LPSs), <200 ka old, and Holocene sediments have been studied for high-resolution climate records compared to older archives because of the contentious chronological issues of the older deposits. Earlier studies revealed moderate climatic conditions from ~65.8 ± 7.2 ka to 44.3 ± 5.8 ka, followed by periods of extreme dry phases of enhanced wind velocity, coinciding with the last major magnetic inversion. The climatic conditions have produced strong pedogenic signatures on the LPSs during the MIS-3 (~43–34.7 ± 2.3). The dry arid climate phases recorded during the MIS-2 stage up to ~14.7 ± 5.4 ka revealed a weak pedogenic alteration and a high amount of $CaCO_3$ accumulation in the loess. Subsequent sporadic alluvial deposition of sediments over the LPSs implies widespread precipitation and glacial melting linked to the onset of the Holocene warming punctuated by dry and cold climate phases corresponding to the Bond events of 0, 3, 4, 5, and 7, which indicated a westerly-dominated climate during the Holocene. This review therefore critically examines existing literature on Karewa deposits in the Kashmir Valley, identifies knowledge gaps, and offers recommendations for future research, emphasizing their paleoclimatic potential for the Quaternary Period.

1. Introduction

The Quaternary Period covers a minor fraction of the Earth's geological history, beginning at 2.5 Ma and continuing to the present (Cohen et al., 2013). It is the best-studied period of the Earth's past because it is well preserved compared to other periods of geological time (Gibbard and Cohen, 2014). The most distinctive characteristic of the Quaternary is the interplay of the cold and warm periods representing glacial and interglacial cycles (Lowe and Walker, 1997). During the glacial periods, continental ice sheets grow and cover much of the northern hemisphere; during interglacial periods, the ice sheets melt and are reduced drastically (Denton et al., 2010). The variations in the spatial and seasonal distribution of solar radiation incident on the Earth's surface driven by Milankovitch cycles are believed to be the ultimate drivers of the glacial and interglacial cycles (Kerr, 1978). Considerable variations in the sea level and climate have occurred worldwide during the Quaternary glacial and interglacial periods (Schnack and Pirazzoli, 1990; Kumar et al., 2020). The sedimentary deposits laid down during the Quaternary Period are found at or near the Earth's surface in plains, valleys, intermontane basins and sea floors. These deposits are essential for knowing the geologic history because they can easily be correlated globally, regionally, and with modern sedimentary deposits (Mir et al., 2022). Various dating techniques and climatic proxies provide relatively precise timing of the Quaternary climate events and their rates of change (Lisiecki and Raymo, 2005). In this context, the Quaternary offers an opportunity to use past environments to predict future climate scenarios.

During the last few decades, a large number of climate studies led to the availability of high-resolution Quaternary climatic records, particularly from the polar ice cores and oceanic sediment cores (Alley et al., 1997; Schilt et al., 2010; Ehlers and Gibbard, 2011; Jouzel, 2013). Though comprehensive Quaternary climatic records from continental

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