

1 SUPPLEMENTARY INFORMATION

3 Supporting information (order occurring in the text)

6 **Figure S1:** Methylation and demethylation figures for experiments testing the effect of added carbon (1
7 mM and 10 mM). The top panel (pink points) for each lake represents the increase in Me¹⁹⁹Hg (i.e.
8 methylation) and the bottom panel (green points) for each lake represents the decrease in Me¹⁹⁸Hg (i.e.
9 demethylation). The horizontal red line is the concentration of spiked MeHg at the start (t=0) of each
10 incubation.

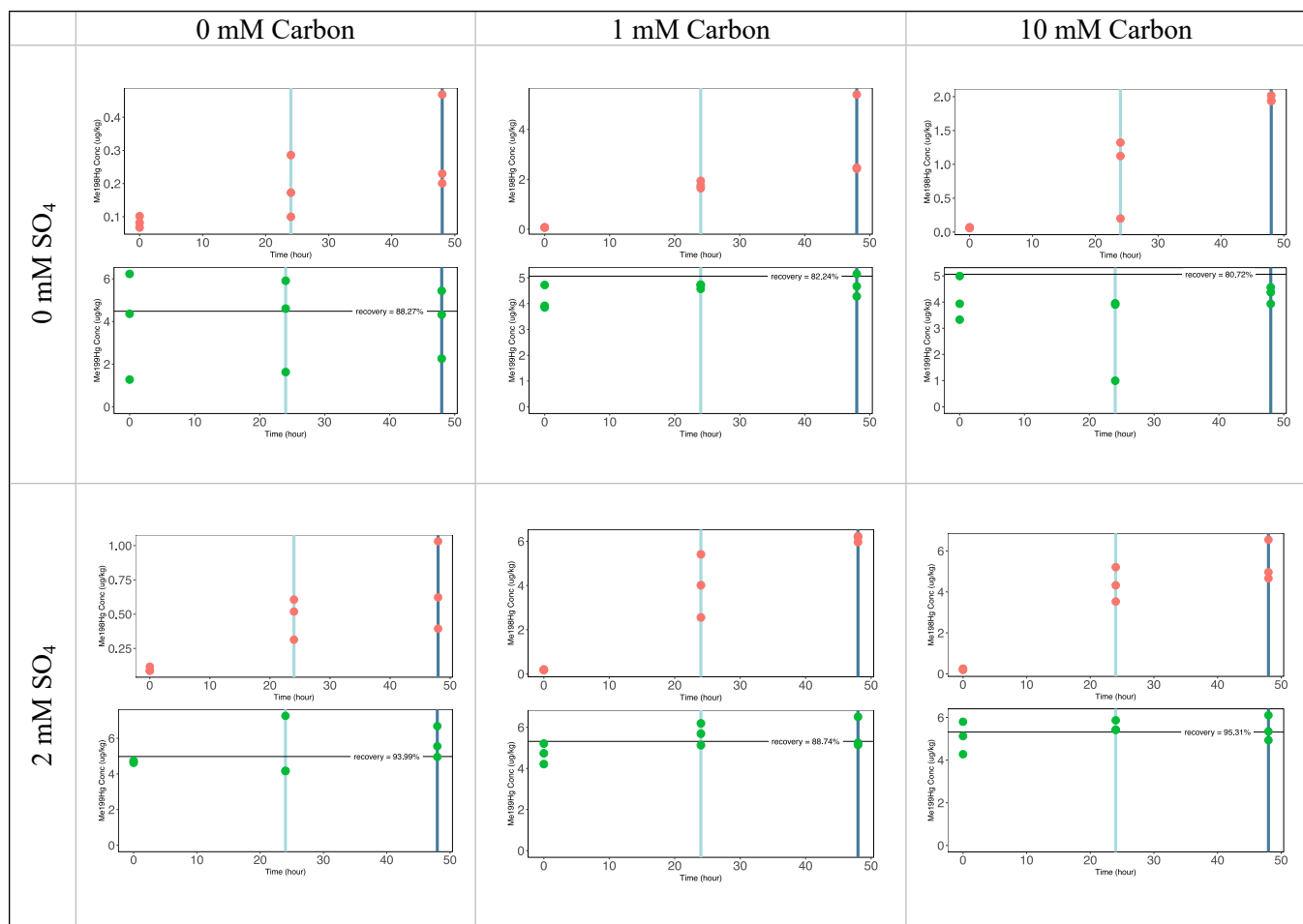
12 **Figure S2:** Methylation and demethylation figures for all experiments testing the effect of sulfate and
13 arsenate amendments, all samples also have a 1 mM carbon amendment. The top panel (pink points) for
14 each lake represents the increase in Me¹⁹⁹Hg (i.e. methylation) and the bottom panel (green points) for
15 each lake represents the decrease in Me¹⁹⁸Hg (i.e. demethylation). The horizontal red line is the
16 concentration of spiked MeHg at the start (t=0) of each incubation.

18 **Table S1:** Chemistry of the overlying water of the sediments in each incubation experiments. Water
19 chemistry was measured at the beginning (0h) and at the end (48h). Sulfate, sulfide, and arsenic species
20 concentrations are measured on filtered samples. As(III) (DL : 0.049 µg/L), As(V) (DL : 0.046 µg/L),
21 arsenobetaine (DL : 0.030 µg/L), MMA (monomethylarsonic acid, DL : 0.050 µg/L), and DMA
22 (dimethylarsinic acid, DL : 0.023 µg/L) were measured using ICP-MS. SRM inhibitor refers to
23 experiment which used a sulfate reducing microbial inhibitor, and abiotic inhibitor refers to experiments
24 in which all microbial activity was ceased. N.A. : Not available, BDL : below detection limit.

26 **Figure S3:** Methylation rates, arsenite increase, and sulfide increase of treatments without carbon, only
27 with carbon and with carbon and sulfate. These results are from preliminary experiments in which we
28 tested the effect of 1 mM and 10 mM carbon amendments.

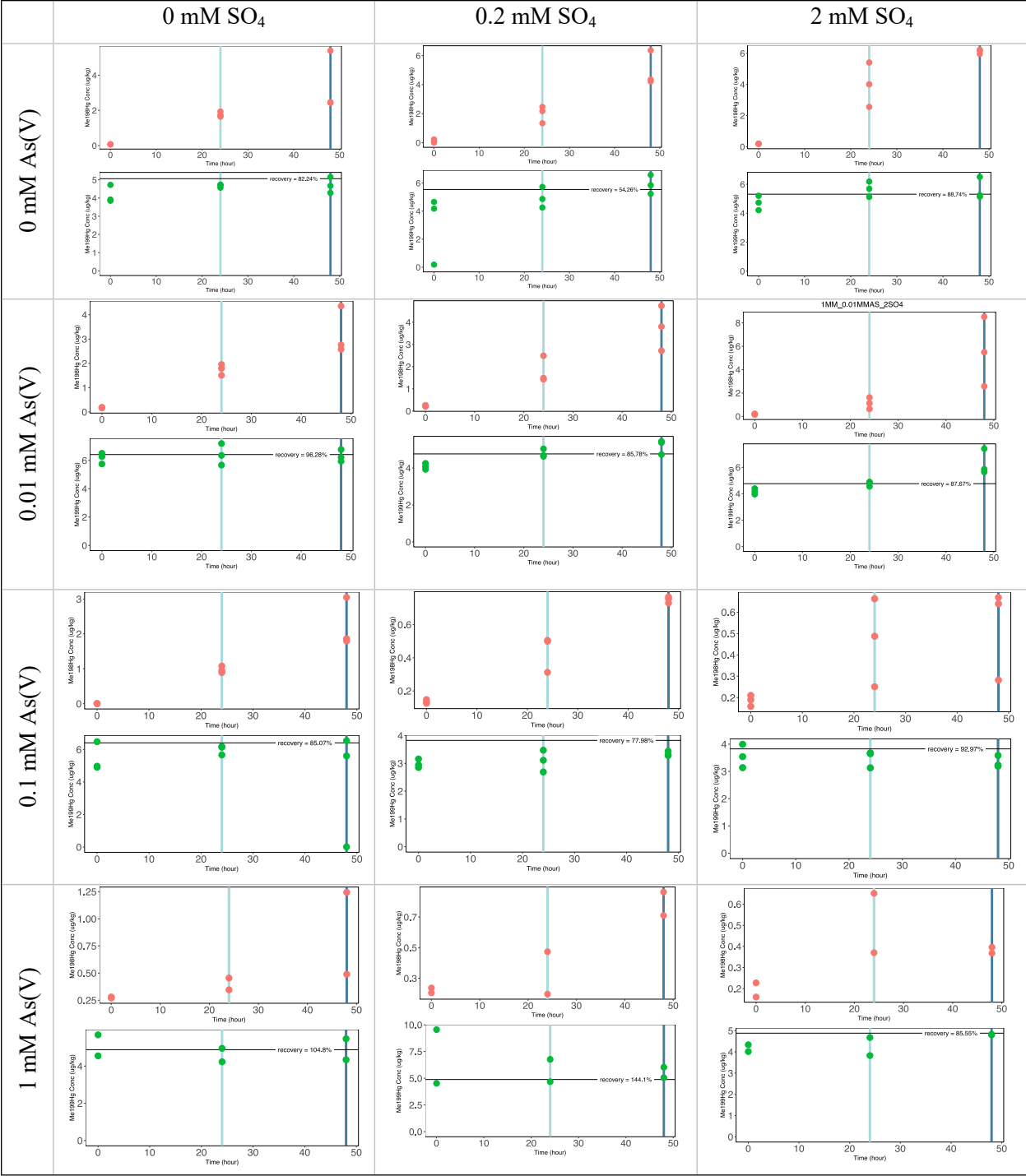
30 **Figure S4:** Fold change in sulfide (A) and arsenite (B) produced in overlying water during the incubation
31 experiments.

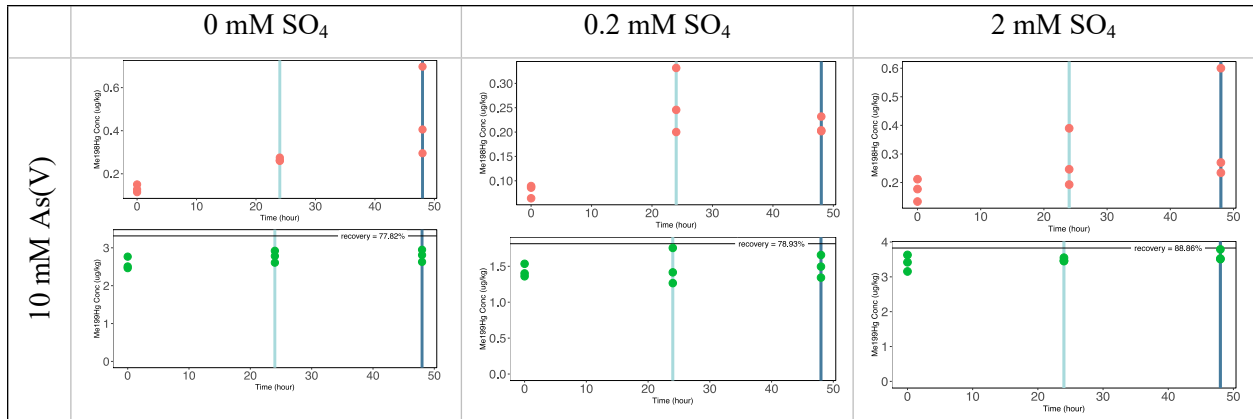
33 **Figure S5:** Results from control experiments. Top figure show the fold change in sulfide produced in
34 overlying water, middle figure shows the fold change in arsenite produced in overlying water and the
35 bottom figure show methylation rate constants (with standard deviations) for control experiments. Biotic
36 controls (biotic) were tested when all microbial activity was suppressed while sulfate reduction (SRB)
37 controls were tested when all microbial activity from sulfate reducing microbes were suppressed.



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Figure S1: Methylation and demethylation figures for experiments testing the effect of added carbon (1 mM and 10 mM). The top panel (pink points) for each lake represents the increase in Me¹⁹⁹Hg (i.e. methylation) and the bottom panel (green points) for each lake represents the decrease in Me¹⁸⁸Hg (i.e. demethylation). The horizontal red line is the concentration of spiked MeHg at the start (t=0) of each incubation.





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49 **Figure S2:** Methylation and demethylation figures for all experiments testing the effect of sulfate and
50 arsenate amendments, all samples also have a 1 mM carbon amendment. The top panel (pink points) for
51 each lake represents the increase in Me¹⁹⁹Hg (i.e. methylation) and the bottom panel (green points) for
52 each lake represents the decrease in Me¹⁹⁸Hg (i.e. demethylation). The horizontal red line is the
53 concentration of spiked MeHg at the start (t=0) of each incubation.
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55 **Table S1:** Chemistry of the overlying water of the sediments in each incubation experiments. Water chemistry was measured at the beginning (0h) and at the end (48h). Sulfate, sulfide, and
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57 µg/L), and DMA (dimethylarsinic acid, DL : 0.023 µg/L) were measured using ICP-MS. SRM inhibitor refers to experiment which used a sulfate reducing microbial inhibitor, and abiotic inhibitor
58 refers to experiments in which all microbial activity was ceased. N.A. : Not available, BDL : below detection limit.
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| Inhibitor | carbon | sulfate | arsenate | Sulfate (0h) | Sulfate (48h) | Sulfide (0h) | Sulfide (48h) | Arsenate (0h) | Arsenate (48h) | Arsenite (0h) | Arsenite (48h) | Arsenobetaine (0h) | Arsenobetaine (48h) | MMA (0h) | MMA (48h) | DMA (0h) | DMA (48h) | |
|-----------|--------|---------|----------|-----------------|------------------|-----------------|------------------|------------------|-------------------|------------------|-------------------|-----------------------|------------------------|-------------|--------------|-------------|--------------|----------|
| None | 1 | 0 | 0 | 0.197 | 0 | 0.004 | 0.034 | 1.00E-05 | 4.67E-06 | 7.50E-05 | 3.15E-05 | 3.71E-07 | 8.98889E-07 | BDL | BDL | 5.9E-07 | 2.65E-06 | |
| | | | 0.01 | 0.105 | 0.037 | 0.011 | 0.019 | 0.00079 | 1.17E-05 | 0.00021 | 0.00129 | 4.49E-07 | 5.95514E-07 | BDL | BDL | 8.3E-07 | 6.3E-07 | |
| | | | 0.1 | 0.091 | 0.023 | 0.01 | 0.021 | 0.00267 | 5.45E-05 | 0.0002 | 0.002134 | 1.37E-06 | 1.28653E-06 | BDL | BDL | 6.3E-07 | 4.49E-07 | |
| | | | 1 | 0.116 | 0.125 | 0.007 | 0.005 | 0.772 | 0.746 | 0.001 | 0.018 | 5.23E-07 | 9.38777E-05 | BDL | BDL | 7.8E-07 | BDL | |
| | | | 10 | 0.144 | 0.114 | 0.007 | 0.008 | 3.022 | 2.595 | 0.002 | 0.018 | 0.0001 | 0.000395129 | BDL | BDL | 2.8E-07 | BDL | |
| | | | 0.2 | 0 | 0.248 | 0.088 | 0.019 | 0.042 | 1.33E-05 | 1.54E-05 | 4.58E-05 | 4.26E-05 | 2.36E-07 | 3.03375E-07 | BDL | BDL | 2.2E-07 | 4.35E-07 |
| | | | | 0.01 | 0.509 | 0.389 | 0.015 | 0.023 | 0.00317 | 0.00015 | 0.00014 | 0.002495 | BDL | BDL | BDL | BDL | BDL | BDL |
| | | | | 0.1 | 0.444 | 0.427 | 0.016 | 0.03 | 0.03646 | 0.00096 | 0.00032 | 0.017102 | BDL | BDL | BDL | BDL | BDL | BDL |
| | | | | 1 | 0.399 | 0.367 | 0.005 | 0.006 | 0.68708 | 0.5996 | 0.00087 | 0.018745 | 0.00067 | 0.000106069 | BDL | BDL | BDL | BDL |
| | | | | 10 | 0.512 | 0.501 | 0.011 | 0.011 | 4.55968 | 2.18371 | 0.00101 | 0.002579 | 0.000061 | 0.000429939 | BDL | BDL | 2.1E-06 | BDL |
| | 2 | 0 | 1.135 | 1.097 | 0.009 | 0.054 | 0.00251 | 0.00015 | 0.0002 | 0.001594 | 5.84E-07 | 4.045E-07 | BDL | BDL | 1.1E-06 | 4.78E-07 | | |
| | | 0.01 | 2.014 | 1.946 | 0.015 | 0.03 | 0.00251 | 0.00015 | 0.0002 | 0.001594 | 4.89E-07 | N.A. | BDL | BDL | 8.3E-07 | BDL | | |
| | | 0.1 | 1.88 | 1.998 | 0.014 | 0.027 | 0.03582 | 0.00187 | 0.00067 | 0.032429 | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | | |
| | | 1 | 1.951 | 1.878 | 0.006 | 0.005 | 0.74814 | 0.63362 | 0.00047 | 0.017917 | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | | |
| | | 10 | 2.093 | 1.831 | 0.017 | 0.01 | 4.41121 | 3.8251 | 0.0024 | 0.024833 | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | | |
| | 0 | 0 | 0 | 0 | 0.156 | 0.142 | 0.005 | 0.006 | 1.39E-05 | 1.34E-05 | 9.77E-05 | 7.57E-05 | 2.64049E-07 | 3.37083E-07 | BDL | BDL | 4.8E-07 | 5.51E-07 |
| | | | | 2 | 1.352 | 1.24 | 0.006 | 0.006 | 1.90E-05 | 2.66E-05 | 0.00015 | 0.000151 | 2.86521E-07 | 2.75285E-07 | BDL | BDL | 1.1E-06 | 8.55E-07 |
| | | 10 | 0 | 0 | 0.102 | 0.091 | 0.005 | 0.018 | 1.05E-05 | 7.34E-06 | 9.41E-05 | 6.58E-05 | 3.31465E-07 | 3.70792E-07 | BDL | BDL | 3.2E-07 | 4.57E-07 |
| | | | | 2 | 1.043 | 0.795 | 0.007 | 0.065 | 1.54E-05 | 9.88E-06 | 8.87E-05 | 7.96E-05 | 2.64049E-07 | 2.58431E-07 | BDL | BDL | 4.4E-07 | 4.42E-07 |
| | SRB | 1 | 0 | 0 | 0.839 | 0.449 | 0.004 | 0.004 | 0.00024 | 7.03E-05 | 8.93E-05 | 0.000226 | BDL | BDL | BDL | BDL | BDL | 1.27E-06 |
| 0.1 | | | | 1.105 | 0.721 | 0.011 | 0.002 | 0.03262 | 0.00059 | 0.00023 | 0.036145 | BDL | BDL | BDL | BDL | 1.3E-07 | BDL | |
| biotic | 1 | 0 | 0 | 0.22 | 0.22 | 0.002 | 0.002 | 5.74E-05 | 5.68E-05 | 8.16E-06 | 6.74E-06 | BDL | BDL | BDL | BDL | BDL | BDL | |

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BDL

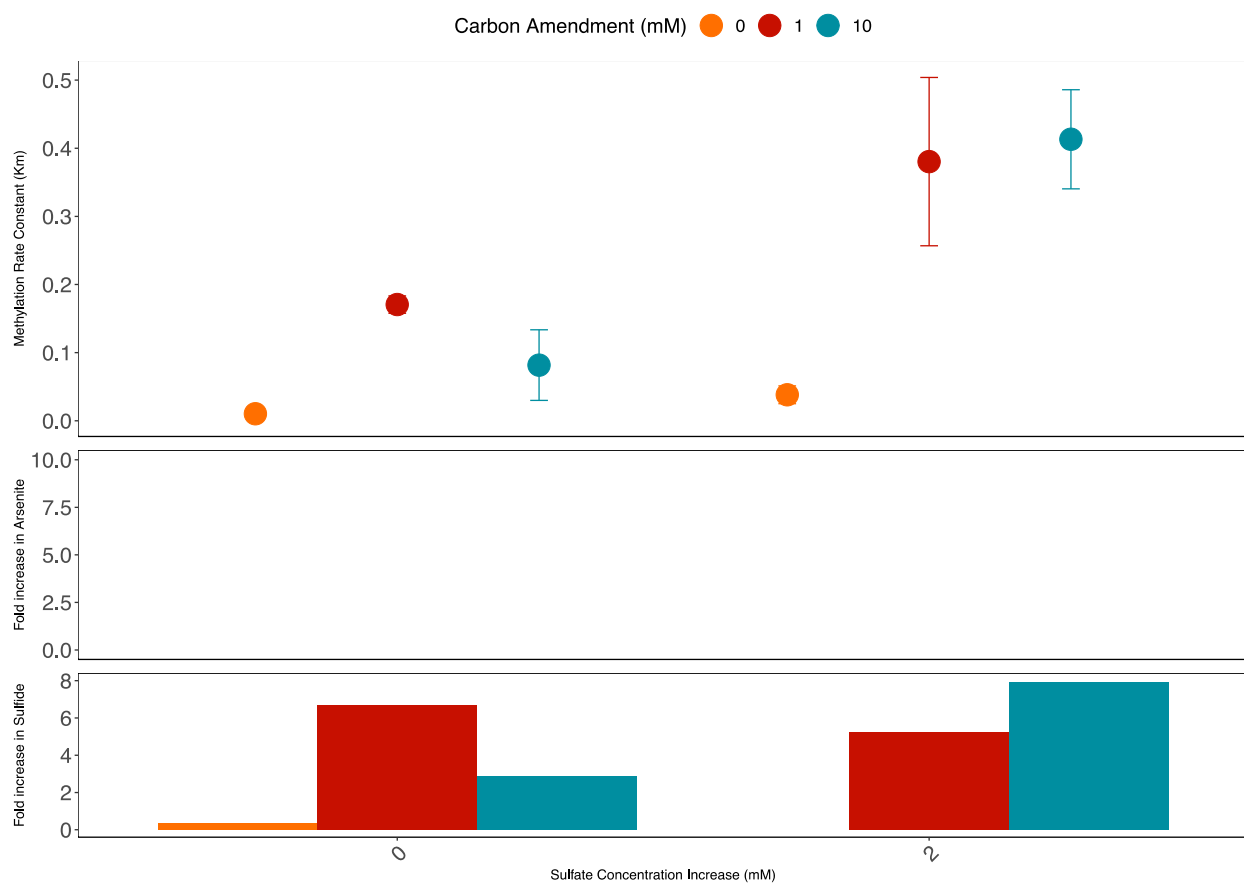
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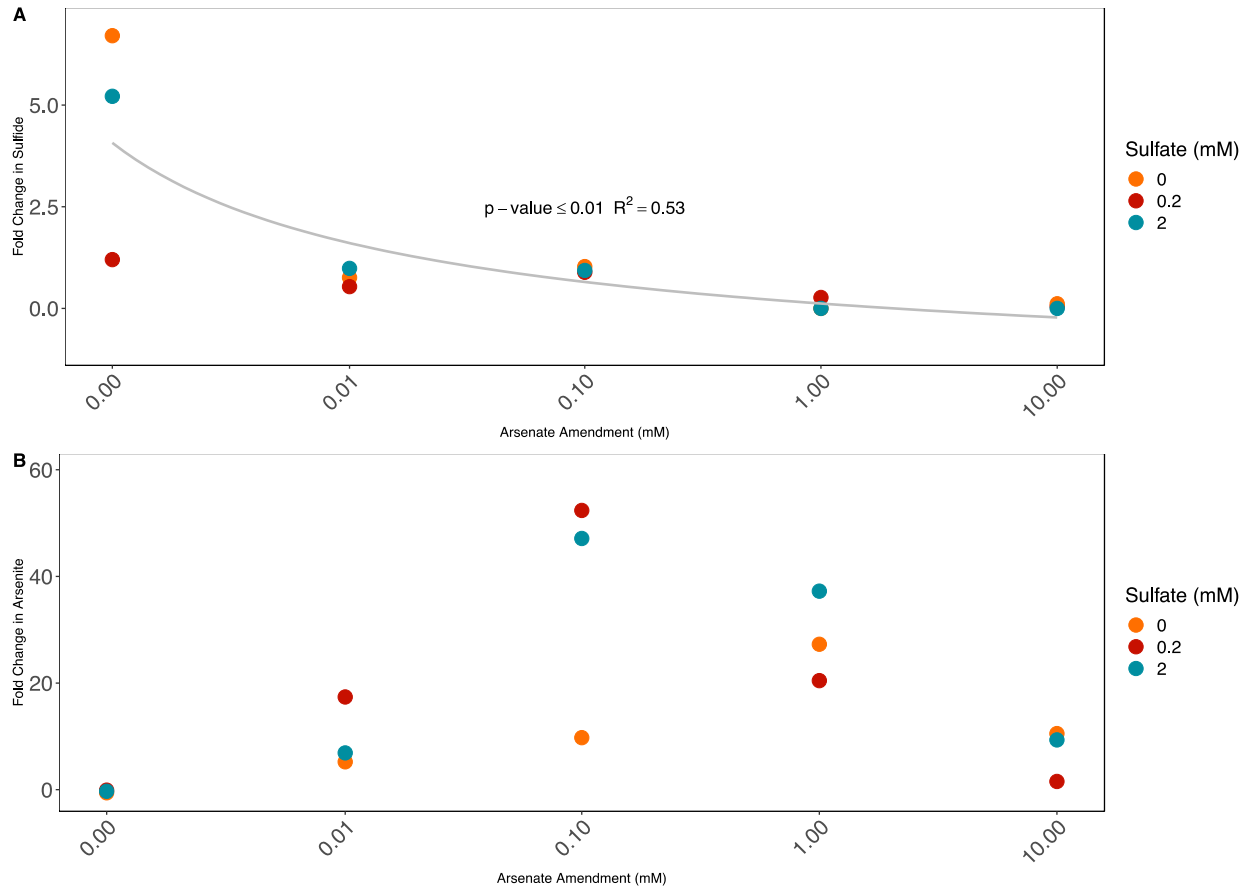
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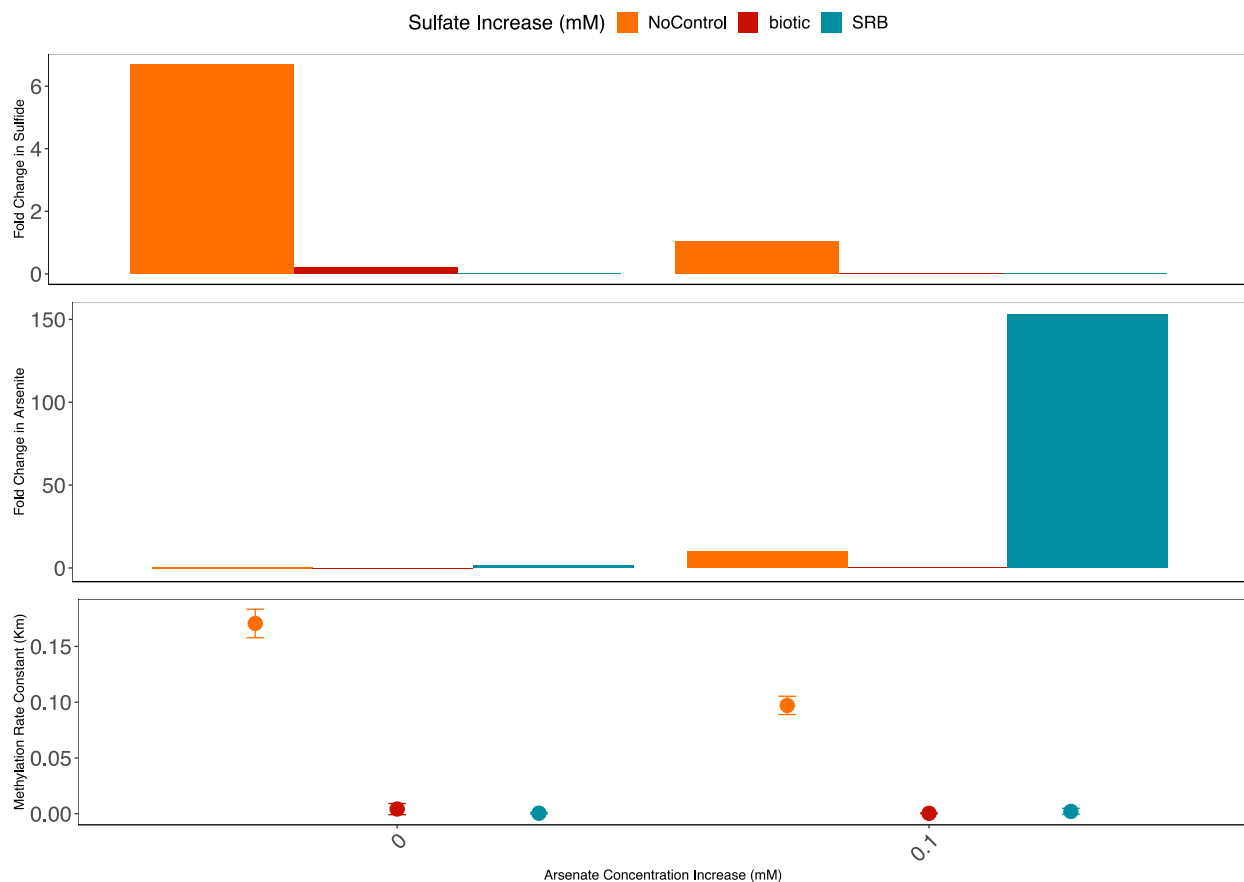
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63 **Figure S3:** Methylation rates, arsenite increase (none detected), and sulfide increase of treatments without
 64 carbon, only with carbon and with carbon and sulfate. These results are from preliminary experiments in
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75 bottom figure show methylation rate constants (with standard deviations) for control experiments. Biotic
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