

FIU

Applied Research
Center



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

Project 5 - Task 1

Hydroxyapatite Injection for Sequestering Uranium (U) in Groundwater

Olivia Bustillo (DOE Fellow)

*Worlds
Ahead*

Advancing the research and academic mission of Florida International University

Overall Needs:

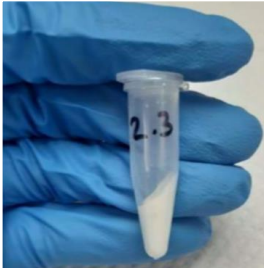
- Old Rifle, CO was previously a uranium/vanadium ore processing facility.
- Uranium that remained in the subsurface under the capped waste piles was predicted to be flushed by natural groundwater flow.
- Uranium has persisted at elevated concentrations in groundwater much longer than predicted.
- Several studies proved that injection of apatite into groundwater have shown to sequester uranium.
- LM has conducted a pilot study using a hydroxyapatite Permeable Reactive Barrier to remediate uranium at the DOE Old Rifle site in Colorado.
- While this process has proved to be effective, a better understanding of the mechanisms behind the interaction is required.

Objectives:

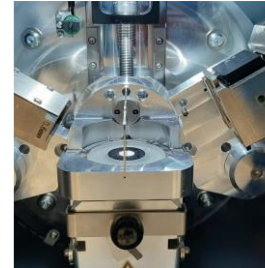
- Study the mechanism of U removal/sequestration from groundwater by apatite.
- Study the environmental factors that influence the stability of the removal of uranium.



FIU Year 2 Highlights: Hydroxyapatite

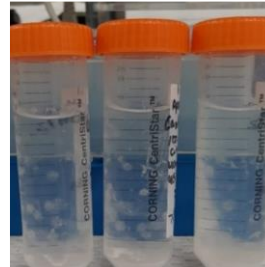


Finalized synthesis and characterization studies of the formation of apatite at varying Ca:Citrate:PO₄ ratios

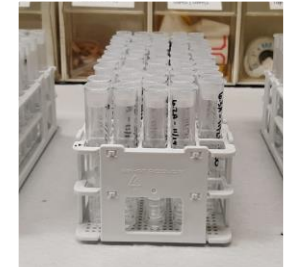


Characterized samples via XRD to confirm successful synthesis of hydroxyapatite through the elemental composition

Synthesized hydroxyapatite at three varying Ca:Citrate:PO₄ ratios to study incorporation and co-precipitation of HA



Collected and analyzed aliquots on ICP-MS/OES for total Ca, P, and U concentrations



	Scenario 1	Scenario 3	Scenario 4
Calcium Concentration	40 mM	80 mM	40 mM
Citrate Concentration	100 mM	100 mM	100 mM
Phosphate Concentration	45 mM	45 mM	90 mM

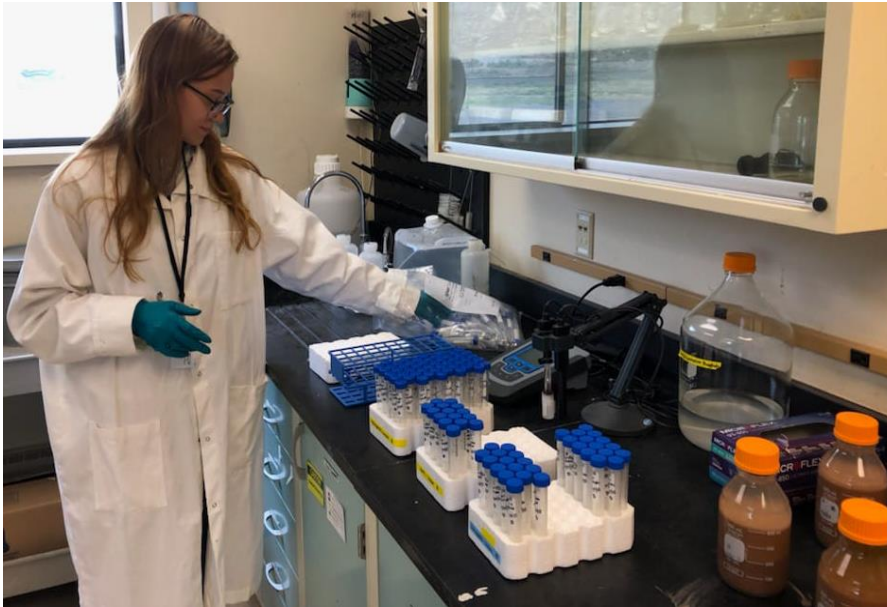
FIU Year 2 Highlights: Conferences



FIU Participants at Waste Management Symposia 2022

- Participated in Waste Management Symposia 2022
 - Professional presentation
 - Student poster
 - “Wants and Needs of Recent Graduates and New Engineers” panel
- Submitted Professional Abstract for Waste Management Symposia 2023





- Conducted experiments to support proof-of-principle study at Moab, UT that will occur in Fall 2022
- Altered hydroxyapatite formulation while utilizing Moab groundwater and sediment

Original HA recipe from Old Rifle injection (2017)

Calcium + Citrate only

Phosphate solution only

Sodium Acetate

Control (only Moab groundwater and sediment)

FIU Year 2 Highlights: Graduate School



Fellow Olivia Bustillo at Graduation

- Began Environmental Engineering Master's Program at FIU
- Thesis track- continuing research
- Expected graduation: Summer 2023

Future work

Finalize summer
internship
experiments.



Analyze dry solids on
SEM-EDS for
elemental and
structural
characterization.



Conduct studies to
investigate how
uranium interacts
with HA after it has
precipitated and is
interacting with
flowing groundwater.

Acknowledgments

- **FIU ARC Mentors**
 - Leonel Lagos
 - Ravi Gudavalli
- **Department of Energy- Legacy Management Liaisons**
 - Jalena Dayvault
 - David Shafer
- **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.**





Thank You. Questions?