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OSL dating for incision rate estimation in Pamir

Margret Fuchs (1), Richard Gloaguen (1), Matthias Krbetschek (2), and Adam Szulc (1)

(1) TU Bergakademie Freiberg, Germany (fuchsm@student.tu-freiberg.de), (2) Quaternary Geochronology, Senckenberg Natural History Collections Dresden

The Pamir and Tien Shan are among Earth's largest and most active intra-continental orogen, currently shortening at a rate of ~20 mm/a along two continental subduction zones. The continuing post-collision deformation with northward subduction of the Indian plate is producing some of the most active areas of intermediate-depth seismicity, and a host to some of the highest uplift rates and most powerful river systems on the planet.

We focus on the evolution of the drainage network in the Pamir-Tien Shan of Tajikistan and use it as a proxy for characterizing the rates and distribution of neotectonic deformation. This evolution involves topographic growth of the Pamir by northward propagating deformation establishing east-west-trending belts of shortening along which catchment discharge and corresponding sediment transport was aligned. The influence of the Westerlies results in focused precipitation. Such complex tectonic-geomorphologic-climatic feedbacks are well exhibited especially in river-capture, river-reversal and regional erosion history. The Panj, for example, is unusual in that it flows northwards and then doubles back to the southwest, cutting the Darvaz range and other major Cenozoic deformation zones. We suggest that the complex structure of the Panj is a composite feature, developed by river capture from the pre-existing east-flowing drainage pattern and likely controlled by an active continental subduction zone beneath.

Focusing on the Panj trunk river and its major tributaries, we have conducted detailed sampling of river terraces and lake sediments. These have been subjected to a combination of optically stimulated luminescence (OSL) and cosmogenic nuclide (10Be) dating to provide the timing of terrace or lake sedimentation and abandonment, and to quantify the response rates of the landscape to tectonic-climatic forcing. Preliminary results from 20 OSL samples provide Panj terrace ages between 1 and 30 ka. Accurate measurements of the relative heights of these terrace–sediment bodies above the modern river level are achieved by differential GPS. Terrace heights from 5 to 85 m a.s.l. correlate with increasing OSL ages. Estimated OSL ages and corresponding terrace altitudes enable quantification of incision rates to be between 2 and 6 mm/a. Pronounced erosion is indicated by narrow valley morphology and agrees with estimates derived by OSL. The relation to fault structures is analysed based on longitudinal river profiles. Additional information on tectonic forcing is deduced from tectonic geomorphology via remote sensing technologies.