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FUNNEL AND GATE APPROACH FOR ACTIVE SEDIMENT CAPS

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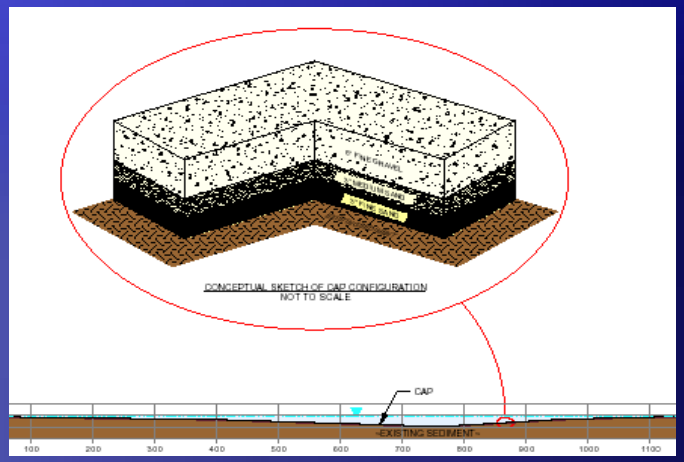
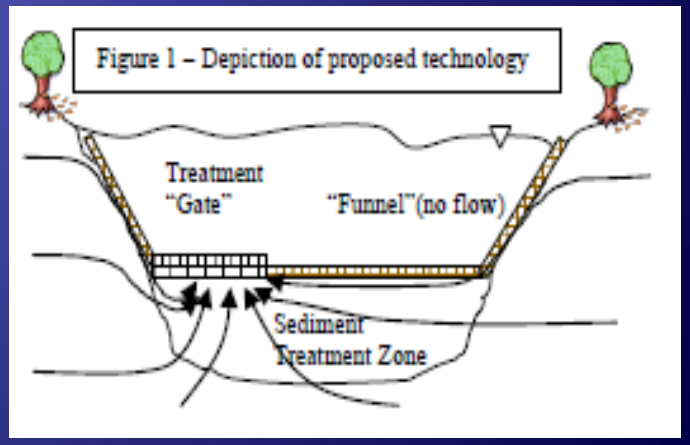
Sediment In-situ Capping/Treatment

- Reduce risk by:
  - Stabilizing sediments
  - Physically isolating sediment contaminants
  - Reducing contaminant flux to benthos and water column
- Sand effective for strongly solid associated contaminants
- "Active caps" for other situations (w/amendments)
- Funnel and Gate approach to maximize ability to place/replace amendments

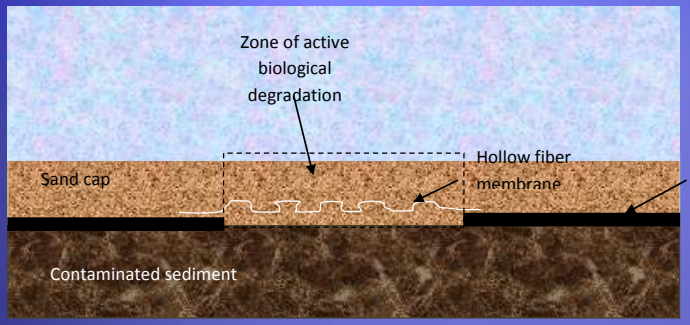


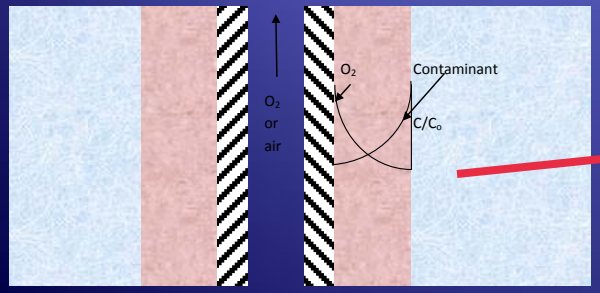


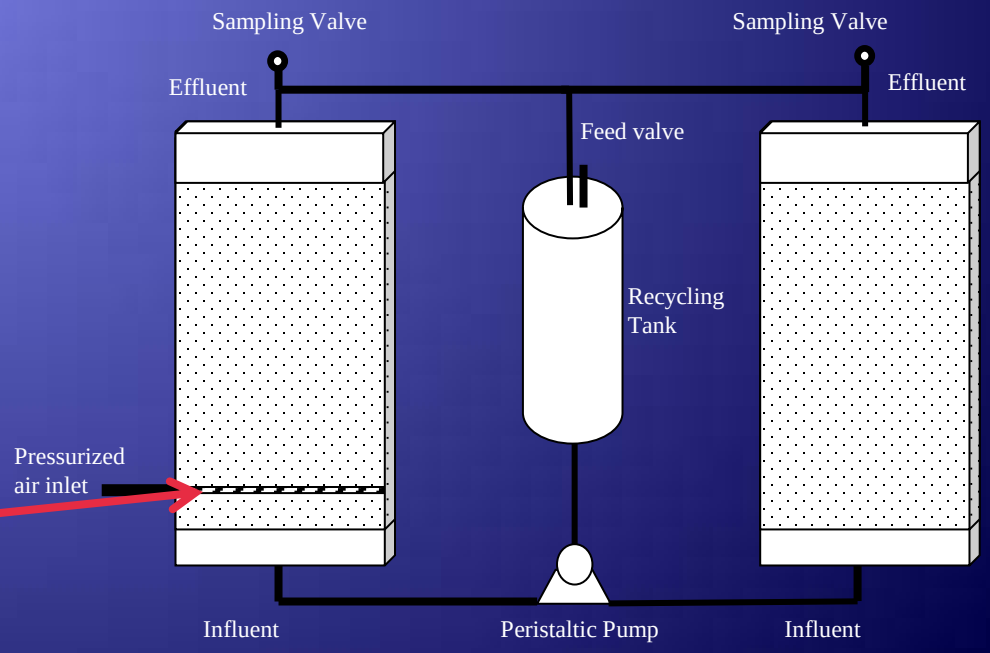
Project Objectives and Scope

- Can a funneling cap effectively contain contaminants and effectively channel interstitial fluids (water or NAPL) to a collection or treatment gate
- Can treatment gates composed of reactive materials effectively manage residual contamination from the in-situ treatment zone
- Scope
  - Preliminary studies with sorbents (e.g. organoclays and activated carbon)
  - Hollow fiber membrane to introduce oxygen in reduced environment
  - Low voltage electrodes to encourage development of appropriate redox conditions

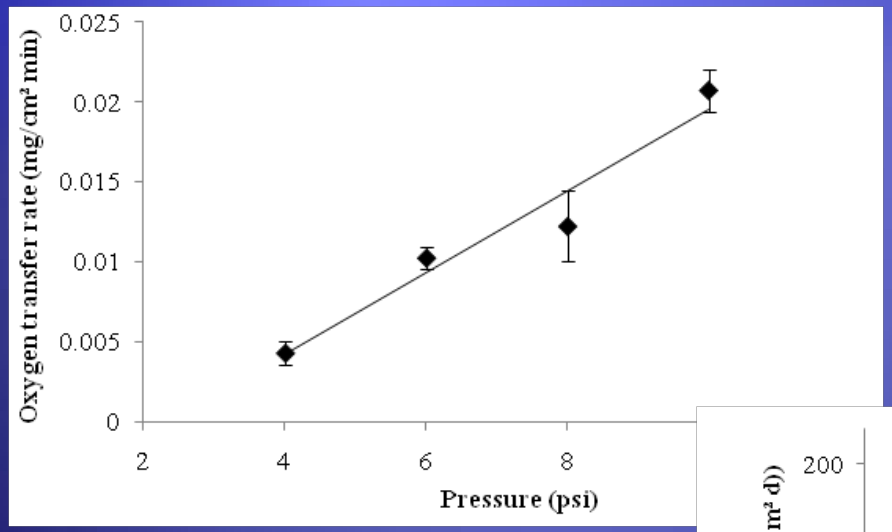
Hollow fiber membrane to introduce oxygen & encourage aerobic degradation







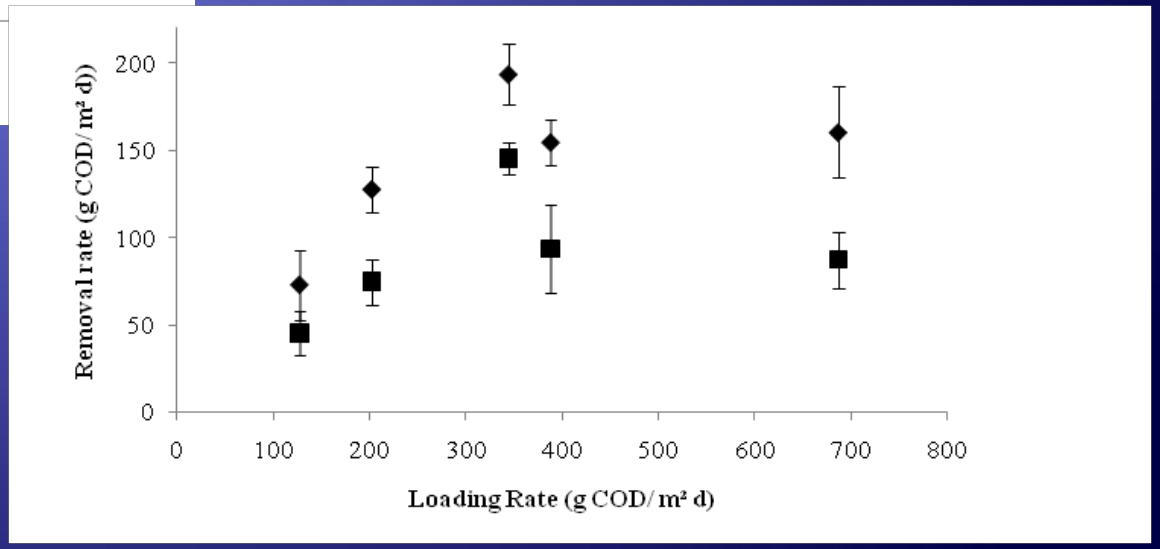
Hollow Fiber Membrane Induced Oxidation



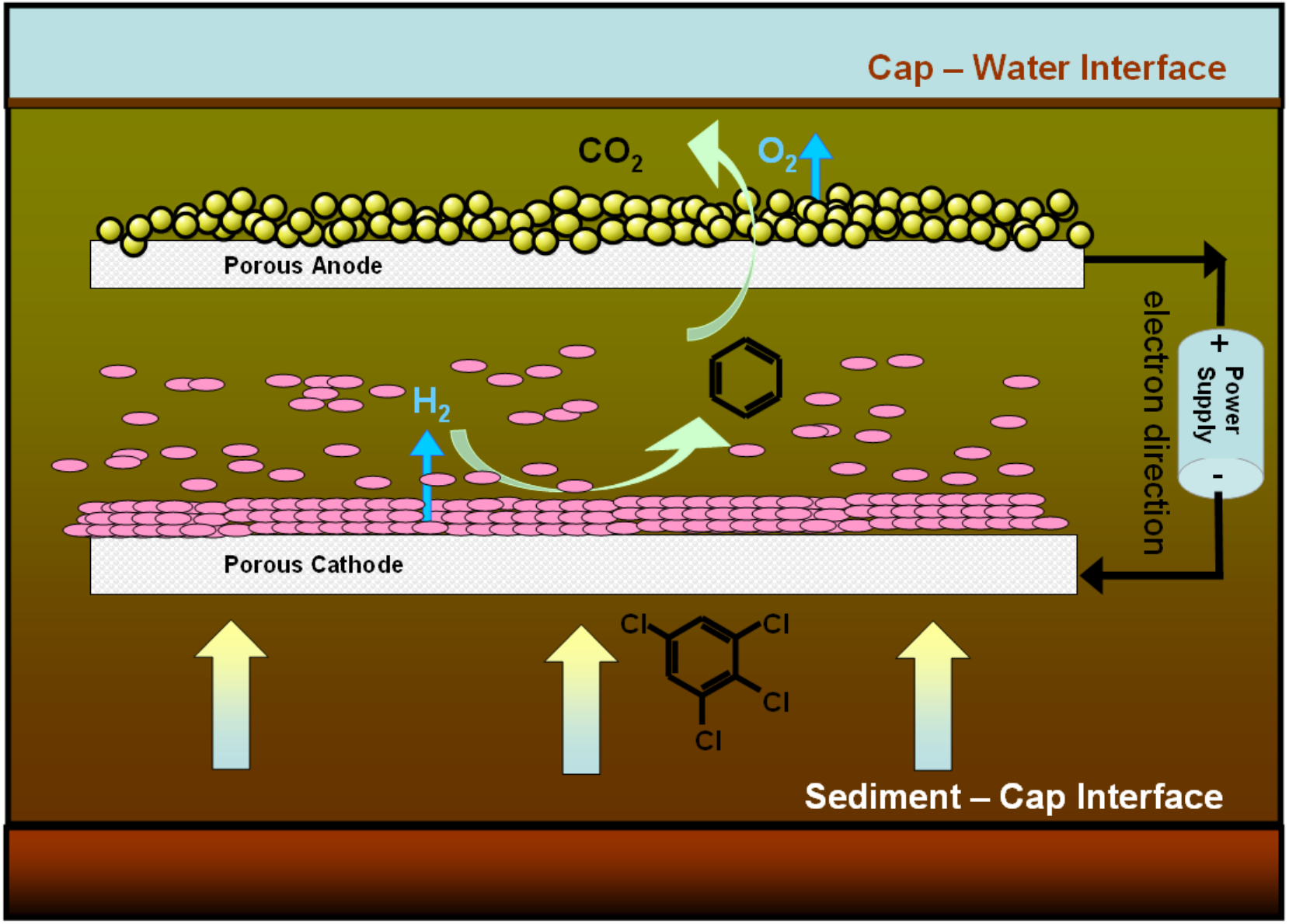
Initially reduced conditions without oxygen introduction via pressurized air

Minimal membrane fouling

Acetate oxidation



Conceptual model- Electrode cap



The idea of electro-reactive capping

- Functions:
  - Provide redox control
  - Direct reduction and oxidation on electrode surface
  - Deliver electron donor and acceptor for further degradation
- Advantages:
  - Real time and site-specific control
  - complete mineralization of contaminants through sequential reduction and oxidation

ctro-reactive capping

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d oxidation on electrode surface

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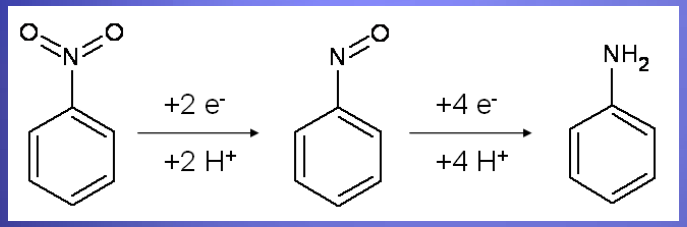
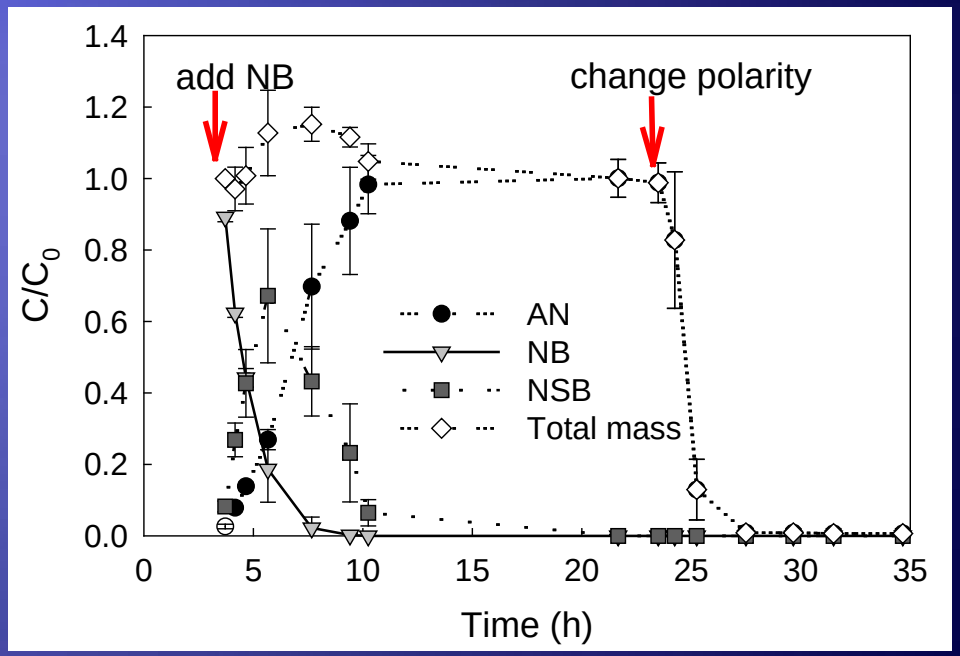
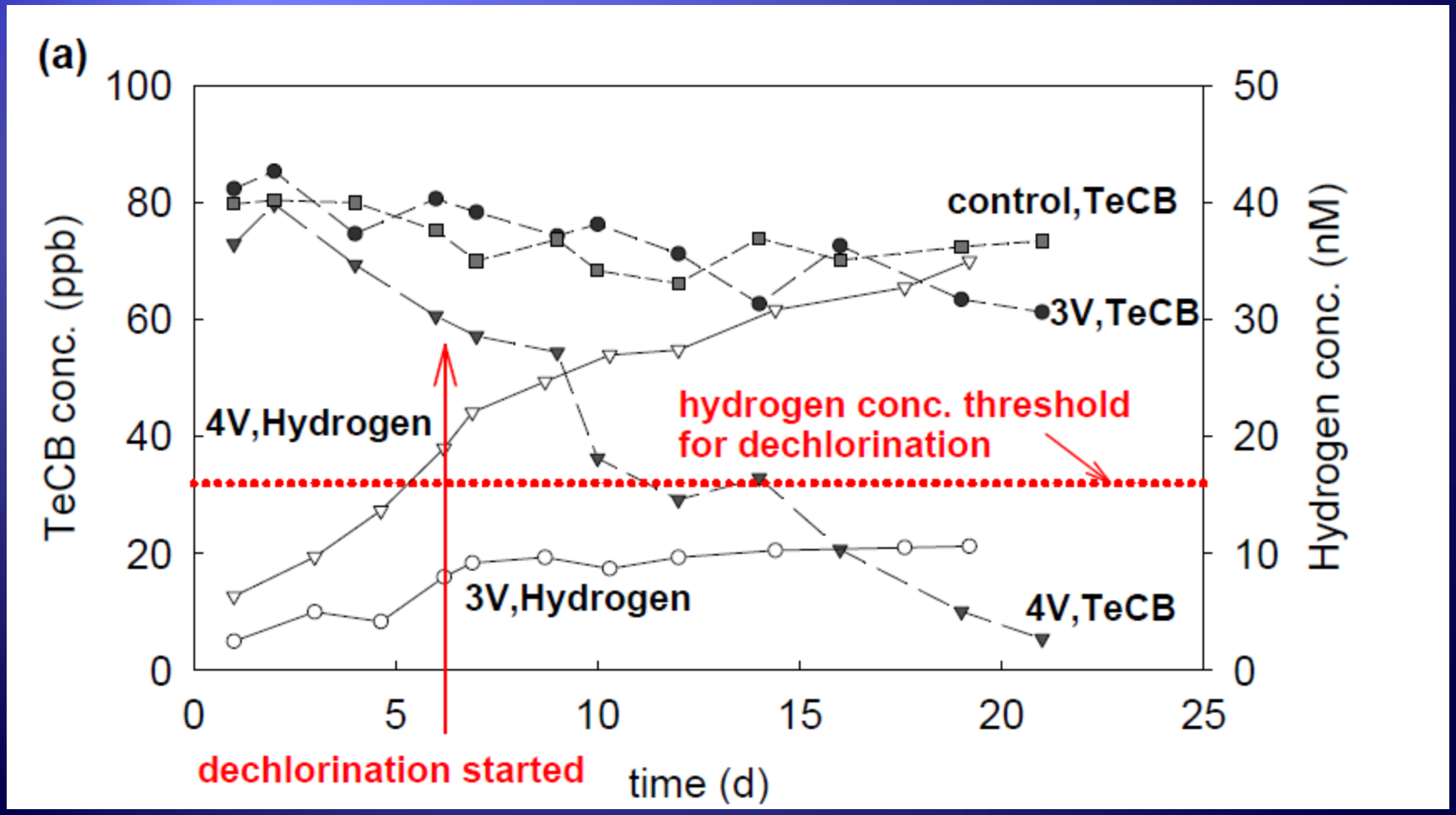
Nitrobenzene reduction
Aniline oxidation

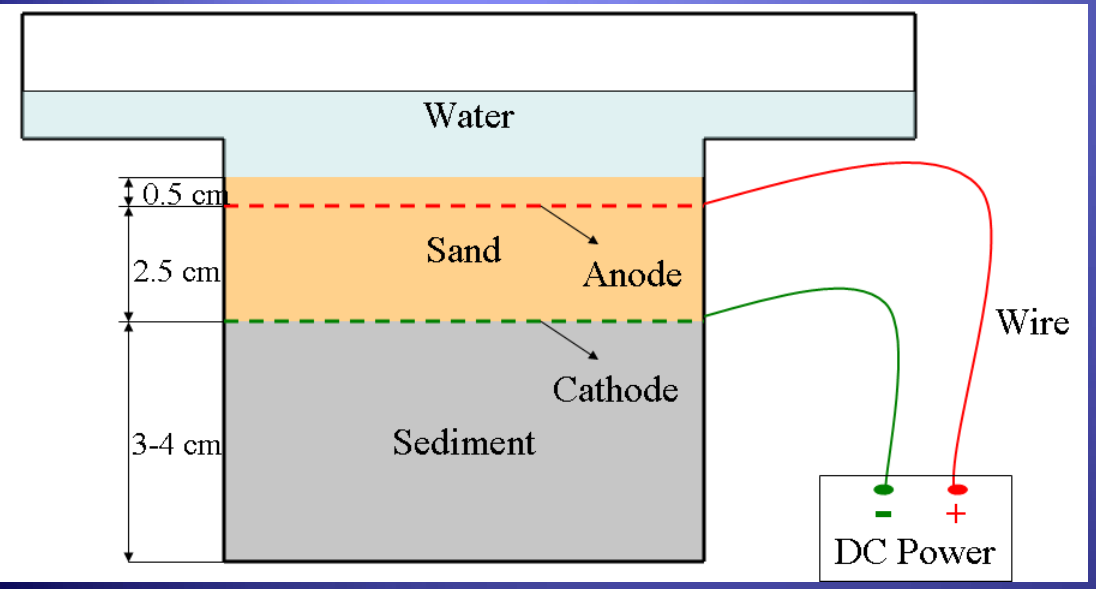


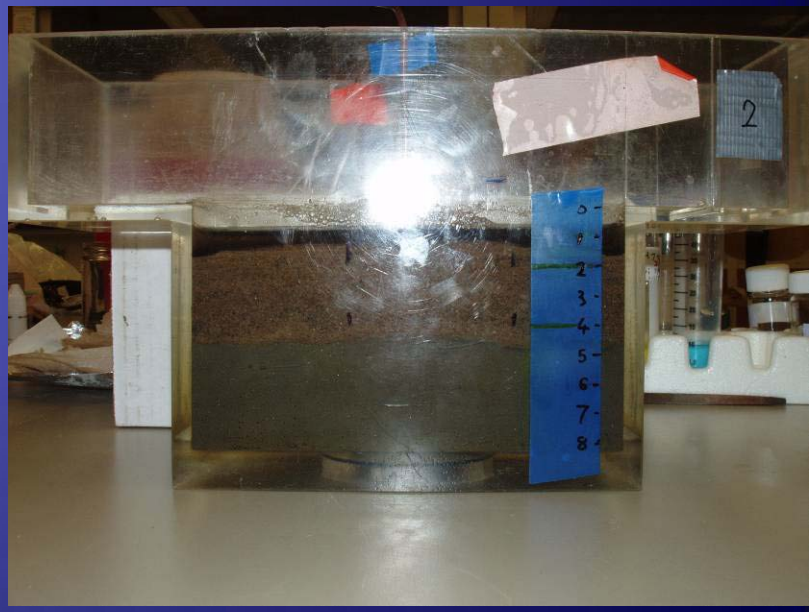


Electrode induced dechlorination

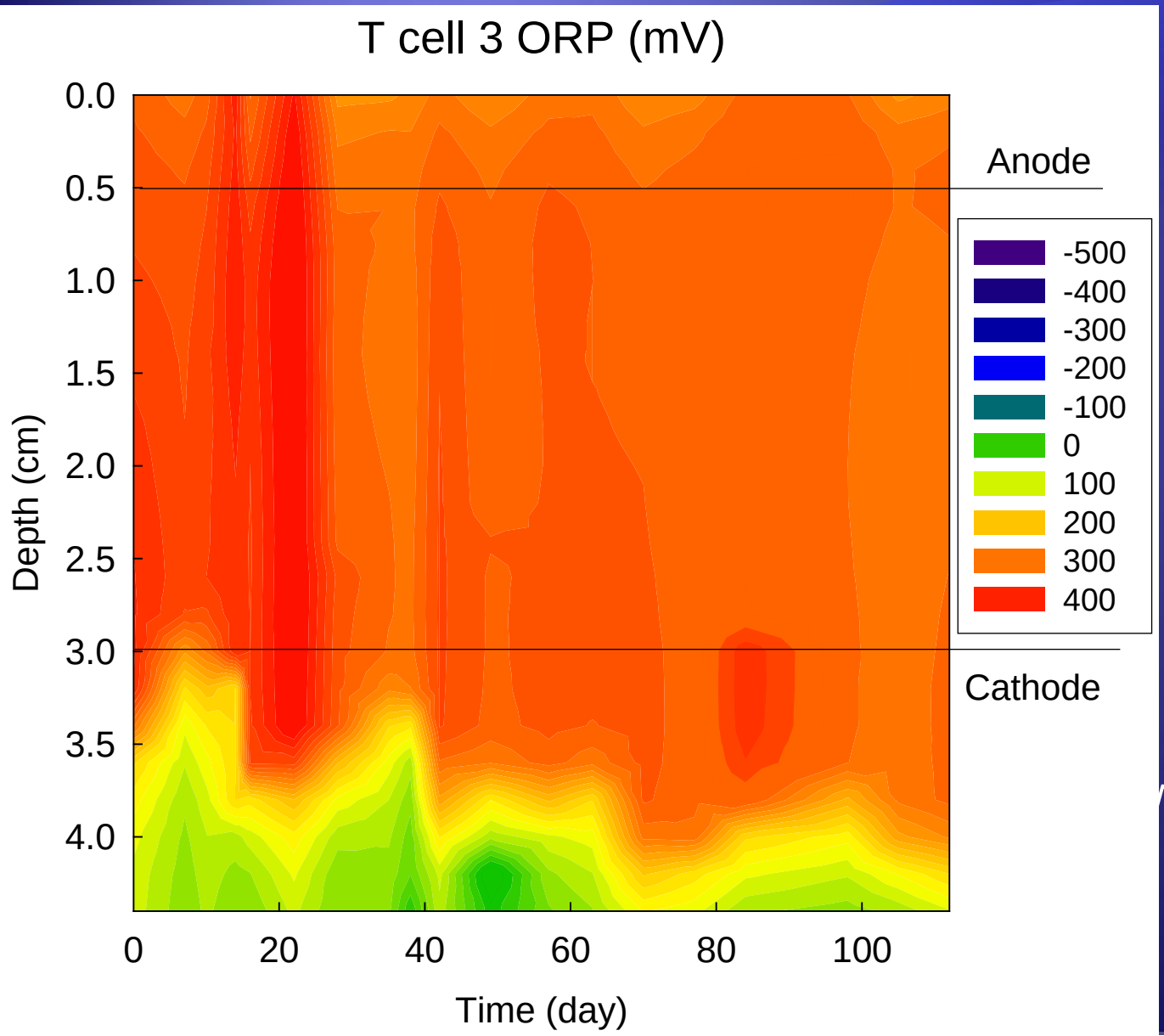


Redox control and pH changes



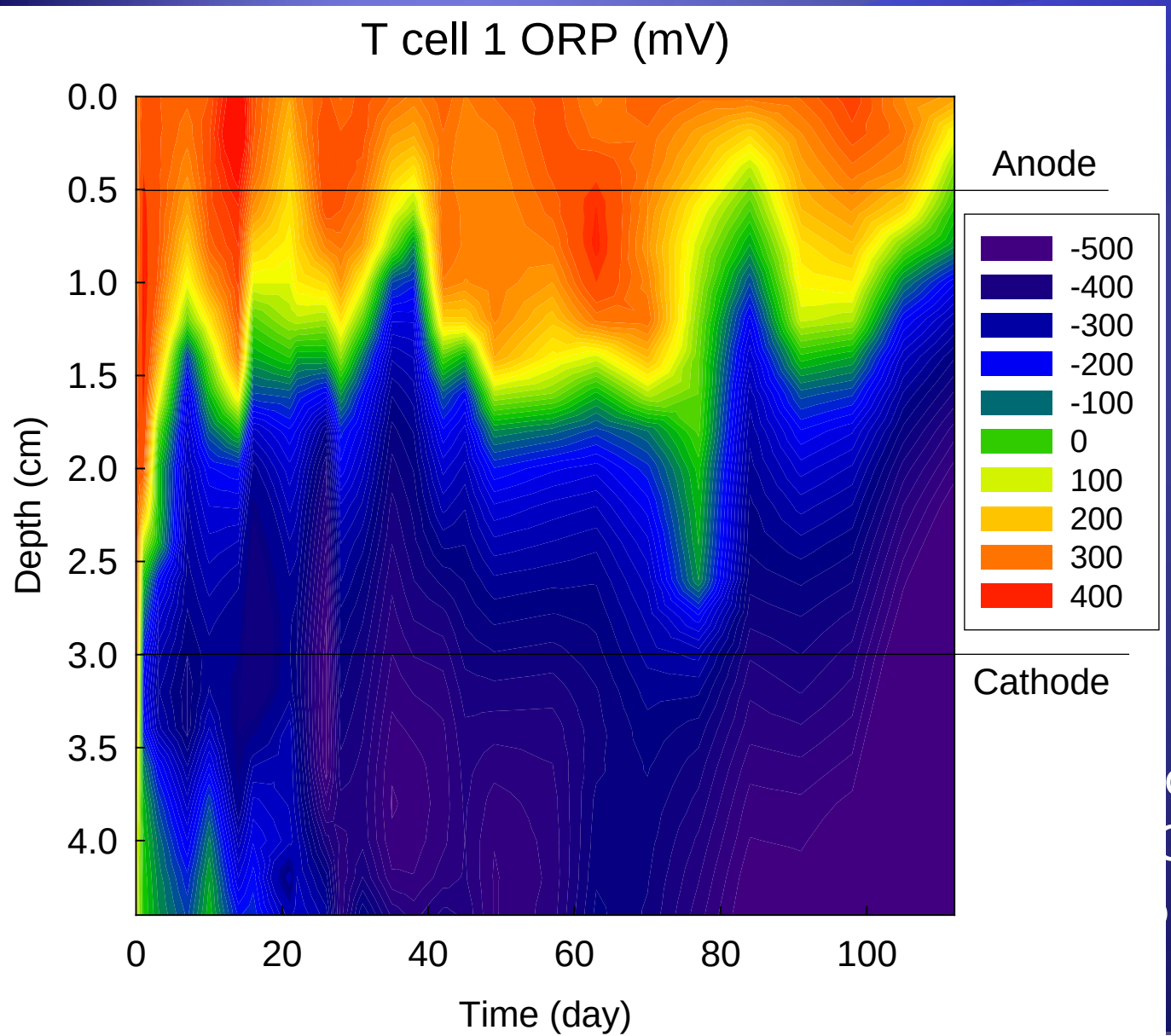


Redox control



wered control

Redox control



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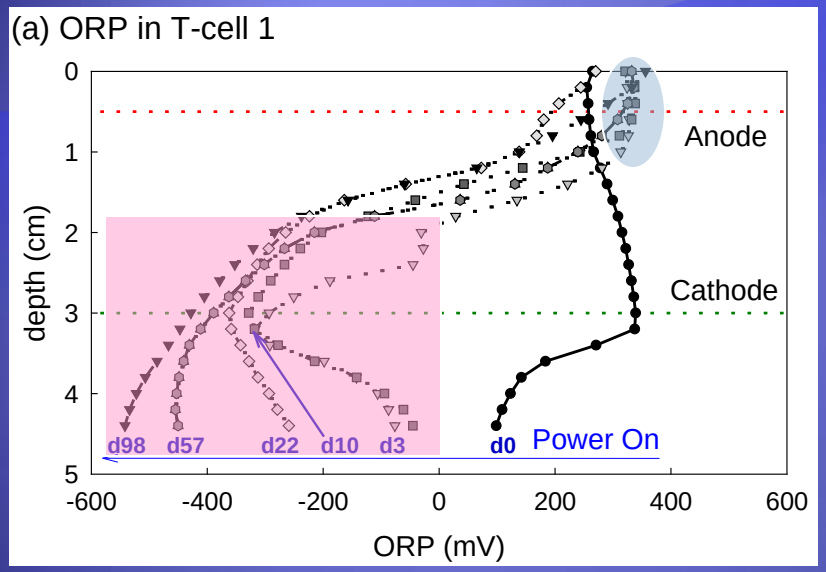
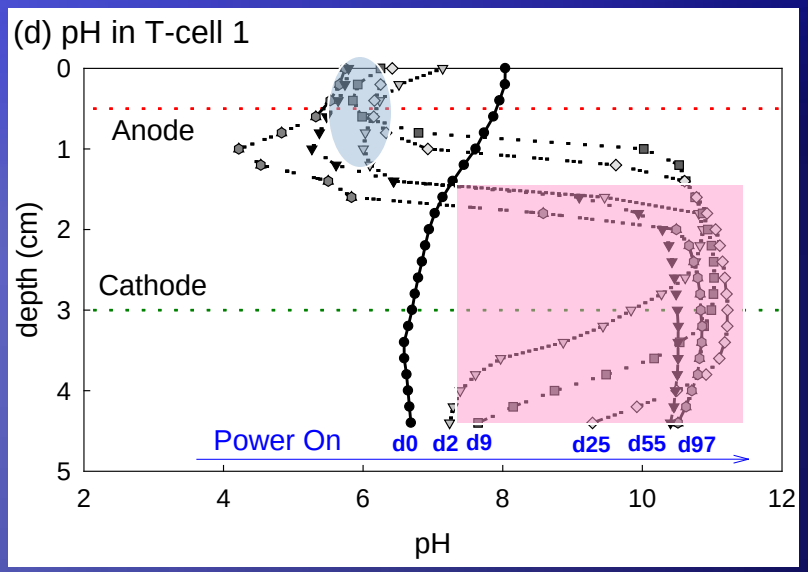
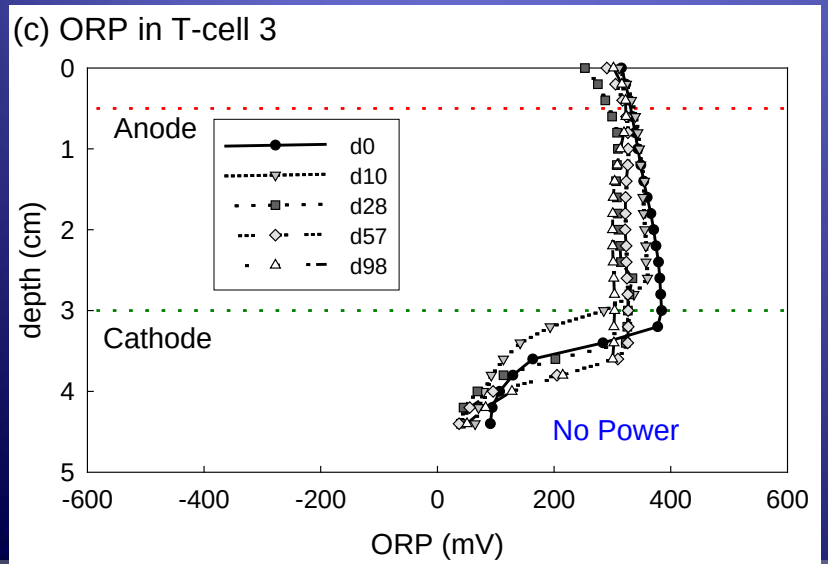
C power supply
days

Redox and pH Changes





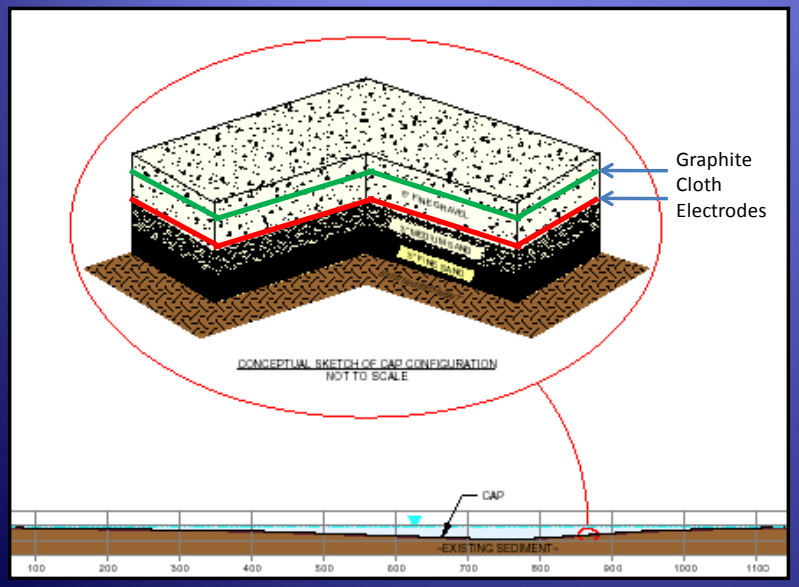


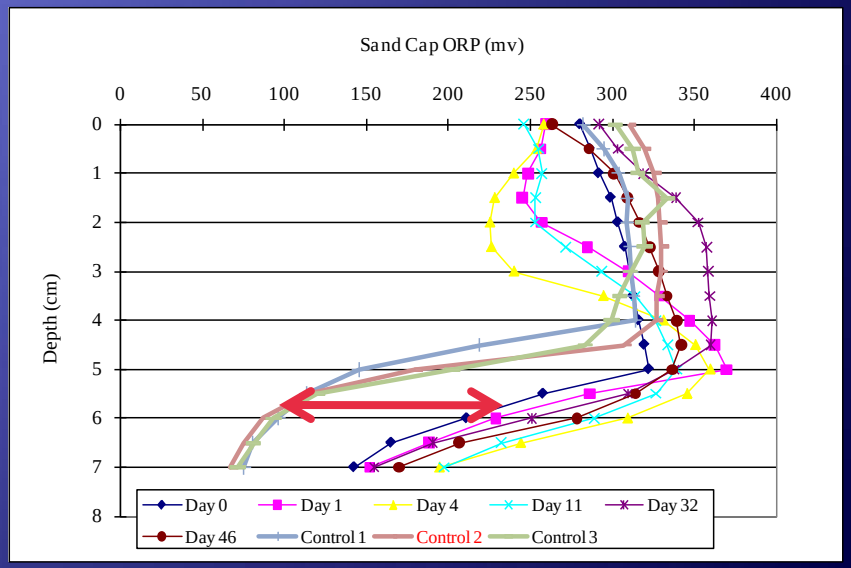
Oxidized zone - Anode

Reduced zone - Cathode

In-Situ Modification of Redox Conditions

Application of low voltage, low current source to graphite cloth electrodes to drive more reduced or more oxidized layer in sediments (cap layer) for enhancement of fate processes





Technology Transfer Supplement

- Large flume demonstrations
  - 2 dimensional flow (upwelling, river flow, hyporheic flow

Conclusions

- Funnel and gate approach allows significantly more complex and sophisticated capping
  - Regular replacement of finite capacity sorbents
  - Sustainable biodegradation
- Hollow fiber membranes to introduce air/oxygen and encourage aerobic degradation
- Low power electrodes for encouragement of reduction/oxidation at different layers in sediments