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Hydro-climatic variability during last five thousand years and its impact on human colonization and cultural transition in Ladakh sector, India

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ABSTRACT

The Ladakh Range in the Trans Himalaya houses sub-routes of the Silk route through its passes (La in local language) which may have been the main commercial and cultural passage to connect the central Asia and Tibetan region with the rest of India. A ca 6400-220 cal yr B.P. hydroclimatic record of two lakes viz Tsoltak lake and Yaya Tso near the Chang La and Hor La passes of Ladakh Range is presented here. The overall record (mineral magnetic analysis and microbiota) from the Ladakh range shows wetter conditions ca 6400 cal yr BP consistently declining till ~5000 cal yr BP and moderately wet and stable till ~4300 cal yr BP, followed by an arid cold phase (~4300-4000 cal yr BP). This precedes two moderately wet phases (ca 4300-3500 cal yr BP and ca 1260-220 cal yr BP) and the peak arid conditions between 3500 and 2860 cal yr B P and 2230-855 cal yr BP, which may have affected the trade activities and had an adverse affect of cultural transitions during these periods across the Ladakh Range on the to and fro movements from this northern sub-route branch. The biotic assemblage is rich in Non Pollen Palynomorphs (76%) with minor amounts of pollens (24%). An improvement in the conditions since 855 cal yr BP and thereafter from 340 to 220 cal yr BP records the onset of the cold arid conditions again in the Ladakh Range. Presently due to contemporary deglaciation the Ladakh Range is becoming ice free and a number of lakes surrounded by herbaceous meadows are seen in the area due to glacial melt, likely to encourage the human settlements to soon occupy the higher reaches that will negatively affect the natural lake productivity.

1. Introduction

The influence of climate change in the Himalayan region is a complex debatable subject (Zheng, 1989; Burbank and Cheng, 1991; Anderson and Prell, 1993; Owen et al., 1997). In the north western parts of the Himalayan mountain chain spread over India and Pakistan the dynamics of moisture laden westerly winds from the Mediterranean, Black Sea, and Caspian Sea provide winter precipitation that largely controls the retreat or advance of glaciers in the entire region (Inoue, 1978; Owen, 1989; Owen et al., 1996; Dimri et al., 2016). A secondary source of precipitation is the Indian Summer Monsoon (ISM) which transports substantial amounts of moisture during boreal summer across the Indian Ocean into the Indian subcontinent. The dynamic interactions of the Westerlies and the ISM have resulted in the hydroclimatic changes in the region that can be linked to the human settlement/migration and trade routes of the region. The livestock is very much influenced by this climatic phenomenon as it affects the socio-economic, cultural and

ecological changes of the cold and treeless region of Ladakh sector which is among the harshest ecosystems on the earth. This sector in Trans-Himalaya is strategically placed in terms of movement, demographic shifts and rich multicultural heritage. The Trans-Himalaya houses sub-route of the Ancient Silk road/route to connect the Central Asia and Tibetan region (Fig. 1A) to the Indian subcontinent via the Ladakh sector. This route was once the main commercial and cultural passage between the west and the east Eurasia (Hansen, 2012) and was very much influenced by the Holocene moisture changes and the studies indicate that the rise and decline of the ancient Silk route was definitely influenced by climate change (Du et al., 1996; Zhong et al., 2000; Wu et al., 2020).

Ladakh is the land of passes and the Ladakh Range (trending almost NE-SW), a part of the Karakoram Mountain, is a ~350 km stretch separating the Shyok-Tangtse and Pangong catchments from the Indus Valley in the Ladakh sector. With a crest line of about 6100m this range is parallel to the Indus River (Fig. 1B). This range has several passes, viz.

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