Geophysical Research Abstracts
Vol. 20, EGU2018-1240-1, 2018
EGU General Assembly 2018

Geomorphic constraints on sedimentary archives and soil development on the Qilian Mountains, northeast Tibetan Plateau

Fei Yang (1,2) and Gan-Lin Zhang (1)

(1) Institute of Soil Science, Chinese Academy of Sciences, Nanjing, China, (2) Institute of Geography, Georg-August-University Goettingen, Goettingen, Germany (fei.yang@geo.uni-goettingen.de)

Various types of sediments including aeolian, fluvial, lacustrine, glacial and periglacial deposits have been recorded across the Qilian Mountains. These sediments, typically in stratified layers, have widely been used to reconstruct paleoclimates and geomorphological dynamics on the northeast Tibetan plateau. Yet, little attention has been paid to identify the variation patterns of sedimentary archives shaped by geomorphic settings at the watershed scale, and hardly any work has been undertaken to explore the differences in soil formation taking place in the various sediments.

In a typical intermountain basin of the Qilian Mountains, 55 soil layers/horizons from 15 pedosedimentary profiles in three major geomorphic settings, i.e., floodplains, alluvial fans and hillslopes, were analyzed to study the influence of geomorphology on sedimentary archives and consequential soil development. Granulometric characteristics allow for the differentiation of three major sediment types, i.e., aeolian sediments, fluvial sediments and periglacial slope deposits, as well as further subdivision of these sediment types. Three recurring modal sizes at $\sim$16 μm, $\sim$35 μm and $\sim$80 μm reflect three different aeolian dust sources that are ubiquitous on the NE Tibetan Plateau. Fluvial sediments were separated further into silty, sandy and gravelly fluvial deposits, based on field observations and granulometric data.

Sediment types and their stratifications show clear dependence on geomorphic settings. Aeolian silt covers all studied soils on floodplains and hillslopes, and occasionally occurs also on alluvial fans. Fluvial gravel forms the base of the floodplains and some uplifted hillslope positions, while sandy and silty fluvial deposits occur exclusively on alluvial fans. Periglacial slope deposits are widespread on hillslopes, whereby their proportions of loess in different layers vary greatly with slope position.

Variations of morphological and selected chemical soil properties (pH, $CaCO_3$ and soil organic carbon contents) show strong correlations with geomorphic settings and sediment types. The overall soil horizon sequence is rather related to the stratigraphic record of various types of sediments than a product of uniform pedogenesis as traditionally defined. For example, the vertical distribution patterns of $CaCO_3$ in soil profiles share similarities in the same geomorphic unit and exhibit considerable differences between different geomorphic units. In soils on floodplains carbonates accumulate close to the surface, while on alluvial fans they form a calcic horizon at some depth, and on hillslopes they are leached to greater depth or even completely out of the soil profile. Soil organic carbon and grass roots strongly accumulate in silty surface soils providing sufficient moisture. Soils on sandy fluvial sediments, however, have a much lower potential to retain soil organic carbon, probably due to their low water holding capacity, resulting in less biomass production, and increased soil organic matter (SOM) decomposition due to their coarse pores allowing for efficient aeration and accessibility of the SOM for microbes.

In conclusion, the spatial pattern of sedimentary archives on the Qilian Mountains is largely determined by geomorphologic settings, and the soils in turn develop as a function of sedimentary history and climatic conditions under the first-order control of their geomorphic position.