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Control on the erosional and depositional dynamics inferred from grain size variation along the Pisco river, Western Peru.

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The Pisco Valley situated on the western side of the Andes represents an ideal laboratory for exploring potential controls on the accumulation and subsequent erosion of sediment because it hosts several well-preserved cut-and-fill terrace sequences. In this study we infer that a climatic change in combination with eustatic sea level drop have been the main drivers of erosion of the valley flanks and subsequent sedimentation of the Quaternary terrace deposits. We mostly focused on the sediments of the well preserved 40 ka-old terrace level (Minchin pluvial period) and compare them with the modern bed material to explore relationships between longitudinal and temporal variations of grain size downstream fining, water budgets and sediment transport dynamics recorded by the modern and the terrace deposits. To this extent, grain size data were collected from digital images taken at five different sites along the channel. We measured the b-axis of the particles on digital images, which yielded in a total of ca. 2500 grain size measurements per site for the modern material and ca. 4000 per site for the terrace deposits.

The results reveal a higher downstream fining rate for the modern material than for the terrace deposits for the D50 and D84 but the inverse for the D96. For the modern sediments, the fining rate is 0.7 mm/km for the D50 while the equivalent percentile of the terrace deposits has a lower fining rate of 0.3 mm/km. The modern deposits are better sorted and have finer grains than the ancient sediments. The results of hydrological calculations suggest that the water discharge required to transport the D50 of the Pisco River during modern and Minchin times and to evacuate the supplied material has been nearly identical whereas the water discharge required to transport supplied material is higher during the Minchin time than today if the D96 is taken as threshold value. We propose a scenario where eustatic sea level drop initiated the beginning of the accumulation of the terrace deposits. Increase in the maximum water flux, related to high-intensity El Niño-like storms along the Pacific coast paired with more moisture on the Altiplano most likely allowed the erosion and the transport of coarser grains and metric scale boulders. The end of the Minchin pluvial period finally controlled the end of the Minchin terrace sedimentation.

Key words: Fluvial erosion, Grain size, downstream fining, Pisco valley