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Fixed grain size ratios for loess-paleosol sequences - useful proxies for past aeolian dynamics or controlled by pedogenesis?

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Loess-paleosol sequences are sensitive terrestrial archives of past aeolian dynamics and paleoclimatic change. Numerous paleoenvironmental reconstructions from loess records have traditionally depended on the analysis of grain size (GS) distributions. A number of GS based statistical approaches are widely used. However, the GS distribution of a loess sample is not solely a function of aeolian dynamics; rather, complex polygenetic depositional and post-depositional processes must also be taken into account.

This study assesses the reliability of fixed GS ratios as proxies for past sedimentation dynamics, using several case studies from different regions in the Eurasian loess belt. Highly resolved GS data derived by laser diffraction are visualized using heatmap signatures (Schulte in press). Based on this, meaningful proxies for grain-size shifts due to post-depositional pedogenic processes are identified. Our proposed approach facilitates the identification of variability within loess-paleosol sequences without horizontal or vertical data loss.

We conclude that fixed grain size ratios are unreliable proxies for past aeolian dynamics on their own and lead to the loss of important data. Soil formation processes cause "true" variations within sensitive GS classes (e.g. clay and fine silt formed by pedogenesis), but these variations may be masked by relative changes in the more frequently occurring size fractions when single value parameters are used.