SUPPLEMENTAL ONLINE MATERIAL

SUPPLEMENTAL RESULTS

Supplemental Table 1. Number of cells, amount of carbon assimilated, measured analyte (H_2S, Fe^{3+}, Fe^{2+}, and SO_4^{2-}) where applicable, and calculated amounts of energy available per mol electron transferred during the specified times in cultures of *Acidianus* sp. DS80 grown at 80°C in base salts medium (pH 3.0) with CO_2 as the carbon source, H_2 as electron donor, and S° as electron acceptor.

		Substrate H_2 / S° (e^- donor/acceptor)					
Time	**Cells**	**CO_2 (fmol)**	**H_2S (M)**	**Fe^{3+} (M)**	**Fe^{2+} (M)**	**SO_4^{2-} (M)**	**ΔG (kJ (mol e-)$^{-1}$)**
0	2.66×10^5	4.07×10^6	2.95×10^{-5}	N/A	N/A	N/A	-28.20
24	2.66×10^5	4.10×10^6	2.95×10^{-5}	N/A	N/A	N/A	-28.20
48	1.10×10^6	4.74×10^6	5.61×10^{-5}	N/A	N/A	N/A	-27.25
72	2.76×10^6	6.15×10^6	1.18×10^{-4}	N/A	N/A	N/A	-26.15
96	4.56×10^6	1.14×10^7	2.57×10^{-4}	N/A	N/A	N/A	-25.01
120	5.73×10^6	1.49×10^7	4.62×10^{-4}	N/A	N/A	N/A	-24.15
144	7.59×10^6	2.09×10^7	7.35×10^{-4}	N/A	N/A	N/A	-23.47
168	8.07×10^6	2.07×10^7	9.46×10^{-4}	N/A	N/A	N/A	-23.10
192	7.70×10^6	2.04×10^7	1.08×10^{-3}	N/A	N/A	N/A	-22.90

Abbreviations: N/A, Not Applicable.

Supplemental Table 2. Number of cells, amount of carbon assimilated, measured analyte (H_2S, Fe^{3+}, Fe^{2+}, and SO_4^{2-}) where applicable, and calculated amounts of energy available per mol electron transferred during the specified times in cultures of *Acidianus* sp. DS80 grown at 80°C in base salts medium (pH 3.0) with CO_2 as the carbon source, S° as the electron donor, and Fe^{3+} as the electron acceptor.

		Substrate S° / Fe^{3+} (e^- donor/acceptor)					
Time	**Cells**	**CO_2 (fmol)**	**H_2S (M)**	**Fe^{3+} (M)**	**Fe^{2+} (M)**	**SO_4^{2-} (M)[1]**	**ΔG (kJ (mol e-)$^{-1}$)**
0	2.04×10^5	4.21×10^6	N/A	9.25×10^{-3}	B.D.	0.00	-41.83
24	2.04×10^5	4.33×10^6	N/A	9.24×10^{-3}	1.00×10^{-5}	1.67×10^{-6}	-82.95
48	2.10×10^5	4.32×10^6	N/A	9.22×10^{-3}	2.88×10^{-5}	4.81×10^{-6}	-79.84
72	2.46×10^5	4.21×10^6	N/A	9.18×10^{-3}	7.48×10^{-5}	1.25×10^{-5}	-77.02
96	2.57×10^6	6.67×10^6	N/A	8.36×10^{-3}	8.96×10^{-4}	1.49×10^{-4}	-69.46
120	4.62×10^6	1.29×10^7	N/A	7.01×10^{-3}	2.24×10^{-3}	3.73×10^{-4}	-66.24
144	6.14×10^6	1.98×10^7	N/A	5.57×10^{-3}	3.68×10^{-3}	6.14×10^{-4}	-64.06
168	6.87×10^6	2.49×10^7	N/A	4.45×10^{-3}	4.81×10^{-3}	8.01×10^{-4}	-63.53
192	8.09×10^6	2.73×10^7	N/A	2.55×10^{-3}	6.70×10^{-3}	1.12×10^{-3}	-59.88
216	1.01×10^7	3.47×10^7	N/A	1.85×10^{-3}	7.40×10^{-3}	1.23×10^{-3}	-58.61
240	1.03×10^7	3.10×10^7	N/A	1.11×10^{-3}	8.14×10^{-3}	1.36×10^{-3}	-56.81

[1]Calculated by subtracting SO_4^{2-} in cultures from SO_4^{2-} in abiotic controls.
Abbreviations: N/A, Not Applicable; B.D., Below Detection
Detection limits for Fe^{2+} and SO_4^{2-} are 0.3 and 5.0 µM, respectively.

Supplemental Table 3. Number of cells, amount of carbon assimilated, measured analyte (H_2S, Fe^{3+}, Fe^{2+}, and SO_4^{2-}) where applicable, and calculated amounts of energy available per mol electron transferred during the specified times in cultures of *Acidianus* sp. DS80 grown at 80°C in base salts medium (pH 3.0) with CO_2 as the carbon source, H_2 as the electron donor, and Fe^{3+} as the electron acceptor.

		Substrate H_2 / Fe^{3+} (e^- donor/acceptor)					
Time	**Cells**	**CO_2 (fmol)**	**H_2S (M)**	**Fe^{3+} (M)**	**Fe^{2+} (M)**	**SO_4^{2-} (M)[1]**	**ΔG (kJ (mol e-)$^{-1}$)**
0	1.85×10^5	4.28×10^6	N/A	9.25×10^{-3}	B.D.	B/D	-68.56
24	1.95×10^5	4.33×10^6	N/A	9.25×10^{-3}	3.17×10^{-6}	B/D	-110.41
48	2.08×10^5	4.21×10^6	N/A	9.24×10^{-3}	7.50×10^{-6}	B/D	-107.88
72	2.08×10^5	4.17×10^6	N/A	9.24×10^{-3}	1.60×10^{-5}	B/D	-105.65
96	3.17×10^5	4.19×10^6	N/A	4.60×10^{-3}	3.63×10^{-5}	B/D	-101.15
120	8.17×10^5	4.57×10^6	N/A	9.10×10^{-3}	1.56×10^{-4}	B/D	-98.92
144	1.22×10^6	5.21×10^6	N/A	8.84×10^{-3}	4.09×10^{-4}	B/D	-96.01
168	2.33×10^6	7.35×10^6	N/A	8.40×10^{-3}	8.58×10^{-4}	B/D	-93.70
192	4.05×10^6	8.82×10^6	N/A	7.82×10^{-3}	1.43×10^{-3}	B/D	-92.00
216	8.59×10^6	1.55×10^7	N/A	6.63×10^{-3}	2.62×10^{-3}	B/D	-89.75
240	1.39×10^7	2.47×10^7	N/A	4.73×10^{-3}	4.52×10^{-3}	B/D	-87.16
264	1.40×10^7	2.82×10^7	N/A	4.19×10^{-3}	5.06×10^{-3}	B/D	-86.47

[1]Calculated by subtracting SO_4^{2-} in cultures from SO_4^{2-} in abiotic controls.

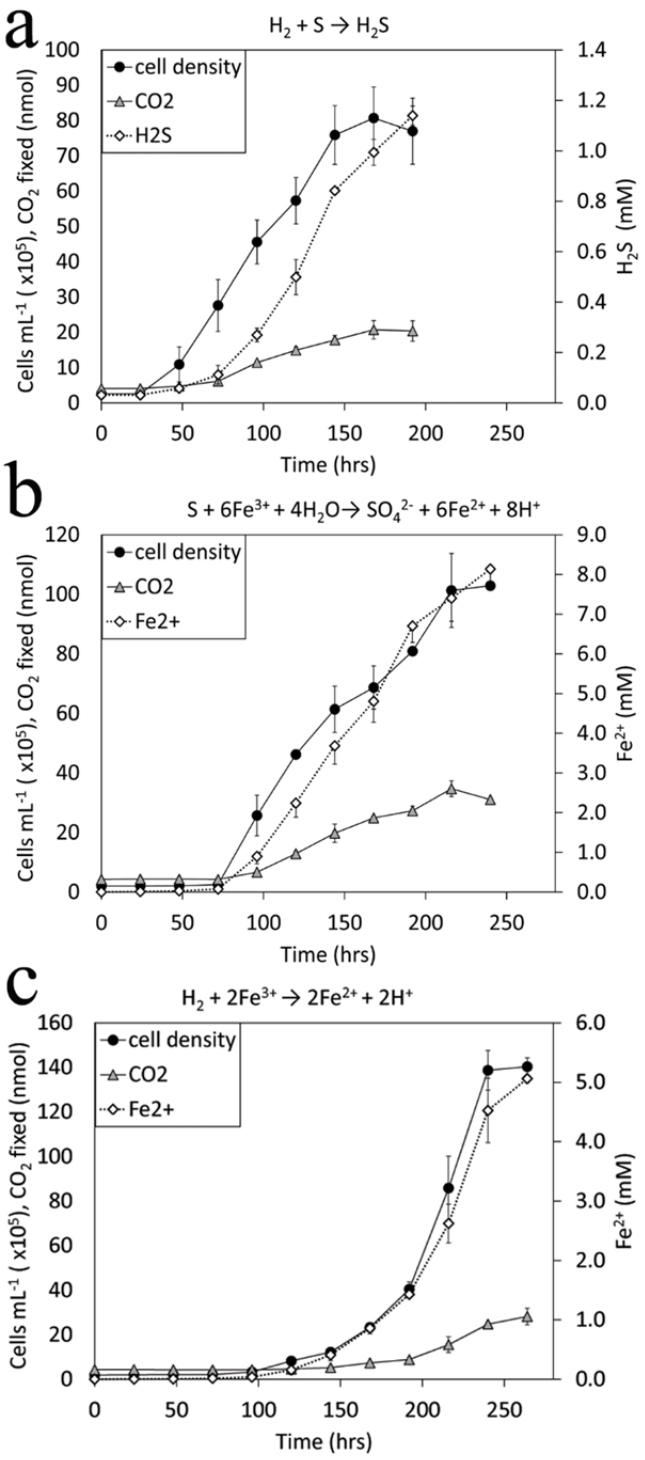
Abbreviations: N/A, Not Applicable. B.D., Below Detection

Detection limits for Fe^{2+} and SO_4^{2-} are 0.3 and 5.0 µM respectively.

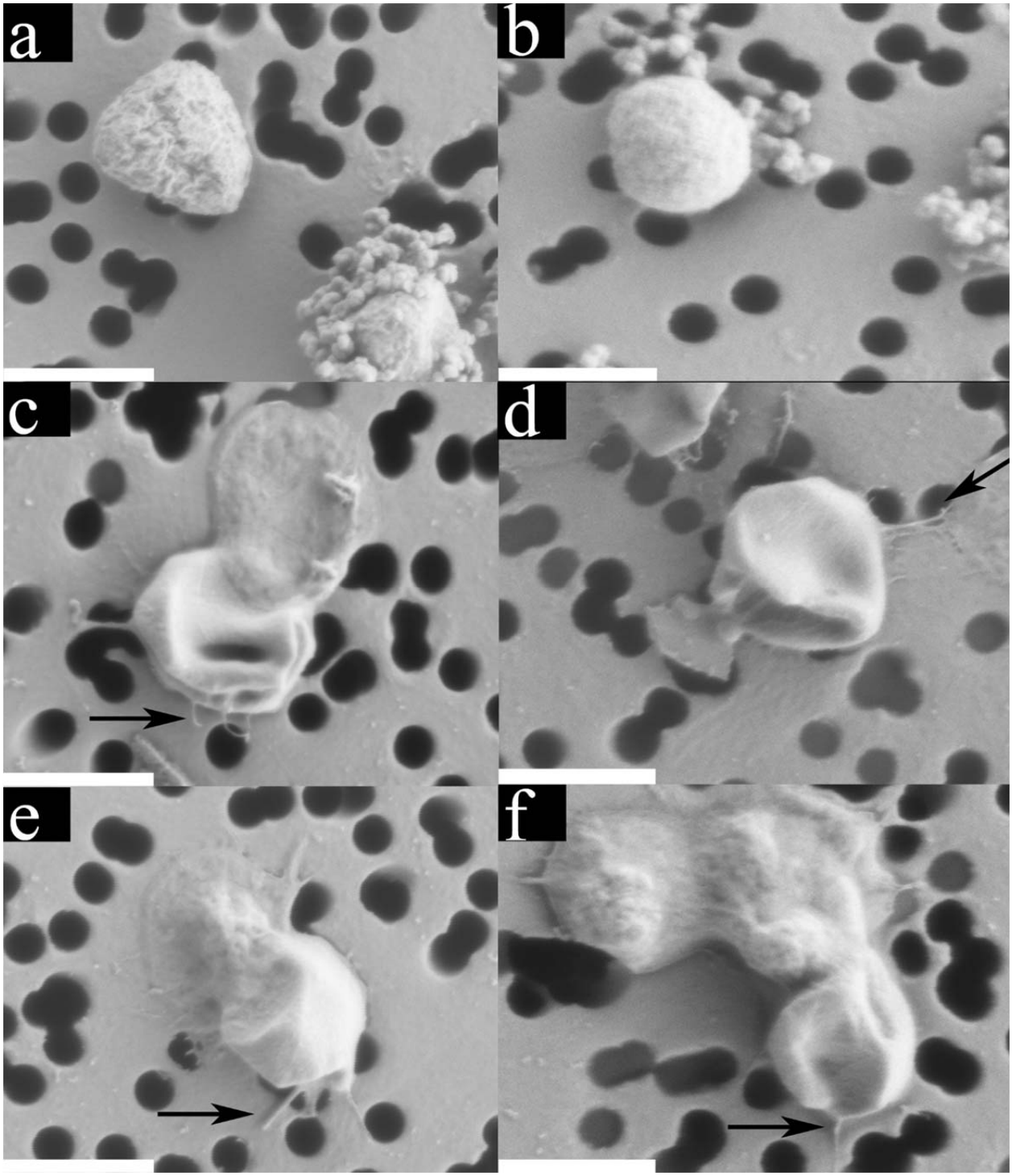
Supplemental Table 4. Number of cells, amount of carbon assimilated, and measured analyte (H_2S, Fe^{3+}, Fe^{2+}, and SO_4^{2-}) where applicable during the specified times in cultures of *Acidianus* sp. DS80 grown at 80°C in base salts medium (pH 3.0) with CO_2 as sole carbon source.

Substrate H_2/S°/Fe^{3+}						
Time	**Cells**	**CO_2 (fmol)**	**H_2S (M)**	**Fe^{3+} (M)**	**Fe^{2+} (M)**	**SO_4^{2-} (M)[1]**
0	2.57×10^5	4.07×10^6	6.72×10^{-8}	8.83×10^{-3}	2.08×10^{-5}	B/D
24	2.57×10^5	4.07×10^6	6.72×10^{-8}	8.18×10^{-3}	4.76×10^{-4}	B/D
48	6.83×10^5	4.56×10^6	1.88×10^{-5}	7.54×10^{-3}	1.04×10^{-3}	B/D
72	2.27×10^6	5.97×10^6	1.33×10^{-4}	4.06×10^{-3}	2.76×10^{-3}	B/D
96	3.44×10^6	7.19×10^6	3.35×10^{-4}	2.37×10^{-3}	2.28×10^{-3}	B/D
120	5.82×10^6	1.43×10^7	5.85×10^{-4}	1.26×10^{-4}	4.78×10^{-4}	B/D
144	7.05×10^6	1.73×10^6	1.27×10^{-3}	4.48×10^{-6}	3.72×10^{-5}	B/D
168	7.52×10^6	2.01×10^6	1.41×10^{-3}	6.98×10^{-6}	1.31×10^{-5}	B/D

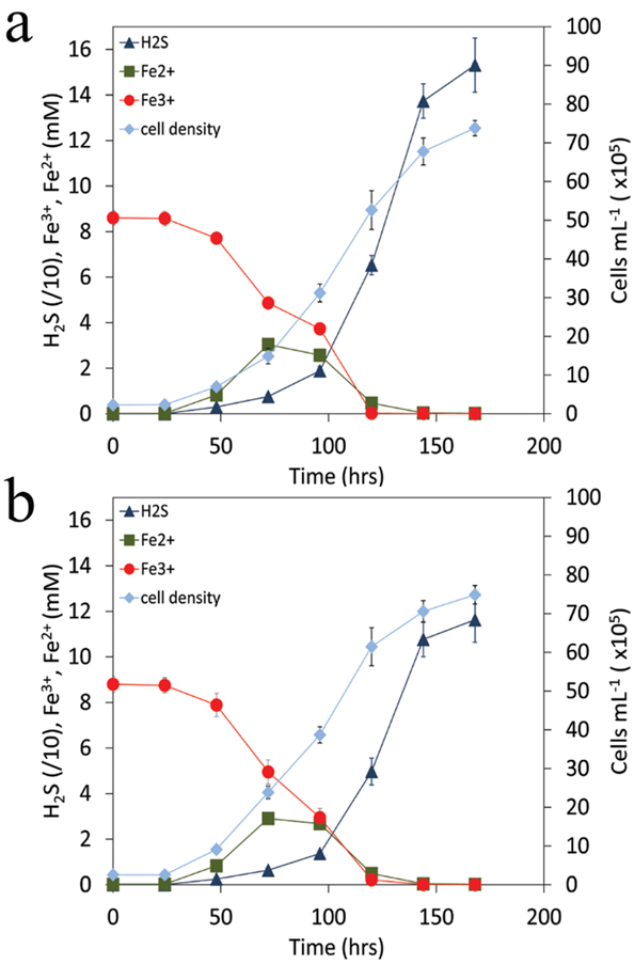
[1]Calculated by subtracting SO_4^{2-} in cultures from SO_4^{2-} in abiotic controls.
Abbreviations: B.D., Below Detection
Detection limits for SO_4^{2-} is 5 µM respectively.



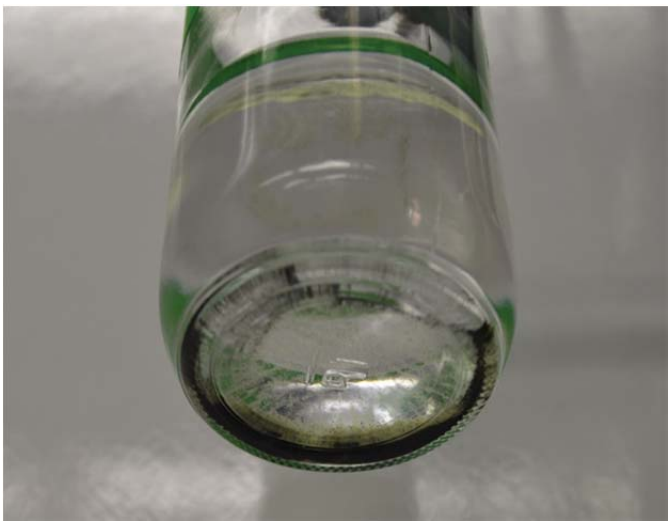
Supplemental Figure 1. Growth kinetics and substrate transformation activities of cultures of DS80 grown with H_2/S° (**a**), S°/Fe^{3+} (as ferric sulfate) (**b**), or H_2/Fe^{3+} (as ferric sulfate) (**c**). All cultures were provided with CO_2 as a carbon source. Error bars reflect the standard deviation of measurements made on three separate cultures.



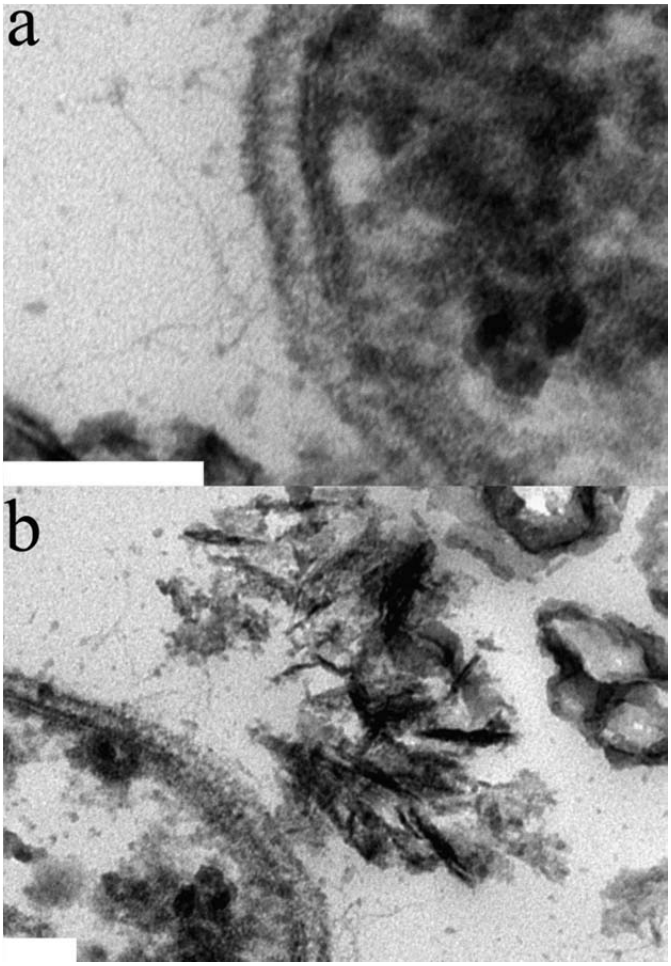
Supplemental Figure 2. Field emission scanning electron micrographs (FE SEMs) of cells grown with H_2/S° (**a,b**), S°/Fe^{3+} (**c,d**), and H_2/Fe^{3+} (**e,f**) with arrows denoting pilin-like structures where present. Scale bars represent 1000 nm.



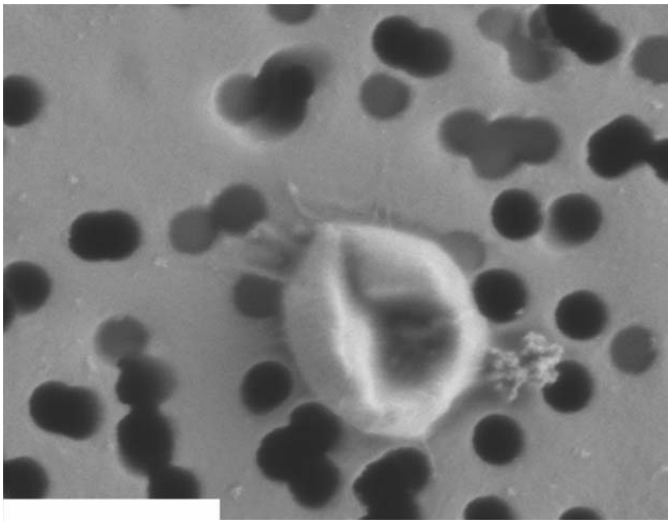
Supplemental Figure 3. Growth kinetics and substrate transformation activities of cultures of DS80 grown with H_2/S°/Fe^{3+} (as ferric sulfate). The inoculum used in experiments presented in the **"a"** panel was grown with S°/Fe^{3+} (as ferric sulfate) whereas the inoculum used in experiments presented in the **"b"** panel was grown with H_2/Fe^{3+} (as ferric sulfate). All cultures were provided with CO_2 as a carbon source. Error bars reflect the standard deviation of measurements made on three separate cultures.



Supplemental Figure 4. Insoluble, black iron sulfide precipitates produced during microbial growth in medium containing $H_2/S°/Fe^{3+}$.



Supplemental Figure 5. Thin section transmission electron micrographs (TEMs) of cells grown with the H_2/Fe^{3+} redox couple (**a**). Scale bars represent 100 nm. Both images show the presence of a precipitate of unknown composition (**b**).



Supplemental Figure 6. Field emission scanning electron micrograph (FE SEM) of cells grown with H_2/ferrihydrite. Scale bar represent 1000 nm.