

An alternative explanation for late Quaternary fluvial dynamics in the western Andes: the role of north Atlantic Heinrich events and nonrecoverable interseismic deformation

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The formation of fluvial terraces in the western Peruvian Andes over the past 100 ka has commonly been associated to summer insolation maxima of the precession cycle which coincide with increased precipitation and fluvial aggradation. Fluvial incision is also thought to be a result of climate cyclicity, even though there is an ongoing debate about the exact details. Tectonic uplift is generally not considered to play a role as the western Andes attained its maximum elevation during the late Miocene after which mountain building shifted towards the eastern Andes and Subandine belt. Based on fluvial terrace mapping, longitudinal profile reconstructions and IRSL dating, we show that fluvial aggradation was more likely connected to increased precipitation as a result of the North Atlantic Heinrich events. Our dataset of >1300 days of GNSS-measured vertical crustal motions between the years of 2009 and 2015 shows that uplift is occurring with rates of 1.9 mm/yr during the interseismic cycle. We suggest that nonrecoverable, interseismic deformation is an important driver for tectonic uplift and fluvial incision over the 100-ka timescale contributing a maximum of 0.5 mm/yr to long-term uplift. Superimposed on tectonic uplift, changes in the discharge-to-sediment-load ratio of fluvial systems cause highly fluctuating, time-variable fluvial incision. The number of fluvial terraces, the timing of their formation and the reconstructed incisional dynamics in our study area shows strong parallels with those of other fluvial systems in Peru. We present therefore an alternative view of late Quaternary fluvial dynamics for the entire western Peruvian Andes.