



Erosion rates in the Rio La Paz drainage basin: evidence for spatially and temporally variable erosion processes

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With a total drainage area of 4850 km² the morphometry of the La Paz drainage basin in the Bolivian Altiplano results from a combination of feedback mechanisms involving erosion and crustal bending. Apart from the Rio Consata the Rio de La Paz constitutes the only drainage system sourced on the Altiplano that cuts across the eastern Altiplano boundary in the Cordillera Real and links this region with Amazonia. The fluvial network therefore connects geomorphically and geologically very different zones: 1) the virtually flat Altiplano with its Mio-Pliocene fluvio-lacustrine deposits and volcanics, 2) the high Cordillera, mainly comprised of Paleozoic metasediments, Mesozoic plutons, and Miocene volcanics, and 3) the folded sedimentary rocks of foothills of the Subandean zone. Cross-cutting relationships between dated strata and incised valleys indicate that incision in the Rio La Paz headwaters postdates 5 Ma, and possibly even 2.8 Ma. The volume of about 3950 km³, which has been evacuated since then (assuming 2.8 Ma as starting point of incision) by the Rio La Paz drainage system to the Rio Beni relates to an average erosion rate of 290 mm/ky. In order to investigate this long-term erosion rate with respect to possible spatial and temporal variations, we studied catchment-wide erosion rates in the Rio La Paz basin and contributing areas of adjacent subbasins using terrestrial cosmogenic nuclides (TCN). This method allows the determination of catchment-wide erosion rates from sediments being currently exported from the basin over timescales ranging from 1-10ky.

Our preliminary results reveal an erosion rate of 230 mm/ky for the entire Rio La Paz basin (sample from basin outlet). Subbasin erosion rates vary from ca. 100 up to 600 mm/ky. So far, no direct correlation of mean slopes (and other morphometric parameters) in the subbasins and their respective erosion rates are obvious. However, there is a trend that the subbasins with high erosion rates are located close to the Cordillera, whereas subbasins with low erosion rates are located in immediate vicinity of the Altiplano. Present-day erosion rates in the Rio La Paz catchment obtained for a time frame spanning a decade range from 600-6000 mm/ky, based on sediment-yield data from published data, which is significantly higher than the ones revealed with TCN and the long-term volume estimates. The strong increase in the most recent erosion rates is most likely caused by human land-use practices (e.g. deforestation).

The different roles of erosion processes (e.g. headwater expansion by landsliding and / or fluvial incision) and relief might be a cause for spatially variable erosion rates. In contrast, on the Altiplano west of the Rio La Paz drainage divide, erosion rates are one to two orders of magnitude lower than in the Rio La Paz catchment (Hippe et al. in prep.). In summary, the TCN results from the interior parts of the Rio La Paz catchments indicate spatially and temporally variable climatic and tectonic signals along the margins of Earth's second largest plateau.