Geophysical Research Abstracts
Vol. 12, EGU2010-13510, 2010
EGU General Assembly 2010

Correlations between morphometric parameters and catchment wide denudation rates in catchments affected by crustal bending

Gerold Zeilinger (1), Florian Kober (2), and Kristina Hippe (3)

(1) University of Potsdam, Institute of Earth and Environmental Sciences, D-14476 Golm, Germany (zeilinger@geo.uni-potsdam.de), (2) Institute of Geology, ETH Zurich, CH-8092 Zurich, Switzerland, (3) Institute of Geochemistry and Petrology, ETH Zurich, CH-8092 Zurich, Switzerland

We analyzed the morphological parameters of catchments incising the Bolivian Altiplano and the Eastern Cordillera. The correlation of mean slopes and mean relief in the subbasins and their respective erosion rates are not instantly recognizable. 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. This observation led us to a more detailed analysis of the subbasins and their river networks in order to investigate the feedback mechanism between erosion rates and a surface morphology possibly affected by crustal response.
Our test area, the La Paz drainage system is sourced on the very low relief Altiplano and links this region with the Subandean zone by cutting across the eastern high Cordillera. The catchment, with a total drainage area of 4850 km^2, is shaped by a combination of feedback mechanisms involving erosion and crustal bending. Cross-cutting relationships between dated strata and incised valleys indicate that incision in the Rio La Paz headwaters postdates 2.8 Ma. The volume of about 3950 km^3, which has been evacuated since then by the Rio La Paz drainage system to the Rio Beni relates to an average erosion rate of 290 mm/ky. This is in a similar range as the catchment-wide erosion rates determined by using terrestrial cosmogenic nuclides (TCN) derived from sediments being currently exported from the Rio La Paz basin. The method integrates for a timescales ranging from 1-10ky. Our results show an erosion rate of 230 mm/ky for the entire Rio La Paz basin (sample from basin outlet) and erosion rates from ca. 100 up to 600 mm/ky in the subbasins. 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.
We observed that the higher erosion rates correlate unexpectedly with a lower hypsometric integral for the subbasins in the Rio La Paz catchment. Further analysis concentrates on parameters derived from the channel network. Particularly parameters like Stream-gradient index (SL), Steepness index (k_s) and Specific Stream Power (SSP) reveal the focus of erosion within the studied catchments. These spots of enhanced erosion coincide in general with the parts of the rivers, where mixed channel or bedrock incision is observed, and mainly where the channel length profiles show knickpoints. A spatial analysis of the geological properties detects those knickpoints induced by structures (faults and folds) and changes in lithology.
We will demonstrate that the TCN results from the interior parts of the Rio La Paz catchments correlate only to certain extend with the surface morphology within the catchment. However, including the erosion rates and morphometric parameters from the catchments on the Altiplano, the correlation spanning data from both landscapes is obvious. This implies that the effects of feedback mechanisms between erosion and lithospheric deformation are substantial at the scale of individual structures, where flexural feedback mechanisms between erosion and rock uplift influences the morphometry of catchments and channel morphologies. When the dominant type of erosion processes (e.g. headwater expansion by landsliding and / or fluvial incision) is possibly influenced by tectonics then it can also cause the spatially variable erosion rates and different surface morphologies and consequently the partly inconclusive correlations.