Holocene megaflood history and provenance of the upper Indus-River. Implication for human migration along the ancient Silk Road at Ladakh.

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The Indus River originating from the Manasarovar Lake runs along the Indus Tsangpo Suture Zone at Ladakh separating the Tethyan Himalaya in the south from the Karakoram Zone in the north. Due to the barrier created by the Pir Panjal Ranges and the Higher Himalaya, Ladakh falls in the rain shadow zone of ISM (Indian Summer Monsoon) with an average annual temperature of ~7.3°C. Random catastrophic hydrological events are known to endanger lives and properties of people residing here. So, determination of frequency, recurrence and forcing mechanism of past extreme floods are crucial in this highly vulnerable area.

Here we studied Holocene mega flood history of the Upper Indus River at Ladakh using slack water deposits (SWDs). SWDs are composed of stacks of sand-silt couplets deposited during high flooding events. They are deposited instantly from suspension associated with sharp reduction of flow velocity due to local obstructions. Each couplet represent a flooding event. These events are dated employing Optically Stimulated Luminescence (OSL) using sand and AMS ¹⁴C using charcoal specks and hearth layers. The frequency of these events suggest higher occurrence of mega floods during pronounced northward penetration of ISM. Recurrence Interval (RI) analysis of these events suggest spatial variation in forcing mechanism between the trunk and the main tributary channel (Zanskar). Sedimentary provenance of these events are also analyzed using detrital zircon geochronology. The provenance analysis indicate more efficient sediment transportation along the Zanskar River as compared to the main Indus channel. Post LGM (Last Glacial Maximum) human migration along the channel is revealed from hearths found within these SWDs which generally occurs during post flooding episodes. Materials found within the hearths, chronology and the fashion of occurrence imply migration and cultural connectivity between the Indian sub-continent and the Central Asia along the ancient Silk Road at Ladakh as old as ~14 ka.