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Do different components of terrestrial sources contribute to the riverine suspended load?

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Establishing the relationship between source (bedrock, soil, floodplain sediments, vegetation) and mobilized materials (bedload and suspended load) within a river drainage network is critical to understanding the fate of particulate matter exported to the coastal ocean. First, linking material carried in river channels to its terrestrial sources aides in predicting the reactivity of organic matter associated with mineral particles and understanding which portions of a watershed contribute substantially to organic carbon fluxes and transformations in these systems. Second, identifying terrestrial reservoirs of future riverine suspended material can enhance our ability to comprehensively characterize the chemical and physical nature of fluvial sediments.

We present a study of sedimentological and bulk organic carbon properties of sediments from across the Fraser River watershed in southwestern British Columbia, Canada. Bulk samples and size fractions from surface soils and riverbank sediments, as well as vegetation, are analyzed for metrics including carbon and nitrogen content, ^{13}C and ^{14}C composition, and specific surface area. These are compared with measurements of riverine suspended sediments and size fractions of sediments deposited in the Fraser estuary. The correspondence of suspended sediment properties with different portions of soil, alluvial, and vegetation pools from different sites suggests a complex link between source materials and exported material. Such variability may stem from the heterogeneous nature of soil types, hillslope morphology, and runoff regimes in different portions of the drainage basin; settling/resuspension processes during river transit; and/or modification of particle structure and organic matter between mobilization of terrestrial material and arrival at distant downstream sites. The preferential loss/preservation of different size fractions within mineral source materials highlights the unequal importance of different mineral phases and continental regions to fluvial transport and fate of terrestrial carbon in the coastal ocean.

A focus on the Fraser River basin is advantageous for its extraordinary diversity of rock types and rainfall distribution (leading to stark contrasts in plant and soil types, as well as organic and inorganic isotopic signatures), and the lack of intermittent storage reservoirs (dams, lakes) on the main stem. The modest size ($\sim$240,000 km^2) and excellent hydrological monitoring of this watershed make it possible to characterize the basin in great detail. Such a case study can readily be extended to basins less likely to exhibit distinct spatial variations and systems with less available baseline data, in order to gain a broader perspective of global processes. The exploitation of sediment size fractions to understand suspended sediment properties further offers a potentially potent tool for better characterizing materials which are typically difficult to collect in sufficiently large quantities for detailed biogeochemical, sedimentological, and petrographical characterization.