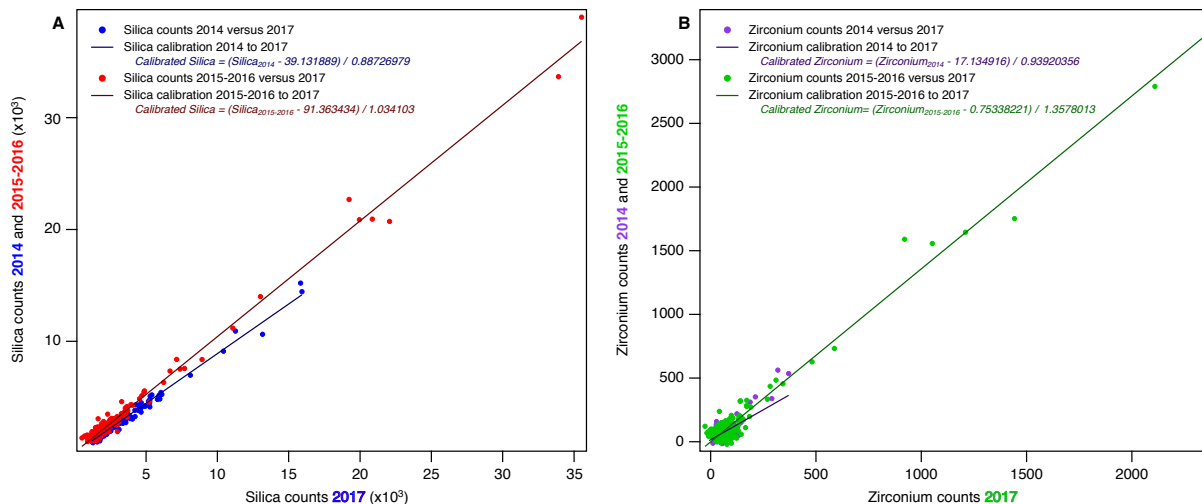


Supplementary Information to “Reinforcing the North Atlantic backbone: revision and extension of the composite splice at ODP Site 982”

This supplemental file contains a description of the calibration process used to enable comparison of the XRF datasets collected at different times, and the code that was used to generate the MTM spectra shown in Figure 5. Additionally, this file contains the Supplementary Tables 2 and 6 and Figures 2-4, which were referred to in the main manuscript, as well as the captions for Supplementary Tables 1, 3-5 and 7, which are stored on the open access PANGAEA database (<https://doi.org/10.1594/PANGAEA.884300>). Supplementary Tables 1, 3-7 are also included as excel files in the supplementary information folder accompanying this publication. A CODD experiment for Site 982 and all composite core photos, including a spliced composite core image, are also available as supplementary information on PANGAEA. Please note, all references cited here are included in the main manuscript's reference list.

CALIBRATION OF XRF CORE SCANNING DATA

The X-Ray Fluorescence (XRF) core scanning data was collected at the MARUM (University of Bremen) between April 2014 and June 2016 on the XRF Core Scanner II (AVAATECH Serial No. 2). Between 2014 and 2015, the X-Ray tube was replaced. To account for differences in measurement intensity, a number of sections were re-measured in 2017 and linear regressions between the new 2017 dataset and the 2014 and 2015-2016 datasets (Supplementary Figure 1.A for the 2014 to 2017 calibration; Supplementary Figure 1.B for the 2015-2016 to 2017 calibration) were used to calibrate the data and enable comparison across the entire dataset.



Supplementary Figure 1. The linear regressions used to calibrate the XRF data to enable intercomparison are shown in A) for silica and in B) for zirconium. Separate calibrations were calculated for data from 2014 to 2017 and for data from 2015-2016 to 2017.

CODE FOR MTM SPECTRA (FIGURE 5)

The following code was used to generate the MTM spectra using the Astrochron (Meyers, 2014) for R:

for the $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ data on depth (m):

```
mtm("data_on_depth",tbw=3,ntap=5,padfac=2,demean=T,detrend=T,siglevel=0.99,ar1=T,
    T,output=1,CLpwr=T,xmin=0,xmax=5,pl=1,sigID=T,genplot=T,verbose=T)
```

for the $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ data on age (Myr):

```
mtm("data_on_age",tbw=3,ntap=5,padfac=2,demean=T,detrend=T,siglevel=0.99,ar1=T,
    output=1,CLpwr=T,xmin=0,xmax=80,pl=1,sigID=T,genplot=T,verbose=T)
```

Please see the Astrochron help files for further information on the syntax.

SUPPLEMENTARY TABLES 2 and 6

Supplementary Table 2. Species specific offsets (Shackleton et al., 1984, 1995) used to correct the raw isotopic data in Supplementary Table 3 to equilibrium.

Species	Abbr.	$\delta^{18}\text{O}$ offset	$\delta^{13}\text{C}$ offset	Source
<i>Cibicidoides mundulus</i>	CMUND	0.64	0.00	Shackleton et al., 1995
<i>Cibicidoides wuellerstorfi</i>	CWUE	0.64	0.00	Shackleton et al., 1984

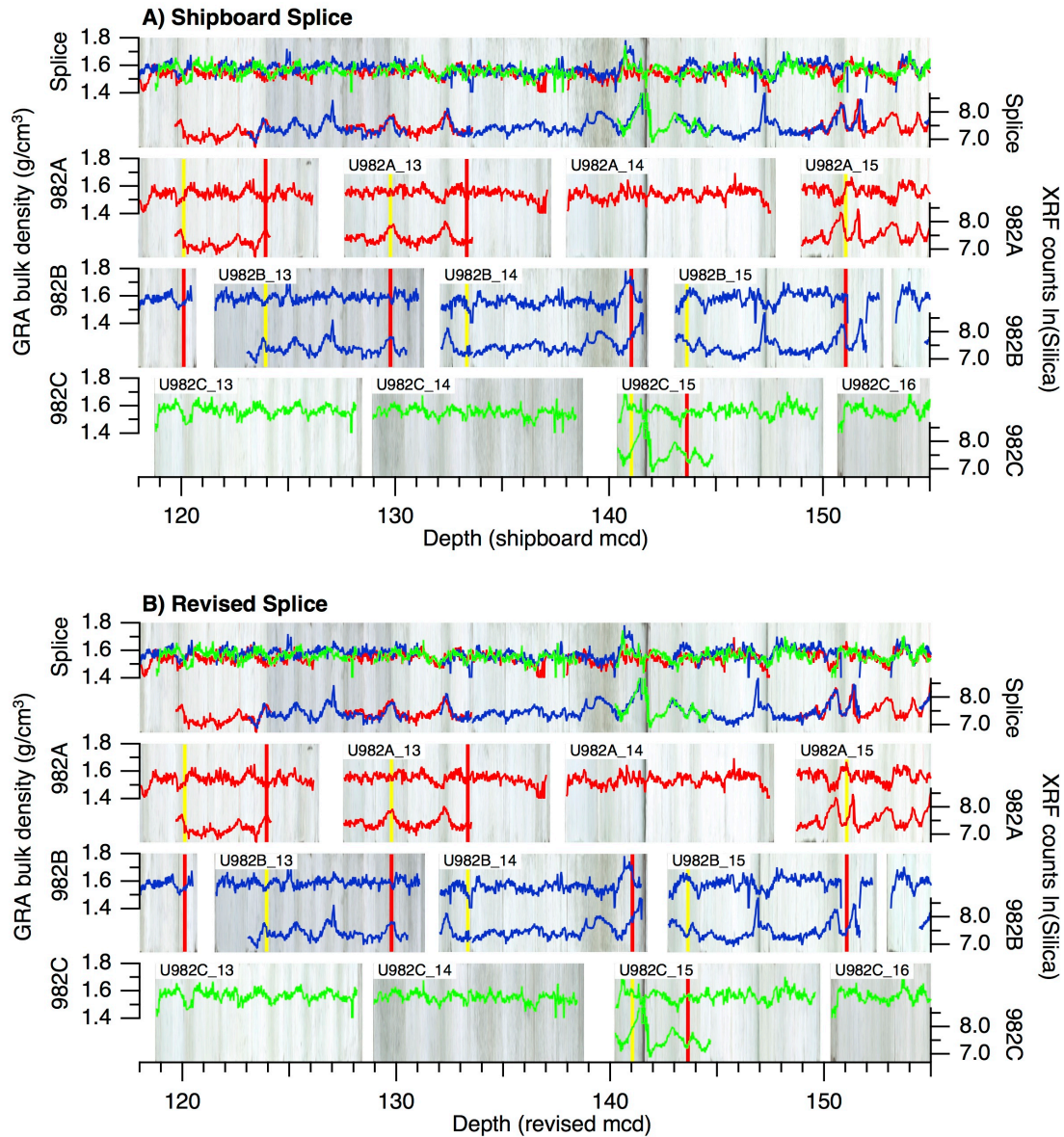
Supplementary Table 6. Initially, first-order age model based on a 3rd order polynomial fit through 20 shipboard nannofossil and planktonic foraminiferal datums (updated to GTS2012 Hilgen et al., 2012).

Biohorizon (from Site 982 a)	Type	Top and Bottom Sample ID, mbsf rmcd a		mid Depth rmcd	Depth error	GTS2012 Age b
		TOP 162-982	TOP 162-982	(m)	(m)	(Ma)
LO P. lacunosa	Nannofossil	B-2H-2-W 124 8.24 9.56	B-2H-3-W 144 9.94 11.26	10.41	0.85	0.44
FO Gephyrocapsa spp. C/D	Nannofossil	B-3H-3-W 65 18.65 20.81	B-3H-4-W 10 19.6 21.76	21.28	0.48	0.61
LO C.macintyreii	Nannofossil	B-4H-2-W 124 27.24 30.32	B-4H-3-W 110 28.6 31.68	31.00	0.68	1.60
FO Gr. inflata	Planktonic foraminifera	A-4H-CC-W 10.5 36.99 39.49	A-5H-CC-W 17.5 46.54 50.47	44.98	5.49	2.10
LO D.surculus T	Nannofossil	B-7H-1-W 18 53.18 58.95	B-7H-2-W 18 54.68 60.45	59.70	0.75	2.49
LO D. tamalis T	Nannofossil	A-7H-5-W 18 61.88 69.85	A-7H-6-W 18 63.38 71.35	70.60	0.75	2.80
LO Gr. cf. crassula T	Planktonic foraminifera	A-8H-CC-W 12 74.97 83.75	A-9H-CC-W 23 83.61 93.44	88.59	4.85	3.29
LO A.primus T	Nannofossil	A-14H-3-W 10 125.3 141.02	A-14H-4-W 10 126.8 142.52	141.77	0.75	4.50
LO D. quinquenarius	Nannofossil	A-18H-4-W 10 164.8 184.15	A-18H-5-W 10 166.3 185.65	184.90	0.75	5.59
d. to s. N. atlantica	Planktonic foraminifera	B-26H-3-W 20 236.7 263.59	B-26H-4-W 20 238.2 265.09	264.34	0.75	6.99
FO D. surculus	Nannofossil	B-26H-CC-W 19 242.95 269.84	B-27X-CC-W 18.5 249.49 277.91	273.87	4.03	7.79
FO N. acostaensis	Planktonic foraminifera	B-35X-CC-W 35.5 323.06 352.73	B-36X-1-W 19 326.49 356.16	354.44	1.72	9.83
LO Gr. mayeri	Planktonic foraminifera	B-35X-CC-W 35.5 323.06 352.73	B-36X-1-W 19 326.49 356.16	354.44	1.72	10.46
LO C. miopelagicus	Nannofossil	B-41X-2-W 10 376.1 405.77	B-41X-3-W 10 377.6 407.27	406.52	0.75	10.97
LO C. floridanus	Nannofossil	B-49X-1-W 10 451.5 481.17	B-49X-2-W 10 453 482.67	481.92	0.75	11.85
LO S. heteromorphus	Nannofossil	B-47X-CC-W 45.5 438.66 468.33	B-48X-CC-W 38.5 450.14 479.81	474.07	5.74	13.53
FO O. suturalis	Planktonic foraminifera	B-53X-CC-W 35 498.62 528.29	B-54X-1-W 41 499.71 529.38	528.83	0.54	15.10
LO C. dissimilis	Planktonic foraminifera	B-57X-CC-W 34 535.72 565.39	B-58X-CC-W 30.5 541.59 571.26	568.32	2.93	17.54
FO S. heteromorphus	Nannofossil	B-60X-CC-W 33.5 561.18 590.85	B-61X-CC-W 29.5 570.22 599.89	595.37	4.52	17.71
LO S. belemnoides	Nannofossil	B-60X-CC-W 33.5 561.18 590.85	B-61X-1-W 10 566.8 596.47	593.66	2.81	17.95
Polynomial age model c		Age = (21.007 * depth) + (2.6974 * depth^2) + (-0.11423 * depth^3)				
a Site 982 report (Shipboard scientific party Leg 162, 1997)						
b Hilgen et al., 2012						

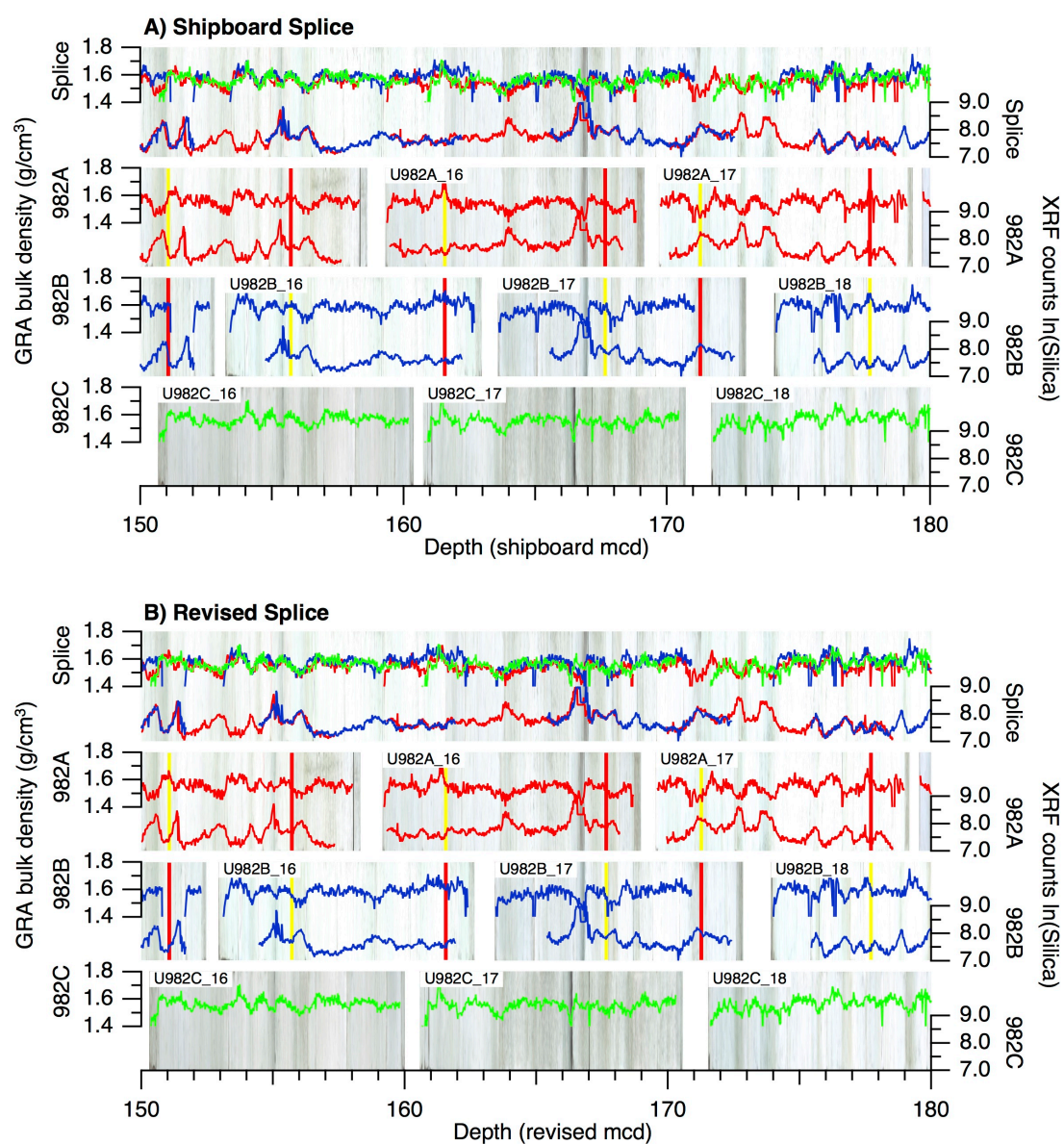
SUPPLEMENTARY FIGURES 2-4

Supplementary Figure 2. Panels showing A) the shipboard composite splice and B) the revised splice between 120 and 290 m revised composite depth (rmcd) in ~30 m intervals (Panels 1-6). Each panel consists of the composite core images of the Site 982 splice and Holes 982A, 982B and 982C, with the XRF $\ln(\text{Silica counts})$. Tie point locations are shown by yellow (upper tie point within a core) and red (lower tie point within a core) lines.

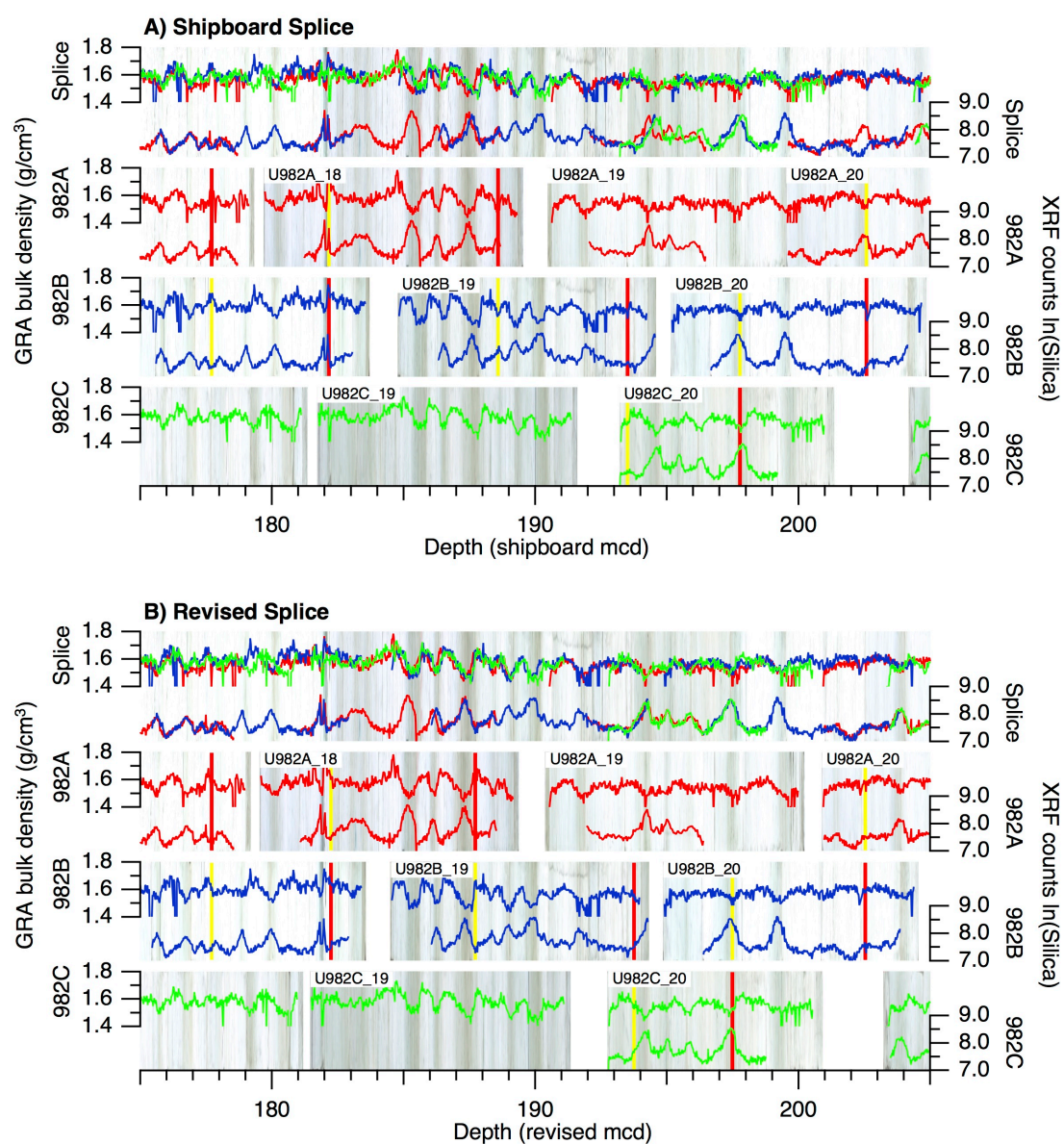
Panel 1: 118-155 (r)mcd.



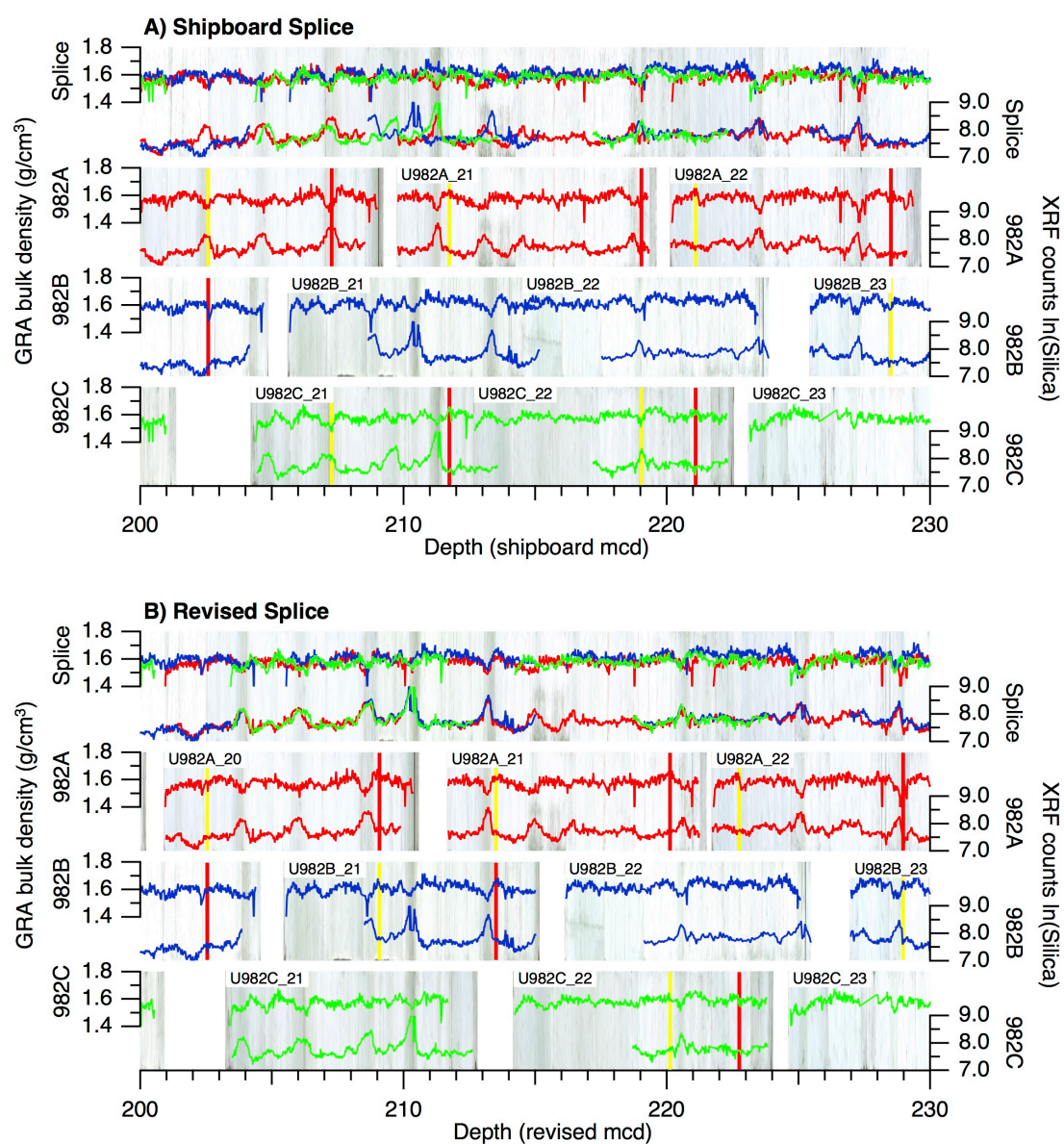
Panel 2: 150-180 (r)mcd.



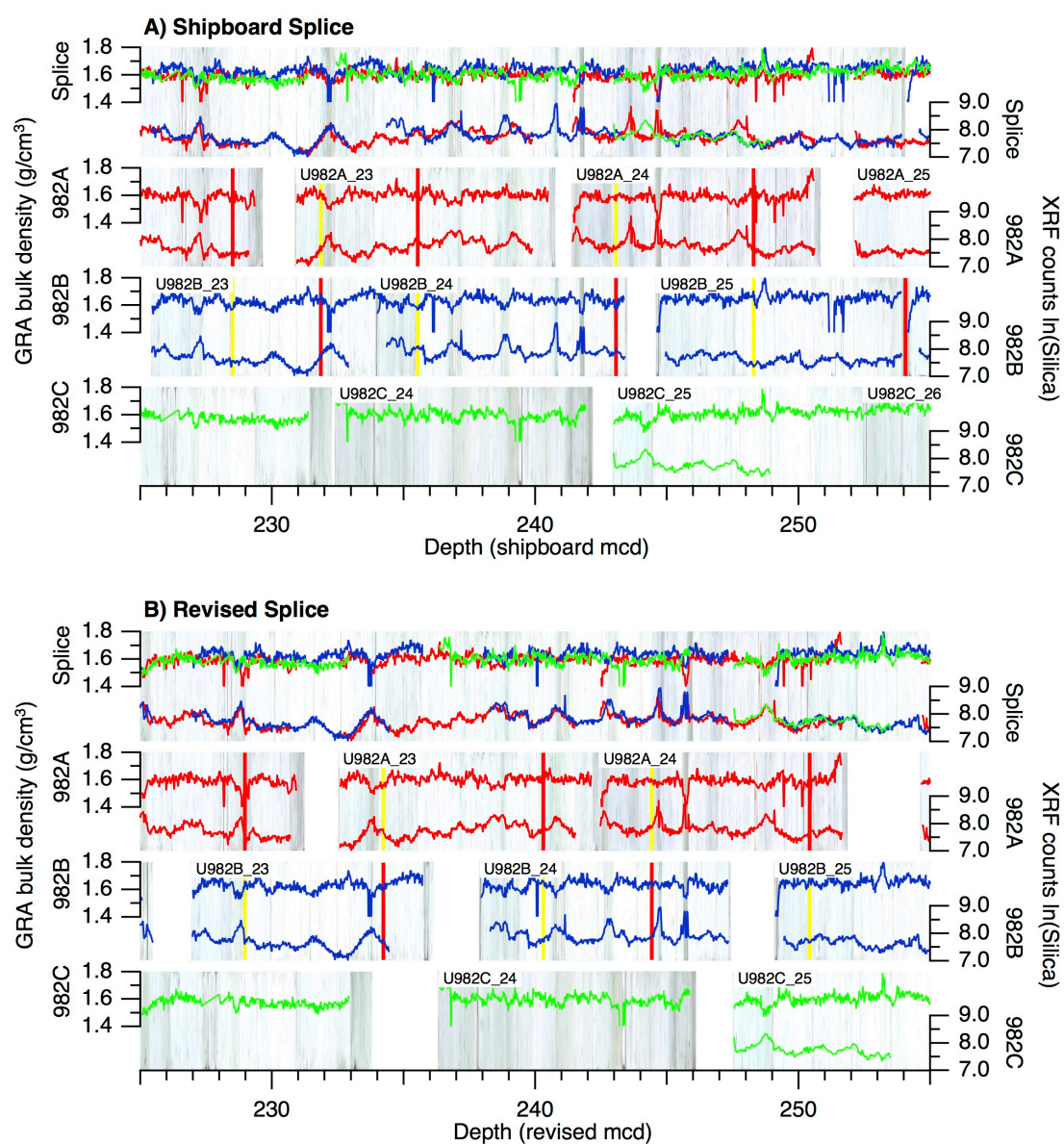
Panel 3: 175-205 (r)mcd.



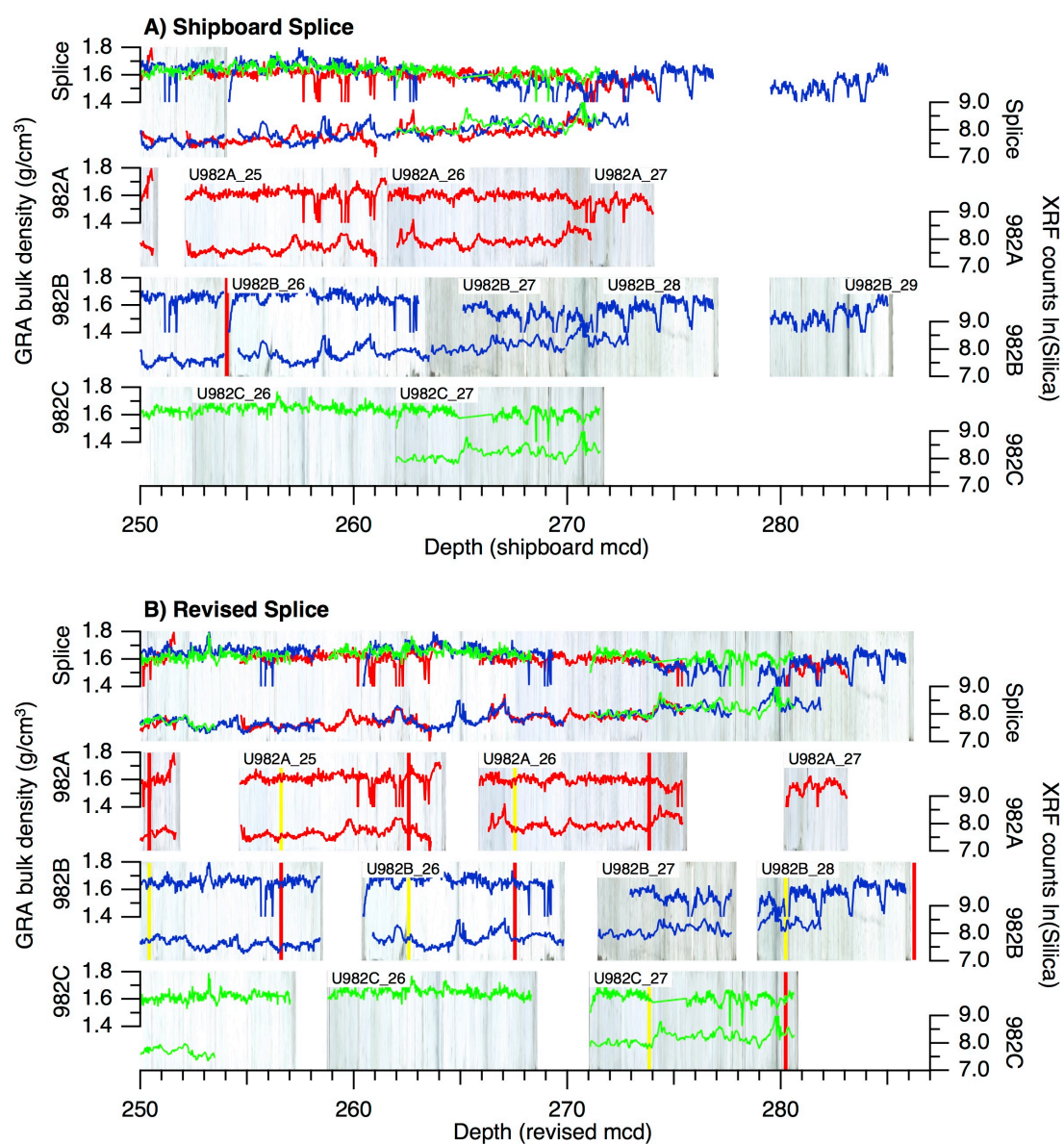
Panel 4: 200-230 (r)mcd.



Panel 5: 225-255 (r)mcd.

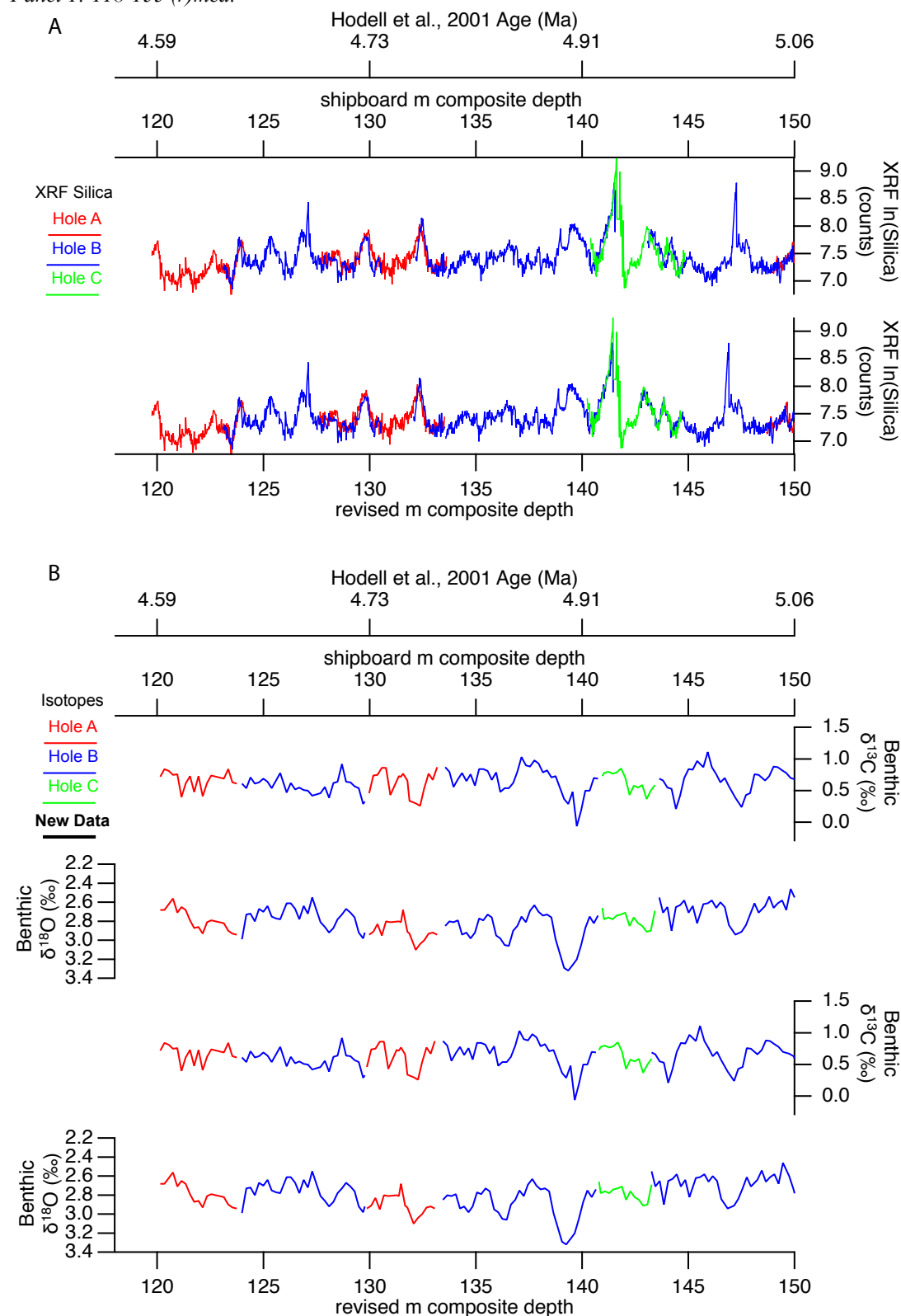


Panel 6: 250-287 (r)mcd.

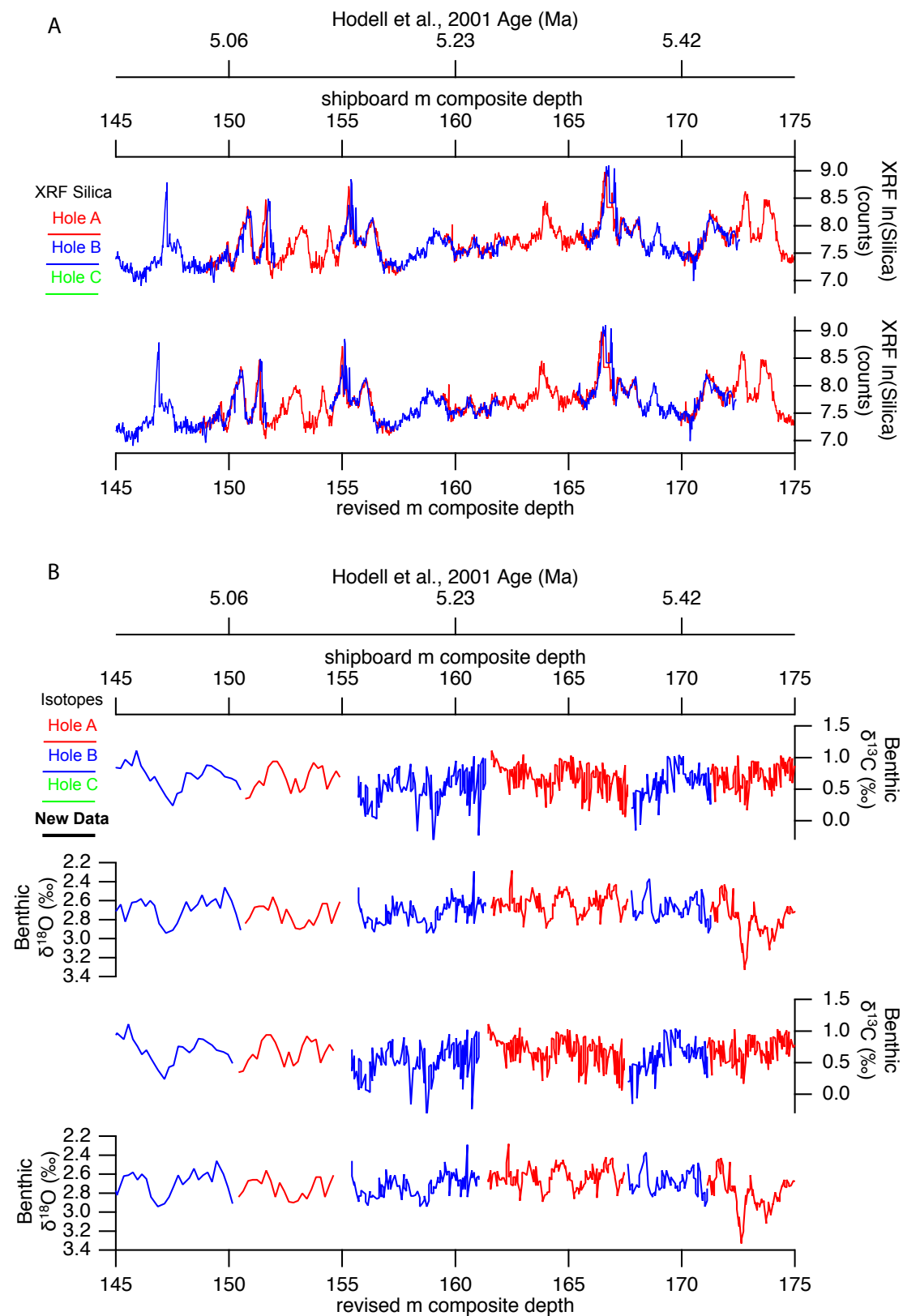


Supplementary Figure 3. A) Site 982 XRF In(Silica) on the shipboard composite depth with the Hodell et al. (2001) age on the top axis, and on the revised composite depth on the bottom axis. B) Site 982 stable isotope $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ records published in Hodell et al. (2001) on the shipboard composite depth and age on the top axis. On the bottom axis, the published stable isotope data is plotted on the revised composite depth, together with the new stable isotope data (black lines) produced in this study. The splice is shown from 120-300 m revised composite depth (rmcd) over 7 panels at ~ 30 m intervals.

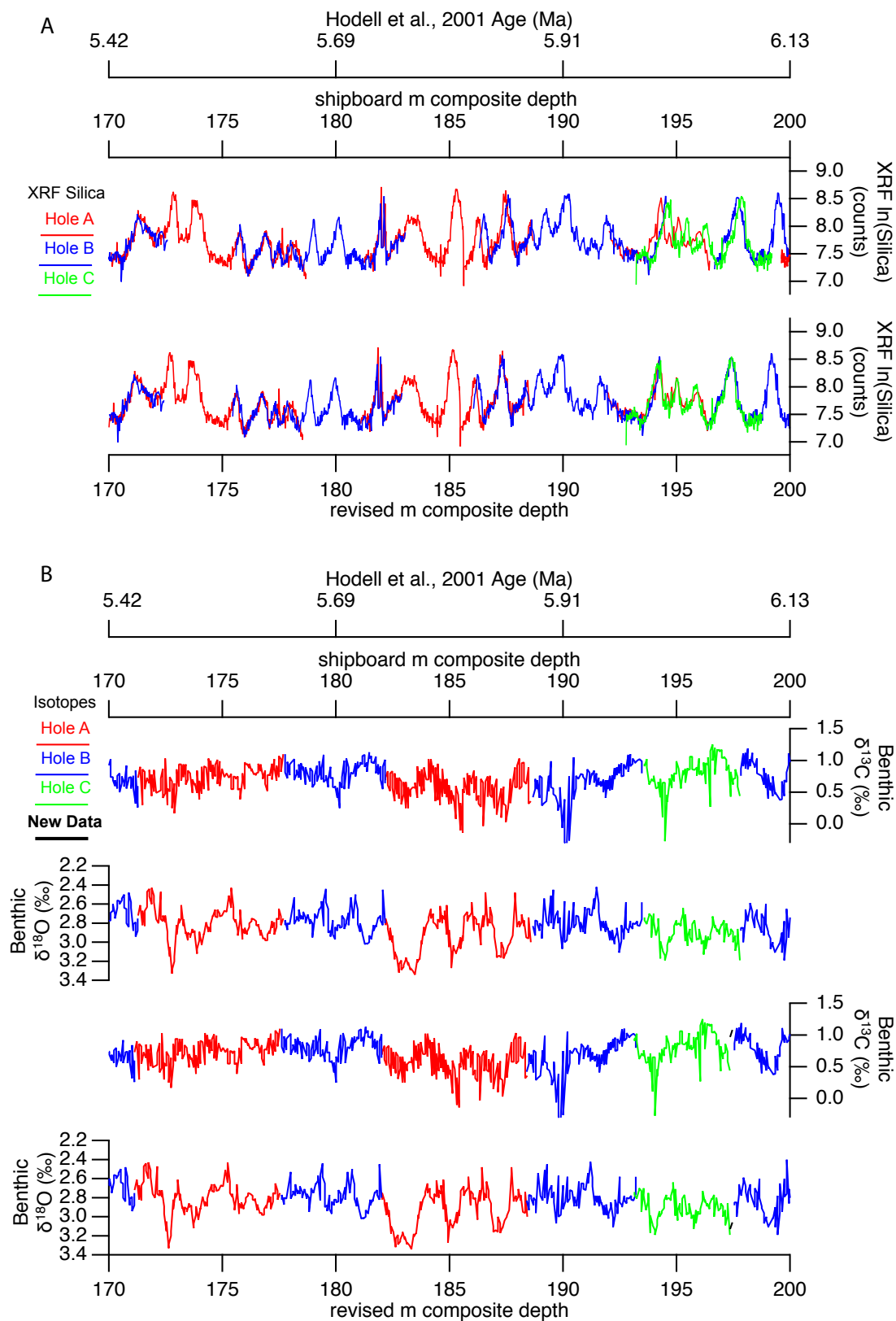
Panel 1: 118-155 (r)mcd.



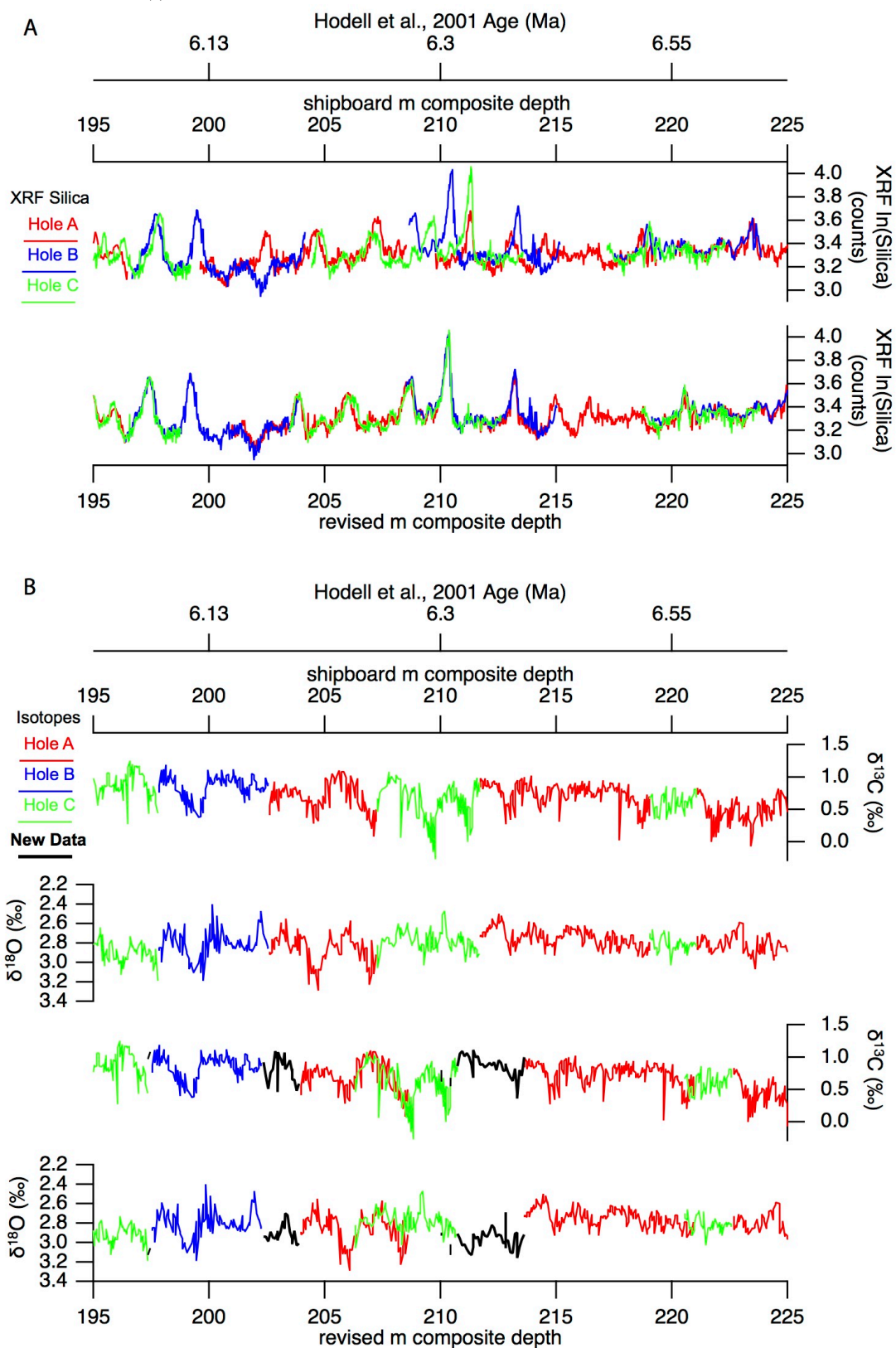
Panel 2: 145-175 (r)mcd.



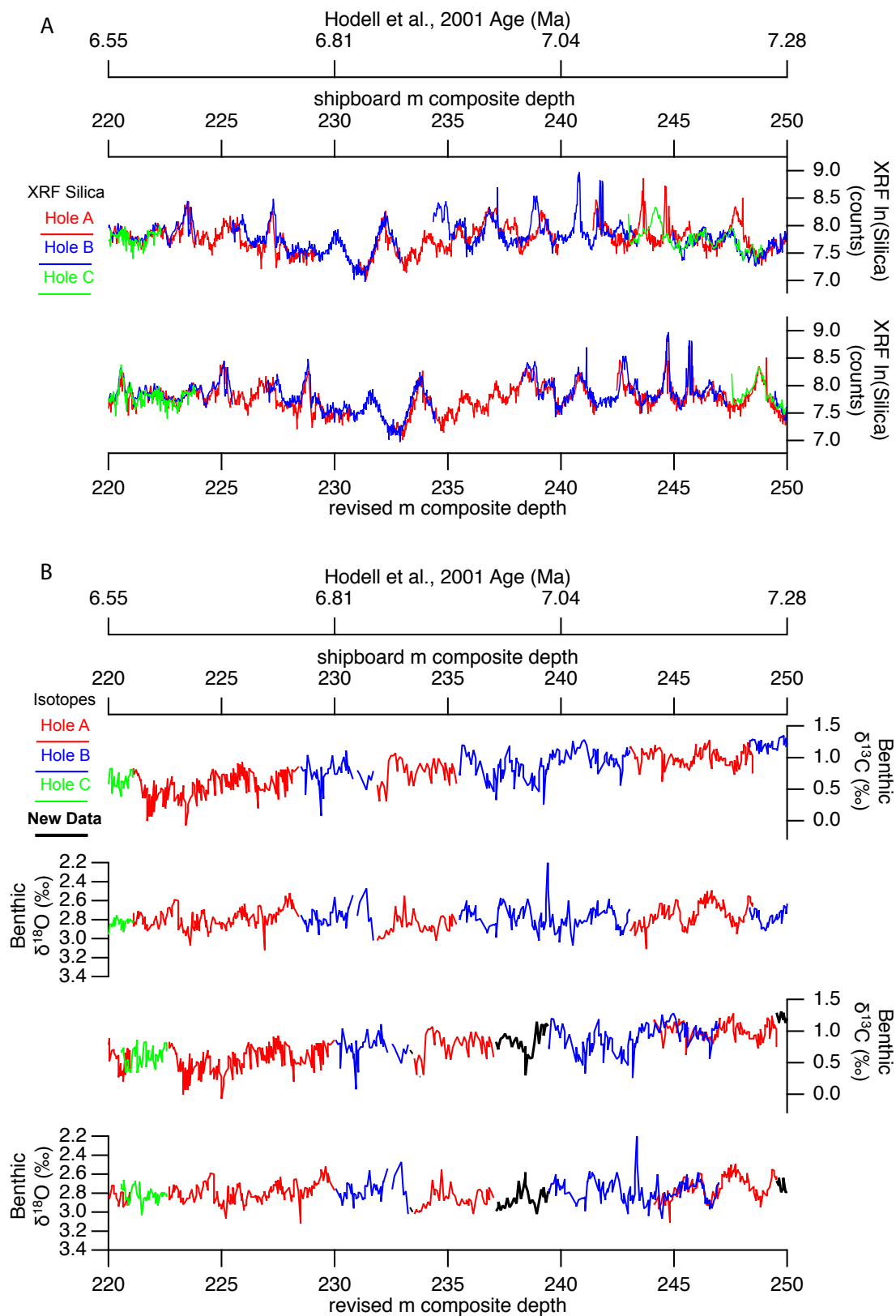
Panel 3: 170-200 (r)mcd.



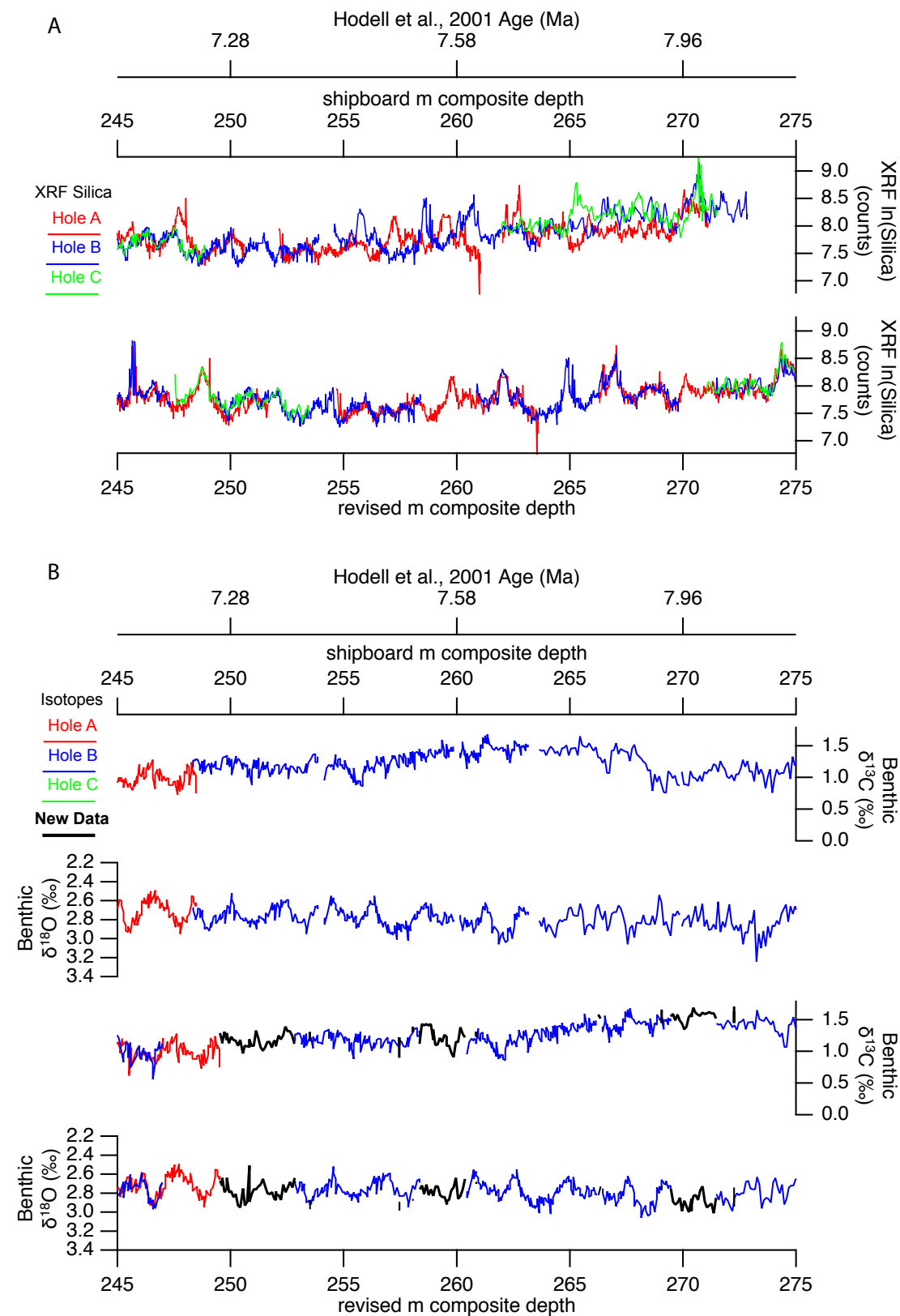
Panel 4: 195-225 (r)mcd.



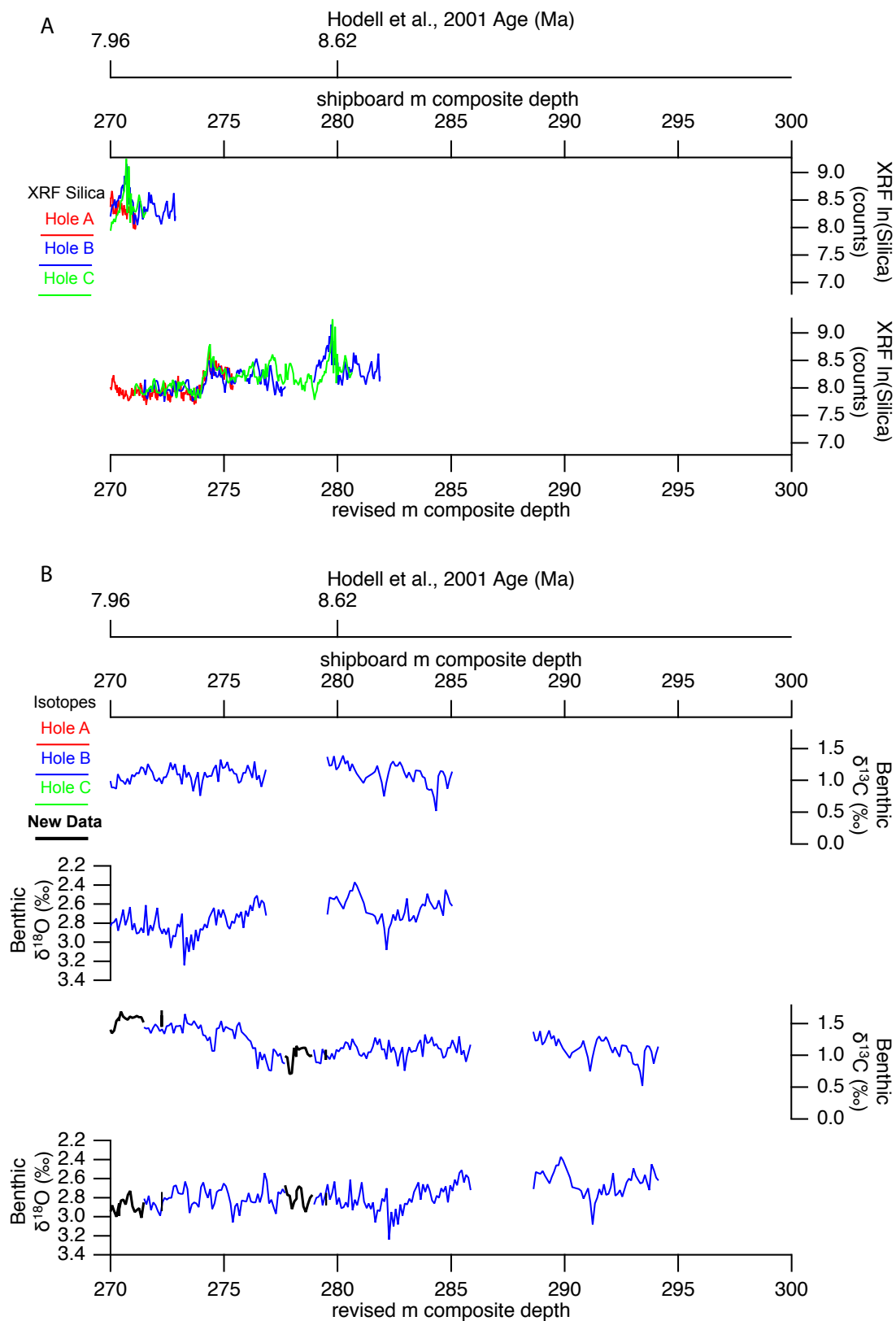
Panel 5: 220-250 (r)mcd.



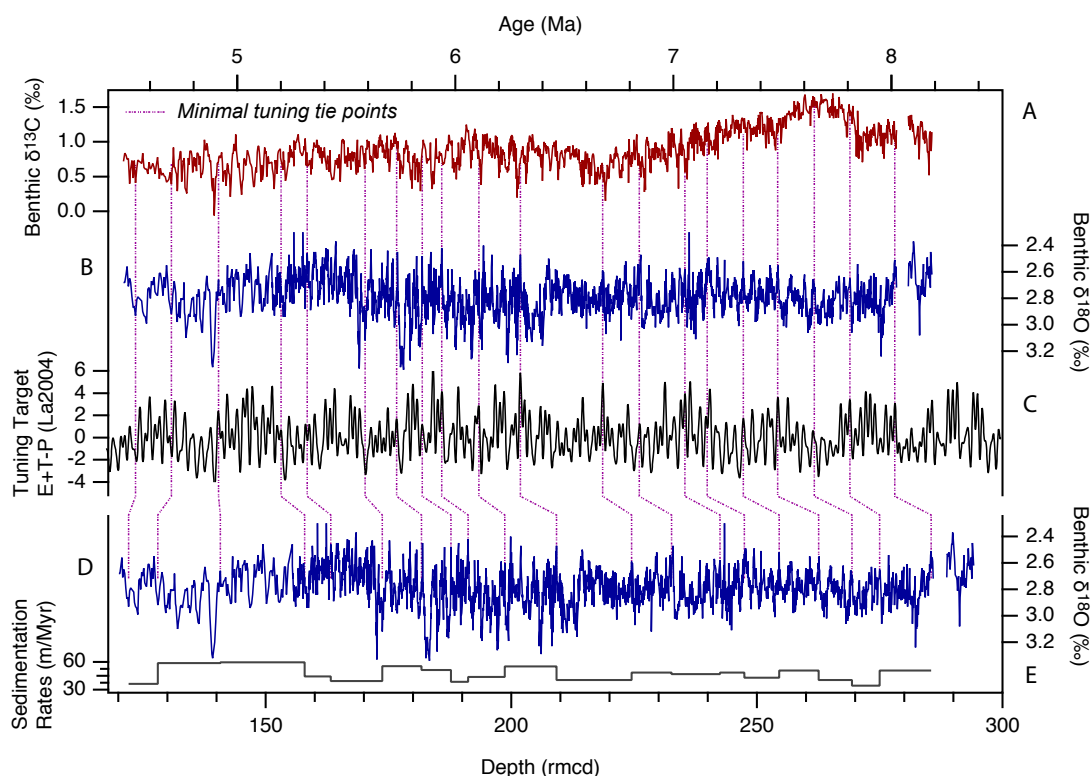
Panel 6: 245-275 (r)mcd.



Panel 7: 270-300 (r)mcd.



Supplementary Figure 4. Minimally-tuned astrochronology for Site 982, with minimal tuning tie points indicated in purple. A: Benthic foraminiferal $\delta^{13}\text{C}$ on age (in ‰ versus VPDB). B: Benthic foraminiferal $\delta^{18}\text{O}$ on age (in ‰ versus VPDB). C: Eccentricity+Tilt-Precession tuning target (E+T-P) from Laskar et al. (2004) D: Benthic foraminiferal $\delta^{18}\text{O}$ (in ‰ versus VPDB) on depth rmcd. E: Fine-tuned sedimentation rates (in m/Myr) on depth rmcd.



**CAPTIONS FOR ADDITIONAL SUPPLEMENTARY TABLES AVAILABLE
ON PANGAEA AT <https://doi.org/10.1594/PANGAEA.884300> AND AT
*CLIMATE OF THE PAST***

Supplementary Table 1 (Pangaea). Hole specific and splice XRF core scanning Zirconium, Silica and $\ln(\text{Si})$ for Site 982.

Supplementary Table 3 (Pangaea). Site 982 raw and corrected isotope data.

Supplementary Table 4 (Pangaea). Site 982 revised offset tables for Holes A-D.

Supplementary Table 5 (Pangaea). Site 982 revised splice tie and interval tables.

Supplementary Table 7 (Pangaea). Minimal and fine tuning tie points for the U1337 astronomical age model.