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Reassessing Catastrophic Infill of the Pokhara Valley, Nepal Himalaya

Wolfgang Schwanghart (1), Anne Bernhardt (1), Amelie Stolle (1), Basantha Adhikari (2), and Oliver Korup (1)
(1) University of Potsdam, Institute of Earth and Environmental Science, Potsdam-Golm, Germany (w.schwanghart@geo.uni-potsdam.de), (2) Institute of Engineering, Tribhuvan University, Kathmandu, Nepal

The Pokhara valley, home to Nepal's second largest city and a major tourist attraction (28°15′N, 83°58′E), is covered by 4-5 km3 and 50-100 m thick intramontane fan deposits that resulted from massive aggradation of the Seti Khola, a river draining the Annapurna Massif of the Greater Himalaya. Poorly sorted, gravelly fluvial facies intercalated with debris-flow and mud-flow facies known as the Pokhara Gravels attest to highly energetic transport conditions during one or several catastrophic flow events. In May 2012, a devastative flash flood/debris flow in the Seti Khola rekindled interest in the formation processes and timing of the Pokhara Gravels as they may provide constraints on the magnitudes and frequencies of similar past events.

Interpretations of previous sedimentological work and radiocarbon dating (Yamanaka, 1982; Fort, 1987) culminated in the belief that the Pokhara Gravels were catastrophically emplaced only 500 to 1000 years ago, although the exact nature, timing, and triggers of the purported event(s) remain obscure. Specifically, it remains debated whether the Pokhara Gravels were deposited instantaneously, possibly within less than a year, or whether sedimentation was more protracted over perhaps decades to millennia.

We present new geomorphological, sedimentological, geochemical, and radiocarbon data and re-assess a potential catastrophic infill of the Pokhara Valley during one or several high-magnitude events. Support for this scenario is given by laterally continuous long-runout ($\sim$40 km) debris-flow deposits topped by large (i.e. up to >11-m) boulders, a distinctly calcareous lithology diagnostic of a small Greater Himalayan source area tens of kilometres upstream, and by historical anecdotes of a large flood that destroyed an earlier settlement in the area. However, we show that dated outcrops of fine-grained sediments in tributaries blocked by the Pokhara Gravels yield asynchronous ages. Although our radiocarbon dates are consistent with previously reported ones, pooled ages may equally well reflect more than one depositional event. We infer that massive aggradation must have been ongoing after rivers began incising into the Pokhara Gravels.

Yet, geochemical fingerprinting of stillwater sediments located several kilometers upstream in these and other tributary valleys suggests a common and strikingly dominant sediment source limited to the Seti Khola's glaciated headwaters. These findings are at odds with the sedimentology of the Pokhara Gravels that point at one or more phases of deposition, most likely by high-magnitude events, possibly even by different transport processes. In summary, our results call for a much more detailed enquiry into the timing and mode of emplacement of the Pokhara Gravels in order to avoid gross misestimates of the hazard portfolio of the Pokhara valley.

References:
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