Climate control on erosion distribution over the Himalaya during the past ~100 ka: REPLY

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We thank Srivastava and Shukla (2010) for their interest in our work (Rahaman et al., 2009). We clearly established the impact on erosion distribution over the Himalaya. Srivastava and Shukla have raised two issues regarding our interpretations: (1) the age model of the core and its implication on sediment provenance as deduced from Sr-Nd isotope data, and (2) the sedimentation history of the region in terms of valley-interfluve connectivity. We address these issues and reaffirm our conclusions.

Sinha et al. (2007) provided the chronology of the Indian Institute of Technology Kanpur (IITK) core based on four infrared stimulated luminescence (IRSL) dates. For our age model, we relied on these four ages, as well as one 14C age of calcrete at 2.25 m depth, which may be used as a minimum age for the host sediments. Srivastava and Shukla ignored these “measured” ages and instead used two approximate ages provided by Sinha et al. (2007) for the base (ca. 100 ka) and top (ca. 15 ka) of the core for their age model. Figure 1 shows various age models for the IITK core.

The age of the first higher 87Sr/86Sr excursion at ~34 m based on models (i) and (ii) is nearly the same (68–70 ka), but increases to ca. 73 ka in the Srivastava and Shukla model (Fig. 1). The age of the second 87Sr/86Sr excursion at ~6.6 m based on models (i) and (ii) falls between 16–18 ka (Fig. 1), within the range of marine isotope stage (MIS) 2. The Srivastava and Shukla model places this excursion at 26.2 ka, outside MIS 2. Thus, their model overestimates the ages of both 87Sr/86Sr excursions as it is based on approximate core top and base ages.

Our work on the Ganga plain, and that of Clift et al. (2008) on the Holocene sediments of the Indus delta, agree on the role of climate on Himalayan erosion. They however, differ on the spatial pattern of erosion. Sediments of the Indus delta are derived from multiple sources; with both the Higher Himalaya (HH) and the Lesser Himalaya (LH) contributing to the lower εNd sediments. In contrast, temporal variations in isotope composition of IITK core sediments are due to variations in sediment mixing proportions from HH and LH. Thus, the difference in the erosion history captured by isotopes in sediments of the Indus delta and at the IITK core site persists.

The observation of Srivastava and Shukla that “Rahaman et al. hypothesize extensive glacier cover in order to explain the Lesser Himalayan provenance” is contrary to our hypothesis that increased glacier cover reduces sediment supply from HH, resulting in an increase in the relative proportion of LH sediments. Quoting from our paper, “Thus, lower precipitation coupled with a greater aerial extent of glaciations in the Higher Himalaya appears to be responsible for decreasing erosion rates there…” (Rahaman et al., 2009, p. 561). The Comment by Srivastava and Shukla on the coupling between monsoon intensity and erosion is also incorrect. We argued for strong coupling between monsoon intensity and erosion.

Another issue raised by Srivastava and Shukla deals with the sedimentation scenarios of Sinha et al. (2007) and in our paper. The valley and floodplain detachment discussed in Sinha et al. (2007) and Gibling et al. (2005) underscores the role of monsoonal fluctuations in valley-interfluve relationships on a landscape scale. Sinha et al. (2007) demonstrated that both valley incision (due to intensified monsoons) and valley underfitting (due to monsoon decline) could lead to detachment between the main valley of a large river system, such as the Ganga, and the floodplains. Our work has validated this suggestion in terms of excursions in 87Sr/86Sr data in the interfluve core for both MIS 2 and MIS 4. The primary upstream control of climate-induced variations in erosion is expressed through longitudinal connectivity in MIS 2 and MIS 4. Also, the detachment model of Gibling et al. (2005) and Sinha et al. (2007) is a landscape-scale expression of temporal variations of lateral connectivity. This model does not imply that all locations in the floodplain have lost connectivity with the valley and its channels, as implicitly construed by Srivastava and Shukla.

From the above discussions, it follows that (1) the chronology of the IITK core given by us is valid, whereas that advanced by Srivastava and Shukla based on approximate ages is not supported by the analysis shown in Figure 1, and (2) the higher 87Sr/86Sr and lower εNd of sediments during MIS 2 and MIS 4 result from the relatively lower contribution from the HH due to less intense monsoon and larger glacial cover over the region.

REFERENCES CITED


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