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Characterization of Microbial Consortia and the Products Associated with Selenium Reduction in Real Flue Gas Desulfurization (FGD) Wastewater

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Background

Selenate (SeO_4 - Soluble) → Selenite (SeO_3 - Soluble) → Elemental Selenium (Insoluble)

- Coal is a significant source of electricity generation in the US and globally.
- Energy generation from coal creates several waste streams.
- Selenium nanoparticles are garnering attention in environmental, medical, and sensor applications.
- FGD wastewater show promise for elemental Selenium recovery

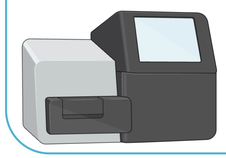
Methods

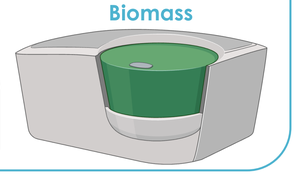
Anaerobic Reactors

40°C
7 Days
4 Transfers
N_2 Headspace
MSM Media
ED: Acetate
20mmol SeO_4/SeO_3

DNA Analysis

MiSeq
16S Metagenome
ddPCR
Biomass





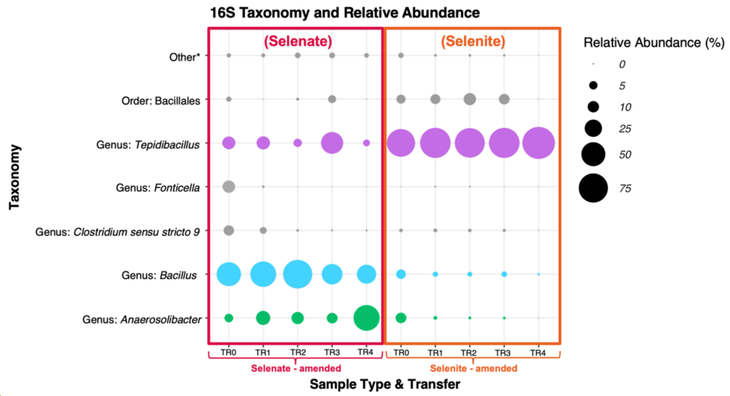
Chemical Analysis

IC
Chemistry

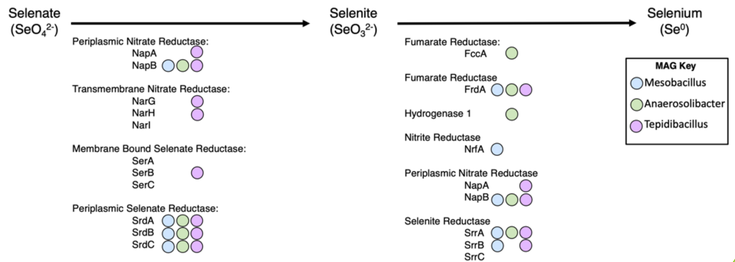
Particle Analysis

SEM | XRD | spICP-TOF-MS

Distinct Microbial Communities Arise for Each Selenium Oxyanion

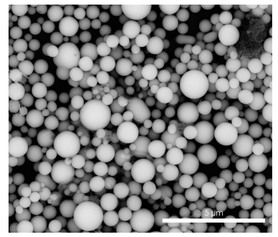


Known Selenium Oxyanion Reduction Genes Matched in MAGs

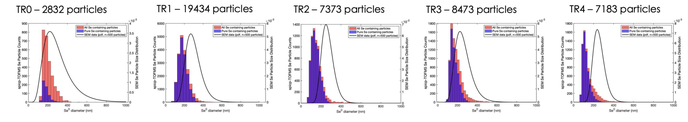


Selenium Bioparticles Increase in Purity with Proceeding Transfers

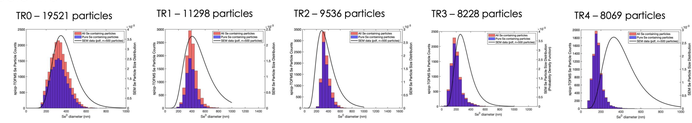
Average Diameter Size of Se Bioparticles
Selenate: ~300nm
Selenite: ~400nm



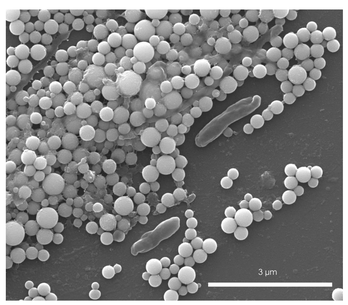
Selenate

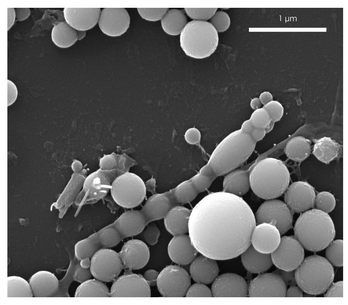


Selenite

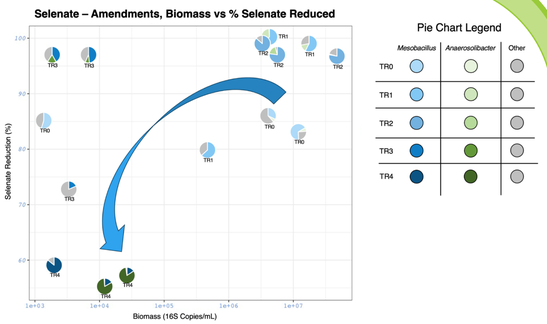


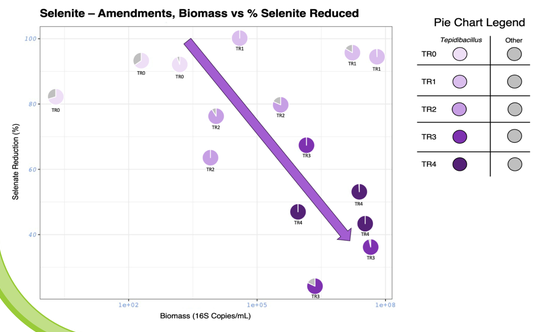
Location of Formation Biogenic Selenium Remains Unclear





Selenate Reduction Dependent on Microbial Community and Microbial Abundance





Loss in Efficiency of Selenite Reduction with Proceeding Transfers

Highlights

1) Novel anaerobic selenium oxyanion reducers native to FGD wastewater uncovered
2) Different microbial communities for each selenium oxyanion
3) Novel selenite respiration ability for *Tepidibacillus*
4) FGD wastewater could be a source for domestic selenium production

Read more here!

https://doi.org/10.1128/aem.01222-24
Novel anaerobic selenium oxyanion reducers native to FGD wastewater for enhanced selenium removal
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