Tectonic and climatic forcing on the Panj river system during the Quaternary

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Surface processes in Pamir involve complex feedbacks between tectonic and climatic factors that drive the relief evolution during the Late Quaternary. The ongoing India-Asia collision provokes the development of east-west trending mountain ranges that guide flow directions of the Pamir rivers. The interplay of relief with the Westerlies and the Indian Summer Monsoon superimpose strong moisture gradients and control the emplacement of glaciers. Glacial records from the Pamir Plateau attest for strong climatic variability and suggest glacial advances restricted to the plateau since marine isotope stage (MIS) 4. The Panj, the major trunk river of Pamir, deflects from the pre-dominant westward drainage, connecting its main tributaries at the western margin of the drainage basin. Indices of fluvial incision (Hack index, valley shape ratios, profile modelling) further characterize the Panj as a composite river. Modelled riverbed profiles distinguish three Panj reaches that suggest successive upstream river captures in response to local base level changes. The northward-deflected river reaches link the local base levels, which coincide with the southern boundaries of the Shakhdara and Yazgulom Dome and Darvaz Range.

OSL-based terrace ages from 17 study sites along the northward deflected Panj and downstream reaches reflect short-term, locally restricted fluvial deposition over the past 23 ka while overall the river still incises bedrock. Especially the concentration of younger terraces at the northern rim of the Shakhdara Dome suggests a dominant role of local factors on terrace formation. From regression analyses, we infer a regional fluvial incision of ~5 mm/a in the Pamir. Higher incision rates of 6 – 10 mm/a coincide with the river reaches cutting through the Shakhdara Dome. Relatively low incision rates of 2 – 3 mm/a are associated to the upstream reach, south of Southern Pamir Shear Zone (SPSZ), while estimates north of the Shakhdara Dome scatter between 2 and 6 mm/a. Changes in rock types, catchment or local climate are not plausible for explaining the variations in incision rates.

Keywords: Pamir, Panj river network, fluvial incision, OSL dating, river longitudinal profile, valley shape ratios