

Identification of novel chloroethene respiring microorganisms by stable isotope probing

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Haloorganic compounds, such as the solvent perchloroethene (PCE), are known as persistent contaminants in aquifers, soils, and sediments that can be reductively dechlorinated by anaerobically halo-respiring microorganisms. However, diversity and distribution of halo-respiring microorganisms in the environment is still largely unexplored. We have been able to identify novel PCE-respiring populations by RNA-based stable isotope probing (SIP), a technique that allows to directly link structure and function of yet uncultivated microbial populations.

Sediment microcosms were incubated for 1 to 4 weeks with PCE as electron acceptor at different temperature regimes upon which dechlorination activity was detected by the formation of cis-dichloroethene (freshwater), trans-DCE (marine), or even ethene, the completely dechlorinated end product. To identify the microbes actively involved in dechlorination, the microbial community was probed with ¹³C-labelled acetate as electron donor and carbon source. Using SIP analysis, we found that the predominant populations involved in PCE dechlorination represented novel sequence clusters in the wider radiation of the Dehalococcoidetes, and the beta-Proteobacteria with Dechloromonas spp. as closest relatives. Also, in ethene-forming microcosms known Dehalococcoides spp. were detected. Our data show that the diversity of PCE-dechlorinating bacteria is by far larger than was previously assumed.

Molecular arguments for new semantics in organic matter research

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This talk presents the audience with arguments for a revision of biogeochemical terminology and concepts that were established long before molecular methods have put the community in a position to work with measurable parameters that can be expressed numerically. For example, the terms “recalcitrance”; “labile carbon” and “stable carbon” are verbal, non-numeric categories intended to characterise the resistance of soil organic matter against decomposition. It has been posited that selective preservation due to recalcitrance of OM is the only mechanism by which soil organic C can be protected for long periods of time [1]. The problem with a statement of this kind is that a metaphoric, descriptive category like “recalcitrance” can not be measured and expressed in absolute, numeric terms. It appears that the community that works with “labile” carbon (for examples see the literature on priming phenomena [2]) tends to understand this category as energy based (measured in Joule), and equates high lability with a high energy content of the organic compound under consideration. The idea behind this is that an energy rich compound would be highly attractive to decomposer organisms and thus be consumed preferentially, implying a short residence time within the system.

On the other hand, the community that concentrates on issues of carbon stabilization tends to use the term “stable” in a time based manner, equating stability with long turnover time [3] and measuring stability as a time unit (Years). This practice has led to paradoxa and to conceptual problems, particularly when radiocarbon concentrations are used to calculate turnover times. An energy rich and thus operationally “labile” carbohydrate can be exclusively made of ¹²C and thus have a ¹⁴C content of zero, making it appear very old and/or having a very long turnover time. In that case, the same compound would be energetically “labile” and biogeochemically “stable” at the same time. With this presentation, I show how the resistance of organic materials against decomposition can be expressed numerically by a variety of molecular parameters. The fact that these parameters may vary independently and in opposing directions for the same organic molecule underlines the necessity to develop new concepts and terminology.

- [1] Krull *et al.* (2003) *Funct. Plant Biol.* **30**, 207-222. [2] Kuzyakov *et al.* (2000) *Soil Biol. Biochem.* **32**, 1485-1498. [3] Von Lützw, M. *et al.* (2008) *J. Plant Nut. Soil Sci.* **171**, 111-124.