

Competition for H₂ in a PCE-contaminated aquifer

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Introduction

Chlorinated ethenes (CEs) belong to the most common groundwater contaminants. Organohalide respiration is a bacterial anaerobic respiration in which CEs are sequentially reduced to harmless ethene. The interesting potential for bioremediation brought by organohalide respiration is limited by the uncertainty of the end-product, with an occasional accumulation of the toxic vinyl chloride (VC).

Research questions

What are the reasons for VC accumulation in the contaminated site?

- Does the contaminated site exhibit the metabolic potential for natural attenuation by the means of CE respiration?
- What are the main bacterial processes going on?
- Can these processes explain VC accumulation?

Results

- ✓ *Dehalococcoides* sp. and *vcrA* detected on the site
- ✓ Identification of significant environmental factors governing the distribution of the communities in situ (fig.1)

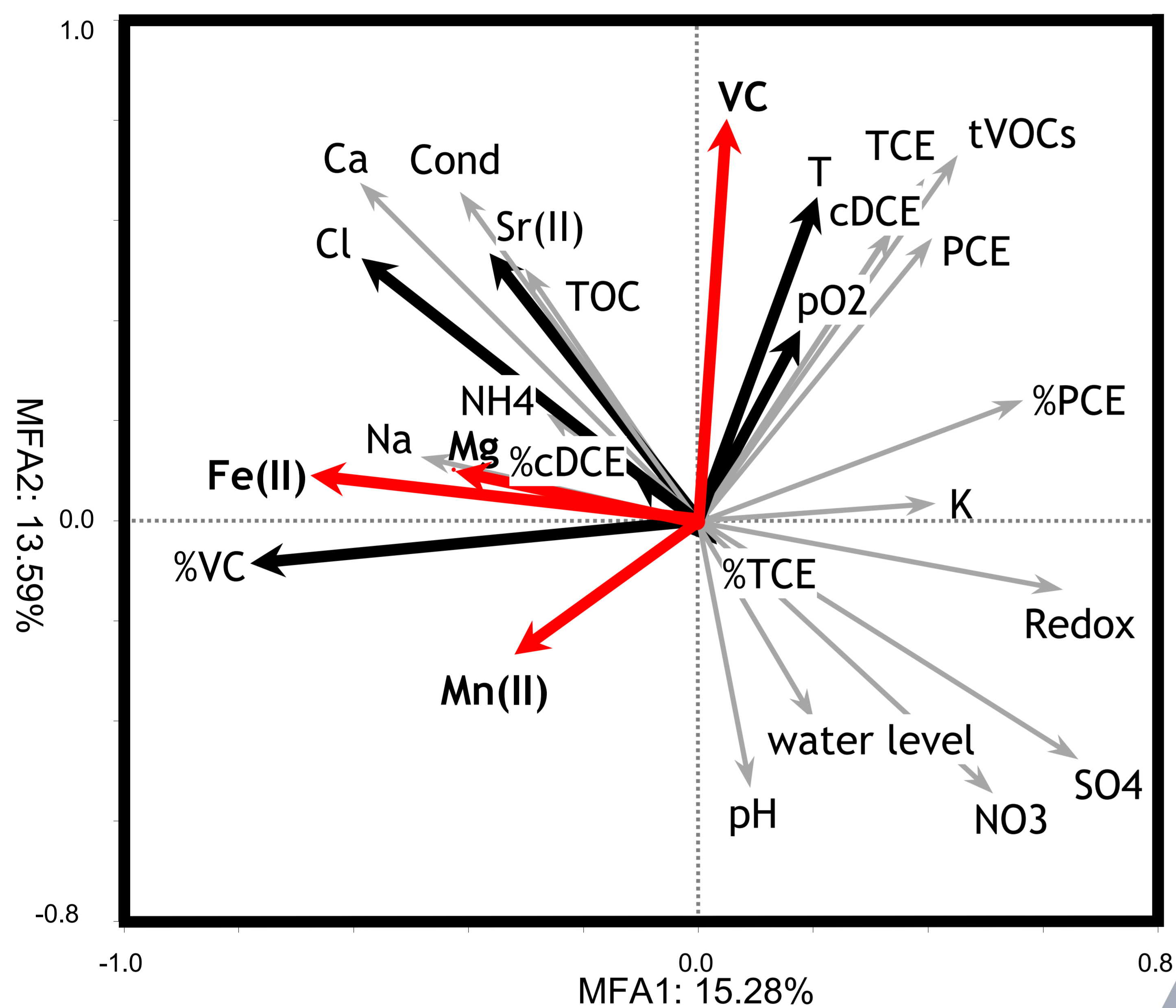


Fig. 1. Multifactorial analysis on bacterial communities and environmental variables. Red arrows: highly significant variables (p-value < 0.005); black arrows: moderately significant variables (p-value 0.05 - 0.5); grey arrows: non significant variables (p-value > 0.05).

- ✓ In presence of Fe(III) organohalide respiring bacteria are outcompeted for H₂ (fig.2)

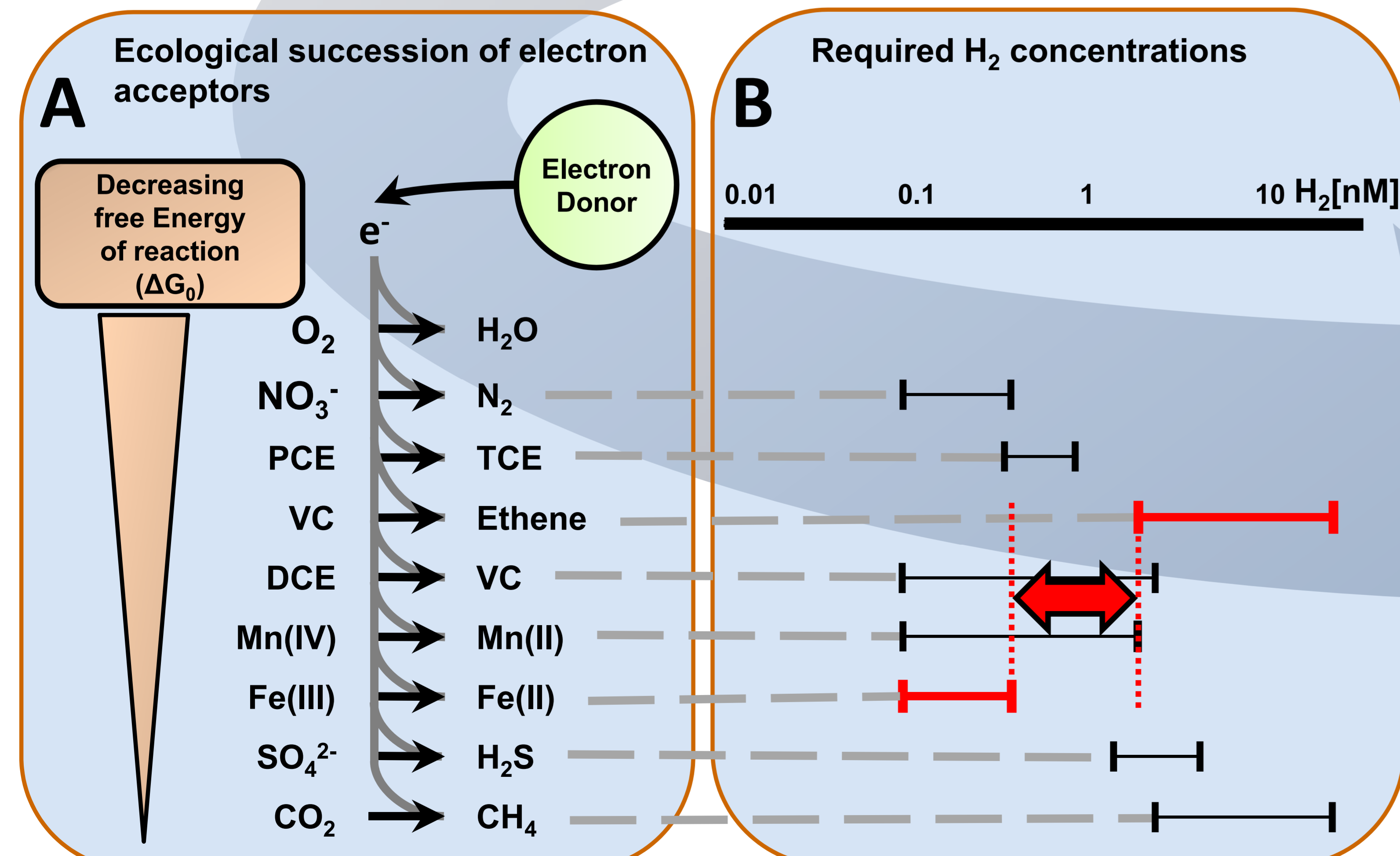
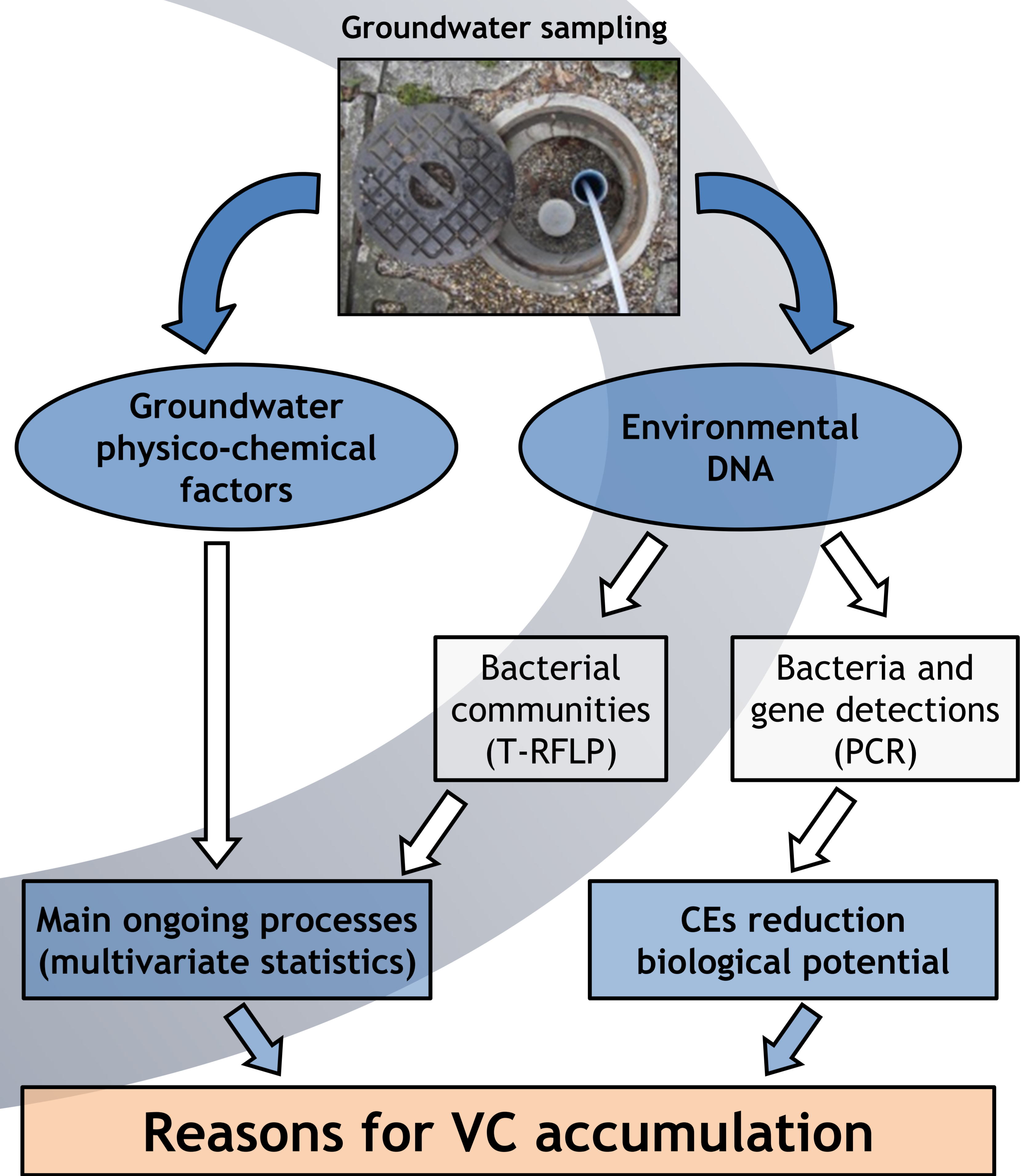


Fig.2 A. Ecological succession of electron acceptors according to Gibbs free energy. Modified from McMahon and Chapelle, 2008. B. H₂ concentration thresholds for several TEAPs.

Procedure



Conclusions

- Biological potential for natural attenuation present in the site (detection of *Dehalococcoides* sp. and *vcrA*).
- VC and Fe(II) explained the largest part of the variance displayed by the bacterial community structures.
- Fe(III)-reducing bacteria probably outcompeted VC-reducing bacteria for the electron donor H₂, although Fe(II) reduction is energetically less favorable.

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