Isotopic constraints on microbial carbon cycling of montane soils (East River, Colorado)

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Variations in temperature and precipitation can have significant effects on carbon cycling in high-altitude montane ecosystems. In an effort to better constrain existing carbon cycling models in high-altitude ecosystems, we measured carbon concentrations and stable isotope signatures to improve our understanding of carbon cycling of montane ecosystem soils. The study area is charaterized by a snow-dominated headwater catchment of the Colorado River (East River, Colorado). An isotope mass balance approach was applied to constrain the carbon soil budget by analyzing the different carbon reservoir isotopic signatures. Carbon isotopes and concentrations of soil organic carbon, dissolved inorganic carbon (DIC), soil gas CO_2, microbial biomass, and litter organic carbon (LOM) have been measured to date. The $\delta^{13}C$ of microbial biomass (-22.9 ± 2.2‰) overlaps the range measured for soil organic carbon (SOC) $\delta^{13}C$ (-24.3 ± 0.4‰) and is clearly distinguishable from that of DIC (-13.1 ± 0.7‰), and from soil gas CO_2 (from -21.6 to -8.7‰). DIC from water of saturated soil collected during snowmelt clearly indicates a system close to equilibrium with CO_2 from bacterial respiration. The $\delta^{13}C$ values of soil gas CO_2 indicate partial exchange with atmospheric CO_2 and carbonate dissolution. A carbon isotope mass balance based on SOC content, the fraction of microbial biomass, and respired CO_2 suggests that a high proportion of microbially decomposed organic C was respired as CO_2 correcting for dissolution of carbonate minerals. The isotopic signatures act as reliable tracers of the carbon reservoirs and can be a useful approach to evaluate C fluxes between reservoir to further understanding changes in montane ecosystem carbon cycle.