Title:	Luminescence chronology and climatic implication of the late quaternary glaciation in the Nubra valley, Karakoram Himalaya, India
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Abstract:	The present study investigates moraines, outwash gravel terraces, relict lake deposits and alluvial fans to reconstruct the pattern of glacier advances and associated climate variability in the Nubra Valley, Karakoram Himalaya, India. Optical chronologies obtained on stratigraphically constrained lateral moraines indicate that the oldest preserved record of glacier advance (Tirith-II) is dated to 60.4 ± 5.2 ka and corresponds to Marine Isotopic Stage-4 (MIS-4). During MIS-4, the Nubra valley was occupied by ~700 m thick ice cover that extended beyond the Nubra-Shyok confluence. It was followed by pulsating decrease in the ice-volume (vertical shrinking) with an insignificant lateral recession that continued until around 42.0 ± 3.0 ka (mid- MIS-3). The second major glacial advance (Tirith-I) is dated to 30 ± 2.5 ka (beginning of MIS-2) when the Siachen glacier reached up to the Nubra-Shyok confluence albeit, with lesser ice thickness (~300 m). The Tirith-I glacier advance continued to occupy the entire Nubra valley until around 18.2 ± 1.8 ka (Last Glacial Maximum). A deglaciation followed after 15.8 ± 1.6 ka and continued until the early Holocene (10.3 ± 1.3 ka). The third minor glacial advance-Siachen Glacial Advance (SGA) is dated to the mid-Holocene (6.8 ± 1.0/7.2 ± 1.4 ka) when the glacier extended below the Siachen glacier snout, whereas the youngest glacial expansion reached a few hundred meters below the present day snout and is dated between 1.0 ± 0.4 ka and 0.5 ± 0.2 ka. The study suggests that glacier advances were driven by a decrease in temperature with corresponding increase in the moisture contribution due to the enhanced mid-latitude westerlies during MIS-4, MIS-2, and the mid-Holocene. Within the age uncertainty, it can be suggested that the snout-proximal recessional moraines indicate marginal glacier expansion during the Little Ice Age (LIA). Following this, the glacier receded to its present position and seems to have stabilized since then. Unlike other Himalayan glaciers, the Siachen glacier does not show any alarming retreat after the LIA and is in conformity with recent observations suggesting that the glaciers in Karakoram region are either marginally advancing or stand still.
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