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The Tibetan Plateau act as a Geological Carbon Source? Quantifying the Weathering of Petrogenic Organic Carbon Using Rhenium Proxies

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Mountain uplift, along with the associated erosion and weathering processes, play a crucial role in the long-term carbon cycle, profoundly influencing the Earth's climate evolution. Conventional studies suggest that silicate chemical weathering and organic carbon burial under terrestrial photosynthesis are important geological carbon sinks, with mountain uplift enhancing these processes. However, the weathering of petrogenic organic carbon (OC_{petro}) in rocks, as a potential carbon source, has not been fully understood in terms of its net carbon balance and temporal variation due to human activity interference and the insufficiency of quantitative research. In this study, we investigated the upper reaches of major rivers within and on the eastern and southeastern margins of the Qinghai - Tibet Plateau, focusing on using rhenium as a tracer to measure the weathering rate of OC_{petro}. Through analyses of the major element composition, rhenium concentration, and organic carbon content in both river water and bedload sediments, combined with Monte Carlo simulation calculations, we quantified the OC_{petro} weathering flux in the study area. The results demonstrated that the carbon source derived from OCpetro weathering surppasses the carbon sink from silicate chemical weathering in the study region. The overall OC_{petro} weathering rate and net carbon budget of the Tibetan Plateau are 1.95(±0.60) t $C \cdot km^{-2} \cdot yr^{-1}$ and $1.81\ ^{+0.34}/_{-0.49}$ t $C \cdot km^{-2} \cdot yr^{-1}$, respectively. The findings suggest that the Tibetan Plateau may act as a geological carbon source. This study not only refines our understanding of the OC_{petro} weathering but also reveals a dynamic transforming impact on the geological carbon cycle during different stages of mountain building.