Figure F1. Eauripik Rise within the Caroline Basin showing location of Sites U1488–U1490 (yellow circles).

Figure F2. Contoured bathymetric map showing location of Site U1489 on seismic Lines RR1313-WP4-2 and RR1313-WP4-3 collected during the R/V *Roger Revelle* 13-13 cruise. Bathymetry is based on EM122 multibeam survey collected during the same cruise. Numbers along the seismic lines (black) are common depth points. Location of hydrocast Station HC38 is shown with data displayed in Figure F4. Contour interval = 20 m.

Figure F3. Seismic Line RR1313-WP4-3 showing the location of Site U1489. Location of crossing seismic lines shown with dashed line at top. CDP = common depth point. Seismic data available at http://www-udc.ig.utexas.edu/sdc/cruise.php?cruiseIn=rr1313.

Figure F4. Hydrographic profiles of temperature, salinity, and dissolved oxygen near Sites U1488 and U1489 at hydrocast Station HC38 on Figure F2 (Y. Rosenthal, unpubl. data). NPSTW = North Pacific Subtropical Water, NPIW = North Pacific Intermediate Water, UCDW = Upper Circumpolar Deepwater, LCDW = Lower Circumpolar Deepwater.

Figure F5. Lithologic summary, Site U1489. cps = counts per second, MS = magnetic susceptibility, SHMSL = Section Half Multisensor Logger.

Figure F6. Color alternation in foraminifer-bearing clay-rich nannofossil ooze in Subunit IA, Site U1489. A, B. Alternation between light greenish gray and greenish gray sediment. C, D. Alternation between light greenish gray and pale yellow sediment.

Figure F7. Soft-sediment deformation in Subunit IA, Site U1489. A. Foraminifer ooze. B. Thick-bedded homogeneous sediment. C, D. Inclined layers.

Figure F8. Tephra layers, Site U1489.

Figure F9. Main lithologies in Subunit IB, Hole U1489C. A. Top of Subunit IB (32X-1, 0 cm). B. Alternation between white and light gray sediment. C. Inclined layers within soft-sediment deformation interval. D. Alternation between white and pale yellow sediment. E. Boundary of pale yellow foraminifer-bearing radiolarian-rich chalk and white foraminifer chalk.

Figure F10. Light brown foraminifer-bearing diatom-rich nannofossil ooze in Subunit IA, Site U1489. A. Thick-bedded light brown sediment. B. Thin-bedded light brown sediment.

Figure F11. Sedimentary components in two of the primary lithologies, Site U1489. D = diatom, Sp = sponge spicule, Sf = silicoflagellate, R = radiolarian. A, B. Light brown foraminifer-bearing diatom-rich nannofossil ooze. C, D. Pale yellow clay-rich foraminifer-rich chalk.

Figure F12. Comparison of MS and NGR in different colored sediments of Subunit IA, Site U1489. cps = counts per second. A. Light greenish gray and greenish gray. B. Light greenish gray and pale yellow. C. White.

Figure F13. Core image with XRD results from different colored sediment in Subunit IA, Site U1489.

Figure F14. Calcareous nannofossils, Site U1489 (XPL). A. *Calcidiscus leptoporus* (U1489C-1H-CC). B, C. *Cyclicargolithus floridanus* (B: U1489C-38X-6, 40 cm; C: 41X-CC). D. *Coccolithus pelagicus* (U1489C-4H-CC). E. *Coronocyclus nitescens* (U1489C-42X-4, 30 cm). F. *Gephyrocapsa* >5.5 µm (U1489B-3H-CC). G, H. *Pseudoemiliania lacunosa* (G: U1489B-2H-6, 75 cm; H: U1489C-2H-6, 60 cm). I. *Reticulofenestra asanoi* (U1489C-2H-CC). J. *Reticulofenestra pseudoumbilicus* (U1489B-10H-CC). K. *Ceratolithus cristatus* (U1489B-3H-CC). L. *Helicosphaera* sp. (U1489B-3H-CC). M. *Helicosphaera granulata* (U1489C-19H-CC). N. *Minylitha convallis* (U1489C-29H-CC). O. *Triquetrorhabdulus carinatus* (U1489C-41X-CC). P. *Scyphosphaera tubifera* (U1489C-38X-6, 40 cm). Q. *Scyphosphaera pulcherrima* (U1489B-5H-CC). R. *Sphenolithus belemnos* (U1489C-41X-CC). S, T. *Sphenolithus heteromorphus* (S: U1489C-41X-CC; T: U1489C-38X-4, 40 cm). All photos are at same magnification (scale bar in A).

Figure F15. Calcareous nannofossils, Site U1489 (PPL). A. *Amaurolithus primus* (U1489C-22H-CC). B. *Amaurolithus delicatus* (U1489C-23H-CC). C–E. *Nicklithus amplificus* (U1489B-12H-CC). F. *Orthorhabdus rugosus* (U1489B-12H-CC). G. *Catinaster calyculus* (U1489C-30F-CC). H. *Discoaster triradiatus* (U1489B-10H-CC). I. *Discoaster tamalis* (U1489B-6H-CC). J. *Discoaster brouweri* (U1489B-5H-CC). K, L. *Discoaster quinqueramus* (U1489C-24H-CC). M. *Discoaster berggrenii* (U1489B-14H-CC). N–P. *Discoaster variabilis* (N, O: U1489B-12H-CC; P: U1489C-25H-CC). Q, R. *Discoaster neohamatus* (Q: U1489B-14H-CC; R: U1489C-28H-CC). S, T. *Discoaster surculus* (U1489B-12H-CC). All photos are at same magnification (scale bar in A).

Figure F16. Coiling patterns in *Pulleniatina*, Holes U1489B and U1489C.

Figure F17. *Globigerinoidesella fistulosa* whole tests and individual chambers (U1489C-6H-CC).

Figure F18. Comparison of coiling patterns in *Neogloboquadrina acostaensis*, Sites U1488 and U1489. Tie points: blue lines = planktonic foraminifer biohorizons, red lines = calcareous nannofossil biohorizons.

Figure F19. Downhole foraminifer preservation states, Site U1489. A. Light microscope images to assess the extent of fragmentation and staining and whether the tests are glassy or opaque. B. SEM images of selected specimens (*T. trilobus, P. wuellerstorfi*, and *Cibicidoides* sp.) as whole tests, umbilical side upward. C. High-magnification images of outer wall surfaces to examine additional features such as spine holes, pustules, etc. D. High-magnification images of wall cross sections to find original microgranules or diagenetic crystallites. E. High-magnification images of inner wall surfaces focusing on evidence for internal overgrowth and cementation.

Figure F20. Age-depth plot for Site U1489 showing integrated biomagnetochronology in Hole U1489C with additional paleomagnetic data from Hole U1489D. Data plotted on the mbsf depth scales for Holes U1489C and U1489D account for the difference in the measured depths of paleomagnetic reversals in the two holes. The stratigraphy of the base of Hole U1489C is constrained by biohorizon base *Sphenolithus belemnos* (19.03 Ma) and by the presence of *Dentoglobigerina binaiensis* (>19.30 Ma) and absence of *Globigerinoides altiaperturus* (>20.03 Ma) and *Tenuitella munda* (<20.78 Ma) at ~380 mbsf. Average sedimentation rates vary from ~0.3 to 5 cm/ky. PF = planktonic foraminifer.

Figure F21. Archive-half NRM intensity after 15 mT AF demagnetization, discrete sample χ and SIRM, and discrete sample χARM/SIRM and IRM_{300mT}/IRM_{1000mT} ratios, Holes U1489B and U1489C.

Figure F22. A–F. Discrete sample AF demagnetization results, Site U1489. Left plots: intensity variation through progressive demagnetization steps. Middle and right plots: NRM vector measurements after each AF demagnetization treatment on orthogonal (Zijderveld; blue = horizontal projections, red = vertical projections) and stereographic (solid squares = positive inclination, open squares = negative inclination) projections, respectively. MAD = maximum angular deviation.

Figure F23. NRM intensities before and after 15 mT AF demagnetization, WRMSL MS, maximum angular deviation (MAD), and inclination (dashed lines = predicted values assuming a geomagnetic axial dipole [GAD] field for normal [4°] and reversed [–4°] polarity for the site latitude) and azimuthally corrected declination after 15 mT AF demagnetization, Hole U1489B. Black squares = discrete samples. Magnetostratigraphy and GPTS shown at right. Question marks at major chron boundaries reflect depth uncertainties for boundaries that were not observed in Hole U1489B. Black = normal polarity, white = reversed polarity.

Figure F24. NRM intensities before and after 15 mT AF demagnetization, WRMSL MS, maximum angular deviation (MAD) (black = Hole U1489C, gray = Hole U1489B), and inclination (dashed lines = predicted values assuming a GAD field for normal [4°] and reversed [–4°] polarity for the site latitude) and declination (red = azimuthally corrected values, dark red = uncorrected HLAPC cores) after 15 mT AF demagnetization, Hole U1489C. Black squares = discrete samples. Magnetostratigraphy and GPTS shown at right. Black = normal polarity, white = reversed polarity, gray = no magnetostratigraphic interpretation made from the data.

Figure F25. NRM intensities before and after 15 mT AF demagnetization, WRMSL MS, and inclination (dashed lines = predicted values assuming a GAD field for normal [4°] and reversed [–4°] polarity for the site latitude) and azimuthally corrected declination after 15 mT AF demagnetization, Hole U1489D. Magnetostratigraphy and GPTS shown at right. Black = normal polarity, white = reversed polarity, gray = no magnetostratigraphic interpretation made from the data.

Figure F26. Physical property measurements, Holes U1489C and U1489D. GRA bulk density, magnetic susceptibility, and *P*-wave data were measured on the WRMSL. cps = counts per second.

Figure F27. WRMSL GRA bulk density, MS, NGR, and *P*-wave velocity overlaid on core photos (generated using Code for Ocean Drilling Data [CODD] [Wilkens et al., 2017]) from Hole U1489C between 18 and 58 mbsf. cps = counts per second.

Figure F28. Comparison of discrete and whole-round *P*-wave velocity measurements, Holes U1489B and U1489C.

Figure F29. MAD dry, bulk, and grain densities and porosity, WRMSL GRA bulk density, and thermal conductivity, Holes U1489B and U1489C. Yellow shading = interval in both holes disturbed by mechanical shearing of the shear pins prior to shooting the cores (see Operations).

Figure F30. Comparison of APCT-3 temperature-time series. Unshaded area = time interval with exponential decrease in temperature. A. Hole U1489B. B. Hole U1489D.

Figure F31. Heat flow calculations, Holes U1489B and U1489D. A. Sediment temperature profile, Hole U1489B. The anomalous measurement for Core 12H is circled. B. Sediment temperature profile, Hole U1489D. C. Thermal conductivity data from Holes U1489B and U1489C. Green line = calculated thermal resistance; gray vertical line = average thermal conductivity value used for calculation of thermal resistance; black diamonds and dashed line = corrected thermal conductivity; open, light blue, and dark blue diamonds = uncorrected thermal conductivity.

Figure F32. WRMSL MS data for Holes U1489A–U1489D divided into 50 m intervals. The MS vertical scale varies between the 50 m graph segments. Upper panel shows the MS splice constructed by combining data from all holes for the upper and lower splice intervals. (Continued on next two pages.)

Figure F32 (continued). (Continued on next page.)

Figure F32 (continued).

Figure F33. Spliced L*, NGR, and WRMSL MS and GRA bulk density data, Site U1489 for the (A) upper and (B) lower splice intervals. cps = counts per second.

Figure F34. A. Comparison of mbsf and composite depth scales in the Site U1489 splice. B. Comparison of the growth of cumulative depth offset and mbsf depth scale.

Figure F35. Methane, carbonate, TOC, and TN, Holes U1489B and U1489C.

Figure F36. Interstitial water concentration profiles, Holes U1489B and U1489C. Black stars = mudline samples, dashed line = transition at 88 mbsf from Hole U1489B samples to Hole U1489C samples; sharp offsets seen at this depth should be accounted for in any interpretation of these geochemical profiles. Fe mudline concentration of was below detection limit and is not plotted.

Figure F37. Interstitial water concentration profiles, Holes U1489B and U1489C. Black stars = mudline samples, dashed line = transition at 88 mbsf from Hole U1489B samples to Hole U1489C samples; sharp offsets seen at this depth should be accounted for in any interpretation of these geochemical profiles.