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Transformation of organic particulates along a river-ocean continuum in a small mountainous river system, eastern Taiwan

YUN-HSUAN LEE[1], PEI-LING WANG[2], LI-HUNG LIN[3] AND CHIH-CHIEH SU[2]

[1]National Taiwan University
[2]Institute of Oceanography, National Taiwan University
[3]Department of Geosciences, National Taiwan University
Presenting Author: asdzxc22578@gmail.com

Tracking the fate of organic carbon (OC) delivered from land to ocean by small mountainous rivers (SMRs) is essential to resolve the global carbon cycle but needs to be better understood. We examined the elemental and isotopic compositions of organic particulates in the Beinan river and its offshore marine sediments in eastern Taiwan to investigate their origin and transformation along a river-ocean continuum. Based on low C/N ratios and $\delta^{13}C$ values, the riverine organic particulates were mainly petrogenic in origin. The detailed examination further revealed that the suspended particulates contained higher OC contains with higher C/N ratios and lower $\delta^{13}C$ values than the bedload at any sampling site, and the upstream particulates were characterized by lower $\delta^{13}C$ values than the downstream particulates. These results suggest a higher contribution of fresh biogenic or soil OC to the suspended fraction or upstream particulates. Furthermore, the trap sediments collected near the river mouth offshore over a period with heavy rainfall events were characterized by lower total nitrogen, OC contents, C/N ratios, and radiocarbon activities and higher $\delta^{13}C$ values than those collected without heavy rain events. In contrast, the trap sediments collected distantly from the river mouth were similar in their elemental and stable isotope compositions with low radiocarbon activities regardless of rainfall events. The geochemical characteristics of nearshore sediments were comparable with those of downstream riverine sediments. The results from the trap and nearshore sediments all point to a higher contribution of petrogenic OC sourced to the riverine export, particularly during high discharge events. Overall, the Beinan river system demonstrates the importance of rapid transport and burial of petrogenic OC along a river-ocean continuum manifested by extreme weather events and active orogenesis. While such a routing system enables the quantitative export of OC, its contribution to the attenuation of atmospheric CO_2 is marginally significant.