Carbon cycling in groundwater ecosystems - controls and limitations

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Aquifers in the terrestrial subsurface harbor about 10 times the amount of freshwater that is contained in surface waters. Although important in quantity, we lack detailed knowledge on the down below carbon cycling, in particular the carbon import, subterranean turnover and storage, as well as export. Shielded from the surface by soil and sediment layers, groundwater ecosystems are typically poor in organic carbon, low in microbial biomass, and low in (chemolithoautotrophic and heterotrophic) productivity; unless the systems have been contaminated with organics and nutrients. In my presentation, I attempt to dissect the various pools of organic carbon in aquifers. The quantity and quality of the individual sources are examined and evaluated in conjunction with microbial biomass, community growth efficiencies and productivity. Introducing exemplary results from numerous lab experiments and field studies, I will specifically tackle the following aspects of the subterranean carbon cycle: (1) OM turnover in relation to its composition and degradability, (2) lower limits of DOM degradation, (3) priming, (4) drivers of bacterial growth efficiency (BGE) and heterotrophic production, and (4) CO2 fixation by heterotrophes. Finally, I will highlight the most important knowledge-gaps that we need to fill in the near future to be able to deliver and implement subterranean-specific data into regional and global carbon models.