Science, policy and implementation gaps: An exploration of groundwater management in Hungary

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If the potential human impacts of groundwater resources contaminated by geogenic chemicals are to be prevented, it is essential to understand how to secure scientifically sound management. There is a large body of work into agenda setting and bridging the science-policy divide. Through presenting evidence from an EU-based case study, this paper will argue that this is only half the story. Indeed it is equally important to consider implementation gaps and how and why they occur.

This paper presents evidence emerging from a study into the management of groundwater contaminated by geogenic arsenic in Hungary. Data is collected via document review, observation and ongoing interviews with institutional representatives. The data collected is used to highlight the gaps between legislation, policy and actual management. Social network analysis is being used to explore the reasons behind these gaps.

The results highlight two key implementation gaps. The reasons emerging are firstly, that the agenda-setting and management capabilities of institutions are not matched to their mandates and responsibilities. Secondly, that remedying this situation is complicated by wider political contexts. These results suggest a need to focus on institutional management capability if scientific knowledge is to be effectively employed to prevent the human impacts of geogenic groundwater contamination.

The author acknowledges funding from the European Commission (AquaTRAIN MRTN-CT-2006-035420)

High metabolic diversity in single organisms as a survival strategy under extreme energy limitation: the case of acetogens

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Acetogens are microbes that gain energy from the *de novo* synthesis of acetate via the reductive acetyl CoA pathway. Acetogenic reactions tend to yield less free energy than competing sulfate reduction, methanogenesis, or fermentation reactions, which is why acetogens are often believed to be outcompeted for common substrates under energy limitation, as in most microbial habitats [1]. Yet, the ability to perform acetogenesis has been demonstrated in 19 bacterial and 2 archaeal genera, and acetogens are widespread across anoxic environments [2], even in ones as energy-deprived as deep subsurface sediments [3]. This raises the question why this seemingly inferior metabolic pathway is so widespread.

Using calculations of *in situ* Gibbs free energy yields in deep subsurface sedimemnts, I examine the possibility that versatility with regards to substrates used allows acetogens to compensate for lower energy yields per substrate by pooling energy from more substrates. Calculations for deep subseafloor sediments suggest that *in situ* Gibbs free energies of acetogenic reactions from several low-molecular weight organic substrates are below the proposed minimum energy quantum of -10 kJ mol^{-1} of substrate. Differences in energy yields per substrate may be trivial at low substrate turnover rates compared to numbers of available substrates used. Pooling energy from many substrates may not only allow acetogens to survive at lower energy yields per substrate, but may even allow acetogens to drive substrate concentrations below the thresholds required by microbes with narrower substrate spectra to meet maintenance energy requirements.

These findings suggest that cumulative free energy yields, rather than energy yields per single catabolic reaction, might in some cases determine survival or even competitive outcomes among microbes under energy limitation. Conditions and substrates for which one might expect acetogens to successfully compete with sulfate reducers, methanogens and fermenters are discussed.

[1] Morita (1997) Bacteria in Oligotrophic Environments. [2] Drake *et al*. (2006) *The Prokaryotes* **2**, 354-420. [3] Lever *et al*., submitted.