Supplementary Materials for:

# Subsurface ocean warming preceded Heinrich Events

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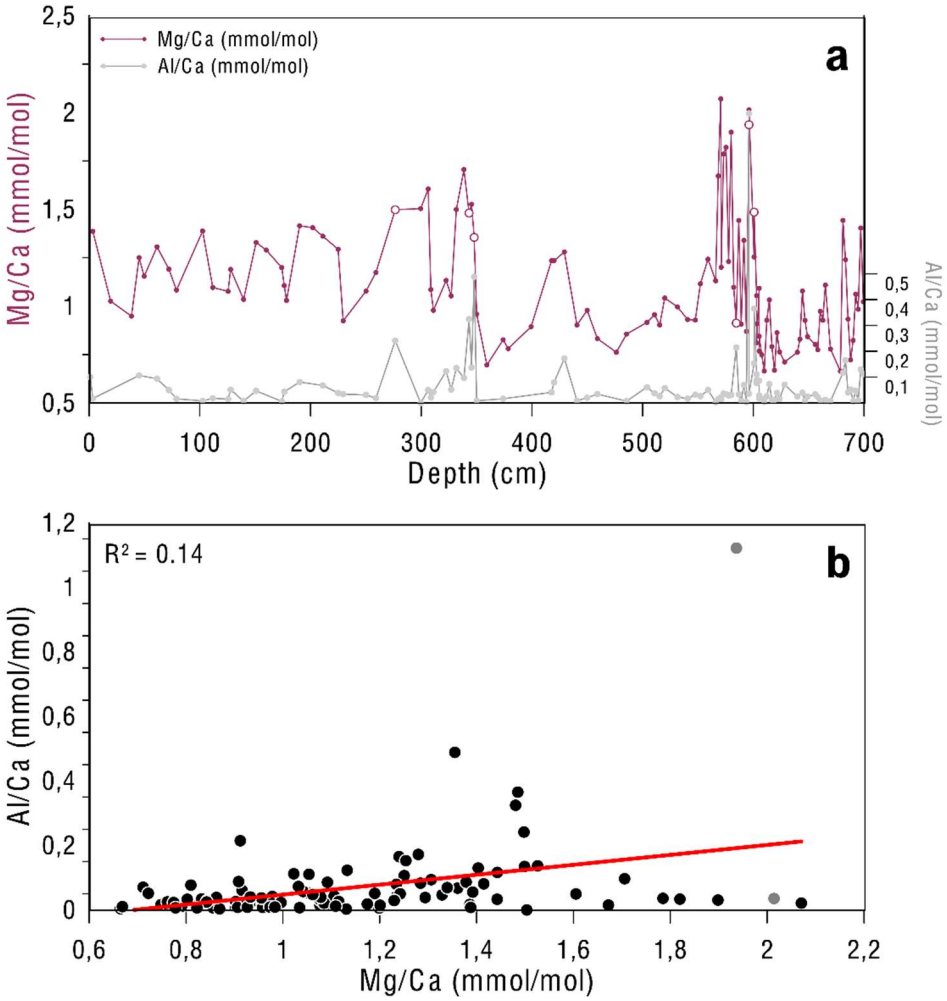
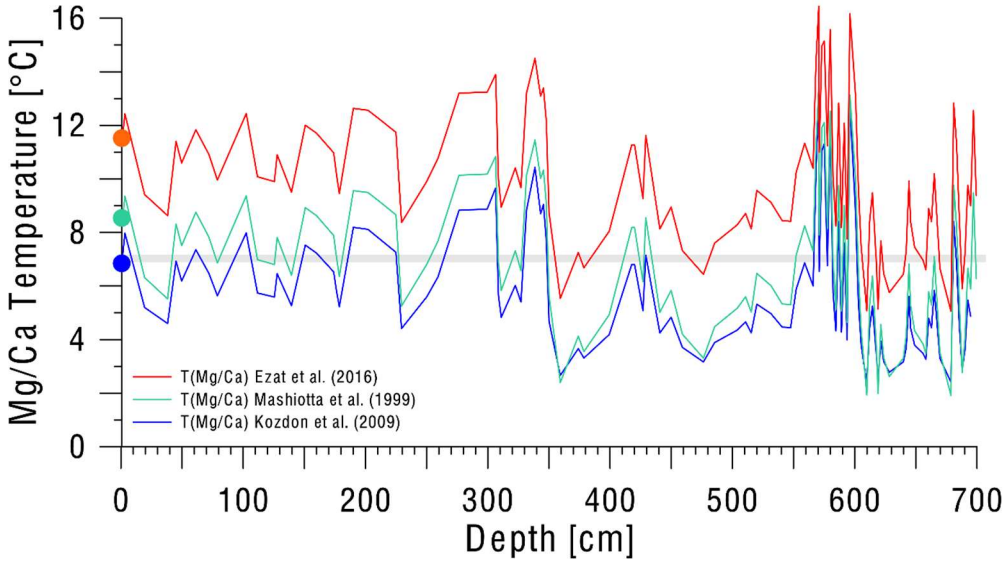
This supplementary document contains the following information:

Supplementary Figs. 1 to 4

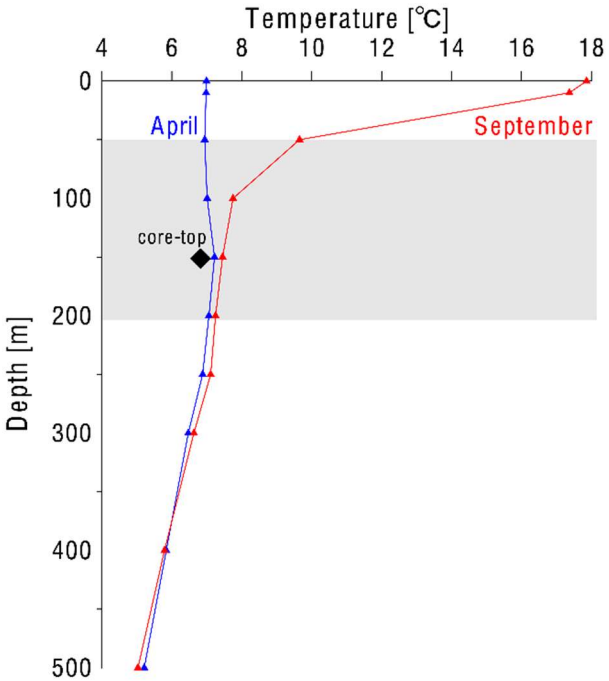
Supplementary Table 1



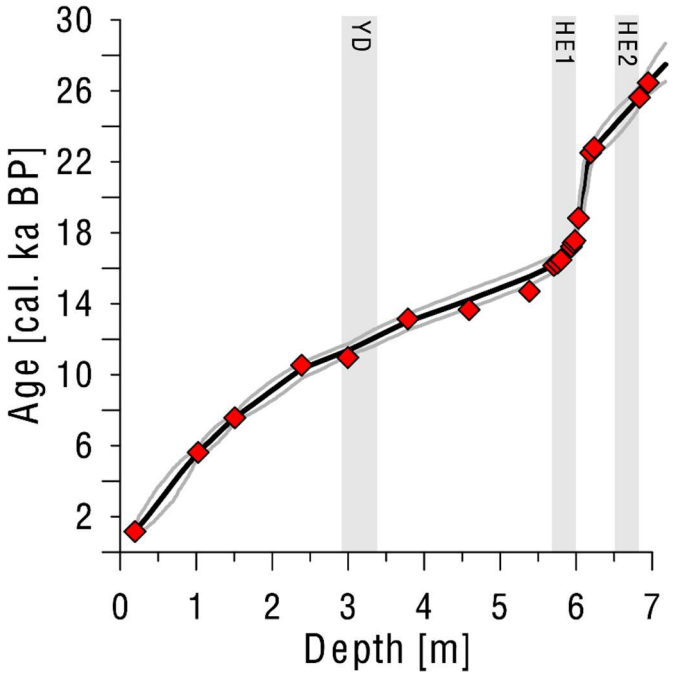

**Supplementary Fig. 1 Quality control for Mg/Ca measurements**. **(a)** Al/Ca is used to monitor the potential influence of silicate contamination in foraminiferal Mg/Ca ratios. Al/Ca >0.1 mmol/mol suggest contamination may be significant[40]. Most samples are well below Al/Ca >0.1 mmol/mol. Six samples (open circles) have values above Al/Ca >0.2 mmol/mol but do not appear to have anomalously elevated Mg/Ca ratios. **(b)** Cross-plot of Mg/Ca values versus Al/Ca values showing generally weak correlation between Mg/Ca and Al/Ca ($r^2 = 0.14$). Grey spots indicate replicate measurements of a sample with highly elevated Al/Ca ratio.




**Supplementary Fig. 2 Comparison of different *N.pachyderma* sin. Mg/Ca-temperature calibrations[42-44].** Grey bar indicates modern $subSST_{150m}$[15] near core site GeoB18530-1. Coloured spots indicate core-top Mg/Ca-temperatures for different calibrations.




**Supplementary Fig 3. Instrumental temperature profiles near site GeoB18530-1.** Temperature profile for April (blue) and September (red) close to core site GeoB18530-1[15]. Grey bar indicates modern habitat depth range of *N.pachyderma* sin. in the North Atlantic[43,45]. Black diamond = core-top Mg/Ca temperature of GeoB18530-1 calibrated after ref.43.




**Supplementary Fig. 4 Age model of sediment core GeoB18530-1.** Results of age-depth modeling using the R script BACON[51] with mean ages (black line) and 95% confidence intervals (grey lines) for GeoB18530-1. Red diamonds = Age control points from accelerator mass spectrometry radiocarbon datings; Grey bars = Heinrich Layers and YD.

**Supplementary Table 1** Radiocarbon ages and derived age model of GeoB18530-1.

List of radiocarbon ages from core GeoB18530-1

| Depth [m] | Lab code | Type | $^{14}$C age raw [ka] | Age error +/- [ka] | Reservoir Age [ka] | lower age [ka] 2σ | upper age [ka] 2σ | Calendar age [ka BP] | Sample type |
|---|---|---|---|---|---|---|---|---|---|
| 0,194 | Poz-81680 | AMS | 1,65 | 0,03 | 0,445 | 0,98 | 1,28 | 1,13 | *N.pachyderma* sin. |
| 1,025 | Poz-81681 | AMS | 5,33 | 0,035 | 0,436 | 5,47 | 5,88 | 5,64 | *N.pachyderma* sin. |
| 1,508 | BE-12553.1.1 | AMS | 7,20 | 0,046 | 0,468 | 7,43 | 7,69 | 7,59 | *N.pachyderma* sin. |
| 2,387 | Poz-81682 | AMS | 9,72 | 0,06 | 0,359 | 10,28 | 11,06 | 10,57 | *N.pachyderma* sin. |
| 2,995 | BE-12554.1.1 | AMS | 10,54 | 0,049 | 0,722 | 10,88 | 11,61 | 11,25 | *N.pachyderma* sin. |
| 3,786 | Poz-81683 | AMS | 12,33 | 0,06 | 0,844 | 13,07 | 13,79 | 13,38 | *N.pachyderma* sin. |
| 4,591 | Poz-81685 | AMS | 12,83 | 0,07 | 0,781 | 13,50 | 14,83 | 14,01 | *N.pachyderma* sin. |
| 5,384 | Poz-81686 | AMS | 13,31 | 0,07 | 0,802 | 14,06 | 15,36 | 14,70 | *N.pachyderma* sin. |
| 5,706 | BE-12555.1.1 | AMS | 13,96 | 0,051 | 0,874 | 15,15 | 16,26 | 15,69 | *N.pachyderma* sin. |
| 5,754 | BE-12556.1.1 | AMS | 14,06 | 0,051 | 0,875 | 15,26 | 16,38 | 15,82 | *N.pachyderma* sin. |
| 5,8 | BE-12557.1.1 | AMS | 14,28 | 0,06 | 0,896 | 15,56 | 16,74 | 16,12 | mixed planktics (*G. bulloides/N.pachyderm* a sin.) |
| 5,938 | BE-12558.1.1 | AMS | 15,14 | 0,054 | 1,002 | 16,65 | 17,83 | 17,22 | *N.pachyderma* sin. |
| 5,961 | BE-12559.1.1 | AMS | 15,03 | 0,054 | 0,982 | 16,50 | 17,72 | 17,07 | *N.pachyderma* sin. |
| 5,984 | BE-12560.1.1 | AMS | 15,40 | 0,053 | 1,027 | 17,05 | 18,12 | 17,55 | *N.pachyderma* sin. |
| 6,03 | BE-12561.1.1 | AMS | 16,60 | 0,058 | 1,02 | 18,31 | 19,36 | 18,87 | *N.pachyderma* sin. |
| 6,191 | BE-12562.1.1 | AMS | 20,19 | 0,084 | 1,014 | 22,68 | 23,75 | 23,21 | *N.pachyderma* sin. |
| 6,237 | Poz-81687 | AMS | 19,97 | 0,12 | 1,05 | 22,38 | 23,67 | 22,82 | *N.pachyderma* sin. |
| 6,833 | BE-12563.1.1 | AMS | 22,30 | 0,099 | 1,204 | 24,98 | 25,87 | 25,44 | *N.pachyderma* sin. |
| 6,948 | Poz-81689 | AMS | 24,09 | 0,18 | 1,241 | 26,46 | 27,66 | 27,11 | *N.pachyderma* sin. |
| 7,5 | Poz-81690 | AMS | 31,20 | 0,4 | 1,087 | 33,81 | 35,45 | 34,64 | *N.pachyderma* sin. |