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Environmental reconstructions on the NE Tibetan Plateau based on sediment characteristics and multivariate statistics (EMMA)

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Detailed analysis of sedimentological data allows reconstruction of transport conditions and the associated environmental situations. Interpretation of individual grain-size distributions ignores the influence of outliers and local anomalies. Multivariate statistics enable simultaneous interpretation of a set of parameters in order to reconstruct general transport conditions of distinct populations within the dataset.

We performed end-member mixing analysis of a large sedimentological dataset (912 samples) of terrestrial sediments in the Donggi Cona catchment on the NE Tibetan Plateau. The results show that 91% of the variance within the dataset is represented by three typical populations. The first population contains well-sorted coarse sands with a median size of 322 μm. The second one has a median size of 144 μm, representing the (partly reworked) fine sand to coarse loess sediments deposited in the higher mountain regions. The third population shows a bimodal distribution with two medians at 13 and 215 μm.
The coarse sand population represents the sand cover sediments that are found in the lower part of the catchment. The sand deposits show a WSW-ENE orientation, in line with the main local wind direction that results from the catchment shape. The sediments originate from former lake beds, alluvial fans and occasionally dry river beds. The well-sorted second end-member is (partly) blown out from the sandy deposits from the first end-member.
The third end-member is particularly well represented in the north-eastern catchment. It is often found in situations where coarse slope debris is mixed with reworked loess, or deposited on or close to moraine ridges. The latter is often polymodal, as a product of different erosion mechanisms.

End-member mixing analysis allows simultaneous interpretation of a large number of samples, resulting in a general catchment-specific sedimentological characterization. The general characterization of sediment populations indicates the dominant sediment production and transport processes. The spatial distribution of typical end-members allows reconstruction of transport ways and provenance of sediments. This results in a better understanding of past and present environmental conditions.