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# Spatio-temporal climatic variations during the last five millennia in the Ladakh Himalaya (India) and its links to archaeological finding(s) (including coprolites) in a palaeoecological and palaeoenvironmental context: A reappraisal

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## ABSTRACT

Ladakh region (Trans-Himalaya) is strategically placed as far as movement, demographic shifts and rich multicultural heritage is concerned owing to being a meeting point between Central Asia and South Asia i.e., utilization of the world famous "Silk Route" during the last two millennia. Further, the Ladakh region has in the past decade gained attention of geoscientists interested to understand the Holocene climate variability and its effect(s) on the region's geomorphology, flora, and fauna (including humans) as being positioned within the transitional zone of the Indian Summer Monsoon and the Westerlies. In the present article, we reassess the available records on climatic variation(s) for the past five millennia in this important region. Our reappraisal of the previously available palaeoclimatic reconstructions from sediment records viz. Tsokar, Tso-moriri, Pulu (north and south), Upshi, and Pensila allowed us to demarcate four broad climatic zones -Temporal-cultural Phase 1 [cold and arid; 5 to ~2.5 ka (terminal Neolithic to early Historical)], Temporal-cultural Phase 2 [moderately cold and arid; 2.5 to ~1.5 ka (early Historical to later Historical)], Temporal-cultural Phase 3 [warm and wet; 1.5 to ~ 0.9 ka (later Historical continued)], and Temporal-cultural Phase 4 [cold and arid; 0.9 ka onwards (early Medieval period)] since the past five millennia. In addition, the known archaeological records (petroglyphs and other artifacts) from Ladakh in a chronological, palaeoenvironmental, and palaeoecological context also support prevalence of an arid climate from 0.9 ka to present in the region. Further, considering non-existence or absolute rarity of research on Holocene coprolites (palaeofeces) from India, a first detailed record on coprolites (represented by four morphotypes linked to Lagomorphs, Chiropterans, and Aves) from a cave site (Rumtse), Ladakh Himalaya is presented herein that corroborates our findings on prevalence of cold and arid climate. Finally, the Ladakh region certainly holds potential for recovery of ichnofossils (particularly coprolites), associated faunal remains and other archaeological features (e.g., petroglyphs) from the Holocene interval. Thus, future archaeological endeavors can become quite instrumental in furthering our knowledge to understand any change(s) in the dietary pattern(s) within individual faunal groups (including humans) and their surrounding ecology linked to change(s) in the climate of the Ladakh sector.

## 1. Introduction

Ladakh situated in the Trans-Himalayan mountain range is famous for its spectacular glaciers, high passes, river valleys and rich cultural history. Ladakh, for many centuries, occupied a strategic location as it was a meeting point between Central Asia and South Asia when the Silk route was utilized. The 60-day journey on the Ladakh route linking Amritsar (Northwest India) and Yarkand (Southwest China) on the Silk

Road (southern branch) was routinely employed by merchants before Mainland China closed the borders in the late 18th century (Rizvi, 2001). Apart from commercial movements, this region witnessed numerous other demographic shifts resulting in a rich multicultural history. Since, the past decade or more, a sudden increase in research activity on wider perspectives of sedimentation processes, climatic changes, climatic forcing(s) and other related aspects within the region is witnessed. Published literature in the last decade shows an emphasis

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