Supplementary Material

Carbon dynamics during the formation of sea ice at different growth rates

Daniela König\*, Lisa A. Miller, Kyle G. Simpson, Svein Vagle

**\* Correspondence:** Daniela König:daniela.koenig@liverpool.ac.uk

# Air temperatures

Table S1. Mean values and standard deviations of air temperatures for each run as measured by the weather station in the cold lab. For stirred Runs 5 to 8, temperatures were averaged between the end of the last pre-ice water sampling and the start of the under-ice water sampling. For the unstirred Runs 10 to 12, we averaged the temperature over the period between the shut down of the stirring system (which coincided with the setting of the desired room temperature and was within a couple of hours after the pre-ice water samples were collected), and the under-ice water sampling. Time series of air temperatures during each run are shown by König (2017).

|  |  |  |
| --- | --- | --- |
| **Run** | **Mean air temperature***°C* | **Standard deviation***°C* |
| **8** | -15.0 | 1.0 |
| **5** | -24.9 | 1.9 |
| **6** | -41.5 | 2.1 |
| **12** | -14.8 | 0.9 |
| **10** | -24.4 | 2.2 |
| **11** | -40.7 | 4.6 |

# Water and ice melt samples

Table S2. Results for all analysed water and ice melt samples. Error estimates for laboratory measurements are shown for samples where two or more replicates were analysed; for pH samples, the standard deviation of the four replicates was used; for TIC, AT, and salinity, the difference between the duplicates, divided by two.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Experiment** | **Sample type** | **TIC***µmol/kg* | **AT** *µmol/kg* | **pH***total scale* | **Salinity** |
| **Run 5** | *Pre-ice 1* | 2226.7 | ± | 0.3 | 2405 | ± | 3 | 7.535 | ± | 0.003 | 33.8256 |   |   |
| - 25 °C | *Pre-ice 2* | 2229.5 | ± | 0.4 | 2413 |   |   | 7.530 | ± | 0.001 | 33.8832 |   |   |
| stirred | *Under-ice* | 2578.4 | ± | 1.1 | 2769 | ± | 2 | 7.503 | ± | 0.004 | 39.1169 |   |   |
|  | *Ice core 1* | 810.0 | ± | 0.4 | 881 |   |   |   |   |   | 12.5300 |   |   |
|  | *Ice core 2* | 801.4 | ± | 0.1 | 892 |   |   |   |   |   | 12.0810 |   |   |
|  | *Ice core 3* | 847.9 | ± | 0.02 | 912 |   |   |   |   |   | 12.8235 |   |   |
|  | *Ice core 4* | 817.8 | ± | 0.1 | 879 | ± | 1 |   |   |   | 12.2177 |   |   |
| **Run 6** | *Pre-ice*  | 2225.4 | ± | 0.1 | 2424 | ± | 5 | 7.539 | ± | 0.001 | 33.7634 |   |   |
| - 40 °C | *Under-ice* | 2509.8 | ± | 0.2 | 2711 |   |   | 7.522 | ± | 0.003 | 38.0804 |   |   |
| stirred | *Ice core 1* | 1001.7 | ± | 0.1 | 1083 |   |   |   |   |   | 15.2175 |   |   |
|  | *Ice core 2* | 1062.1 | ± | 0.1 | 1132 | ± | 1 |   |   |   | 15.9773 |   |   |
|  | *Ice core 3* | 1090.1 | ± | 0.3 | 1173 | ± | 3 |   |   |   | 16.4539 |   |   |
| **Run 8** | *Pre-ice 1* | 2240.8 | ± | 0.4 | 2380 | ± | 4 | 7.541 | ± | 0.005 | 33.8110 |   |   |
| - 15 °C | *Pre-ice 2* | 2243.6 | ± | 0.2 | 2387 | ± | 3 | 7.541 | ± | 0.003 | 33.8216 |   |   |
| stirred | *Under-ice* | 2601.5 | ± | 0.3 | 2741 | ± | 2 | 7.532 | ± | 0.004 | 39.2441 |   |   |
|  | *Ice core 1* | 616.6 | ± | 1.1 | 718 | ± | 2 |   |   |   | 9.7974 |   |   |
|  | *Ice core 2* | 594.1 | ± | 0.3 | 653 | ± | 0.2 |   |   |   | 8.9046 |   |   |
|  | *Ice core 3* | 660.0 | ± | 0.2 | 739 | ± | 3 |   |   |   | 10.2180 |   |   |
|  | *Ice core 4* | 603.4 | ± | 0.6 | 666 | ± | 0.1 |   |   |   | 9.0329 |   |   |
| **Run 10** | *Pre-ice 1* | 2256.1 | ± | 0.8 | 2406 | ± | 0.3 | 7.552 | ± | 0.002 | 33.7593 | ± | 0.0005 |
| - 25°C | *Pre-ice 2* | 2255.6 | ± | 0.7 | 2408 | ± | 2 | 7.551 | ± | 0.004 | 33.7703 | ± | 0.0007 |
| unstirred | *Under-ice* | 2706.0 | ± | 0.04 | 2896 | ± | 2 | 7.514 | ± | 0.001 | 40.5831 | ± | 0.0626 |
|  | *Ice core 1* | 815.5 | ± | 0.4 | 909 | ± | 5 |   |   |   | 12.4870 | ± | 0.0007 |
|  | *Ice core 2* | 702.6 | ± | 0.1 | 771 | ± | 1 |   |   |   | 10.5764 | ± | 0.00002 |
|  | *Ice core 3* | 804.4 | ± | 0.1 | 884 | ± | 2 |   |   |   | 12.1064 |   |   |
|  | *Ice core 4* | 730.2 | ± | 0.4 | 805 | ± | 0.1 |   |   |   | 10.9354 |   |   |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Run 11** | *Pre-ice*  | 2255.0 | ± | 0.2 | 2422 | ± | 1 | 7.560 | ± | 0.005 | 33.7755 | ± | 0.0008 |
| - 40 °C | *Under-ice* | 2627.1 |   |   | 2825 |   |   | 7.514 | ± | 0.002 | 39.3754 | ± | 0.0241 |
| unstirred | *Ice core 1* | 1103.0 | ± | 0.2 | 1209 | ± | 0.04 |   |   |   | 16.6271 |   |   |
|  | *Ice core 2* | 1007.9 | ± | 0.1 | 1098 | ± | 1 |   |   |   | 15.0792 |   |   |
|  | *Ice core 3* | 1036.5 | ± | 0.1 | 1133 | ± | 1 |   |   |   | 15.4886 |   |   |
|  | *Ice core 4* | 999.3 | ± | 0.2 | 1094 | ± | 6 |   |   |   | 15.0012 |   |   |
| **Run 12** | *Pre-ice*  | 2253.4 | ± | 0.2 | 2384 | ± | 2 | 7.559 | ± | 0.002 | 33.6969 | ± | 0.0017 |
| - 15 °C | *Under-ice* | 2710.7 | ± | 2.2 | 2865 | ± | 8 | 7.526 | ± | 0.001 | 40.5593 | ± | 0.0753 |
| unstirred | *Ice core 1* | 684.3 | ± | 0.2 | 745 | ± | 1 |   |   |   | 10.3941 |   |   |
|  | *Ice core 2* | 650.2 | ± | 0.04 | 709 | ± | 1 |   |   |   | 9.7807 |   |   |
|  | *Ice core 3* | 651.3 | ± | 0.2 | 703 | ± | 0.1 |   |   |   | 9.7007 |   |   |
|  | *Ice core 4* | 625.2 | ± | 0.04 | 673 | ± | 1 |   |   |   | 9.2962 |   |   |