

Residence time of sedimentary organic matter in the Fraser River basin, B.C., Canada

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The residence time of organic carbon carried by river sediments, which is controlled by processes influencing storage in soils and temporary intermediate depositional areas, affects the efficiency of terrestrial carbon burial in marine sediments. The Fraser River basin in southwestern Canada has minimal natural or anthropogenic impediments to fluvial sediment transport, and therefore we expect sedimentary organic carbon export to be maximally efficient. Measurements of the radiocarbon content of bulk organic carbon in suspended and bank sediments from across the basin show remarkably coherent behavior in the dilution of a constant proportion of fossil (radiocarbon-dead) organic carbon with widely varying amounts of biospheric (relatively modern) organic carbon. Based on these measurements, we estimate that the average residence time of bulk biospheric organic carbon in the basin is approximately 800 years. The radiocarbon age of higher plant biomarkers, however, is approximately 4000 years. Such a long delay between biospheric fixation and transport through the watershed shows that storage of terrestrial organic carbon on land is significant even in a basin with export-favorable conditions.

Focusing on a suite of suspended sediments collected during freshet and low discharge conditions in 2013, we compare the seasonal variability in sediment sources and composition. In these sediments, the seasonal contrast in organic carbon composition is reflected in the inorganic radioisotope composition (⁸⁷Sr/⁸⁶Sr) of sediments, which links the provenance of organic carbon to that of the sediments themselves. During the spring freshet, a significant portion of sedimentary material derives from the far headwaters of the basin, while during low discharge times, the headwater influence is minimal. Together, these organic and inorganic tools shed light on the variable influences of different regions across the Fraser basin on organic carbon export, and thus terrestrial organic carbon burial potential.