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Constraining sediment fluxes and grain-size characteristics in tectonically-perturbed catchments.

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The depositional characteristics of any basin fill (the sink) are fundamentally a product of the coupled system of sediment release from hinterland catchments (the source) and its evolution during transport downstream. Changes to the tectonic boundary conditions governing the dynamics of erosion in upland catchments will therefore exert a significant effect on the nature and magnitude of sediment supply to neighbouring basins. While recent advances in tectonic geomorphology demonstrate the generic coupling between tectonic uplift and landscape denudation, there has been relatively little work to quantify the timing, characteristics and locus of sediment release from tectonically-perturbed upland catchments, and the way in which this signal subsequently evolves downstream within the fluvial system. We address this challenge using (i) field data to evaluate the characteristics and source areas of sediment exported from modern fluvial catchments draining across active normal faults in the Central Apennines in Italy and (ii) the CHILD landscape evolution model to investigate how the locus and volume of sediment exported from such catchments evolves through time and with the degree of tectonic perturbation. We demonstrate that catchments undergoing a transient response to an increase in fault uplift rate at 0.8 Ma are associated with significant volumetric export of material derived largely from an incised zone upstream of the fault, producing bi-modal grain-size distributions with elevated D_{84}values within the transient reach. This response is substantially driven by input from coupled hill-slopes, and we show the amplitude and timescale of the landscape response is modulated by the degree of tectonic perturbation. Our results challenge the view the sediment is sourced uniformly from tectonically active catchments, and demonstrate that transient responses to tectonics control the locus, magnitude and calibre of sediment supply to basins. More widely, this work offers new insights for geomorphologists seeking to decode the interactions between hill-slopes, sediment flux and channel incision in transient landscapes, and we provide a fresh perspective for sedimentologists trying to predict proximal hanging-wall stratigraphy in normal fault bounded terrains.