Geophysical Research Abstracts
Vol. 21, EGU2019-15480, 2019
EGU General Assembly 2019

Are drainage adaptations in northern Chile driven by climate, tectonics, or geomorphic thresholds?

Steven Binnie (1), Klaus Reicherter (2), Pia Victor (3), Gabriel González (4), Ariane Binnie (1), Karin Niemann (2), Jorien van der Wal (2), and Jana Mittelstädt (3)

(1) Institute for Geology and Mineralogy, University of Cologne, Cologne, Germany (sbinnie@uni-koeln.de), (2) Department for Geography, RWTH Aachen University, Aachen, Germany, (3) GFZ Potsdam, Potsdam, Germany, (4) Departamento de Ciencias Geológicas, Universidad Católica del Norte, Antofagasta, Chile

The prevalence of ancient abandoned fluvial landforms in the northern Chilean Atacama Desert is a testament to both the long-term hyperaridity of this setting and its sensitivity to change. Ascertaining what has driven drainage adaptations has the potential to reveal past environmental changes and whether they were localized or regional in extent. However, it is typically unclear whether processes related to climate, tectonics, or both, are the cause of drainage reorganization. Alternatively, an often overlooked driver of topographic change is the breaching of geomorphic thresholds, whereby abrupt erosional or depositional episodes occur without the need for external causes. Instances of geomorphic thresholds include periods of degradation and aggradation experienced by ephemeral streams, or stream piracy events. In this paper we will discuss the incision history of the Tiliviche River (Quebrada Tiliviche) in northern Chile and unravel the contributions made by climate, tectonics and geomorphic thresholds to the evolution of this drainage.

Like most of the rivers in northern Chile that reach the Pacific Ocean, the Tiliviche River has its source in the Andes Mountains (Precordillera) and takes a westward route through the hyperarid Central Depression and Coastal Cordillera. Using a cosmogenic nuclide derived chronology for the formation of a flight of river terraces located in the Central Depression we infer a dramatic increase of the incision rate of the Tiliviche River at around 350 ka ago. The fluvial terraces lie downstream of a subtle, fault-related, upward warping of the surrounding pediment surface for tens of km north and south of our sample site. Explanations for a more rapid rate of river incision over the last ca. 350 ka include: an increase in the amount of water available for discharge, possibly related to more precipitation in the Andean headwaters of the basin, or brought about by a stream capture event increasing the upstream catchment area; base-level drop in response to local fault driven uplift; or a base-level fall resulting from the draining of a paleolake downstream or connection of the Tiliviche River to the sea. The likelihood of each of these explanations is considered in greater detail with reference to characteristics of the local faults, the timing of abandonment of adjacent paleochannels and mapping of other Tiliviche River terraces, the dating of which is currently underway.