**Supplementary Information**

**Metalloenzyme signatures in authigenic carbonates from the Chukchi Borderlands in the western Arctic Ocean**

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Table S1. Elemental concentrations for carbonate fractions (1M AA leachates) of authigenic carbonates (mg/kg) from the Chukchi Borderlands.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sites** | **Sample ID** | Carbonate fraction (1M AA leachates) (ppm) | | | | | | | |  | |  | |  | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  |  | |  | |  | |  | |  | |  |  | |  | |  | |  |  | Reference |
| Li | Ti | V | Mn | Co | Ni | Cu | Zn | | Rb | | Sr | | Zr | | Mo | | | Ba | | La | | Ce | | Pr | | Nd | | Sm | | Tb | | Dy | | | Y | | Ho | | Er | | Yb | | Lu | | | W | | Pb | | Th | | U |
| **Chukchi borderland**  **(CB)** | CB-1 | 11.66 | 0.53 | 8.07 | 118 | 2.03 | 3.18 | 0.09 | 6.72 | | 5.91 | | 3156 | | 0.34 | | 0.25 | | | 516 | | 2.84 | | 6.26 | | 0.79 | | 3.98 | | 1.04 | | 0.17 | | 0.93 | | | 6.26 | | 0.19 | | 0.49 | | 0.38 | | 0.06 | | | 0.01 | | 0.24 | | 0.04 | | 1.54 | This study |
| CB-2 | 4.26 | 3.77 | 14.12 | 1268 | 0.91 | 2.83 | 0.18 | 9.52 | | 1.78 | | 1722 | | 0.70 | | 10.56 | | | 32 | | 4.94 | | 11.40 | | 1.26 | | 5.85 | | 1.51 | | 0.30 | | 1.92 | | | 23.57 | | 0.46 | | 1.40 | | 1.38 | | 0.24 | | | 0.01 | | 0.41 | | 0.61 | | 83.62 | This study |
| CB-3 | 4.52 | 3.23 | 6.13 | 1641 | 1.21 | n.d. | 0.49 | 5.52 | | 1.93 | | 1177 | | 0.69 | | 1.06 | | | 30 | | 2.57 | | 6.80 | | 0.81 | | 3.66 | | 0.92 | | 0.13 | | 0.69 | | | 4.26 | | 0.13 | | 0.33 | | 0.27 | | 0.04 | | | 0.01 | | 0.65 | | 0.32 | | 1.06 | This study |
| CB-4 | 6.14 | 0.40 | 5.26 | 62 | 1.41 | 1.69 | 0.21 | 6.35 | | 1.91 | | 1692 | | 0.67 | | 0.10 | | | 272 | | 1.21 | | 3.04 | | 0.38 | | 1.80 | | 0.48 | | 0.08 | | 0.45 | | | 2.88 | | 0.09 | | 0.24 | | 0.20 | | 0.03 | | | 0.01 | | 0.28 | | 0.20 | | 0.34 | This study |
| CB-5 | 8.32 | 0.63 | 4.53 | 670 | 3.17 | 3.96 | 0.07 | 5.58 | | 3.72 | | 1912 | | 0.13 | | 4.85 | | | 60 | | 5.00 | | 11.65 | | 1.31 | | 6.21 | | 1.59 | | 0.30 | | 1.83 | | | 15.06 | | 0.40 | | 1.16 | | 1.05 | | 0.18 | | | 0.01 | | 0.32 | | 0.05 | | 4.79 | This study |
| CB-6 | 7.33 | 0.63 | 8.10 | 77 | 1.50 | 2.71 | 0.24 | 13.02 | | 2.46 | | 2392 | | 0.32 | | 0.23 | | | 476 | | 1.87 | | 4.54 | | 0.58 | | 2.72 | | 0.71 | | 0.13 | | 0.74 | | | 5.33 | | 0.15 | | 0.43 | | 0.37 | | 0.06 | | | 0.01 | | 0.51 | | 0.03 | | 1.42 | This study |
| CB-7 | 15.05 | 0.80 | 11.87 | 213 | 2.57 | 3.78 | 0.16 | 13.86 | | 5.73 | | 3659 | | 0.14 | | 0.33 | | | 788 | | 4.24 | | 9.66 | | 1.22 | | 6.65 | | 1.85 | | 0.39 | | 2.36 | | | 16.84 | | 0.51 | | 1.41 | | 1.12 | | 0.19 | | | 0.01 | | 0.39 | | 0.02 | | 9.95 | This study |
| **Congo Fan**  **(CF)** | CF-1 | 4.16 | 0.64 | 3.16 | 413 | 0.19 | 1.14 | 0.12 | 4.42 | | 0.64 | | 1535 | | 0.10 | | 0.71 | | | 798 | | 2.23 | | 8.21 | | 0.70 | | 2.92 | | 0.64 | | 0.10 | | 0.59 | | | 4.28 | | 0.13 | | 0.40 | | 0.38 | | 0.06 | | | 0.02 | | 0.50 | | 0.37 | | 8.07 | Wang et al., 2019 |
| CF-2 | 2.86 | 0.60 | 7.48 | 76 | 0.19 | 0.75 | 0.04 | 1.83 | | 0.34 | | 1121 | | 0.11 | | 0.41 | | | 330 | | 3.24 | | 8.50 | | 0.89 | | 3.80 | | 0.82 | | 0.14 | | 0.87 | | | 6.43 | | 0.20 | | 0.59 | | 0.52 | | 0.08 | | | 0.01 | | 0.11 | | 0.42 | | 7.50 | Wang et al., 2019 |
| CF-3 | 3.22 | 0.56 | 1.63 | 70 | 0.75 | 3.00 | 0.19 | 2.86 | | 0.32 | | 10409 | | 0.13 | | 0.07 | | | 10 | | 5.65 | | 11.69 | | 1.37 | | 5.53 | | 0.93 | | 0.10 | | 0.53 | | | 3.51 | | 0.11 | | 0.28 | | 0.22 | | 0.03 | | | 0.02 | | 0.08 | | 0.47 | | 6.23 | Wang et al., 2019 |
| **Nile Deep-Sea Fan**  **(NDSF)** | NDSF-1 | 1.29 | 0.31 | 8.79 | 266 | 0.54 | 1.90 | 0.24 | 3.87 | | 0.76 | | 9753 | | 0.77 | | 0.18 | | | 18 | | 3.10 | | 6.80 | | 0.77 | | 3.29 | | 0.69 | | 0.11 | | 0.64 | | | 4.06 | | 0.13 | | 0.36 | | 0.31 | | 0.05 | | | 0.01 | | 0.11 | | 0.31 | | 7.02 | Wang et al., 2019 |
| NDSF-2 | 3.31 | 1.27 | 1.77 | 117 | 2.42 | 3.82 | 1.92 | 3.94 | | 0.57 | | 1281 | | 0.41 | | 0.06 | | | 30 | | 8.41 | | 16.56 | | 2.06 | | 8.91 | | 2.00 | | 0.33 | | 1.98 | | | 13.18 | | 0.41 | | 1.12 | | 0.92 | | 0.14 | | | 0.01 | | 0.81 | | 0.40 | | 7.50 | Wang et al., 2019 |
| NDSF-3 | 2.10 | 0.97 | 3.68 | 64 | 0.29 | 1.59 | 3.34 | 5.07 | | 0.50 | | 7619 | | 0.41 | | 0.05 | | | 152 | | 4.44 | | 6.85 | | 1.07 | | 4.59 | | 0.99 | | 0.17 | | 1.06 | | | 9.06 | | 0.23 | | 0.65 | | 0.53 | | 0.08 | | | 0.01 | | 1.01 | | 0.36 | | 3.93 | Wang et al., 2019 |
| NDSF-4 | 1.39 | 0.92 | 3.30 | 115 | 0.38 | 0.93 | 1.96 | 2.84 | | 0.37 | | 9657 | | 0.58 | | 0.06 | | | 444 | | 2.63 | | 4.38 | | 0.66 | | 2.94 | | 0.65 | | 0.11 | | 0.67 | | | 5.58 | | 0.15 | | 0.41 | | 0.33 | | 0.05 | | | 0.01 | | 0.49 | | 0.20 | | 4.58 | Wang et al., 2019 |
| **Niger Fan**  **(NF)** | NF-1 | 0.62 | 0.30 | 4.67 | 4 | 0.03 | 0.72 | 0.21 | 1.53 | | 0.12 | | 10563 | | 0.02 | | 5.13 | | | 32 | | 0.10 | | 0.24 | | 0.02 | | 0.10 | | 0.02 | | 0.00 | | 0.02 | | | 0.20 | | 0.00 | | 0.01 | | 0.01 | | 0.00 | | | 0.02 | | 0.13 | | 0.01 | | 3.95 | Wang et al., 2019 |
| NF-2 | 1.12 | 0.36 | 6.25 | 20 | 0.22 | 0.63 | 0.13 | 1.50 | | 0.30 | | 10327 | | 0.08 | | 0.71 | | | 17 | | 4.36 | | 9.48 | | 0.91 | | 3.73 | | 0.55 | | 0.04 | | 0.21 | | | 1.25 | | 0.04 | | 0.09 | | 0.07 | | 0.01 | | | 0.01 | | 0.40 | | 0.19 | | 6.88 | Wang et al., 2019 |
| NF-3 | 3.01 | 0.53 | 14.46 | 419 | 0.33 | 1.05 | 0.03 | 6.12 | | 1.11 | | 395 | | 0.47 | | 0.19 | | | 65 | | 7.70 | | 24.62 | | 2.33 | | 10.30 | | 2.32 | | 0.41 | | 2.61 | | | 18.20 | | 0.59 | | 1.78 | | 1.67 | | 0.25 | | | 0.01 | | 0.32 | | 1.20 | | 7.77 | Wang et al., 2019 |
| NF-4 | 4.90 | 0.13 | 0.69 | 880 | 1.14 | 6.28 | 0.80 | 11.76 | | 1.71 | | 485 | | 0.14 | | 0.07 | | | 100 | | 15.97 | | 39.61 | | 4.25 | | 18.13 | | 3.73 | | 0.53 | | 3.07 | | | 21.00 | | 0.65 | | 1.86 | | 1.64 | | 0.25 | | | 0.01 | | 0.18 | | 2.31 | | 1.36 | Wang et al., 2019 |
| **Gulf of Mexico**  **(GoM)** | GoM-1 | 0.84 | 0.21 | 1.20 | 167 | 0.54 | 1.60 | 0.90 | 2.07 | | 0.92 | | 15455 | | 0.45 | | 0.07 | | | 92 | | 3.31 | | 4.88 | | 0.73 | | 3.06 | | 0.62 | | 0.08 | | 0.47 | | | 3.12 | | 0.10 | | 0.25 | | 0.20 | | 0.03 | | | 0.01 | | 0.11 | | 0.21 | | 8.21 | Wang et al., 2019 |
| GoM-2 | 2.12 | 0.14 | 1.64 | 295 | 0.52 | 1.25 | 0.46 | 3.68 | | 0.71 | | 1074 | | 0.44 | | 0.12 | | | 162 | | 1.84 | | 3.17 | | 0.41 | | 1.74 | | 0.38 | | 0.06 | | 0.37 | | | 3.00 | | 0.08 | | 0.23 | | 0.21 | | 0.03 | | | 0.01 | | 0.03 | | 0.07 | | 1.19 | Wang et al., 2019 |
| GoM-3 | 0.83 | 0.06 | 0.83 | 91 | 0.08 | 4.32 | 1.68 | 2.64 | | 0.47 | | 12430 | | 0.34 | | 0.13 | | | 31 | | 3.83 | | 2.43 | | 0.85 | | 3.73 | | 0.66 | | 0.07 | | 0.38 | | | 2.32 | | 0.07 | | 0.19 | | 0.14 | | 0.02 | | | 0.01 | | 0.29 | | 0.08 | | 9.30 | Wang et al., 2019 |
| GoM-4 | 3.88 | 0.09 | 1.39 | 564 | 0.60 | 4.73 | 1.23 | 5.44 | | 0.74 | | 3051 | | 0.12 | | 0.09 | | | 652 | | 2.90 | | 3.60 | | 0.70 | | 3.20 | | 0.75 | | 0.12 | | 0.69 | | | 5.49 | | 0.15 | | 0.39 | | 0.31 | | 0.05 | | | 0.01 | | 0.06 | | 0.07 | | 9.13 | Wang et al., 2019 |
| GoM-5 | 2.27 | 0.26 | 2.21 | 160 | 0.51 | 1.67 | 0.85 | 3.35 | | 0.59 | | 1141 | | 0.34 | | 0.06 | | | 295 | | 3.33 | | 4.54 | | 0.77 | | 3.39 | | 0.75 | | 0.12 | | 0.73 | | | 5.62 | | 0.16 | | 0.43 | | 0.35 | | 0.05 | | | 0.01 | | 0.13 | | 0.09 | | 0.50 | Wang et al., 2019 |
| GoM-6 | 2.77 | 0.09 | 1.95 | 182 | 0.53 | 3.19 | 1.19 | 3.52 | | 0.71 | | 1445 | | 0.20 | | 0.06 | | | 318 | | 5.99 | | 5.92 | | 1.39 | | 6.26 | | 1.42 | | 0.24 | | 1.42 | | | 11.07 | | 0.31 | | 0.83 | | 0.64 | | 0.10 | | | 0.01 | | 0.22 | | 0.09 | | 0.50 | Wang et al., 2019 |
| GoM-7 | 2.14 | 0.94 | 6.90 | 167 | 0.42 | 1.18 | 0.85 | 3.86 | | 0.64 | | 1228 | | 1.08 | | 0.07 | | | 657 | | 4.94 | | 9.38 | | 1.11 | | 4.53 | | 0.95 | | 0.15 | | 0.88 | | | 6.20 | | 0.19 | | 0.52 | | 0.46 | | 0.07 | | | 0.01 | | 0.14 | | 0.44 | | 5.17 | Wang et al., 2019 |

n.d. indicates ‘not determined’.

Table S2. Elemental concentrations for sulfide fractions (3M HNO3 leachates) of authigenic carbonates (mg/kg) from the Chukchi Borderlands.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sites** | **Sample ID** | Sulfide fraction (3M HNO3 leachates) (ppm) | | | | | | | |  | |  | |  | |  | |  | |  |  |  | |  | |  | |  | |  | |  |  |  | |  | |  | |  | |  |  | |  | |  | |  | |  |  | | Reference |
| Li | Ti | V | Mn | Co | Ni | Cu | Zn | | Rb | | Sr | | Zr | | Mo | | Ba | | La | | Ce | | Pr | | Nd | | Sm | | Tb | | Dy | | Y | | Ho | | Er | | Yb | | | Lu | | W | | Pb | | Th | | | U |
| **Chukchi borderland**  **(CB)** | CB-1 | 2.79 | 13.12 | 4.32 | 52 | 1.59 | 2.80 | 2.54 | 11.03 | | 2.28 | | 212 | | 1.83 | | 0.17 | | 66 | | 1.33 | | 3.00 | | 0.40 | | 1.71 | | 0.42 | | 0.06 | | 0.34 | | 1.83 | | 0.06 | | 0.16 | | 0.13 | | | 0.02 | | 0.00 | | 1.93 | | 0.76 | | | 0.16 | This study |
| CB-2 | 2.55 | 12.66 | 5.90 | 267 | 1.28 | 2.16 | 2.81 | 8.41 | | 2.54 | | 509 | | 1.61 | | 2.81 | | 7 | | 1.82 | | 3.77 | | 0.48 | | 2.05 | | 0.50 | | 0.08 | | 0.52 | | 4.53 | | 0.11 | | 0.33 | | 0.32 | | | 0.05 | | 0.01 | | 2.03 | | 0.79 | | | 10.23 | This study |
| CB-3 | 2.53 | 15.88 | 4.00 | 352 | 1.79 | 2.69 | 3.83 | 9.67 | | 2.64 | | 206 | | 2.34 | | 0.28 | | 11 | | 2.17 | | 4.93 | | 0.61 | | 2.57 | | 0.60 | | 0.09 | | 0.50 | | 2.97 | | 0.10 | | 0.26 | | 0.22 | | | 0.03 | | 0.01 | | 2.41 | | 1.02 | | | 0.52 | This study |
| CB-4 | 2.34 | 10.43 | 3.95 | 80 | 1.60 | 2.83 | 4.30 | 11.31 | | 2.28 | | 217 | | 2.13 | | 0.08 | | 55 | | 1.41 | | 3.39 | | 0.47 | | 2.05 | | 0.52 | | 0.08 | | 0.42 | | 2.26 | | 0.08 | | 0.19 | | 0.14 | | | 0.02 | | 0.00 | | 2.38 | | 0.92 | | | 0.14 | This study |
| CB-5 | 2.50 | 13.79 | 5.37 | 397 | 2.19 | 2.91 | 2.27 | 8.68 | | 2.31 | | 210 | | 1.69 | | 0.62 | | 13 | | 2.01 | | 4.37 | | 0.54 | | 2.29 | | 0.55 | | 0.10 | | 0.58 | | 3.84 | | 0.12 | | 0.34 | | 0.33 | | | 0.05 | | 0.01 | | 1.79 | | 0.84 | | | 0.68 | This study |
| CB-6 | 3.29 | 14.01 | 6.14 | 48 | 1.36 | 2.64 | 3.78 | 11.86 | | 2.20 | | 257 | | 3.27 | | 0.14 | | 80 | | 2.22 | | 5.15 | | 0.65 | | 2.67 | | 0.61 | | 0.09 | | 0.49 | | 2.92 | | 0.09 | | 0.24 | | 0.19 | | | 0.03 | | 0.01 | | 2.48 | | 1.03 | | | 0.33 | This study |
| CB-7 | 2.37 | 16.30 | 3.94 | 100 | 1.72 | 3.05 | 3.52 | 10.32 | | 2.61 | | 271 | | 2.11 | | 0.16 | | 234 | | 2.03 | | 4.52 | | 0.59 | | 2.57 | | 0.65 | | 0.12 | | 0.69 | | 4.17 | | 0.14 | | 0.39 | | 0.36 | | | 0.05 | | 0.01 | | 2.19 | | 1.00 | | | 1.12 | This study |
| **Congo Fan**  **(CF)** | CF-1 | 1.28 | 9.51 | 1.85 | 95 | 0.37 | 1.94 | 2.05 | 3.81 | | 1.32 | | 276 | | 0.48 | | 0.36 | | 862 | | 1.00 | | 3.46 | | 0.30 | | 1.20 | | 0.25 | | 0.03 | | 0.20 | | 1.52 | | 0.04 | | 0.13 | | 0.13 | | | 0.02 | | 0.00 | | 0.56 | | 0.47 | | | 1.52 | Wang et al., 2019 |
| CF-2 | 1.18 | 11.78 | 4.18 | 38 | 0.47 | 1.61 | 2.06 | 3.51 | | 1.27 | | 276 | | 0.56 | | 0.44 | | 110 | | 1.70 | | 4.54 | | 0.46 | | 1.88 | | 0.39 | | 0.06 | | 0.39 | | 3.09 | | 0.09 | | 0.25 | | 0.24 | | | 0.03 | | 0.00 | | 0.58 | | 0.54 | | | 1.99 | Wang et al., 2019 |
| CF-3 | 1.72 | 19.23 | 9.27 | 20 | 0.58 | 2.16 | 1.13 | 5.13 | | 1.01 | | 1757 | | 0.66 | | 0.36 | | 4 | | 2.25 | | 5.21 | | 0.54 | | 2.06 | | 0.35 | | 0.04 | | 0.21 | | 1.48 | | 0.04 | | 0.11 | | 0.09 | | | 0.01 | | 0.01 | | 0.80 | | 0.71 | | | 1.55 | Wang et al., 2019 |
| **Nile Deep-Sea Fan**  **(NDSF)** | NDSF-1 | 0.70 | 15.11 | 10.92 | 108 | 1.87 | 3.38 | 5.07 | 4.98 | | 1.53 | | 1967 | | 4.01 | | 2.16 | | 5 | | 2.83 | | 6.67 | | 0.79 | | 3.21 | | 0.65 | | 0.09 | | 0.51 | | 3.13 | | 0.10 | | 0.26 | | 0.21 | | | 0.03 | | 0.00 | | 0.81 | | 0.51 | | | 1.73 | Wang et al., 2019 |
| NDSF-2 | 1.39 | 33.08 | 11.93 | 100 | 3.84 | 4.44 | 4.11 | 3.34 | | 1.21 | | 229 | | 3.72 | | 0.21 | | 10 | | 3.60 | | 8.80 | | 0.87 | | 3.58 | | 0.75 | | 0.12 | | 0.67 | | 5.09 | | 0.14 | | 0.38 | | 0.32 | | | 0.05 | | 0.01 | | 1.91 | | 0.44 | | | 1.90 | Wang et al., 2019 |
| NDSF-3 | 0.82 | 20.93 | 5.83 | 20 | 0.32 | 1.53 | 2.59 | 2.85 | | 0.85 | | 1534 | | 1.23 | | 0.05 | | 42 | | 1.57 | | 2.55 | | 0.38 | | 1.56 | | 0.32 | | 0.05 | | 0.30 | | 2.90 | | 0.06 | | 0.17 | | 0.15 | | | 0.02 | | 0.01 | | 0.54 | | 0.18 | | | 0.93 | Wang et al., 2019 |
| NDSF-4 | 0.79 | 14.75 | 4.31 | 39 | 0.39 | 1.54 | 2.40 | 2.57 | | 0.78 | | 1958 | | 1.63 | | 0.27 | | 1110 | | 1.43 | | 2.51 | | 0.35 | | 1.45 | | 0.30 | | 0.04 | | 0.26 | | 2.30 | | 0.05 | | 0.14 | | 0.12 | | | 0.02 | | 0.01 | | 0.57 | | 0.23 | | | 1.21 | Wang et al., 2019 |
| **Niger Fan**  **(NF)** | NF-1 | 0.23 | 2.01 | 1.15 | 1 | 0.03 | 0.29 | 0.32 | 0.41 | | 0.10 | | 2660 | | 0.02 | | 0.49 | | 5 | | 0.08 | | 0.16 | | 0.02 | | 0.06 | | 0.01 | | 0.00 | | 0.01 | | 0.10 | | 0.00 | | 0.01 | | 0.00 | | | 0.00 | | 0.01 | | 0.04 | | 0.01 | | | 1.54 | Wang et al., 2019 |
| NF-2 | 0.34 | 4.27 | 2.31 | 4 | 0.30 | 0.66 | 0.68 | 0.69 | | 0.25 | | 2302 | | 0.13 | | 0.31 | | 4 | | 1.31 | | 2.75 | | 0.26 | | 1.04 | | 0.16 | | 0.01 | | 0.06 | | 0.45 | | 0.01 | | 0.03 | | 0.02 | | | 0.00 | | 0.00 | | 0.15 | | 0.07 | | | 1.74 | Wang et al., 2019 |
| NF-3 | 0.98 | 11.50 | 9.29 | 138 | 0.83 | 1.89 | 1.81 | 2.93 | | 1.83 | | 74 | | 1.43 | | 1.41 | | 19 | | 3.65 | | 11.76 | | 1.10 | | 4.73 | | 1.04 | | 0.18 | | 1.17 | | 9.18 | | 0.26 | | 0.79 | | 0.76 | | | 0.11 | | 0.01 | | 0.64 | | 0.63 | | | 2.58 | Wang et al., 2019 |
| NF-4 | 1.96 | 10.86 | 37.56 | 445 | 2.30 | 7.34 | 2.91 | 12.32 | | 4.34 | | 54 | | 1.73 | | 0.12 | | 40 | | 7.73 | | 20.59 | | 2.06 | | 8.37 | | 1.69 | | 0.23 | | 1.34 | | 9.51 | | 0.28 | | 0.79 | | 0.74 | | | 0.11 | | 0.01 | | 1.96 | | 1.90 | | | 0.39 | Wang et al., 2019 |
| **Gulf of Mexico**  **(GoM)** | GoM-1 | 1.58 | 18.57 | 10.78 | 92 | 1.26 | 2.44 | 3.13 | 5.24 | | 2.14 | | 2193 | | 2.23 | | 0.34 | | 20 | | 2.14 | | 3.96 | | 0.51 | | 2.02 | | 0.41 | | 0.06 | | 0.29 | | 2.03 | | 0.06 | | 0.15 | | 0.12 | | | 0.02 | | 0.02 | | 1.39 | | 0.65 | | | 1.48 | Wang et al., 2019 |
| GoM-2 | 3.18 | 29.58 | 11.11 | 221 | 2.47 | 4.98 | 4.13 | 9.57 | | 3.58 | | 280 | | 6.51 | | 0.78 | | 57 | | 2.27 | | 4.69 | | 0.59 | | 2.39 | | 0.52 | | 0.07 | | 0.38 | | 2.89 | | 0.08 | | 0.20 | | 0.18 | | | 0.03 | | 0.02 | | 1.79 | | 0.82 | | | 0.48 | Wang et al., 2019 |
| GoM-3 | 0.80 | 11.98 | 4.68 | 128 | 0.76 | 3.39 | 2.67 | 3.45 | | 1.08 | | 2325 | | 0.76 | | 0.26 | | 8 | | 1.57 | | 2.17 | | 0.36 | | 1.45 | | 0.26 | | 0.03 | | 0.16 | | 1.20 | | 0.03 | | 0.08 | | 0.07 | | | 0.01 | | 0.02 | | 0.93 | | 0.23 | | | 1.80 | Wang et al., 2019 |
| GoM-4 | 1.43 | 13.71 | 26.48 | 199 | 1.30 | 3.89 | 2.97 | 6.77 | | 1.51 | | 270 | | 2.22 | | 1.48 | | 100 | | 1.79 | | 3.32 | | 0.46 | | 1.87 | | 0.39 | | 0.06 | | 0.31 | | 2.40 | | 0.06 | | 0.17 | | 0.15 | | | 0.02 | | 0.02 | | 1.43 | | 0.52 | | | 1.28 | Wang et al., 2019 |
| GoM-5 | 1.95 | 19.85 | 10.82 | 112 | 1.43 | 3.38 | 2.26 | 6.11 | | 1.94 | | 179 | | 2.87 | | 0.09 | | 57 | | 1.96 | | 3.70 | | 0.49 | | 1.98 | | 0.42 | | 0.06 | | 0.33 | | 2.65 | | 0.07 | | 0.18 | | 0.15 | | | 0.02 | | 0.01 | | 1.47 | | 0.51 | | | 0.12 | Wang et al., 2019 |
| GoM-6 | 2.20 | 24.58 | 16.41 | 219 | 2.91 | 5.73 | 3.26 | 7.76 | | 2.30 | | 184 | | 3.41 | | 0.13 | | 60 | | 3.06 | | 5.35 | | 0.74 | | 3.06 | | 0.66 | | 0.10 | | 0.56 | | 4.61 | | 0.12 | | 0.31 | | 0.26 | | | 0.04 | | 0.01 | | 2.53 | | 0.67 | | | 0.54 | Wang et al., 2019 |
| GoM-7 | 2.21 | 36.44 | 6.36 | 60 | 0.98 | 2.63 | 2.96 | 6.17 | | 2.72 | | 191 | | 3.67 | | 0.46 | | 126 | | 3.30 | | 6.68 | | 0.79 | | 3.10 | | 0.62 | | 0.08 | | 0.45 | | 3.23 | | 0.09 | | 0.24 | | 0.21 | | | 0.03 | | 0.01 | | 1.42 | | 0.83 | | | 1.22 | Wang et al., 2019 |

Table S3. Elemental concentrations for detrital silicate fractions (concentrated HF + HCl leachates) of authigenic carbonates (mg/kg) from the Chukchi Borderlands.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sites** | **Sample ID** | Detrital silicate fractions (conc. HF+HCl) (ppm) | | | | | | |  | |  | |  |  |  | |  | |  | |  | |  | |  | |  | |  |  | |  | |  | |  |  | |  | |  | |  |  | |  | |  | |  |  | Reference |
| Li | Ti | V | Mn | Co | Ni | Cu | Zn | Rb | | Sr | | Zr | Mo | Ba | | La | | Ce | | Pr | | Nd | | Sm | | Tb | | | Dy | | Y | | Ho | | | Er | | Yb | | Lu | | | W | | Pb | | Th | | U |
| **Chukchi borderland**  **(CB)** | CB-1 | 57.02 | 4652.94 | 142.26 | 157 | 7.19 | 23.46 | 4.81 | 90.02 | 107.61 | | 142.87 | | 114.21 | 0.86 | 458 | | 21.14 | | 43.76 | | 4.90 | | 17.45 | | 2.81 | | 0.34 | | | 2.32 | | 18.91 | | 0.53 | | | 1.66 | | 1.85 | | 0.27 | | | 1.50 | | 4.80 | | 5.39 | | 2.00 | This study |
| CB-2 | 59.00 | 4967.64 | 154.12 | 212 | 7.07 | 24.03 | 4.70 | 85.95 | 123.49 | | 155.10 | | 126.87 | 9.20 | 502 | | 19.88 | | 41.80 | | 4.76 | | 16.84 | | 2.82 | | 0.36 | | | 2.48 | | 20.69 | | 0.56 | | | 1.75 | | 1.97 | | 0.30 | | | 1.62 | | 3.64 | | 5.73 | | 3.10 | This study |
| CB-3 | 55.70 | 4817.46 | 116.62 | 182 | 6.35 | 20.03 | 4.74 | 75.07 | 99.88 | | 111.20 | | 134.34 | 1.13 | 410 | | 20.69 | | 44.14 | | 5.15 | | 18.07 | | 3.02 | | 0.38 | | | 2.45 | | 17.53 | | 0.55 | | | 1.71 | | 1.81 | | 0.28 | | | 1.64 | | 4.53 | | 6.15 | | 2.05 | This study |
| CB-4 | 68.78 | 4384.58 | 160.75 | 120 | 6.18 | 25.84 | 5.94 | 115.34 | 107.11 | | 108.64 | | 112.09 | 0.71 | 488 | | 22.65 | | 46.31 | | 5.08 | | 17.46 | | 2.68 | | 0.31 | | | 2.10 | | 17.33 | | 0.49 | | | 1.55 | | 1.75 | | 0.27 | | | 1.52 | | 4.99 | | 5.12 | | 2.13 | This study |
| CB-5 | 39.99 | 3764.94 | 89.69 | 240 | 6.01 | 18.51 | 4.65 | 91.18 | 77.98 | | 136.00 | | 125.14 | 1.91 | 329 | | 19.70 | | 36.57 | | 4.13 | | 14.80 | | 2.56 | | 0.34 | | | 2.30 | | 18.57 | | 0.52 | | | 1.60 | | 1.74 | | 0.26 | | | 1.24 | | 4.25 | | 4.87 | | 1.75 | This study |
| CB-6 | 59.56 | 4614.30 | 121.88 | 115 | 5.25 | 20.94 | 5.98 | 115.95 | 95.24 | | 106.86 | | 142.17 | 0.72 | 431 | | 20.92 | | 43.80 | | 4.97 | | 17.46 | | 2.83 | | 0.36 | | | 2.43 | | 20.12 | | 0.55 | | | 1.72 | | 1.89 | | 0.28 | | | 1.57 | | 5.00 | | 5.59 | | 2.11 | This study |
| CB-7 | 62.14 | 4769.26 | 145.82 | 141 | 6.65 | 22.55 | 11.98 | 130.72 | 112.85 | | 438.29 | | 127.76 | 0.89 | 3846 | | 22.52 | | 47.07 | | 5.40 | | 18.84 | | 3.00 | | 0.36 | | | 2.49 | | 20.82 | | 0.58 | | | 1.82 | | 2.04 | | 0.31 | | | 1.57 | | 5.26 | | 5.80 | | 2.31 | This study |
| **Congo Fan**  **(CF)** | CF-1 | 93.60 | 3453.00 | 65.00 | 70 | 6.08 | 24.00 | 12.60 | 45.40 | 70.00 | | 931.00 | | 98.00 | 1.67 | 22659 | | 24.40 | | 35.50 | | 4.20 | | 13.89 | | 2.41 | | 0.30 | | | 1.81 | | 10.94 | | 0.37 | | | 1.09 | | 1.14 | | 0.17 | | | 1.44 | | 9.80 | | 5.41 | | 4.23 | Wang et al., 2019 |
| CF-2 | 101.30 | 4052.00 | 74.40 | 64 | 6.50 | 25.80 | 11.50 | 43.80 | 72.00 | | 35.00 | | 125.00 | 1.56 | 257 | | 24.10 | | 34.92 | | 4.16 | | 13.72 | | 2.34 | | 0.33 | | | 1.98 | | 12.89 | | 0.41 | | | 1.23 | | 1.30 | | 0.19 | | | 1.59 | | 10.18 | | 5.59 | | 1.95 | Wang et al., 2019 |
| CF-3 | 107.50 | 4421.00 | 80.50 | 68 | 5.83 | 44.40 | 15.30 | 59.00 | 64.00 | | 63.00 | | 135.00 | 4.31 | 396 | | 38.62 | | 55.56 | | 6.56 | | 21.53 | | 3.47 | | 0.39 | | | 2.16 | | 12.10 | | 0.41 | | | 1.16 | | 1.13 | | 0.16 | | | 1.79 | | 17.14 | | 8.52 | | 2.53 | Wang et al., 2019 |
| **Nile Deep-Sea Fan**  **(NDSF)** | NDSF-1 | 52.00 | 7421.00 | 109.00 | 103 | 7.75 | 33.90 | 8.10 | 52.70 | 46.00 | | 163.00 | | 261.00 | 5.69 | 204 | | 28.31 | | 43.31 | | 4.96 | | 16.96 | | 2.91 | | 0.42 | | | 2.76 | | 20.34 | | 0.61 | | | 1.89 | | 2.05 | | 0.30 | | | 1.58 | | 5.86 | | 3.60 | | 1.60 | Wang et al., 2019 |
| NDSF-2 | 57.70 | 6905.00 | 123.60 | 228 | 15.93 | 52.20 | 37.20 | 59.20 | 61.00 | | 91.00 | | 213.00 | 24.75 | 209 | | 16.20 | | 25.97 | | 3.05 | | 10.83 | | 2.02 | | 0.35 | | | 2.29 | | 15.97 | | 0.50 | | | 1.54 | | 1.65 | | 0.24 | | | 1.56 | | 8.44 | | 3.94 | | 1.71 | Wang et al., 2019 |
| NDSF-3 | 57.60 | 5832.00 | 119.90 | 129 | 7.82 | 34.70 | 15.70 | 47.70 | 62.00 | | 113.00 | | 217.00 | 1.86 | 231 | | 26.90 | | 45.32 | | 5.10 | | 17.82 | | 3.07 | | 0.43 | | | 2.73 | | 18.90 | | 0.59 | | | 1.77 | | 1.91 | | 0.28 | | | 1.21 | | 7.60 | | 6.77 | | 2.14 | Wang et al., 2019 |
| NDSF-4 | 41.20 | 4062.00 | 65.00 | 106 | 6.13 | 27.20 | 11.40 | 44.00 | 59.00 | | 1091.00 | | 144.00 | 3.96 | 13128 | | 19.67 | | 32.94 | | 3.73 | | 13.11 | | 2.31 | | 0.33 | | | 2.11 | | 14.54 | | 0.46 | | | 1.39 | | 1.50 | | 0.22 | | | 0.97 | | 7.12 | | 3.61 | | 1.57 | Wang et al., 2019 |
| **Niger Fan**  **(NF)** | NF-1 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | | n.d. | | n.d. | n.d. | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | | n.d. | | n.d. | | n.d. | | | n.d. | | n.d. | | n.d. | | | n.d. | | n.d. | | n.d. | | n.d. | Wang et al., 2019 |
| NF-2 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | | n.d. | | n.d. | n.d. | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | | n.d. | | n.d. | | n.d. | | | n.d. | | n.d. | | n.d. | | | n.d. | | n.d. | | n.d. | | n.d. | Wang et al., 2019 |
| NF-3 | 109.40 | 5623.00 | 109.00 | 77 | 6.73 | 30.30 | 5.90 | 45.70 | 78.00 | | 92.00 | | 183.00 | 5.19 | 239 | | 51.02 | | 89.50 | | 8.98 | | 29.57 | | 4.63 | | 0.52 | | | 2.98 | | 18.01 | | 0.61 | | | 1.77 | | 1.82 | | 0.27 | | | 1.33 | | 16.61 | | 7.38 | | 1.89 | Wang et al., 2019 |
| NF-4 | 68.40 | 3291.00 | 176.80 | 211 | 9.58 | 31.90 | 5.60 | 66.70 | 68.00 | | 52.00 | | 118.00 | 3.31 | 144 | | 35.20 | | 57.90 | | 6.27 | | 20.56 | | 3.26 | | 0.37 | | | 2.09 | | 12.20 | | 0.42 | | | 1.21 | | 1.25 | | 0.19 | | | 2.16 | | 14.64 | | 5.45 | | 1.14 | Wang et al., 2019 |
| **Gulf of Mexico**  **(GoM)** | GoM-1 | 46.50 | 3588.00 | 154.70 | 91 | 4.45 | 16.00 | 5.70 | 42.00 | 102.00 | | 143.00 | | 116.00 | 1.22 | 511 | | 19.11 | | 33.25 | | 3.66 | | 12.65 | | 2.02 | | 0.27 | | | 1.78 | | 12.93 | | 0.41 | | | 1.32 | | 1.48 | | 0.22 | | | 1.01 | | 4.42 | | 4.28 | | 1.95 | Wang et al., 2019 |
| GoM-2 | 54.90 | 3065.00 | 120.70 | 98 | 4.37 | 16.80 | 3.50 | 34.70 | 111.00 | | 80.00 | | 109.00 | 1.69 | 497 | | 24.67 | | 45.29 | | 4.92 | | 16.95 | | 2.64 | | 0.34 | | | 2.24 | | 15.39 | | 0.51 | | | 1.59 | | 1.74 | | 0.26 | | | 0.87 | | 4.77 | | 5.37 | | 2.74 | Wang et al., 2019 |
| GoM-3 | 49.90 | 3711.00 | 132.90 | 100 | 4.80 | 28.60 | 21.70 | 47.60 | 102.00 | | 125.00 | | 123.00 | 3.12 | 478 | | 24.25 | | 41.85 | | 4.65 | | 16.02 | | 2.56 | | 0.34 | | | 2.23 | | 15.63 | | 0.50 | | | 1.56 | | 1.72 | | 0.25 | | | 1.36 | | 7.65 | | 7.34 | | 2.65 | Wang et al., 2019 |
| GoM-4 | 59.50 | 3911.00 | 133.80 | 178 | 6.83 | 29.80 | 12.10 | 58.20 | 120.00 | | 93.00 | | 125.00 | 12.18 | 441 | | 25.05 | | 44.53 | | 4.82 | | 16.55 | | 2.64 | | 0.36 | | | 2.36 | | 16.39 | | 0.53 | | | 1.65 | | 1.79 | | 0.26 | | | 1.39 | | 6.16 | | 5.57 | | 2.24 | Wang et al., 2019 |
| GoM-5 | 51.40 | 3360.00 | 110.50 | 117 | 6.03 | 18.50 | 10.30 | 41.30 | 107.00 | | 90.00 | | 129.00 | 1.21 | 547 | | 24.19 | | 45.22 | | 4.87 | | 16.96 | | 2.74 | | 0.38 | | | 2.53 | | 17.14 | | 0.56 | | | 1.73 | | 1.84 | | 0.27 | | | 1.16 | | 6.87 | | 6.35 | | 2.48 | Wang et al., 2019 |
| GoM-6 | 53.20 | 4096.00 | 130.60 | 145 | 7.87 | 23.20 | 15.30 | 49.10 | 123.00 | | 97.00 | | 131.00 | 1.81 | 500 | | 24.85 | | 45.51 | | 4.95 | | 17.25 | | 2.80 | | 0.39 | | | 2.57 | | 17.79 | | 0.57 | | | 1.77 | | 1.88 | | 0.28 | | | 1.39 | | 7.03 | | 5.75 | | 2.53 | Wang et al., 2019 |
| GoM-7 | 34.00 | 3164.00 | 71.50 | 133 | 4.63 | 15.70 | 6.80 | 30.30 | 76.00 | | 134.00 | | 168.00 | 1.68 | 510 | | 18.61 | | 34.02 | | 3.78 | | 13.44 | | 2.34 | | 0.34 | | | 2.23 | | 15.51 | | 0.50 | | | 1.54 | | 1.65 | | 0.24 | | | 0.80 | | 6.16 | | 4.25 | | 1.67 | Wang et al., 2019 |

n.d. indicates ‘not determined’.

Table S4. Elemental concentrations for total lipids of authigenic carbonates (mg/kg) from the Chukchi Borderlands.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sites** | **Sample**  **ID** | Total lipid fractions (ppm) | | | | | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  |  | |  | |  | |  |  |  | |  | |  | |  |  | |  | |  | |  |  | | Reference |
| Li | Ti | V | Mn | Co | Ni | | Cu | | Zn | | Rb | | Sr | | Zr | | Mo | | Ba | | La | | Ce | | Pr | | Nd | | | Sm | | Tb | | Dy | | Y | | Ho | | Er | | Yb | | | Lu | | W | | Pb | | Th | U |
| **Chukchi**  **Borderland**  **(CB)** | CB-1 | 29.94 | 27.34 | 6.70 | 8.54 | 0.55 | 19.70 | | 6.44 | | 103.98 | | 3.13 | | 25.67 | | n.d. | | 0.84 | | 17.50 | | 0.32 | | 0.61 | | 0.07 | | 0.29 | | | 0.03 | | 0.00 | | 0.04 | | 0.27 | | 0.01 | | 0.01 | | 0.03 | | | 0.01 | | n.d. | | 2.06 | | 0.09 | 0.04 | This study |
| CB-2 | 26.81 | 13.55 | 2.68 | 27.17 | 0.22 | 4.26 | | 3.02 | | 45.30 | | 2.19 | | 21.03 | | n.d. | | 2.93 | | 13.02 | | 0.24 | | 0.48 | | 0.06 | | 0.19 | | | 0.04 | | 0.00 | | 0.06 | | 0.35 | | 0.02 | | 0.03 | | 0.02 | | | 0.01 | | n.d. | | 1.15 | | 0.09 | 0.77 | This study |
| CB-3 | 13.31 | 28.94 | 3.41 | 40.18 | 0.94 | 8.55 | | 9.38 | | 54.86 | | 2.30 | | 11.61 | | n.d. | | 1.08 | | 16.39 | | 0.42 | | 0.96 | | 0.13 | | 0.45 | | | 0.09 | | 0.01 | | 0.07 | | 0.33 | | 0.01 | | 0.01 | | 0.03 | | | 0.01 | | n.d. | | 1.07 | | 0.15 | 0.03 | This study |
| CB-4 | 2.80 | 222.31 | 15.41 | 17.81 | 1.93 | 18.35 | | 5.44 | | 64.80 | | 3.03 | | 36.47 | | n.d. | | 0.45 | | 22.34 | | 0.64 | | 1.34 | | 0.18 | | 0.67 | | | 0.14 | | 0.01 | | 0.11 | | 0.49 | | 0.02 | | 0.06 | | 0.03 | | | 0.00 | | n.d. | | 1.56 | | 0.21 | 0.02 | This study |
| CB-5 | 6.59 | 110.71 | 5.02 | 59.34 | 8.61 | 26.88 | | 4.48 | | 60.40 | | 4.13 | | 45.05 | | n.d. | | 1.94 | | 20.60 | | 0.55 | | 0.95 | | 0.11 | | 0.69 | | | 0.11 | | 0.02 | | 0.11 | | 0.87 | | 0.03 | | 0.12 | | 0.04 | | | 0.00 | | n.d. | | 4.83 | | 0.21 | 0.15 | This study |
| CB-6 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | | n.d. | | n.d. | | n.d. | | n.d. | n.d. | This study |
| CB-7 | 21.88 | 33.39 | 5.64 | 30.60 | 0.99 | 18.06 | | 225.07 | | 300.38 | | 3.90 | | 34.27 | | n.d. | | 1.81 | | 51.97 | | 0.29 | | 0.75 | | 0.10 | | 0.52 | | | 0.09 | | 0.01 | | 0.11 | | 0.47 | | 0.01 | | 0.05 | | 0.05 | | | 0.01 | | n.d. | | 4.17 | | 0.13 | 0.16 | This study |
| **Congo Fan**  **CF)** | CF-1 | 27.90 | 13.04 | 1.41 | 25.00 | 0.22 | 2.18 | | 2.74 | | 13.50 | | 1.40 | | 77.20 | | 0.46 | | 0.42 | | 634.00 | | 0.38 | | 1.00 | | 0.10 | | 0.36 | | | 0.07 | | 0.01 | | 0.05 | | 0.35 | | 0.01 | | 0.03 | | 0.03 | | | n.d. | | 0.04 | | 0.47 | | 0.13 | 0.47 | Wang et al., 2019 |
| CF-2 | 21.70 | 16.99 | 2.61 | 8.30 | 0.29 | 2.60 | | 2.38 | | 10.10 | | 1.01 | | 51.90 | | 1.04 | | 0.52 | | 38.00 | | 0.38 | | 0.97 | | 0.09 | | 0.34 | | | 0.07 | | 0.01 | | 0.06 | | 0.43 | | 0.01 | | 0.04 | | 0.04 | | | 0.01 | | 0.04 | | 0.66 | | 0.14 | 0.44 | Wang et al., 2019 |
| CF-3 | 10.10 | 17.58 | 1.96 | 5.90 | 0.15 | 1.17 | | 0.94 | | 6.50 | | 0.68 | | 183.00 | | 0.27 | | 0.14 | | 8.70 | | 0.44 | | 0.88 | | 0.09 | | 0.36 | | | 0.06 | | 0.01 | | 0.03 | | 0.20 | | 0.01 | | 0.02 | | 0.01 | | | n.d. | | 0.01 | | 0.51 | | 0.13 | 0.19 | Wang et al., 2019 |
| **Nile Deep-Sea**  **Fan**  **(NDSF)** | NDSF-1 | 17.10 | 26.06 | 1.91 | 15.40 | 0.36 | 1.56 | | 4.48 | | 10.20 | | 0.71 | | 208.00 | | 0.92 | | 0.67 | | 5.40 | | 0.37 | | 0.82 | | 0.09 | | 0.37 | | | 0.07 | | 0.01 | | 0.06 | | 0.32 | | 0.01 | | 0.03 | | 0.02 | | | n.d. | | 0.01 | | 0.27 | | 0.06 | 0.24 | Wang et al., 2019 |
| NDSF-2 | 12.90 | 10.14 | 1.10 | 10.00 | 0.38 | 1.65 | | 2.86 | | 11.20 | | 0.57 | | 19.80 | | 0.34 | | 0.20 | | 8.20 | | 0.21 | | 0.57 | | 0.05 | | 0.22 | | | 0.05 | | 0.01 | | 0.04 | | 0.26 | | 0.01 | | 0.02 | | 0.02 | | | n.d. | | 0.02 | | 0.59 | | 0.04 | 0.12 | Wang et al., 2019 |
| NDSF-3 | 24.40 | 11.98 | 1.27 | 4.80 | 0.27 | 9.84 | | 37.90 | | 6.80 | | 0.68 | | 153.00 | | 0.24 | | 0.55 | | 8.90 | | 0.19 | | 0.36 | | 0.05 | | 0.20 | | | 0.04 | | 0.01 | | 0.04 | | 0.32 | | 0.01 | | 0.02 | | 0.02 | | | n.d. | | 0.05 | | 0.39 | | 0.03 | 0.11 | Wang et al., 2019 |
| NDSF-4 | 16.40 | 3.01 | 0.41 | 3.00 | 0.07 | 1.54 | | 20.50 | | 12.70 | | 0.48 | | 87.60 | | 0.14 | | 0.17 | | 163.00 | | 0.08 | | 0.16 | | 0.02 | | 0.09 | | | 0.02 | | n.d. | | 0.01 | | 0.10 | | n.d. | | 0.01 | | 0.01 | | | n.d. | | 0.01 | | 0.24 | | 0.01 | 0.05 | Wang et al., 2019 |
| **Niger Fan**  **(NF)** | NF-1 | 9.79 | 2.58 | 1.66 | 2.10 | 0.09 | 1.87 | | 3.21 | | 9.30 | | 0.84 | | 507.00 | | 0.14 | | 2.98 | | 13.50 | | 0.06 | | 0.18 | | 0.01 | | 0.07 | | | 0.01 | | 0.00 | | 0.01 | | 0.05 | | n.d. | | n.d. | | n.d. | | | n.d. | | 0.02 | | 0.39 | | 0.01 | 0.30 | Wang et al., 2019 |
| NF-2 | 32.60 | 8.23 | 2.08 | 7.00 | 0.33 | 2.73 | | 3.41 | | 23.10 | | 1.01 | | 1106.00 | | 0.26 | | 0.76 | | 28.80 | | 0.66 | | 1.41 | | 0.14 | | 0.59 | | | 0.09 | | 0.01 | | 0.04 | | 0.23 | | 0.01 | | 0.02 | | 0.01 | | | n.d. | | 0.03 | | 0.86 | | 0.06 | 0.99 | Wang et al., 2019 |
| NF-3 | 31.30 | 1.14 | 0.72 | 5.90 | 0.40 | 3.10 | | 2.80 | | 7.70 | | 0.80 | | 3.84 | | 0.12 | | 0.16 | | 2.80 | | 0.14 | | 0.38 | | 0.04 | | 0.16 | | | 0.04 | | 0.00 | | 0.03 | | 0.20 | | 0.01 | | 0.02 | | 0.02 | | | n.d. | | 0.02 | | 0.29 | | 0.02 | 0.08 | Wang et al., 2019 |
| NF-4 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | | n.d. | | n.d. | | n.d. | | n.d. | n.d. | Wang et al., 2019 |
| **Gulf of Mexico**  **(GoM)** | GoM-1 | 6.76 | 4.78 | 2.13 | 11.80 | 0.17 | 1.48 | | 3.79 | | 6.30 | | 0.82 | | 221.00 | | 0.26 | | 0.12 | | 8.70 | | 0.20 | | 0.42 | | 0.05 | | 0.19 | | | 0.04 | | n.d. | | 0.03 | | 0.17 | | 0.01 | | 0.01 | | 0.01 | | | n.d. | | 0.02 | | 0.30 | | 0.07 | 0.15 | Wang et al., 2019 |
| GoM-2 | 9.03 | 4.61 | 9.30 | 10.50 | 0.22 | 5.39 | | 3.49 | | 46.50 | | 0.83 | | 28.00 | | 0.34 | | 0.14 | | 7.90 | | 0.15 | | 0.35 | | 0.04 | | 0.14 | | | 0.03 | | n.d. | | 0.02 | | 0.12 | | n.d. | | 0.01 | | 0.01 | | | n.d. | | 0.03 | | 0.21 | | 0.04 | 0.03 | Wang et al., 2019 |
| GoM-3 | 6.94 | 8.38 | 1.79 | 25.60 | 0.24 | 1.81 | | 3.59 | | 4.00 | | 0.89 | | 410.00 | | 0.32 | | 0.20 | | 12.70 | | 0.35 | | 0.59 | | 0.08 | | 0.33 | | | 0.06 | | 0.01 | | 0.04 | | 0.23 | | 0.01 | | 0.02 | | 0.02 | | | n.d. | | 0.04 | | 0.38 | | 0.08 | 0.39 | Wang et al., 2019 |
| GoM-4 | 8.19 | 24.43 | 8.62 | 58.60 | 0.46 | 2.20 | | 2.55 | | 8.10 | | 2.20 | | 104.00 | | 0.99 | | 0.63 | | 34.40 | | 0.65 | | 1.24 | | 0.16 | | 0.60 | | | 0.12 | | 0.01 | | 0.09 | | 0.62 | | 0.02 | | 0.05 | | 0.05 | | | 0.01 | | 0.08 | | 0.62 | | 0.18 | 0.42 | Wang et al., 2019 |
| GoM-5 | 6.60 | 29.35 | 6.39 | 33.50 | 0.57 | 3.75 | | 3.35 | | 6.30 | | 2.62 | | 82.00 | | 1.33 | | 0.21 | | 33.70 | | 0.88 | | 1.69 | | 0.21 | | 0.81 | | | 0.16 | | 0.02 | | 0.12 | | 0.81 | | 0.03 | | 0.07 | | 0.06 | | | 0.01 | | 0.02 | | 0.89 | | 0.22 | 0.08 | Wang et al., 2019 |
| GoM-6 | 6.94 | 27.91 | 6.12 | 49.60 | 0.72 | 2.65 | | 2.10 | | 4.80 | | 2.43 | | 72.00 | | 1.40 | | 0.19 | | 29.90 | | 1.00 | | 1.86 | | 0.24 | | 0.95 | | | 0.19 | | 0.02 | | 0.17 | | 1.10 | | 0.03 | | 0.09 | | 0.08 | | | 0.01 | | 0.01 | | 0.95 | | 0.24 | 0.21 | Wang et al., 2019 |
| GoM-7 | 8.25 | 29.55 | 5.25 | 8.50 | 0.19 | 1.73 | | 7.49 | | 22.20 | | 1.00 | | 33.00 | | 0.44 | | 0.13 | | 19.50 | | 0.40 | | 0.80 | | 0.09 | | 0.34 | | | 0.07 | | 0.01 | | 0.05 | | 0.30 | | 0.01 | | 0.03 | | 0.02 | | | n.d. | | 0.01 | | 0.37 | | 0.08 | 0.09 | Wang et al., 2019 |

n.d. indicates ‘not determined’.

Table S5. Lipid biomarker data for authigenic carbonates from the Chukchi Borderlands.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sites** | **Sample**  **ID** | Irregular hydrocarbons | | | | | | isoprenoid dialkyl glycerol diethers | | | | | | non-isoprenoid dialkyl glycerol diethers | | | | | | fatty acids | | | | | | | | | | Reference |
| Crocetane | | PMI | | PMI:3 | | archaeol | | *sn*-2-hydroxyarchaeol | | *sn*-3-hydroxyarchaeol | | DGD\_If | | DGD\_IIa | | DGD\_IId | | i-C15:0 | ai-C15:0 | C16:1ω7 | C16:0 | C17:0 | C18:1ω9 | C18:1ω7 | C18:0 | C20:0 | C22:0 |
| μg g-1dw | ‰ VPDB | μg g-1dw | ‰ VPDB | μg g-1dw | ‰ VPDB | μg g-1dw | ‰ VPDB | μg g-1dw | ‰ VPDB | μg g-1dw | ‰ VPDB | μg g-1dw | ‰ VPDB | μg g-1dw | ‰ VPDB | μg g-1dw | ‰ VPDB | μg g-1dw | | | | | | | | | |
| **Chukch**  **borderland**  **(CB)** | CB-1 | 0.01\* | n.d. | 0.02 | -65.2 | n.d. | n.d. | 0.02 | -87.6 | 0.02 | -90.6 | n.d. | n.d. | 0.03 | -66.5 | 0.01 | n.d. | 0.01 | n.d. | 0.02 | 0.05 | 0.23 | 0.62 | 0.04 | 0.09 | 0.15 | 0.47 | 0.07 | 0.13 | This study |
| CB-2 | 0.03\* | -28.5 | 0.03 | -68.4 | n.d. | n.d. | 0.04 | -94.1 | 0.05 | -94.7 | n.d. | n.d. | 0.05 | -54.9 | 0.04 | -77.7 | 0.02 | -80.6 | 0.01 | 0.01 | 0.01 | 0.28 | 0.02 | 0.01 | 0.03 | 0.24 | 0.02 | 0.02 | This study |
| CB-3 | 0.02\* | -28.5 | 0.02 | -79.2 | n.d. | n.d. | 0.05 | -92.1 | 0.05 | -99.4 | n.d. | n.d. | 0.02 | -56.5 | 0.01 | n.d. | 0.01 | n.d. | 0.01 | 0.02 | 0.08 | 0.22 | 0.01 | 0.04 | 0.06 | 0.12 | 0.09 | 0.01 | This study |
| CB-4 | 0.02\* | -27.9 | 0.02 | -83.9 | n.d. | n.d. | 0.09 | -85.6 | 0.1 | -87.5 | n.d. | n.d. | 0.06 | -53.7 | 0.04 | -50.3 | 0.03 | -50.6 | n.d. | 0.02 | 0.34 | 0.28 | 0.02 | 0.17 | 0.08 | 0.08 | 0.09 | 0.01 | This study |
| CB-5 | 0.01\* | n.d. | 0.02 | -60.9 | n.d. | n.d. | 0.03 | -97.4 | 0.03 | -94.1 | n.d. | n.d. | 0.02 | -58.5 | 0.01 | n.d. | 0.01 | n.d. | 0 | 0.01 | 0.04 | 0.21 | 0.01 | 0.07 | 0.05 | 0.11 | 0.05 | 0.02 | This study |
| CB-6 | 0.01\* | n.d. | 0.02 | -88.2 | n.d. | n.d. | 0.18 | -102.9 | 0.32 | -108.0 | n.d. | n.d. | 0.11 | -78.0 | 0.1 | -84.9 | 0.08 | -88.6 | 0.01 | 0.01 | 0.06 | 0.26 | 0.02 | 0.07 | 0.11 | 0.16 | 0.07 | 0.08 | This study |
| CB-7 | 0.05\* | -25.4 | 0.04 | -61.5 | n.d. | n.d. | 0.03 | -82.9 | 0.02 | -96.9 | n.d. | n.d. | 0.05 | -60.3 | 0.02 | -60.8 | 0.02 | -65.5 | n.d. | n.d. | 0.03 | 0.09 | 0.01 | 0.04 | 0.06 | 0.04 | 0.07 | n.d. | This study |
| **Congo Fan**  **(CF)** | CF-1 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0.01 | n.d. | 0.03 | -112.5 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0.16 | n.d. | n.d. | n.d. | 0.21 | n.d. | 0.04 | Wang et al., 2019 |
| CF-2 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0.03 | -97.6 | 0.04 | -97.4 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0.14 | n.d. | n.d. | 0.02 | 0.2 | 0.02 | 0.02 | Wang et al., 2019 |
| CF-3 | 0.03 | -87.8 | 0.25 | -122.1 | n.d. | n.d. | 0.83 | -116.2 | 0.6 | -117.3 | 0.22 | -118.6 | 0.43 | -104.7 | 0.07 | -87.1 | 0.11 | -68.8 | 0.01 | n.d. | 0.01 | 0.64 | 0.05 | 0.01 | 0.01 | 0.88 | 0.02 | 0.03 | Wang et al., 2019 |
| **Nile Deep-Sea**  **Fan**  **(NDSF)** | NDSF-1 | 0.21 | -57.9 | 0.42 | -123.6 | 0.49 | -109.9 | 0.92 | -109.3 | 1.28 | -108.9 | 0.1 | -103.4 | 0.17 | -87.5 | 0.16 | -83.7 | 0.22 | -75.1 | 0.05 | 0.02 | 0.05 | 0.23 | 0.03 | 0.07 | 0.14 | 0.39 | 0.04 | 0.02 | Wang et al., 2019 |
| NDSF-2 | 0.08 | -45.9 | 0.1 | -112.5 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0.06 | n.d. | 0.01 | n.d. | 0.15 | 0.01 | 0.02 | Wang et al., 2019 |
| NDSF-3 | 0.05 | -67.9 | 0.02 | -134.4 | n.d. | n.d. | 0.21 | -122.2 | 0.48 | -116.5 | 0.03 | -118.5 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0.01 | 0.22 | n.d. | n.d. | 0.02 | 0.18 | 0.01 | 0.02 | Wang et al., 2019 |
| NDSF-4 | 0.02 | -52.1 | 0.03 | -107.7 | n.d. | n.d. | 0.36 | -117.4 | 0.46 | -111.0 | 0.21 | -115.9 | 0.06 | -109.9 | 0.12 | -85.5 | 0.22 | -80.3 | n.d. | 0.01 | n.d. | 0.24 | 0.02 | 0.03 | 0.02 | 0.19 | 0.01 | 0.02 | Wang et al., 2019 |
| **Niger Fan**  **(NF)** | NF-1 | 0.25 | -119.7 | 0.25 | -127.5 | 0.01 | n.d. | 6.97 | -125.3 | 22.13 | -120.1 | n.d. | n.d. | 0.41 | -84.0 | 1.07 | -108.6 | 0.55 | -116.3 | 0.02 | 0.02 | n.d. | 0.14 | n.d. | 0.04 | 0.02 | 0.08 | n.d. | 0.01 | Wang et al., 2019 |
| NF-2 | 0.07 | -67.4 | 0.05 | -105.3 | n.d. | n.d. | 0.73 | -104.9 | 1.34 | -103.0 | 0.2 | -105.9 | 0.04 | -92.0 | n.d. | n.d. | n.d. | n.d. | n.d. | 0.01 | n.d. | 0.35 | n.d. | 0.01 | 0.01 | 0.3 | 0.01 | 0.02 | Wang et al., 2019 |
| NF-3 | 0.09 | -57.0 | n.d. | n.d. | n.d. | n.d. | 0.09 | -123.8 | 0.23 | -115.7 | 0.02 | -112.4 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0.02 | 0.06 | 0.22 | 0.02 | 0.02 | 0.08 | 0.19 | n.d. | 0.06 | Wang et al., 2019 |
| NF-4 | 0.13 | -49.6 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0.05 | 0.12 | 0.87 | 0.05 | 0.16 | n.d. | 0.78 | 0.02 | 0.02 | Wang et al., 2019 |
| **Gulf of Mexico**  **(GoM)** | GoM-1 | 0.17 | -50.1 | 0.09 | -102.2 | n.d. | n.d. | 0.31 | -124.6 | 0.68 | -99.8 | 0.04 | -100.4 | 0.12 | -32.5 | n.d. | n.d. | n.d. | n.d. | 0.05 | 0.06 | 0.09 | 1.99 | 0.14 | 0.09 | 0.14 | 1.61 | 0.05 | 0.07 | Wang et al., 2019 |
| GoM-2 | 0.25 | -32.3 | n.d. | n.d. | n.d. | n.d. | 0.02 | -87.7 | n.d. | n.d. | n.d. | n.d. | 0.04 | -36.3 | n.d. | n.d. | n.d. | n.d. | 0.03 | 0.03 | 0.06 | 0.89 | 0.12 | 0.1 | n.d. | 0.63 | 0.03 | 0.06 | Wang et al., 2019 |
| GoM-3 | 0.13 | -93.9 | 0.11 | -119.8 | n.d. | n.d. | 1.76 | -111.8 | 3.2 | -107.3 | 0.29 | -105.4 | 0.21 | -30.2 | n.d. | n.d. | n.d. | n.d. | 0.05 | 0.03 | n.d. | 0.62 | 0.05 | 0.02 | 0.05 | 0.46 | 0.02 | 0.01 | Wang et al., 2019 |
| GoM-4 | 0.15 | -95.5 | 0.14 | -111.8 | n.d. | n.d. | 1.48 | -116.5 | 3.08 | -110.7 | 0.09 | -111.4 | 0.29 | -37.6 | 0.25 | -99.8 | 0.39 | -94.0 | 0.01 | 0.02 | n.d. | 0.78 | 0.05 | 0.03 | 0.06 | 0.63 | 0.03 | 0.02 | Wang et al., 2019 |
| GoM-5 | 0.07 | -45.4 | 0.03 | -109.4 | n.d. | n.d. | 0.04 | -121.1 | 0.03 | -122.7 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0.02 | 0.02 | n.d. | 0.76 | 0.02 | 0.03 | 0.05 | 0.61 | 0.02 | 0.02 | Wang et al., 2019 |
| GoM-6 | 0.06 | -57.0 | 0.04 | -132.9 | n.d. | n.d. | 0.06 | -121.7 | 0.04 | -120.6 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0.02 | n.d. | 0.55 | 0.03 | n.d. | 0.08 | 0.39 | 0.01 | 0.06 | Wang et al., 2019 |
| GoM-7 | 0.06 | -55.3 | 0.03 | -109.6 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0.02 | n.d. | 0.45 | 0.05 | 0.02 | 0.04 | 0.36 | 0.02 | 0.07 | Wang et al., 2019 |

n.d. indicates ‘not determined’.

\* indicates not crocetane but phytane.

Table S6. Microbial diversity in authigenic carbonates from the Chukchi Borderlands.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Taxanomy· | | Study sites | | | | | | | | | | | | | | | | | | | | | |
| Domain | Phylum | Chukchi borderland (Western Arctic) | | | | | | | Gulf of Mexico | | | | | | Nile Deep-Sea Fan | | | Niger Fan | | | Congo Fan | | |
| CB-1 | CB-2 | CB-3 | CB-4 | CB-5 | CB-6 | CB-7 | GoM-1 | GoM-2 | GoM-3 | GoM-4 | GoM-5 | GoM-6 | NDSF-1 | NDSF-2 | NDSF-3 | NF-1 | NF-2 | NF-3 | CF-1 | CF-2 | CF-3 |
| Archaea | Euryarchaeota | 85.00 | n.d. | 98.94 | 99.98 | 92.38 | 99.41 | 96.67 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 90.78 | n.d. | n.d. | 97.45 | n.d. | n.d. | n.d. | n.d. | n.d. |
| Lokiarchaeota | 14.37 | n.d. | 0.00 | 0.00 | 6.12 | 0.45 | 1.48 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 8.69 | n.d. | n.d. | 2.55 | n.d. | n.d. | n.d. | n.d. | n.d. |
| Bathyarchaeota | 0.48 | n.d. | 1.06 | 0.00 | 1.05 | 0.05 | 0.67 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0.15 | n.d. | n.d. | 0.00 | n.d. | n.d. | n.d. | n.d. | n.d. |
| Thaumarchaeota | 0.15 | n.d. | 0.00 | 0.00 | 0.46 | 0.04 | 1.17 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0.00 | n.d. | n.d. | 0.00 | n.d. | n.d. | n.d. | n.d. | n.d. |
| Unclassified archaea | n.d. | n.d. | n.d. | 0.02 | n.d. | 0.04 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0.38 | n.d. | n.d. | 0.00 | n.d. | n.d. | n.d. | n.d. | n.d. |
| Bacteria | Firmicutes | n.d. | n.d. | n.d. | n.d. | n.d. | 0.66 | n.d. | 98.28 | 20.17 | 87.13 | 88.21 | 49.17 | 64.60 | 1.77 | 88.53 | 62.94 | 4.27 | 19.17 | n.d. | 1.44 | 9.31 | 5.46 |
| Proteobacteria | n.d. | n.d. | n.d. | n.d. | n.d. | 7.58 | 11.49 | 1.21 | 19.19 | 10.37 | 10.00 | 36.71 | 30.20 | 30.15 | 9.68 | 26.25 | 20.40 | 35.79 | n.d. | 74.52 | 65.20 | 56.11 |
| Atribacteria | n.d. | n.d. | n.d. | n.d. | n.d. | 61.38 | 77.85 | 0.00 | 0.15 | 0.03 | 0.00 | 0.00 | 0.00 | 2.07 | 0.00 | 1.32 | 0.71 | 0.00 | n.d. | 5.77 | 1.47 | 2.18 |
| Actinobacteria | n.d. | n.d. | n.d. | n.d. | n.d. | 7.04 | 2.73 | 0.26 | 25.30 | 0.11 | 0.59 | 7.80 | 3.06 | 3.94 | 1.33 | 2.54 | 2.70 | 24.10 | n.d. | 0.00 | 4.90 | 3.06 |
| Bacteroidetes | n.d. | n.d. | n.d. | n.d. | n.d. | 2.18 | 0.46 | 0.15 | 10.68 | 1.45 | 0.74 | 2.60 | 1.37 | 2.39 | 0.22 | 1.69 | 31.54 | 6.78 | n.d. | 8.65 | 15.93 | 6.77 |
| Planctomycetes | n.d. | n.d. | n.d. | n.d. | n.d. | 4.80 | 5.56 | 0.04 | 3.85 | 0.33 | 0.00 | 1.20 | 0.00 | 12.53 | 0.08 | 0.75 | 4.02 | 0.06 | n.d. | 2.88 | 0.98 | 6.77 |
| WM88 | n.d. | n.d. | n.d. | n.d. | n.d. | 0.12 | 0.00 | 0.00 | 0.20 | 0.03 | 0.00 | 0.00 | 0.00 | 11.19 | 0.02 | 1.03 | 21.06 | 0.00 | n.d. | 0.00 | 0.00 | 3.28 |
| Others | n.d. | n.d. | n.d. | n.d. | n.d. | 16.23 | 1.91 | 0.06 | 20.46 | 0.56 | 0.45 | 2.51 | 0.77 | 35.97 | 0.13 | 3.48 | 15.29 | 14.10 | n.d. | 6.73 | 2.21 | 16.38 |

n.d. indicates ‘not determined’.

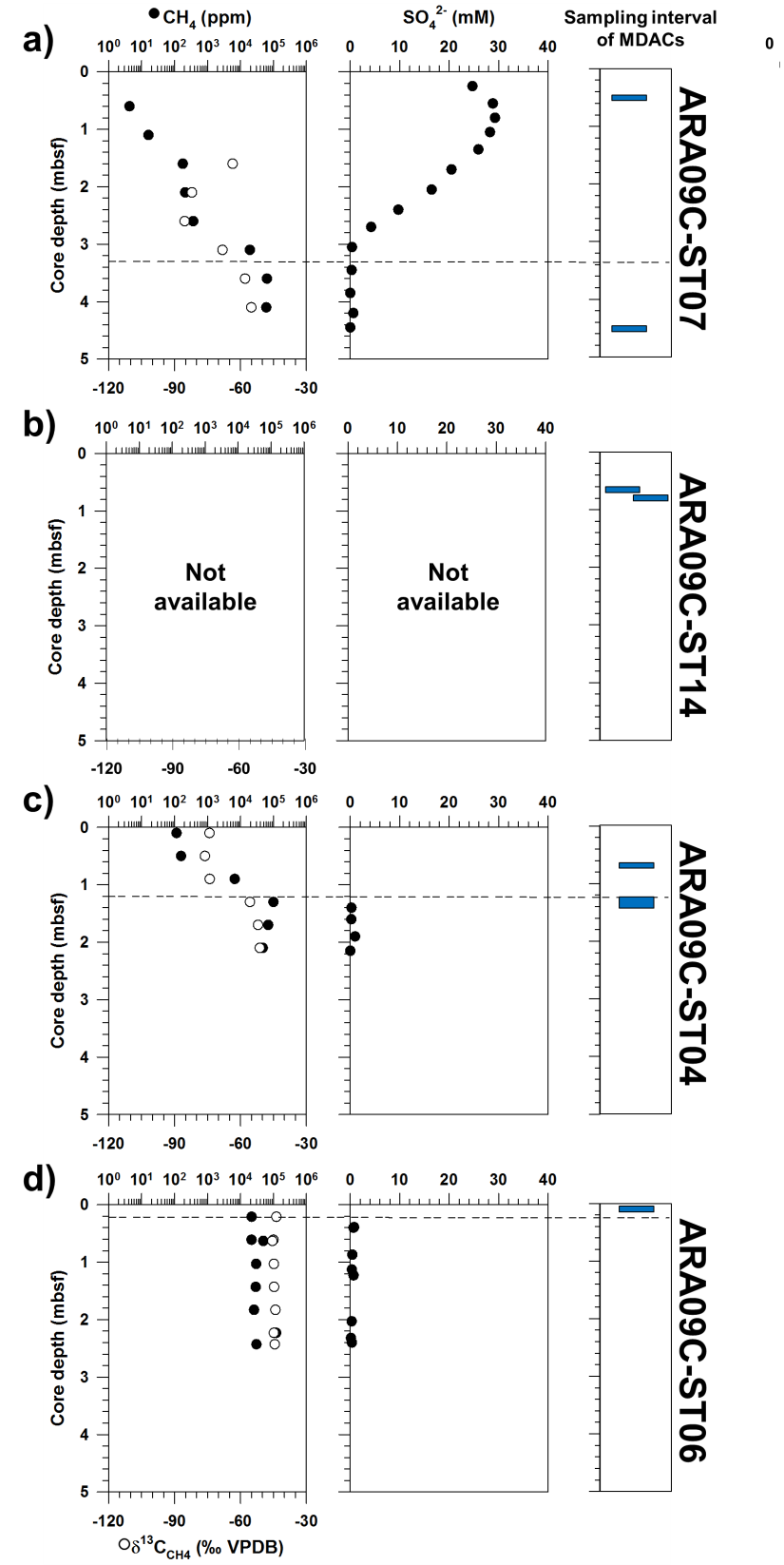


Figure S1. Downcore profiles of CH4 concentrations (ppm) and δ13CCH4 values (‰ VPDB) of headspace gases and dissolved sulfate (mM) in porewater with the indication of the MDAC sampling interval at sites a) ARA09C-ST07, b) ARA09C-ST014, c) ARA09C-ST04, and d) ARA09-ST06 (Kim et al., 2020 and 2022). Note that the data for ARA09C-ST014 are not available. Black dash lines indicate the depths of sulfate-methane transition zone (SMTZ).

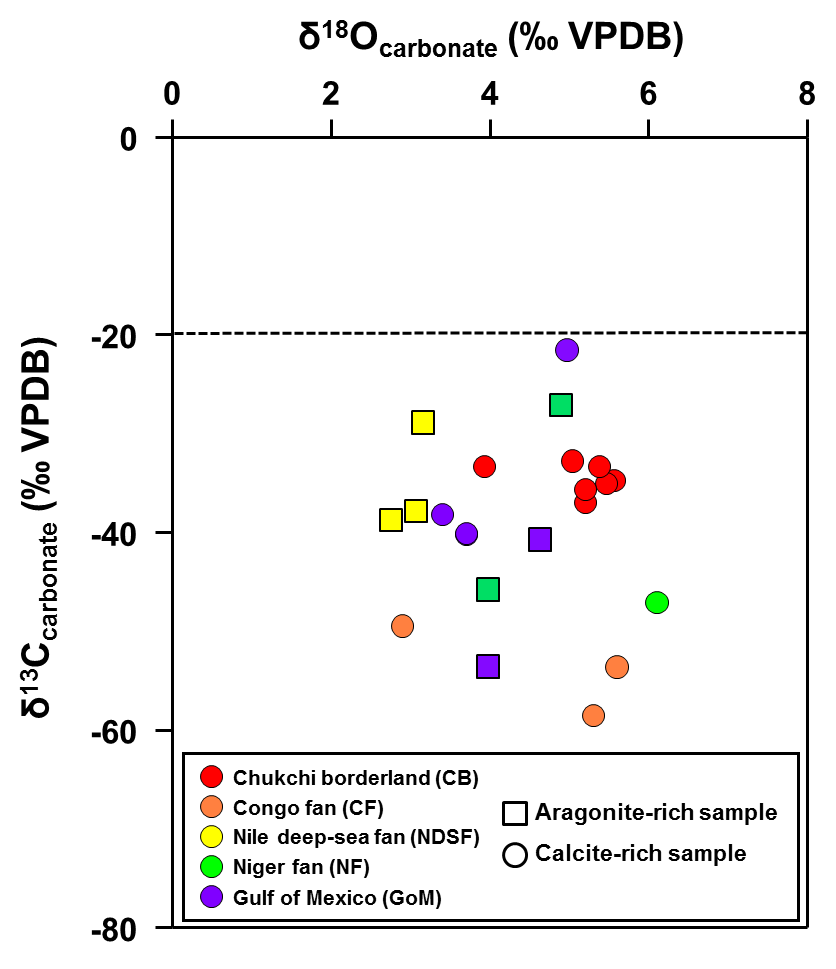


Figure S2. Scatter plot of 18Ocarbonate and 13Ccarbonate of authigenic carbonate samples considered in this study. The dashed line indicates the 13C baseline between marine- and methane-derived carbonates.

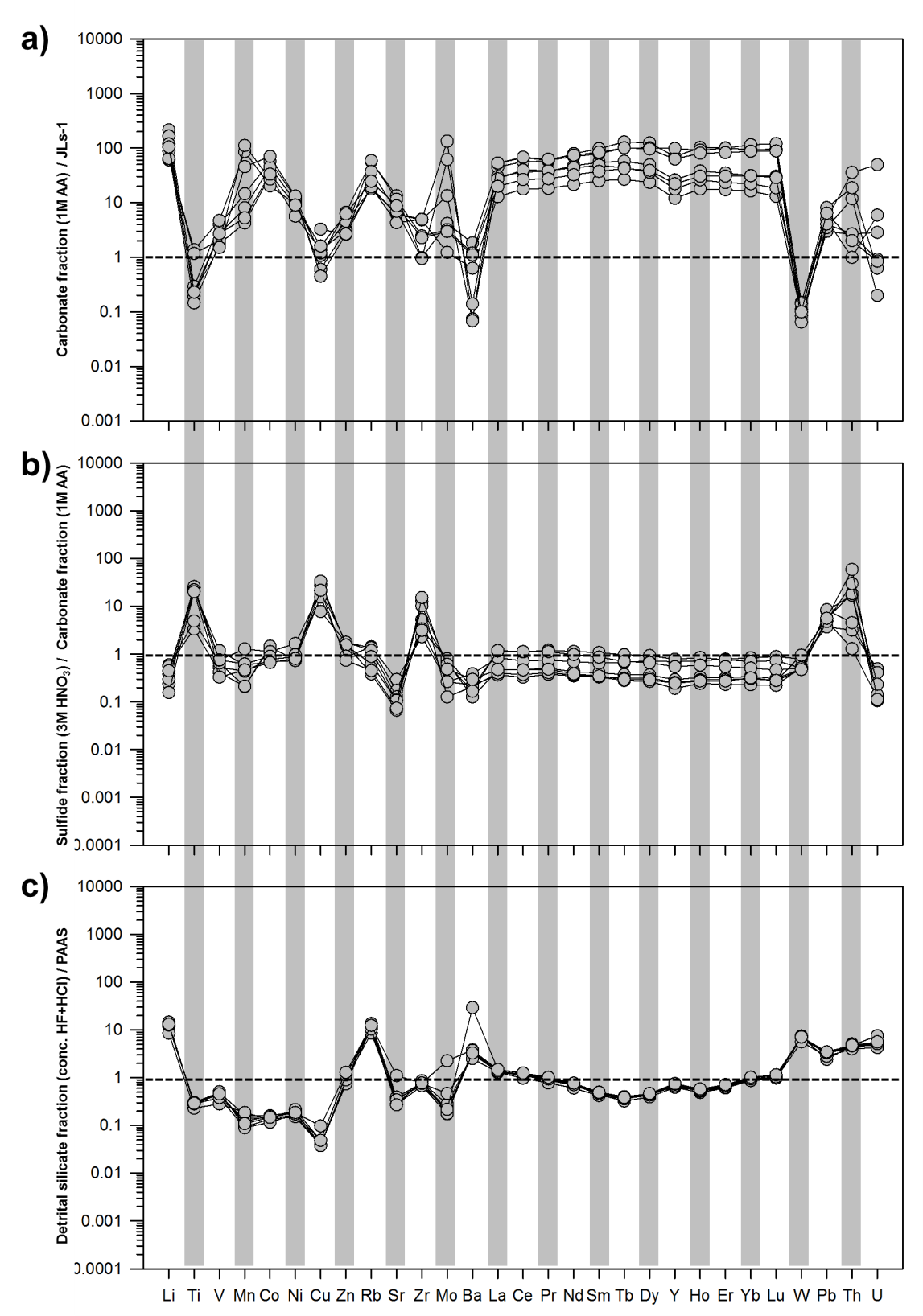


Figure S3. Enrichment factors of a) carbonate fraction (1M AA leachates) data normalized to values for the JLs-1 carbonate reference material, b) sulfide fraction (3M HNO3 leachates) data normalized to values for corresponding carbonate fractions (1M AA leachates), and c) detrital silicate fraction (concentrated HF + HCl leachates) data normalized to values for the PAAS reference material.

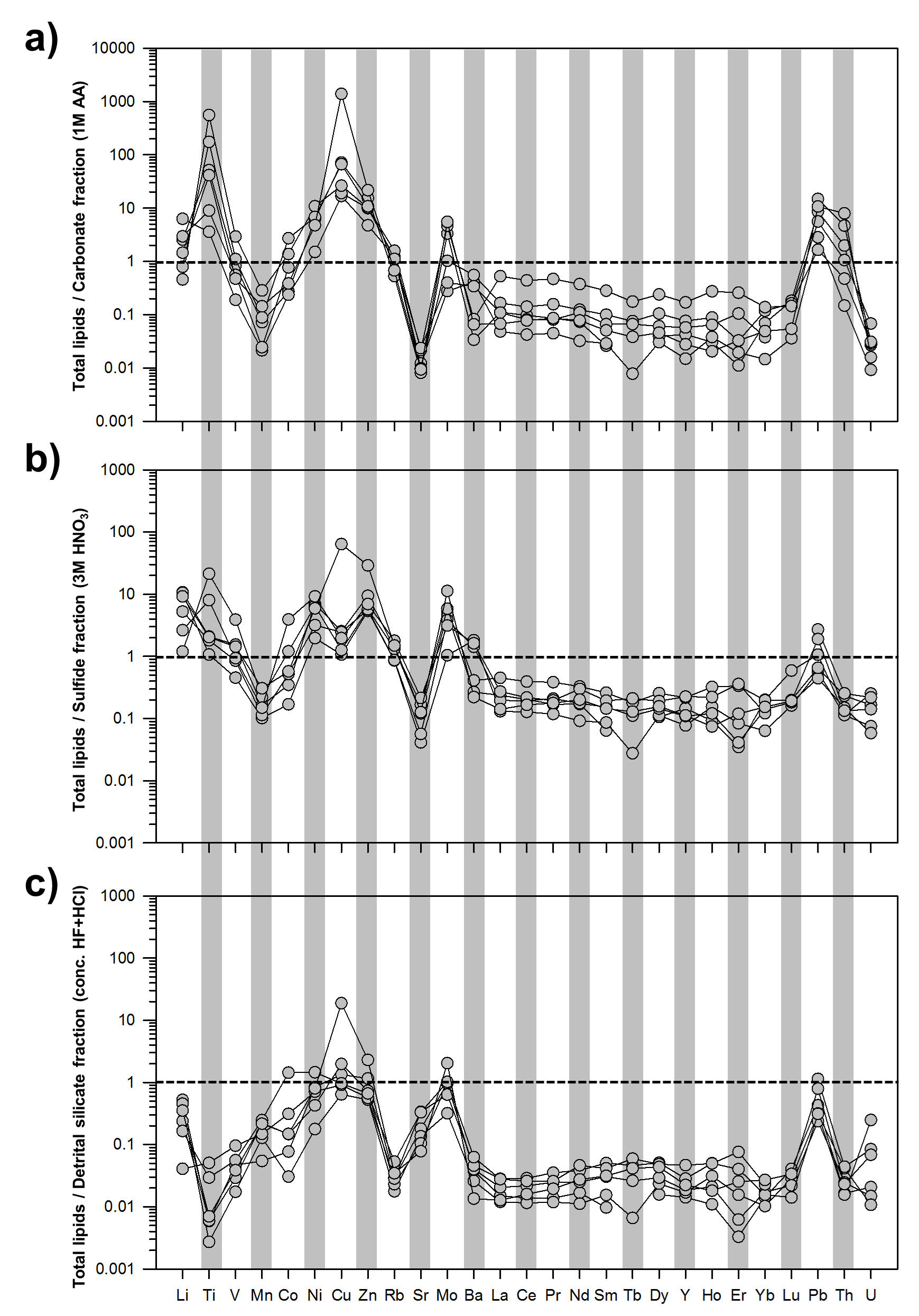


Figure S4. Enrichment factors of total lipids normalized to values for a) carbonate fractions (1M AA leachates), b) sulfide fractions (3M HNO3 leachates), and c) detrital silicate fractions (concentrated HF + HCl leachates).

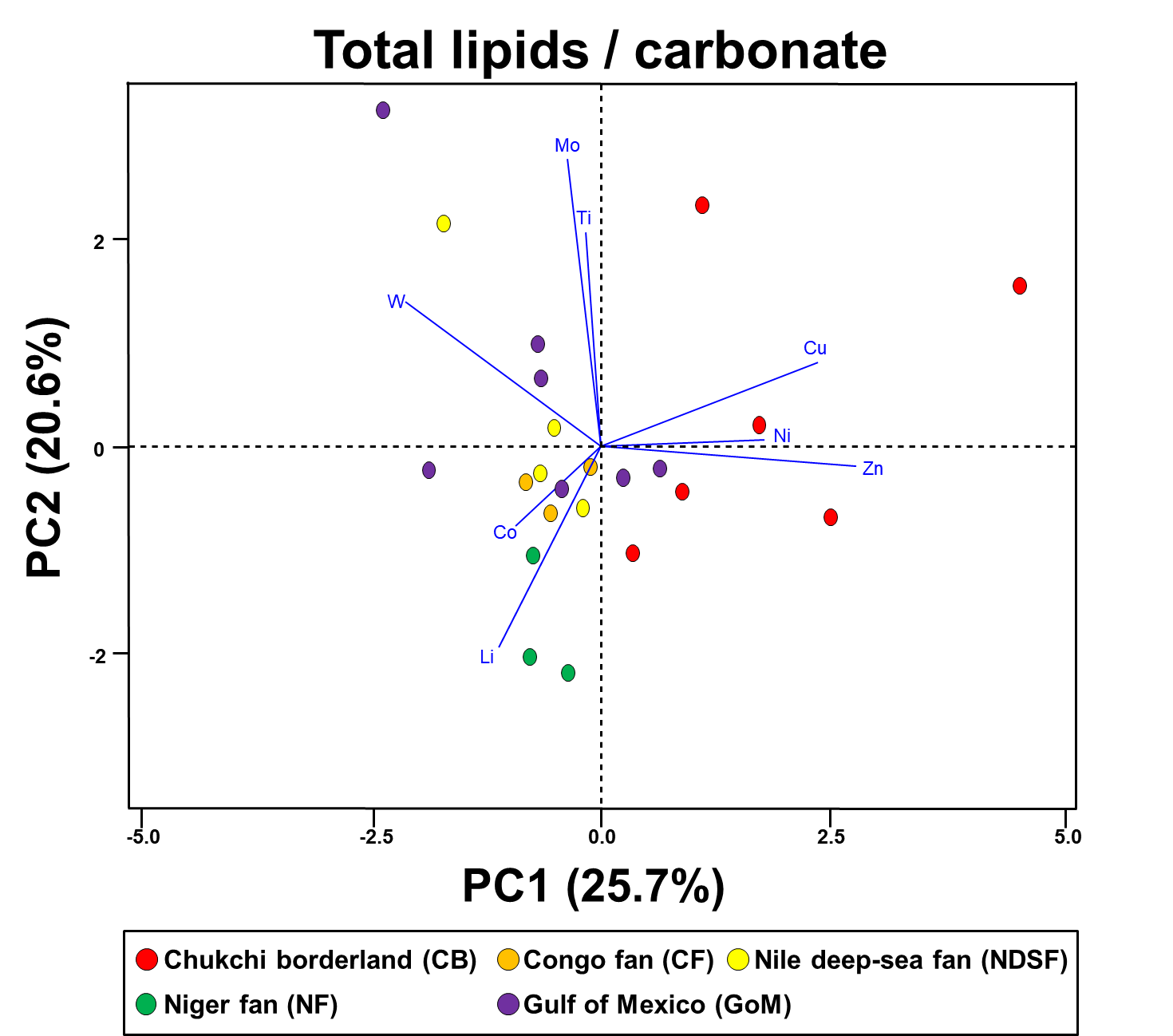


Figure S5. PCA results for the trace metal data for the total lipids normalized to the values of the carbonate fraction.