Data report: composite depth scale and splice revision for IODP Site U1488 (Expedition 363 Western Pacific Warm Pool) using XRF core scanning data and core images

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Abstract

The Western Pacific Warm Pool (WPWP) is a major source of heat and moisture to the atmosphere. Small perturbations in WPWP sea-surface temperatures greatly influence local Hadley and Walker cells, thereby affecting global atmospheric circulation patterns. International Ocean Discovery Program (IODP) Expedition 363 sought to document the regional expression and driving mechanisms of WPWP climate variability during the Neogene on millennial, orbital, and geological timescales. Located in the heart of the WPWP, IODP Site U1488 (02°02.59′N, 141°45.29′E) was drilled in 2604 m water depth on the southern part of the Eauripik Rise in the Caroline Basin. At Site U1488, a continuous shipboard composite stratigraphic section from 0 to ~331 m core composite depth below seafloor (CCSF) was compiled using high-resolution shipboard physical property data from three holes. This section comprises upper Miocene to recent foraminifer-rich nannofossil ooze and foraminifer-nannofossil ooze, making Site U1488 ideally suited to reconstruct the paleoceanographic history of the central WPWP region. However, the high carbonate content (>90% below ~180 m CCSF) of Site U1488 sediments means that the physical property data sets commonly used for splice construction (gamma ray attenuation bulk density, magnetic susceptibility, and natural gamma radiation) were too low amplitude to provide robust constraints on splice tie points below 120 m CCSF. As a result, P-wave data, which are relatively untested as a correlation tool, became critical for correlating between holes. Here, we verify and extend the Site U1488 shipboard composite splice using high-resolution (2 cm) X-ray fluorescence Ba/Sr core scanning data combined with composite line-scan images. Overall, using these data at Site U1488 resulted in revised core offsets that differ by up to 0.84 m relative to the shipboard core offsets and a composite depth scale down to 329.33 m revised CCSF. The revised splice will allow optimization of post-expedition research and ensure that high-resolution studies of Site U1488 are conducted on a continuous stratigraphic section.

Introduction

The Western Pacific Warm Pool (WPWP) is the largest reservoir of oceanic heat on Earth and as a result plays a pivotal role in oceanic and atmospheric heat and transport processes (Rosenthal et al., 2018a). Forming part of the larger Indo-Pacific Warm Pool,
the WPWP is a major source of heat and moisture to the atmosphere. Small perturbations in regional sea-surface temperatures (SSTs) greatly affect the local Hadley and Walker cells and perturb global atmospheric circulation patterns, thereby significantly affecting regional and global hydrological cycles (Rosenthal et al., 2018a). Prior to Expedition 363, expanded and continuous sedimentary archives documenting WPWP Neogene history were scarce. A key objective of International Ocean Discovery Program (IODP) Expedition 363 (6 October – 8 December 2016) was recovery of continuous sedimentary archives to document the regional expression and driving mechanisms of WPWP climate variability throughout the Neogene on millennial, orbital, and geological timescales.

Three holes at IODP Site U1488 (02°02.59N, 141°45.29E; Figure F1) were drilled in 2604 m water depth on the southern part of the Eauripik Rise in the Caroline Basin. Because of its location in the heart of the WPWP, Site U1488 is ideally suited to reconstruct the Neogene paleoceanographic history of the central WPWP region (Rosenthal et al., 2018c). Three holes were cored to a maximum depth of ~315 m core depth below seafloor, method A (CSF-A; hereafter referred to as meters below seafloor [mbsf]), comprising upper Miocene to recent foraminifer-rich nannofossil oozes and foraminifer-nannofossil ooze. Shipboard studies show very good to good preservation of benthic and planktonic foraminifers throughout most of the sequence, and because the site remained above the calcite compensation depth throughout its history, dissolution effects on planktonic foraminifers are minimal (Rosenthal et al., 2018c). Based on shipboard nannofossil and planktonic foraminiferal biostratigraphic and paleomagnetic datums, sedimentation rates were ~2 cm/ky in the Pleistocene and ~4 cm/ky throughout the late Miocene and Pliocene. During the expedition, high-resolution shipboard physical property data were used to construct a continuous shipboard composite depth scale and stratigraphic splice from 0 to ~331 m core composite depth below seafloor (CCSF), which spanned from recent to ~9.4 Ma based on shipboard biostratigraphy (Rosenthal et al., 2018c).

At Site U1488, P-wave velocity data, which are relatively untested as a stratigraphic correlation tool, were critical for determining the hole-specific cumulative core offsets (Figure F2) (Rosenthal et al., 2018b). This was necessary because the high carbonate content at Site U1488 (>90% below ~180 m CCSF) meant that the physical property data sets commonly used for splice construction (gamma ray attenuation [GRA] bulk density, magnetic susceptibility [MS], and natural gamma radiation [NGR]) had amplitude variability that was too low to provide a robust means for stratigraphic correlation between holes (Figure F2) (Rosenthal et al., 2018b; Rosenthal et al., 2018c). The shipboard composite depth scale and splice were predominantly generated using MS in the upper ~65 m CCSF (Figure F2A). Below 65 m CCSF, the amplitude of the MS data greatly decreased, and between 65 and ~120 m CCSF the composite depth scale and splice were constructed using a combination of MS, P-wave velocity, and GRA bulk density data. Below 120 m CCSF, the amplitude of the variability in the MS data was too low to use for stratigraphic correlation, so only P-wave velocity and GRA bulk density data were used (Figure F2B) (Rosenthal et al., 2018c).

The stratigraphic splice for Site U1488 must be robust to facilitate postexpedition research, which includes the generation of high-resolution paleoclimatological records to contribute to the overarching objectives of Expedition 363. However, research on other high-carbonate content settings (e.g., Ocean Drilling Program [ODP] Site 982 in the North Atlantic) has shown that physical property data can be highly unreliable for generating robust, continuous composite depth scales and stratigraphic splices (Drury et al., 2018). As such, it is crucial to verify shipboard composite depth scales and splices from high-carbonate sites such as Site U1488.

Here, we present linescan core images and high-resolution (2 cm) Ba/Sr X-ray fluorescence (XRF) core scanning data for Site U1488. We combine these two data sets with the available shipboard physical property data to verify and revise the shipboard composite depth scale and splice for Site U1488.

**Methods and materials**

**XRF core scanning data**

XRF core scanner Ba and Sr data were collected every 2 cm downcore over a 1.2 cm² area with a downcore slit size of 10 mm and a cross-core slit size of 12 mm (50 kV; 0.5 mA; 7 s count time) from the split core surface of Site U1488 archive halves with the XRF Core Scanner III (AVANTECH Serial No. 12) at MARUM (the Center for Marine Environmental Sciences), University of Bremen (Germany). Where needed, the split core surface of the archive half was lightly scraped with a glass slide to achieve a flat surface suitable for XRF core scanning. The split core surface was then covered with a 4 μm thick SPEXCert Prep Ultralene I foil to avoid contamination of the XRF measurement unit and desiccation of the sediment. The data reported here utilize the SGX Sensortech Silicon Drift Detector (Model SiriusSD D65133B-INF with 133eV X-ray resolution), the Topaz-X High-Resolution Digital MCA, and an Oxford Instruments 100W Neptune X-Ray tube with rhodium (Rh) target material. The raw X-ray data spectra were processed using the Iterative Least Square software (WIN AXIL) package from Canberra Eurisys.

**Linescan core and spliced images**

To assist with composite depth scale and splice verification, core images for Site U1488 were compiled using Code for Ocean Drilling Data (CODD; https://www.codd-home.net) (Wilkens et al., 2017) from the digital linescan images taken during the expedition. For each hole, cropped linescan section images were downloaded from the IODP laboratory information management system (LIMS) database (https://web.iofp.tamu.edu/LORE) while on board the R/V JOIDES Resolution. Images from Sections 363-U1488C-3H-2 through 7H-CC and 14H-5 through 17H-CC were slightly lightened because the original linescan images from these sections were obvi-
Figure F2. Shipboard magnetic susceptibility (MS), shipboard P-wave, and new X-ray fluorescence (XRF) Ba/Sr data, Holes U1488A–U1488C. A. Shipboard MS was essential for correlation, which is confirmed by shipboard P-wave and XRF Ba/Sr data. B. Shipboard MS can no longer be used for correlation, but it is clear that the variability in the P-wave data can mostly be used to correlate between holes, which is confirmed by the XRF Ba/Sr data.
board interhole relationships and tie points when revising the CCSF depth scale and splice. Where the new data showed the shipboard offsets and splice required revision, we chose interhole ties and splice intervals that avoided the top and bottom ~50 cm and disturbed intervals of a core. We chose splice intervals from cores that best represented the stratigraphic characteristics of the section in question.

Here, we report depths on the core depth below seafloor, method A (CCSF-A) depth scale as meters below seafloor (mbsf) in line with the terminology used in the Expedition 363 Proceedings (Rosenthal et al., 2018b). The shipboard composite depth scale “core composite depth below seafloor” is referred to as CCFS. The revised composite depth scale is referred to as “revised CCFS.” The CODD Includes SplicingRevise Menu was used to assist with the composite verification and revision process (Wilkens et al., 2017). As with the shipboard CCFS depth scale and splice, features used for correlating between holes and creating the revised CCFS depth scale and splice are only precisely correlated between holes at the exact location of the splice and/or offset tie point. Away from these ties, the correlation of individual stratigraphic features within a core may be less accurate between holes. Studies from other sites have provided an adjusted CCFS depth scale where the off-splice intervals are adjusted or “mapped” onto the splice to ensure as accurate a correlation between holes as possible (e.g., adjusted CCFS [Wilkens et al., 2013]; CCFS-M [van Peer et al., 2017]). This could not be done for Site 1488 because the physical property data and core images were not distinct enough to use accurately and the XRF data were not collected for all holes.

Results

Revised composite depth scale

The XRF core scanning ratio of Ba/Sr provided a robust proxy for stratigraphic correlation between all three holes (Figure F3). The shipboard cumulative core offsets were initially rounded to the nearest centimeter. In total, the offsets for 26 cores were changed from the shipboard offsets (Table T1; Figure F3):

- Cores 363-U1488A-14H, 21H, 23H, 26H, 31H, 34F, and 35F;
- Cores 363-U1488B-2H, 8H, 10H–11H, 16H, 21H, 23H, 27H–28H, 30H–31H, and 33H; and
- Cores 363-U1488C-3H, 9H–10H, 12H–14H, and 16H.

Most changes are small, and the revised offsets generally differ 0.02–0.17 m relative to the shipboard offsets. A further three offsets were changed by 0.30–0.32 m (Cores 363-U1488A-26H and 34F–35F; Figure F3K, F3N). Two of these changes were to the successive core gaps between Cores 363-U1488B-33H, 363-U1488A-34F, and 363-U1488A-35F, where the original growth factor-derived offset was increased by 30 cm to make it clearer that these cores are not part of a continuous succession (Table T1).

The largest changes to the shipboard offsets occurred in Cores 363-U1488C-12H (+0.74 m; Figure F3E) and 363-U1488B-27H (−0.75 m; Figure F3K) and 363-U1488B-31H (−0.84 m; Figure F3L, F3M). Changes to offsets were applied to every core in all holes below the depth of the core that was shifted, resulting in cumulative changes of 0.03–1.59 m in the revised CCFS scale relative to the shipboard CCFS scale (Table T1).

All preconditioned physical property data ("cleaned" GRA, MS, P-wave, and NGR) for Holes U1488A, U1488B, and U1488C were revised to the updated CCFS. These data are available as supplementary tables ST1–ST12 in the DATA_HOLE folder in the Supplementary material for this data report. During the expedition, preconditioning treatments were applied to the raw records to “clean up” and aid in the interpretation of noisy or spiky data (for details, see Physical properties in the Methods chapter [Rosenthal et al., 2018b]). The preconditioned physical property data ("cleaned" GRA, MS, P-wave, and NGR) provided along the revised stratigraphic splice are available as supplementary tables ST1–ST14 in the DATA_SPLICE folder in the Supplementary material for this data report.

Revised stratigraphic splice

The revised composite depth scale results in an updated stratigraphic splice down to 329.33 m revised CCFS (Table T2). Appended Cores 363-U1488A-34F and 35F extend the total sedimentary succession to 339.69 m revised CCFS overall (Table T2). The revised composite depth scale required adjustment of 25 splice tie points. Mostly, these changes constituted small revisions to optimize the location of the splice tie point between two holes within a sedimentary cycle. In addition, the exact interval and mbsf depth of some of the shipboard ties were adjusted by up to 1 cm to accommodate the rounding of the shipboard offsets to the nearest centimeter prior to revision of the composite depth scale (Tables T1, T2; both also available in the TABLES folder in the Supplementary material for this data report).

The largest revision occurred around ~134 m revised CCFS between Cores 363-U1488B-14H and 363-U1488C-14H, where a small section of Core 363-U1488A-14H was originally included in the shipboard splice. Following revision of the composite depth scale, Cores 363-U1488B-14H and 363-U1488C-14H were correlated at 134.13 m revised CCFS and Core 363-U1488A-14H was removed from the splice (Figure F3F). Generally, most splice ties are robust because there is excellent agreement between the XRF data, composite core photos, and physical property data among holes.

The splice tie point from Core 363-U1488A-32H to Core 363-U1488B-33H at 323.20 m revised CCFS remains ambiguous and should be treated cautiously because the XRF data did not provide a good correlation between the cores from different holes (Figure F3M). This interhole variability could be due to increased coring disturbance at the base of both holes. This tie point cannot be better resolved with the current data. However, because this tie point is located at the base of the revised splice, the consequences for high-resolution studies should be minimal.

Summary

We present a revised composite depth scale and stratigraphic splice for Site U1488, which was generated using XRF Ba/Sr core scanning data, linescan core images, and physical property data. The revised cumulative offsets differ by up to 0.84 m relative to the shipboard offsets. Splice tie points were adjusted where needed. Site U1488 now has a continuous and expanded revised composite depth scale down to 329.13 m revised CCFS. This revised splice will especially benefit postexpedition research that utilizes high-resolution studies on Site U1488 sediments and will contribute toward understanding orbital-scale climate dynamics in the central WPWP over the last ~9.4 My.

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Figure F3. A–N. Linescan core images and XRF Ba/Sr ratios for Holes U1488A (orange), U1488B (blue), and U1488C (green), as well as the spliced core images on the original shipboard composite depth scale and stratigraphic splice (upper panel) and on the revised composite and stratigraphic splice (lower panel). Yellow and red lines denote the top (yellow) and base (red) of intervals from a core included in the splice. Solid lines indicate where shipboard splice ties remained unchanged, and dashed lines indicate where changes were made (Table T2). (Continued on next thirteen pages.)
Figure F3 (continued).

**B** Shipboard

![Shipboard graph](image)

Depth shipboard CCSF (m)

**Revised (this study)**

![Revised graph](image)

Depth revised CCSF (m)
Figure F3 (continued).

C Shipboard

Depth revised CCSF (m)

Revised (this study)

Depth revised CCSF (m)
Figure F3 (continued).
Figure F3 (continued).

**E** Shipboard

![Image of shipboard CCSF depth scale]

**Revised (this study)**

![Image of revised CCSF depth scale]
Figure F3 (continued).

F  Shipboard

Revised (this study)
Figure F3 (continued).

G Shipboard

Depth shipboard CCSF (m)

Revised (this study)

Depth revised CCSF (m)
Figure F3 (continued).

H. Shipboard

Revised (this study)
Figure F3 (continued).

[Diagram of shipboard and revised CCSF depths with labels for U1488A-21, U1488A-22, U1488A-23, U1488B-22, U1488B-23, and U1488C, showing depth revised CCSF and shipboard splice revisions for IODP Site U1488.]
Figure F3 (continued).

**Shipboard**

**Revised (this study)**
Figure F3 (continued).

K Shipboard

Revised (this study)
Figure F3 (continued).

Shipboard

Revised (this study)
Figure F3 (continued).

**Shipboard**

- U1488A-31
- U1488A-32
- U1488A-33
- U1488B-31
- U1488B-32
- U1488C-33

**Depth shipboard CCSF (m)**

**Revised (this study)**

- U1488A-31
- U1488A-32
- U1488A-33
- U1488B-32
- U1488B-33

**Depth revised CCSF (m)**
Figure F3 (continued).

**Shipboard**

- U1488A-33
- U1488A-34
- U1488A-35

**Depth shipboard CCSF (m)**

**Revised (this study)**

- U1488A-34
- U1488A-35

**Depth revised CCSF (m)**

**Ba/Sr**

- U1488A
- U1488B
- U1488C

**0.5**

0.4

0.3

0.2

0.5

0.4

0.3

0.2

U1488 shipboard splice

U1488A Ba/Sr

U1488B Ba/Sr

U1488C Ba/Sr

U1488 revised splice

U1488A Ba/Sr

U1488B Ba/Sr

U1488C Ba/Sr

325 330 335 340 345 350 355

325 330 335 340 345 350 355

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Table T1. Affine table for Site U1488. * = uncertain tie point. GF = growth factor. MS = magnetic susceptibility, GRA = bulk density, PWL = P-wave, L* = luminosity, NGR = natural gamma radiation, XRF = X-ray fluorescence. (Continued on next page.) Download table in CSV format.

| Site | Hole | Core type | Depth (mbsf) | Shipboard offset (m) | Revisited offset (m) | Change in offset | Depth revised CCSF (m) of top of core | Depth revised CCSF (m) of core shift tie point | Type of shift | Data used | Reference core | Comments |
|------|------|-----------|-------------|----------------------|----------------------|-----------------|--------------------------------------|-----------------------------------------------|-------------|-----------|----------------|----------|
| U1488 | A 1 | H | 0.00 | 0.00 | 0.00 | 0.00 | 4.53 | SET | MS | C-1H | Shipboard offset adjusted to changes in prior offsets |
| U1488 | A 2 | H | 5.90 | 0.51 | 0.58 | 0.07 | 6.48 | 10.42 | Tie | XRF | B-2H | Offset verified with XRF |
| U1488 | A 3 | H | 15.40 | 2.06 | 2.13 | 0.07 | 17.53 | 21.26 | Tie | MS | B-3H | Shipboard offset adjusted to changes in prior offsets |
| U1488 | A 4 | H | 24.90 | 3.05 | 3.08 | 0.03 | 27.98 | 31.80 | Tie | XRF | B-4H | Offset verified with XRF |
| U1488 | A 5 | H | 34.40 | 4.03 | 4.06 | 0.03 | 38.46 | 41.69 | Tie | MS | B-5H | Shipboard offset adjusted to changes in prior offsets |
| U1488 | A 6 | H | 43.90 | 4.73 | 4.76 | 0.03 | 48.66 | 52.14 | Tie | MS | B-6H | Shipboard offset adjusted to changes in prior offsets |
| U1488 | A 7 | H | 53.40 | 5.28 | 5.31 | 0.03 | 58.71 | 63.25 | Tie | XRF | B-7H | Offset verified with XRF |
| U1488 | A 8 | H | 62.90 | 6.61 | 6.58 | -0.03 | 69.48 | 74.65 | Tie | MS | C-8H | Shipboard offset adjusted to changes in prior offsets |
| U1488 | A 9 | H | 72.40 | 7.78 | 7.75 | -0.03 | 80.15 | 83.07 | Tie | XRF | B-9H | Offset verified with XRF |
| U1488 | A 10 | H | 81.90 | 8.73 | 8.70 | -0.03 | 90.60 | 94.12 | Tie | MS | B-10H | Shipboard offset adjusted to changes in prior offsets |
| U1488 | A 11 | H | 91.40 | 9.42 | 9.35 | -0.07 | 100.75 | 101.45 | Tie | MS | C-10H | Shipboard offset adjusted to changes in prior offsets |
| U1488 | A 12 | H | 100.90 | 8.89 | 9.54 | 0.65 | 110.44 | 114.06 | Tie | XRF | C-12H | Offset verified with XRF |
| U1488 | A 13 | H | 110.40 | 9.56 | 10.04 | 0.08 | 120.44 | 127.22 | Tie | GRA | B-14H | Shipboard offset adjusted to changes in prior offsets |
| U1488 | A 14 | H | 119.90 | 10.59 | 11.01 | 0.42 | 130.91 | 134.03 | Tie | XRF | B-15H | Offset verified with XRF |
| U1488 | A 15 | H | 129.40 | 11.29 | 11.74 | 0.45 | 141.14 | 144.41 | Tie | MS | B-15H | Shipboard offset adjusted to changes in prior offsets |
| U1488 | A 16 | H | 138.90 | 12.46 | 12.91 | 0.45 | 151.81 | 154.13 | Tie | PWL | B-16H | Shipboard offset adjusted to changes in prior offsets |
| U1488 | A 17 | H | 148.40 | 13.27 | 13.63 | 0.36 | 162.03 | 165.63 | Tie | XRF | B-17H | Offset verified with XRF |
| U1488 | A 18 | H | 157.90 | 13.52 | 13.90 | 0.38 | 171.80 | 175.96 | Tie | XRF | B-18H | Offset verified with XRF |
| U1488 | A 19 | H | 167.40 | 14.30 | 14.68 | 0.38 | 182.08 | 186.12 | Tie | XRF | B-19H | Offset verified with XRF |
| U1488 | A 20 | H | 176.90 | 14.98 | 15.36 | 0.38 | 192.26 | 196.72 | Tie | XRF | B-20H | Offset verified with XRF |
| U1488 | A 21 | H | 186.40 | 15.73 | 16.15 | 0.42 | 202.55 | 206.98 | Tie | XRF | B-21H | Offset verified with XRF |
| U1488 | A 22 | H | 195.90 | 15.97 | 16.39 | 0.42 | 212.29 | 216.35 | Tie | XRF | B-22H | Offset verified with XRF |
| U1488 | A 23 | H | 205.40 | 16.50 | 17.10 | 0.60 | 222.50 | 227.24 | Tie | XRF | B-23H | Offset verified with XRF |
| U1488 | A 24 | H | 214.90 | 17.13 | 17.73 | 0.60 | 232.63 | 237.25 | Tie | XRF | B-24H | Offset verified with XRF |
| U1488 | A 25 | H | 224.40 | 17.84 | 18.44 | 0.60 | 242.84 | 246.94 | Tie | XRF | B-25H | Offset verified with XRF |
| U1488 | A 26 | H | 233.90 | 18.40 | 18.68 | 0.28 | 252.58 | 257.28 | Tie | XRF | B-26H | Offset verified with XRF |
| U1488 | A 27 | H | 243.40 | 19.94 | 19.57 | -0.07 | 262.87 | 264.75 | Tie | XRF | B-27H | Offset verified with XRF |
| U1488 | A 28 | H | 253.90 | 20.76 | 20.41 | -0.35 | 273.31 | 274.58 | Tie | XRF | B-28H | Offset verified with XRF |
| U1488 | A 29 | H | 264.00 | 21.32 | 20.97 | -0.35 | 283.37 | 284.80 | Tie | XRF | B-29H | Offset verified with XRF |
| U1488 | A 30 | H | 271.90 | 22.18 | 21.66 | -0.52 | 293.56 | 294.49 | Tie | XRF | B-30H | Offset verified with XRF |
| U1488 | A 31 | H | 281.40 | 23.71 | 22.25 | -1.46 | 303.65 | 304.76 | Tie | XRF | B-31H | Offset verified with XRF |
| U1488 | A 32 | H | 290.90 | 24.90 | 23.44 | -1.46 | 314.34 | 315.20 | Tie | XRF | B-32H | Offset verified with XRF |
| U1488 | A 33 | F | 300.40 | 25.82 | 24.23 | -1.59 | 324.63 | 323.43 | Tie | XRF | B-33H | Offset verified with XRF |
| U1488 | A 34 | F | 305.10 | 25.94 | 24.78 | -1.16 | 329.88 | SET | XRF | A-33H | Offset verified with XRF |
| U1488 | A 35 | F | 309.80 | 26.33 | 25.17 | -1.16 | 334.97 | SET with GF = 1.085 + 30 cm | XRF | A-34H | Offset verified with XRF |

Download table in CSV format.
| Site | Hole | Core | Core type | Depth (mbsf) | Shipboard offset (m) | Revised offset (m) | Change in offset | Depth revised CCSF (m) of top of core | Depth revised CCSF (m) of core shift tie point | Type of shift | Data used | Reference core | Comments |
|------|------|------|-----------|--------------|---------------------|-------------------|-----------------|------------------------------------|-----------------------------------------------|-------------|-----------|--------------|----------|
| U1488 | B    | 21   | H         | 181.40       | 15.82              | 16.32             | 0.50            | 197.72                             | 198.64                                          | Tie         | XRF      | A-20H       | Offset verified with XRF |
| U1488 | B    | 22   | H         | 190.90       | 16.34              | 16.76             | 0.42            | 207.66                             | 208.21                                          | Tie         | XRF      | A-21H       | Offset verified with XRF |
| U1488 | B    | 23   | H         | 200.40       | 17.02              | 17.55             | 0.53            | 217.95                             | 219.09                                          | Tie         | XRF      | A-22H       | Offset verified with XRF |
| U1488 | B    | 24   | H         | 209.90       | 17.92              | 18.52             | 0.60            | 228.42                             | 229.45                                          | Tie         | XRF      | A-23H       | Offset verified with XRF |
| U1488 | B    | 25   | H         | 219.40       | 18.60              | 19.2              | 0.60            | 238.60                             | 239.38                                          | Tie         | XRF      | A-24H       | Offset verified with XRF |
| U1488 | B    | 26   | H         | 228.90       | 18.80              | 19.4              | 0.60            | 248.30                             | 248.98                                          | Tie         | XRF      | A-25H       | Offset verified with XRF |
| U1488 | B    | 27   | H         | 238.40       | 20.39              | 19.92             | −0.47           | 258.32                             | 260.22                                          | Tie         | XRF      | A-26H       | Offset verified with XRF |
| U1488 | B    | 28   | H         | 247.90       | 21.38              | 21.03             | −0.35           | 268.93                             | 271.26                                          | Tie         | XRF      | A-27H       | Offset verified with XRF |
| U1488 | B    | 29   | H         | 257.40       | 21.74              | 21.39             | −0.35           | 278.79                             | 279.59                                          | Tie         | XRF      | A-28H       | Offset verified with XRF |
| U1488 | B    | 30   | H         | 266.90       | 22.64              | 22.12             | −0.52           | 289.02                             | 291.67                                          | Tie         | XRF      | A-29H       | Offset verified with XRF |
| U1488 | B    | 31   | H         | 276.40       | 23.84              | 22.48             | −1.36           | 298.88                             | 299.73                                          | Tie         | XRF      | A-30H       | Offset verified with XRF |
| U1488 | B    | 32   | H         | 285.90       | 24.89              | 23.43             | −1.46           | 309.33                             | 312.43                                          | Tie         | XRF      | A-31H       | Offset verified with XRF |
| U1488 | B    | 33   | H         | 295.40       | 25.83              | 24.24             | −1.59           | 319.64                             | 323.43                                          | Tie         | XRF      | A-32H       | Offset verified with XRF; Difficult to align tie point |
| U1488 | C    | 1    | H         | 0.00         | 0.00               | 0                 | 0.00            | 0.00                               | 0.00                                            | Mudline     | XRF      | B-2H        | Offset verified with XRF |
| U1488 | C    | 2    | H         | 7.30         | 2.29               | 2.36              | 0.07            | 9.66                               | 10.42                                           | Tie         | XRF      | B-3H        | Offset verified with XRF |
| U1488 | C    | 3    | H         | 16.80        | 3.34               | 3.37              | 0.03            | 20.17                              | 21.26                                           | Tie         | XRF      | B-4H        | Offset verified with XRF |
| U1488 | C    | 4    | H         | 26.30        | 4.66               | 4.69              | 0.03            | 30.99                              | 31.80                                           | Tie         | XRF      | B-5H        | Offset verified with XRF |
| U1488 | C    | 5    | H         | 35.80        | 5.29               | 5.32              | 0.03            | 41.12                              | 41.69                                           | Tie         | XRF      | B-6H        | Offset verified with XRF |
| U1488 | C    | 6    | H         | 45.30        | 5.98               | 6.01              | 0.03            | 51.31                              | 52.14                                           | Tie         | XRF      | B-7H        | Offset verified with XRF |
| U1488 | C    | 7    | H         | 54.80        | 6.10               | 6.13              | 0.03            | 60.93                              | 63.25                                           | Tie         | XRF      | B-8H        | Offset verified with XRF |
| U1488 | C    | 8    | H         | 64.30        | 7.57               | 7.54              | −0.03           | 71.84                              | 73.65                                           | Tie         | XRF      | B-9H        | Offset verified with XRF |
| U1488 | C    | 9    | H         | 73.80        | 8.43               | 8.34              | −0.09           | 82.14                              | 83.07                                           | Tie         | XRF      | B-10H       | Offset verified with XRF |
| U1488 | C    | 10   | H         | 83.30        | 9.60               | 9.53              | −0.07           | 92.83                              | 94.12                                           | Tie         | XRF      | B-11H       | Offset verified with XRF |
| U1488 | C    | 11   | H         | 92.80        | 10.20              | 10.11             | −0.09           | 102.91                             | 104.78                                          | Tie         | XRF      | B-12H       | Offset verified with XRF; Overlap is not very long |
| U1488 | C    | 12   | H         | 102.30       | 10.11              | 10.76             | 0.65            | 113.06                             | 113.47                                          | Tie         | XRF      | B-13H       | Offset verified with XRF; Overlap is not very long |
| U1488 | C    | 13   | H         | 111.80       | 10.53              | 11.01             | 0.48            | 122.81                             | 123.45                                          | Tie         | XRF      | B-14H       | Offset verified with XRF |
| U1488 | C    | 14   | H         | 121.30       | 11.69              | 12.14             | 0.45            | 133.44                             | 134.13                                          | Tie         | XRF      | B-15H       | Offset verified with XRF |
| U1488 | C    | 15   | H         | 130.80       | 12.08              | 12.53             | 0.45            | 143.33                             | 144.41                                          | Tie         | XRF      | B-16H       | Offset verified with XRF |
| U1488 | C    | 16   | H         | 140.30       | 12.71              | 13.07             | 0.36            | 153.37                             | 154.13                                          | Tie         | XRF      | B-17H       | Offset verified with XRF |
Table T2. Revised splice interval table, Site U1488. CSF = core depth below seafloor, mbsf = meters below seafloor. MS = magnetic susceptibility, GRA = gamma ray attenuation bulk density, PWL = P-wave velocity, L* = luminosity, NGR = natural gamma radiation, XRF = X-ray fluorescence. Status column indicates how a tie point was changed: "Shipboard - verified" was verified using the XRF data but not changed, "Shipboard - adjusted" indicates small (~1 cm) changes to the interval and CSF of the original shipboard tie point to account for the rounding of the shipboard cumulative core offsets to the nearest centimeter, "Revised" indicates splice tie points that were revised to accommodate changes to the composite depth scale. The Comments column specifies which tie point was revised by 1 cm.

| Site | Core | Depth CCSF (mbsf) | Splice type for tie point | Data used for tie point | Other data needed to verify tie | Status | Comment |
|------|------|-------------------|---------------------------|-------------------------|-------------------------------|--------|---------|
| U1488 C | 1 H | 0 0 0 0 | ANCHOR | MS | verified by XRF | Shipboard - verified | C-1 to B-2 tie revised; Bottom B-2 interval and CSF adjusted by 1 cm |
| U1488 B | 2 H | 2 105 3.45 6.36 | Top B-9 interval and CSF | revised by 1 cm | | | |
| U1488 B | 2 H | 1 76 8.06 10.42 | Top C-5 interval and CSF | revised by 1 cm | | | |
| U1488 B | 3 H | 71 14.11 18.39 | Top B-6 interval and CSF | revised by 1 cm | | | |
| U1488 C | 3 H | 109 17.89 21.26 | Bottom B-17 interval and CSF | revised by 1 cm | | | |
| U1488 B | 4 H | 3 124 24.14 29.27 | Top and bottom B-4 interval and CSF adjusted by 1 cm | revised by 1 cm | | | |
| U1488 C | 4 H | 1 81 27.11 31.8 | Top and bottom C-4 interval and CSF adjusted by 1 cm | revised by 1 cm | | | |
| U1488 B | 5 H | 4 23 34.13 40.11 | | | | | |
| U1488 C | 5 H | 1 57 36.37 41.69 | | | | | |
| U1488 B | 6 H | 4 91 44.31 50.2 | | | | | |
| U1488 C | 6 H | 1 83 46.13 52.14 | | | | | |
| U1488 B | 7 H | 4 67 53.57 60.31 | | | | | |
| U1488 C | 7 H | 2 82 57.12 63.25 | | | | | |
| U1488 B | 8 H | 3 83 61.67 70.04 | | | | | |
| U1488 C | 8 H | 2 31 66.11 73.65 | | | | | |
| U1488 B | 9 H | 4 42 72.32 80.55 | | | | | |
| U1488 C | 9 H | 1 93 74.73 83.07 | | | | | |
| U1488 B | 10 H | 4 82 82.22 91.29 | | | | | |
| U1488 C | 10 H | 1 129 84.59 94.12 | | | | | |
| U1488 B | 11 H | 4 89 91.79 101.45 | | | | | |
| U1488 C | 11 H | 2 37 94.67 104.78 | | | | | |
| U1488 B | 12 H | 4 36 100.76 110.75 | | | | | |
| U1488 C | 12 H | 1 41 102.71 113.47 | | | | | |
| U1488 B | 13 H | 4 140 111.3 121.55 | | | | | |
| U1488 C | 13 H | 1 64 112.44 123.45 | | | | | |
| U1488 B | 14 H | 4 48 119.88 130.42 | | | | | |
| U1488 C | 14 H | 1 69 121.99 134.13 | | | | | |
| U1488 B | 15 H | 4 130 130.2 141.89 | | | | | |
| U1488 C | 15 H | 1 108 131.88 144.41 | | | | | |
| U1488 B | 16 H | 4 108 139.48 152.09 | | | | | |
| U1488 C | 16 H | 1 76 141.06 154.13 | | | | | |
| U1488 B | 17 H | 4 121 149.11 162.46 | | | | | |

Download in CSV format.
| Site  | Hole | Core | Offset (cm) | Depth CCSF (m) | Depth CCSF (m) | Splice type | Data used for tie point | Other data needed to verify tie | Status | Comment |
|-------|------|------|-------------|----------------|----------------|-------------|-------------------------|--------------------------------|--------|---------|
| U1488 | A    | 17   | 3          | 60             | 152            | 165.63      | Tie PWL                | verified by XRF                  | Shipboard-verified              |         |
|       | B    | 18   | 1          | 73             | 153.63         | 167.6       | Tie XRF                |                                    | Revised                           |         |
| U1488 | A    | 18   | 3          | 116            | 162.06         | 175.96      | Tie PWL                | verified by XRF                  | Shipboard-verified              |         |
|       | B    | 19   | 1          | 104            | 163.44         | 178.07      | Tie PWL                | verified by XRF                  | Shipboard-verified, A-17 to B-18 tie revised |         |
| U1488 | A    | 19   | 3          | 104            | 171.44         | 187.93      | Tie PWL                | verified by XRF                  | Shipboard-verified              |         |
|       | B    | 20   | 1          | 50             | 172.4          | 187.93      | Tie PWL                | verified by XRF                  | Shipboard-verified, Top B-19 interval and CSF adjusted by 1 cm |         |
| U1488 | A    | 20   | 3          | 146            | 181.36         | 196.72      | Tie PWL                | verified by XRF                  | Shipboard-verified              |         |
|       | B    | 21   | 1          | 92             | 182.32         | 196.64      | Tie XRF                |                                    | Revised                       | A-20 to B-21 and A-21 to A-21 ties revised |
| U1488 | A    | 21   | 3          | 141            | 190.81         | 206.96      | Tie XRF                |                                    | Revised                       | B-21 to A-21 tie revised, Top B-22 interval and CSF adjusted by 1 cm |         |
|       | B    | 22   | 1          | 55             | 191.45         | 216.35      | Tie XRF                | verified by XRF                  | Shipboard-verified              |         |
| U1488 | A    | 22   | 3          | 106            | 199.96         | 219.09      | Tie XRF                | verified by XRF                  | Shipboard-verified              |         |
|       | B    | 23   | 1          | 114            | 201.54         | 227.24      | Tie XRF                |                                    | Revised                       | A-22 to B-23 and B-23 to A-23 tie revised |
| U1488 | A    | 23   | 4          | 24             | 210.14         | 229.45      | Tie XRF                |                                      | Shipboard-verified              |         |
|       | B    | 24   | 1          | 103            | 210.93         | 237.25      | Tie PWL                | verified by XRF                  | Shipboard-verified              |         |
| U1488 | A    | 24   | 4          | 12             | 219.52         | 239.38      | Tie GRA                |                                      | Shipboard-verified              |         |
|       | B    | 25   | 1          | 78             | 220.18         | 246.94      | Tie PWL                | verified by XRF                  | Shipboard-verified, Top B-25 interval and CSF adjusted by 1 cm |         |
| U1488 | A    | 25   | 3          | 110            | 228.5          | 248.98      | Tie PWL                | verified by XRF                  | Shipboard-verified, Top A-25 interval and CSF adjusted by 1 cm |         |
|       | B    | 26   | 1          | 68             | 229.58         | 257.28      | Tie L*                 |                                      | Shipboard-verified              |         |
| U1488 | A    | 26   | 4          | 20             | 238.6          | 262.22      | Tie XRF                |                                    | Revised                       | B-26 to A-26 and A-26 to B-27 ties revised |
|       | B    | 27   | 2          | 40             | 240.3          | 264.75      | Tie XRF                | verified by XRF                  | Shipboard-verified              |         |
| U1488 | A    | 27   | 2          | 38             | 245.28         | 271.26      | Tie GRA                |                                    | Shipboard-verified              | A-27 to B-28 tie revised, Top and bottom A-28 interval and CSF adjusted by 1 cm |         |
| U1488 | B    | 28   | 2          | 83             | 250.23         | 274.58      | Tie XRF                |                                      | Shipboard-verified              |         |
| U1488 | A    | 28   | 1          | 127            | 254.17         | 279.59      | Tie GRA                | verified by XRF                  | Shipboard-verified, Bottom B-29 interval and CSF adjusted by 1 cm |         |
|       | B    | 29   | 1          | 80             | 258.2          | 284.8       | Tie GRA                | verified by XRF                  | Shipboard-verified              |         |
| U1488 | A    | 29   | 1          | 143            | 263.8          | 291.67      | Tie GRA                | verified by XRF                  | Shipboard-verified              |         |
|       | B    | 30   | 2          | 115            | 269.55         | 291.67      | Tie XRF                |                                    | Revised                       | A-29 to B-30 interval and CSF adjusted by 1 cm |         |
| U1488 | A    | 30   | 1          | 93             | 272.83         | 299.73      | Tie GRA                | verified by XRF                  | Shipboard-verified              |         |
|       | B    | 31   | 1          | 85             | 277.25         | 304.76      | Tie GRA                | verified by XRF                  | Shipboard-verified, A-30 to B-31 and B-31 to A-31 ties revised |         |
| U1488 | A    | 31   | 1          | 111            | 282.51         | 312.43      | Tie XRF                |                                      | Shipboard-verified              | B-31 to A-31 tie revised |
### Table T2 (continued).

| Site | Hole | Core Type | Section | Offset (cm) | Depth (mbsf) | Depth CCSF (m) | Splice Type | Splice Data for Tie Point | Other Data Needed to Verify Tie | Status | Comment |
|------|------|-----------|---------|-------------|--------------|----------------|-------------|--------------------------|---------------------------------|--------|---------|
| U1488 | B    | 32        | H       | 3           | 10           | 289            | 312.43      | Tie                     | GRA                     | verified by XRF | Bottom B-32 interval and CSF adjusted by 1 cm |
| U1488 | A    | 32        | H       | 1           | 86           | 291.76         | 315.2       | Tie                     | XRF                     | Revised | A-32 to B-33 tie revised: ambiguous tie, difficult to align even with XRF |
| U1488 | B    | 33        | H       | 3           | 56           | 298.96         | 323.2       | Tie                     | XRF                     | Revised | A-32 to B-33 tie revised: ambiguous tie, difficult to align even with XRF |
| U1488 | A    | 34        | F       | 1           | 1            | 305.11         | 329.89      | Append                  | XRF                     | Revised | Appended 30 cm lower |
| U1488 | A    | 35        | F       | 1           | 1            | 309.81         | 334.98      | Append                  | XRF                     | Revised | Appended 30 cm lower |