



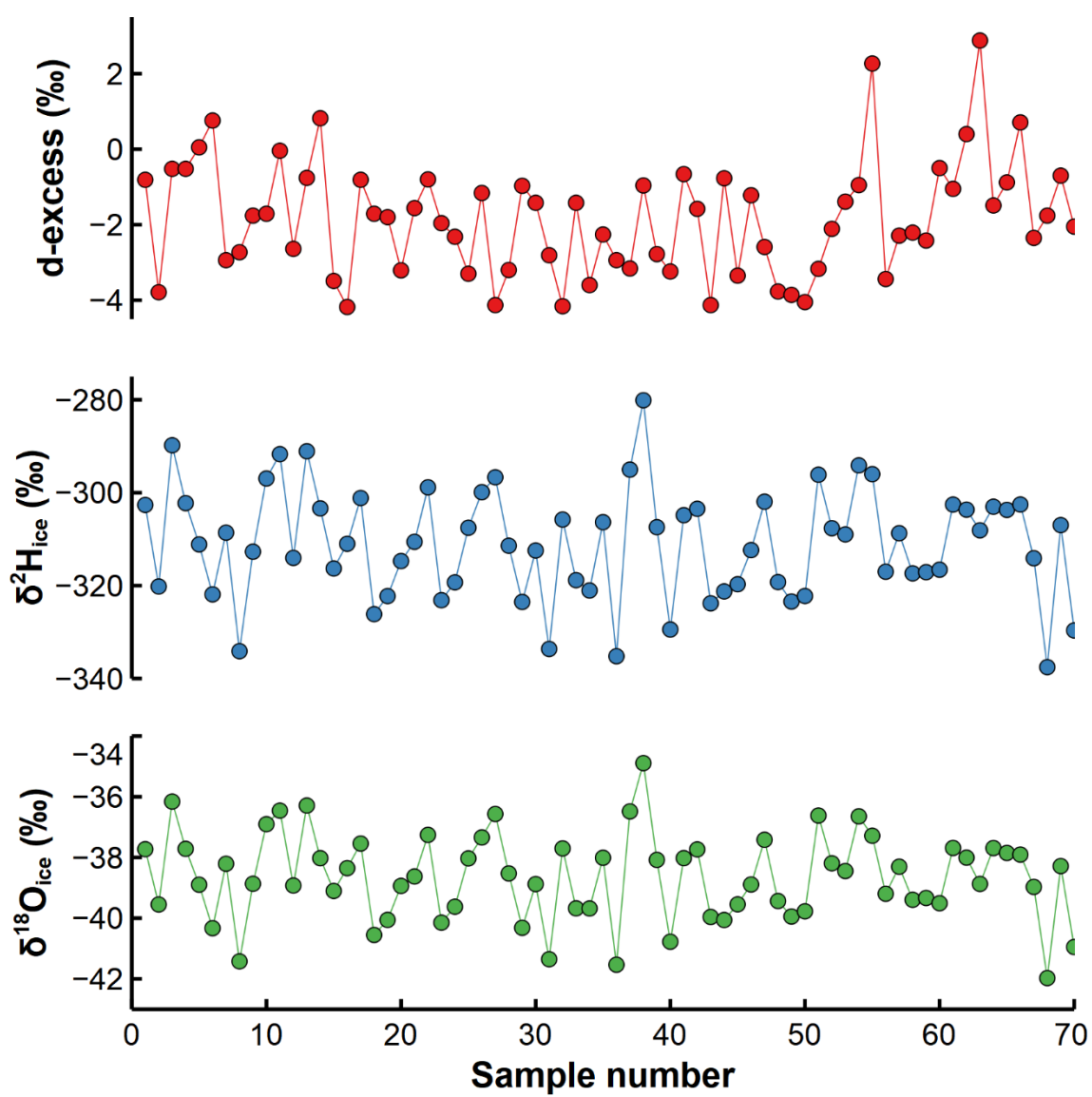
*Supplement of*

## **Identification of 320 000-year-old blue ice at the surface of the Elephant Moraine region, East Antarctica**

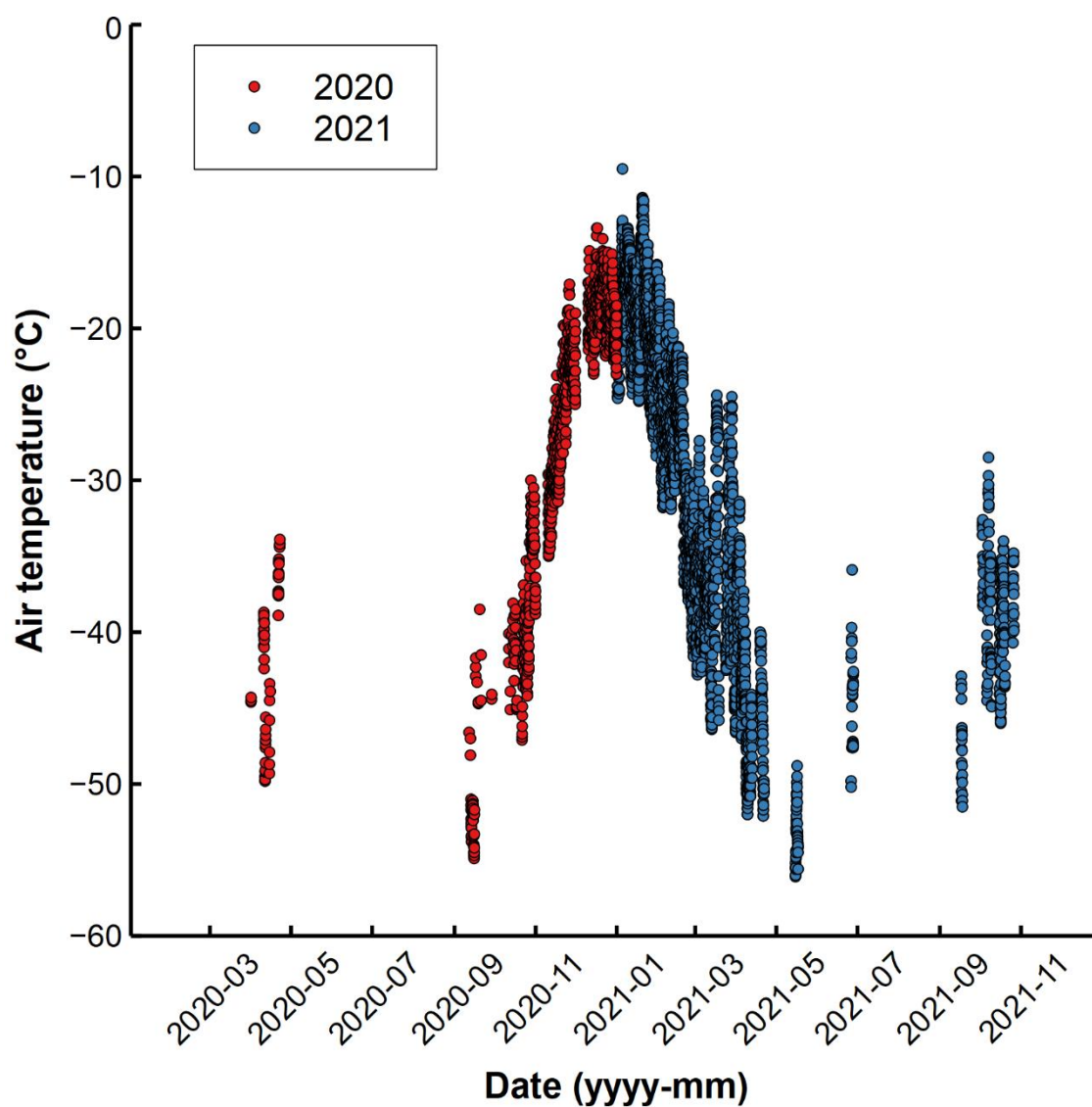
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**Figure S1.** Measured stable water isotope values and d-excess of Reckling Moraine (RM) blue ice.



15 **Figure S2.** Air temperature record provided by KOPRI's automatic weather station (AWS) during 2020–2021 in Elephant Moraine region (76.27° S, 156.71° E).

25     **Table S1.** CO<sub>2</sub> concentrations of EM-B, EM-C, and EM-K core from the Elephant Moraine region measured at SNU.

| EM-B       |                       | EM-C       |                       | EM-K       |                       |
|------------|-----------------------|------------|-----------------------|------------|-----------------------|
| Depth (cm) | CO <sub>2</sub> (ppm) | Depth (cm) | CO <sub>2</sub> (ppm) | Depth (cm) | CO <sub>2</sub> (ppm) |
| 7.5        | 378.5                 | 2.5        | 410.7                 | 52.5       | 285.8                 |
| 17.5       | 368.9                 | 7.5        | 379.8                 | 62.5       | 628.2                 |
| 30.0       | 343.8                 | 12.5       | 378.2                 | 70.5       | 420.9                 |
| 48.0       | 347.5                 | 17.5       | 402.5                 | 90.5       | 292.4                 |
| 58.0       | 294.3                 | 22.3       | 471.6                 | 110.5      | 303.8                 |
| 92.8       | 310.3                 | 82.0       | 280.2                 | 153.5      | 307.5                 |
| 150.0      | 294.3                 | 87.0       | 270.7                 | 197.5      | 299.8                 |
| 248.0      | 278.5                 | 92.0       | 278.0                 | 255.5      | 294.0                 |
| 517.5      | 294.4                 | 97.0       | 281.5                 | 361.5      | 288.5                 |
| 526.8      | 251.0                 | 102.0      | 288.6                 | 402.5      | 294.5                 |
| 532.5      | 271.5                 | 107.0      | 287.4                 | 468.5      | 358.5                 |
| 542.0      | 262.8                 | 132.8      | 284.1                 | 473.5      | 364.2                 |
| 546.5      | 264.0                 | 279.0      | 312.1                 | 501.5      | 300.5                 |
| 551.5      | 261.6                 | 289.0      | 292.6                 | 542.5      | 333.6                 |
| 562.5      | 263.7                 | 299.0      | 290.6                 |            |                       |
| 572.5      | 263.5                 | 309.0      | 248.5                 |            |                       |
| 583.5      | 256.0                 | 319.0      | 263.1                 |            |                       |
| 593.5      | 273.5                 | 324.0      | 268.9                 |            |                       |
| 603.5      | 264.8                 | 334.0      | 258.8                 |            |                       |
| 639.5      | 265.6                 | 344.0      | 285.5                 |            |                       |
| 649.0      | 248.7                 | 354.0      | 262.6                 |            |                       |
| 658.5      | 259.6                 | 364.0      | 264.5                 |            |                       |
| 668.5      | 247.4                 | 373.5      | 269.7                 |            |                       |
| 678.5      | 273.6                 | 384.0      | 274.5                 |            |                       |
| 693.5      | 269.6                 | 397.0      | 271.2                 |            |                       |
| 703.5      | 250.2                 | 419.0      | 273.9                 |            |                       |
| 713.5      | 255.2                 | 439.0      | 266.3                 |            |                       |
| 723.0      | 263.4                 | 462.0      | 267.9                 |            |                       |
| 727.5      | 247.0                 | 480.0      | 285.5                 |            |                       |
| 786.5      | 288.9                 | 500.0      | 264.5                 |            |                       |
| 796.5      | 267.6                 |            |                       |            |                       |
| 806.5      | 255.4                 |            |                       |            |                       |
| 817.5      | 266.2                 |            |                       |            |                       |
| 832.5      | 249.0                 |            |                       |            |                       |
| 855.0      | 256.8                 |            |                       |            |                       |
| 869.5      | 260.9                 |            |                       |            |                       |

|        |       |
|--------|-------|
| 879.5  | 342.9 |
| 891.5  | 330.8 |
| 906.5  | 295.3 |
| 918.5  | 257.0 |
| 928.5  | 267.2 |
| 938.5  | 276.2 |
| 948.5  | 277.1 |
| 959.5  | 285.6 |
| 969.5  | 274.8 |
| 984.5  | 289.8 |
| 997.5  | 289.1 |
| 1007.5 | 255.4 |

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45     **Table S2.** CH<sub>4</sub> concentrations of EM-B, EM-C, and EM-K core from the Elephant Moraine region measured at SNU.

| EM-B       |                       | EM-C       |                       | EM-K       |                       |
|------------|-----------------------|------------|-----------------------|------------|-----------------------|
| Depth (cm) | CH <sub>4</sub> (ppb) | Depth (cm) | CH <sub>4</sub> (ppb) | Depth (cm) | CH <sub>4</sub> (ppb) |
| 5.0        | 1360.3                | 5.0        | 918.8                 | 55.0       | 457.6                 |
| 15.0       | 1166.2                | 15.0       | 1148.2                | 78.0       | 207.4                 |
| 32.5       | 642.4                 | 85.0       | 681.8                 | 98.0       | 348.1                 |
| 66.0       | 747.6                 | 113.5      | 746.1                 | 117.0      | 296.1                 |
| 76.0       | 545.3                 | 159.5      | 577.6                 | 156.0      | 381.3                 |
| 86.0       | 564.2                 | 189.5      | 519.1                 | 195.0      | 431.8                 |
| 99.5       | 1044.2                | 221.5      | 725.7                 | 258.0      | 612.9                 |
| 129.5      | 633.6                 | 250.0      | 579.3                 | 326.0      | 596.8                 |
| 155.5      | 507.4                 | 281.5      | 537.1                 | 369.0      | 590.9                 |
| 189.5      | 534.8                 | 316.5      | 565.3                 | 481.0      | 666.9                 |
| 255.5      | 531.9                 | 351.5      | 533.7                 | 509.0      | 956.9                 |
| 300.5      | 557.9                 | 380.5      | 519.5                 | 540.0      | 954.7                 |
| 344.5      | 502.9                 | 405.0      | 551.3                 |            |                       |
| 374.5      | 540.4                 | 446.5      | 525.4                 |            |                       |
| 417.5      | 573.8                 | 487.5      | 576.3                 |            |                       |
| 455.5      | 527.2                 | 512.5      | 539.5                 |            |                       |
| 491.0      | 564.3                 | 535.0      | 570.5                 |            |                       |
| 508.0      | 557.6                 | 563.0      | 554.9                 |            |                       |

**Table S3.** Stable water isotope measurements of surface ice from the Reckling Moraine Icefield measured at KOPRI.

| Reckling Moraine samples (RMS) |                                        |                                     |              |
|--------------------------------|----------------------------------------|-------------------------------------|--------------|
| Sample no.                     | $\delta^{18}\text{O}_{\text{ice}}$ (‰) | $\delta^2\text{H}_{\text{ice}}$ (‰) | d-excess (‰) |
| 1                              | -37.73                                 | -302.63                             | -0.81        |
| 2                              | -39.55                                 | -320.19                             | -3.79        |
| 3                              | -36.16                                 | -289.79                             | -0.52        |
| 4                              | -37.72                                 | -302.25                             | -0.52        |
| 5                              | -38.90                                 | -311.13                             | 0.05         |
| 6                              | -40.33                                 | -321.88                             | 0.76         |
| 7                              | -38.21                                 | -308.60                             | -2.94        |
| 8                              | -41.42                                 | -334.11                             | -2.73        |
| 9                              | -38.87                                 | -312.70                             | -1.76        |
| 10                             | -36.90                                 | -296.94                             | -1.71        |
| 11                             | -36.46                                 | -291.70                             | -0.04        |
| 12                             | -38.92                                 | -314.04                             | -2.64        |
| 13                             | -36.29                                 | -291.08                             | -0.76        |
| 14                             | -38.02                                 | -303.38                             | 0.82         |
| 15                             | -39.10                                 | -316.31                             | -3.49        |
| 16                             | -38.35                                 | -311.00                             | -4.18        |
| 17                             | -37.54                                 | -301.15                             | -0.81        |
| 18                             | -40.55                                 | -326.14                             | -1.71        |
| 19                             | -40.06                                 | -322.26                             | -1.80        |
| 20                             | -38.94                                 | -314.71                             | -3.21        |
| 21                             | -38.63                                 | -310.57                             | -1.56        |
| 22                             | -37.26                                 | -298.85                             | -0.80        |
| 23                             | -40.15                                 | -323.14                             | -1.96        |
| 24                             | -39.62                                 | -319.30                             | -2.32        |
| 25                             | -38.03                                 | -307.54                             | -3.30        |
| 26                             | -37.34                                 | -299.89                             | -1.16        |
| 27                             | -36.57                                 | -296.68                             | -4.13        |
| 28                             | -38.53                                 | -311.41                             | -3.20        |
| 29                             | -40.32                                 | -323.51                             | -0.97        |
| 30                             | -38.88                                 | -312.44                             | -1.42        |

|    |        |         |       |
|----|--------|---------|-------|
| 31 | -41.35 | -333.63 | -2.81 |
| 32 | -37.70 | -305.78 | -4.16 |
| 33 | -39.68 | -318.83 | -1.42 |
| 34 | -39.68 | -321.05 | -3.60 |
| 35 | -38.01 | -306.34 | -2.26 |
| 36 | -41.53 | -335.21 | -2.94 |
| 37 | -36.48 | -295.03 | -3.16 |
| 38 | -34.89 | -280.10 | -0.96 |
| 39 | -38.08 | -307.42 | -2.78 |
| 40 | -40.78 | -329.45 | -3.24 |
| 41 | -38.02 | -304.84 | -0.66 |
| 42 | -37.73 | -303.46 | -1.58 |
| 43 | -39.96 | -323.81 | -4.13 |
| 44 | -40.06 | -321.25 | -0.77 |
| 45 | -39.54 | -319.70 | -3.35 |
| 46 | -38.89 | -312.35 | -1.22 |
| 47 | -37.42 | -301.93 | -2.59 |
| 48 | -39.43 | -319.24 | -3.77 |
| 49 | -39.95 | -323.43 | -3.86 |
| 50 | -39.77 | -322.24 | -4.05 |
| 51 | -36.62 | -296.12 | -3.17 |
| 52 | -38.19 | -307.65 | -2.11 |
| 53 | -38.45 | -308.98 | -1.39 |
| 54 | -36.65 | -294.12 | -0.95 |
| 55 | -37.28 | -296.00 | 2.27  |
| 56 | -39.20 | -317.01 | -3.44 |
| 57 | -38.30 | -308.72 | -2.29 |
| 58 | -39.39 | -317.36 | -2.21 |
| 59 | -39.34 | -317.10 | -2.42 |
| 60 | -39.51 | -316.57 | -0.50 |
| 61 | -37.69 | -302.55 | -1.05 |
| 62 | -38.01 | -303.65 | 0.40  |
| 63 | -38.87 | -308.10 | 2.88  |
| 64 | -37.69 | -303.01 | -1.49 |

|    |        |         |       |
|----|--------|---------|-------|
| 65 | -37.85 | -303.70 | -0.88 |
| 66 | -37.91 | -302.54 | 0.71  |
| 67 | -38.97 | -314.11 | -2.35 |
| 68 | -41.97 | -337.55 | -1.76 |
| 69 | -38.28 | -306.98 | -0.70 |
| 70 | -40.95 | -329.65 | -2.05 |

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**Table S4.** Stable water isotope measurements of EM-K core measured at KOPRI.

| Mid-depth<br>(cm) | $\delta^{18}\text{O}_{\text{ice}}$ (‰) | $\delta^2\text{H}_{\text{ice}}$ (‰) | d-excess (‰)  |
|-------------------|----------------------------------------|-------------------------------------|---------------|
| 55                | -45.57                                 | -361.0                              | 3.6           |
| 67                | -45.50                                 | -360.6                              | 3.4           |
| 78                | -45.64                                 | -361.6                              | 3.5           |
| 98                | -45.46                                 | -359.9                              | 3.8           |
| 116               | -45.51                                 | -360.6                              | 3.5           |
| 117               | -45.36                                 | -360.0                              | 2.9           |
| 156 (n =2)        | -45.66 $\pm$ 0.11                      | -364.2 $\pm$ 0.3                    | 1.0 $\pm$ 0.5 |
| 176               | -45.21                                 | -361.1                              | 0.6           |
| 195               | -45.64                                 | -362.5                              | 2.6           |
| 213.5             | -45.34                                 | -362.7                              | 0.0           |
| 236               | -45.47                                 | -363.3                              | 0.5           |
| 258               | -45.68                                 | -362.1                              | 3.3           |
| 271               | -45.64                                 | -362.7                              | 2.4           |
| 326               | -45.58                                 | -362.4                              | 2.2           |
| 339               | -45.60                                 | -362.1                              | 2.7           |
| 369 (n =2)        | -46.73 $\pm$ 0.05                      | -372.6 $\pm$ 0.1                    | 1.3 $\pm$ 0.3 |
| 481               | -45.72                                 | -361.6                              | 4.2           |
| 509               | -45.76                                 | -362.1                              | 4.0           |
| 517.5             | -45.56                                 | -360.6                              | 3.9           |
| 527.5             | -45.53                                 | -360.6                              | 3.6           |
| 540               | -45.73                                 | -362.0                              | 3.8           |