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RAPID $p\text{CO}_2$ DECLINE IN HEADWATER STREAMS OF THE UPPER PIEDMONT, SOUTH CAROLINA

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First-order headwater streams may be quantitatively important in terrestrial carbon (C) cycling both because they account for a majority of channel length and they transfer soil-derived CO_2 to the atmosphere. However, few studies have quantified CO_2 dynamics near the headwater springs. Spatial trends in CO_2 concentrations were examined for six headwaters in the upper piedmont of NW South Carolina. Three of the watersheds had 95-100% forest cover, while the other three watersheds had 0-30% forest cover and 60-80% low density residential cover. Between June and September 2008, we collected samples along high-resolution transects with total lengths of 240 to 1800 m. Conductivity, pH, dissolved oxygen, and temperature were measured at each location. Samples were analyzed for major ions and dissolved organic C. Bicarbonate concentrations were calculated using the Gran method. Carbonate species concentrations and $p\text{CO}_2$ were calculated from carbonate equilibria equations using measured bicarbonate and in situ pH and temperature. Additionally, one transect of 16 samples was collected for stable C isotope analyses of total dissolved inorganic C (DIC).

At all streams, the partial pressure of CO_2 ($p\text{CO}_2$) was highest at the source spring (141 to 3317 times atmospheric $p\text{CO}_2$) and declined with distance downstream. The mean distance required for $p\text{CO}_2$ to decline by 85% of its source value (zone of rapid decline, ZRD) was 36.7 m for the forest streams and 112 m for urban streams. For the isotope transect, $\delta^{13}\text{C}$ increased from -19.3‰ at the source to -16.1‰ at 60 m (the end of the ZRD) suggesting degassing of CO_2 and increasing contributions of bicarbonate to DIC. Concurrently, pH rose from 4.89 to 6.13, and $p\text{CO}_2$ declined from 79,400 to 5,586 μatm . However, concentrations of bicarbonate, chloride, and sodium varied by less than 0.1%, 3.1%, and 5.2% respectively, suggesting that dilution was not a factor controlling $p\text{CO}_2$ decline in the ZRD. This pattern was observed in the ZRD for all 6 streams. Isotopic data indicates soil respiration is the source of CO_2 in these headwaters. Such rapid $p\text{CO}_2$ declines suggest that the reaches near headwater springs are biogeochemical hotspots for CO_2 degassing and may represent a large soil to atmosphere flux.

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Session No. 16--Booth# 18

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