**Supplementary material**

Table S1. Measured calcification rates of the four coccolithophores species used for fits with eq. (5). Given are rates on a per cell basis and relative rates where each measurement was normalized to the species-specific maximum measured rate.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Species | CO2  (µmol kg-1) | HCO3- (µmol kg-1) | pH (free scale) | H+ (µmol kg-1) | calcification rate (pg cell-1 d-1) | calcification rate (relative) | Reference |
| *Calcidiscus leptoporus* | 3.6 | 1608 | 8.66 | 0.00219 | 45.0 | 0.48 | (Langer et al., 2006) |
| 7.4 | 1798 | 8.39 | 0.00406 | 78.0 | 0.83 |
| 12.6 | 1896 | 8.18 | 0.00654 | 94.0 | 1.00 |
| 16.3 | 1934 | 8.08 | 0.00830 | 80.0 | 0.85 |
| 26.2 | 1981 | 7.89 | 0.01300 | 75.0 | 0.80 |
| 33.0 | 1968 | 7.78 | 0.01651 | 62.0 | 0.66 |
| *Coccolithus pelagicus* | 2.0 | 1150 | 8.78 | 0.00167 | 57.2 | 0.20 | this study |
| 2.6 | 1221 | 8.71 | 0.00196 | 84.3 | 0.29 |
| 3.1 | 1289 | 8.65 | 0.00223 | 99.5 | 0.35 |
| 3.8 | 1359 | 8.58 | 0.00265 | 126.4 | 0.44 |
| 4.4 | 1400 | 8.53 | 0.00293 | 153.3 | 0.53 |
| 7.0 | 1538 | 8.37 | 0.00428 | 275.2 | 0.96 |
| 9.4 | 1644 | 8.27 | 0.00537 | 288.1 | 1.00 |
| 18.7 | 1859 | 8.03 | 0.00942 | 223.1 | 0.77 |
| 28.3 | 1972 | 7.87 | 0.01349 | 175.0 | 0.61 |
| 37.9 | 2039 | 7.76 | 0.01746 | 177.0 | 0.61 |
| 51.3 | 2102 | 7.64 | 0.02291 | 86.6 | 0.30 |
| 71.3 | 2158 | 7.51 | 0.03097 | 61.7 | 0.21 |
| 77.2 | 2159 | 7.47 | 0.03357 | 47.5 | 0.16 |
| 83.5 | 2163 | 7.44 | 0.03622 | 34.3 | 0.12 |
| *Gephyrocapsa oceanica* | 0.9 | 864 | 8.93 | 0.00117 | 3.7 | 0.24 | (Sett et al., 2014) |
| 2.2 | 1184 | 8.68 | 0.00209 | 10.5 | 0.67 |
| 4.1 | 1413 | 8.49 | 0.00324 | 11.7 | 0.74 |
| 10.7 | 1787 | 8.17 | 0.00668 | 15.7 | 1.00 |
| 16.0 | 1891 | 8.02 | 0.00949 | 14.4 | 0.92 |
| 21.9 | 1979 | 7.91 | 0.01240 | 12.2 | 0.78 |
| 28.8 | 2033 | 7.80 | 0.01587 | 9.4 | 0.59 |
| 36.5 | 2085 | 7.71 | 0.01957 | 6.0 | 0.38 |
| 45.1 | 2113 | 7.62 | 0.02384 | 4.4 | 0.28 |
| 47.1 | 2166 | 7.61 | 0.02432 | 7.1 | 0.45 |
| 50.3 | 2196 | 7.59 | 0.02562 | 6.7 | 0.43 |
| 87.0 | 2182 | 7.35 | 0.04454 | 2.7 | 0.17 |
| *Emiliania huxleyi* | 0.7 | 804 | 9.06 | 0.00087 | 2.4 | 0.22 | (Bach et al., 2012, 2011) |
| 1.9 | 1125 | 8.81 | 0.00155 | 4.1 | 0.37 |
| 3.4 | 1355 | 8.63 | 0.00232 | 5.4 | 0.49 |
| 5.3 | 1531 | 8.49 | 0.00322 | 7.2 | 0.65 |
| 7.8 | 1678 | 8.36 | 0.00438 | 8.9 | 0.81 |
| 10.8 | 1776 | 8.24 | 0.00569 | 9.1 | 0.83 |
| 14.9 | 1880 | 8.13 | 0.00744 | 11.0 | 1.00 |
| 18.4 | 1940 | 8.05 | 0.00887 | 8.9 | 0.81 |
| 23.3 | 1986 | 7.96 | 0.01091 | 7.2 | 0.66 |
| 27.9 | 2040 | 7.89 | 0.01280 | 4.8 | 0.43 |
| 33.4 | 2068 | 7.82 | 0.01512 | 6.0 | 0.55 |
| 37.6 | 2105 | 7.78 | 0.01672 | 7.1 | 0.64 |
| 43.6 | 2119 | 7.72 | 0.01921 | 6.0 | 0.54 |
| 67.1 | 2166 | 7.54 | 0.02904 | 4.1 | 0.37 |
| 91.4 | 2199 | 7.41 | 0.03892 | 3.5 | 0.32 |
| 115.2 | 2229 | 7.32 | 0.04835 | 3.0 | 0.27 |
| 36.9 | 2086 | 7.78 | 0.01654 | 6.9 | 0.63 |
| 139.7 | 2252 | 7.24 | 0.05763 | 2.4 | 0.22 |
| 179.3 | 2260 | 7.13 | 0.07404 | 1.9 | 0.17 |
| 205.8 | 2290 | 7.08 | 0.08406 | 1.5 | 0.13 |
| 1.5 | 138 | 7.98 | 0.01037 | 0.9 | 0.09 |
| 3.0 | 274 | 8.00 | 0.01011 | -0.2 | -0.02 |
| 3.5 | 326 | 7.99 | 0.01019 | -0.6 | -0.05 |
| 4.8 | 451 | 8.00 | 0.01007 | 2.0 | 0.18 |
| 7.1 | 655 | 7.99 | 0.01019 | 3.0 | 0.27 |
| 8.3 | 751 | 7.98 | 0.01035 | 5.1 | 0.46 |
| 14.5 | 1329 | 7.99 | 0.01027 | 6.2 | 0.56 |
| 18.5 | 1689 | 7.99 | 0.01029 | 6.8 | 0.62 |
| 34.2 | 3173 | 8.00 | 0.01011 | 8.9 | 0.81 |
| 39.7 | 3735 | 8.00 | 0.00998 | 7.5 | 0.68 |
| 52.5 | 4874 | 8.00 | 0.01011 | 6.6 | 0.60 |
| 72.7 | 6830 | 8.00 | 0.00998 | 6.7 | 0.61 |
| 121.0 | 11466 | 8.00 | 0.00990 | 5.5 | 0.50 |
| 137.0 | 13061 | 8.01 | 0.00985 | 5.8 | 0.52 |
| 16.9 | 517 | 7.51 | 0.03067 | 0.2 | 0.01 | (Bach et al., 2013, 2012) |
| 14.3 | 508 | 7.58 | 0.02648 | 0.3 | 0.03 |
| 12.0 | 494 | 7.64 | 0.02286 | 0.6 | 0.05 |
| 18.0 | 780 | 7.66 | 0.02169 | 4.0 | 0.37 |
| 18.0 | 785 | 7.67 | 0.02152 | 4.0 | 0.36 |
| 18.4 | 787 | 7.66 | 0.02200 | 4.4 | 0.40 |
| 17.4 | 1093 | 7.83 | 0.01495 | 6.3 | 0.57 |
| 17.8 | 1116 | 7.83 | 0.01495 | 6.4 | 0.58 |
| 17.4 | 1112 | 7.83 | 0.01465 | 6.7 | 0.61 |
| 15.2 | 1754 | 8.09 | 0.00815 | 8.1 | 0.74 |
| 15.1 | 1750 | 8.09 | 0.00812 | 8.0 | 0.73 |
| 15.2 | 1753 | 8.09 | 0.00815 | 7.6 | 0.69 |
| 15.6 | 3531 | 8.38 | 0.00414 | 9.3 | 0.85 |
| 15.2 | 3515 | 8.39 | 0.00407 | 9.3 | 0.84 |
| 15.3 | 3519 | 8.39 | 0.00408 | 10.2 | 0.93 |
| 3.9 | 201 | 7.74 | 0.01815 | 0.2 | 0.02 |
| 3.1 | 160 | 7.74 | 0.01818 | 0.2 | 0.02 |
| 4.0 | 205 | 7.74 | 0.01815 | 0.2 | 0.02 |
| 5.7 | 298 | 7.75 | 0.01793 | 0.2 | 0.02 |
| 6.3 | 329 | 7.75 | 0.01793 | 0.4 | 0.04 |
| 6.1 | 321 | 7.75 | 0.01782 | 0.4 | 0.03 |
| 16.7 | 865 | 7.74 | 0.01807 | 4.4 | 0.40 |
| 16.5 | 852 | 7.74 | 0.01811 | 4.3 | 0.40 |
| 16.9 | 871 | 7.74 | 0.01818 | 4.7 | 0.42 |
| 37.5 | 1920 | 7.74 | 0.01833 | 7.2 | 0.65 |
| 37.6 | 1920 | 7.74 | 0.01837 | 8.1 | 0.74 |
| 37.6 | 1916 | 7.74 | 0.01840 | 7.5 | 0.68 |
| 73.3 | 3853 | 7.75 | 0.01782 | 8.0 | 0.73 |
| 73.0 | 3832 | 7.75 | 0.01786 | 8.6 | 0.79 |
| 73.2 | 3841 | 7.75 | 0.01786 | 9.1 | 0.83 |
| 134.9 | 6983 | 7.74 | 0.01811 | 7.8 | 0.71 |
| 135.5 | 6972 | 7.74 | 0.01822 | 8.4 | 0.76 |
| 134.5 | 6964 | 7.74 | 0.01811 | 8.8 | 0.80 |
| 0.9 | 173 | 8.32 | 0.00479 | 0.1 | 0.01 |
| 0.8 | 155 | 8.33 | 0.00465 | 0.1 | 0.01 |
| 0.8 | 168 | 8.33 | 0.00465 | 0.1 | 0.01 |
| 3.9 | 778 | 8.33 | 0.00465 | 4.5 | 0.41 |
| 3.8 | 781 | 8.34 | 0.00460 | 4.4 | 0.40 |
| 3.8 | 781 | 8.34 | 0.00461 | 4.3 | 0.39 |
| 9.6 | 1955 | 8.34 | 0.00461 | 6.9 | 0.63 |
| 9.6 | 1957 | 8.34 | 0.00461 | 7.5 | 0.68 |
| 9.6 | 1957 | 8.34 | 0.00460 | 7.8 | 0.71 |
| 16.5 | 3406 | 8.34 | 0.00456 | 7.1 | 0.65 |
| 16.6 | 3410 | 8.34 | 0.00457 | 7.3 | 0.67 |
| 16.6 | 3418 | 8.34 | 0.00457 | 7.8 | 0.71 |
| 27.8 | 5794 | 8.35 | 0.00450 | 8.2 | 0.75 |
| 27.7 | 5792 | 8.35 | 0.00450 | 8.1 | 0.74 |
| 27.7 | 5784 | 8.35 | 0.00449 | 8.4 | 0.76 |
| 43.3 | 8643 | 8.33 | 0.00470 | 9.1 | 0.83 |
| 43.5 | 8663 | 8.33 | 0.00471 | 8.0 | 0.73 |