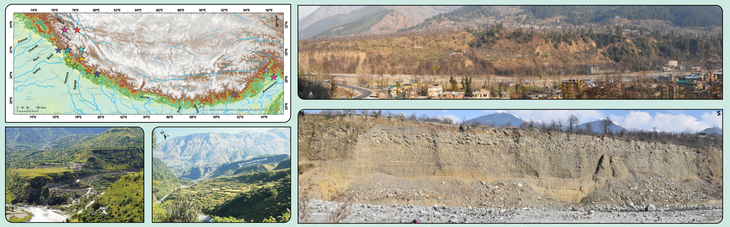
Chronology of Himalayan valley fills: a key to assessing the fluvial geomorphic response to climate change

Vaishanavi Chauhan[1], Sanjay Kumar Mandal[1,2] and Manoj K. Jaiswal[1]

E-mail: vc19rs086@iiserkol.ac.in

[1] Earth surface dynamics lab, Indian Institute of Science Education and Research, Kolkata, India, [2]Centre for Climate and Environmental Studies

1 Introduction



Evidences of thick valley fills around NW Himalaya: A) This study (Beas), B) Yamuna river valley (Scherler et.al., 2015), C) Alaknanda river valley (Juyal et.al., 2010)

Background

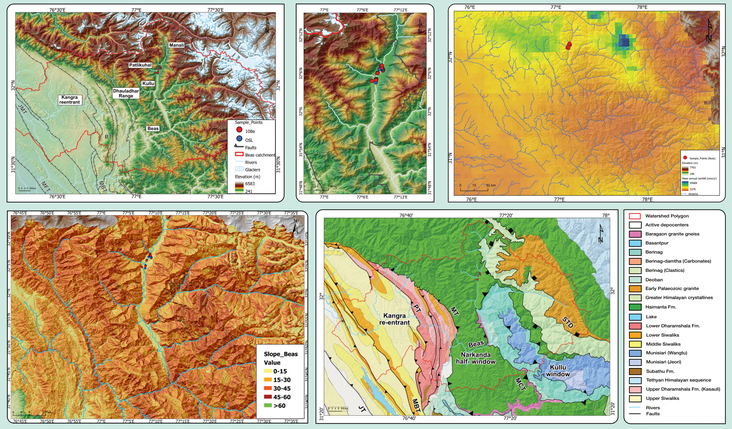
The thick valley fills in the northwest Himalaya provide evidence of an imbalance between sediment supply and river transport capacity. This phenomenon has been observed globally and linked to glacial-interglacial cycles. In the Satluj valley, increased sediment supply due to high-intensity rainfall has been noted, while reduced river discharge during weakened monsoons has been observed in the Yamuna valley. However, the role of tectonics in Quaternary aggradation remains unclear. In this study, we assess the impact of monsoon rainfall variability on both the hillslope erosion rates and transport capacity of streams of Beas river valley exposed near Kullu, Himachal Pradesh, India.

Objectives

The major objectives of this study include:

- ✔ Characterization of valley fill based on compositional and textural variablity, grain size distribution and lithofacies association.
- ✔ Construction of chronological model of aggradation using luminescence dating.
- ✔ Estimation of late Quaternary palaeo erosion rates of Beas river valley derived from cosmogenic nuclide ^{10}Be conc. in fill terrace deposits.
- ✔ Comparison of modern and palaeo erosion rates to construct detailed hill slope erosion rate chronology during late Quaternary episode of river aggradation.

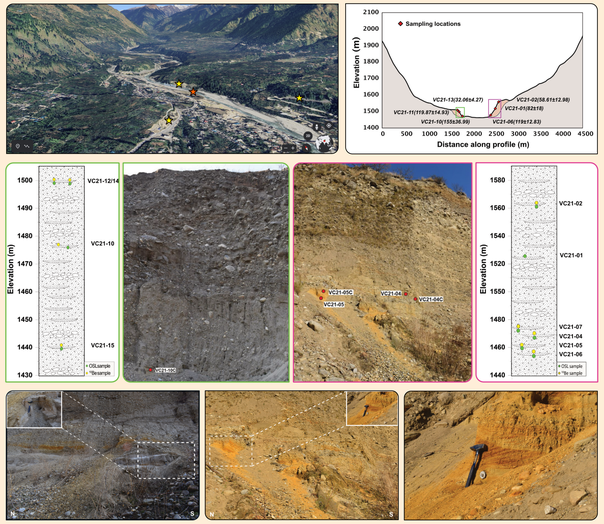
2 Study area



3 Methodology

Luminescence dating

Samples for Luminescence dating collected from fine sand lenses from top, middle and bottom of exposed terrace in order to have a complete profile of age model.

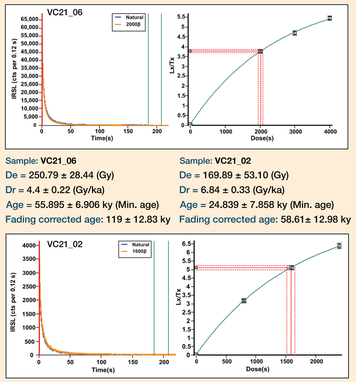


^{10}Be derived erosion rates

Coarser sand fractions preferred for Cosmo samples.

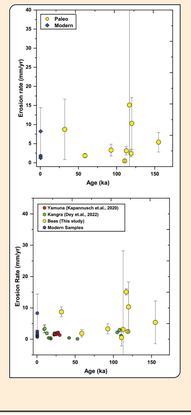
4 Analysis of river terraces

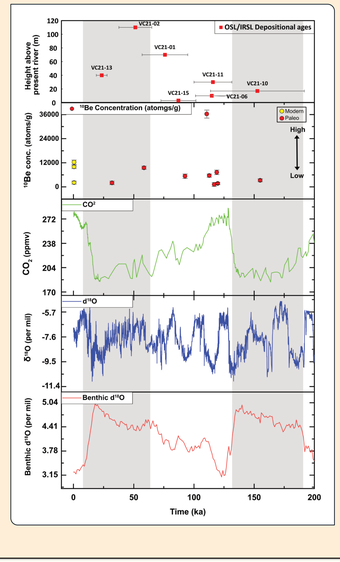
- Minimum age reported for one of the topmost terrace sample: **32.06 ± 4.27 kyr**
- Aggradation ages derived from IRSL dating: **155 ± 36.99 to 58.61 ± 12.98 kyr**
- Paleo erosion rates ranged between **1.85±0.37 mm yr^{-1}** and **15.10±24.90 mm yr^{-1}**
- Modern erosion rates: **1.44±0.29 mm yr^{-1}** and **1.76±0.36 mm yr^{-1}**



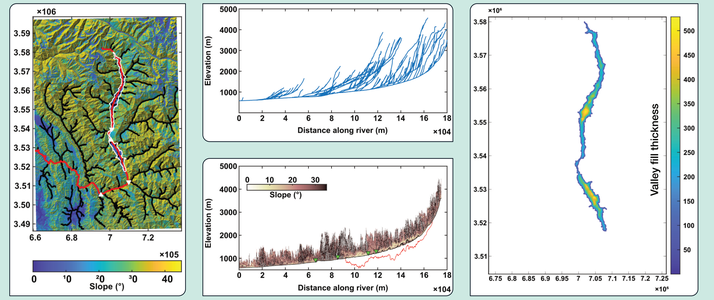
Sample: **VC21_06**
De = 250.79 ± 28.44 (Gy)
Dr = 4.4 ± 0.22 (Gy/ka)
Age = 55.895 ± 6.906 ky (Min. age)
Fading corrected age: **119 ± 12.83 ky**

Sample: **VC21_02**
De = 169.89 ± 53.10 (Gy)
Dr = 6.84 ± 0.33 (Gy/ka)
Age = 24.839 ± 7.858 ky (Min. age)
Fading corrected age: **58.61± 12.98 ky**

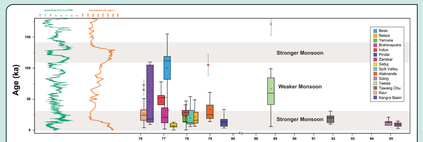


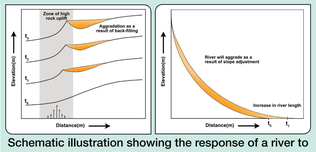


5 Valley fill geometry

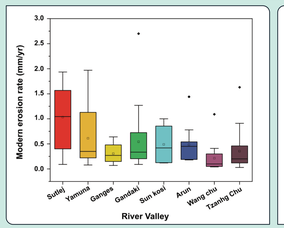


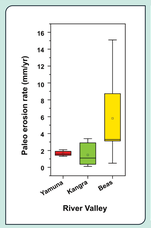
6 Discussion

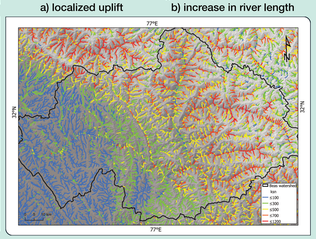




Schematic illustration showing the response of a river to
a) localized uplift b) increase in river length







7 Conclusion

- Aggradation in the Kullu valley of Beas catchment likely occurred between 155± 36.99 ka and 58.61± 12.98 ka. These ages when compared with other Himalayan River valleys, indicate a much older and prolonged phase of aggradation.
- The exceptionally low in situ-produced ^{10}Be concentrations in quartz from modern and late Pleistocene terrace sand can be explained by low ^{10}Be production beneath glaciers and subglacial derived sediments.
- Based on the derived hillslope erosion rate chronology and peculiar geomorphic features, we suspect that tectonics is the main driver causing aggradation of these thick valley fills and setting high erosion rates in the Beas catchment.

8 References

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