Loess provenance using zircon and rutile

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Provenance of loess is most commonly approached by bulk geochemistry, although the use of major, trace and rare earth elements rarely provide diagnostic information on the hinterland. Sr and Nd isotopes of bulk loess or grain size separates provide more insight, and in some specific cases, end members (and thereby major dust sources) can be identified using mixing models. Nevertheless, in such bulk approaches the isotopic compositions are not uniquely determined by single minerals, but by multiple phases yielding a bulk signal which is often useless in source discrimination. In contrast to this, in situ chemical and isotopic analyses of single heavy mineral grains enable us to more clearly link source rocks to loess sediments containing these target minerals.
Investigations on a limited number of last glacial loess samples from the southeastern foreground of the Bohemian Massif (BM) and north of the Eastern Alps (EA) in Austria reveal that both zircon and rutile provides robust information for discriminating heavy mineral sources. U-Pb ages and Hf isotopic compositions of detrital zircons imaged for their internal structures and chemistry-thermometry data as well as U-Pb ages of rutiles all imply strong contributions from eroded local rocks of the south BM and EA. While the in situ chemical/isotopic analysis of rutile seems to be a powerful tool in gaining insight into metamorphic source lithologies, metamorphic events and cooling history of the hinterland (Újvári et al., 2013), cathodoluminescence imaged zircons provide information on the thermotectonic history of source terrains and the geochemical environment in which the zircon crystallized by the combined use of the U-Pb and Lu-Hf isotopic systems (Újvári and Klötzli, 2015). This latter approach allows distinguishing between grains having the same crystallization ages but formed in crustal domains separated from the mantle at different times. The combined use of zircon and rutile may open up new vistas in loess provenance studies of the Chinese loess, too, and may contribute to the understanding of major sediment transport pathways in the desert-river-loess system in China.

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