A global perspective on riverine export of terrestrial organic carbon to the ocean

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The atmosphere is a small reservoir of carbon compared to rocks, the biosphere and the ocean. As such, its size is sensitive to small imbalance of C exchange with and between larger reservoirs. Over long timescales, the continental biosphere is mostly at equilibrium with the atmosphere, most of the net photosynthetic primary production being quickly returned to the atmosphere via respiration. However, rivers deliver particulate organic carbon (OC) from continental to oceanic reservoirs, where OC can be buried and stored over long timescales. This "leak" of biospheric carbon away from the biosphere-atmosphere loop represents a net sequestration of atmospheric C. Rivers also transfer OC from the rock reservoir (petrogenic C) to marine sediments, thereby transferring C between two reservoirs disconnected from the atmosphere. During this transfer, oxidation of petrogenic C represents another "leak'' of C, in this case towards the atmosphere. Riverine export of OC to the ocean thus fundamentally affects the atmospheric C inventory, over both long and short timescales. Nevertheless, global riverine OC export to and burial in marine sediments has heretofore remained poorly constrained and the respective fluxes of biospheric and petrogenic C have simply been unknown. Even more importantly, the mechanisms controlling OC export and burial have remained poorly defined, impeding our ability to make quantitative predictions of OC fluxes under forcing scenarios. Based on bulk, ramped-pyrolysis and molecular level ^{14}C dating of OC in modern river sediments as well as in marine sedimentary sequences, we present: 1) an evaluation of the global delivery of petrogenic and biospheric OC to the ocean and, 2) a characterization of the dominant drivers of petrogenic and biospheric OC delivery to marine sediments.