**Supplemental Material**

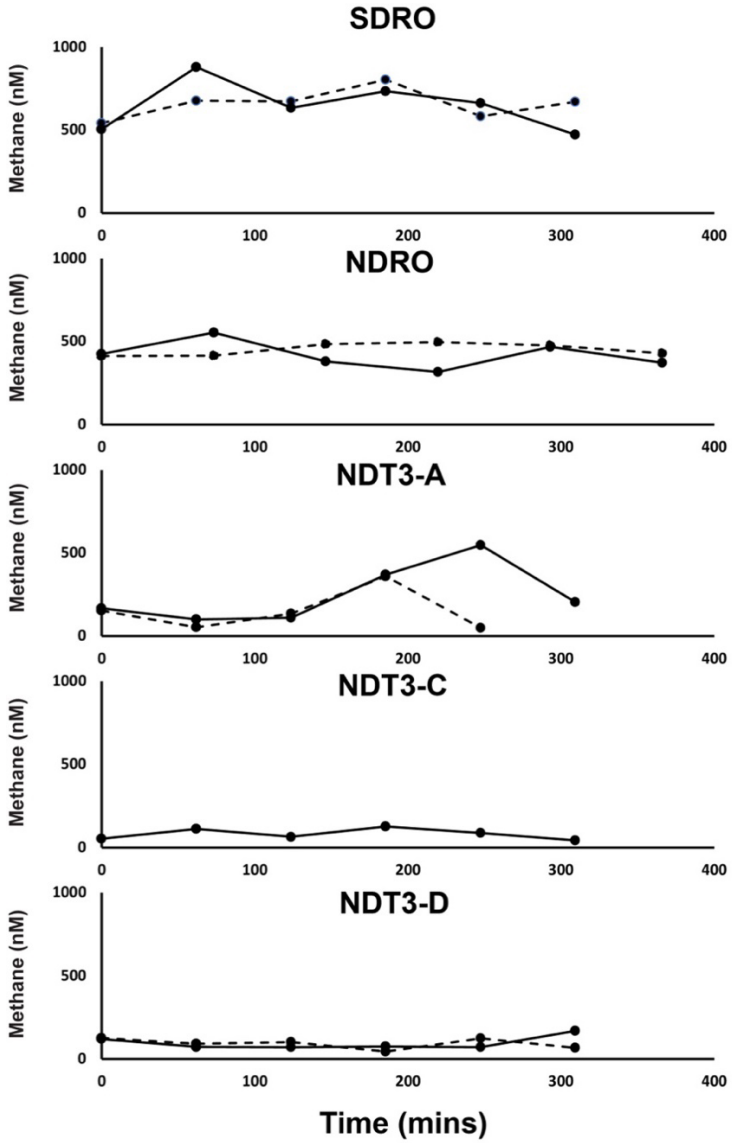


**Figure S1.** Methane concentrations from benthic flux chamber experiments across the depth transect of the Santa Barbara Basin. Solid lines are methane concentrations from benthic flux chamber 1. Dashed lines are methane concentrations from benthic flux chamber 2.

**Table S1.** Porewater concentrations of acetate, methanol and methylamine detected within two sediment intervals at each station sampled in this study.

| Station, Sediment Depth (cm) | Acetate (µM) | Methanol (µM) | Methylamine (µM) |
|---|---|---|---|
| SDRO, 1-2cm | BQ | BD | BQ |
| SDRO, 9-10 cm | BD | BD | BD |
| NDRO, 1-2 cm | BQ | BD | BD |
| NDRO, 9-10 cm | BD | BD | BD |
| NDT3-A, 1-2 cm | 21 | BQ | BQ |
| NDT3-A, 9-10 cm | BD | BD | BD |
| NDT3-C, 1-2 cm | BD | BD | BD |
| NDT3-C, 9-10 cm | BD | BD | BD |
| NDT3-D, 1-2 cm | BD | BD | BD |
| NDT3-D, 9-10 cm | BD | BD | BD |

**Table S2.** Porewater concentrations of methane and ex situ rate data and rate constants (k) of AOM from directly from $^{14}C$-$CH_4$ (AOM- $CH_4$), AOM derived from $^{14}C$-mono-methylamine (AOM-MMA), and methanogenesis from $^{14}C$-mono-methylamine (MG-MMA).

| Station | Sediment Depth For methane (cm) | Methane (μM) | Sediment Depth for Rates (cm) | AOM-CH4 (nmol cm$^{-3}$ d$^{-1}$) | AOM-CH4 k (d$^{-1}$) | AOM-MMA (nmol cm$^{-3}$ d$^{-1}$) | AOM-MMA k (d$^{-1}$) | MG-MMA (nmol cm$^{-3}$ d$^{-1}$) | MG-MMA k (d$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|
| SDRO | 0.5 | 10.80 | 0.5 | 0.92 | 0.09 | 9.95 | 0.92 | 0.40 | 0.13 |
| SDRO | 1.5 | 7.04 | 1.5 | 0.29 | 0.04 | 6.49 | 0.92 | 0.45 | 0.15 |
| SDRO | 2.5 | 6.56 | 2.5 | 0.03 | 0.00 | 6.03 | 0.92 | 0.29 | 0.10 |
| SDRO | 3.5 | 5.68 | 3.5 | 0.01 | 0.00 | 0.00 | 0.00 | 0.18 | 0.06 |
| SDRO | 4.5 | 7.65 | 4.5 | 0.00 | 0.00 | 7.02 | 0.92 | 0.32 | 0.11 |
| SDRO | 5.5 | 5.83 | 5.5 | 0.01 | 0.00 | 5.37 | 0.92 | 0.41 | 0.14 |
| SDRO | 6.5 | 10.89 | 6.5 | 0.00 | 0.00 | 10.02 | 0.92 | 0.31 | 0.10 |
| SDRO | 7.5 | 10.12 | 7.5 | 0.00 | 0.00 | 9.31 | 0.92 | 0.29 | 0.10 |
| SDRO | 8.5 | - | 8.5 | 0.01 | 0.00 | 0.00 | 0.00 | 0.33 | 0.11 |
| SDRO | 9.5 | - | 9.5 | 0.01 | 0.00 | 0.00 | 0.00 | 0.28 | 0.09 |
| SDRO | 11 | - | 10.5 | 0.02 | 0.00 | 9.14 | 0.90 | 0.28 | 0.09 |
| SDRO | 13 | - | 11.5 | 0.00 | 0.00 | 9.15 | 0.90 | 0.30 | 0.10 |
| SDRO | 15 | - | 12.5 | 0.00 | 0.00 | 9.17 | 0.91 | 0.24 | 0.08 |
| SDRO | 17 | - | 13.5 | 0.00 | 0.00 | 9.17 | 0.91 | 0.27 | 0.09 |
| SDRO | 19 | - | 14.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.26 | 0.09 |
| NDRO | 0.5 | 5.96 | 0.5 | 0.05 | 0.01 | 5.31 | 0.89 | 0.41 | 0.14 |
| NDRO | 1.5 | 11.10 | 1.5 | 0.05 | 0.00 | 0.00 | 0.00 | 0.29 | 0.10 |
| NDRO | 2.5 | 3.55 | 2.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.28 | 0.09 |
| NDRO | 3.5 | 11.72 | 3.5 | 0.02 | 0.00 | 0.00 | 0.00 | 0.31 | 0.10 |
| NDRO | 4.5 | 3.96 | 4.5 | 0.01 | 0.00 | 0.00 | 0.00 | 0.43 | 0.14 |
| NDRO | 5.5 | 9.26 | 5.5 | 0.00 | 0.00 | 8.35 | 0.90 | 0.34 | 0.11 |
| NDRO | 6.5 | 8.28 | 6.5 | 0.00 | 0.00 | 7.50 | 0.91 | 0.35 | 0.12 |
| NDRO | 7.5 | 7.67 | 7.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.36 | 0.12 |
| NDRO | 8.5 | 9.51 | 8.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.30 | 0.10 |
| NDRO | 9.5 | 5.33 | 9.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.22 | 0.07 |
| NDRO | 11 | 10.46 | 10.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.21 | 0.07 |
| NDRO | 13 | 5.58 | 11.5 | 0.01 | 0.00 | 0.00 | 0.00 | 0.21 | 0.07 |
| NDRO | 15 | 7.51 | 12.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.25 | 0.08 |
| NDRO | 17 | 13.56 | 13.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.21 | 0.07 |
| NDRO | 19 | 15.68 | 14.5 | 0.00 | 0.00 | - | - | - | - |
| NDT3-A | 0.5 | 7.88 | 0.5 | 0.03 | 0.00 | 7.09 | 0.90 | 0.45 | 0.15 |
| NDT3-A | 1.5 | 5.66 | 1.5 | 0.07 | 0.01 | 5.09 | 0.90 | 0.41 | 0.14 |
| NDT3-A | 2.5 | 5.21 | 2.5 | 0.04 | 0.01 | 4.66 | 0.90 | 0.27 | 0.09 |
| NDT3-A | 3.5 | 4.03 | 3.5 | 0.00 | 0.00 | 3.62 | 0.90 | 0.29 | 0.10 |
| NDT3-A | 4.5 | 7.92 | 4.5 | 0.01 | 0.00 | 7.11 | 0.90 | 0.33 | 0.11 |
| NDT3-A | 5.5 | 2.68 | 5.5 | 0.00 | 0.00 | 2.40 | 0.90 | 0.34 | 0.11 |
| NDT3-A | 6.5 | 8.81 | 6.5 | 0.00 | 0.00 | 7.91 | 0.90 | 0.32 | 0.11 |
| NDT3-A | 7.5 | 4.05 | 7.5 | 0.00 | 0.00 | 3.64 | 0.90 | 0.32 | 0.11 |
| NDT3-A | 8.5 | 8.70 | 8.5 | 0.00 | 0.00 | 7.78 | 0.89 | 0.24 | 0.08 |
| NDT3-A | 9.5 | 4.62 | 9.5 | 0.00 | 0.00 | 4.14 | 0.90 | 0.24 | 0.08 |
| NDT3-A | 11 | 5.29 | 10.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.18 | 0.06 |
| NDT3-A | 13 | - | 11.5 | 0.00 | 0.00 | 4.71 | 0.89 | 0.27 | 0.09 |
| NDT3-A | 15 | - | 12.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.25 | 0.08 |
| NDT3-A | 17 | - | 13.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| NDT3-A | 19 | - | 14.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.26 | 0.09 |
| NDT3-C | 0.5 | 5.21 | 0.5 | 1.68 | 0.32 | 4.28 | 0.82 | 0.33 | 0.11 |
| NDT3-C | 1.5 | 8.47 | 1.5 | 0.08 | 0.01 | 6.94 | 0.82 | 0.26 | 0.09 |
| NDT3-C | 2.5 | 9.38 | 2.5 | 0.06 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| NDT3-C | 3.5 | 5.82 | 3.5 | 0.33 | 0.06 | 4.79 | 0.82 | 0.28 | 0.09 |
| NDT3-C | 4.5 | 5.99 | 4.5 | 0.05 | 0.01 | 4.88 | 0.81 | 0.22 | 0.07 |
| NDT3-C | 5.5 | 6.79 | 5.5 | 0.07 | 0.01 | 0.00 | 0.00 | 0.05 | 0.02 |
| NDT3-C | 6.5 | 7.22 | 6.5 | 0.02 | 0.00 | 5.66 | 0.78 | 0.19 | 0.06 |
| NDT3-C | 7.5 | 7.25 | 7.5 | 0.03 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 |
| NDT3-C | 8.5 | 11.10 | 8.5 | 0.13 | 0.01 | 9.17 | 0.83 | 0.19 | 0.06 |
| NDT3-C | 9.5 | 7.24 | 9.5 | 0.01 | 0.00 | 5.69 | 0.79 | 0.22 | 0.07 |
| NDT3-C | 11 | 7.24 | 10.5 | 0.04 | 0.01 | 5.14 | 0.71 | 0.22 | 0.07 |
| NDT3-C | 13 | 6.38 | 11.5 | - | - | - | - | - | - |
| NDT3-C | 15 | 7.73 | 12.5 | - | - | - | - | - | - |
| NDT3-C | 17 | 9.19 | 13.5 | - | - | - | - | - | - |
| NDT3-D | 0.5 | 12.29 | 0.5 | 4.52 | 0.37 | 0.00 | 0.00 | 0.05 | 0.02 |
| NDT3-D | 1.5 | 12.75 | 1.5 | 1.76 | 0.14 | 15.91 | 1.25 | 0.34 | 0.11 |
| NDT3-D | 2.5 | 10.26 | 2.5 | 0.95 | 0.09 | 12.76 | 1.24 | 0.25 | 0.08 |
| NDT3-D | 3.5 | 9.93 | 3.5 | 0.49 | 0.05 | 12.36 | 1.24 | 0.25 | 0.08 |
| NDT3-D | 4.5 | 11.86 | 4.5 | - | - | 14.80 | 1.25 | 0.22 | 0.07 |
| NDT3-D | 5.5 | 8.88 | 5.5 | - | - | 11.07 | 1.25 | 0.19 | 0.06 |
| NDT3-D | 6.5 | 10.20 | 6.5 | 0.12 | 0.01 | 12.62 | 1.24 | 0.20 | 0.07 |
| NDT3-D | 7.5 | 9.31 | 7.5 | 0.01 | 0.00 | 11.48 | 1.23 | 0.23 | 0.08 |
| NDT3-D | 8.5 | 8.58 | 8.5 | 0.02 | 0.00 | 10.73 | 1.25 | 0.22 | 0.07 |
| NDT3-D | 9.5 | 9.11 | 9.5 | 0.41 | 0.05 | 9.95 | 1.09 | 0.30 | 0.10 |
| NDT3-D | 11 | 12.19 | 10.5 | 0.26 | 0.02 | 12.35 | 1.01 | 0.38 | 0.13 |
| NDT3-D | 13 | 11.29 | 11.5 | 0.49 | 0.04 | 9.05 | 0.80 | 0.47 | 0.16 |
| NDT3-D | 15 | 9.88 | 12.5 | - | - | - | - | - | - |
| NDT3-D | 17 | 9.14 | 13.5 | - | - | - | - | - | - |
| NDT3-D | 19 | 10.26 | 14.5 | - | - | - | - | - | - |