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Summary

Red Clay and overlying loess-palaeosol sequences are typical for the area in Northern China that is known as the Chinese Loess Plateau (CLP). These primarily aeolian sediments provide one of the best terrestrial archives of Neogene-Quaternary climate change, and their formation has been linked to the uplift of the Tibetan Plateau, the progressive aridification of East Asia and the onset of and changes in the East Asian monsoon. In the present study, the sediment provenance was reconstructed using a combination of analytical techniques that allowed better understanding of the (long-term) shifts in sediment delivery in response to changes in the climate and tectonic evolution.

Zircon U–Pb age spectral and backtrace trajectory modelling of three well known Red Clay sequences distributed across the CLP revealed the spatiotemporal variations in the provenance of late Miocene-Pliocene Red Clay. The results indicated that the Red Clay in the southern and western CLP was mainly derived from the Northern Tibetan Plateau (NTP) and the Taklimakan Desert. In contrast Red Clay in the northeastern CLP displays a zircon U–Pb age signature of the broad area of the Central Asian Orogenic Belt. In addition, the north-eastern Red Clay shows increased contributions from the west around 3.6 Ma, possibly suggesting an intensified westerly wind strength and/or aridity of the NTP and Taklimakan Desert arising from the uplift of the NTP and Tianshan Mountains in the Pliocene. This could also be caused by the onset of enhanced Yellow River drainage in response to the increased NTP denudation since 3.6 Ma.

To further investigate the role of the Yellow River in supplying dust to the Quaternary loess deposits, the sedimentology and source signal of the unique loess-palaeosol sequence of the Mangshan Loess Plateau (MLP) along the lower reach of the Yellow River was investigated by end-member modelling of the loess grain-size records and single-grain zircon U–Pb dating. The results suggest that the Yellow River floodplain north of the MLP has served as a major dust source at least since 900 ka. The sudden change in sedimentology (accumulation rate, grain-size distribution) of the Mangshan sequence above palaeosol unit S2 may have been initiated by a combination of tectonic movements in the Weihe Basin and in the Yellow River floodplain north of the MLP around 240 ka. Subsequent rapid fluvial incision in the northern part of the Weihe Basin resulted in increased sediment flux being transported to the lower reach of the Yellow River. Tectonic movements in the floodplain north of the MLP would have caused a southward migration of the Yellow River course, explaining the formation of an impressive scarp and the more proximal location of the sediment source.

In addition to provenance analysis, grain size and shape characteristics obtained by dynamic image analysis (DIA) were used to fingerprint the transport processes of silt particles in a series of Quaternary loess-palaeosol sequences. The results revealed a decrease in the aspect ratio of the particles as a function of increasing grain size, thus indicating that systematic shape sorting occurred during the aeolian transport of the silt particles. A similar particle-shape sorting trend has also been found in a series of Red Clay

sequences, confirming that the Red Clay deposits are predominantly of aeolian origin. This study indicates that DIA of grain size and shape characteristics can be an additional powerful tool for fingerprinting trends in grain size and shape sorting, determining the dominant mode of transport, and reconstructing the transportation pathways of silt-sized aeolian sediments.

The final part of this thesis comprised a pilot study on the use of the trace-element composition of quartz as a provenance tool to constrain the source area of the late Neogene and Quaternary dust deposits in Northern China. It revealed that quartz in the Mangshan loess deposits is largely derived from the Qaidam Basin of the NTP. The likely dust contribution from the Taklimakan Desert to the Red Clay deposits in Baode is also reflected in the trace element content of quartz. These results are comparable with the source signal obtained from the zircon U-Pb age spectra, suggesting that the trace element composition of quartz could be applied as an alternative tool to other single-grain provenance analytical approaches to track the dust source and dust pathways of the aeolian sediments.