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Using caesium-134 and cobalt-60 as tracers to assess the remobilization of recently-deposited overbank-derived sediment on river floodplains over subsequent inundation events

Philip Greenwood, Desmond Walling, and Timothy Quine

Geography, School of Life & Environmental Sciences, University of Exeter, Devon, EX4 4RJ, UK (T.A.Quine@exeter.ac.uk)

River floodplains act as stores of fine-sediment and sediment-associated nutrients and contaminants and increasing recognition of their environmental importance has necessitated a need for an improved understanding of the fate and residence times of overbank-derived sediment over a broad range of timescales. Whilst most previous investigations have focused on establishing accretion rates over medium timescales, those estimates typically represent net deposition from multiple flood events spanning several decades. In contrast, determining the fate of recently-deposited sediment over subsequent overbank events has received only limited attention, primarily due to inherent difficulties in accurately measuring the movement of small quantities of fine-sediment over such short timescales. This communication presents the findings from a novel tracing technique designed to assess the remobilization of recently-deposited overbank-derived sediment on river floodplains during subsequent inundation events, using the artificial radionuclides, caesium-134 (134Cs) and cobalt-60 (60Co). The investigation was conducted on small reaches of the floodplains of the River Taw and River Culm in Devon, UK. The approach involved simulating the deposition associated with an overbank event to deposit small quantities of fine-sediment (> 63 μm), pre-labelled with known activities of either 134Cs or 60Co, at 15 representative locations across the surface of each floodplain. The surface inventory of each 0.3 m diameter 'plot' of labelled sediment was measured before and after subsequent flood events and reductions in the inventory were used to estimate the equivalent loss of sediment (expressed as g m-2) during each event. Significant losses were interpreted as evidence of the remobilization of the labelled sediment by the inundating floodwaters. The response of the tracers to measure remobilization was documented for three overbank events on each floodplain and the spatial variation of the magnitude of remobilization across each floodplain was related to the local physical conditions at each site. Quantities of sediment equivalent to 63.8%, 11.9% and 1.8% of the original mass were remobilized over the three events respectively from the River Taw floodplain, and the equivalent values for the River Culm floodplain were 49.6%, 12.5% and 2.7%, respectively. The results from both floodplains demonstrate that remobilization declined exponentially over the three events. The relative differences in the quantities of sediment remobilized from the two sites over the first flood event are attributed to differences in the physical characteristics of each floodplain and in the magnitude of the two inundation events. The results also indicate that overbank sediment is most vulnerable to remobilization during the first flood event proceeding deposition. Despite a mean of 22.5% and 35.2% of the original mass remaining on the River Taw and Culm floodplains, respectively, after the third event, the quantity of sediment estimated to have been removed from each site during the third event proved too small to be definitively attributed to remobilization by overbank floodwaters. This is interpreted as evidence of the incorporation of the remaining sediment into the longer-term soil profile, effectively making it unavailable for remobilization. The period of time between initial deposition and the cessation of significant remobilization provides a means of estimating the time required for the remaining sediment to be incorporated into the sediment profile. Overall, these findings represent essentially unique information that highlights the importance of remobilization of recently-deposited sediment on river floodplains during subsequent overbank events, and also demonstrates the potential of the tracing-technique.