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Episodic Sediment Supply from Mountains and Downstream Emplacement within Large Tropical Basins

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Application of a new geochronological method for high-resolution 210-Pb dating over the past century has facilitated the identification of individual floodplain sedimentation events across disparate large river basins. Two examples include the pristine 72,000 km2 Beni River basin in northern Bolivia and the similarly natural 36,000 km2 Strickland River basin in Papua New Guinea – that are located on either side of the Equatorial Pacific warm pool that drives the ENSO phenomenon. Published research suggests that large, rapid-rise, cold-phase ENSO floods account for the preponderance of sediment accumulation within these two tropical systems. The vast scale of these temporally discrete deposits (typically 10s to 100s of millions of tonnes throughout these large river systems) begs the question: where did all this sedimentary material originate? Huge deposits require a similarly massive supply from hillslopes and transport of that material to depocentres 100s of km away, often episodically within the very short timescale of a single large flood event. We have identified the principal source of this sedimentary material to be extensive landslides throughout the high-relief headwaters – failures that deliver huge charges of pulverized rock and soil directly into canyons (in both the Bolivian Andes and the PNG Highlands), where raging floodwaters provide efficient transport to lowland depocentres. We explore this theme by presenting results from our ongoing research in these basins, including new data and techniques that we are currently using to track processes and provide better insight into the details of such enormous mass budgets.

Daily discharge data from Bolivia are coupled with radionuclide concentrations, particle size distribution, and biochemistry of carbon and major elements in sediment to elucidate the considerable inter-annual variation of sediment supply from the Andes. Perturbations in the rate and quality of supply directly result from the interaction of Andean erosion, in-channel storage, anthropogenic effects, and the dynamics of extreme climate. Biochemical and geochemical tracers are employed as effective tools within both study basins to track sediments from source to sink, providing insight into the geomorphic processes that modulate the efflux, transport, intermediate channel/floodplain storage, and downstream delivery of sediment during extreme flooding events. Processes, timing, and rates are compared between the two systems, providing insight into the nature of geomorphic hillslope-channel coupling within tropical dispersal systems and motivating our development of new numerical model for the functioning of large river-floodplain systems.