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Conference Abstract

Carbon cycling and food web interaction in groundwater ecosystems - key drivers and major limitations

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Abstract

Groundwater ecosystems are naturally low in productivity (oligotrophic) reflected by a comparably low standing stock of biomass and slow growth and reproduction of organisms. On the other hand, aquifers are, due to their dimensions, enormous (interim) reservoirs of carbon. However, since we typically lack detailed information on carbon and energy flow through groundwater food webs, it is difficult to predict effects of climate and global change on groundwater ecosystems performance with regard to ‘sink’ or ‘source’ of carbon. Applying stable isotope analysis, high end mass spectrometry, and flow cytometry in addition to a suite of established methods in microbiology and geochemistry, we started to dissect, at selected sites, the various pools and fluxes of organic carbon in aquifers, including dissolved organic matter, particulate organic matter, and organisms. Moreover we investigated the link between carbon (organic and inorganic) and microbial growth and productivity. Last but not least, we tried to uncover food sources for groundwater fauna and the connection to microbes. The work was done in collaboration with Roland Hofmann, Katrin Hug, Marion Gallus, Lucas Fillinger, Marina Spona-Friedl, Alexander Braun, Ramona Brejcha (Institute of Groundwater Ecology at the Helmholtz Zentrum München, Germany) and Jenny Uhl, Norbert Hertkorn, and Philip Schmitt-Kopplin (Research Unit Analytical Biogeochemistry at the Helmholtz Zentrum München).

Groundwater rarely contained less than 1 mg/L DOC, however, with only a small fraction being readily biodegradable (BDOC, AOC). Unrecognized, 10-100 times the amount of organic carbon dissolved in groundwater was found to be adsorbed to the sediment matrix. Cell numbers and activities of microbes in aquifers typically ranged 1-3 orders below values from surface waters. In fact, carbon use efficiency (CUE) of groundwater bacterial communities was considerably lower than values from other oligotrophic aquatic environments, with a mean value of 5% (200 samples from 100 sites). There is ample evidence that biogeochemical processes are primarily linked to the sediment associated microbial communities that outnumber their suspended counterparts in terms of biomass and activity by 1-4 orders of magnitude. While groundwater fauna at many sites seem to live on plant derived organic matter and cannibalism, we also collected evidence for chemolithoautotrophic primary production fueling groundwater food webs.

Keywords

organic matter, carbon flow, aquifers, oligotrophic, groundwater, food web

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