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Erosion vs. atmospheric deposition: deciphering a steep climate gradient in hyperarid northern Chile over multiple time scales

Joel Mohren, Steven Binnie, Damián Lopez, Benedikt Ritter, and Tibor Dunai
Institute of Geology and Mineralogy, University of Cologne, Cologne, Germany (joel.mohren@uni-koeln.de)

Long-term and persisting aridity has preserved an almost relict landscape in northern Chile. Thus, the region provides excellent conditions for the study of paleoclimate and the impact of climate and climate change on Earth-shaping processes and topography formation.

Here we present a set of catchment-wide denudation rates and an analysis of surface crust distribution along a short E-W transect on the northern rim of the Río Loa Canyon in the Coastal Cordillera of northern Chile (latitude 21.4˚S). In the study area, a flat sedimentary surface consisting of unconsolidated conglomerates of Oligocene age becomes increasingly dissected and changes into a badland-like topography over a distance of a few kilometers. We derived the denudation rates from cosmogenic ^{10}Be measured in amalgamated fluvial quartz pebbles along a $\sim$3 km transect spanning the changes in topography. The denudation rates increase by as much as one order of magnitude from east to west over the $\sim$3 km of distance, indicating the presence of a steep time-integrated climate gradient in this area. When related to major geomorphologic parameters, the denudation rate patterns point towards the presence of two different erosional regimes. These regimes are sharply bounded against each other by a local ridge, separating detachment-limited erosion processes in the western portion from transport-limited erosion processes in the eastern portion. Only the westernmost catchments show signs of sub-recent discharge. The gypsum crust was mapped in the field and by using an unmanned aerial vehicle (UAV), creating high-resolution orthomosaics of the catchments under investigation. Remnants of well-developed crust are currently covering slopes in faster-eroding catchments, supporting the theory that the gradient in landscape modification by fluvial activity evolved over multiple phases. It is likely that the development of the observed geomorphic gradient is accelerated during wetter periods, such as during stadials, when wetter zones shift northward (Lamy et al. 2000, *Terra Nova 12(1), 8-13*). To test this hypothesis we will measure in-situ cosmogenic ^{14}C in the pebbles to distinguish between long-term Quaternary (^{10}Be) and Holocene (^{14}C) denudation rates..