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Sedimentary weathering signals in the Yangtze Delta plain indicate the complex controls of climate change and human activity Since 7 ka BP

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In large river systems, the complex interplay of sediment source-to-sink processes and anthropogenic perturbations complicates the relationship between chemical weathering and climate change. Here, we reconstruct sedimentary provenance and weathering intensity in the Changjiang (Yangtze River) Basin since 7 ka BP, through a multi-proxy analysis (clay mineralogy, elemental geochemistry, Sr-Nd isotopes) of a continuous sediment core (TY) from the Yangtze Delta Plain. Key findings reveal:

(1) During the mid-Holocene (7.0-1.0 ka BP), restricted ε_{Nd} variability (-12.0 to -11.5) indicates stable sediment provenance dominated by mid-lower Yangtze River sources. The sediments exhibit moderate chemical weathering intensity, with Chemical Index of Alteration (CIA) values ranging from 57.9 to 69.1. Considering the persistence of stable estuarine-bay depositional conditions during high sea-level stands, most weathering indicators are less affected by hydrodynamic sorting effects. Notably, the decoupling of weathering intensity from the weakened East Asian Summer Monsoon (EASM) during this interval implies that sediment recycling and prolonged residence time in mid-lower reaches altered primary weathering signals, masking a direct climate response.

(2) A marked shift occurred at ~1.0 ka BP: ε_{Nd} values increased abruptly (-11.4 to -10.4), signaling enhanced contributions from upper Yangtze River sediments. Despite strong hydrodynamic sorting effects, multiple weathering proxies (e.g., CIA, kaolinite/illite) reveal intensified chemical weathering during delta accumulation. We attribute this tendency to human activities, particularly accelerated deforestation and agricultural expansion since the late Holocene, which remobilized deeply weathered soils and facilitated their transport to the estuarine delta.

This study highlights that, on suborbital timescales, bulk sediment weathering records in large river basins primarily reflect provenance shifts driven by climatic or anthropogenic forcing, rather than direct climate responses.