Earth and Planetary Science Letters 458 (2017) 444–448

Contents lists available at ScienceDirect

Earth and Planetary Science Letters

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Corrigendum

Corrigendum to "Deep water provenance and dynamics of the (de)glacial Atlantic meridional overturning circulation" [Earth Planet. Sci. Lett. 445 (2016) 68–78]

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A R T I C L E   I N F O

Article history:
Received 15 October 2016
Received in revised form 31 October 2016
Accepted 2 November 2016
Available online 21 November 2016
Editor: D. Vance

We have reconstructed past modes of the Atlantic Meridional Overturning Circulation (AMOC) by combining two sedimentary proxies, Nd isotopes (ε_{Nd}) and the $^{231}Pa/^{230}Th$ ratio over the last deglaciation. Combined down-core $^{231}Pa/^{230}Th$ and ε_{Nd} records from six Atlantic Ocean sediment archives are presented (Lippold et al., 2016).

We thank Ines Voigt for pointing out an error in the age model of one of the cores (M35003-4). The age model used in the original publication was misleadingly based on the uncalibrated ^{14}C ages reported by Rühlemann et al. (2004) and Vink et al. (2001). As a consequence, the ages assigned to the samples from which $^{231}Pa/^{230}Th$ and ε_{Nd} were measured were underestimated (from 0.1 ka for the youngest and up to 4.0 ka for the oldest sample). This affects several diagrams although it does not affect the conclusion of the article.

The corrections to the age model also affect the $^{231}Pa/^{230}Th$ ratios. The older sedimentary ages now lead to higher $^{231}Pa/^{230}Th$ ratios due to the relatively larger decay correction of ^{231}Pa (shorter half-live than ^{230}Th). However, due to the relatively young absolute ages compared to the half-live of ^{231}Pa, the values change only within the given analytical error bars. In addition, here we also report one new $^{231}Pa/^{230}Th$ datum and three new opal measurements from this core not reported in the original publication.

We emphasize that the results and interpretations of our study remain unaffected by the age model correction, or rather are even strengthened by the corrected down-core profile of M35003-4: In the original publication, our results from the shallower core sites already supported an active overturning cell of shoaled Glacial North Atlantic Intermediate Water (GNAIW) and the subsequent deglaciation. Now, the highest $^{231}Pa/^{230}Th$ value recorded at site M35003-4 is shifted from the LGM towards older ages, resulting in an even lower average $^{231}Pa/^{230}Th$ during the LGM.

The corrected figures, captions, and text appear below for the reader's convenience. The supplement to this article and the associated data tables have been updated as well.

Figures

(1) Fig. 2: Only values in panel e (M35003-4) are changed. All data for this core shifted towards older ages, with the result that

DOI of original article: http://dx.doi.org/10.1016/j.epsl.2016.04.013.
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http://dx.doi.org/10.1016/j.epsl.2016.11.005

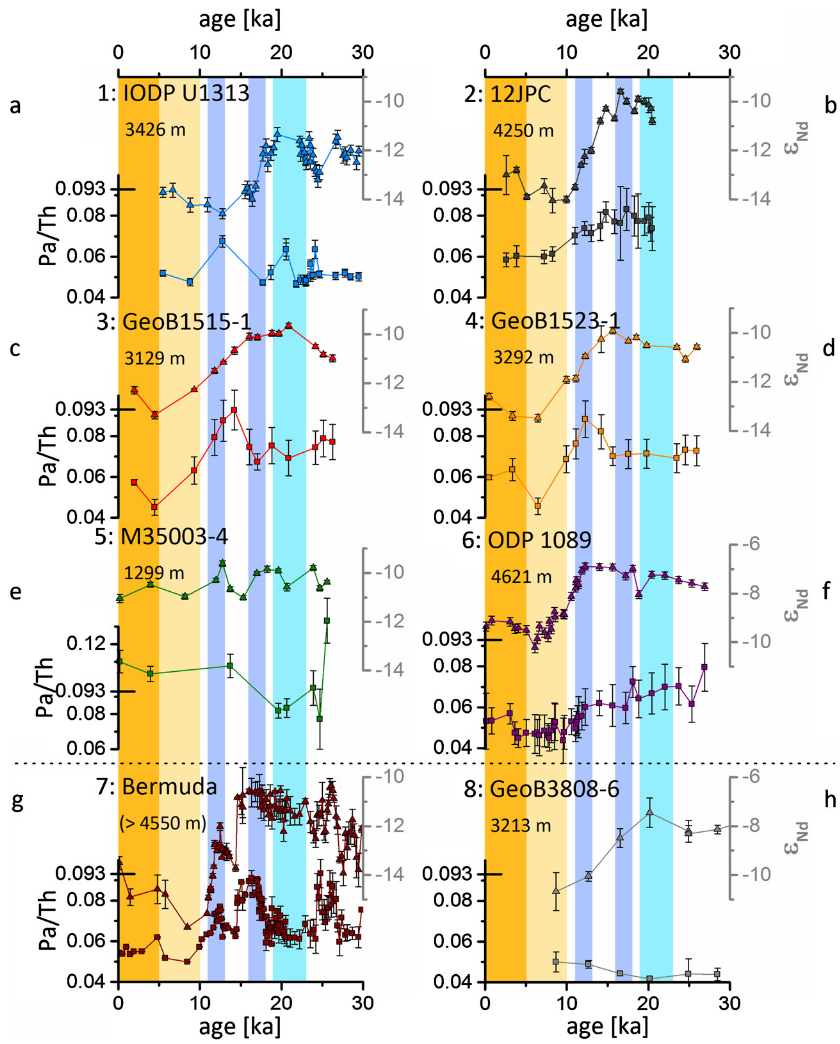

Fig. 2. (a–f) New combined ^{231}Pa/^{230}Th and ε_{Nd} records from six sediment cores located across the entire Atlantic basin extended by combined data sets from the literature below the dotted line (g: Bermuda Rise and h: South Atlantic GeoB3808-6 – Jonkers et al., 2015). The Bermuda Rise record (g) is a combination of the ^{231}Pa/^{230}Th and ε_{Nd} profiles reported by Gutjahr and Lippold (2011), Lippold et al. (2009), McManus et al. (2004) and Roberts et al. (2010). Y-axes ranges have been kept constant with exception of ^{231}Pa/^{230}Th at the shallowest core M35003-4 (e) and ε_{Nd} at the two southern cores ODP Site 1089 and GeoB3808-6 (f, h). Vertical bars indicate the time ranges of the LGM, Heinrich Stadial 1, Younger Dryas and the early and later Holocene.

there is no ^{231}Pa/^{230}Th value available for HS1. Further, we present an additional new ^{231}Pa/^{230}Th datum at 24.7 ka. The corrected figure and caption appear below.

(2) Fig. 4: Only average values from core M35003-4 are changed slightly from the original figure. The corrected figure and caption appear below.

(3) Fig. 5: Only values from core M35003-4 are changed from the original figure. While the LGM values are significantly lower now than in the original incorrect version, there are no ^{231}Pa/^{230}Th values from the HS1 time period available anymore. The corrected figure and caption appear below.

(4) Fig. 6: Only values from core M35003-4 are changed from the original figure. While the difference in ε_{Nd} between LGM and Holocene stays at 0.6 epsilon units the average ^{231}Pa/^{230}Th value is 11% lower (compared to +5% in the incorrect version). The corrected figure and caption appear below.

Text

(5) page 75, paragraph 3.8 “Glacial–Holocene evolution of ocean circulation from a two-proxy point of view”:

[...] However, there are three cores characterised by unchanged (IODP U1313) or even lower (GeoB3808-6, M35003-4) ^{231}Pa/^{230}Th during the LGM (Fig. 5a). [...] In the north ε_{Nd} at IODP Site U1313 equally indicates more radiogenic signatures during the glacial, but with more unradiogenic absolute values (LGM average $\varepsilon_{Nd} \approx -12$), which is indicative of significant NCW admixtures to glacial local deep water. Similarly, the shallowest core M35003-4 shows a barely resolvable shift to-wards more radiogenic signatures ($\Delta\varepsilon_{Nd} = 0.6$). The water mass provenance signal at IODP Site U1313 and M35003-4 changed far less than at the deeper and more southerly cores and circulation strength as indicated by ^{231}Pa/^{230}Th at these sites was comparable or even stronger than today. Thus, we conclude that there was still an active northern overturning cell of GNAIW during the LGM.

(6) page 76, paragraph 3.9 “Heinrich Stadial 1”:

The two sentences after: “Lower HS1 values at ODP Site 1089 and higher values at the Bermuda Rise were accompanied by changes in opal concentrations (S5, Keigwin and Boyle, 2008; Lippold et al., 2009) and may not be solely explained by circulation changes.” are obsolete now.

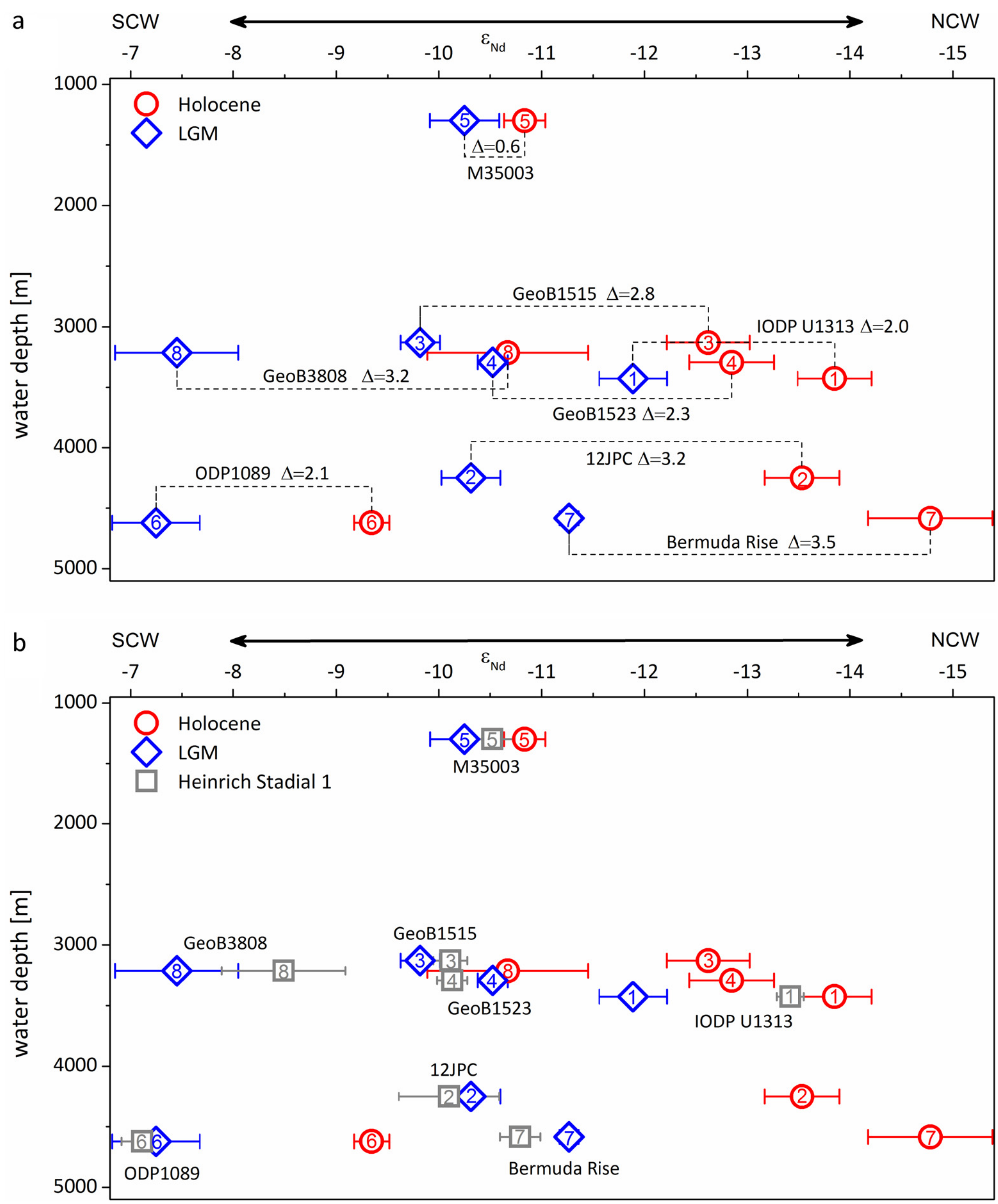

Fig. 4. Water depth versus (a) ε_{Nd} for the time slices of the Holocene (averaged from 0–10 ka, red) and the LGM (averaged from 19–23 ka, blue). Dashed lines indicate the changes in ε_{Nd}. Numbers within the symbols refer to the individual cores (Table 1). Error bars give the standard error for the average of each time slice. If only one datum is within the limits of the time slice, the analytical external reproducibility is given. (b) ε_{Nd} of HS1 (averaged from 15–18 ka, grey) is added. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

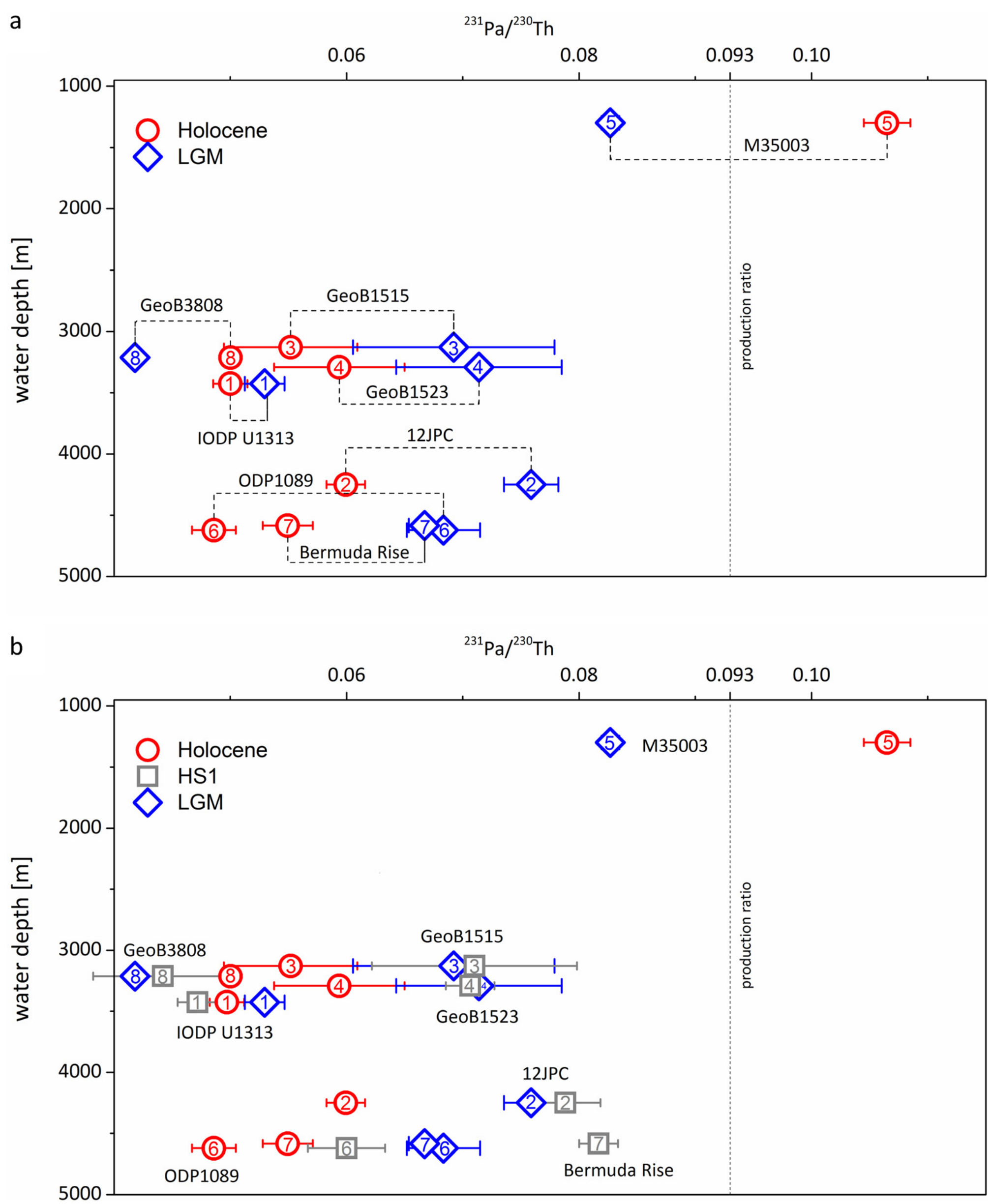

Fig. 5. (a) Water depth versus $^{231}Pa/^{230}Th$ for the time slices of the Holocene (averaged from 0–10 ka, red) and the LGM (averaged from 19–23 ka, blue). Dashed lines indicate the changes in $^{231}Pa/^{230}Th$. Numbers within the symbols refer to the individual cores (Table 1). Error bars give the standard error for the average of each time slice. If only one datum is within the limits of the time slice, the analytical external reproducibility is given. (b) $^{231}Pa/^{230}Th$ averages of HS1 (averaged from 15–18 ka, grey) are added. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

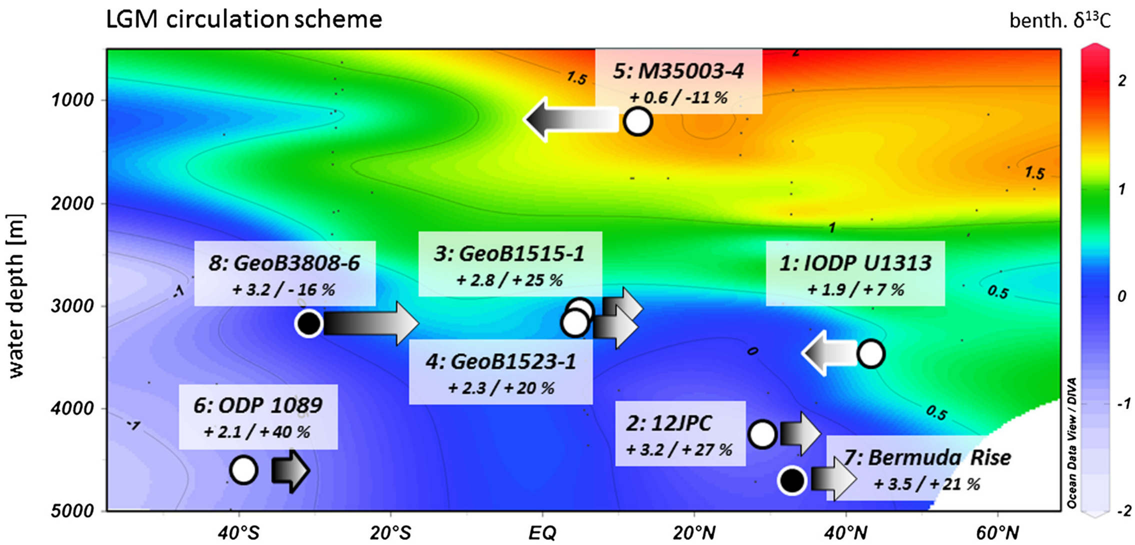

Fig. 6. LGM AMOC circulation scheme based on ^{231}Pa/^{230}Th, ε_{Nd} and δ^{13}C (values indicated by contour lines and colour code – Curry and Oppo, 2005) indicate a shoaled NCW overturning cell. Overlain on the δ^{13}C compilation are directions and relative advection strengths during the LGM derived from ^{231}Pa/^{230}Th and ε_{Nd} for each core location. Shadings of the arrows indicate the contribution of NCW (white) relative to SCW (black) according to a linear end-member mixing model. Lengths of the arrows are scaled to the relative changes in ^{231}Pa/^{230}Th between the LGM and the Holocene. Numbers underneath the core names indicate the differences in ε_{Nd} and relative increases in ^{231}Pa/^{230}Th values during the LGM compared to the average Holocene values. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Supplement

According to the changes in the age model of M35003-4 we also adapted the supplementary material. The corrected supplementary file is attached for the reader's convenience.

Corrections were applied to the following paragraphs:

S3 – Lithogenic contributions to ^{231}Pa and ^{230}Th
S4 – Age control
S5 – Opal and ^{231}Pa/^{230}Th time series
S6 – Data tables

Appendix A. Supplementary material

Supplementary material related to this article can be found online at http://dx.doi.org/10.1016/j.epsl.2016.11.005.

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