The fate of methanotrophically fixed carbon in soils

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The complexities of soil organic matter composition and processing hinder attempts to elucidate and quantify specific carbon flow pathways within soils. Here we focus on C utilization in the soil by simplyfying the system through monitoring the long term utilisation of a very specific isotopically labelled substrate, namely $^{13}CH_4$. The fate of this conserved source of soil carbon can be traced into both specific biomarkers and bulk soil carbon to determine rates of carbon turnover and elucidate C flow through the soil. Our results (e.g. Fig. 1) provide novel insights into the fate of methanotrophically fixed C in soils. For example the different rates that CH_4 derived C is incorporated and released from different C pools has been determined as shown by rapid C assimilation into the methanotrophic PLFA 18:1ω7c, whereas C incorporation into other components such as non-methanotrophic PLFAs, neutral lipids, carbohydrates and amino acids is much reduced reflecting the differing C assimilation pathways and soil C pool sizes. It is also apparent that a significant proportion of CH_4 derived C is being retained long-term within the soil, as opposed to being lost from the soil as CO_2. This is despite a rapidly observed turnover of C from cell material.

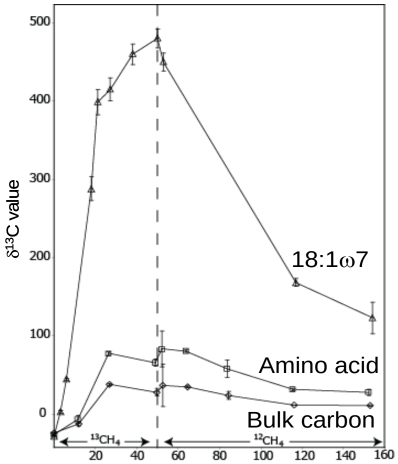

Figure 1: ^{13}C uptake by different soil C pools following $^{13}CH_4$ fixation via methanotrophic bacteria.

Combining hydrometric, chemical and isotopic approaches to assess nitrate loading of rivers in southern Alberta, Canada

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The South Saskatchewan River in western Canada is fed by three major tributaries: the Red Deer River, the Bow River and the Oldman River. These tributaries originate in pristine forested headwater catchments on the eastern slopes of the Rocky Mountains prior to flowing eastwards across the Canadian prairies, where the rivers are progressively impacted by urban and agricultural land use practices. Since land use varies considerably in the three watersheds, these rivers provide an excellent opportunity to assess the cumulative impact of different land use on river water quality. The objective of this study was to combine hydrometric and chemical measurements to determine changes in nitrate fluxes along the river and assess their relation to land use, while stable isotope techniques were used to identify the sources that contribute nitrate to the rivers. River water was repeatedly analyzed for its chemical and isotopic composition (δ^2H, $\delta^{18}O$, $\delta^{15}N_{nitrate}$, $\delta^{18}O_{nitrate}$, $\delta^{34}S_{sulfate}$, $\delta^{18}O_{sulfate}$). Nitrate fluxes in the headwater sections were low and N and O stable isotope data indicated that the nitrate was mainly derived from nitrification in forest soils. With increasing flow distance, there was clear evidence of nitrate loading via agricultural return flows (Oldman River) and via municipal waste water effluents with the latter dominating in the Bow and Red Deer Rivers. Knowledge of the predominant nitrate sources is essential for regulatory efforts addressing riverine nutrient loading and in-stream flow needs.