

Decoding the pedogenic weathering signals from the red clay sequence on the Chinese Loess Plateau

YULONG GUO¹, SHOUYE YANG², LICHENG GUO³ AND
YIBO YANG⁴

¹State Key Laboratory of Marine Geology, Tongji University

²State Key Laboratory of Marine Geology, Tongji University,
Shanghai, China

³Institute of Geology and Geophysics, Chinese Academy of
Sciences

⁴Institute of Tibetan Plateau Research, Chinese Academy of
Sciences

The loess-paleosol sequences and the underlying red clay layers are extensively distributed across the Chinese Loess Plateau, serving as important archives of paleoenvironmental information. However, intense pedogenic alterations can obscure the environmental information recorded in the red clay layers, making it essential to extract the post-depositional pedogenic weathering signals. By applying newly developed geochemical indices, we analyzed the mineral composition characteristics of sediments from a typical loess-paleosol and red clay sequence. The findings indicate that pedogenic weathering within the loess-paleosol sequences is minimal, with the mineralogy, geochemistry, and grain size distribution reflecting the dynamic sorting conditions during deposition. Typically, sediments with weaker chemical weathering and coarser grain sizes exhibit quartz enrichment. In contrast, intense post-depositional alteration in red clays leads to the leaching of mobile elements, the formation of secondary clay minerals, and a subsequent reduction in sediment grain size. Despite these changes, quartz remains stable and unaffected by weathering. Consequently, the geochemistry and grain size of the red clay sediments become decoupled from quartz enrichment, no longer following the sedimentary dynamic sorting rules. Our approach goes beyond merely comparing weathering indices by using particle sorting behavior as a benchmark, thereby largely avoiding interference from changes in provenance. This study enhances the understanding of post-depositional alteration processes and offers new insights into the preservation and modification of environmental signals within the red clay sequences.