Organic carbon retention in mountainous headwater streams of the Colorado Front Range, USA

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Abstract. Sustainability of freshwater resources depends upon many natural processes physical and biological processes. Biologic breakdown and metabolism of organic carbon (OC) are facilitated by physical retention of in headwater streams where organic matter inputs are high. Retention of OC along mountain streams are influenced by valley form, channel geometry, and biotic drivers including beavers and old growth forests. Old growth forests have trees large enough to create persistent channel-spanning log jams that facilitate obstruction to flow, lateral floodplain connectivity and overbank flow, floodplain aggradation, the development of multiple channels of flow across wide valley bottoms, and retention of organic matter. Beaver dams function in a similar way, encouraging retention of organic matter and OC. Our prior work indicates that downed large wood and soil OC are the primary reservoirs for OC storage in mountainous headwaters streams in and around Rocky Mountain National Park. We surveyed downed large wood and floodplain soil along 24 study reaches in mountainous headwater streams of the Colorado Front Range. Comparison of study reaches with various degrees of valley confinement in old growth (>200 yrs) and younger subalpine and montane forests reveals geologic and biogeomorphic controls for OC retention. Preliminary results indicate that unconfined valley segments store much more OC per area (783 Mg/ha) compared to partly confined and confined valley segments (153 Mg/ha). Unconfined valley segments store a significant amount of OC along single thread channels and facilitate potential for development of multithread channels. Reach-average radiocarbon ages from charcoal in floodplain sediment of three study reaches with drainage areas <20 km^2 (~1338 yBP), 20 – 100 km^2 (~527 yBP), and >100 km^2 (~823 yBP) indicate that floodplain sediment turnover time is much longer in small streams at higher, subalpine elevations. Snowmelt-dominated hydrographs in these high-elevation streams rarely exhibit bimodal characteristics typical of the hydrologic disturbance regime in lower elevation montane forests of the region, which are influenced by large convective thunderstorms and monsoons of the southwestern US. The downstream cumulative effect in larger basins at lower elevation appears to be faster turnover times for floodplain sediment and associated soil OC.