

Recent development of sampling and analytical methods for the characterization of contaminates sites

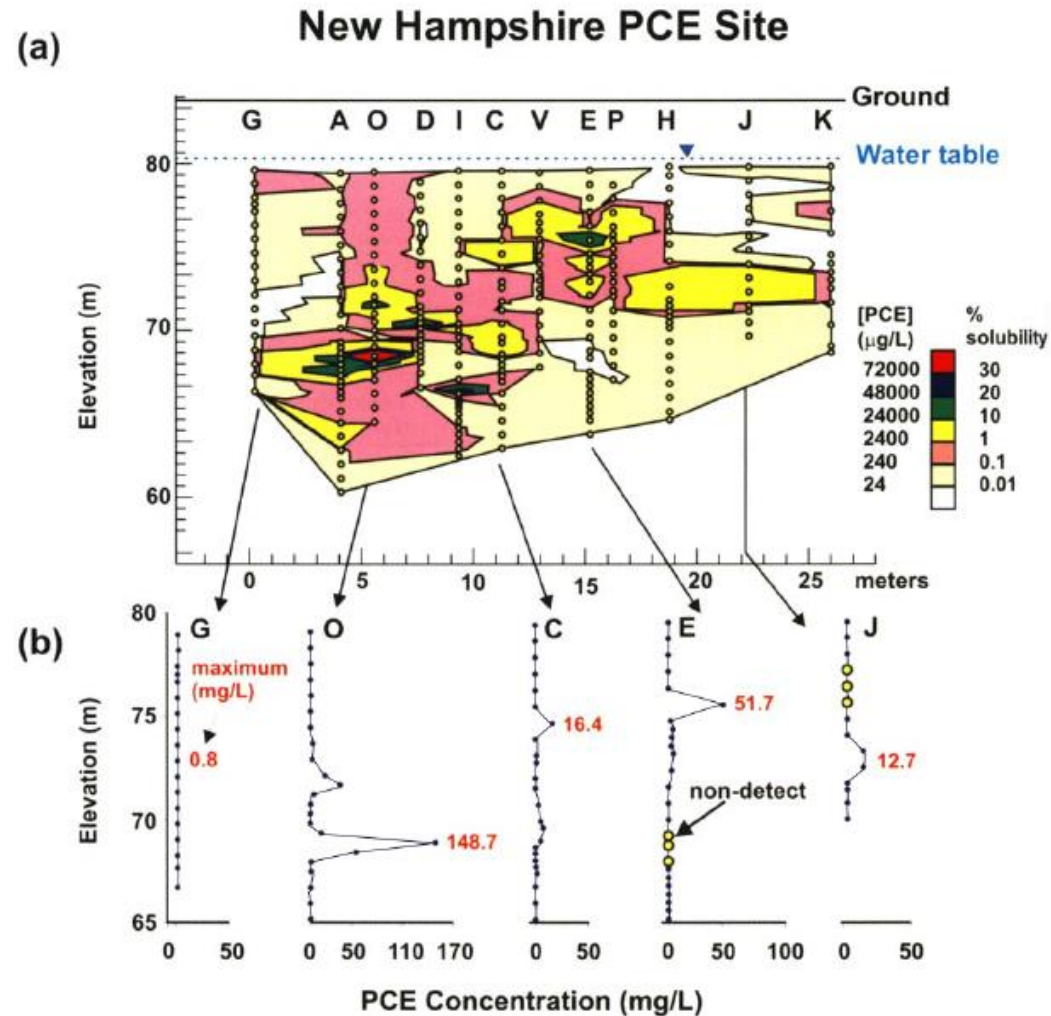
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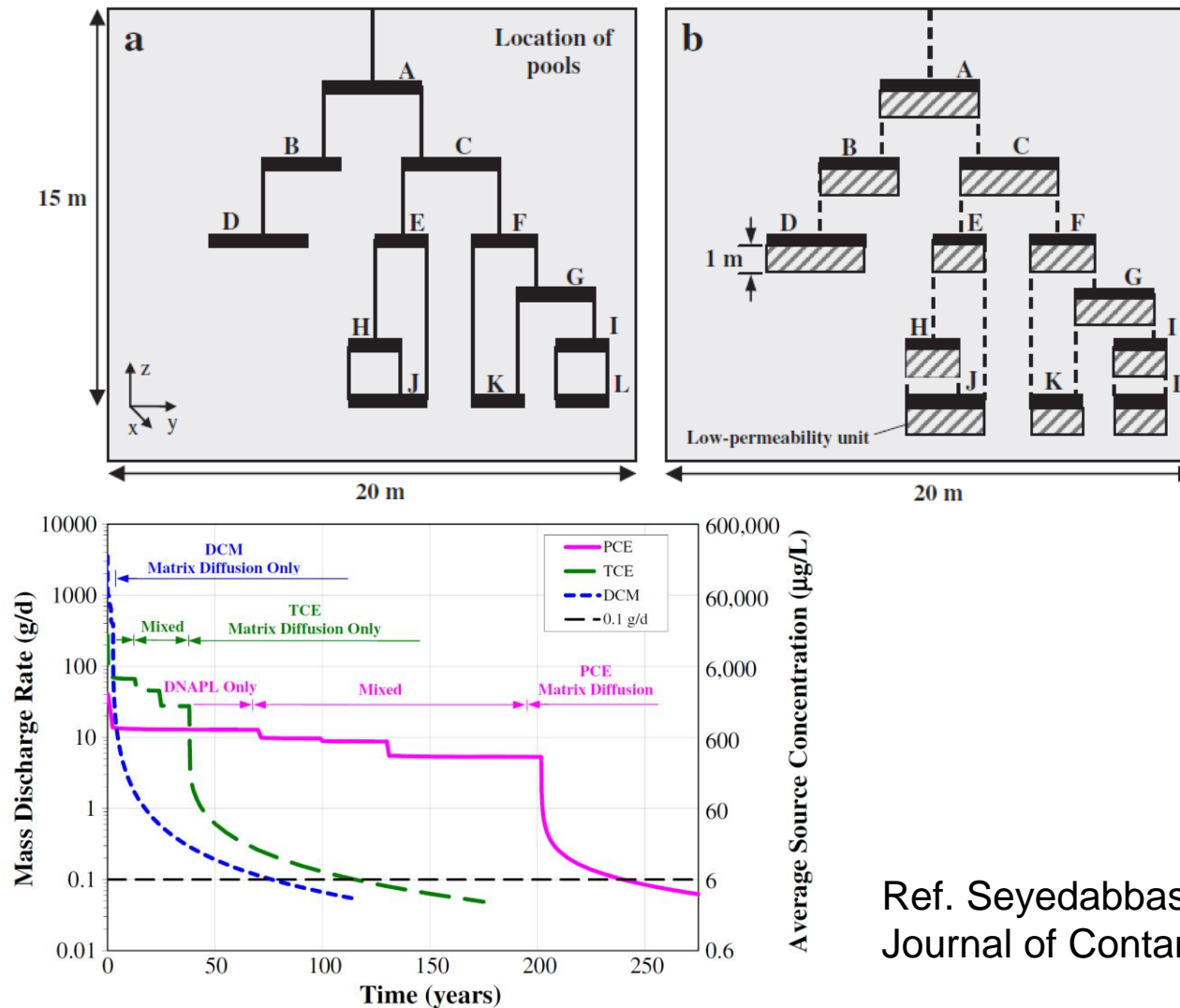
CONTEXT: BEHAVIOR OF CHLORINATED HYDROCARBONS IN THE SUBSURFACE



Ref. Guilbeault etl., 2005.
Ground Water.

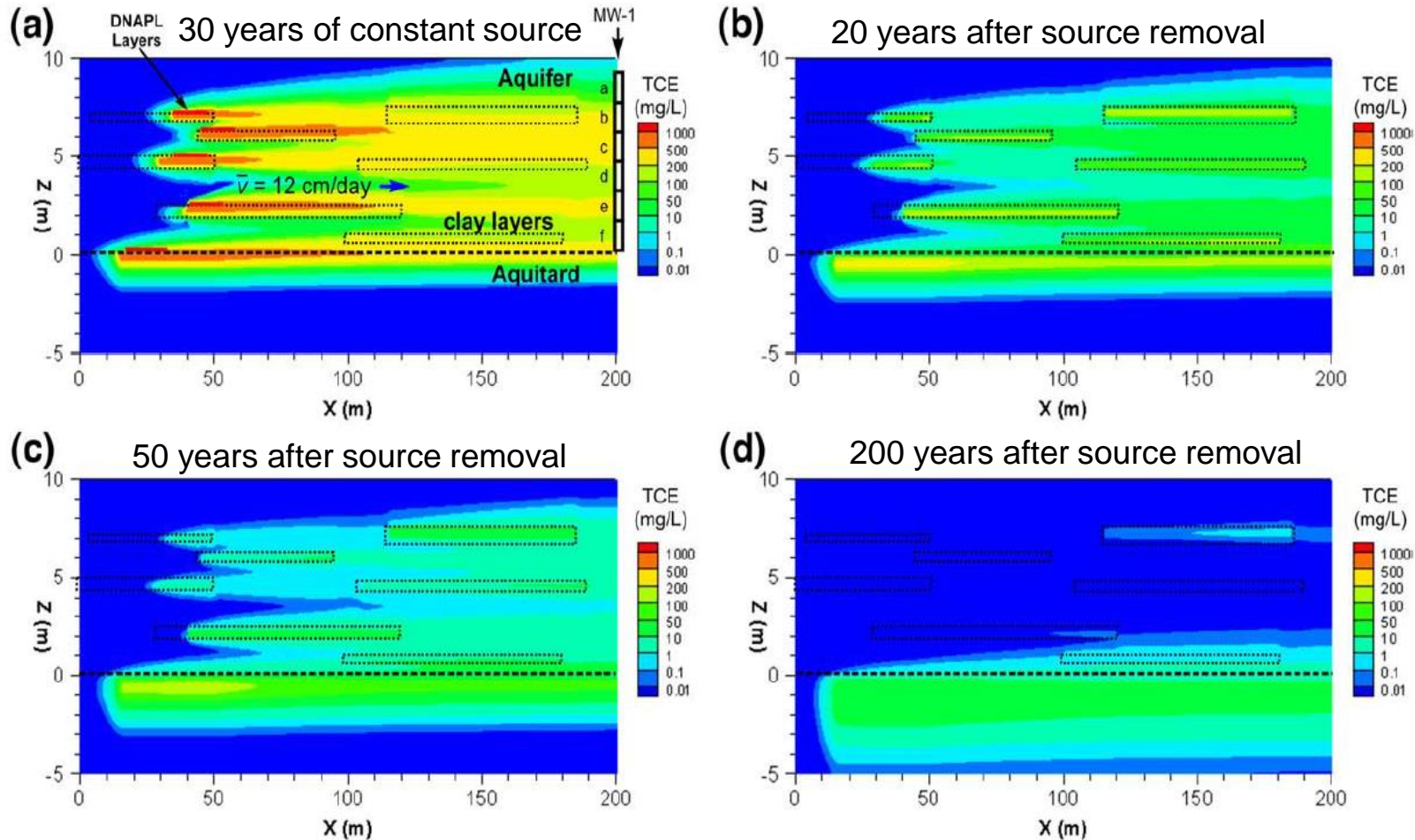


CONTEXT: CHANGING PERCEPTION OF KEY PROCESSES THAT CONTROL EMISSIONS FROM SOURCE ZONES



Ref. Seyedabbasi et al., 2012.
Journal of Contaminant Hydrogeology.

CONTEXT: EFFECT OF BACK-DIFFUSION ON CONTAMINANT PLUME LONGEVITY



Ref. Parker et al., 2008.
Journal of Contaminant Hydrogeology.

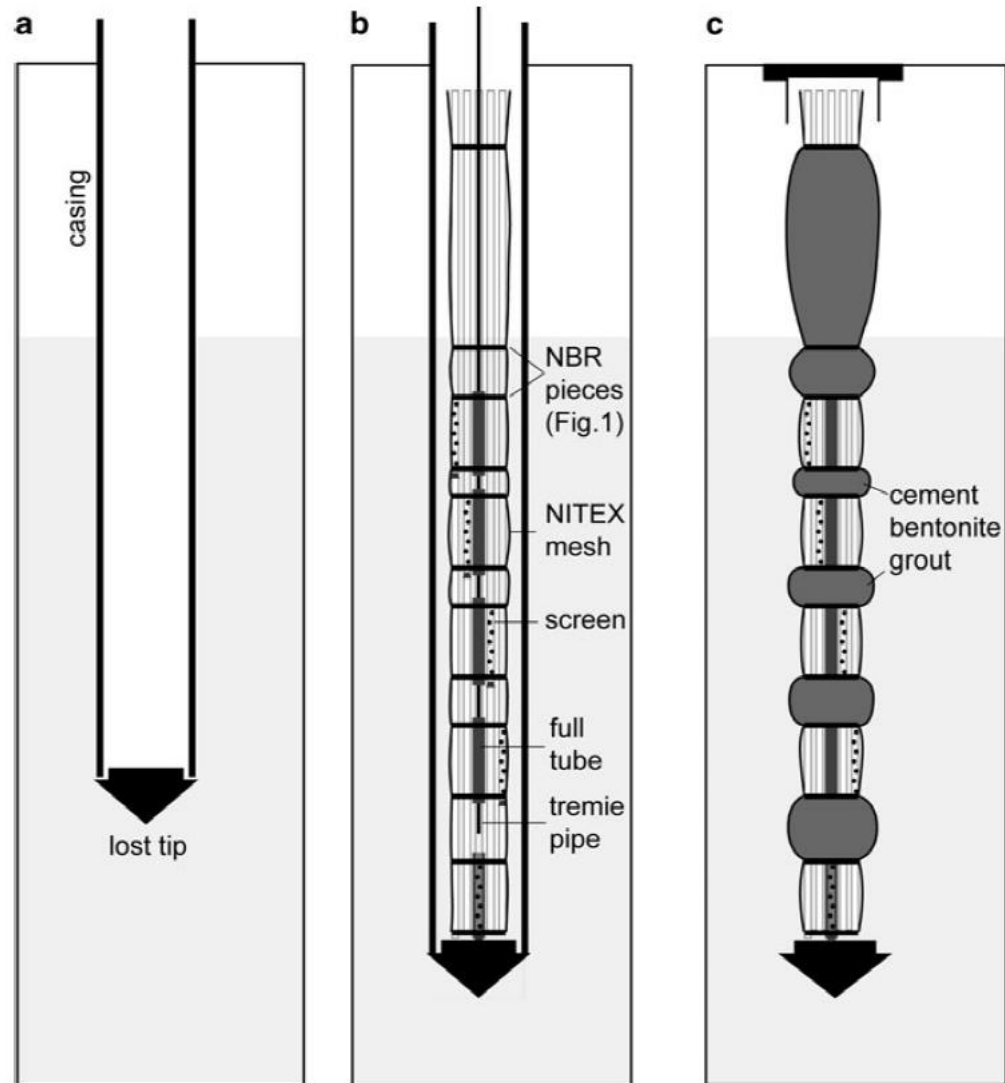
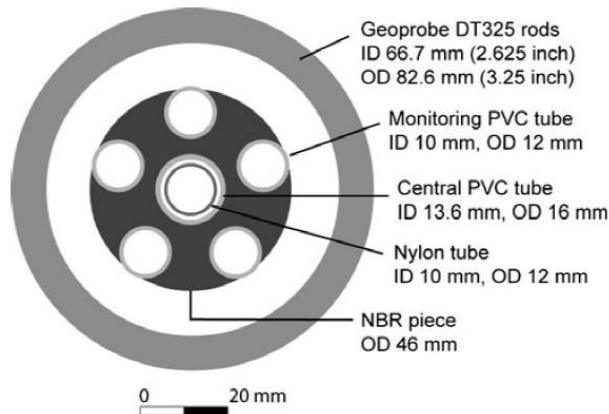
NEED FOR SITE CHARACTERIZATION METHODS

- **High vertical resolution of water samples**
-> several well established method
- **High resolution water sampling across zones with contrasting permeability**
- **Tracking degradation processes that are highly variable in space**

Overall objective:

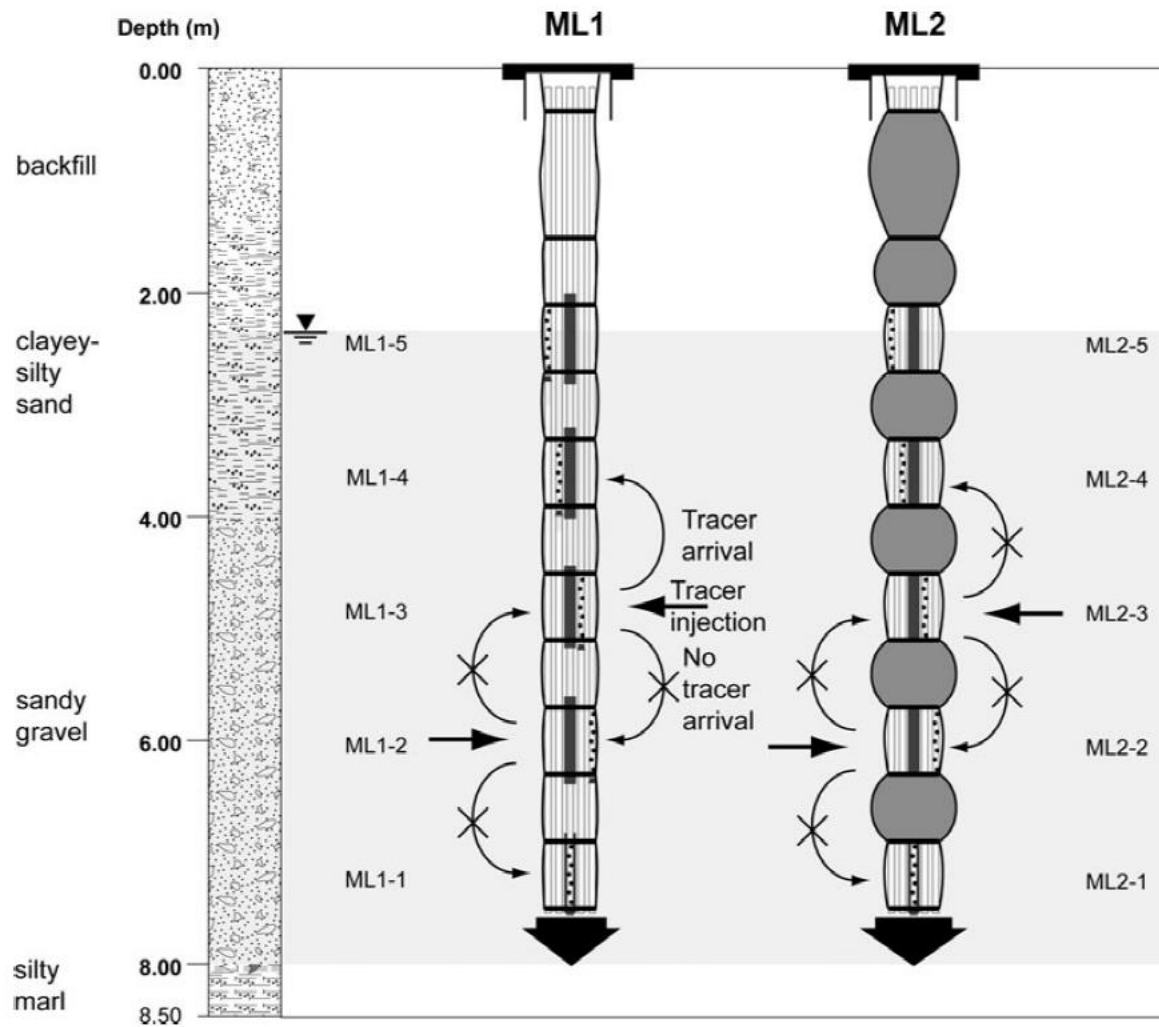
Obtain the data necessary for developing an appropriate conceptual site model for risk assessment and planning of remediation methods.

HIGH RESOLUTION SAMPLING OF GROUNDWATER ACROSS ZONES WITH CONTRASTING PERMEABILITY



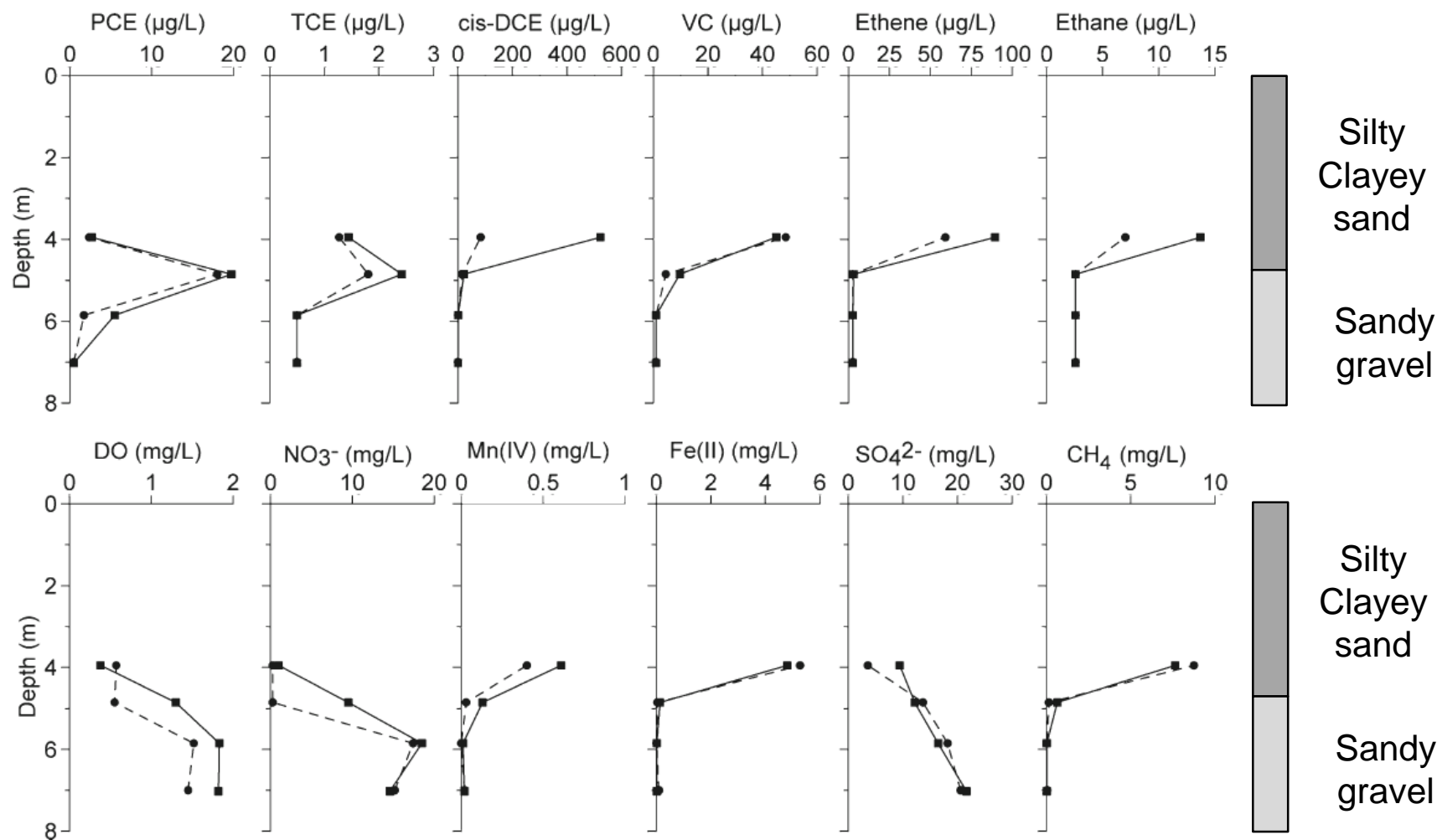
*Ref. Ducommun et al., 2013.
Hydrogeology Journal.*

GROUNDWATER SAMPLING: METHOD VALIDATION USING TRACER TEST



Ref. Ducommun et al., 2013. Hydrogeology Journal.

APPLICATION: CONCENTRATION PROFILES

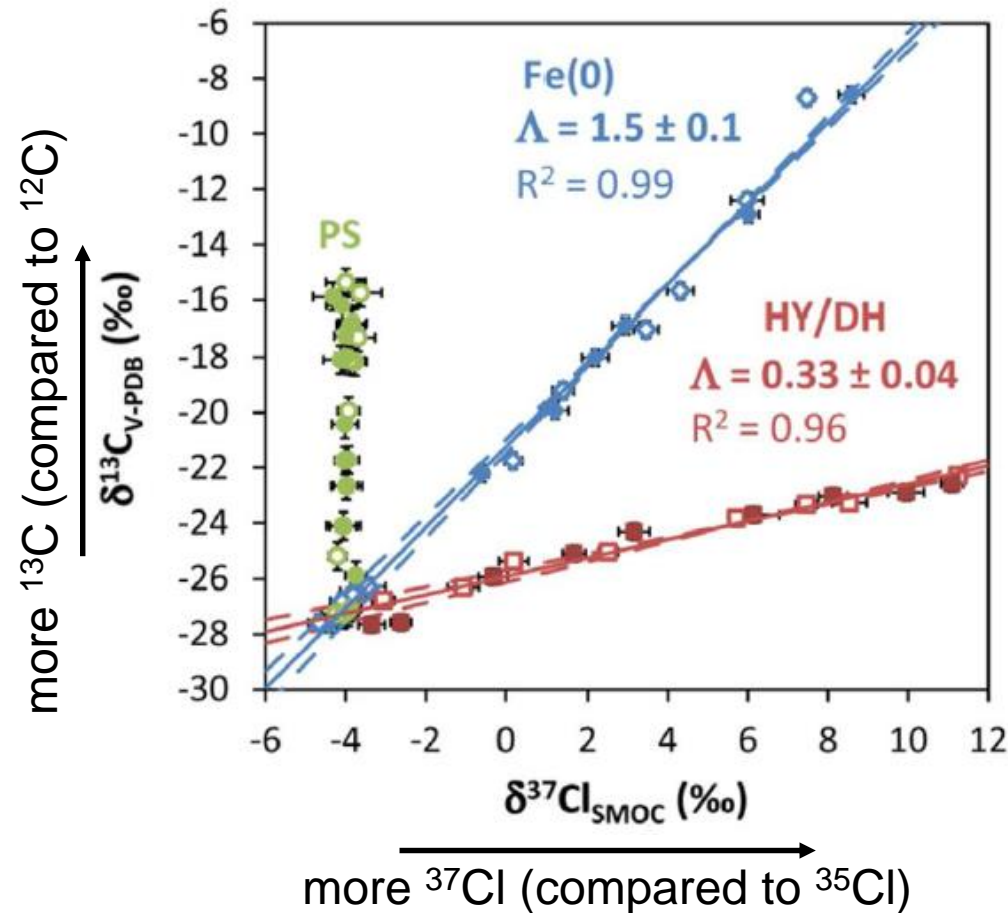


Ref. Ducommun et al., 2013. Hydrogeology Journal.

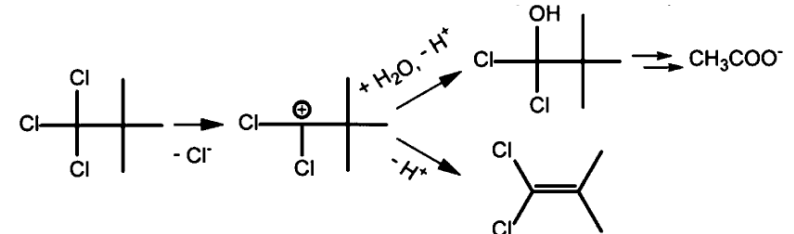
HIGH RESOLUTION SAMPLING METHOD OF SOLID PHASE



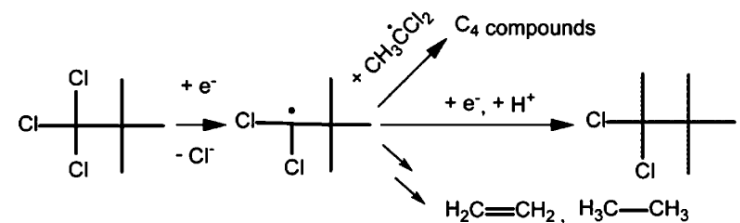
USE OF STABLE ISOTOPE ANALYSIS TO TRACK REACTIVE PROCESSES: 1,1,1-TRICHLOROETHANE DEGRADATION



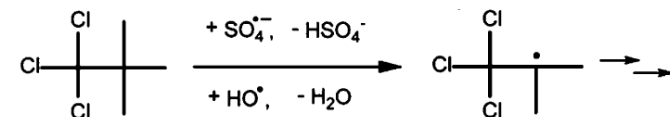
a. Hydrolysis and dehydrohalogenation ($\text{S}_{\text{N}}1$ and $\text{E}1$)



b. Reduction by Fe(0) (SET)



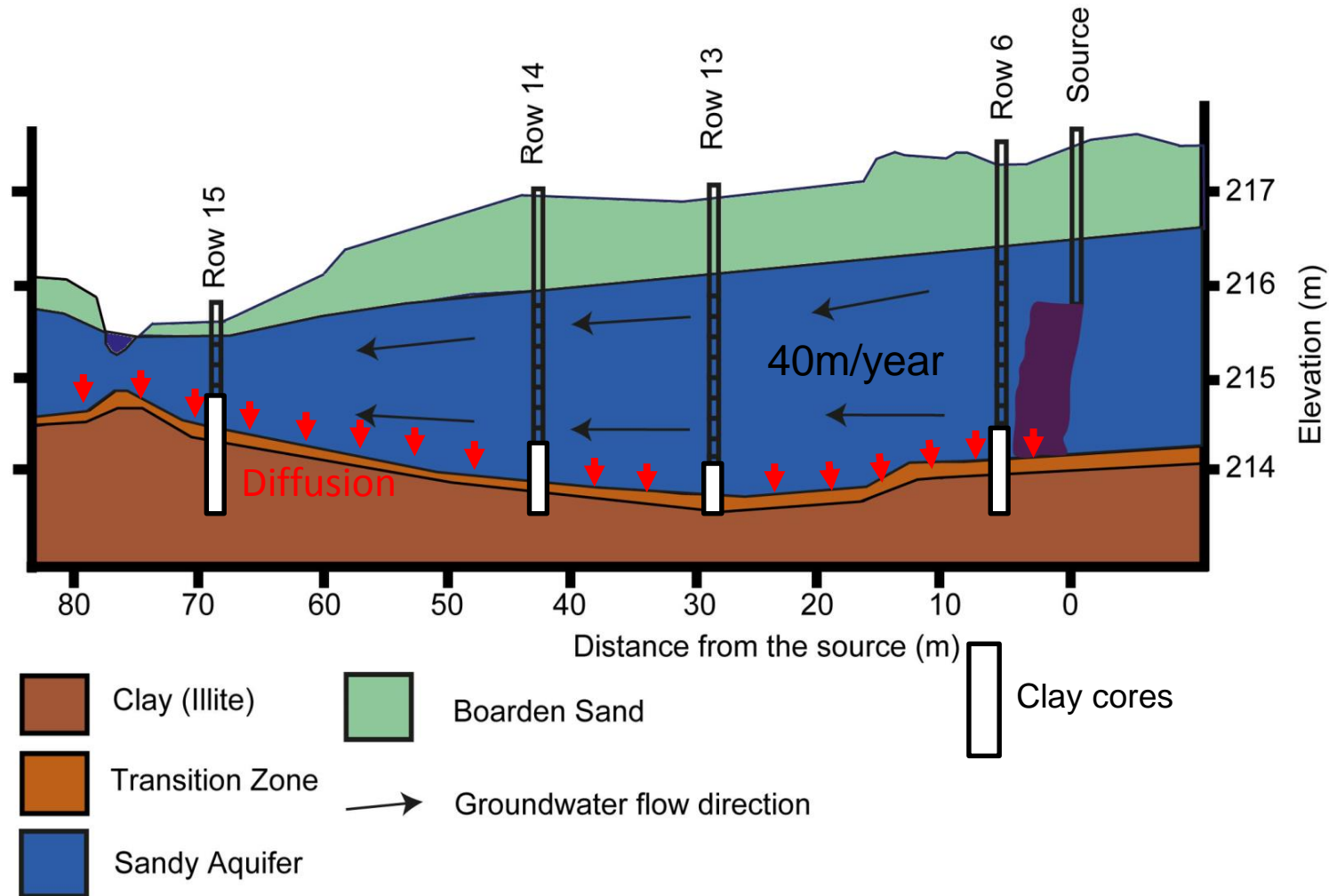
c. Reaction with heat-activated PS (Oxidative C-H bond cleavage)



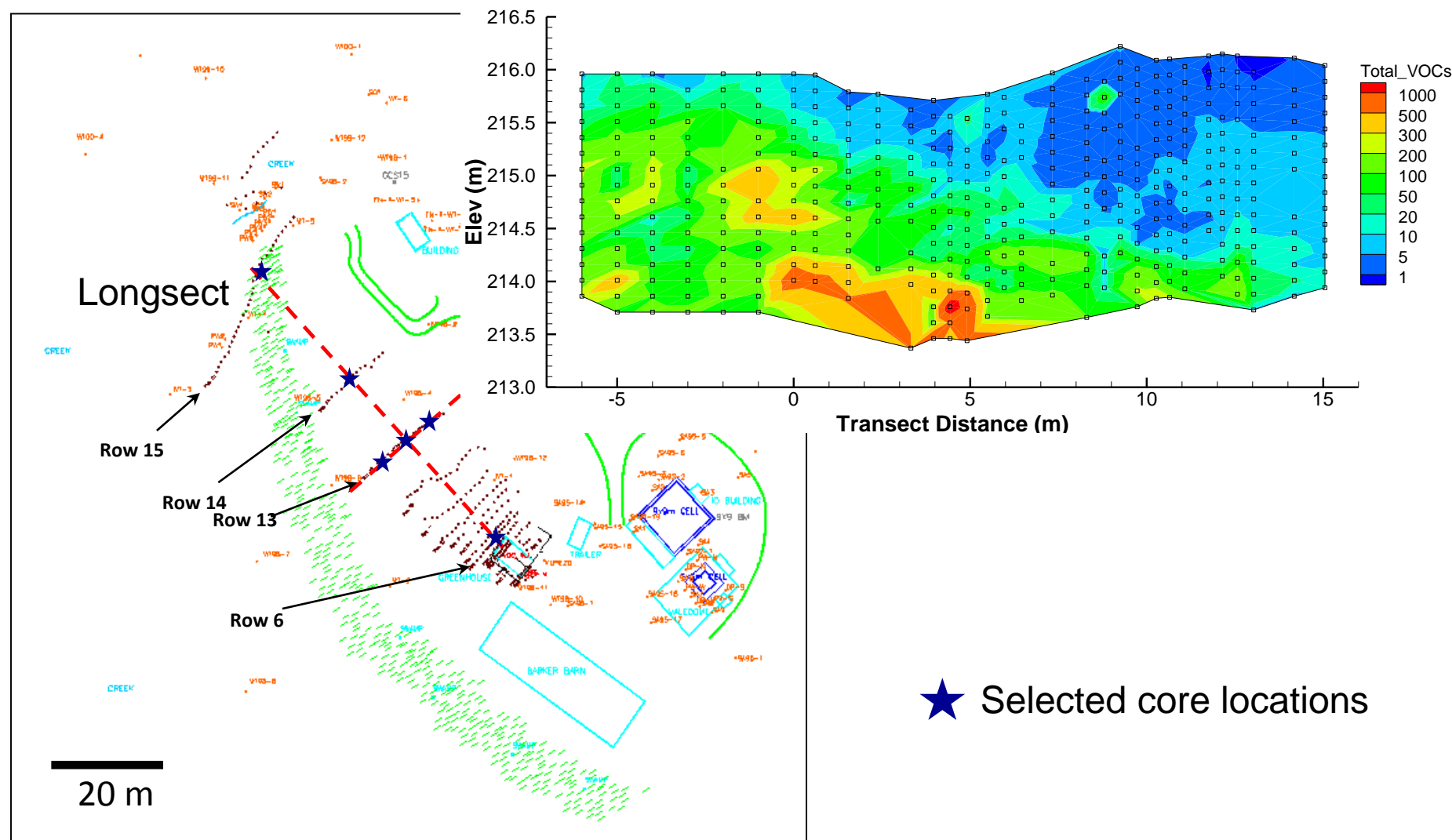
Ref. Palau et al., 2014. *Environmental Science & Technology*.

EFFECT OF AQUIFER-AQUITARD INTERACTION ON CONTAMINANT FATE: CONTROLLED RELEASE EXPERIMENT

50L of DNAPL
(45% PCE, 45% TCE, 10% CF)



CONTAMINANT DISTRIBUTION AND CORING LOCATIONS



CONCENTRATION EVOLUTION IN GROUNDWATER AND IN UNDERLYING AQUITARD

7m

29m

43m

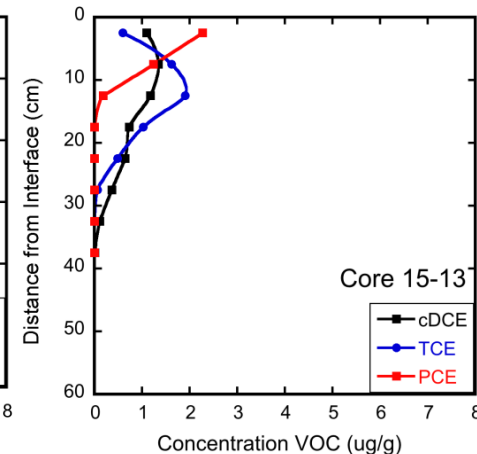
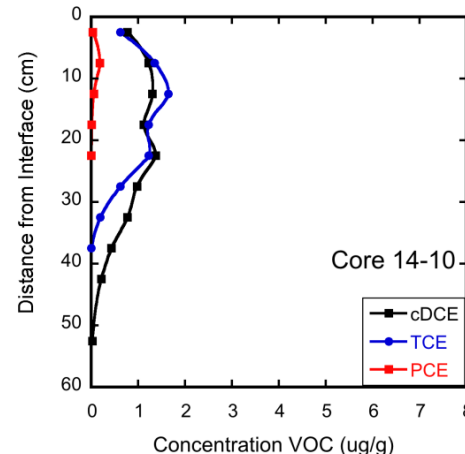
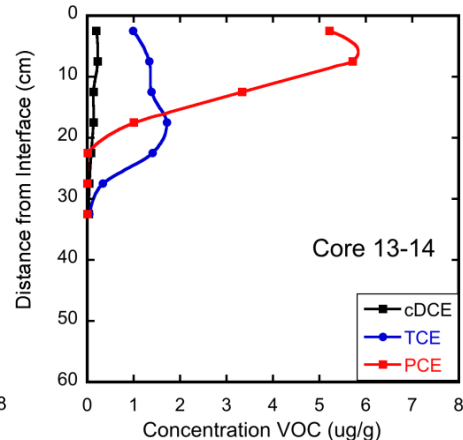
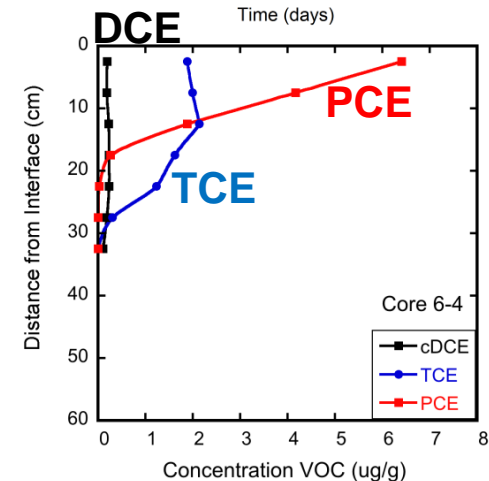
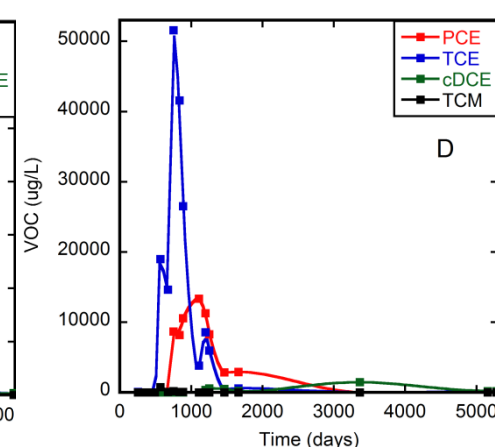
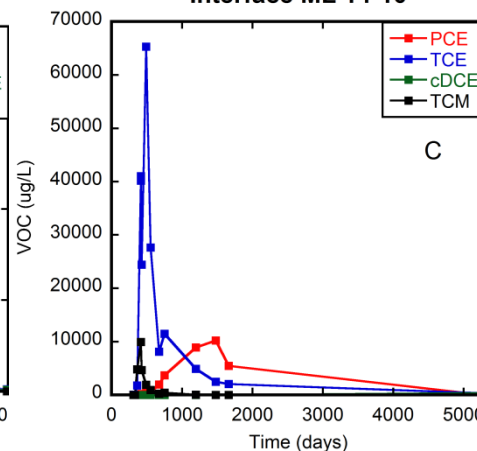
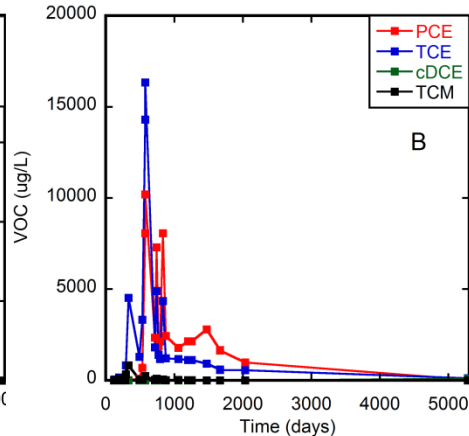
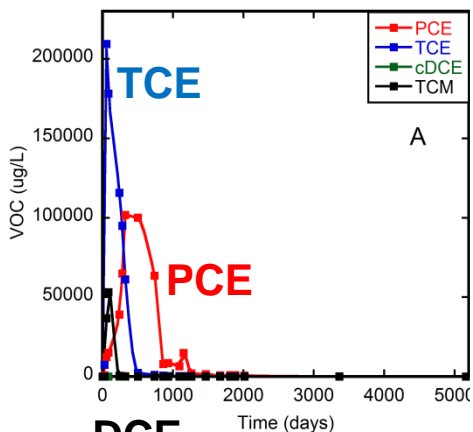
69m

Interface ML 6-4

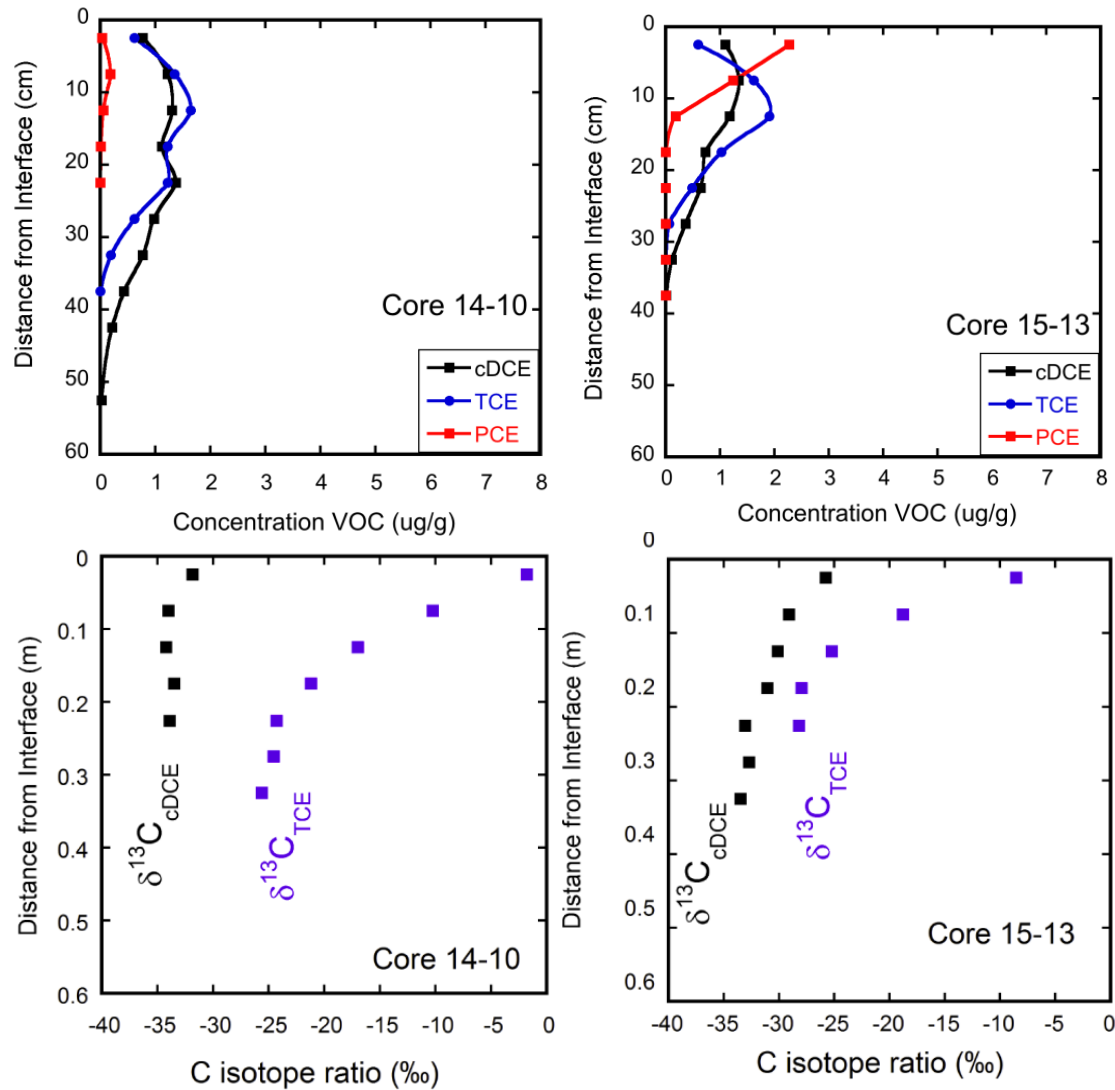
Interface ML 13-14

Interface ML 14-10

Interface ML 15-13



EVIDENCE FOR CONTAMINANT ATTENUATION IN AQUITARD BY STABLE ISOTOPE ANALYSIS



SUMMARY AND CONCLUSION

- **There is a need to consider interactions among zones with varying permeability (and often varying geochemical conditions) in more detail**
- **Such interactions influence the success of remediation and the longevity of contaminant plumes**
- **High resolution groundwater and solid phase sampling across zones with varying permeability/geochemical conditions is possible with cost-effective devices**
- **Compound-specific isotope methods often provide insight into reactive processes and are applicable to groundwater and solid phase samples**
- **High resolution sampling is not just for research. It provides a basis to develop an appropriate conceptual site model, which is an indispensable basis for the management of contaminated sites.**

THANK YOU FOR YOUR ATTENTION



Neuchâtel