Climate Variability during the past 50 ka in the Trans Himalaya- a case study from Tangtse Valley, Ladakh

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The Tangtse valley encompasses the eastern most tip of the Indian territory of Ladakh. In this area, the strike–slip Karakoram Fault (KKF) bifurcates in two strands viz. the SW Tangtse Strand and NE Pangong Strand (Rutter, 2007). The River Tangtse, a tributary of River Shyok has served as a spillway during the high strands (Norin, 1946) of the Pangong Tso (lake), occupies a 94.18 km long course in the KKF zone and covers almost 2170 sq km basin area. Active nature of KKF in the area is evident by presence of various features like strath terraces (28 m), offset of streams (200-400 m), wide valley filled with debris flow, abandoned channels, gorges, straight river course with the swirls and fluvio-lacustrine sediments at the height of ~50-60 m above from the present day river level. Lacustrine, fluvial and flood facies are exposed below the Shachukul village (the type section (ST)). Two phases of fluvial regime at 48 ± 4 and between 30 ± 6 to 21 ± 2 ka draining Pangong Tso into the River Shyok and a lacustrine phase between ~9.6 to ~5.1 ka inundating the whole valley are recorded. A flood event dated to ~3.4 ka is also recorded.

The lacustrine phase between ~9.6 to ~5.1 ka (ST-A of 7.40 m and ST-B of 17.5 m sections) was analysed to decipher the climatic variability using environmental magnetism (χ_{lf}, ARM, χ_{ARM}, χ_{ARM}/χ_{lf}, SIRM, SIRM/ARM, S-ratio and SIRM/χ_{lf}) and loss on ignition. The variations in the fundamental mineral magnetic parameters are correspondent to the changes in catchment weathering, detrital influx and authigenic productivity and are used to indicate the climatic variability between warm and cold conditions. Enhanced susceptibility (χ_{lf}), high χ_{ARM} and enhanced SIRM, indicate increased catchment weathering, increasing concentration of detritus input and show a drier and colder phase. During warm periods, on the other hand, fine sediments were deposited and the magnetic signals of concentration are therefore reduced in this high altitude cold desert region. Therefore it is assumed that the low values of χ_{lf}, SIRM and soft IRM values correspond to comparatively warmer climatic conditions. The variations in the studied parameters divide the lacustrine span (~9.6 to ~5.1 ka) this span in 5 Magneto-zones (MZ-I to MZ-V).

The sections are composed of thick, massive buff coloured clays with intermittently placed sand and silt beds. The MZ1 (~9.6 to ~8.4 ka), MZ-3 (~7.8 to ~7.2 ka) and MZ 5 (~6.8 to ~6 ka) shows a stable lake condition with a warm climate record. While in MZ-2 (~8.4 to ~7.9 ka and MZ-4 (~7.2 to ~6.8 ka) a shift towards cold climate conditions is seen. Perhaps the ~11 ka flooding (Dortch et al., 2011) and the early Holocene warming may have led to the lake formation in this valley with very stable conditions during MZ1.

For ST-A section majority of the pronounced peaks in χ_{lf} positively correlate with the susceptibility of ARM (χ_{ARM}), suggesting predominance of Single Domain (SD) magnetite that is characterizes authigenic forms favouring restricted and calm bottom water conditions and/or (ii) those generated during poorly drained soil forming processes in lake catchments. At ~5 ka an 8 m thick deposit constituting fine to medium sand having clay lens and clay ball at different levels,is recorded with a high sedimentation rate. Later at ~3 ka, a 9.7 m flood facies section of intermittent clay and sand having cross bedded sand, slity sand layers is seen. The authigenic SD magnetite indicate less oxygenated water condition for a short while due to the turbid water of flood event in Flood facies section. High magnetic susceptibility indicates high ferromagnetic content.

A detailed work on chronology, textural and geochemical analysis is in progress and will strengthen this dataset of Quaternary researches from the Ladakh area.

References

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