Dissimilatory Metal Reduction by *Anaeromyxobacter*

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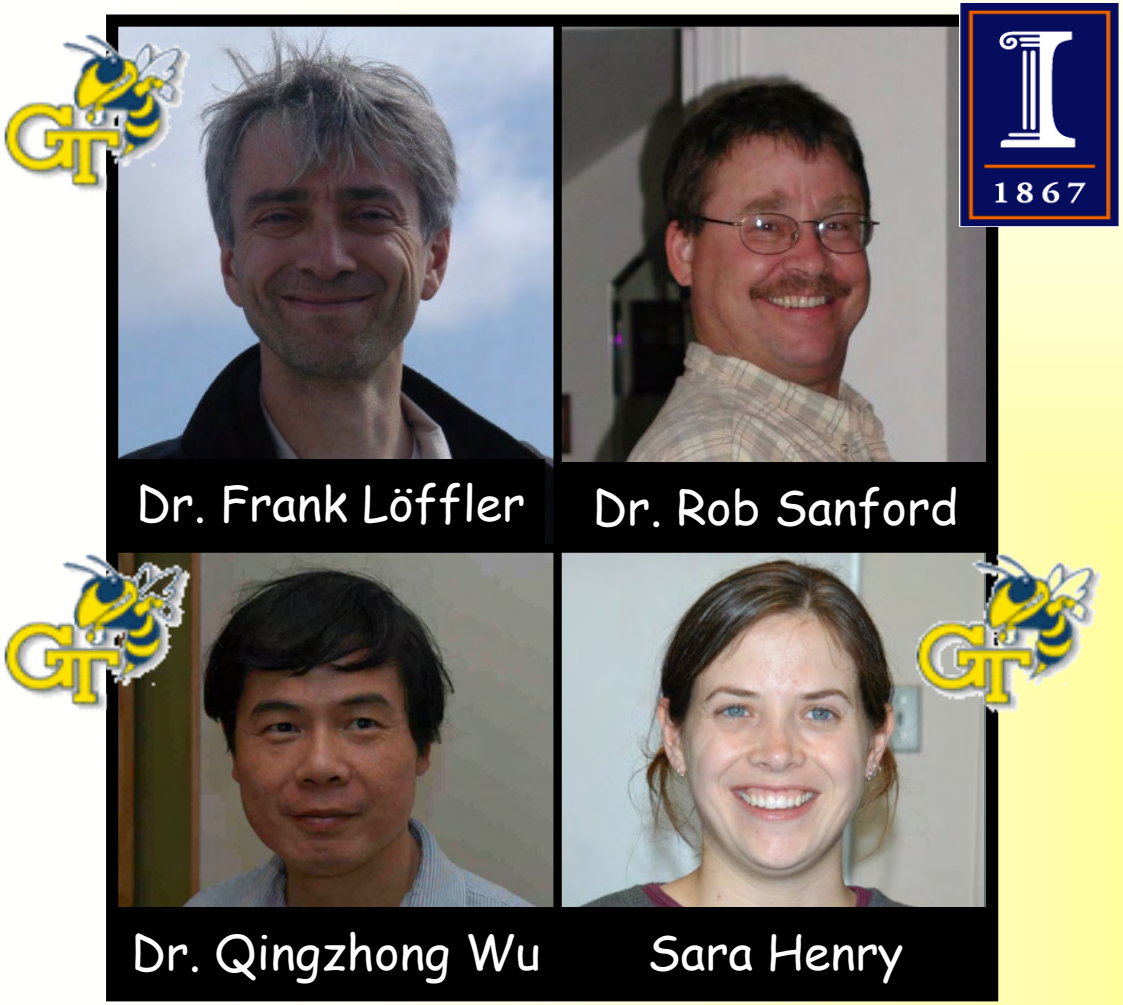
Performers



Performers

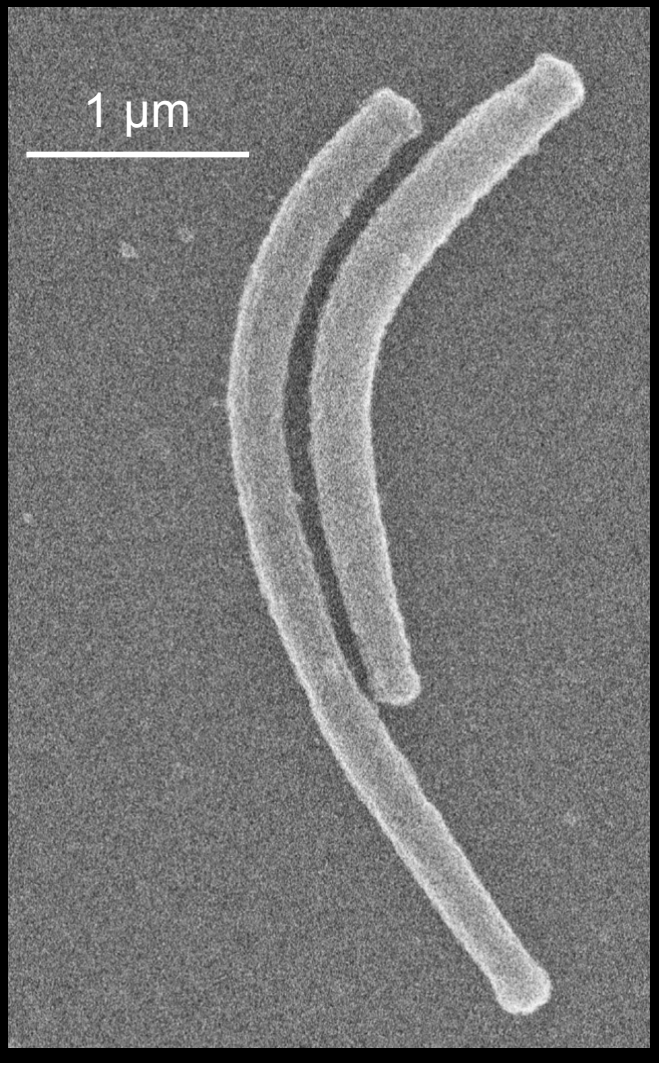
Dr. Frank Löffler

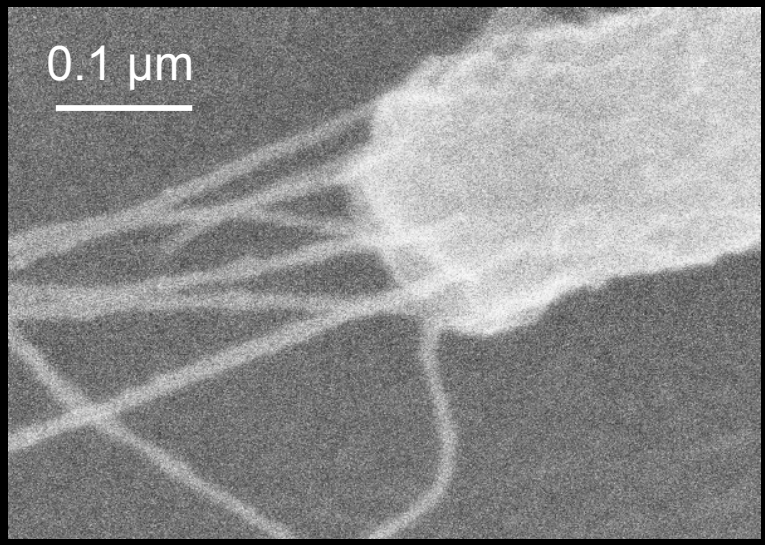
Dr. Rob Sanford

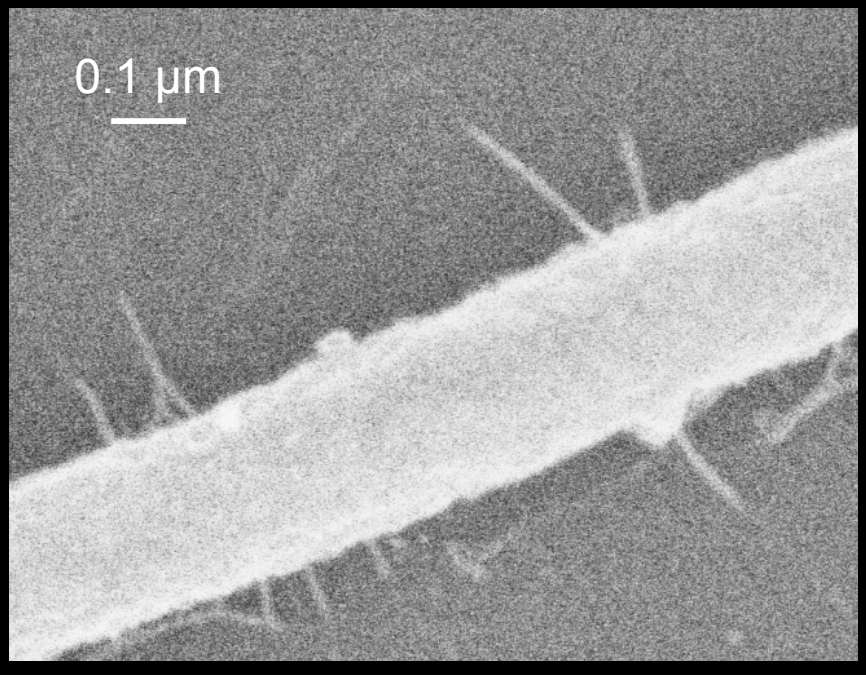
Dr. Qingzhong Wu

Sara Henry

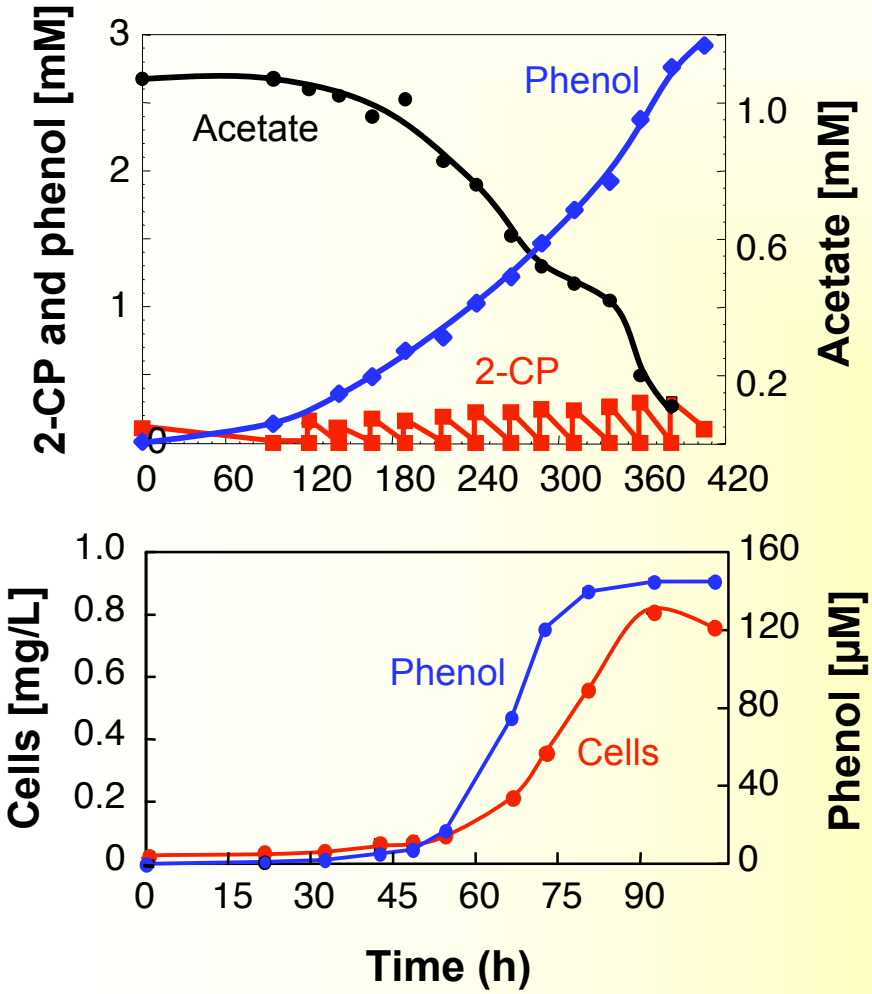
Anaeromyxobacter dehalogenans Strain 2CP-C

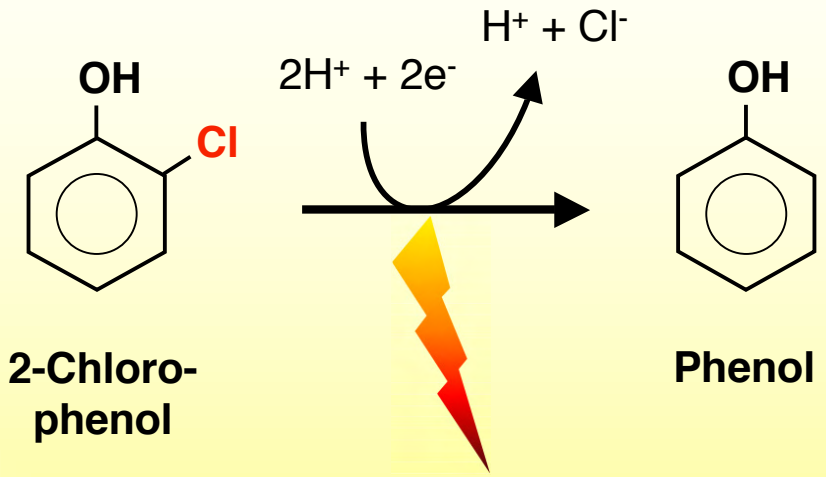






Isolation of *Anaeromyxobacter*





Energy

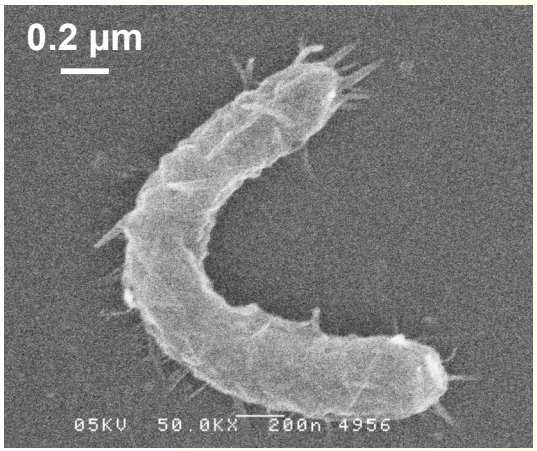
$\Delta G^{\circ\prime} = -157$ kJ/rx with H_2

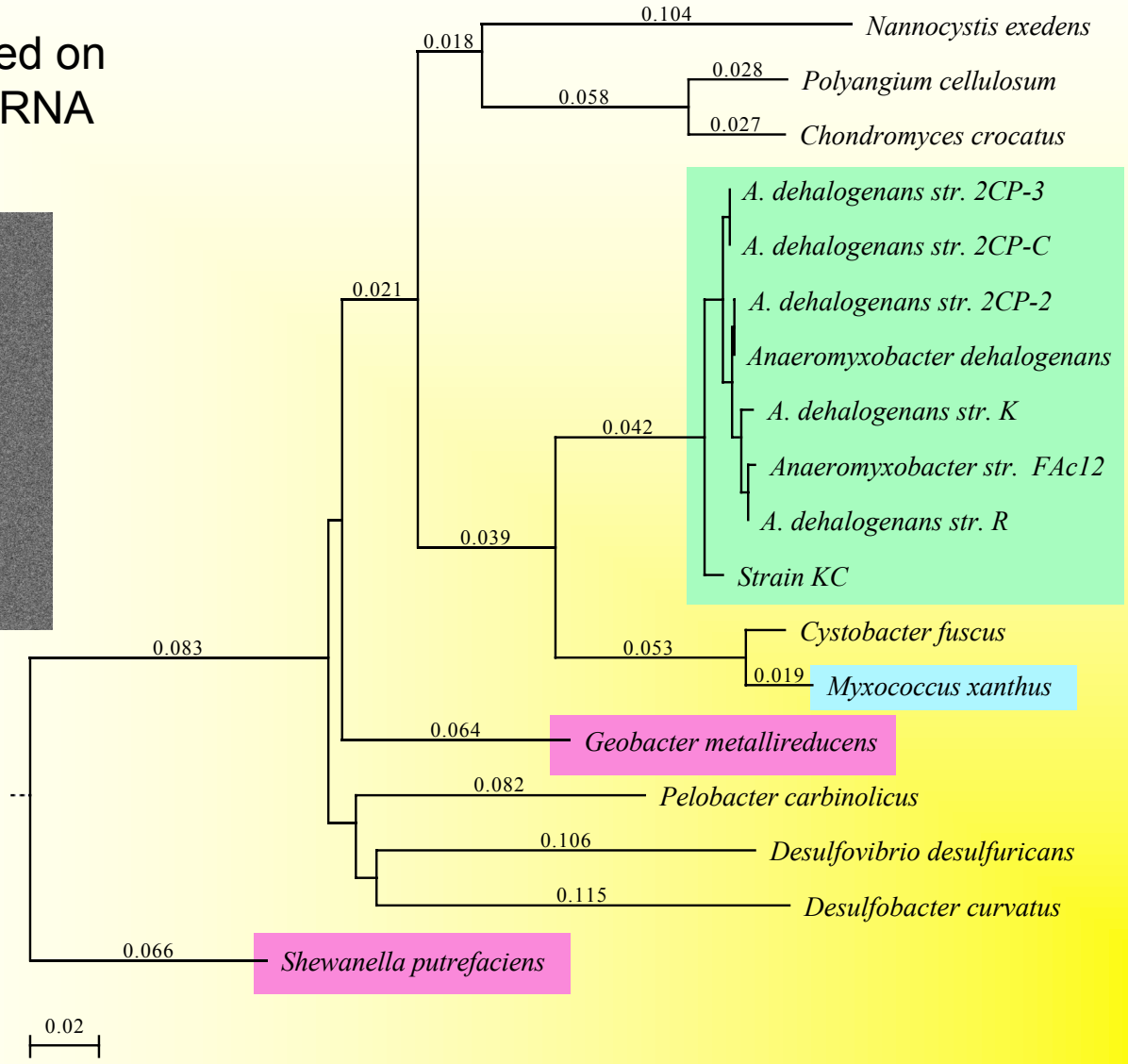
Respiratory Reductive Dechlorination
(De)Chlororespiration

Sanford et al., 2002. Appl. Environ. Microbiol., 68:893-900

Anaeromyxobacter - Phylogeny

Phylogenetic tree based on nearly complete 16S rRNA gene sequences





Anaeromyxobacter - Properties

Electron Acceptors

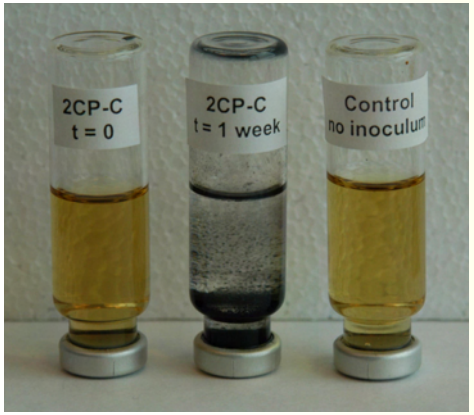
- Ortho-substituted halophenols
- Oxygen
- Nitrate
- Nitrite
- Fumarate
- Soluble and insoluble oxidized metal species

Electron Donors

- Acetate
- Hydrogen
- Succinate
- Pyruvate
- Formate
- Lactate

Anaeromyxobacter - Metal Reduction

Yellow-Brownish



Clear

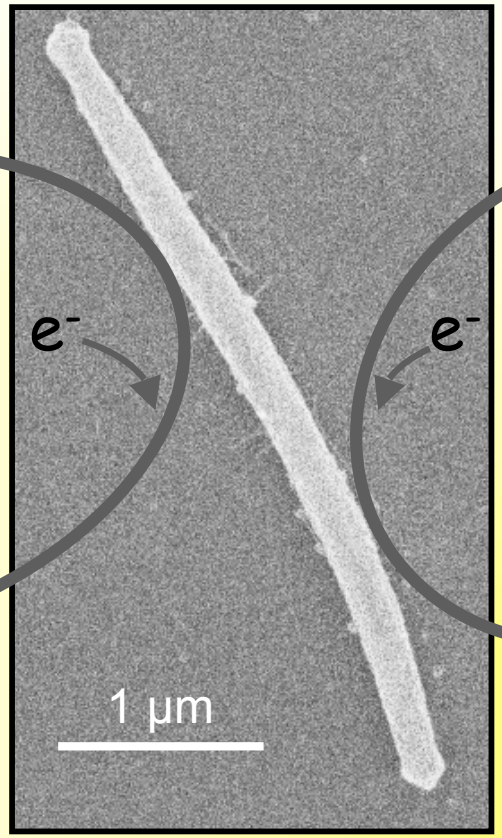
Fe^{3+} → Fe^{2+}

U^{6+} → U^{4+}

e^- e^-

oxidized
soluble
mobile

reduced
insoluble
immobile

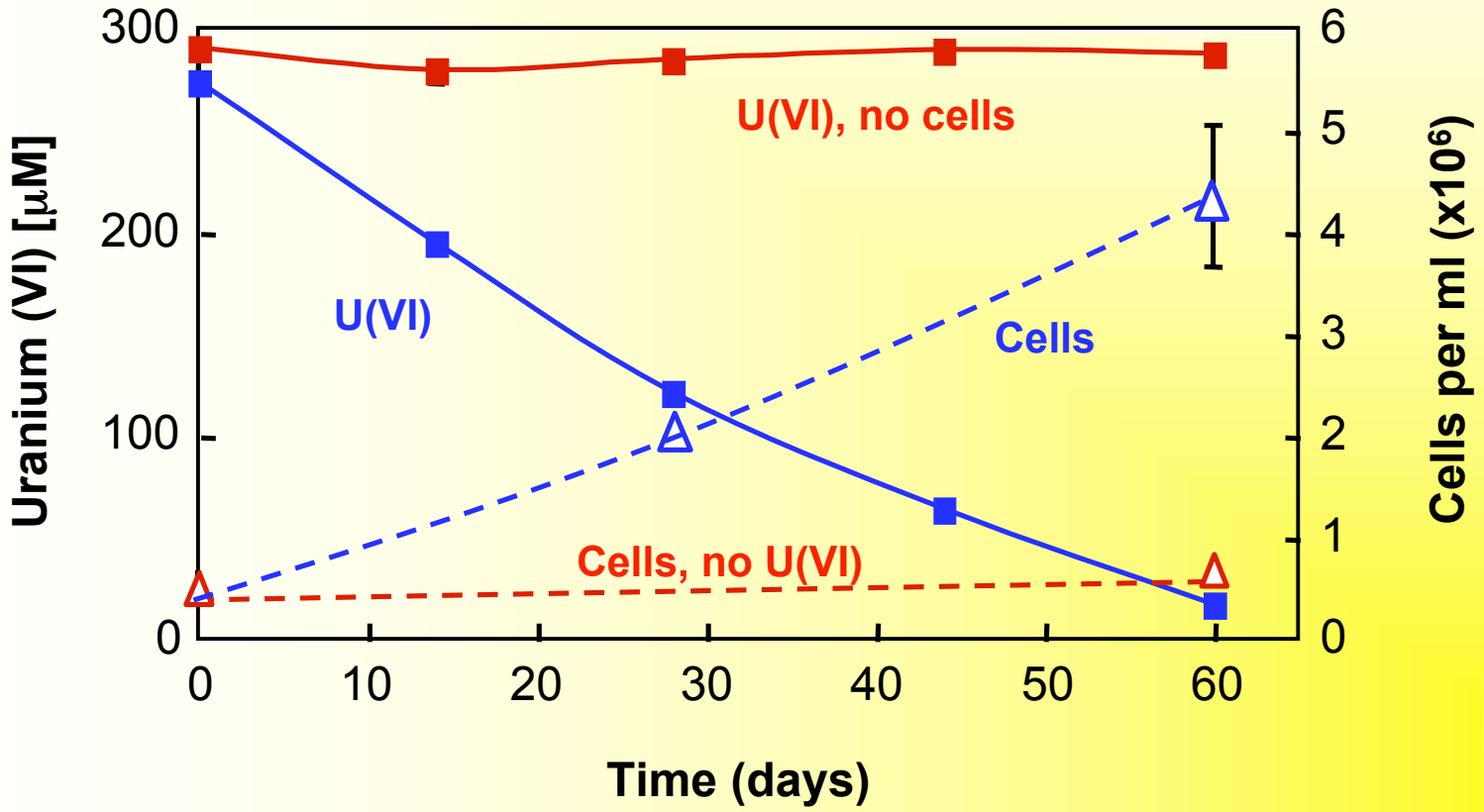


***Anaeromyxobacter dehalogenans* strain 2CP-C**

He & Sanford, 2003. Appl. Environ. Microbiol., 69:2712-2718

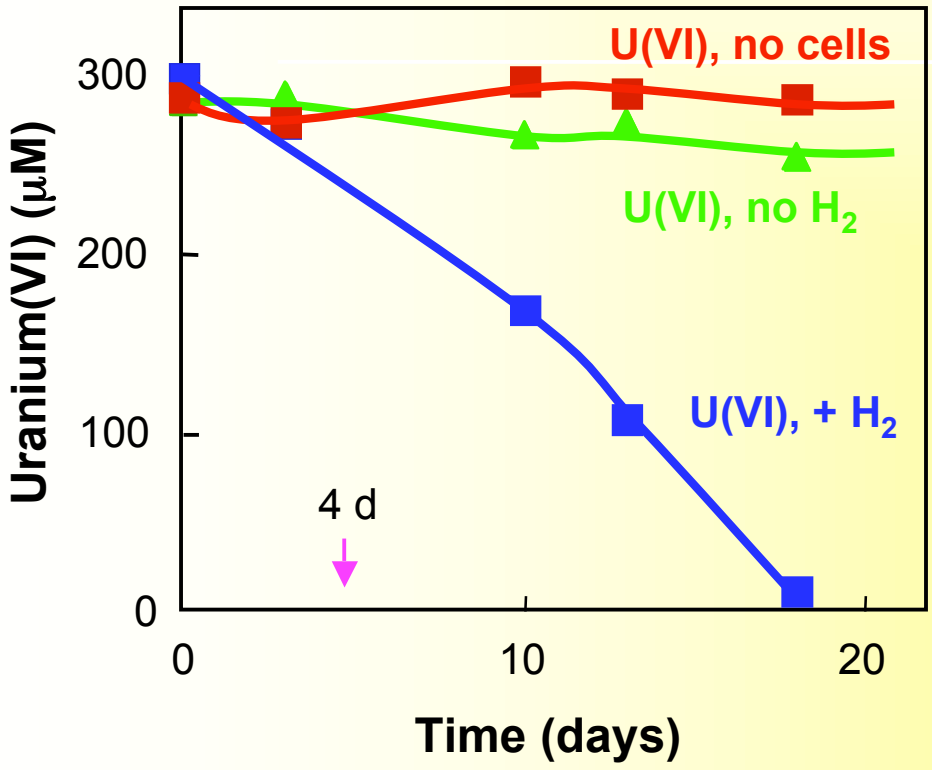
A. dehalogenans Couples Growth to Uranium (VI) Reduction

Mineral salts medium, acetate, H_2
2% (v/v) inoculum

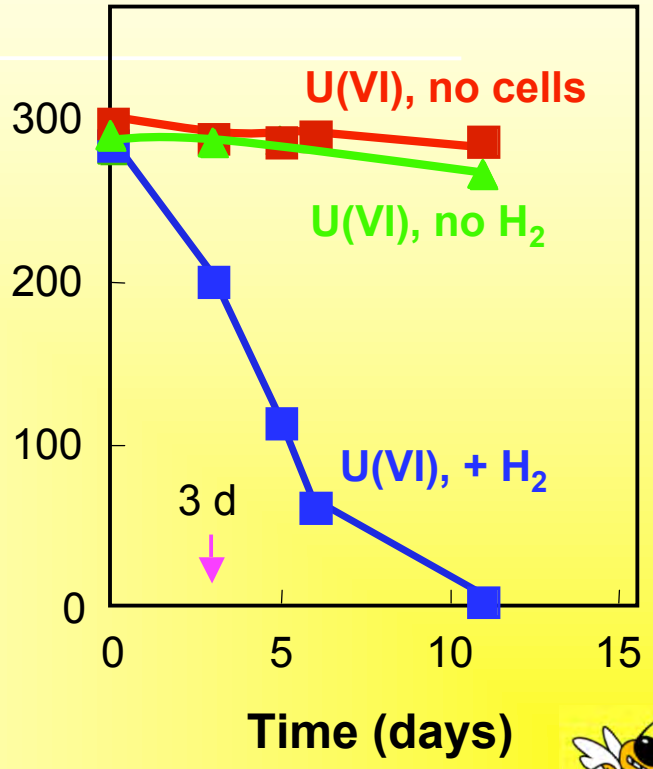


U(VI) Reduction Requires H_2

Cells grown with: Acetate/fumarate (1 mM)
2% inoculum
U(VI), fumarate (1 mM), **± H_2**



Acetate/NO_3^- (0.5 mM),
2% inoculum
U(VI), NO_3^- (0.5 mM), **± H_2**

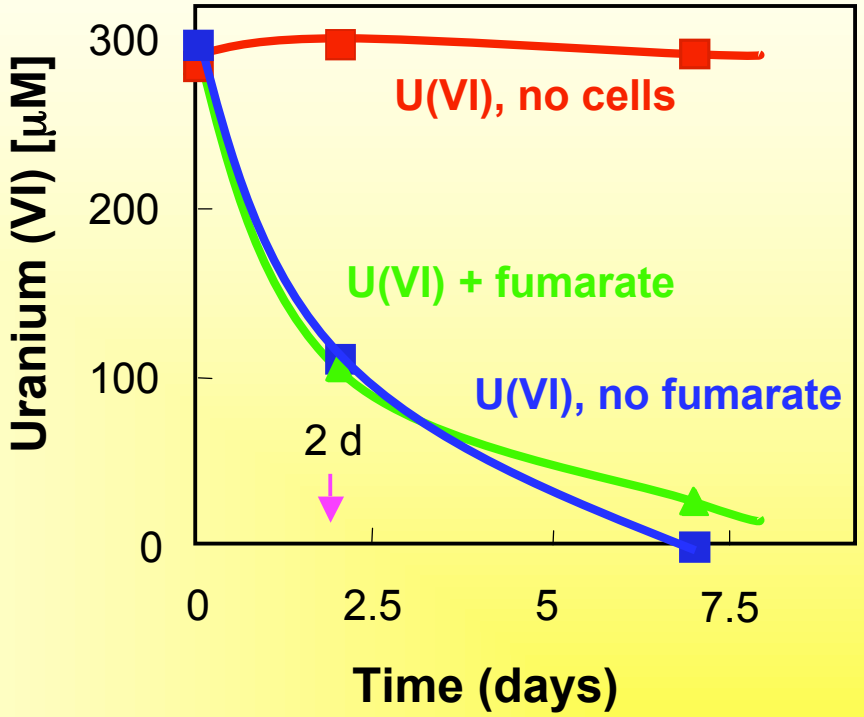


Effect of Fumarate on Uranium (VI) Reduction by *A. dehalogenans*

Resting cell experiment

Cells grown with acetate/fumarate

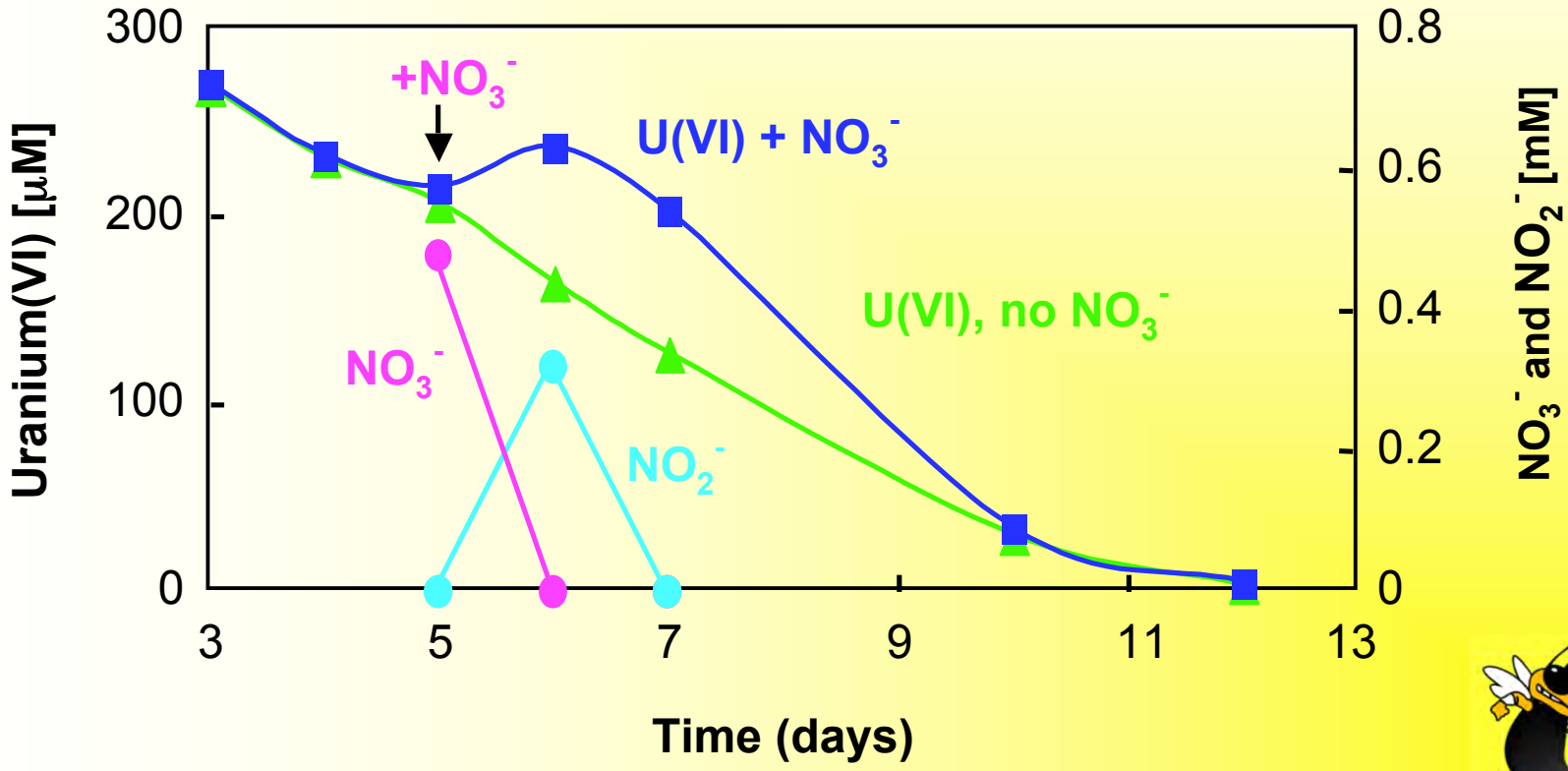
Washed cell suspensions amended with H_2, U(VI) **± fumarate**



Effect of Nitrate on Uranium (VI) Reduction by *A. dehalogenans*

2CP-C grown with acetate/NO_3^- (0.5 mM)

U(VI) and H_2 added after NO_3^- had been consumed (day 3)



A. dehalogenans strain 2CP-C Displays Social Motility Flares

A. dehalogenans strain 2CP-C
Displays Social Motility Flares

- Gliding Motility
- Chemotactic Response

Anaeromyxobacter dehalogenans strain 2CP-C genome sequenced

JGI
DOE JOINT GENOME INSTITUTE
US DEPARTMENT OF ENERGY
OFFICE OF SCIENCE

A Glimpse of the *Anaeromyxobacter dehalogenans* Draft Genome

- 5 MB
- 89 contigs
- 74.8% GC
- 4,313 candidate protein-encoding genes
- single 16S rRNA gene
- 2 RDase genes
- gene clusters for type IV-pilus-based and flagellar motility
- 7 chemotaxis gene clusters
- 18 genes encoding MLPs

93 genes with CXXCH motif

15 genes > 10 CXXCH motifs

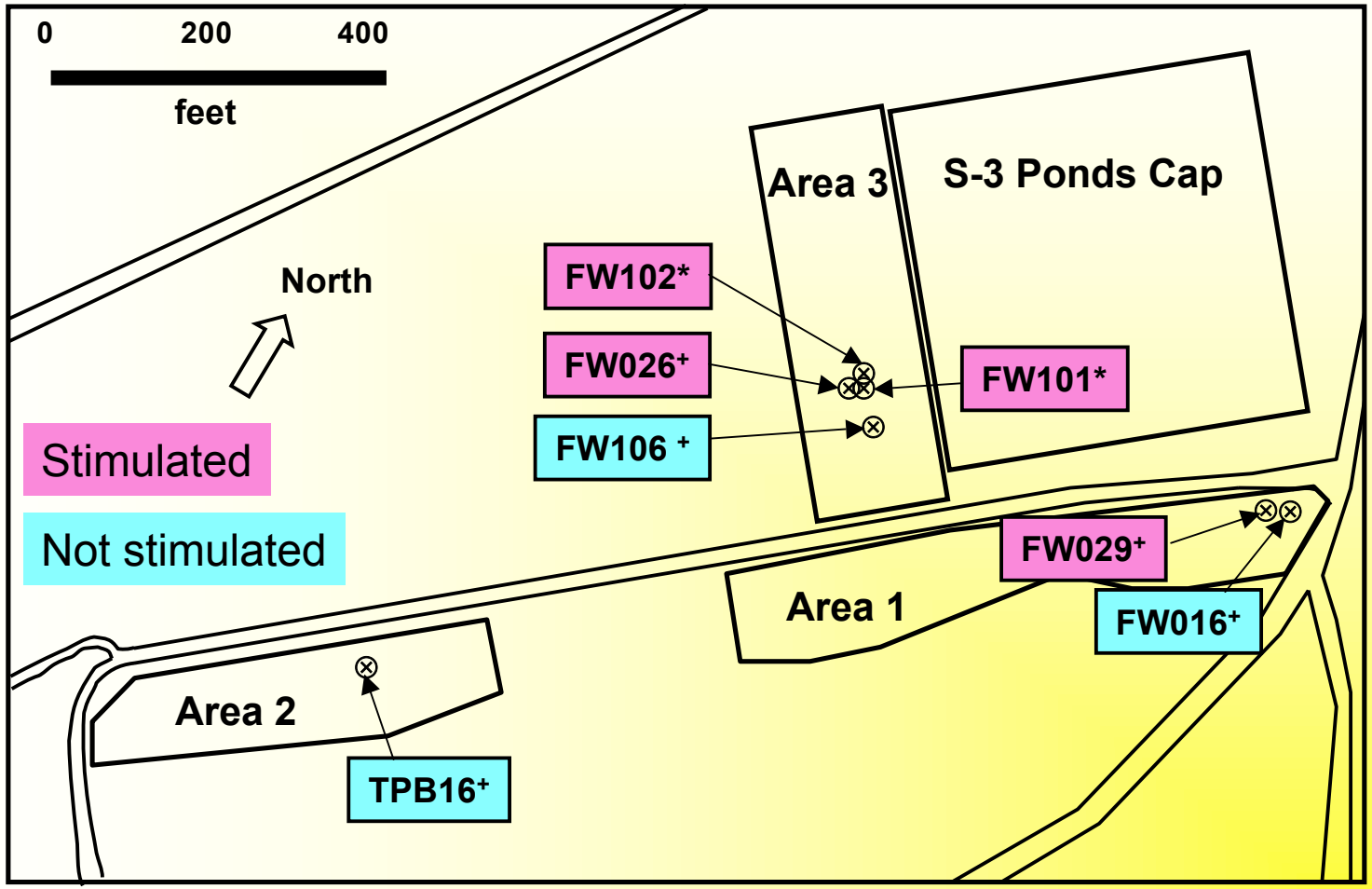
1 with 20 CXXCH motifs

1 with 26 CXXCH motifs

1 with 32 CXXCH motifs

Ryan Wagner

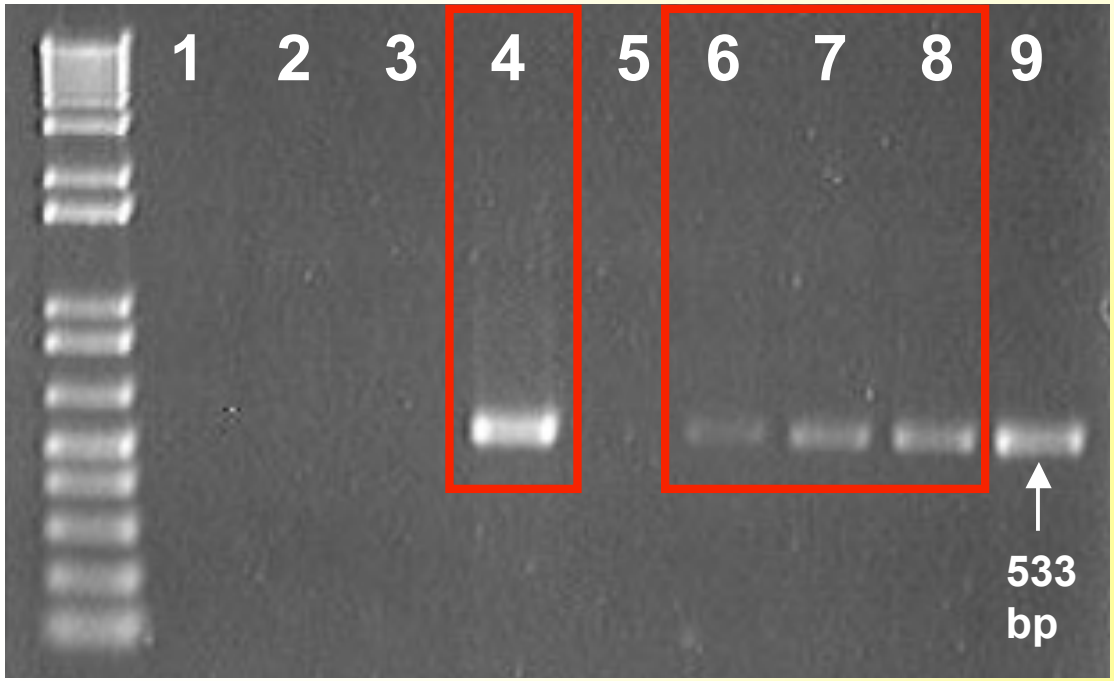
Field Reseach Center (FRC), Oak Ridge, TN



* multiport wells
+ wells

Specific Detection of *Anaeromyxobacter dehalogenans* 2CP-C at the FRC

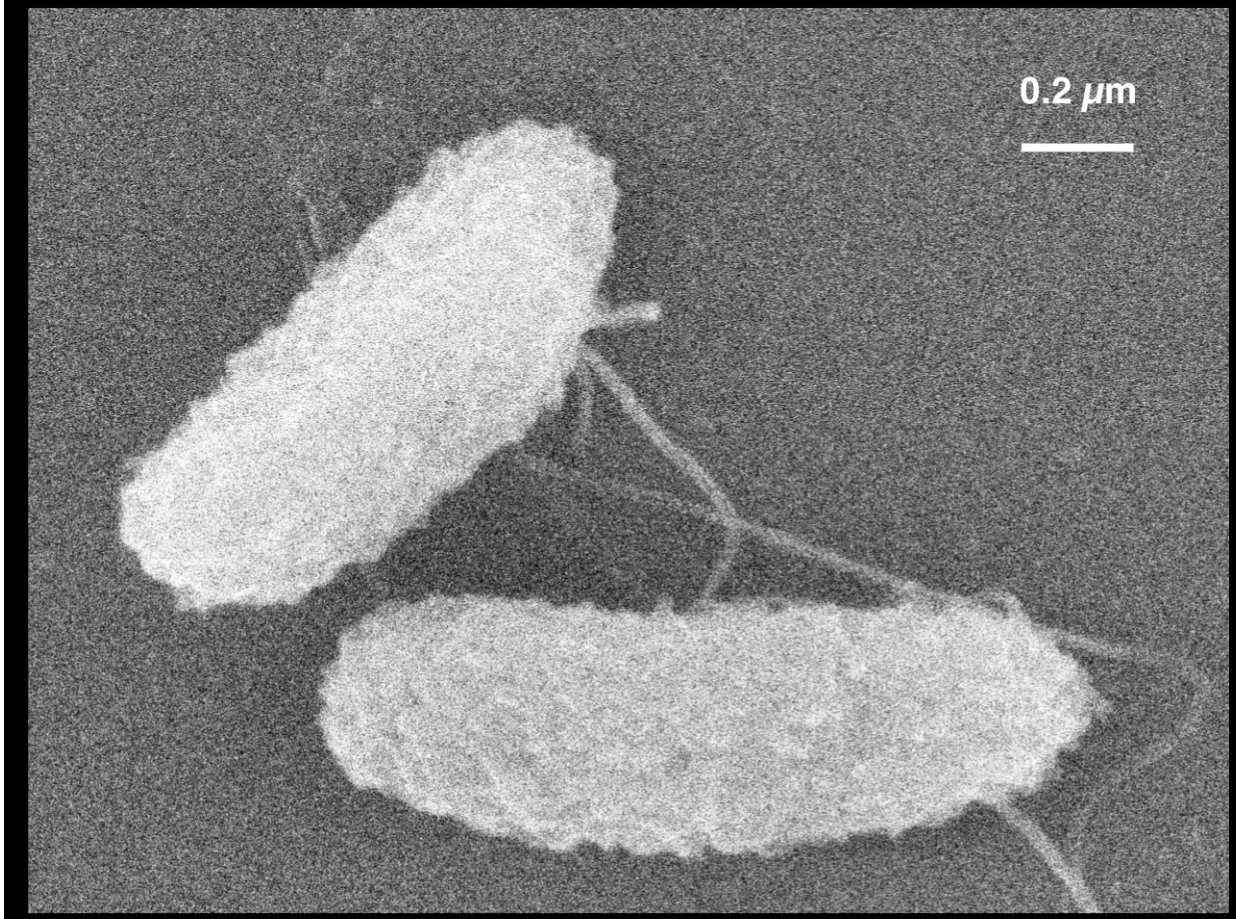
Nested PCR with *Anaeromyxobacter*-specific primers

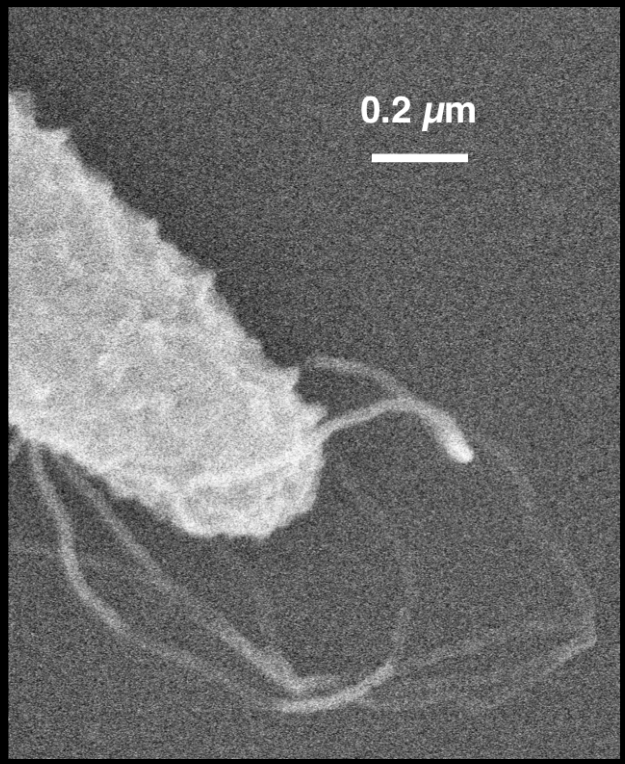


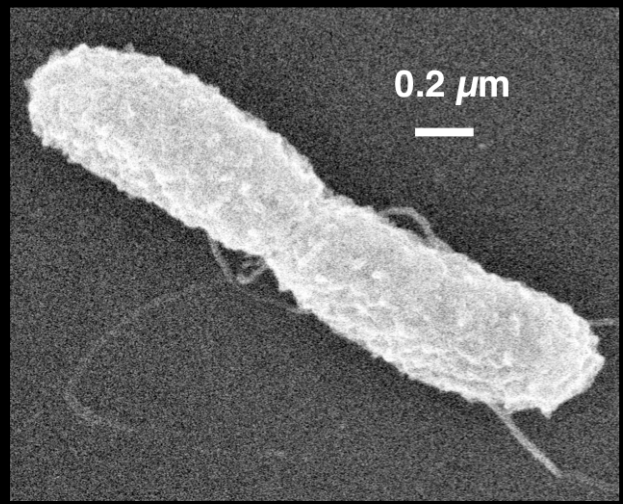
	Location	Area
1.	FBR	
2.	FW016	1
3.	FW026	3
4.	FW029*	1
5.	FW101-2	3
6.	FW102-3	3
7.	FW106	3
8.	TPB16	2
9.	Strain 2CP-C	

* detected by RTm PCR (1.1×10^4 cells/ml)

Geobacter sp. Strain SZ



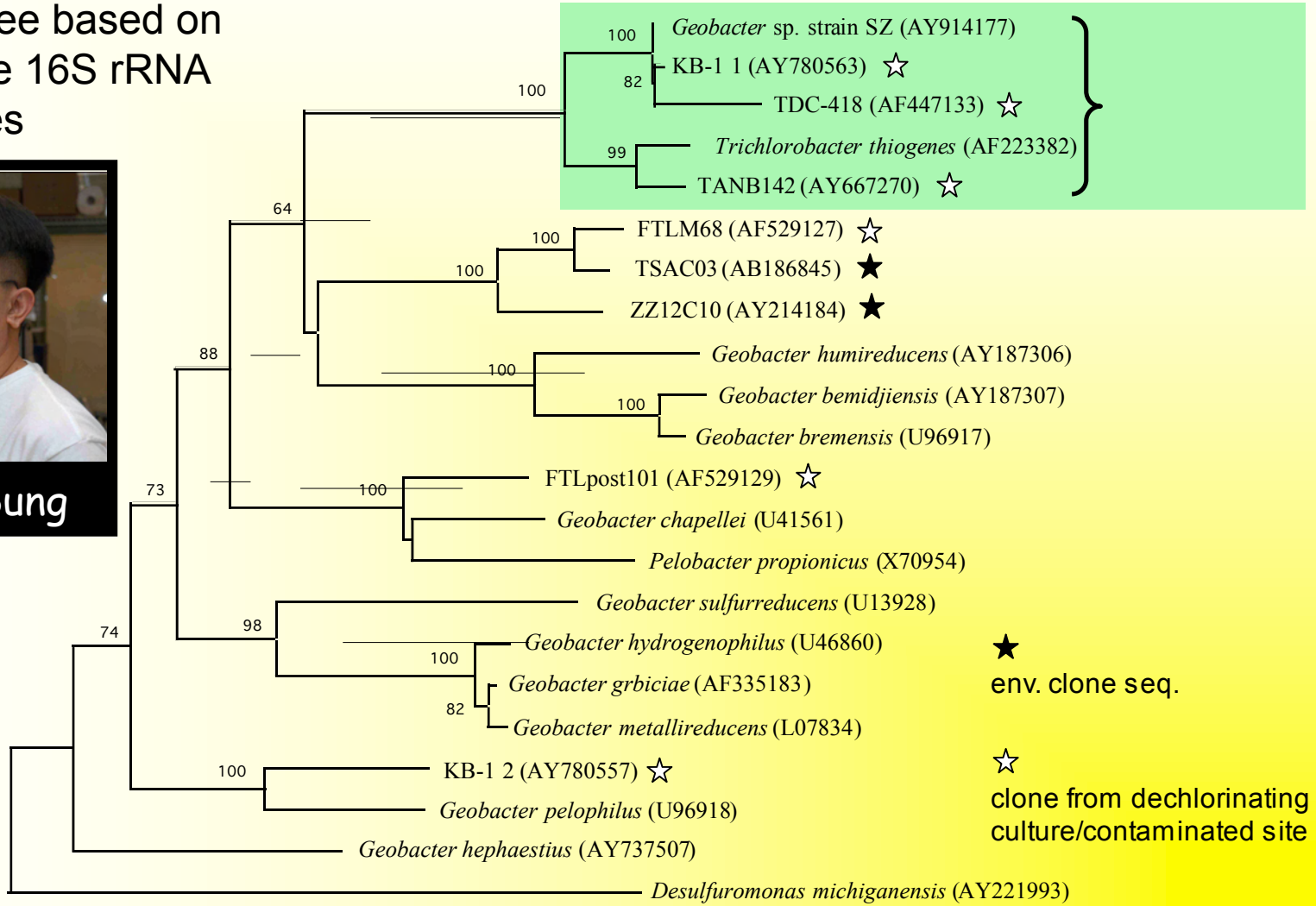




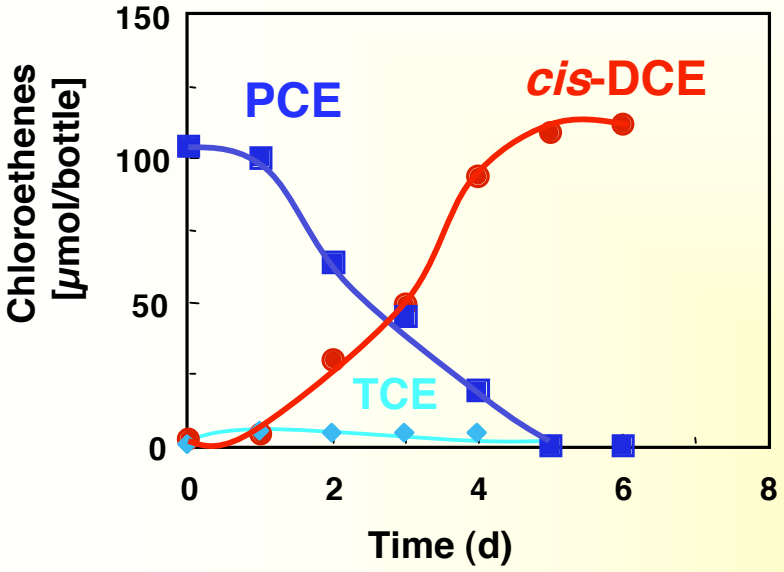
Geobacter Strain SZ - Phylogeny

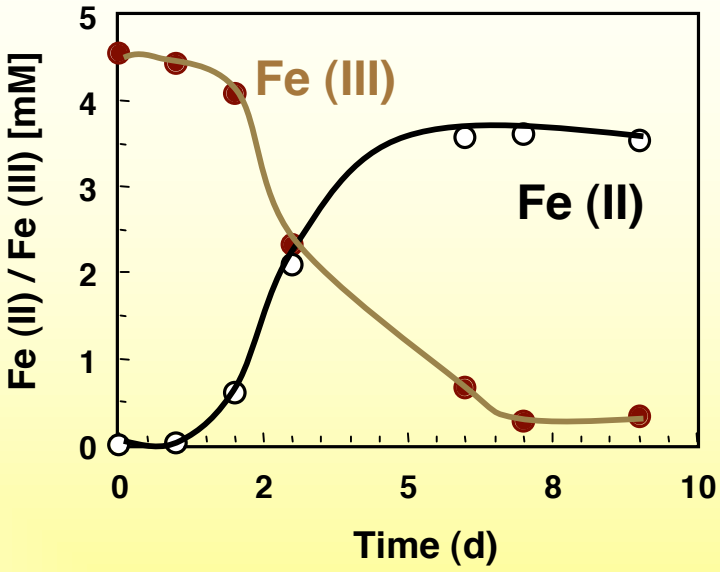
Phylogenetic tree based on nearly complete 16S rRNA gene sequences

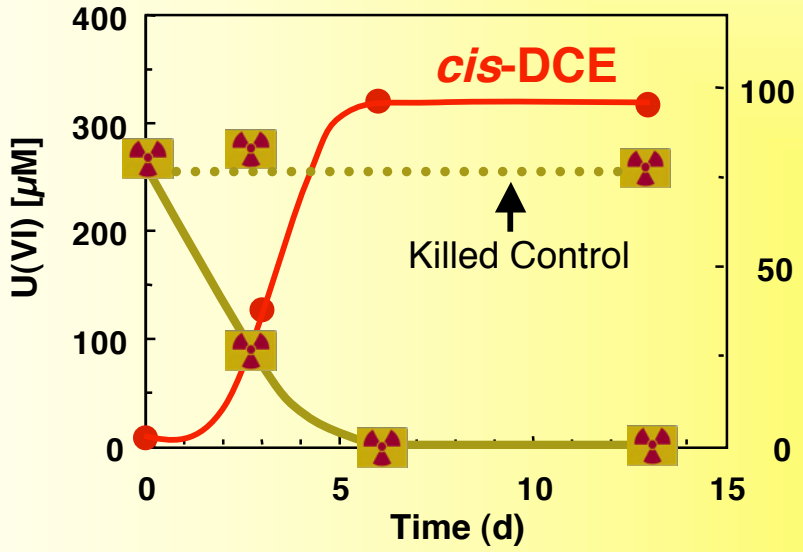
Youlboong Sung



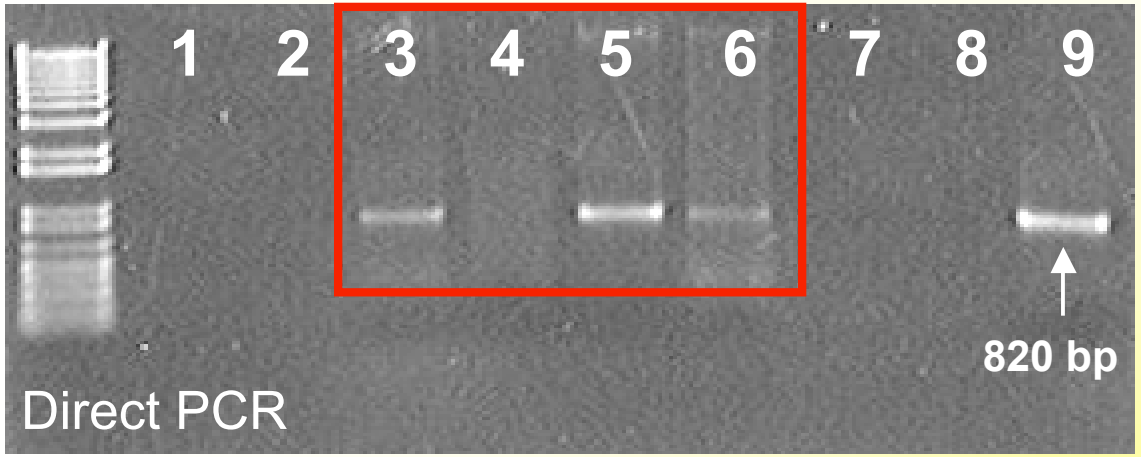
Geobacter sp. Strain SZ

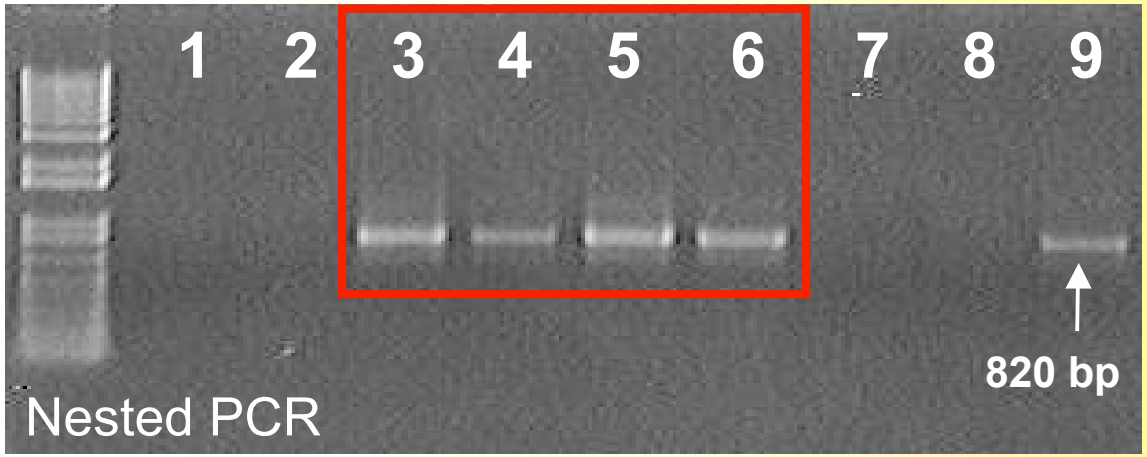






Specific Detection of *Geobacter* sp. Strain SZ at the FRC





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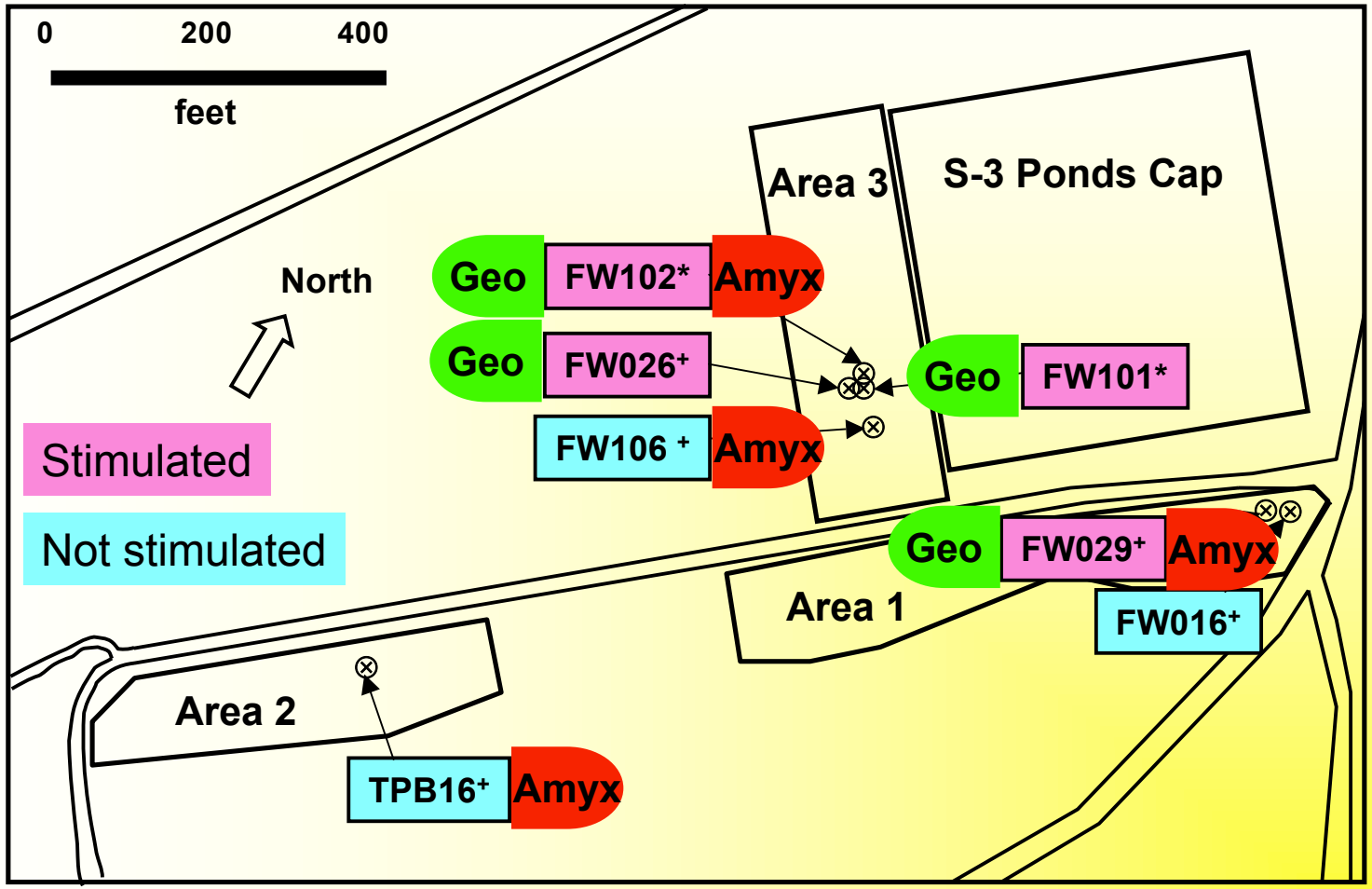
Field Reseach Center (FRC), Oak Ridge, TN



* multiport wells

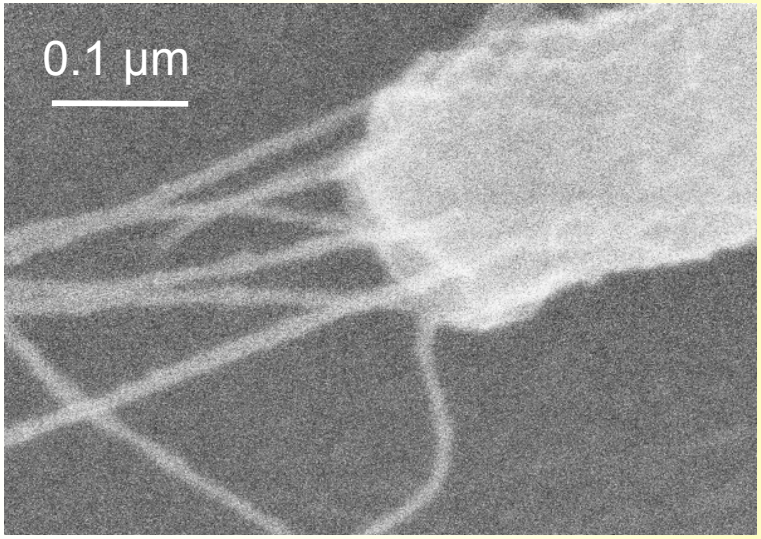
+ wells

Take Home Messages

- Members of the "dechlorinating *Geobacter*"group detected at the FRC
- *Anaeromyxobacter dehalogenans* strain 2CP-C grows on the expense of U(VI) reduction
- Facultative, versatile metabolism
- Requires H_2 for U(VI) reduction
- Specific qualitative and quantitative tools available
- *Anaeromyxobacter* detected at the FRC

Take Home Messages

- *Anaeromyxobacter* - another model organism for studying electron transfer to toxic metals and rads



The Team

Frank Löffler

Qingzhong Wu

Sara Henry

Youlboong Sung

Ryan Wagner

Robert Sanford

John Kirby

Martial Taillefert

Tom DiChristina

Relevant Characteristics of *Anaeromyxobacter* Species

- Rapidly reduce chlorophenols to phenol
- High rate ferric iron reduction (constitutive)
- Reduce (immobilize) U(VI)
- Metabolic versatility (e^- acceptor and e^- donor)
- Pilus-based motility
- Genome analysis suggests chemotaxis and flagellar motility
- *Anaeromyxobacter* 16S rRNA gene sequences retrieved from high NO_3^-, low pH, radionuclide-contaminated FRC site