

Hydrodynamic sorting and provenance controls on silicate weathering indices: evidence from Yarlung Tsangpo-Brahmaputra River System

XIAOBAO GAO¹, LING WANG¹, XINNING XU², ESHA RAY¹, SHIJUN WANG¹, XUE HAN¹ AND SHOUYE YANG³

¹State Key Laboratory of Marine Geology, Tongji University

²Graz University of Technology

³State Key Laboratory of Marine Geology, Tongji University, Shanghai, China

Whether the silicate weathering indices (e.g. chemical index of alteration, CIA) registered in detrital sediments can really indicate the weathering regimes in river basins remains unclear, more case studies are required, especially from big catchments covering different tectonic, geographic and climatic settings. In this study, we report the geochemical and mineralogical compositions of the fine-grained samples, including suspended particulate matter (SPM) and <63 μm and <2 μm fractions of floodplain sediments from the Yarlung Tsangpo-Brahmaputra River (YBR) Basin. By comparing various weathering proxies of different sized sediments, the influence of sorting effect is analyzed. With correcting sorting effect by Al/Si ratio, the dominance of recycling materials to sediments in central plateau is emphasized. Our key findings reveal: (1) Provenance shifts abruptly at the plateau boundary (after Pai town near Nyingchi city), with mainstream sediments above Pai exhibiting southern tributary characteristics (higher illite chemistry index and illite crystallinity, high αCa and αNa . CIA of SPM and floodplains is 70-78 and 62-69 respectively) linked to Tethys Himalayan Sequence sources, contrasting sharply with sediments after Pai (low αCa and αNa , CIA of SPM and floodplains is 61-75 and 42-69 respectively) dominated by rapidly eroded southern Himalayan Foothill materials. (2) Sorting-corrected CIA (CIA_C) values demonstrate distinct spatial patterns: southern tributaries and mainstream sediments above Pai retain high weathering intensities ($\text{CIA}_C = 60-77$, averaged at 70, comparable to that in mid-lower Changjiang reaches), while sediments after Pai show relatively unaltered low CIA_C values (42-73, averaged at 57). Considering the overall weathering-limited condition in Tibetan Plateau, we infer that it's products from weathering or denudation of recycling shale rather than contemporary weathering products dominate the elemental-based sediment weathering indices in central plateau, especially those from the middle reaches of Yarlung Tsangpo. This work advances understanding of sediment generation mechanisms and propagation of silicate weathering signals in southern Tibetan Plateau.