Long-term (~ka) controls on mercury accumulation in the Souther Hemisphere reconstructed using a peat record from Pinheiro mire (Minas Gerais, Brazil)

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Supporting Information document (pp 1-9)

Description of the core stratigraphy

The core stratigraphy is composed of 11 horizons and 4 inorganic layers (see Figure 1 in the main text), which are named according to the terminology of the Soil Survey Staff.[1] They basically differ in the content of mineral/organic matter, texture of the inorganic component, degree of peat decomposition and consistency (described according to [2,3]). The basal layers (C4, C3, C2 and C; >219 cm) are essentially pure quartzitic mineral sediments. C4 also contains micaceous minerals (324-259 cm), C2 (246-244 cm) sandy-silts, and C (244-219 cm) scattered wood fragments. Horizon Oa10 (219-212 cm) contains fine roots and the peat is highly sapric and sticky. Horizon Oa9 (212-198 cm) has a high sand content, but the material is predominantly organic, sapric, and less sticky than the underlying layer. Horizon Oa8 (198-192 cm) is sticky and sapric. Horizon Oa7 (192-171 cm) is less sticky than the underlying layer and has some silty material. Horizon Oa6 (171-158 cm) is similar to horizon Oa9, therefore sandy, sapric, and slightly sticky. Horizon Oa5 (158-136 cm) is highly sticky and silty. Horizon Oa4 (136-98 cm) and Oa3 (98-58 cm) are slightly sticky and with have low mineral matter content, differing only in fine roots content (greater in Oa4 than in Oa3). Horizon Oa2 (58-20 cm) and Oa (20-8 cm) are also similar, both with abundant fine roots and highly sticky. The uppermost layer, Oi (8-0 cm), is a fibric horizon of poorly decomposed peat.

Details on the age/depth model of the PI core

As we stated in the paper, the uncertainty of the ages older than ~25 ka may be large due to the interpolation -it is unlikely that peat accumulation was constant for such a long time period. Neverteheless, as the references cited in the text proof, a similar situation was reported for other peat cores from the Southern Hemisphere. Voelker et al.[4] found highly increased concentrations of ^{14}C for the period 27 to 54 ka, coincident with low paleomagnetic filed intensities. In the PI core the oldest sample of the upper meter provided a calibrated age of 24.4-25.0 ka and the expected age, assuming a constant accumulation rate below 1 m, of the lowest peat sample is ~57 ka, matching the period of anomalous ^{14}C concentrations. This suggests that very high ^{14}C atmospheric concentrations may explain the apparent re-juvenation of the ages.

Another possible cause is the contamination with young carbon, but we find this to an unlikely explanation. No dramatic changes in the stratigraphy and the geochemistry (except for the d13C and mercury concentration) of the core are found at the depth of the age inversion and the shift in age from ~25 ka to ~9 ka in less than 20 cm may imply large proportions of much younger organic matter. One possible situation is the presence of roots of plants that lived at a peatland surface equivalent to the present depth of 40 cm or shallower (surfaces equivalent to ~9 ka or younger), implying roots at least 60 cm long. But no increase in roots is apparent in the section of interest and, in case they were present, they may have also affected the age of the peat sections above ~25ka layer.

In support of the chronology model we propose, we have found that the extrapolated ages of the $\delta^{13}C$ excursions to lighter isotopic compositions in the section below 1 m fit rather nicely with the ages of Heinrich events, which were found to be wet phases in the Southern Hemisphere (see for example [5,6]) and for which a decrease in $\delta^{13}C$ is expected [7]: a shift by ~59 ka that may correspond to H6, another at ~45-50 ka corresponding to H5, ~39- 41 ka corresponding to H4, ~33-34 ka corresponding to H3, and the large shift ~25-26 ka corresponding to H2. Even in the upper meter, with no age problems, the abrupt, punctual excursion to enriched $\delta^{13}C$ values has an estimated age (~17 ka) that fits that of the H1 event. Using the published ages for theses events (see for example [8]) to tie the depth/age relationship below 1 m produces an age model that does not significantly differ from the interpolated ages (Figure S2-B). Thus, for the purpose of this investigation, we decided to assume the extrapolated ages.

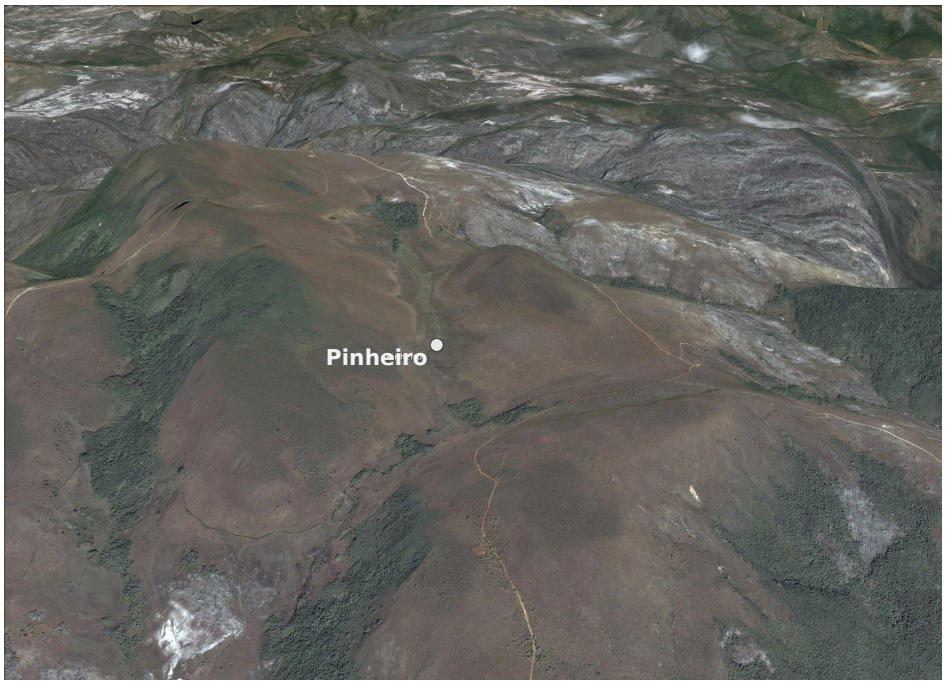

Figure S1 Digital image of the PI core localization (obtained from Google Earth).

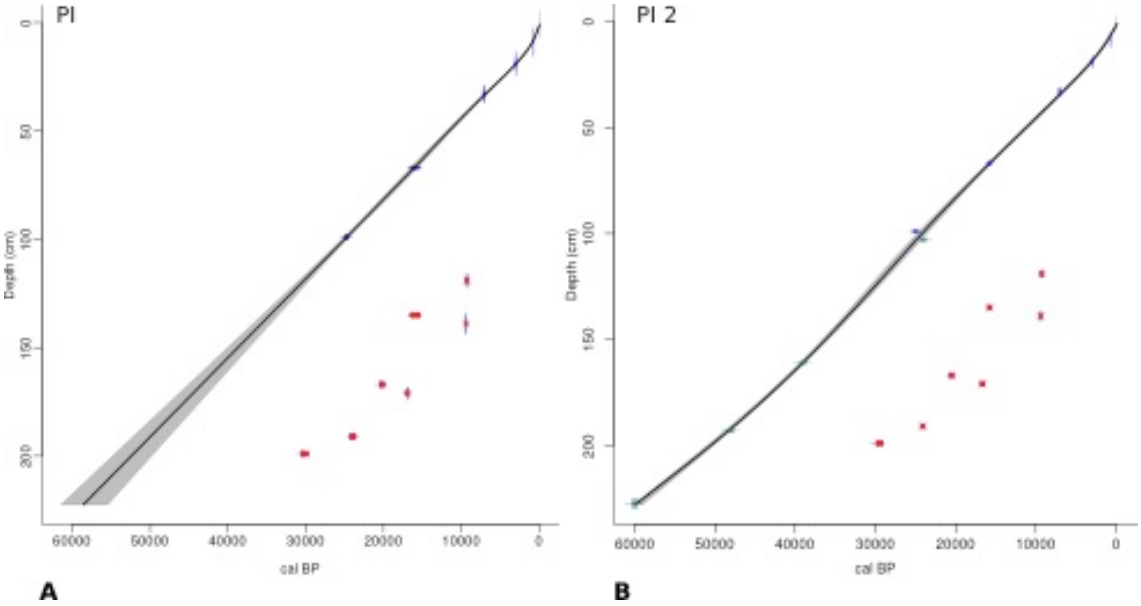

Figure S2 Age-depth models of the PI core built using Clam.R.[9] A: Using the datings for the peat samples of the upper meter of the core (blue) and interpolating below. B: Using the datings for the peat samples of the upper meter of the core (blue) and the section below 1 m tied with the ages corresponding to Heinrich Events H2, H4, H5, H6 (green).

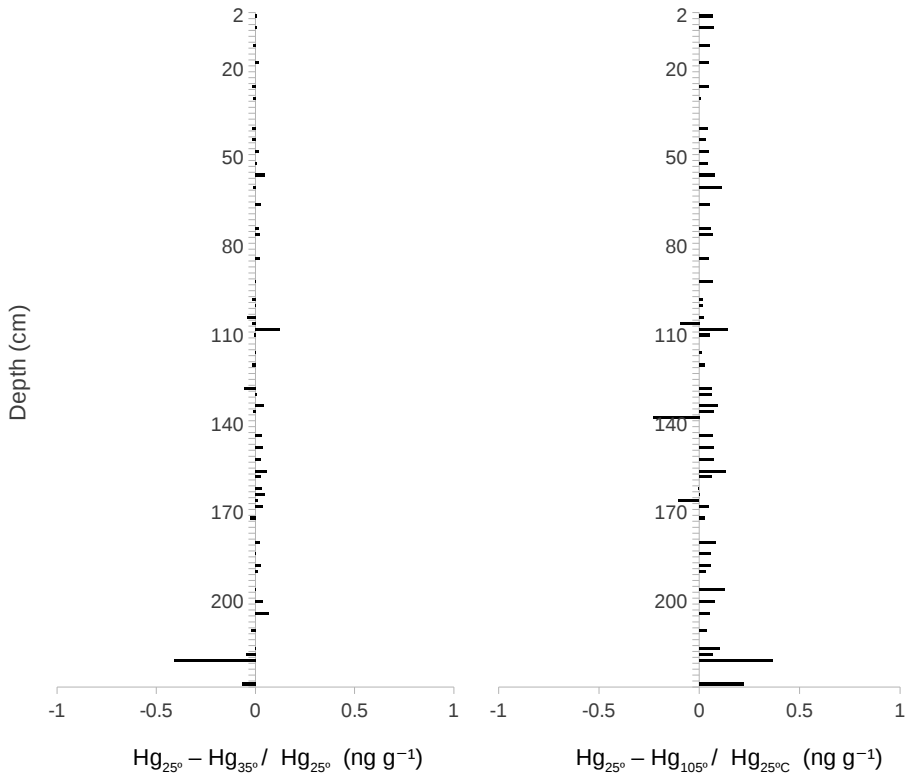

Figure S3: Depth records of the relative difference of mercury concentrations in samples dried at 35º C and 105º C with respect to those obtained at 25º C (Hg25º–HgTº/ Hg25º), where Hg 25º is the concentration obtained after drying at 25º C and HgTº is the concentration at 35 or 105º C.

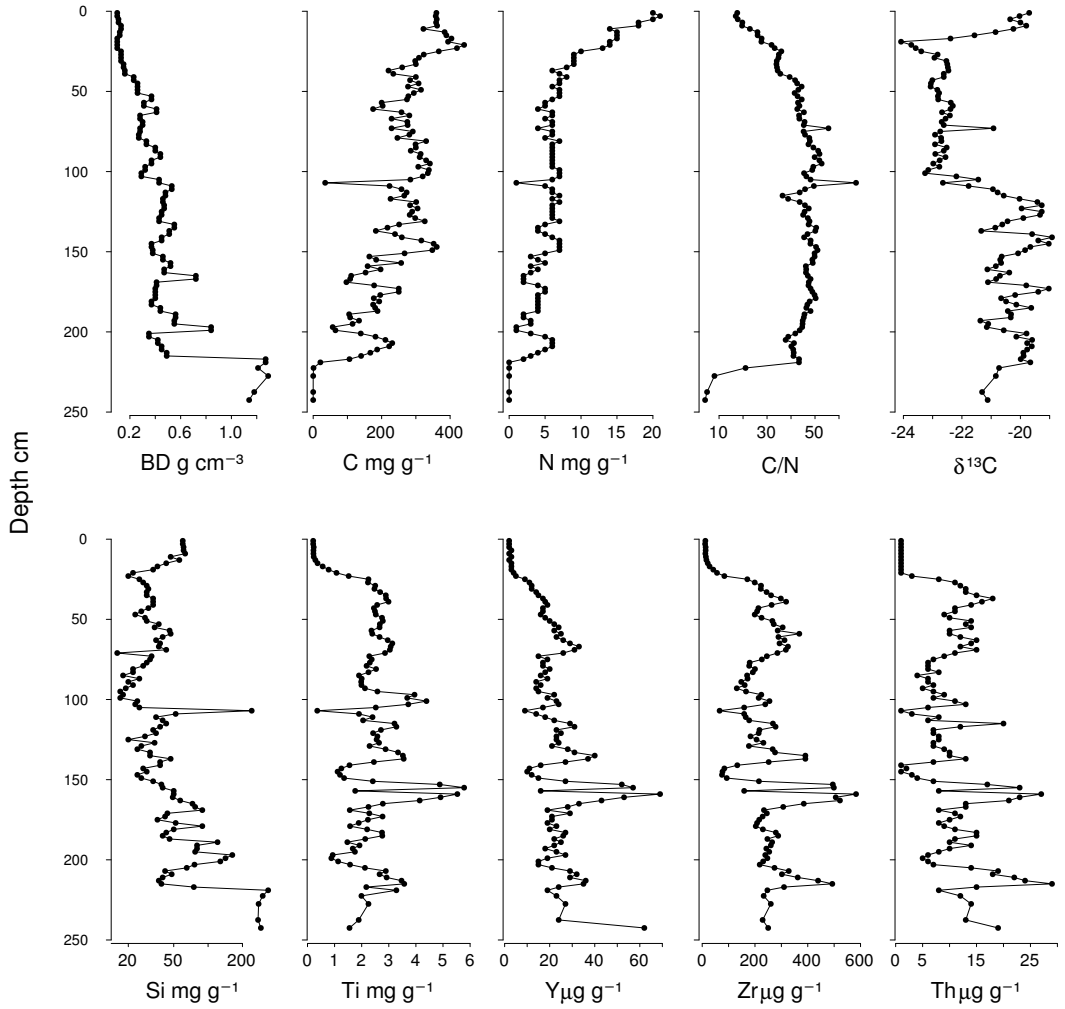

Figure S4 Depth records of physico-chemical properties and elemental composition of the PI core. BD, bulk density; C/N ratios; $\delta^{13}C$ ratio. Note that the Si x-axis is in logarithmic scale.

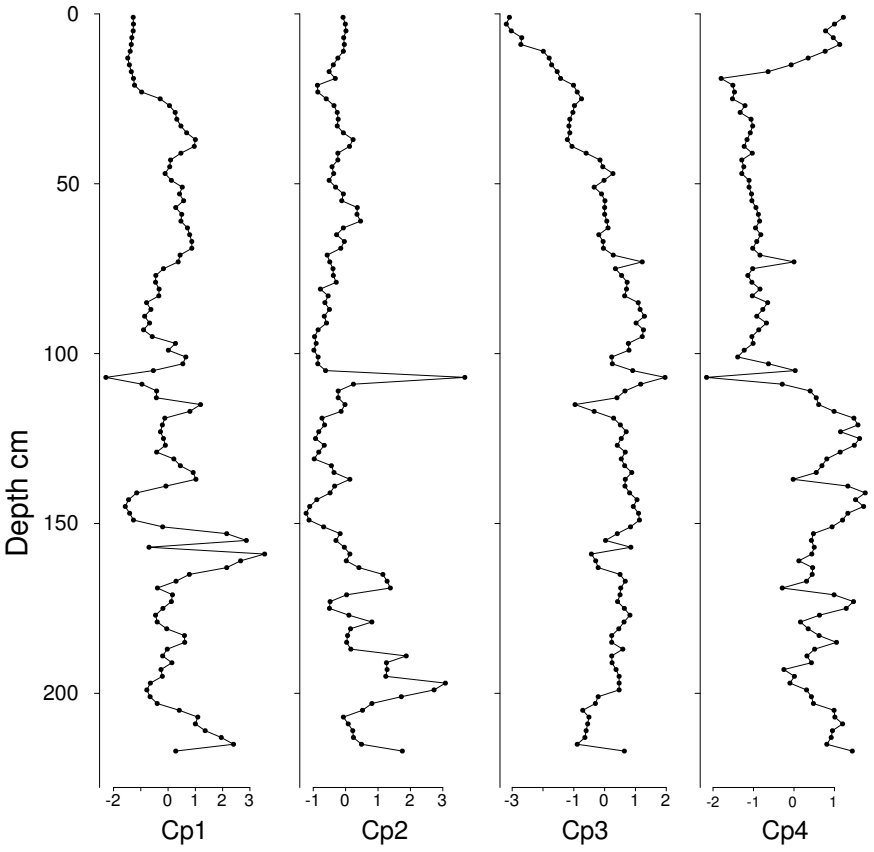

Figure S5 Records of factor scores of the four components of the Principal Component Analysis (Cp1, Cp2, Cp3 and Cp4) for the PI core.

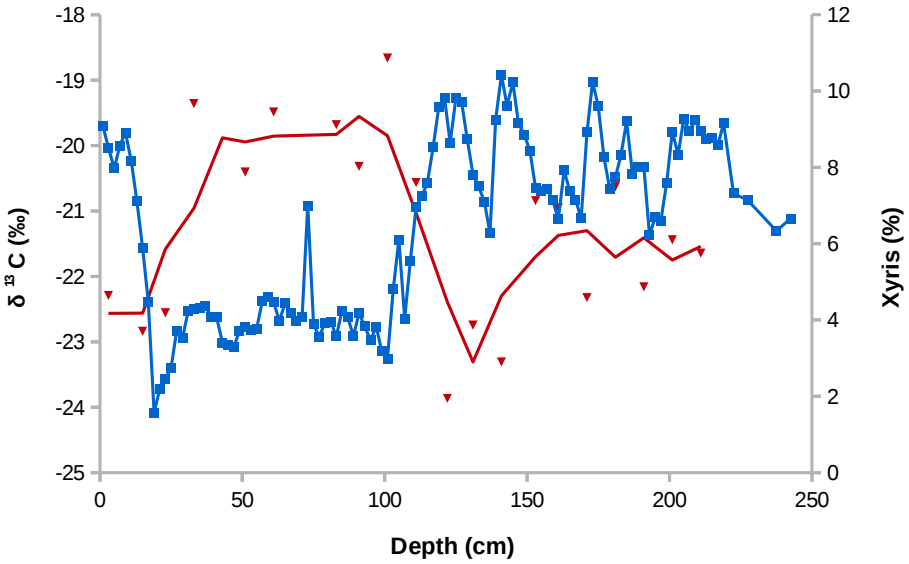

Figure S6 Depth record of $\delta^{13}C$ (blue) and abundance of pollen of *Xyris tp* (red).

Supplementary Table 1. ^{1} δC AMS datings. Ages in italics are younger than expected.

Depth (cm)	Conventional age	Calibrated age 2 sigma (prob)	Laboratory code
8-10	770±30	670-730 (1.00)	Beta-330480
18-20	2860±30	2880-2910 (0.10) 1920-3070 (0.85)	Beta-330481
32-34	6120±40	6905-7160 (1.00)	Beta-330482
66-68	13140±60	15270-16510 (1.00)	Beta-330483
98-100	20730±100	24420-25025 (1.00)	Beta-330484
118-120	*8260±40*	*9090-9100 (0.01)* *9120-9405 (0.94)*	Beta-330485
134-136	*13130±50*	*15265-16485 (1.00)*	Beta-333807
138-140	*8360±40*	*9290-9470 (1.00)*	Beta-330486
166-168	*16990±70*	*19895-20390 (1.00)*	Beta-333808
170-172	*13760±60*	*16710-17055 (1.00)*	Beta-330487

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