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Quantifying Environmental Change Associated with Deforestation, Waipaoa Basin, NZ

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In addition to natural disasters, human land use practices hold the potential to force catastrophic environmental change. Near total conversion of indigenous forest to pasture over the past century in the erosion-prone Waipaoa River Basin, along the tectonically active eastern margin of New Zealand's North Island, has resulted in some of the most dramatic and widespread erosional features on the planet. High-resolution records of sediment delivery, channel response, and offshore deposition, anchored by well-dated tephra deposits across the region, demonstrate the severity of anthropogenic landscape disturbance. Today, the 2200 km^2 Waipaoa River delivers a disproportionately large 15 Mt of sediment to Poverty Bay annually, suggesting a basin-wide average denudation rate of > 2 km/My. Recently compiled detailed seismic surveys of sediment accumulation on the continental shelf and slope yield an average rate of sediment delivery from the Waipaoa of ~1 Mt/yr over the Holocene, implying that human induced sediment delivery is elevated by as much as 15 times over background. While these high-resolution data provide a previously unattainable mass flux from the Waipaoa outlet to the sea through time, there is evidence to suggest that they do not portray the full extent of landscape disturbance caused by deforestation. In regions of the Waipaoa Basin most heavily impacted by land clearance, massive gully complexes and extensive shallow landslides shed prodigious amounts of sediment from pastoral hillslopes. Repeat surveys of channel aggradation in one such basin demonstrate that nearly 50% of the sediment eroded from hillslopes is retained in valley bottoms, indicating that river-outlet sediment yields are not wholly representative of current landscape erosion. In an attempt to establish baseline rates of landscape erosion during the late Holocene, we collected ~60 samples of active channel sediment within and around the Waipaoa River Basin for ^{10}Be and ^{36}Cl analysis. 23 of these samples are from prominent tributary basins, and will help determine how quickly various parts of the basin erode, and where most sediment is produced under natural conditions. The remaining samples are from smaller sub-basins characterized by certain erosional processes and/or different vegetation cover classes (gully vs. landslide and/or paddock vs. natural vegetation dominated basins). When coupled with other high-resolution datasets, these cosmogenic basin-scale erosion rates will define better our understanding of the environmental consequences of pervasive deforestation in tectonically active terrain.