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Sediment supply and grain size export from normal fault footwalls in Southern Italy

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The sedimentary record is the only physical evidence we have of mass transfer across the Earth's surface. In order to understand and ultimately decode this record, it is of key importance to characterize the sediment fluxes that generate stratigraphy. Sediment fluxes from catchments to basins, and their grain size distribution, can be highly sensitive to tectonic, geomorphic and lithological boundary conditions. However, the way in which these variables interact to determine the volume, locus and calibre of sediment released from catchments to basins remains unclear.

Here we use a combination of DEM analysis and fieldwork to quantify the controls on sediment export from catchments crossing tectonically active faults in the Southern Apennines, where fault throw rates along strike, landslide abundances and hanging-wall stratigraphies are well-constrained, over timescales up to 1 Myr. We first use catchment drainage areas and estimates of fault throw rate and channel transport capacities as the main variables to estimate sediment supply along the fault footwalls. Sediment volumes, flux rates, and grain sizes are estimated using three complementary methodologies: 1) based on fault slip rates and topographic steady-state; 2) the BQART model*; 3) Shields stress-based approaches. We then compare these predictions with field data of the grain size distributions exported along the fault footwall catchments; the sediment volumes and grain sizes supplied by landslide populations in the field area; and the volumes and grain sizes of sediments stored in the hangingwall basins.

Our analysis shows that 1) fault throw rates strongly influence channel and hillslope gradients and hence they exert a critical control on the calibre of the sediment released from footwall catchments; 2) grain size distributions correlate with the magnitudes of the sediment fluxes exported from catchments, and both vary significantly along the strike of active faults; 3) bedrock lithology modulates the grain size and locus of sediment export by influencing landslide abundances and input sediment supply. These data imply that hangingwall stratigraphies in areas of active normal faulting fundamentally reflect landscape responses to tectonics.

*Syvitski, J. P. and J. D. Milliman (2007). "Geology, geography, and humans battle for dominance over the delivery of fluvial sediment to the coastal ocean." The Journal of Geology 115(1): 1-19