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Monsoonal versus Anthropogenic Controls on Erosion Patterns and Sediment Flux in the Song Gianh, Vietnam

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The Song Gianh is a small drainage on the northern central coast of Vietnam that delivers sediment into the Gulf of Tonkin. The basin provides the opportunity to evaluate what surface processes control continental erosion rates and patterns because there is a strong monsoonal precipitation gradient from the SW to NE. We apply several complimentary provenance methods to modern siliciclastic sediments of the Song Gianh to pinpoint regions of focused sediment generation and evaluate how sediment is mixed downstream and delivered to the ocean.
We find that detrital zircon populations of Song Gianh main channel change radically downstream of the confluence with the northern Rao Tro tributary, which is dominated by 100–300 Ma grains eroded from granite bedrock. This tributary provides almost as much zircon to the main channel as all the headwater tributaries combined, despite being a much smaller, drier, and flatter sub-basin. In contrast, bulk sediment Nd and Sr isotopes indicate that most sediment is derived from the wetter headwater tributaries. Contribution from the southern tributaries to the net siliciclastic river flux is negligible. Precipitation and topography do not appear to modulate zircon production in the modern river although regions controlling bulk Nd and Sr compositions are wetter and have higher local relief. This apparent contrast in regions of sediment production suggests disequilibrium and differential travel times for zircon and mineral phases rich in Nd and Sr.
Optically Stimulated Luminescence (OSL) dating of alluvial terraces on the main channel show that the valleys aggraded rapidly from ~7–9 ka during a period of strong summer monsoon, suggesting that heavy rainfall generated large sediment volumes. Younger terraces dated to 500–1000 yrs BP are interpreted to reflect erosion and aggradation driven by extensive human agriculture. We speculate that agriculture, together with bedrock compositions, are the most likely control on producing the erosion patterns and geochemical signatures we observe in the modern basin and that the Song Gianh cannot easily be used as an analog for ancient systems.