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Evolution of Gravel Size along the Rivers in an Intermontane Valley – A case study from Dehra Dun, NW Sub-Himalaya

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Evolution of gravel size along the rivers depends on selective transport and abrasion during transportation. In addition, sediment source and its lithology also impact the evolution of gravel size composition. In recent years, several workers have studied the gravel size evolution along the Himalayan rivers and discussed its implications downstream of the mountain exits. In this study, we have investigated the gravel size compositions in the active channel bars along three rivers—the Asan River, the Song River and Jakhan Rao—flowing in Dehra Dun, which is an intermontane valley in the Frontal part of the Himalaya. The rivers flowing in Dehra Dun contribute to the major Himalayan rivers i.e. the Ganga and the Yamuna that mark the eastern and western boundary of the valley respectively. The Dun rivers are mostly seasonal in nature.

We have analysed near surface sediments in active bars that represent the present day sediment distribution pattern. At each sampling site, sediments weighing between 200-400 kg are processed. We have classified them into 5 different classes using 4 sieve sizes, i.e. 2, 4, 6, 8 cm respectively. Because of the higher gravel content, the rivers are classified into gravel bed rivers. In contrast to the ideal condition of fining downstream, the sediment evolution trend shows deviations at several sampling sites. The gradual decrease of the weaker lithologies like Limestone and Shale, and relative enrichment of Sandstone and Quartzite gravel population highlight the role of abrasion in the evolution of sediment composition. However, this evolution also depends on the inherited memory of multi-cyclic sediments contributed to the channel from the piedmonts and surfaces present in the Dun. Competent lithologies like Quartzite and Sandstone show greater survivorship and constitute a major portion of multi-cycle gravels. The structural zones and the hill slope areas with higher connectivity index provide significant amount of sediments to the rivers that get deposited along the downstream stretches to form braid bars resulting in channel widening. The study shows that the wider reaches in these rivers are characterized by increased coarse sediment fraction indicating a correlation between sediment dispersal pattern and channel geometry. Sediment coarsening trend is also noticed along the downstream reaches of the Jakhan Rao, despite poor longitudinal and lateral connectivity. This observation combined with that of change in gravel lithologies suggest reworking of older bed materials along these reaches.