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Seismically induced changes in bedrock erosional efficiency along the Peikang River, central Taiwan: the role of sediment cover variability in controlling long-term incision rates.

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Sediment cover in a fluvial system can modulate bedrock incision rates by mantling underlying bedrock from erosion processes. The degree of sediment buffering can be variable in both time and space, and therefore documenting and understanding changes in sediment cover along a river is important for landscape evolution studies. The supply of sediment to the fluvial system is highly variable in dynamic landscapes as earthquakes and weather events can induce regionally correlated landslide events of diverse magnitudes. Landslides caused by the 1999 Chi-Chi earthquake in central Taiwan are an example of this variable sediment supply. We examine the sediment cover response from this event along a segment of the Peikang River, central Taiwan. This river is undergoing differential incision as it passes over the active Shuilikeng Fault, thus providing a unique natural experiment that highlights the spatially variable responses to this sudden increase in sediment supply. Data derived from topographic cross-section records at a gauging station show that the maximum riverbed aggradation occurred sometime between 2001 and 2003, and field observations indicate that it has not significantly degraded as of January, 2008. Further, we present high-resolution electrical resistivity surveys taken in March, 2008, along the actively incising Peikang River in central Taiwan. The surveys allow the quantification of the spatial variability of the thickness of sediment stored in the river valley following the sudden increase in sediment supply. Comparison of the thickness of sediment cover with incision rate and transport capacity reveals a strong inverse relationship (i.e. high capacity and high incision rate reaches have low sediment cover and vice versa). The high volume of sediment (6-12 m depth) currently stored in the low incision zone suggests that vertical incision has been effectively shut off since the arrival of this sediment pulse. In contrast, the shallower (zero to 4m) stored in the high-incision zone suggest that erosion processes are ongoing, although potentially at a reduced rate. The data presented here support the hypothesis that the frequency of bed exposure to erosive wear is related to channel hydraulics (e.g. transport capacity) and is an important mechanism for the dynamic adjustment of channels to differential incision. The close correspondence between the spatial variability in sediment cover, transport capacity, and incision rate suggests that the degree of sediment buffering in a particular reach is a strong, mechanistic control on the rate of incision along the Peikang River. Further, the data suggests that sediment cover is temporally variable, and the magnitude of this variation may depend on local transport capacity. This suggests that sediment-flux dependent fluvial incision models must account for the temporal variability of sediment supply from hillslopes in order to fully capture the channel response to tectonic and/or climatic forcings. Finally, this study reveals that events that lead to rapid hillslope denudation can reduce the efficiency of fluvial processes.