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The interplay of tectonic and climatic processes in fluvial deposits along the Bogd Fault Zone, SW Mongolia

Jorien L.N. van der Wal (1), Veit Nottebaum (2), Christopher Weismüller (1), Georg C.W. Stauch (2), Frank Lehmkuhl (2), and Klaus R. Reicherter (1)

(1) Neotectonics and Natural Hazards, RWTH Aachen University, Aachen, Germany, (2) Physical Geography and Geoecology, RWTH Aachen University, Aachen, Germany

Uplift of mountain ranges is induced by tectonic activity and often prompts erosion of elevated surfaces and subsequent sediment deposition in the foreland and on mountain slopes. Simultaneously, the fluvial systems that are often responsible for these erosive and sedimentary processes are strongly affected not only by sudden local impulses (e.g. earthquakes, landslides, debris flows), but also by regional and global climate dynamics. This case study aims to determine the interplay of these different processes in one of the most tectonically active intraplate regions of the world.

In the Gobi Altai of SW Mongolia the India-Eurasia collision localises as E-W to NW-SE striking sinistrally transpressive mountain ridges which overprint and reactivate crustal fabrics related to older tectonic events. The northernmost expression of this mountain belt is the Gurvan Bogd range, which formed due to fault activity along the Bogd Fault Zone that last ruptured in 1957 in the M 8.3 Bogd- or Gobi Altai earthquake. Surface ruptures related to this earthquake were observed along 350 km, and (mostly fluvial) markers were offset 3-4 m horizontally (locally 5-7 m) and 2-3 m vertically. The recurrence of major earthquakes along this fault was determined to be 3-5 ka and is evident from high topography (up to 3957 m), as well as from scarps and drainages with cumulative offsets. In SW Mongolia, the study of paleo-earthquakes with such recurrence intervals is facilitated by arid climate conditions which enable the investigation of not only the recent tectonic history, but also of its effect on fluvial and lacustrine deposits in relation to that of large scale climate fluctuations.

We analyse the morphology of fluvial pathways and deposits of the Gurvan Bogd system at different scales. The comparison of observations at the regional scale from 12 m resolution satellite data with local 10-15 cm resolution digital elevation models (DEMs) derived from drone flights shows that large scale alluvial fan morphology is generally related to regional climatic and mainly Pleistocene processes. At the small scale, high resolution DEMs show that local, recent events are more evident: terrace abandonment and channel deflections are a direct response to fault ruptures. Ground-penetrating radar (GPR) measurements across fault scarps as well as existing and new optically stimulated luminescence (OSL) and cosmogenic nuclide ages are analysed to confirm such interpretations and to characterise known and newly localised tectonic structures.

We aim to extrapolate our evaluation of the influential factors on the Gurvan Bogd landscape system to construct a basin-scale landscape evolution model that may have implications for the regional Quaternary evolution of southwest Mongolia.