Hanford 300 Area Subsurface as Microbial Habitat

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Hanford Subsurface Characteristics

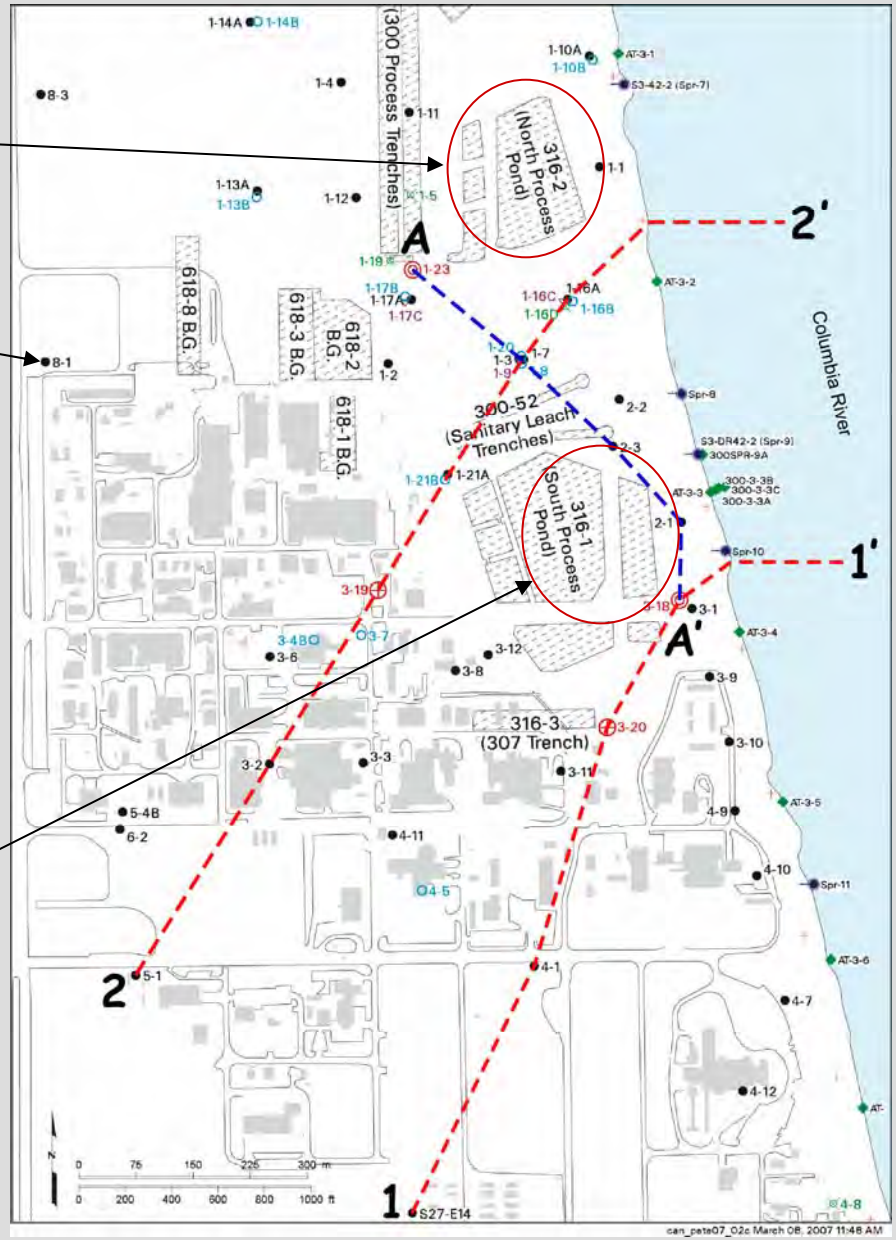
- Semi-arid climate; little to no recharge thru vadose zone (episodic)
- Oligotrophic– low productivity, DOC, nutrients
- Predominantly oxic – visual evidence of reducing conditions in Ringold
- Dilute contaminant levels (aqueous U, Cu)
- Impacts due to Columbia River water mixing with groundwater unknown

N Process Pond

Well 399-8-1

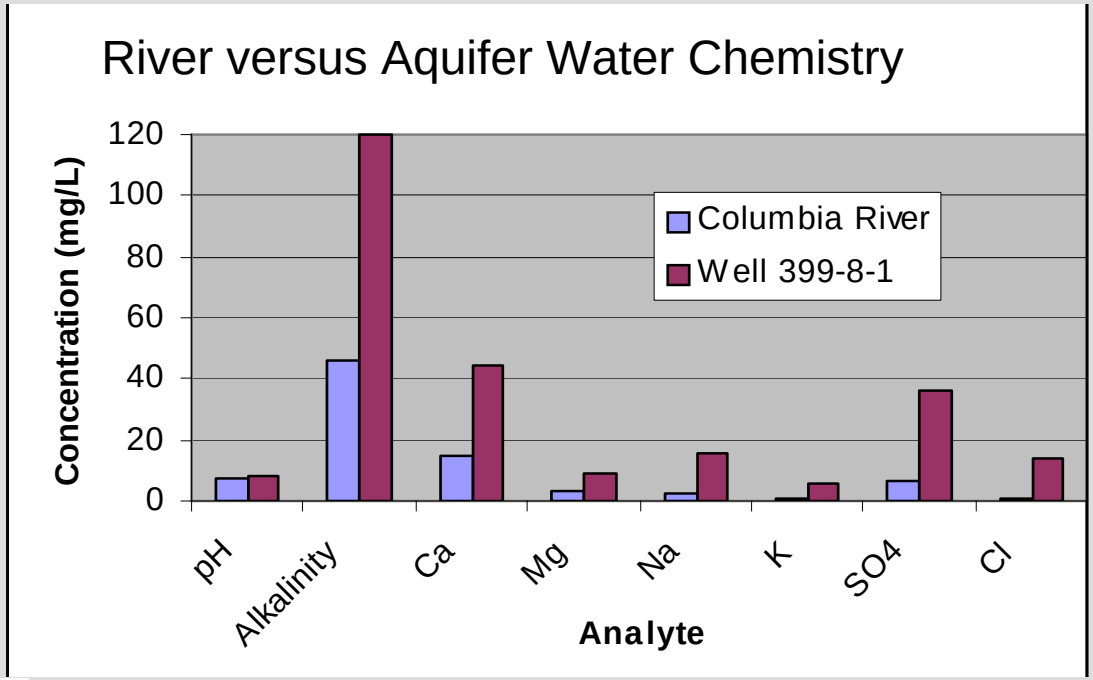
Hanford 300A

S Process Pond



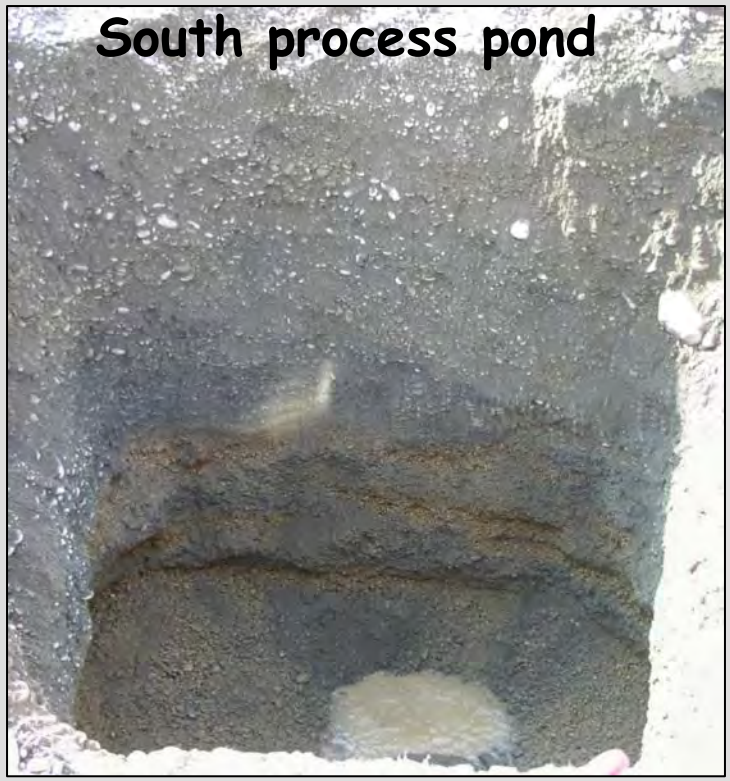
Aquifer-River Solution Chemistry

- River water influx occurs during high stage
- Prolonged seasonal high stage period allows mixing in aquifer with river water
- Significant differences in solution chemistry



S. Yabusaki

Hanford 300 Area N & S Process Pond Sampling



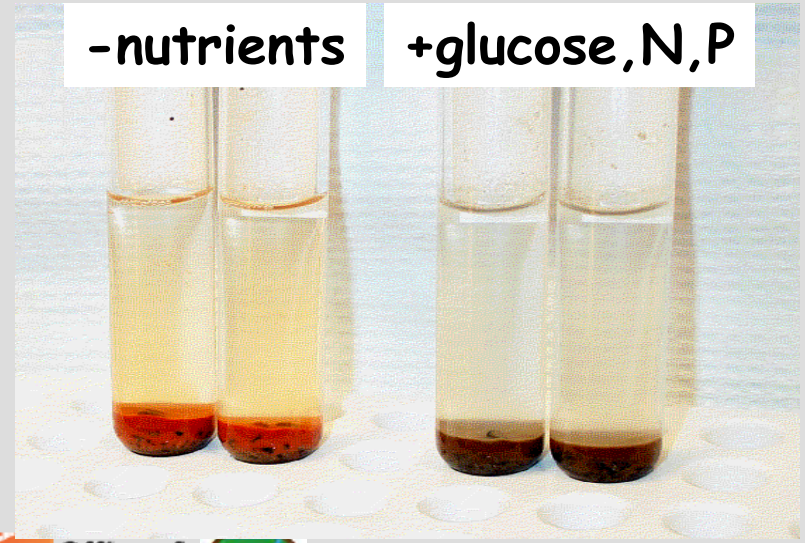
- Open pits, April 2003
- Direct collection (aseptic) above water table
- Matrix-supported gravelly sand
- Pertechnetate biotransformation

Microbial Enrichments from 300A S Pond Sediments

(3 month incubation)

A. unamended +glucose

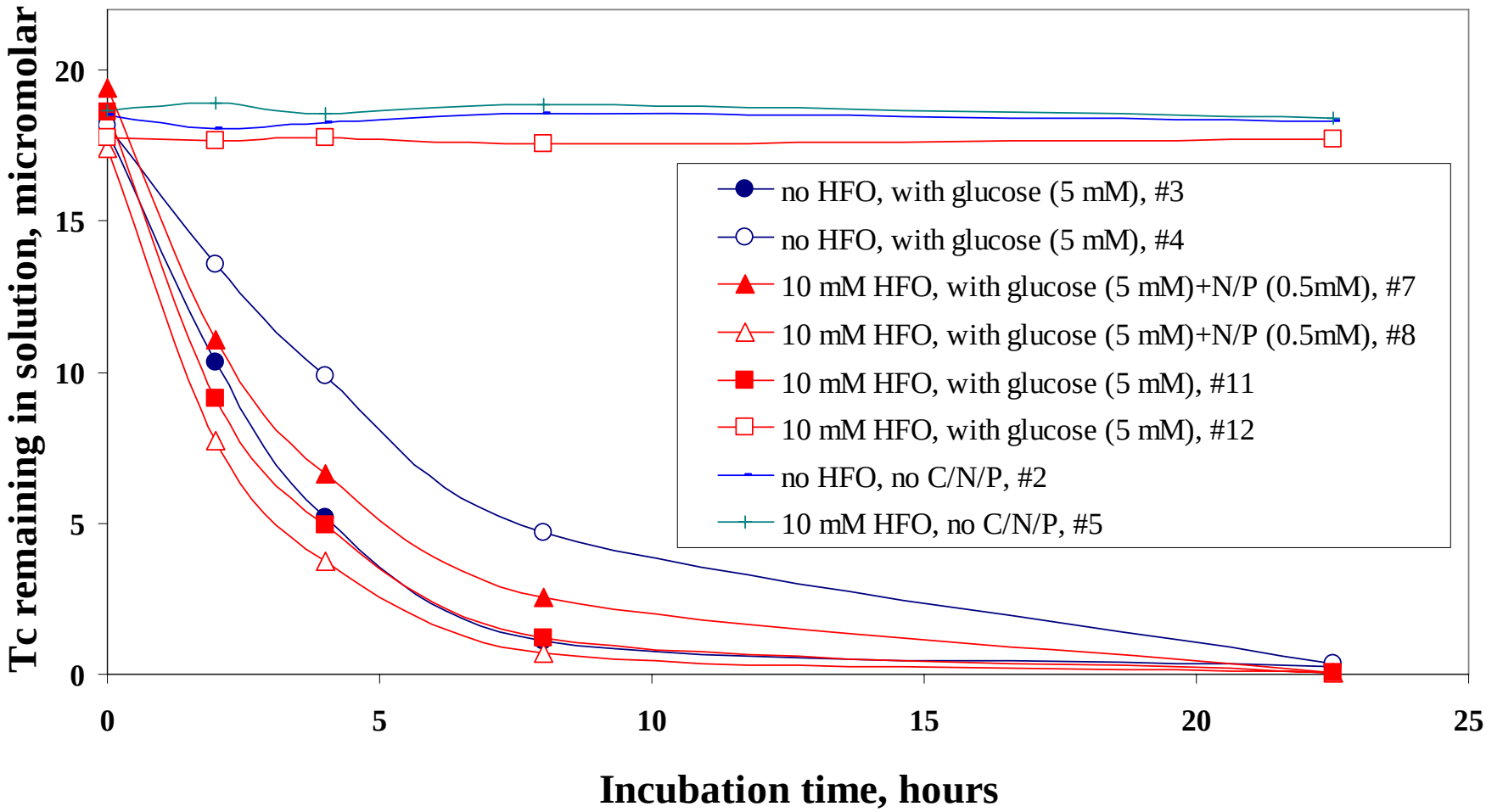
B. +HFO (10 mM)



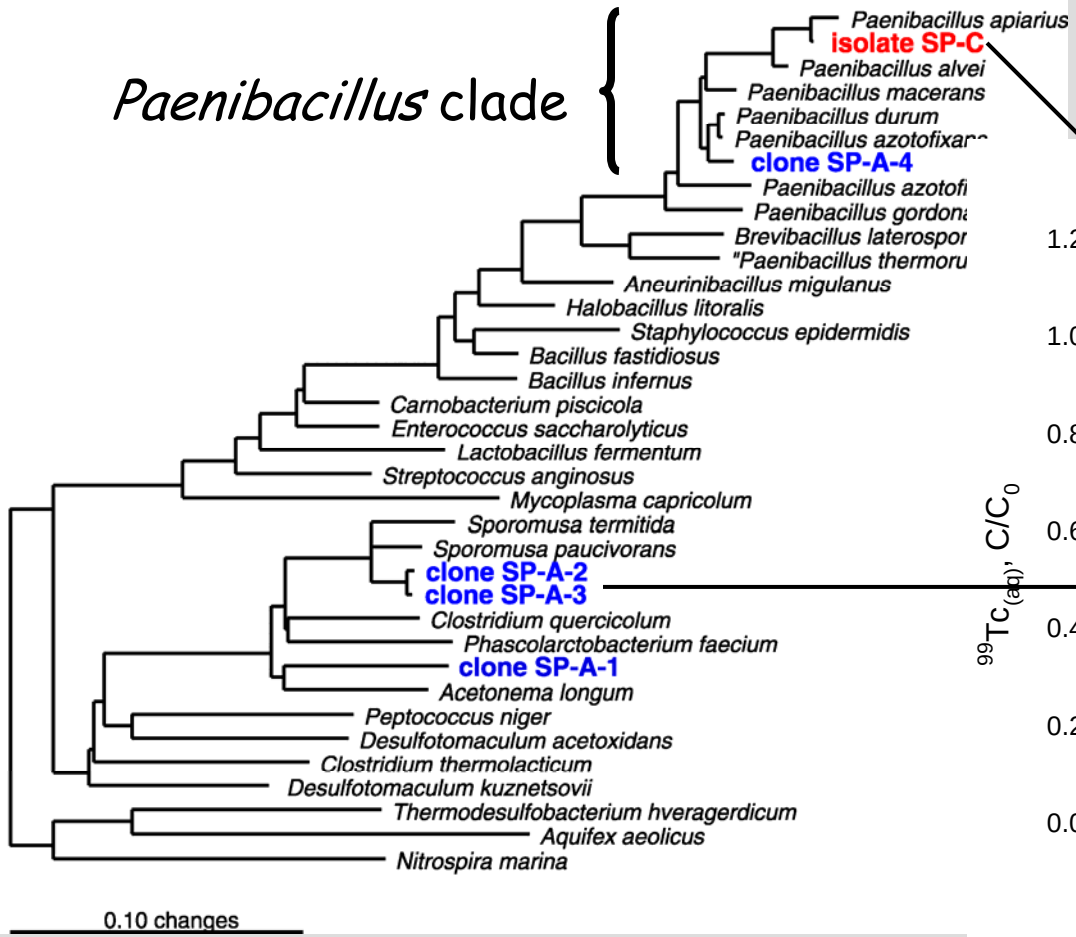
C. +HFO (10 mM)

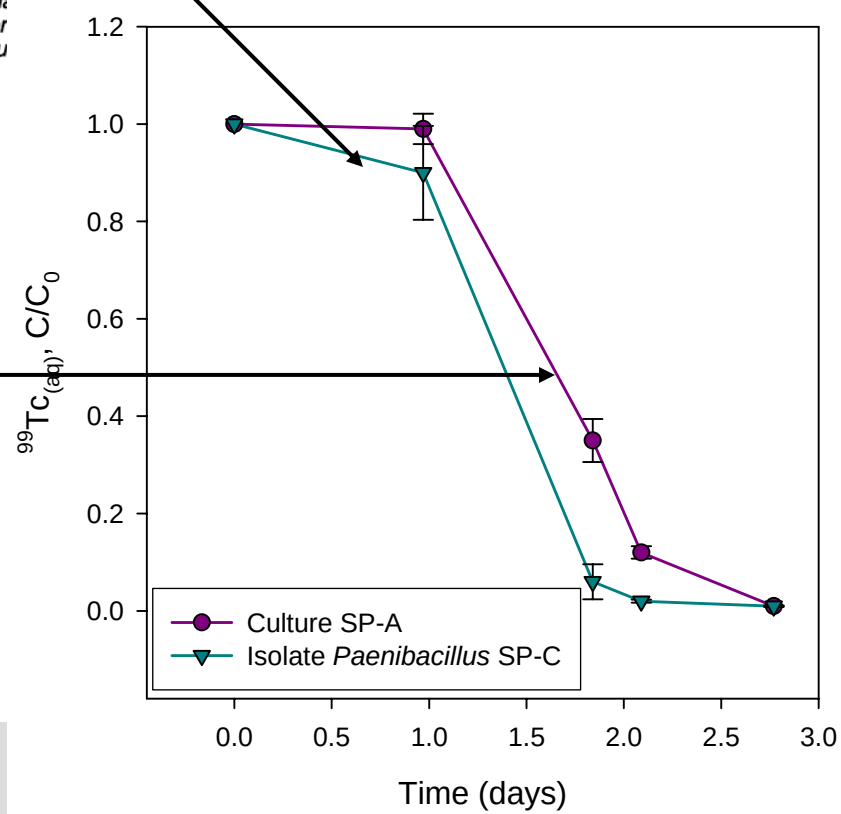
11 12

TcO_4^- Reduction in 300A Sediment Microbial Enrichments



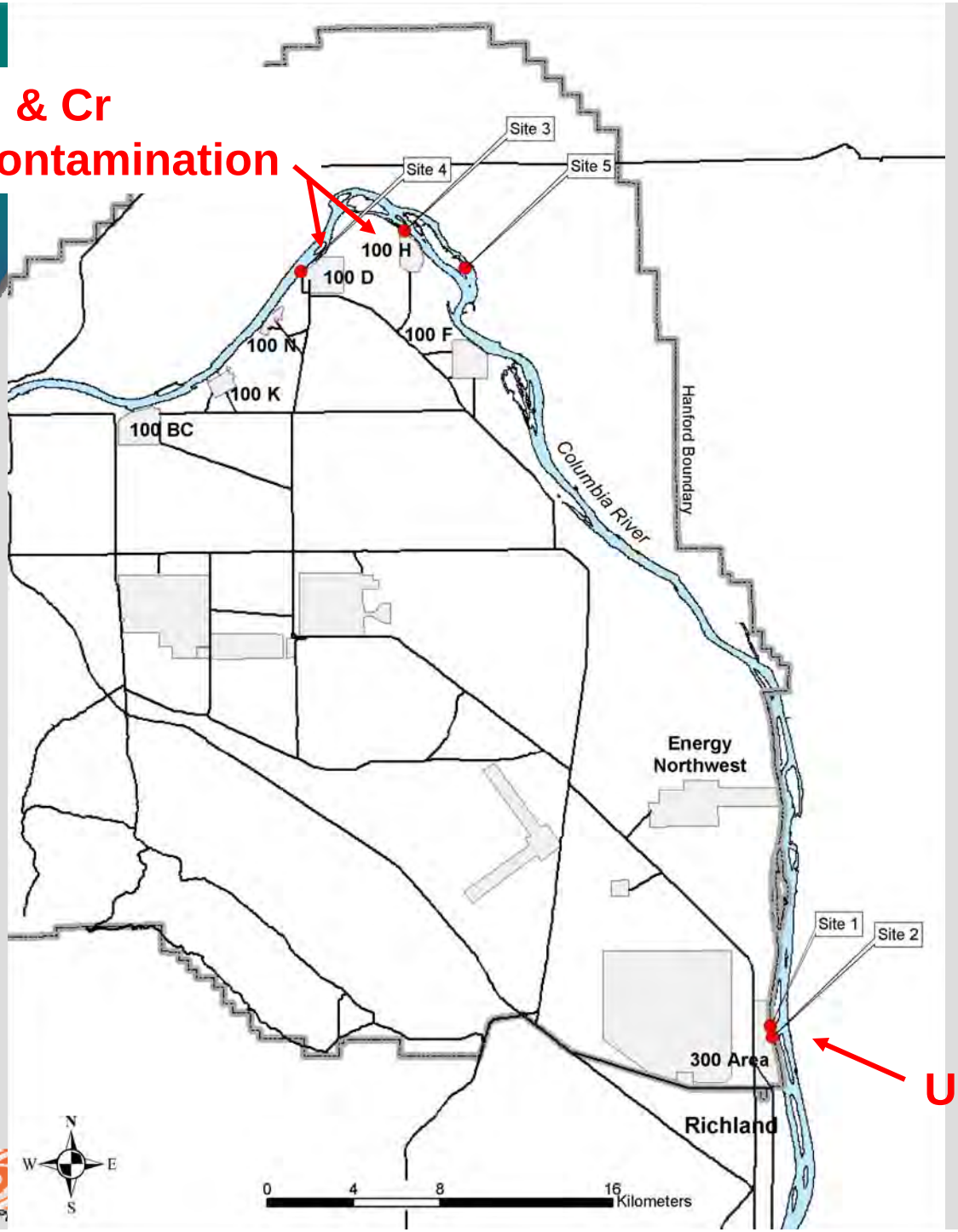
TcO_4^- Reduction by South Pond Isolates





Columbia River Hanford Reach

- Hyporheic zone
- Sediments @ water interface



Columbia River Hyporheic Zone

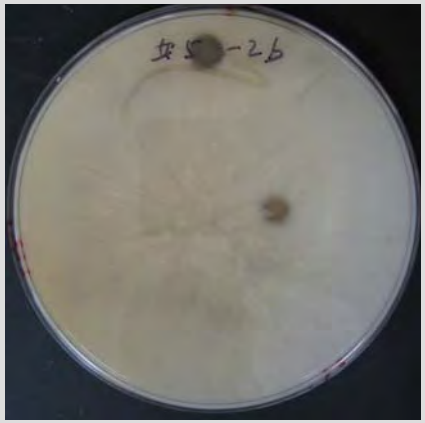
- Cobble-bed samples from the Columbia River Hanford Reach HZ
- Viable aerobic heterotrophic bacteria (10^5-10^7 cfu/g sediment fines)
- Viable populations of sulfate-, nitrate-, and iron-reducing bacteria, fermenters
- Metabolically active (^{14}C-acetate mineralization); reduce chromate

Moser et al. 2003. ES&T

Serum bottle (50 ml) of water/sediment slurry (PNNL)

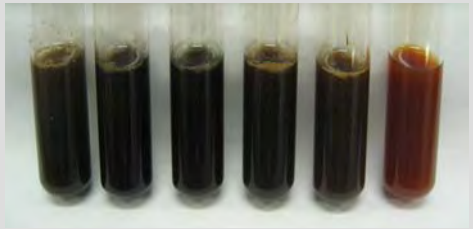
Direct isolation

Counts/AODC

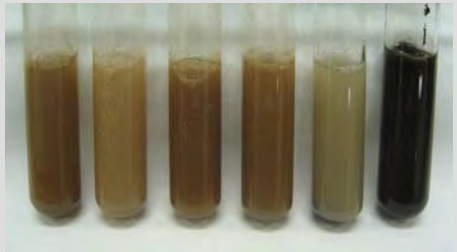


Enrichments

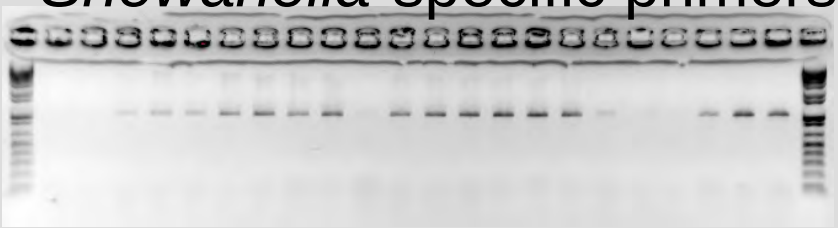
20 mM HFO
20 mM lactate



20 mM MnO_2
20 mM lactate



PCR w/ *Shewanella*-specific primers



Summary - Hanford 300 Area IFC Site

- Microbiology poorly characterized - oligotrophic, aerobic
- Populations sparse but respond to nutrient stimulation
- Enrichments, biogenic Fe(II) & isolates reduce TcO_4^-
- Columbia River water mixing effects unknown, but:
  - Hyporheic zone contains active microbial communities
  - HCR sediment harbors metal-reducing bacteria, *Shewanella* ubiquitous

Acknowledgements

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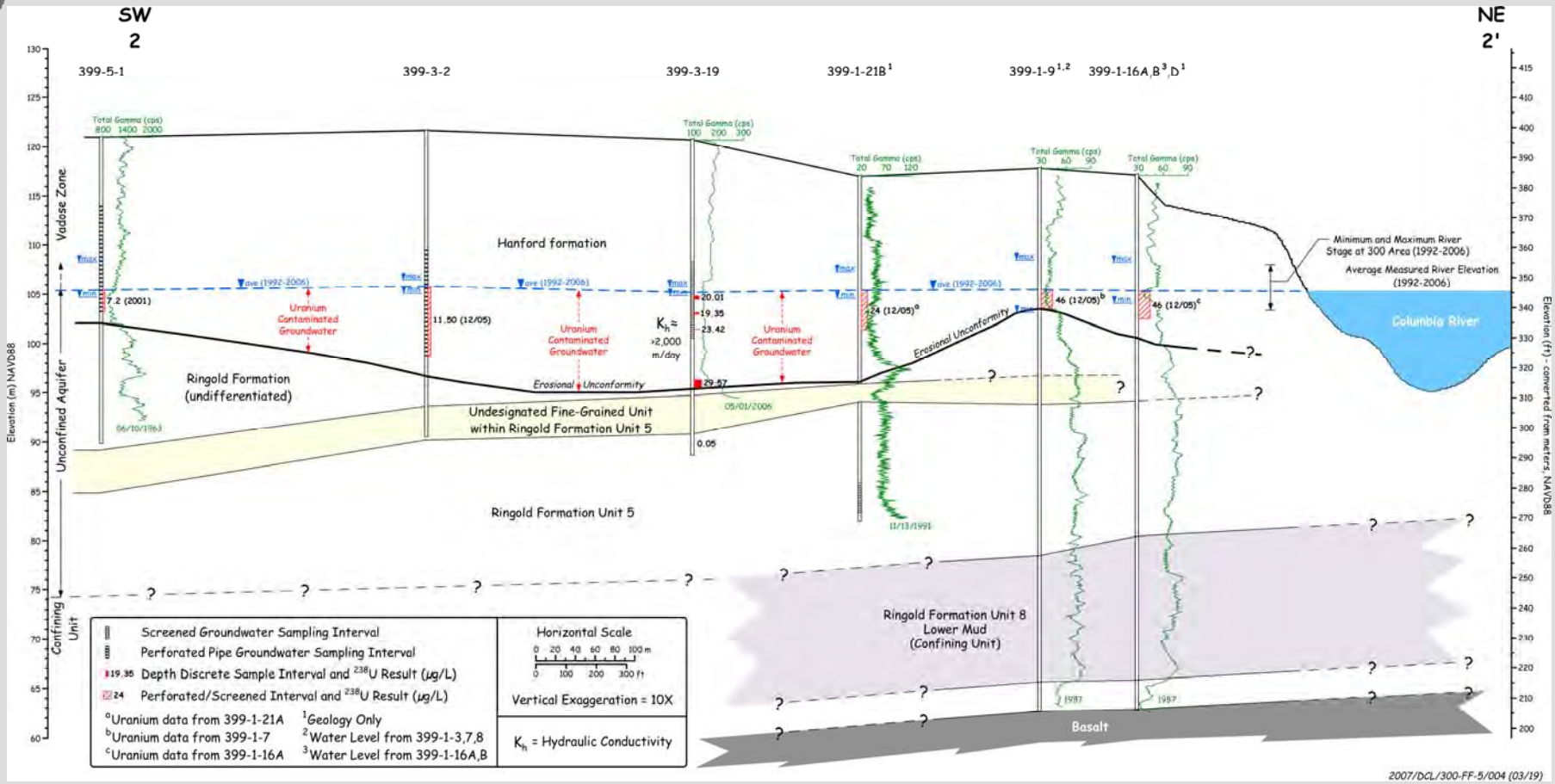
300A Geological X-Section