The Pokhara formation – one or multiple phases of massive aggradation by debris flows and fluvial deposition?

W. Schwanghart[1], A. Bernhardt[1], A. Stolle[1], B. Adhikari[2] and O. Korup[1]

[1] *Inst. of Earth and Environmental Science, Univ. of Potsdam, Germany*
[2] *Institute of Engineering, Tribhuvan University, Kathmandu, Nepal*
w.schwanghart@geo.uni-potsdam.de

Extensive valley sediments and fluvial fill terraces are ubiquitous landforms in alpine landscapes. In the Himalayas, reported ages of thick alluvial valley fills span various orders of magnitudes, with most documented cases covering the Holocene to late Pleistocene. Cut- and fill cycles found in terrace systems thus have often been linked to climate variability at millennial timescales.

The Pokhara valley in Nepal (28°15′N, 83°58′E) features valley fills that stand out from most documented valley fills. Macroscopically, the alluvial fan morphology indicates aggradation from the main river (Seti Khola). Debris flow and fluvial facies with boulders up to 37 m in diameter testify high energetic transport conditions and point at a sporadic, if not catastrophic, origin. Finally, radiocarbon ages suggest an exceptionally young formation. With dates reported between 500-1000 uncal. y. BP [1,2], previous hypotheses of gradual glaciofluvial deposition with terrace levels reflecting glacial/interglacial cycles [3] are now largely dismissed.

Despite broad acceptance of the sporadic deposition hypothesis, the nature and timing of the massive aggradation along the Seti Khola remains largely unclear. Such information is essential for estimating magnitude and frequency of past extreme geomorphological and hydrological events in this area and to reliably assess the probability of similar events in the future. By employing geomorphological, sedimentological and chronostratigraphic methods, our study aims at deciphering the depositional history of the Pokhara formation.

We find that the major part of the Pokhara formation consists of fluvial facies. Debris flow deposits, though pervasive, are mainly found at the base with thicknesses declining with increasing distance from the source. Aggradation led to damming of tributaries as well as drainage reversal and upstream transport of large amounts of silt in tributaries (marginal stillwater sediments). Ages that cluster at 800 cal. y. BP were obtained from radiocarbon dating of organic debris and peaty layers in these fine grained sediments and conform to the previous chronology of the formation. However, onlap geometries of the marginal stillwater sediments onto fluvial gravel of the Pokhara Formation do not support the interpretation that the formation was deposited by a single catastrophic event. Numerous epigenetic bedrock gorges in tributaries provide additional support that fluvial aggradation prevented the tributaries from reincising into the alluvium but repeatedly laterally displaced them, forcing them to incise into less erodible bedrock.

The notion of repeated events rather than a single depositional event significantly alters the assessment of risks exerted by highly energetic geomorphological and hydrological processes along the Seti Khola. Our preliminary results suggest rather repeated deposition largely accomplished by fluvial aggradation. To better support our findings additional work to better constrain the depositional chronology of the formation is required.

[1] A. Yamanaka. The Science Reports of Tohoku University, 7th Series (Geography), 32, 46-60 (1982).
[2] M. Fort. Zeitsch. f. Geom. N.F., Suppl., 63, 9-36 (1987).
[3] K. Hormann. Erdkunde, 28, 161-176 (1974).

Key words (for online publication): Debris flows, valley fills, geomorphological and hydrological hazards, Nepal