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Early Human Adaptation vis-à-vis High Himalayan Landscape and Climate: Ladakh Himalaya, Jammu & Kashmir

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Introduction

Leh, a trans-Himalayan valley is situated in the rain shadow of Great Himalaya with hyper-arid climatic regime, supporting only steppe or desert-steppe type of vegetation. Despite rugged topography, extreme climatic conditions and scant vegetation in the Leh valley there are evidences suggesting existence of early human occupations. The Leh valley has witnessed several periods of glacial and interglacial for the past approximately 400 kyr—the oldest geological record of glaciations in the Himalayas. Works of glaciers and rivers during glacial and interglacial periods have been instrumental in carving various geomorphological forms that have been exploited by early humans occupying the heights to protect them from chilling cold and predators.

Physical background

Leh valley of Ladakh is situated in the trans-Himalayan region and in the rain shadow of the great Himalayan range. The annual precipitation is between 100 and 300 mm that is evenly distributed throughout the year. The southwest monsoons, that bring in the moisture for most part of the northwestern trans-Himalaya, occasionally crosses the high-mountain ridges of Ladakh. The westerlies, associated with the subtropical branch of the northern hemisphere westerly jet are the major contributors to the precipitation in Ladakh and Karakorum. The winters are harsh, severely cold, extremely dry and extend from October to May. The mean monthly maximum temperature during this season ranges from 17 ºC to –2.8 ºC. The minimum temperature starts falling below freezing from October and the mean monthly minimum temperature varies from –14 ºC to –0.9 ºC. The peak winter months are from December to February with January as the coldest month when mean monthly temperature as low as –21 ºC. Abrupt fall in night temperatures are peculiar in winter months. Wide range of fluctuation in winters is due to the western disturbances. 49 per cent of precipitation is received during the winter season in the form of snowfall that begins by November with increasing frequency from December to April.

Rise in temperature starts from late April onwards. May is a transitional period between winter and summer seasons and weather improves from this month onwards. Bright

days and cool nights are common of this month. Freeze and thaw conditions prevail at low altitude ranges up to 3,500 m. The period from June to September records the highest mean monthly maximum temperature that ranges from 24 ºC to 20 ºC. The mean monthly minimum temperature fluctuates between 10 ºC to 5 ºC at this time. The summer season is short and extends from May to September. July is the hottest month with the mean maximum temperature reaching up to 29 ºC. The day temperature remains high and constant whereas night temperature fluctuates facilitating the freeze and thaw that leads to physical weathering. The summer precipitation, though low, is received from June to September mainly in the form of rains and little snow that occurs in the upper reaches of mountains and glaciated areas.

The climate of Ladakh is transitional between that of Central Asia and the monsoonal land of South Asia. It varies considerably with latitude, altitude, aspect and localised relief, e.g., rain shadows caused by high mountain ranges Karakoram, Zanskar and Ladakh. The southern slopes of the mountains act as an effective barrier to moisture from the subcontinent. The geographical location of Leh valley very well explains its present arid to hyper-arid climatic conditions. The scant rainfall and rugged topography of the valley is largely responsible for steppe or desert-steppe type of vegetation between 4,500–5,500 m. The shrubs and woods — chiefly, *Juniperus*, *Ephedra*, *Berberis*, *Hippophae*, *Lonicera*, *Myricaria*, *Salix*, *Rosa* and *Cotoneaster* — occur within an altitude of 3,000 – 4,500 m in the river valleys.

Early human occupants

Investigations on the problem of Neogene/Quaternary successions of upper Indus system in Ladakh Himalaya confirmed the existence of early man in trans-Himalayan region on the basis of the findings of stone artefacts from stratified context in association with Indus terraces located near the villages Nurla, Khalsi, Pashkyum around Kargil (Tripathi *et al.*, 1988). The artefacts represented at least three phases of cultural evolution of which the earliest phase belongs to Lower Palaeolithic that is in association with Indus Pleistocene conglomerate and the last two phases belong to Middle Palaeolithic. A few un-abraded stone artefacts comprising unifacial chopper, bifacial hand axes and retouched worked block from village Alchi on the left bank of Indus (~3,120 m) were reported (Ota, 1993). There are sufficient evidences of early human occupation from the Nubra valley, further north of Leh valley, based on the finding of well finished stone artefacts. Nevertheless, based on the glacial chronology and Quaternary geomorphic history of the Nubra valley, the occupation of the Nubra valley by early humans having adequate skill of making stone artefacts can tentatively be dated to post Diskit Stage-I of glacial history which is dated to approximately 30–40 kyr (Dortch *et al.*, 2010).

The preliminary excavations from Neolithic site at Kairi of Leh valley do subscribe to the fact that the area witnessed better vegetation and game conditions than today for the early humans to meet the physiological and environmental constraints. The Neolithic transhumance occupational sites in Leh valley date between 7,700–2,700 BP (Ota 2009, Ganjoo and Ota, 2012). The time period has been recorded as humid phase with strengthened summer monsoon. The studies, at and around Leh, of Quaternary deposits also sufficiently support the oscillation in climate between wet and dry

phases during terminal Pleistocene and Holocene that could have also been a period when early man ventured into the region. The Ladakh mountain ranges experienced confirmed major periods of glaciation till almost 100 kyr that served as a barrier to the intrusion of early humans to the Leh valley till almost late Pleistocene / early Holocene. Climate and natural barriers have also restricted the invasion of early humans in Hindu Kush and Pamir till almost early Holocene when climate ameliorated to warm and wetter phases and provided favourable summer hunting territories.

A few reports of Neolithic sites from Gaik and Kairi in the Leh valley (~3,900 m) dating to almost mid-Holocene, support the prevalence of ameliorated climatic conditions for the survival and sustenance of early human communities in the region that otherwise witnesses harsh climate and barren landscape (Ganjoo and Ota, 2012).

Geochronological and geomorphological evidences from Leh valley suggest that the valley witnessed glaciation since almost 400 kyr, the oldest record of glaciation in Indian Himalaya. Five stages of glaciation — Indus, Leh, Kar, Bazgo and Khalling — are identified in the Leh valley with last three stages occurring during last 100 kyr. Significant uplift of the Himalaya to the south of Leh and Karakorum to the west of Leh reduced the influence of southwest monsoon and mid-latitude westerlies to this region in the last ~500 kyr.

Landscape archaeology

The strong and convincing archaeological evidences from high mountains undoubtedly confirm the presence of early humans in this difficult terrain during the mid Holocene period. It is obvious that the geological period when early man scaled the heights to enter the valley was a period of climatic amelioration and hence the occupations sustained. It is important to note that the landscapes carved by repeated glacial and fluvial activities during the glacial and interglacial stages, have been exploited by the early humans for occupancy. Some of the landscape features thus developed as result of various geomorphic processes and utilised by the early humans are described below.

Talus deposits

The slopes of high mountains in Leh valley usually have a large accumulation of talus deposits that essentially comprises of the indigenous material derived from the parent rocks with a rare contribution from the river deposits that have been responsible in modifying the talus materials marginally. These assorted deposits are invariably present in most part of the valley and along the river banks where the streams have deeply entrenched the rocks and developed steep relief between the high mountains and the valley floor. The talus deposits ranging from boulder to fine silt are a result of the mass movement activity in the region associated with the semi-arid to arid conditions in the valley. The freeze and thaw conditions of cold environment have largely been responsible in contributing to the varied clast sizes. The movement of the material has enveloped much of the high mountain slopes of the region. The deposits close to rivers have subsequently stabilised owing to the scant vegetation growth and have been exploited by early humans who entered the Leh valley through these valleys. The talus deposits have been dug out to form suitable plain surface for habitation floor and preparation of ovens and hearths (Plate 1). The firewood, plant and small games were available along the riverbanks for these early settlements.

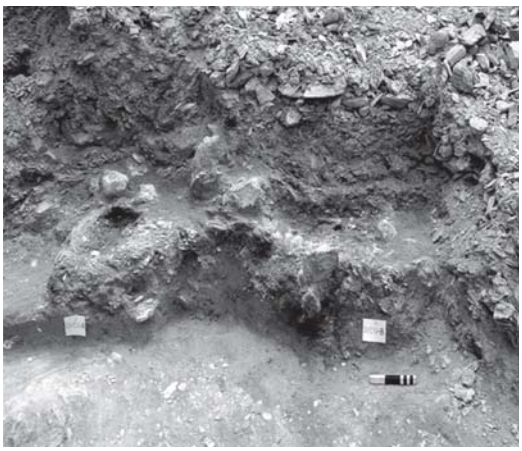

Plate 1. Talus deposit with ovens made in it by early human at Choksar

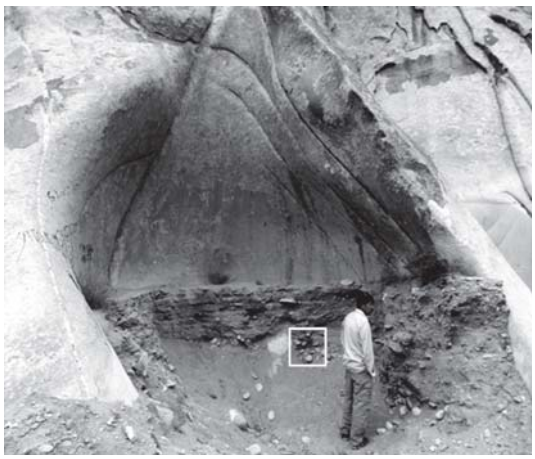

Plate 2. A large pothole on river Indus with archaeological deposit, on way to Chumathang. The marked area is enlarged in Plate 3

Fluvial landforms

The rivers in Leh valley have actively contributed to the architecture of the landforms particularly the warm interglacial periods as landforms developed by glacier activities were modified. Mass movement and lacustrine processes had also contributed to this. Further, the region has been affected by major to minor seismic activities from time to time. The sedimentary deposits laid down by glacier and / or fluvial action preserve convincing evidences of seismotectonic activities in the region that were actively been responsible in changing the base level of erosion in the valley. It is during this period of base level adjustment by the rivers, huge potholes were drilled in the rock bed and rock valley walls. The potholes, thus formed, were large enough to provide space for the shelter of early humans. The preservation of broken and fragmentary faunal materials within the archaeological sediments in the potholes along with the charcoal and fire ash further substantiate to the fact that the potholes were exploited by the early humans negotiating the river valleys (Plates 2, 3).

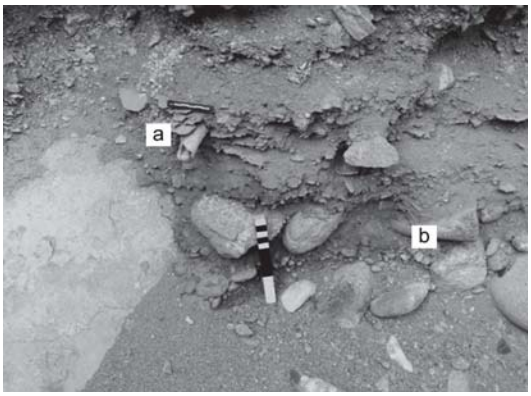

Plate 3. Close up of Fig. 2 with charcoal/coal ash (a) and faunal fragments (b) within the deposits.

Plate 4. Outwash gravel plain with a thick layer of charcoal/coal ash (a) on the top, on way to Chumathang.

Fluvio-glacial landforms

The outwash gravel plains formed by the melt water of glaciers is yet another landform that has been exploited by the early humans in high mountains. The outwash gravel plains are formed during the warm periods when most of glaciers melted out and the sediments carried by the melt water were deposited at the foot of the mountain close to the rivers. The more or less flat topped surface of the gravel plains has been suitable surface for the early humans to occupy for habitation. The presence of thick and extensive deposits of charcoal and coal ash on the top surfaces of gravel plains substantiate the existence of early humans in the valley during the Holocene (Plate 4).

Concluding notes

The selection of early human occupation sites was selective, keeping in view the adequate requirement of water, game, safety from predators and shelter from harsh weather throughout the Himalaya. From the evidences of overgrazing, trampling, peat deterioration and charcoal, it is estimated that the humans arrived at Bhutan Himalaya ~4,500 yr BP. Recent genetic studies of Tibetan population adapting to high altitude environment suggests that permanent occupation in Qinghai-Tibetan plateau (3,300 m) took place in ~7000 yr BP. More archaeo-botanical and archaeo-zoological evidences are required from the transhumance sites of Ladakh to conclude whether the 'Neolithic package' came to China through the Hexi Corridor or along the Upper Indus and Yarlung-Zangbo.

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