Geophysical Research Abstracts,
Vol. 11, EGU2009-10314-1, 2009
EGU General Assembly 2009

The effects of landfills on the isotopic signatures of filamentous algae (Cladophora sp.) in a highly urbanized stream

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Previous studies show that elevated δ^{15}N values in stream water indicate anthropogenic contamination and that aquatic primary producers make excellent monitors of this pollution. Additionally, aquatic primary producers typically derive their carbon from dissolved inorganic carbon (DIC) with an isotopic fractionation of about -20‰ and therefore are typically 20‰ lighter than DIC. Samples of filamentous algae from eight sites in the highly urbanized Casperkill Creek (Poughkeepsie, NY) were collected in July 2007 and May 2008 and were analyzed for δ^{15}N and δ^{13}C in an attempt to understand the biogeochemistry of this small stream and assess potential pollution sources. Water quality was also analyzed at these times. Algal δ^{13}C values in the Casperkill were lighter than expected. δ^{13}C-DIC ranged from -10 to -3‰ therefore the algae was expected to be around -30 to -23‰However, values as low as -45‰ were measured in the algae. Two of the three sites with low δ^{13}C values are downstream from capped landfills, and the other from a stagnant pond, both of which may produce large amounts of methane. Since methane usually contains light carbon, usually around -60‰ oxidation of this carbon source could account for the unusually low δ^{13}C values. This indicates that these landfills are supplying methane to the creek and perhaps other pollutants. δ^{15}N values were also not as expected. The reach of the stream with the highest nitrogen concentrations, the reach assumed to receive the highest pollution load, had the most negative δ^{15}N values, which is contrary to what was expected. However, this stream has elevated ammonium concentrations (up to 73 μM). Ammonium is known to be an isotopically light N species as well as the favored N species for plants. Moreover, plants prefer the light isotopes of NH_4. Thus, when NH_4 is high, plants use the light NH_4 molecules as their N source and as NH_4 decreases the plants use the remaining heavier NH_4. Therefore, as NH_4 (and nitrogen pollution) decreases, δ^{15}N values increase (R^2 = 0.88) – contrary to the generally accepted response. This indicates that understanding nitrogen species cycling within the aquatic environment is crucial to the use of δ^{15}N values as a pollution indicator.