



The internal strength of rivers: autogenic processes in control of the sediment load (Tana River, Kenya)

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The construction of sediment rating curves for monitoring stations is a widely used technique to budget sediment fluxes. Changes in the relationship between discharge and sediment concentrations over time are often attributed to human-induced changes in catchment characteristics, such as land use change, dam construction or soil conservation measures and many models have been developed to quantitatively link catchment characteristics and river sediment load. Conversely, changes in river sediment fluxes are often interpreted as indications of major changes in the catchment. By doing so, autogenic processes, taking place within the river channel, are overlooked despite the increasing awareness of their importance.

We assessed the role of autogenic processes on the sediment load of Tana River (Kenya). The Tana river was impacted by major dam construction between 1968 and 1988, effectively blocking at least 80% of the sediment transfer from the highlands to the lower river reaches. However, a comparison of pre-dam sediment fluxes at Garissa (located 250 km downstream of the dams) with recent measurements shows that sediment fluxes have not changed significantly. This suggests that most of the sediment in the post-dam period has to originate from inside the alluvial plain of the river, as tributaries downstream of the dams are scarce and intermittent.

Several observations are consistent with this hypothesis. We observed that, during the wet season, sediment concentrations rapidly increased below the dams and are not controlled by inputs from tributaries. Also, sediment concentrations were high at the beginning of the wet season, which can be attributed to channel adjustment to the higher discharges. The river sediment does not contain significant amounts of ^{137}Cs or $^{210}\text{Pb}_{xs}$, suggesting that sediments are not derived from topsoil erosion. Furthermore, we observed a counter clockwise hysteresis during individual events which can be explained by the fact that sediment mobilised within the river during a given event travels slower than the water. The highly dynamic behaviour of the river is further demonstrated by the rapid changes in river cross-section at Garissa and meander migration rates of several m y^{-1} .

In order to estimate a time frame for which changes in sediment inputs will be reflected in the sediment concentration at Garissa a single box model was developed. Results indicate that the effects of sediment blockage by the dams will only be visible after several hundreds to perhaps thousands of years. This clearly shows that autogenic processes are dominant in the lower Tana River and that, therefore, changes in sediment delivery cannot be detected in the sediment discharge record. More generally, understanding and interpreting the dynamics of such river systems requires that autogenic processes are correctly accounted for.