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Climate, Tectonics, and Landslides in the Tien Shan: Shaping Alluvial Landscapes in Central Asia

Fluvial terraces are key archives in understanding alluvial river long-profile evolution in response to drivers like climatic changes, tectonic activity, or geomorphic events of low frequency but high amplitude like landslides. The Tien Shan is an excellent location to study this due to tectonic uplift associated with the India-Eurasia collision and the numerous glaciers reacting broadly to global climate. In detail, the Naryn river and its tributaries host several and widespread terrace generations as well as the largest known landslide in Central Asia.

This study investigates the relative contributions of climate, tectonics and a landslide to terrace formation and long-profile evolution. We combine a set of 38 cosmogenic nuclide exposure samples with 10 optically stimulated luminescence samples to constrain aggradation and incision phases of the rivers that are compared to paleoclimate proxies and other alluvial archives. Additionally, we run a numerical model of long-profile river evolution to understand better the lag time and terrace extent to certain forcings.

Our results suggest that, even when considering the impact of a significant landslide-dammed lake, climate is the key driver of terrace formation. This study demonstrates how a multi-method approach, incorporating recent modeling advances, can enhance the interpretation of alluvial river archives even in complex natural settings and understand the key drivers in landscape change.

Author: RUBY, Andreas (GFZ)

Co-authors: Dr MCNAB, Fergus (GFZ, Universität Potsdam); Dr KOLB, Thomas (Universität Gießen); Prof. FUCHS, Markus (Universität Gießen); SCHILDGEN, Taylor (GFZ)

Presenter: RUBY, Andreas (GFZ)