



Hanford 300 A IFC

Hanford 300 Area Subsurface as Microbial Habitat

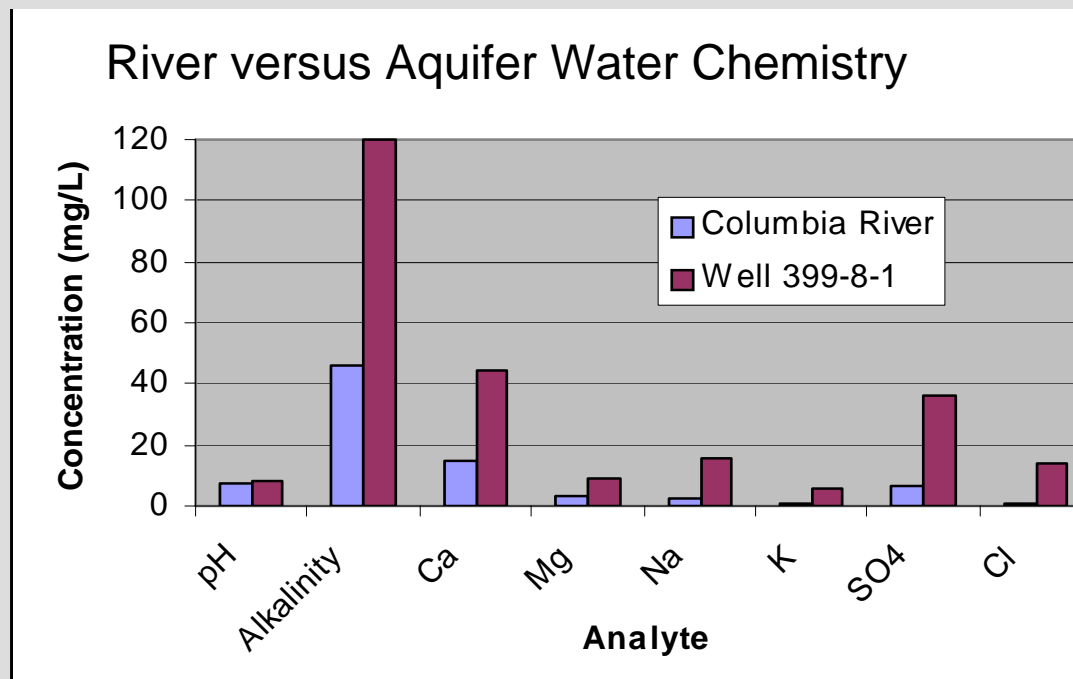
Jim Fredrickson
Pacific NW National Laboratory

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

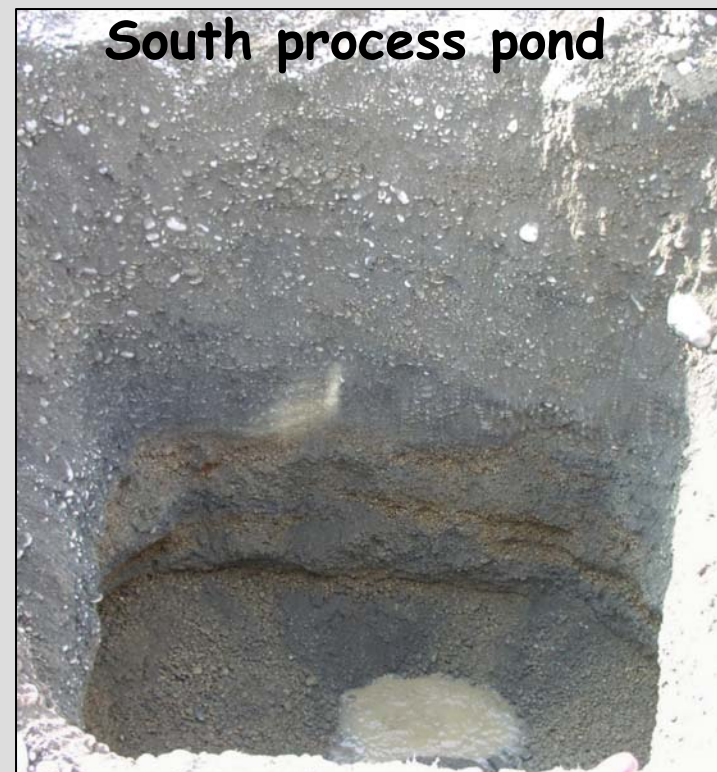
Aquifer-River Solution Chemistry

- ▶ 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

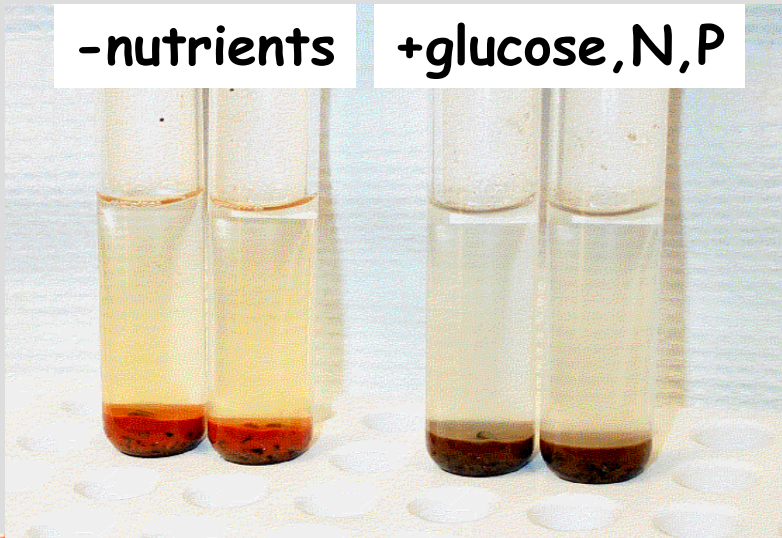
A. unamended +glucose



Microbial Enrichments from 300A S Pond Sediments (3 month incubation)

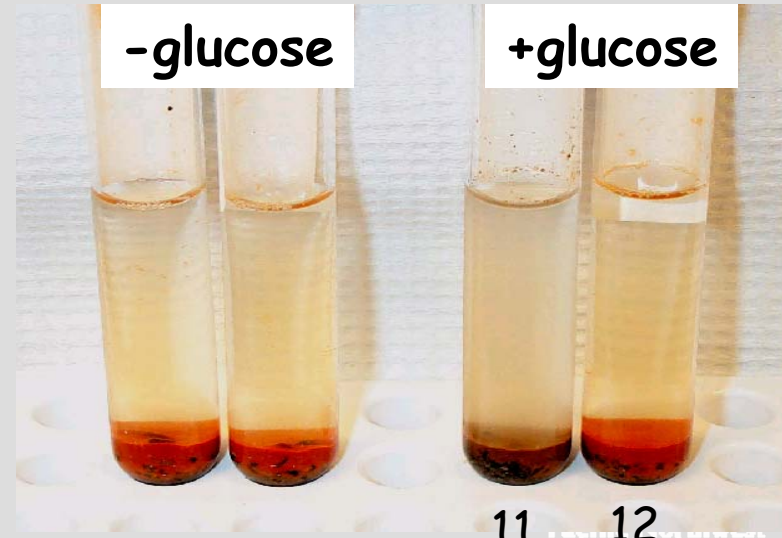
B. +HFO (10 mM)

-nutrients +glucose, N, P

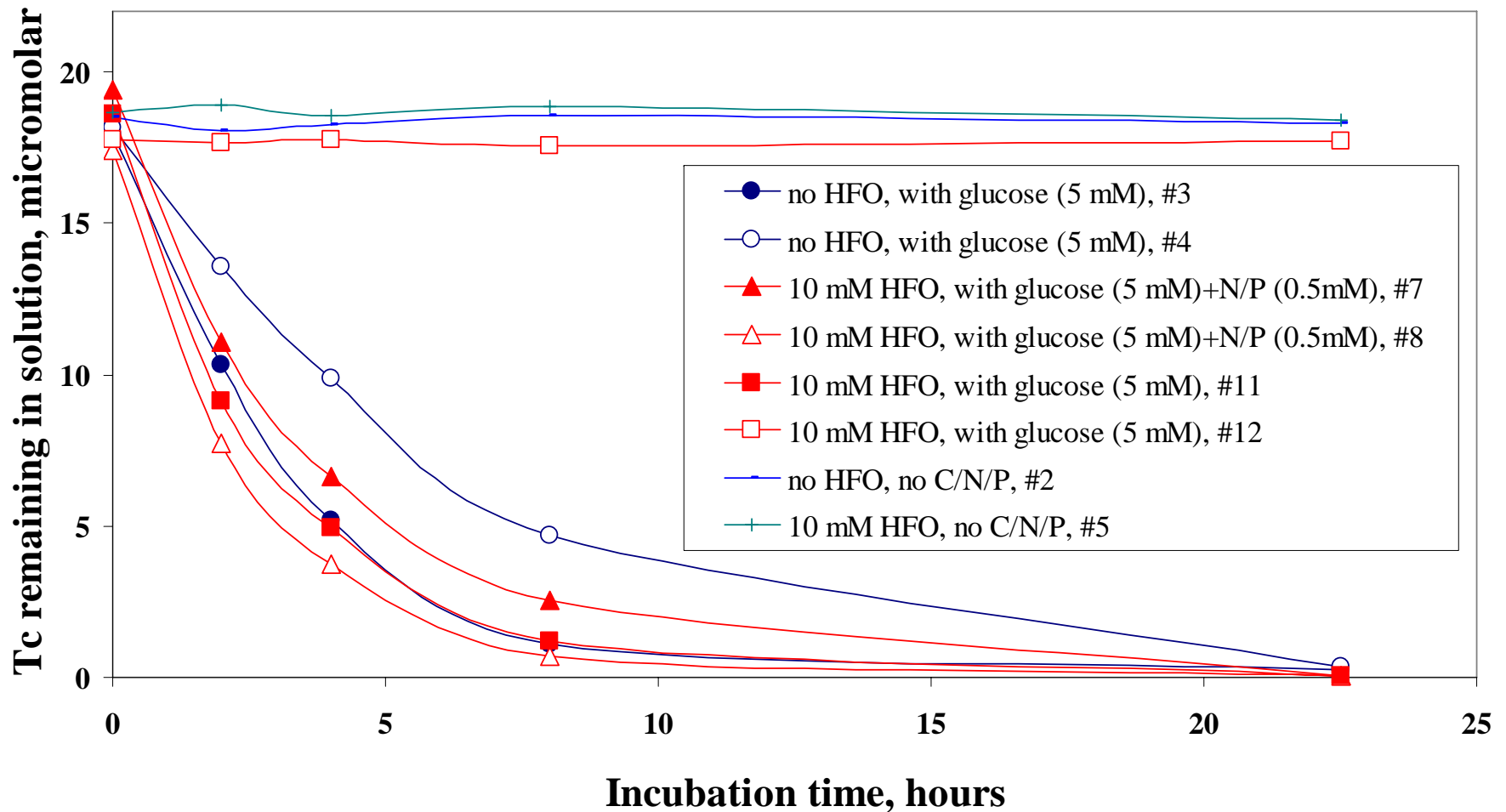


C. +HFO (10 mM)

-glucose +glucose

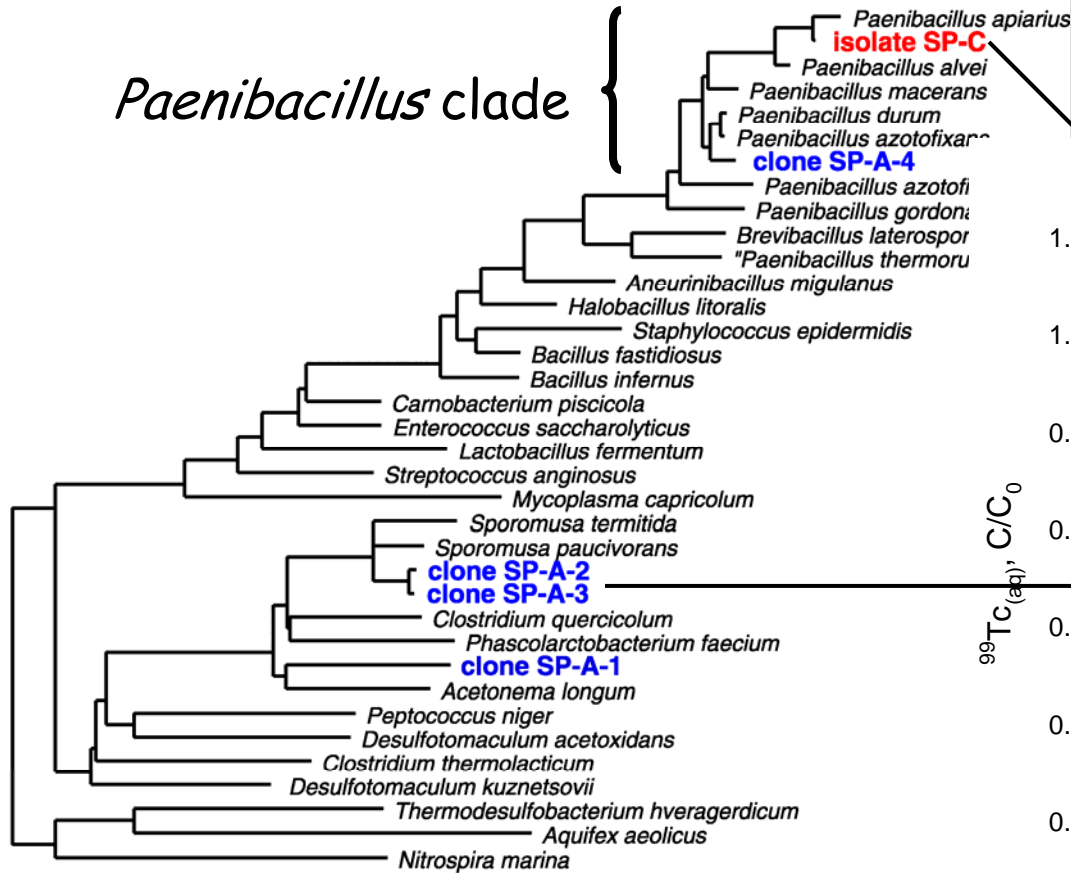


TcO₄⁻ Reduction in 300A Sediment Microbial Enrichments

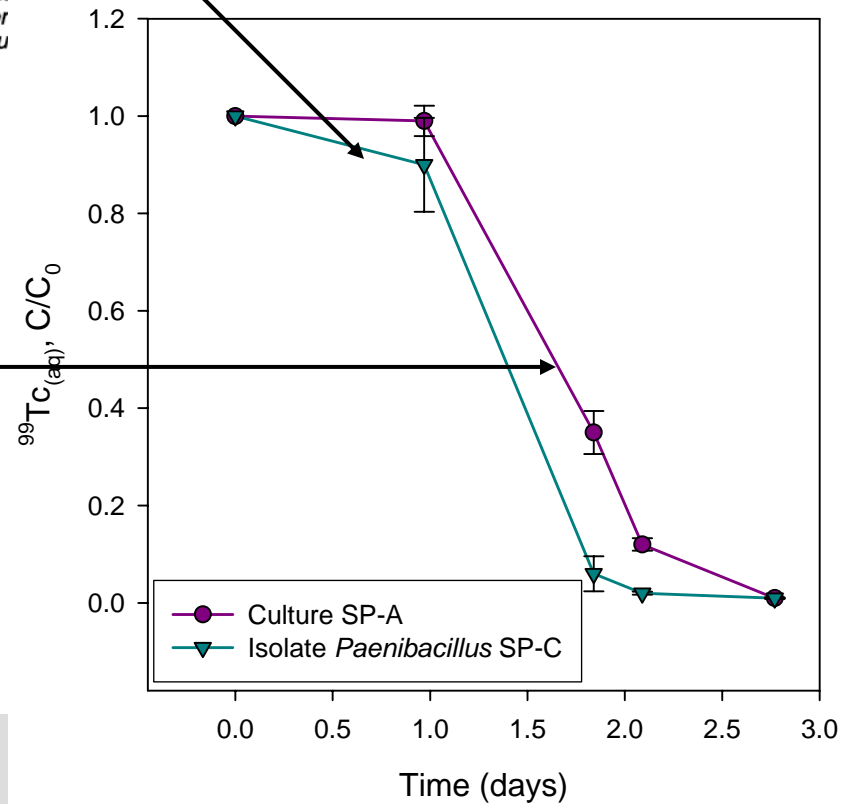


TcO₄⁻ Reduction by South Pond Isolates

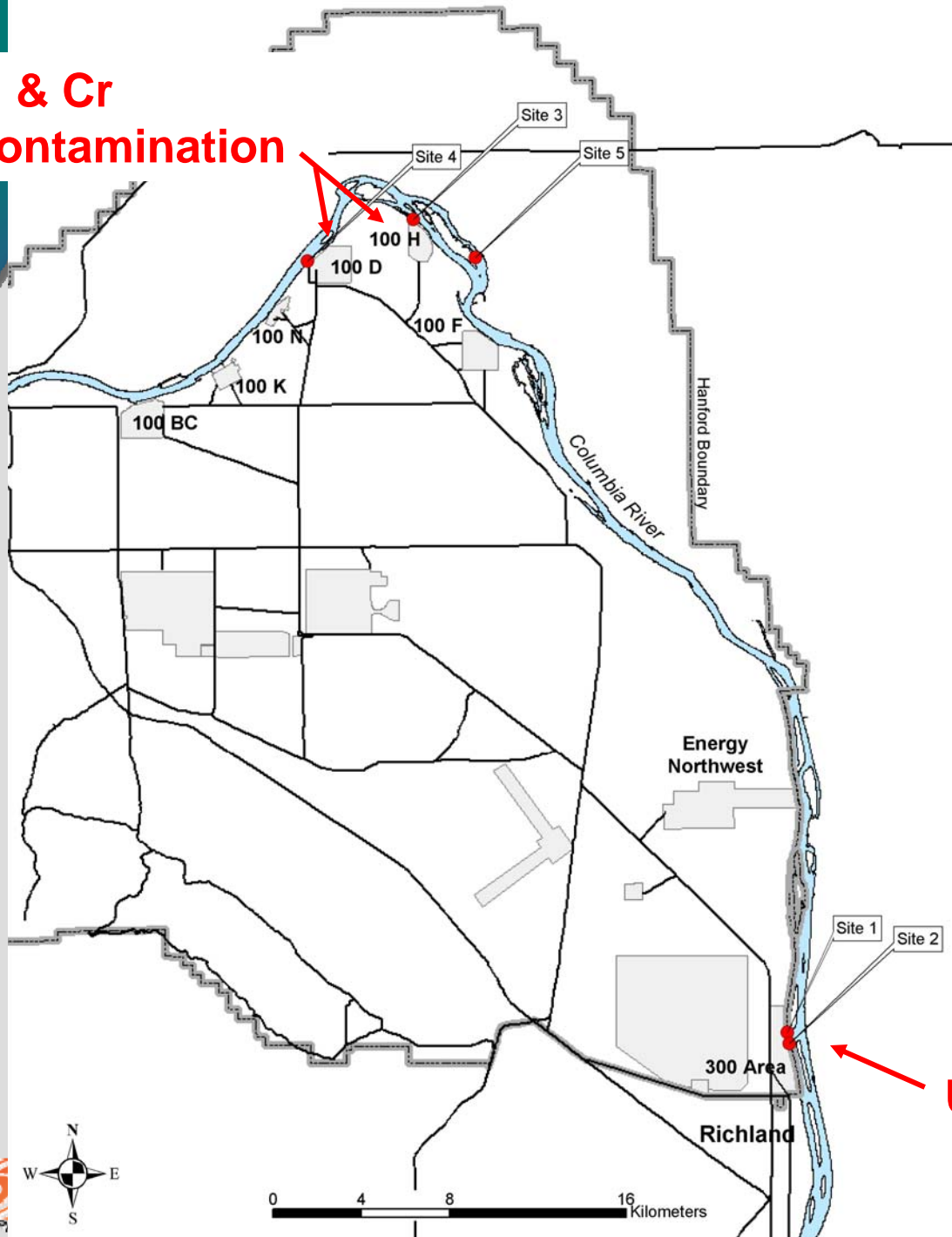
Paenibacillus clade



0.10 changes



**U & Cr
contamination**



Columbia River Hanford Reach

- ▶ Hyporheic zone
- ▶ Sediments @
water interface



U seeps

Columbia River Hyporheic Zone



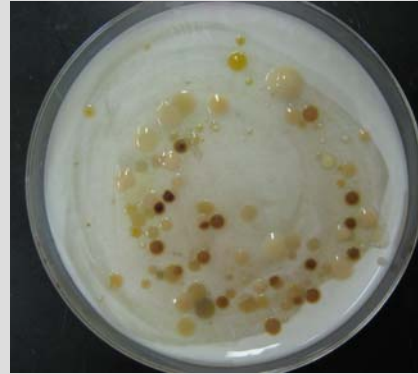
- ▶ Cobble-bed samples from the Columbia River Hanford Reach HZ
- ▶ Viable aerobic heterotrophic bacteria (10^5 - 10^7 cfu/g sediment fines)
- ▶ Viable populations of sulfate-, nitrate-, and iron-reducing bacteria, fermenters
- ▶ Metabolically active (^{14}C -acetate mineralization); reduce chromate

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

Direct isolation

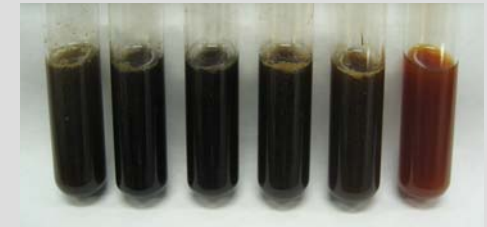


Counts/AODC



Enrichments

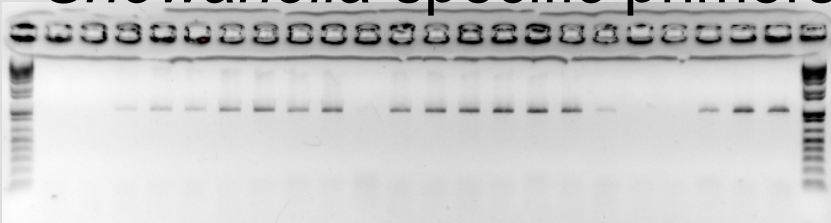
20 mM HFO
20 mM lactate



20 mM MnO₂
20 mM lactate



PCR w/
Shewanella-specific primers



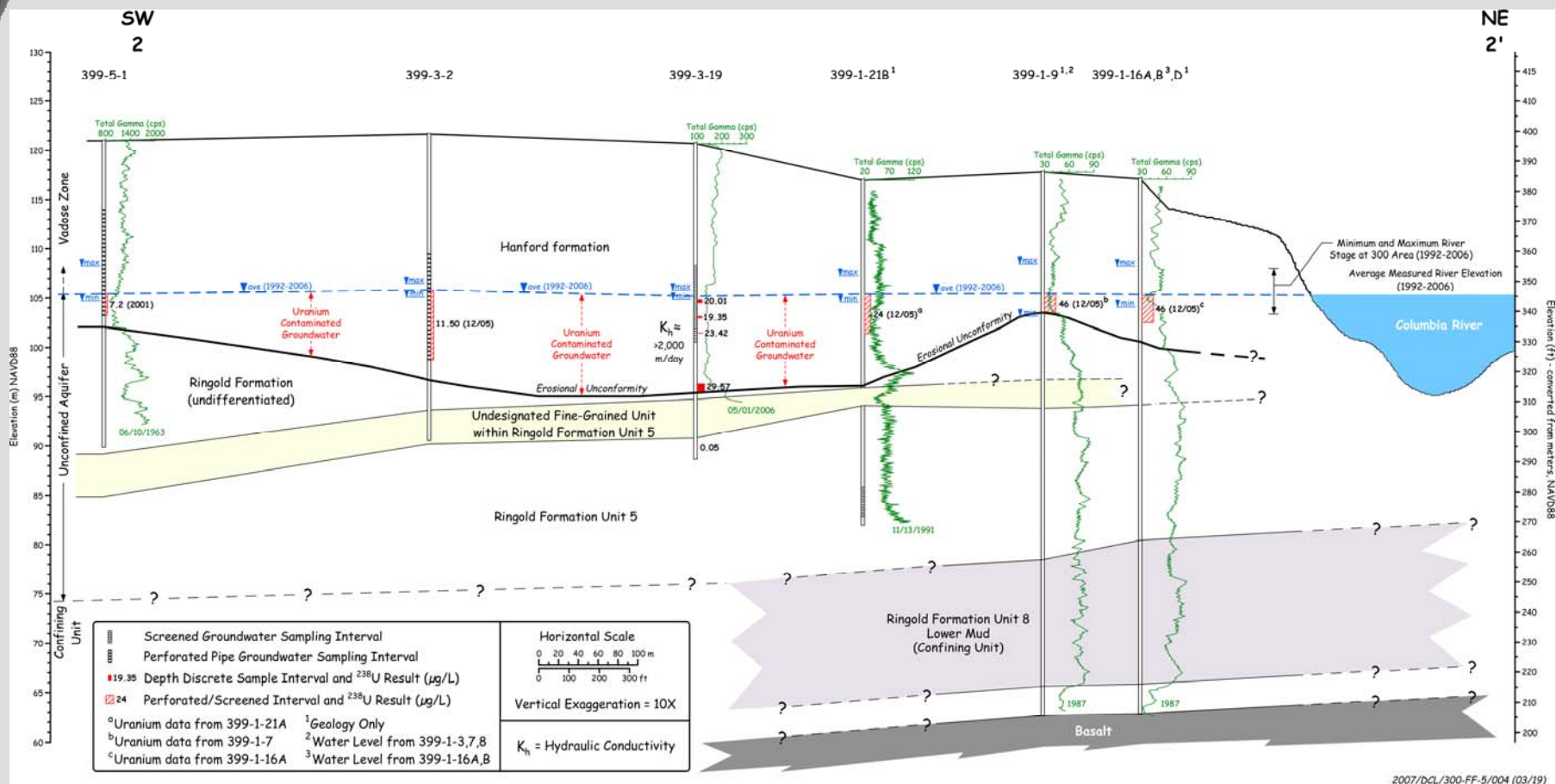
Summary - Hanford 300 Area IFC Site

- ▶ 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

- ▶ John Zachara, Matt Marshall, Tom Gihring, Andy Plymale, Duane Moser, Shu-mei Li, Bruce Bjornstad, Phil Long, Jim McKinley, Steve Yabusaki, Bruce Williams
- ▶ ERSP (NABIR)

300A Geological X-Section



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