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U-series Comminution Age Constrains Large Catchment Erosion and its Response to Climate Change: A Case study from the Changjiang

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Catchment erosion not only plays an important role on landscape evolution, but also determines the exposure of rock debris in the regolith profile, and therefore control chemical weathering and CO_2 absorption to regulate global climate. Uranium-series Comminution Age (t_{com}) of core sediments from Changjiang estuary are employed to reconstruct the catchment erosion, and its relationship with climate changes and human activity during the last ~14 kyrs.

From the last late deglaciation to the mid-Holocene (14 – 4 ka), the t_{com} shows a periodic pattern, which was in a good coupling with climate change. During the cold periods, the sediment t_{com} was large as less precipitation resulted in shallower erosion and the erosion material mainly comes from the top soil with lower $^{234}U/^{238}U$ and longer residence time. Meanwhile, these sediments were transported slowly due to weaker hydrodynamic forces, causing estuarine sediments have large t_{com}. In contrast, during the warm periods, the aboundant precipitation contributes to deep erosion in the catchment, and more fresh materials are mobilized and transported to the estuary through the strong hydrodynamic transport. Therefore, the estuarine sediments record smaller t_{com}. Second, after the middle-late Holocene(4 – 0 ka) while the climate was warm and humid, with the highstand system tract, the t_{com} recorded by estuarine sediments fluctuated apparently. This is because the increasing river flooding caused by abundant precipitation leaded to lateral migration of the channel in the middle-lower reaches, and the sediments deposited in the floodplain early were eroded and mobilized again. In addition, the rapid development of human activities since 2 ka has also accelerated the deforestation and agricultural cultivation, leading to localized erosion of the floodplain. These remobilized sediments were transported and deposited in the estuary, resulting in a larger t_{com}.

This study overall indicates that, in the millennial scale, the sediments t_{com} shows a sensitive and quick response to catchment erosion, and provides new insights into quantifing the time scale of sediment source to sink processes and infering the paleoenvironment accurately.