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Changes in paleo erosion rates during fluvial aggradation in the Yamuna catchment, northern India

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The study of fluvial fill terraces provides information about the tectonic and climatic history and is fundamental for understanding landscape evolution. Deposition of fluvial sediments within actively eroding mountain ranges could result from changes in tectonic uplift rates, climatic conditions and/or surface processes. However, reconstructions of such changes from valley fills are often ambiguous and based on correlating such chronologies with regional climatic changes.

In this study, we present “in situ” cosmogenic ^{10}Be derived paleo erosion rates from sand and pebbles, combined with field observations from a 120 m exposed fluvial river terrace in the Yamuna catchment, northern India. The Yamuna catchment is a relatively small (648km^2) and steep (mean slope $\sim$29°) catchment that exposes different lithologies from the Lesser (LHS) and High Himalayan sequences (HHS). Infrared stimulated luminescence (IRSL) measurements of samples from the base and near the top of the river terrace indicate an aggradation period that was ongoing between 29.9±2.5 ka and 23.2±3.5 ka and suggest a deposition during glacial time. ^{10}Be results from terrace sand indicate paleo erosion rates between 1.5±0.1 mm a^{-1} and 2.3±0.2 mm a^{-1} that were higher than modern river-sediment based erosion rates of 1.1±0.1 mm a^{-1}. The differences between modern and paleo erosion rates could be caused by: (1) different uplift rates within the LHS and the HHS, (2) the influence of glaciation by input of subglacial material which would lower the ^{10}Be concentration and (3) the erosional efficiency of periglacial processes during colder periods.

Interestingly, paleo erosion rates derived from terrace pebbles of LHS origin were lower (0.9±0.1 mm a^{-1} to 1.1±0.1 mm a^{-1}) but higher for pebbles of HHS origin (2.4±0.3 mm a^{-1} to 4.±0.5 mm a^{-1}). These differences in paleo erosion rates from pebbles of LHS and HHS origin clearly document steep spatial gradients in paleo erosion rates and we currently focus on quantifying potential differences due to the above scenarios with simple models.