



DOE-FIU Cooperative Agreement Annual Research Review – FIU Year 2

Project 2 – Task 1

Evaluation of Competing Attenuation Processes for Mobile Contaminants in Hanford Sediments

Mariah Doughman (DOE Fellow)

Evaluation of Competing Attenuation Processes for Mobile Contaminants in Hanford Sediments

Overall Needs: Once active remediation is completed (pump and treat technology), a transition to more passive approaches, such as monitored natural attenuation (MNA), will be considered.

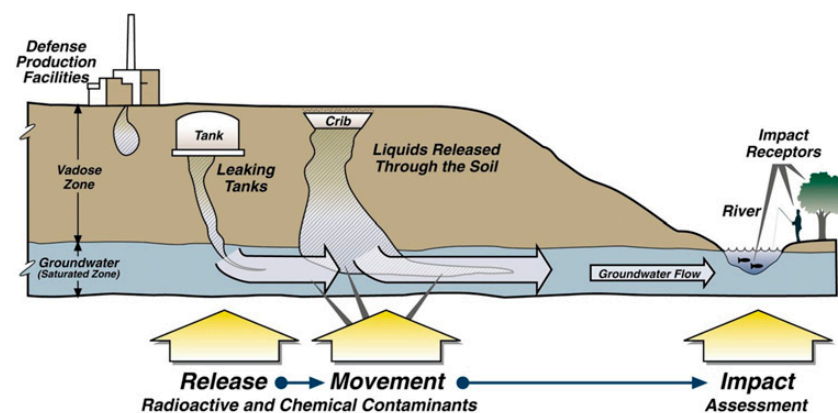
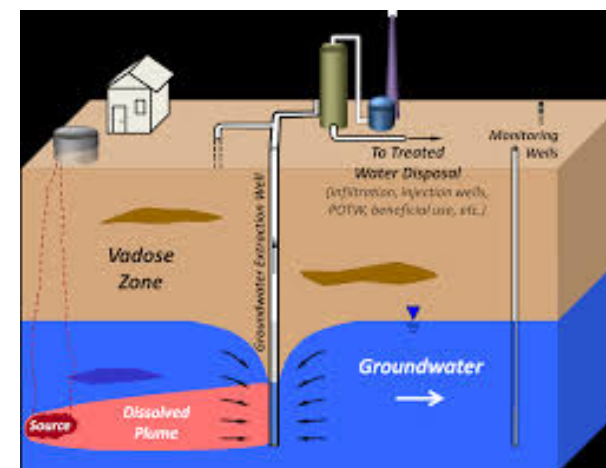


FIG. 2. Schematic diagram of waste discharges to the Hanford Site vadose



Objective: Evaluate the adsorption of contaminants of concern (Cr, U, I-127) onto Hanford Formation sediment at relevant aqueous concentrations in the absence and presence of each other to determine possible natural attenuation processes.

Zachara, J. M. Hanford Site Vadose Zone Studies : An Overview. *Vadose Zo. J.* **2007**, 6 (4), 899–905.

Truex, M. J.; Johnson, C. D.; Becker, D. J.; Lee, M. H.; Nimmons, M. J. *Performance Assessment for Pump-and-Treat Closure or Transition*; **2015**.

Evaluation of Competing Attenuation Processes for Mobile Contaminants in Hanford Sediments



- Solid uranyl nitrate hexahydrate as source of U(VI)
- Potassium chromate as source of Cr(VI)
- 1:1 sediment/artificial groundwater ratio
- End-over-end tube revolver at 8 rpm
- 1-14 days to attain equilibrium conditions

Cr (VI) concentration ($\frac{\mu\text{mol}}{\text{L}}$)	U (VI) concentration ($\frac{\mu\text{mol}}{\text{L}}$)
1.05 ($54.6 \frac{\mu\text{g}}{\text{L}}$)	10.5 ($2500 \frac{\mu\text{g}}{\text{L}}$)
10.5 ($546 \frac{\mu\text{g}}{\text{L}}$)	10.5 ($2500 \frac{\mu\text{g}}{\text{L}}$)
105 ($5460 \frac{\mu\text{g}}{\text{L}}$)	10.5 ($2500 \frac{\mu\text{g}}{\text{L}}$)
1.05 ($54.6 \frac{\mu\text{g}}{\text{L}}$)	168 ($40000 \frac{\mu\text{g}}{\text{L}}$)
10.5 ($546 \frac{\mu\text{g}}{\text{L}}$)	168 ($40000 \frac{\mu\text{g}}{\text{L}}$)
105 ($5460 \frac{\mu\text{g}}{\text{L}}$)	168 ($40000 \frac{\mu\text{g}}{\text{L}}$)
168 ($8736 \frac{\mu\text{g}}{\text{L}}$)	168 ($40000 \frac{\mu\text{g}}{\text{L}}$)
1680 ($87360 \frac{\mu\text{g}}{\text{L}}$)	168 ($40000 \frac{\mu\text{g}}{\text{L}}$)

Evaluation of Competing Attenuation Processes for Mobile Contaminants in Hanford Sediments

FIU Year 2 Highlights:

Dominant U(VI) species:

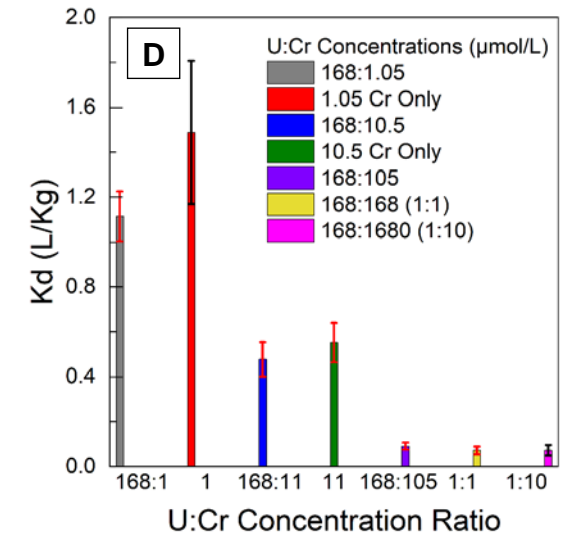
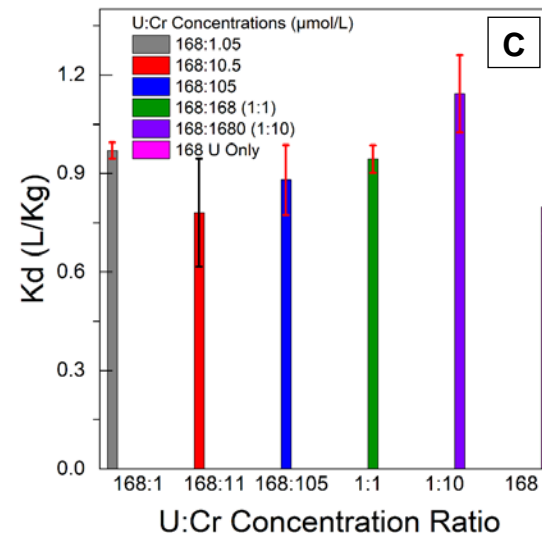
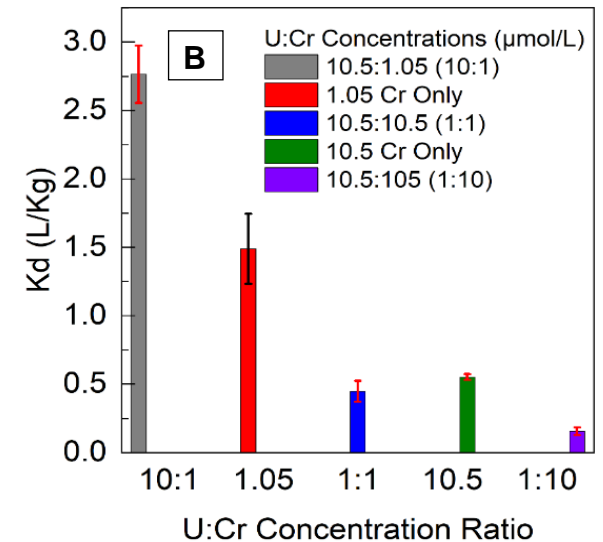
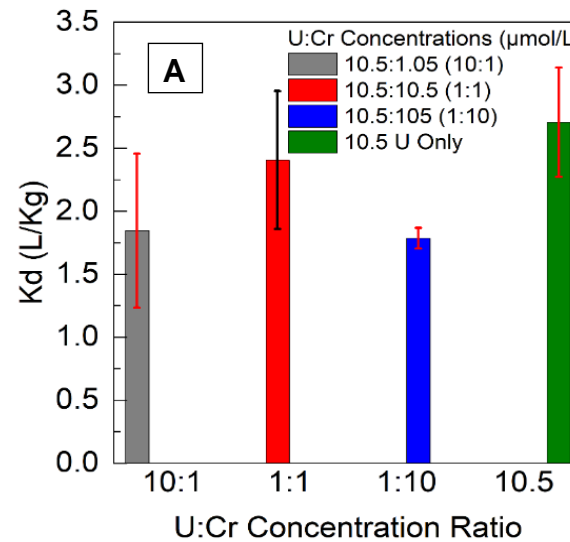
- $\text{Ca}_2\text{UO}_2(\text{CO}_3)_3^0(\text{aq})$ and $\text{CaUO}_2(\text{CO}_3)_3^{2-}$

Dominant Cr(VI) species:

- $\text{CaCrO}_4(\text{aq})$

$$K_d = \frac{[\text{contaminant}]_{\text{sediment}}}{[\text{contaminant}]_{\text{solution}}}$$

A&C: Change in U(VI) K_d B&D: Change in Cr(VI) K_d

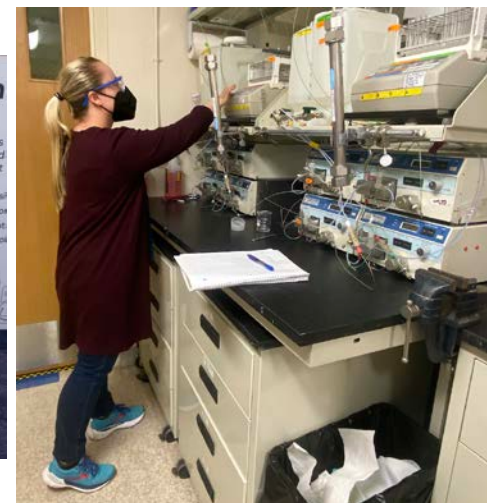


Evaluation of Competing Attenuation Processes for Mobile Contaminants in Hanford Sediments

FIU Year 2 Highlights:

Other Accomplishments:

- RemPlex Global Summit PNNL 2021: *“Impact of Major Groundwater Components on the Adsorption of Hexavalent Uranium (VI) to Hanford Formation”* (oral presentation)
- Roy G. Post scholarship recipient
- Waste Management Symposia 2022: *“Impact of Major Groundwater Components on the Adsorption of Hexavalent Uranium (VI) to Hanford Formation”* (poster presentation)
- Summer Internship at Pacific Northwest National Laboratory with Drs. Nik Qafoku, Jim Szecsody, and Hilary Emerson



Evaluation of Competing Attenuation Processes for Mobile Contaminants in Hanford Sediments

Future work

- Conduct column studies: U, Cr, and competitive U and Cr
- Develop competitive batch studies including U, Cr, and I-127
- Characterize post treated sediment [x-ray diffraction (XRD) and scanning electron microscopy-energy dispersive spectroscopy analysis (SEM-EDS)]



Acknowledgments

- **DOE-FIU Science and Technology Workforce Development Program**
- **Sponsored by the U.S. Department of Energy, Office of Environmental Management, under Cooperative Agreement #DE-EM00005213.**
- Pacific Northwest National Laboratory: Drs. Nik Qafoku, Hilary Emerson, and Jim Szecsody
- Florida International University: Dr. Kevin O'Shea, Dr. Yelena Katsenovich, Dr. Ravi Gudavalli, Dr. Leonel Lagos, and my lab mates
- My committee members:
 - Dr. Kevin O'Shea
 - Dr. Yelena Katsenovich
 - Dr. Konstantin Bukhryakov
 - Dr. Justin Carmel
 - Dr. Joong Ho Moon
 - Dr. Berrin Tansel





Thank You. Questions?