Geophysical Research Abstracts
Vol. 20, EGU2018-12520, 2018
EGU General Assembly 2018


# Paleosols of Upper Mustang (Nepal): new insights into their origin from leaf wax isotope and grain size data

Johanna Menges, Niels Hovius, Micha Dietze, Charlie Swoboda, Christoff Andermann, Kristen Cook, and Dirk Sachse

GFZ German Research Centre for Geosciences, Section 5.1 Geomorphology, Germany (menges@gfz-potsdam.de)

Arid high mountain landscapes such as the Tibetan Plateau and their ecosystems are highly sensitive to environmental change and/or anthropogenic influence. To better understand sensitivity thresholds in these landscapes we investigated paleosols from the Upper Kali Gandaki valley in Nepal which have been dated to 1000 -2500 years BP based on charcoal 14C analysis. The Upper Kali Gandaki valley lies in the rain-shadow of the High Himalayan range and is a thinly vegetated semi-desert without significant active soil development. This prompts the question why soils, which apparently covered a rolling landscape around 2000 years ago, stopped forming and were eroded in part by intense gully formation, across a marked eco-geomorphic tipping point. One hypothesis is that before this transition a stronger monsoon promoted significant vegetation growth and related soil development. We, therefore, aim to reconstruct the depositional and post-depositional setting that resulted in soil genesis and to assess if the hydrological regime was different than today in the Upper Kali Gandaki valley.

The hydrogen isotopic composition ($\delta$D) of plant lipids has become a widely used tool to reconstruct hydrological conditions. The $\delta$D value of the lipid is related to the isotopic composition of the source water the plant uses to synthetize the lipid and can provide information on hydrological conditions at the time of leaf formation. Plant lipids in soils can originate from in-situ plant growth but might also get deposited with clastic sediments. We therefore combine grain size measurements and total organic carbon content from sedimentary sequences containing the paleosols to establish a pedogenic stratigraphy, and apply robust end-member modelling (robEMMA) to identify and quantify the depositional and post-depositional mechanisms.

RobEMMA results in 3 to 5 end members, among them fine dust with clay, local aeolian sediment and local slope deposits. Several paleosol layers have been identified within the profiles based on TOC and clay content. Leaf wax $\delta$D values of the paleosol samples range from -199 to -236 ‰ and are significantly more negative ($P<0.01$) than $\delta$D values from the most abundant modern plant (the shrub Caragana gerardiana) and scarce modern soils from the same altitude. The offset of roughly 20 ‰ could be caused by higher amounts of precipitation and/or and increased relative humidity compared to today, both suggesting a wetter climate than today. EMMA analysis reveals a significant local aeolian component in the studied profiles, suggesting that transport of leaf waxes from the lower valley by upward winds can also be a potential contributor. However, leaf waxes coming from lower parts of the valley should have more positive $\delta$D values instead of the observed more negative values. Our data suggest, therefore, that it is likely that the Upper Mustang paleosols were formed under different climatic conditions as today, likely wetter conditions due to an increased monsoon, and that a drying trend may have contributed to the environmental tipping point now engrained in the local landscape.