



Supplement of

Limited atmospheric iron availability increase during the Younger Dryas in the Northern Hemisphere

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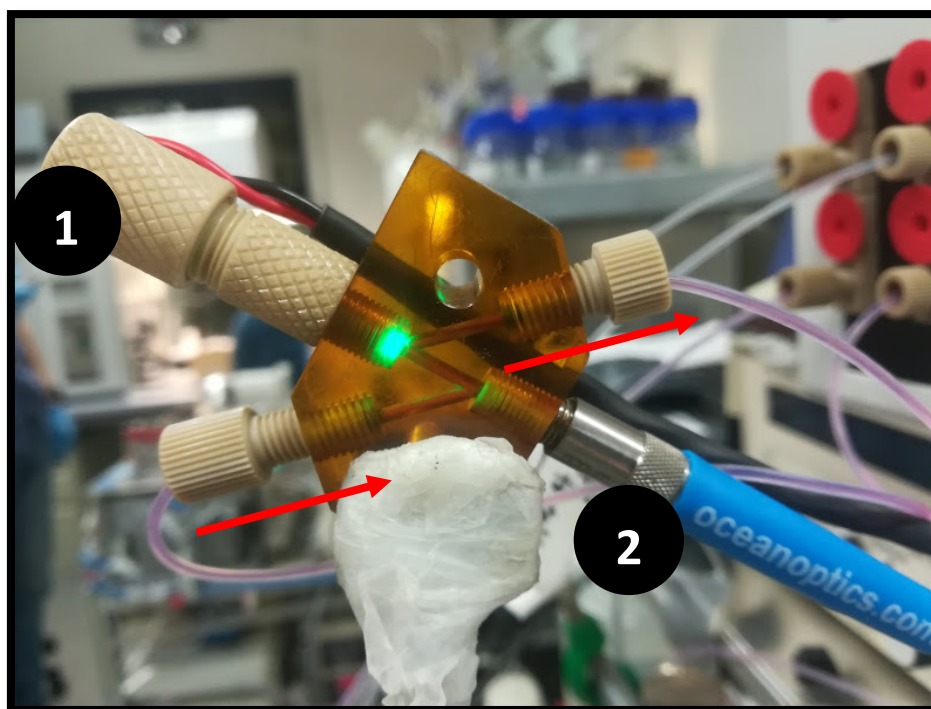


Figure S1– The Z cell used for LFe absorbance determination. The optical path is 1 cm. The upward inclination of the cell resulted to be beneficial to allow air bubbles to easily escape from the flow cell. Red arrows refer to the direction of the flow. 1) LED at 525 nm, 2) the fiber optics connected to the spectrophotometer. The transmittance signal was collected every second and subsequently converted to absorbance value using the Lambert-Beer law.

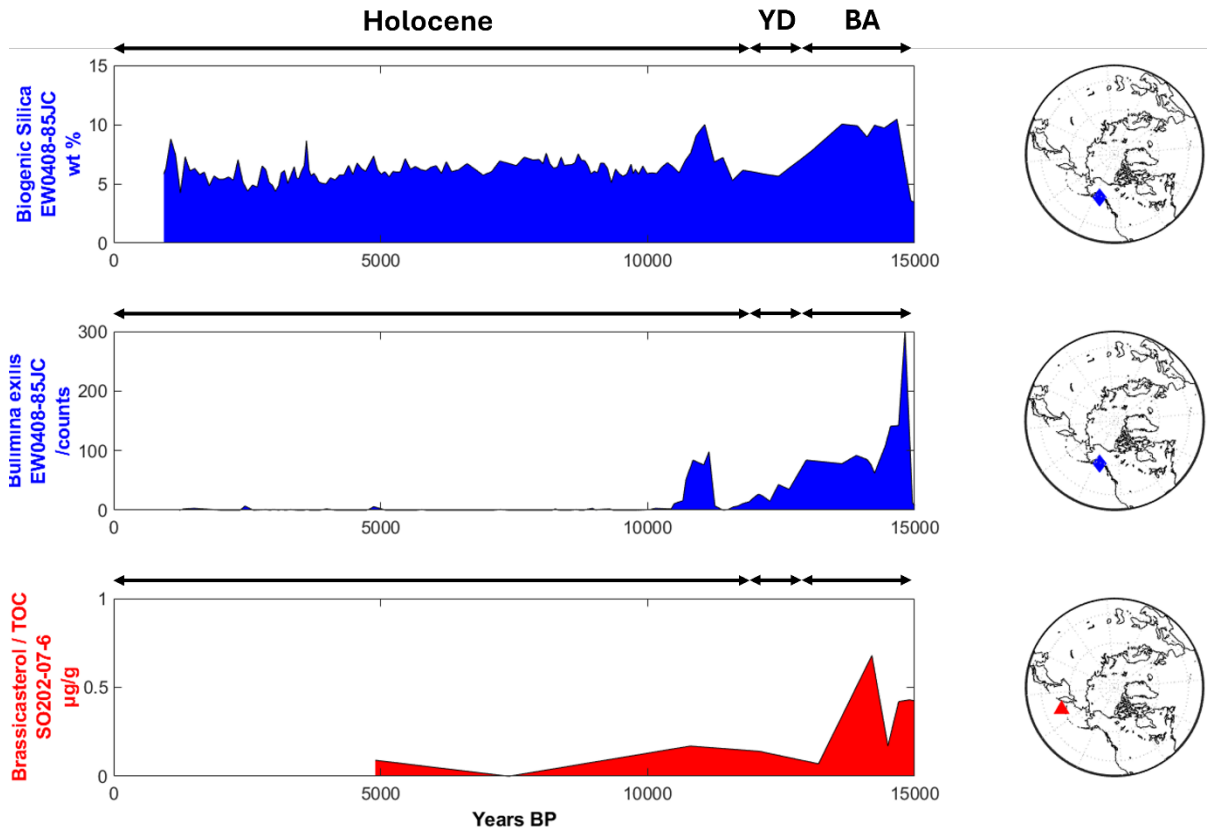


Figure S2– Upper panel: Biogenic Silica record from the EW0408-85JC sediment core (Davies et al., 2011). Middle panel: *Bulimina exilis* record from the EW0408-85JC sediment core (Praetorius et al., 2015). Bottom panel: Brassicasterol record from the SO202-07-6 sediment core (Méheust et al., 2018).

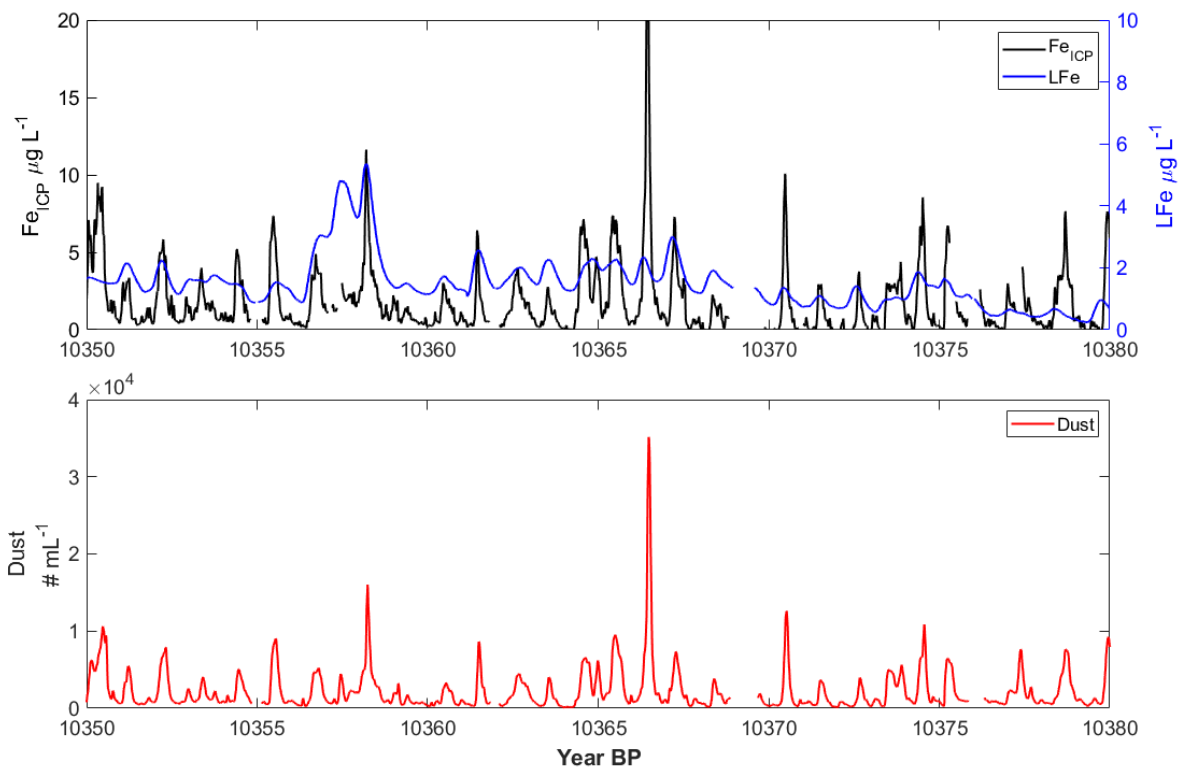


Figure S3– Seasonal signal of Fe_{ICP} (black line), LFe (blue line) and dust (red line).

Table S1 – Concentration ranges for LFe calibration curves. STD = external standard prepared in ultrapure water.

Age	Depth	Bag #	STD 1	STD 2	STD 3	STD 4
/ka	/m		/μg L ⁻¹	/μg L ⁻¹	/μg L ⁻¹	/μg L ⁻¹
10.32-10.39	1150.60-1154.45	2093-2100	0.5	1	1.5	-
10.46-10.50	1159-95-1163.25	2110-2116	0.5	1	1.5	-
10.87-10.93	1190.20-1194.05	2165-2172	0.5	1	1.5	-
11.68-11.79	1243.00-1246.85	2261-2268	1	5	10	-
12.06-12.18	1256.20-1260.05	2285-2292	0.5	1	1.5	-
12.26-12.38	1262.80-1266.65	2297-2304	1	2.5	5	10
12.52-12.64	1271.60-1275.45	2313-2320	1	2.5	5	10
12.90-13.07	1284.80-1293.05	2337-2352	0.5	1	1.5	2.5

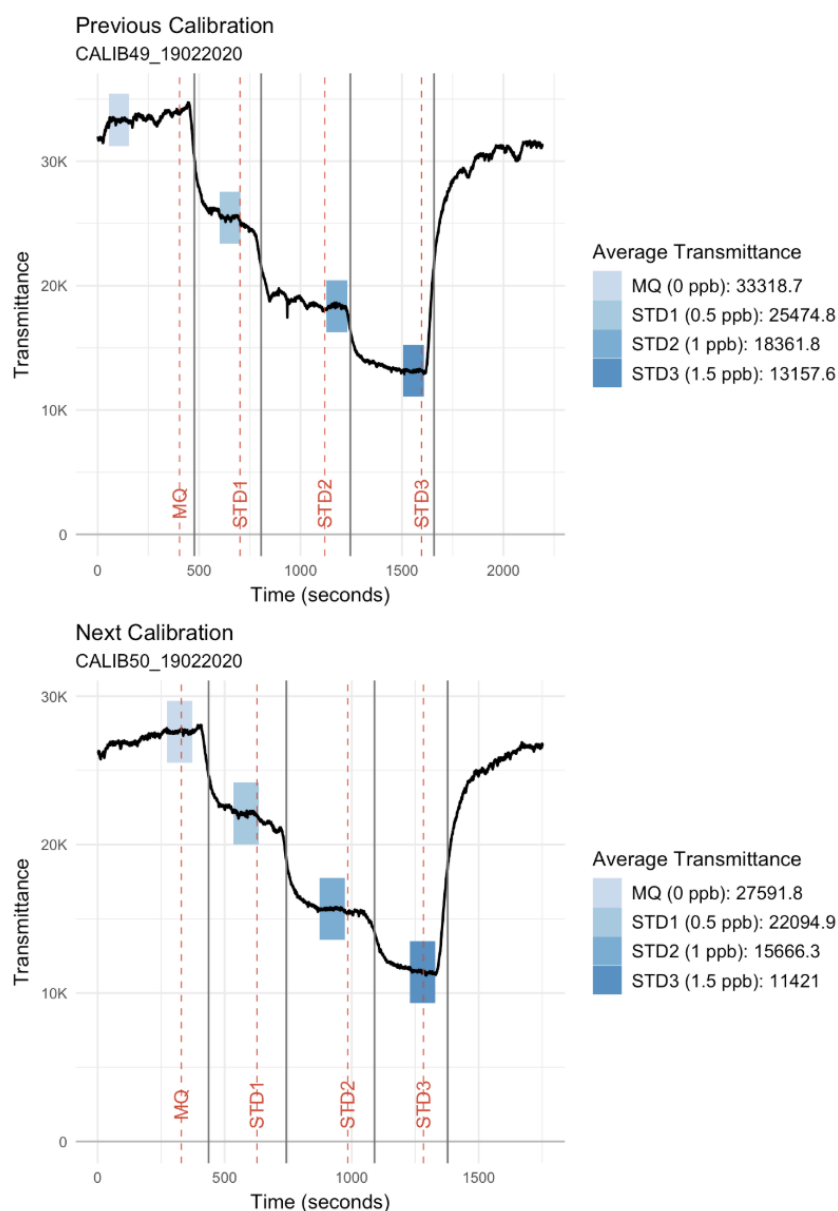
Table S2 – Identified volcanic eruptions in the analyzed EGRIP ice-core sections are reported with average SO₄²⁻ deposition in Greenland [*Lin et al.*, 2022], acidity, conductivity, LFe, Fe_{ICP} and LFe/Fe_{ICP}. *n.a.* = not available, due to lack of data in the time series. Average LFe/Fe_{ICP} were 0.40 during the Holocene, 0.02 during YD and 0.08 during BA. Highlighted eruptions (in bold) are shown in Figure S5.

	SO ₄ ²⁻ deposition	Acidity	Conductivity	LFe	Fe _{ICP}	LFe/Fe _{ICP}
Age	kg km ⁻² yr ⁻¹	μeq L ⁻¹	μS cm ⁻¹	μg L ⁻¹	μg L ⁻¹	
10 345	111.0	<i>n.a.</i>	<i>n.a.</i>	> 12.0	68.8	> 0.18
10 357	147.3	16.8	8.3	5.3	10.4	0.51
10 480	170.6	26.5	13.4	4.2	6.8	0.62
10 900	33.8	10.2	5.2	6.0	6.3	0.95
11 705	96.9	0.6	5.1	6.0	60	0.10
12 600	226.0	2.7	6.9	22.2	<i>n.a.</i>	<i>n.a.</i>
12 917	248.1	27.0	18.0	14.3	64.0	0.22
12 959	n.a	4.3	3.1	3.7	12.3	0.30
12 994	47.4	6.3	3.2	9.5	10.0	0.90
13 027	272.8	27.4	18.5	17.2	66.2	0.26

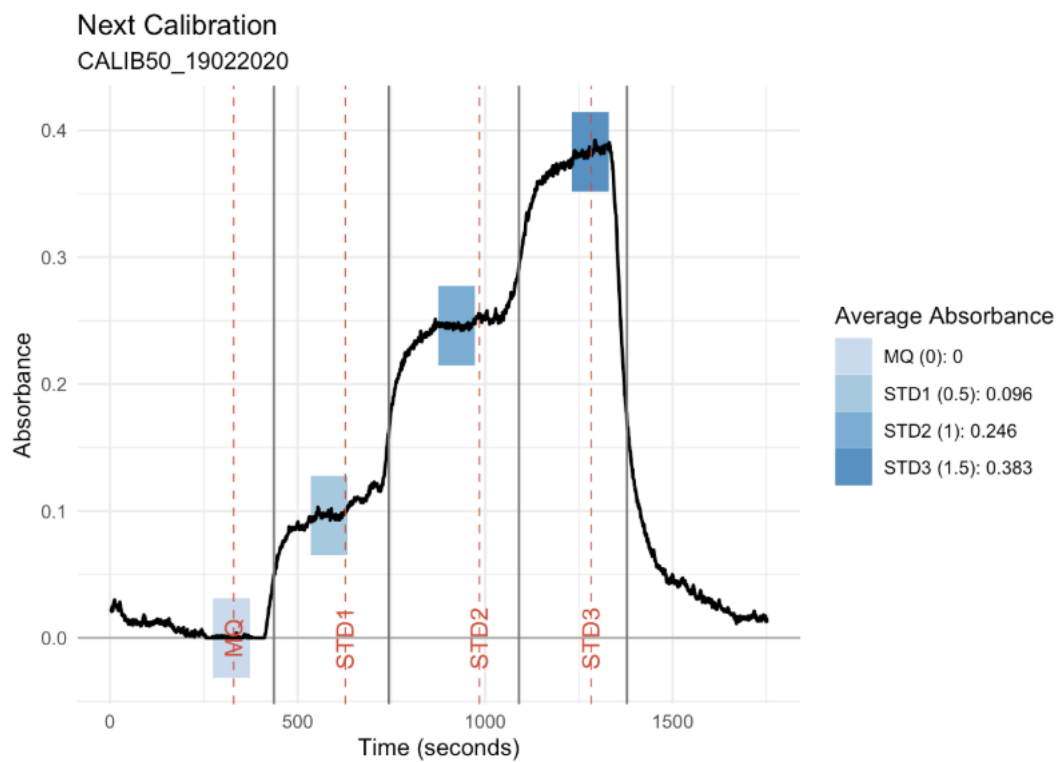
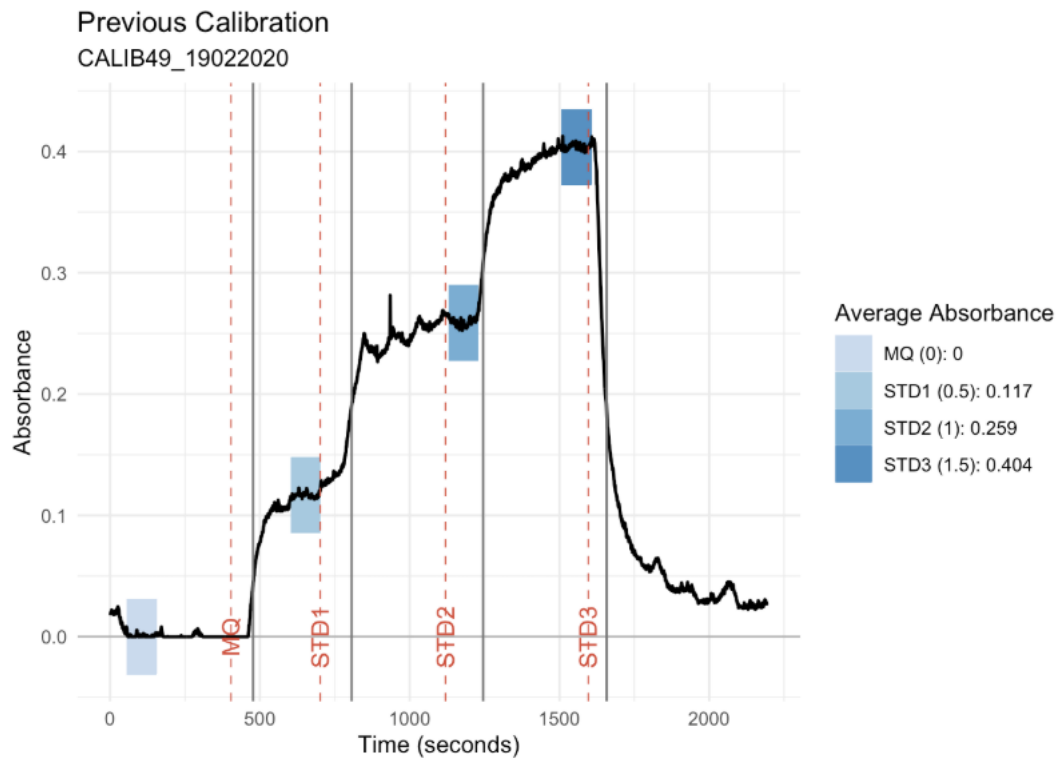
SM Section 1. Processing of raw data from transmittance to concentration values

Here, we present an example on how data were treated from the raw transmittance values to sensitivity and blank corrected concentration values. Other details are reported in the main text.

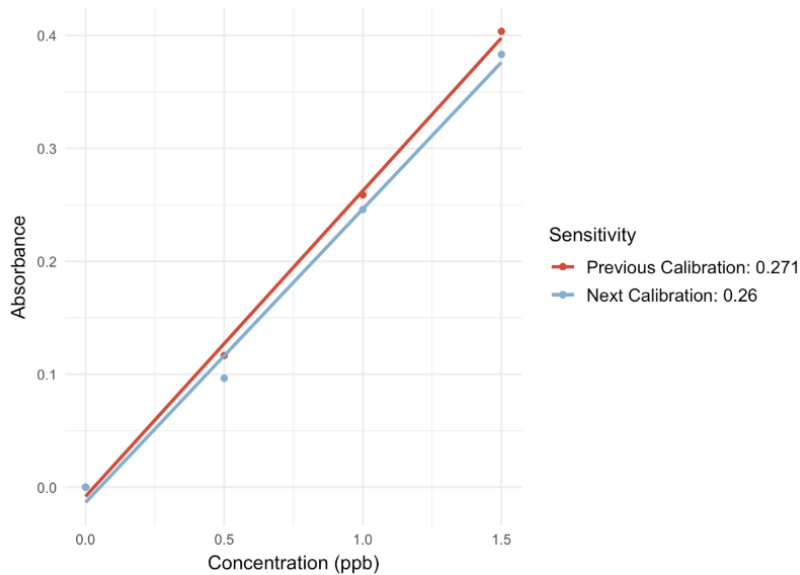
- 1. Processing of calibration files:** calibration files were obtained. In this example, CALIB49 and CALIB50 are the calibrations performed before and after the sample run that included EGRIP bag#2093 to EGRIP bag#2100. MQ, STD1, STD2 and STD3 refer to ultrapure water, first standard at 0.5 ng g^{-1} (or ppb), second standard at 1 ng g^{-1} and third standard at 1.5 ng g^{-1} , respectively. The intensities for every standards were selected when the signal was stable for at least 90 seconds. Gray vertical lines correspond to the breakpoints that segment the calibration measurements, red vertical lines correspond to the recorded times in the logbook where a standard was determined to be stable and shaded boxes indicate the windows which were determined to have the lowest variance, which will give the average transmittance value for each standard that was measured.



2. Calibration signals were converted into absorbance values following the Lambert-Beer equation.



3. Absorbance values are plotted against standard concentration to calculate the sensitivity for both curves. Sensitivity values (i.e., the slope of the calibration curve) are fundamental for later correcting the data for instrumental sensitivity drift.



Previous calibration:

Sensitivity: 0.271

$R^2 = 0.996$

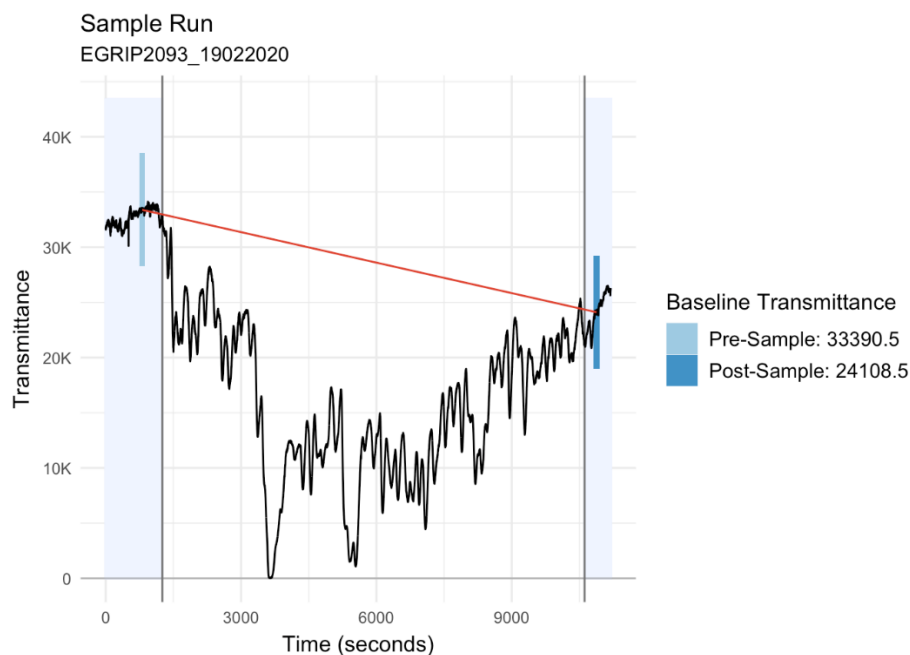
Next calibration:

Sensitivity = 0.260

$R^2 = 0.989$

Δ sensitivity = -4.1%

4. Finding pre- (light blue rectangle) and post-sample (dark blue rectangle) baselines

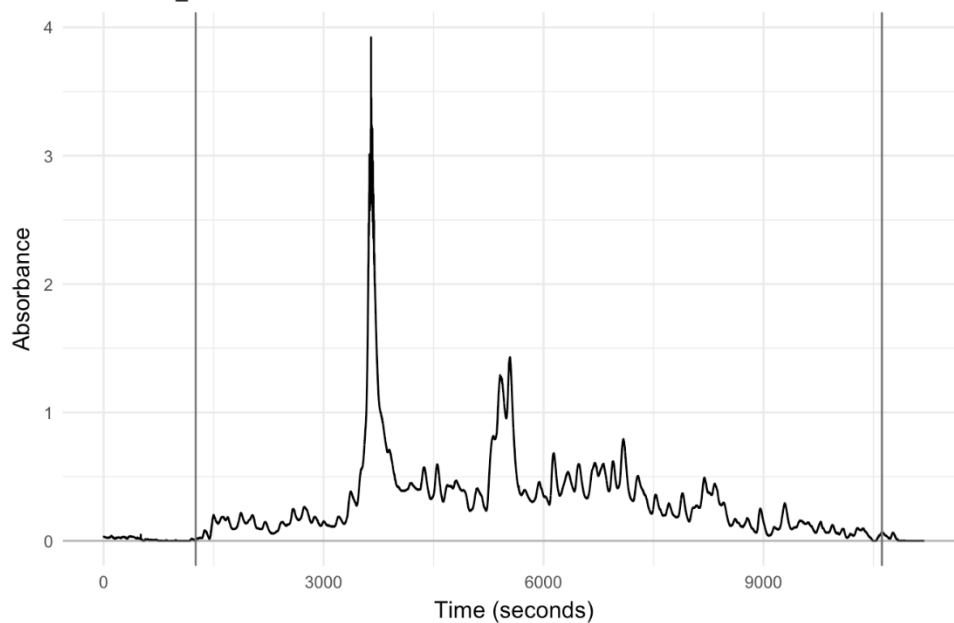


5. Calculating the theoretical blank value at each time step of the sample run to calculate the corresponding I_0 in the Lambert-Beer law. We assumed a linear drift.

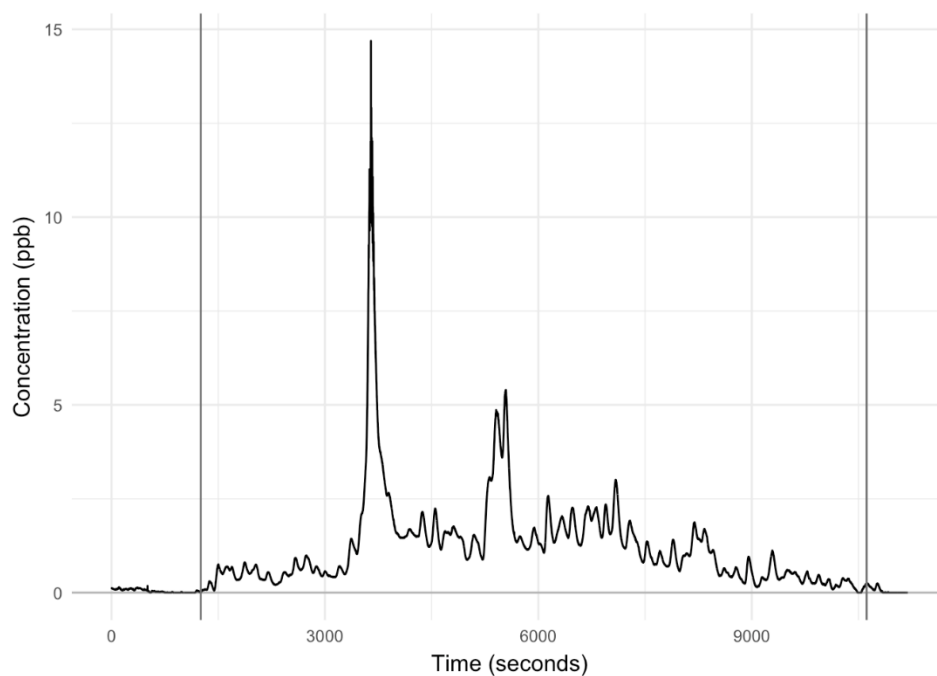
6. **Converting transmittance values into absorbance values** considering the blank drift.

Sample Run

EGRIP2093_19022020

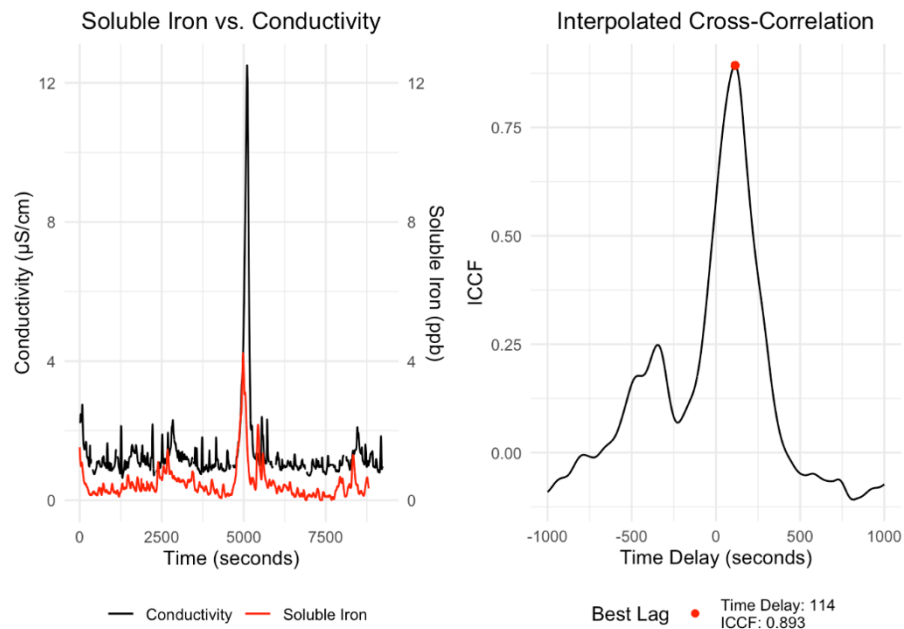


7. **Converting the absorbance signal into concentration values (ppb)**, including the sensitivity correction (we assumed a linear sensitivity drift during the run).

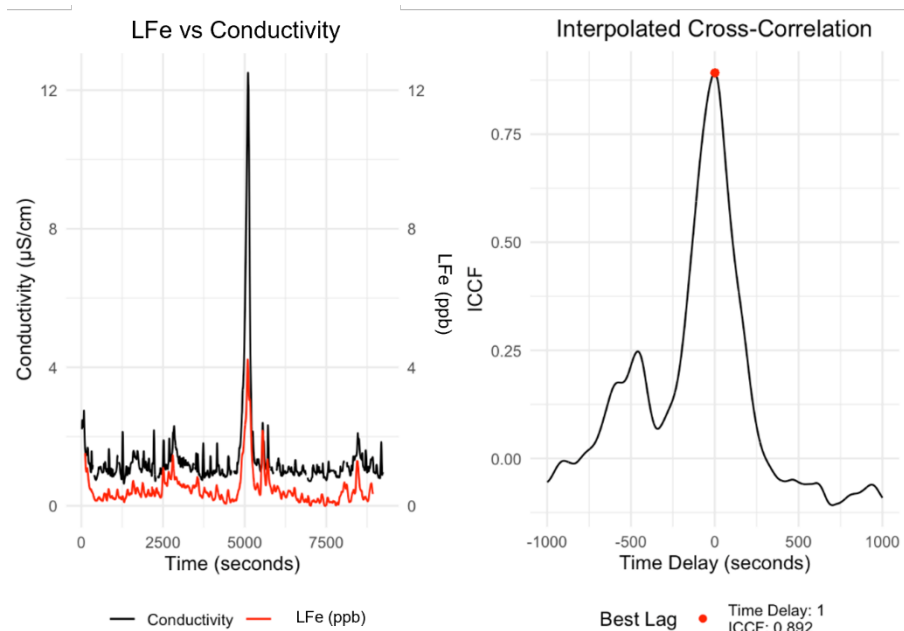


SM Section 2. LFe alignment with Bern CFA data

1. Corrected LFe and conductivity profiles are plotted against analysis time and a cross-correlation is performed between the two time series to find the time lag, i.e., where the ICCF has its highest values. The optimal time lag was found after 114 seconds. In this case the example refers to EGRIP bags #2110-2116.



2. Corrected LFe and conductivity profiles are plotted against each other.

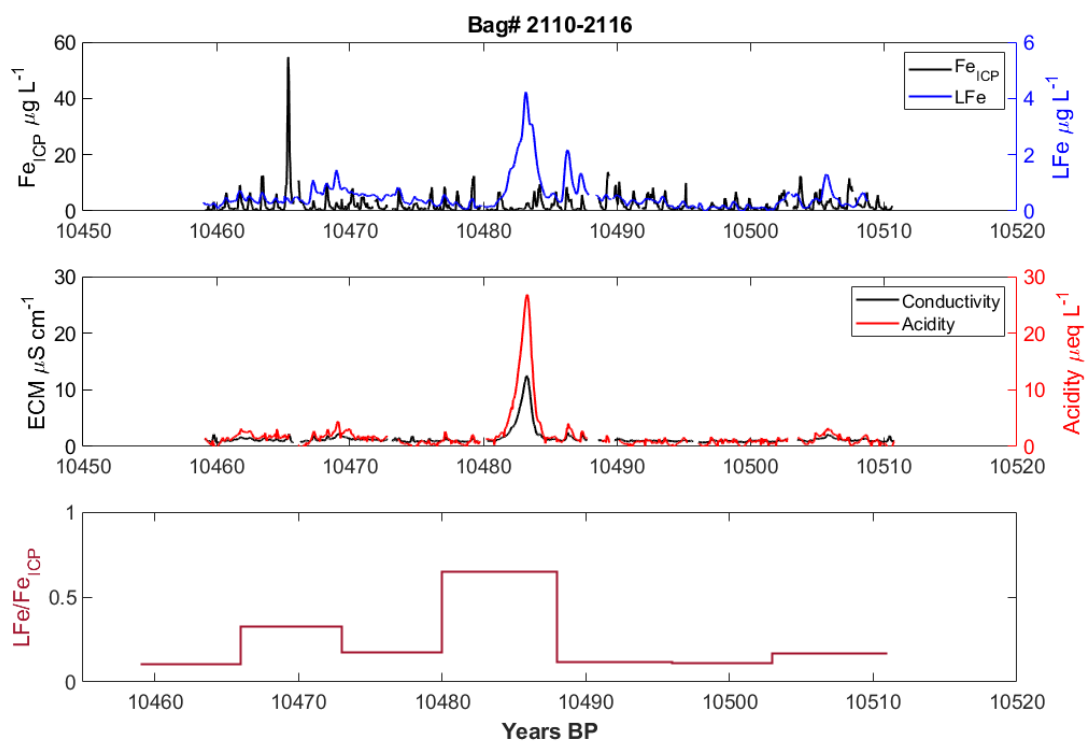
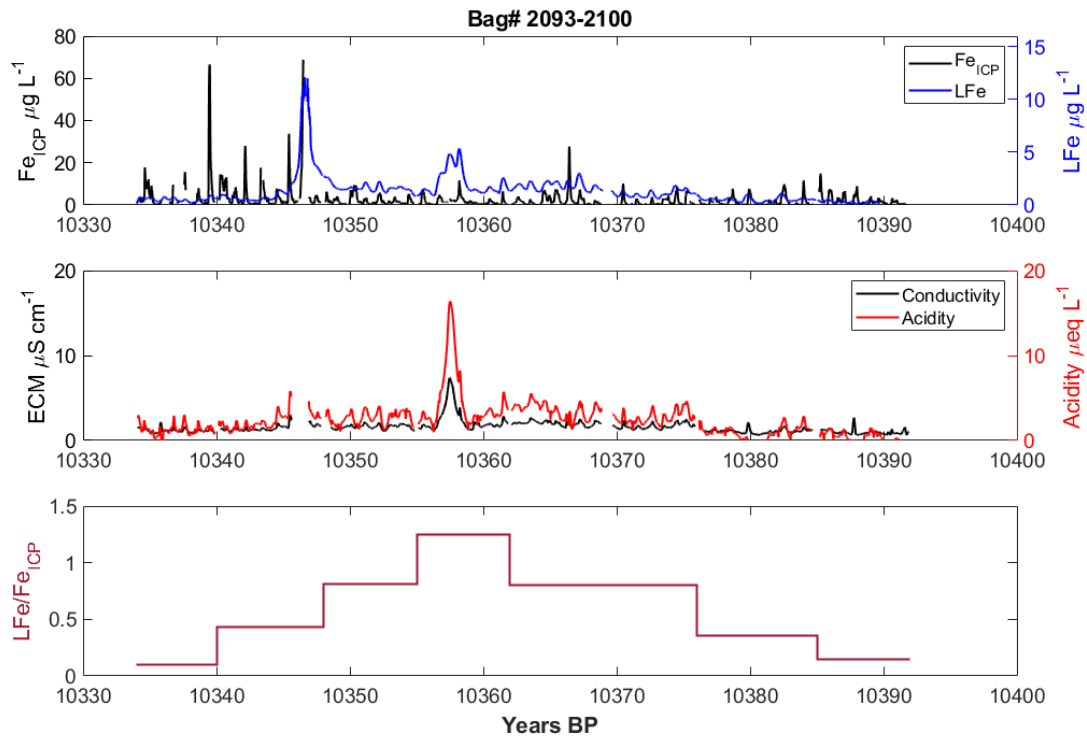


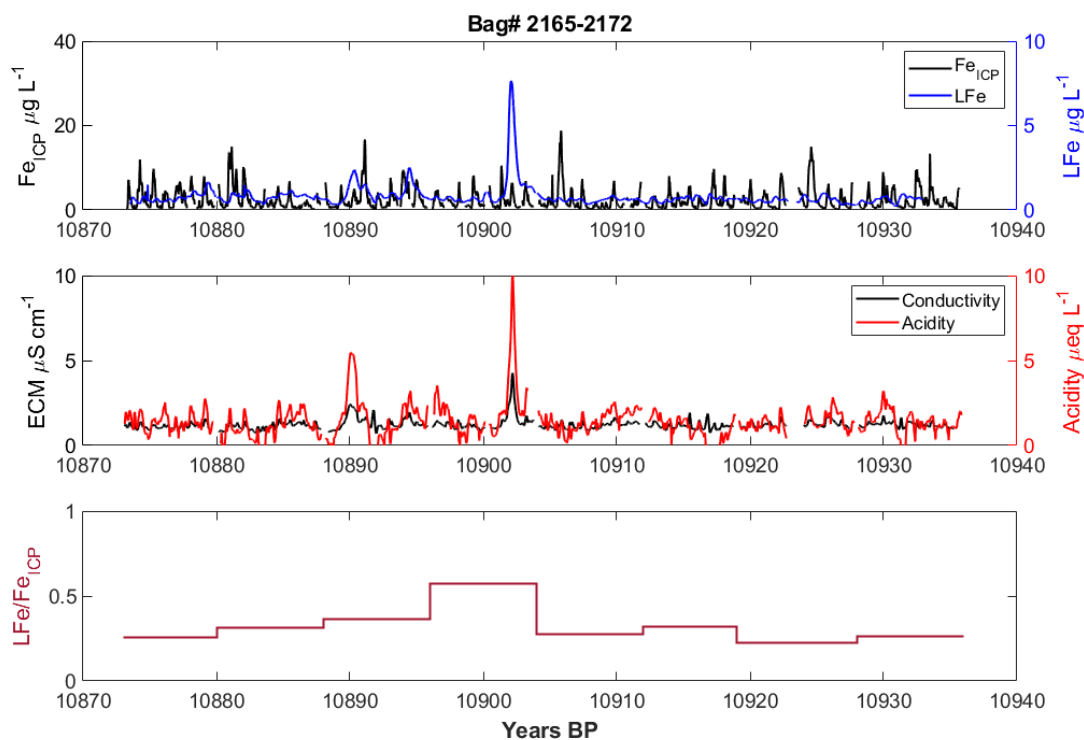
3. Once aligned, corrected LFe were plotted against depth following the available age scale and all the other available data from the Bern CFA (acidity, conductivity, dust and total iron).

SM Section 3. LFe, Fe_{ICP}, acidity and conductivity continuous profiles for the eight selected periods.

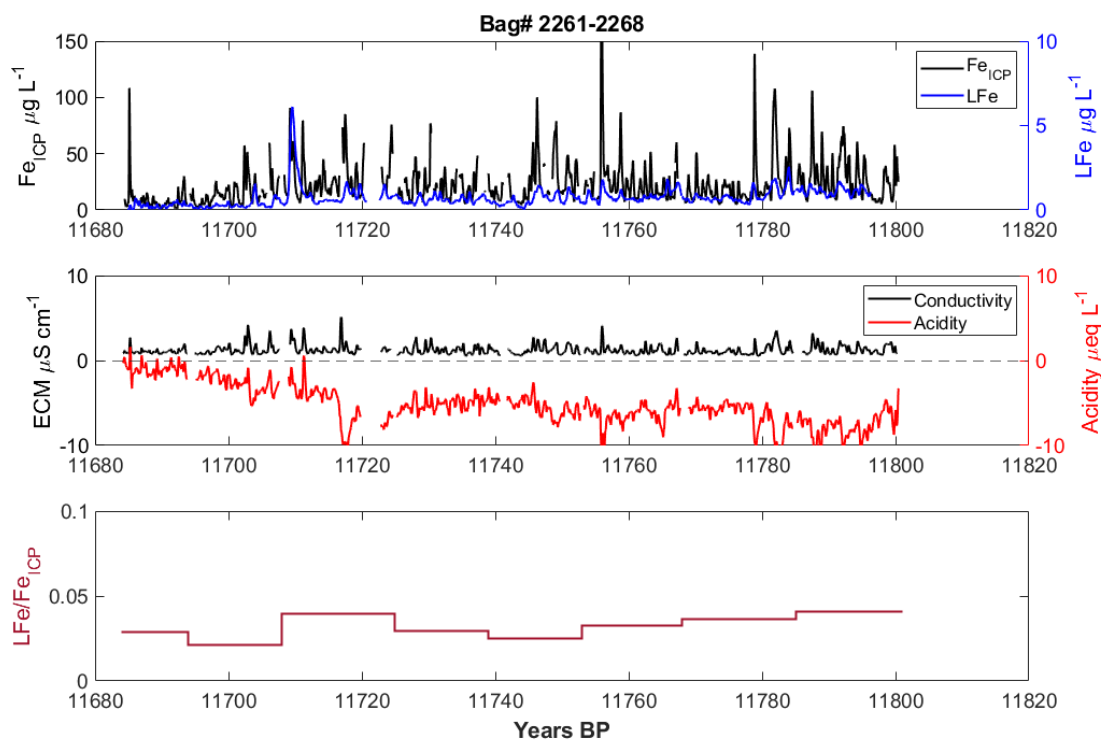
The following plots refer to the continuous temporal profile of the selected periods from the Early Holocene to the Bølling-Allerød.

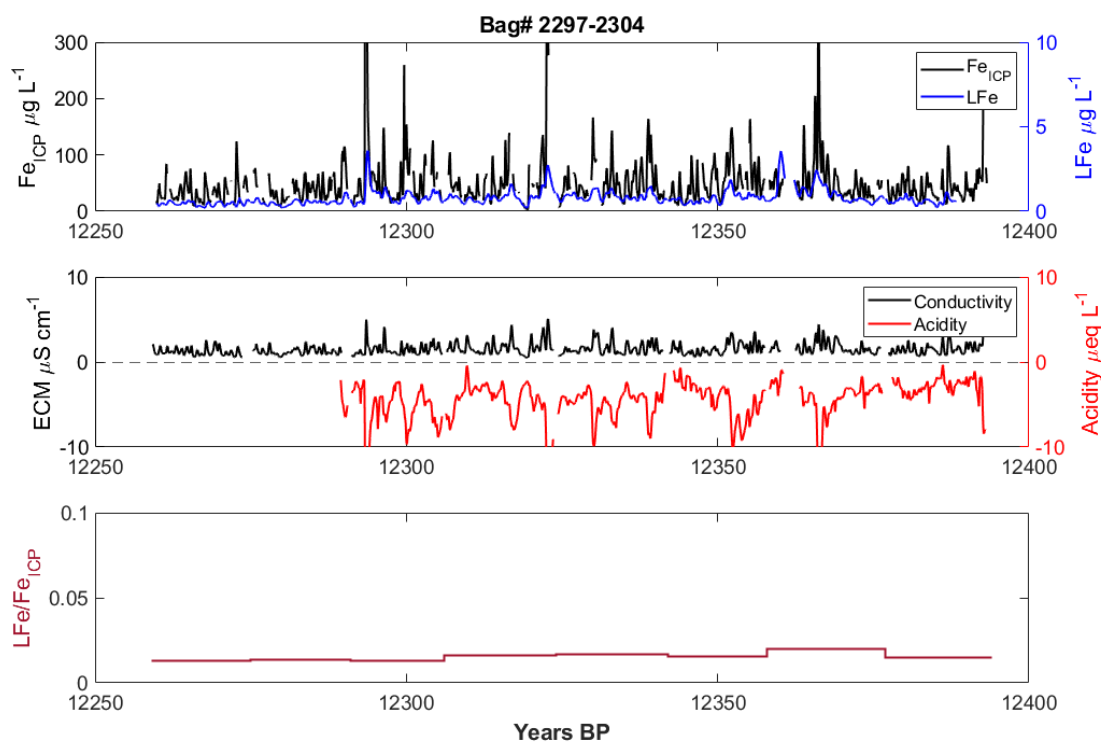
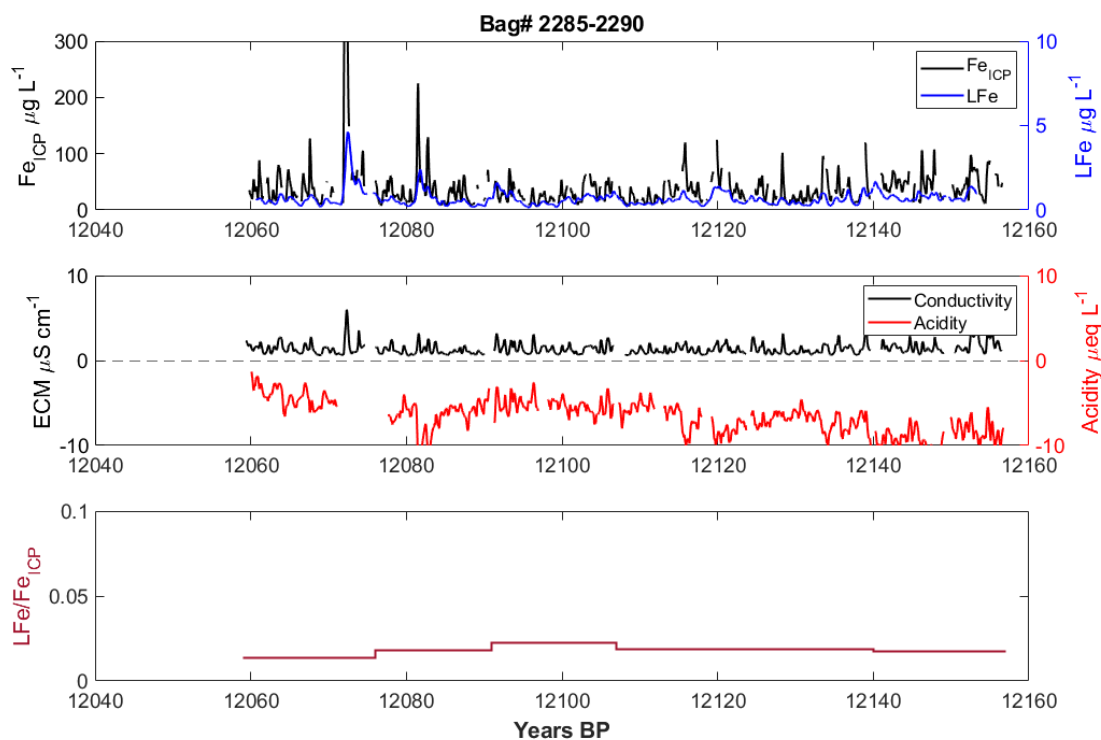
1. Early Holocene runs

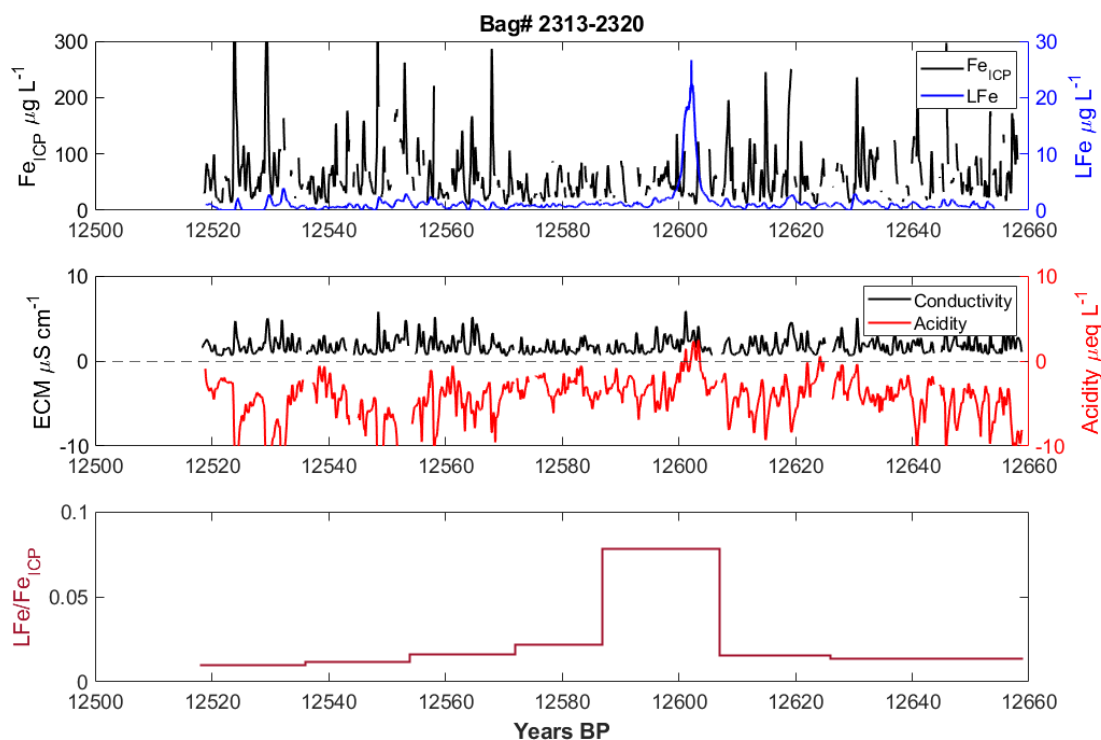




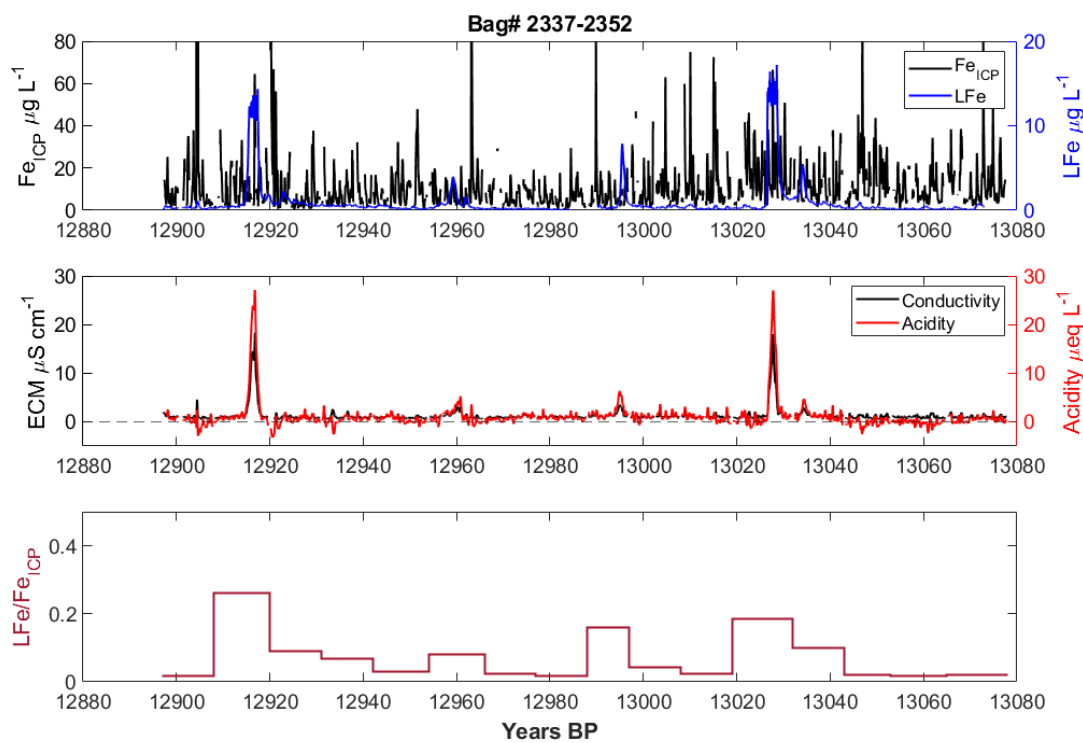
2. Younger Dryas (including transition, bag#2261-2268)







3. Bølling-Allerød



REFERENCES

Lin, J., A. Svensson, C. S. Hvidberg, J. Lohmann, S. Kristiansen, D. Dahl-Jensen, J. P. Steffensen, S. O. Rasmussen, E. Cook, and H. A. Kjær (2022), Magnitude, frequency and climate forcing of global volcanism during the last glacial period as seen in Greenland and Antarctic ice cores (60–9 ka), *Climate of the Past*, 18(3), 485–506.