Figure F1. Oceanographic and bathymetric setting, Site U1541. A. Marine geological features and oceanic fronts. EPR = East Pacific Rise, FZ = fracture zone, SAF = Subantarctic Front, PF = Polar Front (after Orsi et al., 1995). B. Detailed bathymetry with seismic lines and shotpoints.

Figure F2. (A) Multichannel seismic (MCS) and (B) Parasound profiles across Site U1541. TWT = two-way traveltime.

Figure F3. Modern salinity (black lines) and oxygen (colors) distributions in the central South Pacific used to visualize major water masses. SAF = Subantarctic Front, APF = Antarctic Polar Front, NPDW = North Pacific Deep Water, LCDW = Lower Circumpolar Deep Water, AABW = Antarctic Bottom Water.

Figure F4. A–C. Hole summaries, Site U1541. The placement of Pliocene and early Pleistocene stage boundaries in Holes U1541B and U1541C are estimated using the preliminary Site U1541 shipboard age model. GRA = gamma ray attenuation, MSP = point magnetic susceptibility, RGB = red-green-blue, NGR = natural gamma radiation, cps = counts per second. (Continued on next two pages.)

Figure F4 (continued). (Continued on next page.)

Figure F4 (continued).

Figure F5. Primary lithologies used to define sedimentary lithofacies, Site U1541. Pie charts show their relative contributions to Lithostratigraphic Subunits IA and IB, Unit II, and Subunits IIIA and IIIB.

Figure F6. Representative (A) core and (B) X-ray and photomicrograph images of mineral properties of Lithofacies 2 (carbonate-bearing and carbonate-rich diatom ooze) in (C) plane-polarized light (PPL) and (D) cross-polarized light (XPL), Hole U1541C.

Figure F7. Representative (A) core and (B) X-ray and photomicrograph images of mineral properties of Lithofacies 3 (diatom-bearing and diatom-rich calcareous/nannofossil ooze) in (C) PPL and (D) XPL, Hole U1541C.

Figure F8. A–H. Representative images and mineral properties of Lithofacies 4 (nannofossil ooze), Holes U1541A–U1541C. Upper and lower panels show the white and pale orange-yellow varieties in this lithofacies, respectively. (C, G) PPL, (D, H) XPL.

Figure F9. Summary of primary lithostratigraphic variations, Site U1541. Lithostratigraphic units were defined based on the distribution, occurrence, and composition of major lithofacies (see Lithostratigraphic units). Relative age of the units is based on the preliminary Site U1541 shipboard age model (see Biostratigraphy and Stratigraphic correlation). MSP = point magnetic susceptibility, RGB = red-green-blue.

Figure F10. Weathered glass shards in sediment (383-U1541B-15H). A. Rock fragments found at the split surface (15H-5, 45–53 cm). B–F. Volcanic glass shard (15H-CC; C: PPL, D: XPL). Altered devitrified rim is being replaced by Fe (hydr)oxides and clay (E: PPL, F: XPL). G = glass matrix, O = olivine, Pa = palagonite, Pl = plagioclase, Px = pyroxene.

Figure F11. Rock samples (383-U1541B-16X-CC). A. Rock with 5 mm wide chilled margin at the crosscut surface. B–D. Rock specimen (C: PPL, D: XPL). G = glass matrix, Pl = plagioclase, Px = pyroxene.

Figure F12. X-ray diffractograms of representative samples of each lithofacies, Hole U1541B. Minerals occurring in the samples include quartz (Qtz), plagioclase (Pl), and calcite (C) and phyllosilicates including illite (Il), chlorite (Chl), smectite (Sm), kaolinite (K), and their composite ("Clay").

Figure F13. (A) Characteristic patterns of bioturbation across lithologic transitions and (B) selected examples of different types of bioturbation, Holes U1541B and U1541C. Ch = *Chondrites*, Pa = *Paleophycus*, P = *Planolites*, SK = *Skolithos*, TH = *Thalassinoides*, Z = *Zoophycos*. Classification follows Wetzel and Uchman (2012).

Figure F14. A–E. Characteristic variations in major lithology and physical properties, Hole U1541B. Gray bars (A, B) = diatom ooze, light gray bars (C, D) = diatom bearing, orange bars = clay bearing. GRA = gamma ray attenuation, MS = magnetic susceptibility, NGR = natural gamma radiation, cps = counts per second, RGB = red-green-blue.

Figure F15. Relationships between bulk sedimentary carbonate content and (A) red-green-blue (RGB) blue and (B) color reflectance L*, Holes U1541A and U1541B.

Figure F16. Diatom, radiolarian, calcareous nannofossil, and planktonic foraminifer zonations and biostratigraphic events, Site U1541.

Figure F17. Age-depth plot, Site U1541.

Figure F18. Distribution of siliceous and calcareous microfossils, Hole U1541B. B = barren, R = rare, F = few, C = common, A = abundant, D = dominant. Ostracods reported as number of valves per sample (>125 mm fraction)

Figure F19. Distribution of diatoms and nannofossils, Hole U1541C. B = barren, R = rare, F = few, C = common, A = abundant, D = dominant.

Figure F20. Silicoflagellates, Hole U1541B. Focus on basal ring (upper images) and apical structure (lower images). Light microscope. 1. *Dictyocha stapedia*. 2. *Dictyocha aculeata*. 3. *Stephanocha speculum* var. *speculum*. 4. *S. speculum*, large form with indented basal ring sides. 5. *S. speculum* var. *pentagona* with apical ring spines. 6. *S. speculum* var. *septenaria*, large form. 7. *S. speculum* var. *pseudofibula*. 8. *Octactis* sp. 9. *Stephanocha boliviensis* with apical ring spines. 10. *S. boliviensis*. 11. *Dictyocha concavata*. 12. *Dictyocha brevispina*. 13. *Dictyocha perlaevis*. 14. *Bachmannocena diodon* var. *nodosa*. 15. *D. perlaevis*, asperoid form.

Figure F21. Calcareous nannofossils, Hole U1541B. Light microscope. 1. *Emiliania huxleyi* (mudline). 2. *Pseudoemiliania lacunosa* (3H-CC). 3. *Gephyrocapsa omega* (2H-CC). 4. *Reticulofenestra asanoi* (3H-CC). 5. *Gephyrocapsa* large (>5.5 µm) (4H-CC). 6. *Helicosphaera sellii* (5H-CC). 7. *Calcidiscus macintyrei* (5H-CC). 8, 9. *Reticulofenestra pseudoumbilica*; (8) 10H-CC, (9) 11H-3, 71 cm. 10. *Amaurolithus primus*/*delicatus* (10H-CC). 11. *Scyphosphaera* spp. (10H-1, 70 cm). 12. *Discoaster variabilis* (13H-1, 50 cm).

Figure F22. SEM images of calcareous nannofossils, Hole U1541B. Scale bar = 5 µm. 1. *Pseudoemiliania lacunosa*. 2. *Reticulofenestra asanoi*. 3. Transitional form between *Reticulofenestra minutula* and *P. lacunosa*. 4, 5. *R. minutula*. 6. Transitional form between *R. minutula* and *R. asanoi*. 7–17. *R. minutula* showing different degrees of calcification of the central area; (10, 12, 15) closed central area/*Dictyococcites* spp.). 18. R. *minutula* with slits. 19–21. *Reticulofenestra haquii*/*Reticulofenestra* 3–5 µm. 22–26. *Reticulofenestra pseudoumbilicus* showing different sizes (8–12 µm) and different degrees of calcification of the central area; (22, 23, 25, 26) open central area, (24) closed. 27. Coccosphere of *R. pseudoumbilicus*.

Figure F23. Common planktonic foraminifers, Site U1541. Scale bars = 100 µm. A. *Orbulina universa*. B. *Orbulina suturalis*. C. *Globigerina bulloides*. D. *Globigerina umbilicata*. E. *Globigerinita glutinata*. F. *Neogloboquadrina pachyderma*. G. *Neogloboquadrina incompta*. H–J. *Hirsutella juanai* in (H) spiral, (I) side, and (J) umbilical view. K. *Hirsutella scitula*. L, M. *Hirsutella hirsuta* in (L) umbilical and (M) spiral view. N, O. *Truncorotalia crassaformis* in (N) umbilical and (O) side view. P, Q. *T. crassaformis hessi* in (P) umbilical and (Q) spiral view. R. *T. crassaformis imbricata*. S. *Truncorotalia crassula*. T. *T. crassaformis ronda*.

Figure F24. Common planktonic foraminifers, Site U1541. Scale bars = 100 µm. A–C. *Globorotalia miotumida* in (A) umbilical, (B) side, and (C) spiral view.

D–F. *Globoconella pliozea* in (D) umbilical, (E) side, and (F) spiral view. G–I. *Globoconella conomiozea* in (G) umbilical, (H) side, and (I) spiral view. J, K. *Globoconella puncticulata* in (J) umbilical and (K) side view. L, M. *Globoconella puncticulata puncticuloides* in (L) umbilical and (M) side view. N, O. *Globoconella inflata* in (N) umbilical and (O) side view.

Figure F25. Species diversity index (H) and abundance of dominant genus/species Uvigerinids, *Oridorsalis umbonatus, Pullenia* spp., Milliolids, *Melonis* spp., *Globocassidulina subglobosa*, and *Cibicides/Cibicidoides* spp., Site U1541. Gray field = interval potentially influenced by warm bottom water.

Figure F26. Benthic foraminifers, Hole U1541B. Scale bars = 100 µm. 1. *Spiroplectella* sp. (11H-CC). 2. *Stilostomella lepidula*. (14H-CC). 3. *Pleurostomella incrasata* (9H-CC). 4. *Procerolagena clavata* (13H-CC). 5. *Uvigerina* sp. (9H-CC) 6. *Uvigerina peregrina* (10H-CC). 7. *Uvigerina hispida* (13H-CC). 8. *Siphotextularia* sp. (13H-CC). 9. *Lagena plumigera* (10H-CC). 10, 11. *Spiroloculina* sp. (14H-CC). 12. *Bolivina decussata* (10H-CC). 13. *Ehrenbergina* sp. (11H-CC). 14. *Pleurostomella* sp. (14H-CC) 15. *Pseudonodosaria* sp. (9H-CC). 16. *Evolvocassidulina* sp. (6H-CC). 17–19. *Globobulimina* sp. (17, 18) 13H-CC. (19) 15H-CC. 20. *Laticarina pauperata* (14H-CC). 21. *Cibicides wuellerstorfi* (15H-CC). 22. *Pseudoglandulina* sp. (13H-CC). 23. *Lagena quadralata* (14H-CC). 24. *Fissurina* sp. (covered with nannofossils) (15H-CC).

Figure F27. Agglutinated and calcareous benthic foraminifers and bivalves from mudline samples, Site U1541. Scale bars = 100 µm unless otherwise noted. 1. Stained bivalve (both valves intact). 2. Bivalve with concentric growth lines. 3. Bivalve beak. 4. *Lagenammina* sp. 5. Stained calcareous foraminifers. 6. Stained agglutinated foraminifers. 7. Unstained calcareous foraminifers. 8. Unstained agglutinated foraminifers. 9, 10. *Reophax* sp. 11. *Astrorhiza* sp. 12, 13. *Rhabdammina* sp.

Figure F28. Natural remanent magnetization (NRM) intensity before and after 20 mT peak alternating field demagnetization, Holes U1541A–U1541C.

Figure F29. Inclination before and after 20 mT peak alternating field demagnetization, Holes U1541A–U1541C. NRM = natural remanent magnetization.

Figure F30. Natural remanent magnetization (NRM) intensity and inclination after 20 mT peak alternating field demagnetization, Site U1541. Polarity interpretation and correlation to the geomagnetic polarity timescale (GPTS; Cande and Kent, 1995) on geologic timescale of Hilgen et al. (2012; GTS2012) is discussed in text.

Figure F31. Age-depth relationship based on correlation to the geomagnetic polarity timescale (Cande and Kent, 1995), Holes U1541B and U1541C.

Figure F32. Headspace methane concentrations, Holes U1541A and U1541B.

Figure F33. Interstitial water alkalinity and pH, Site U1541. Red square = overlying seawater sample.

Figure F34. Interstitial water chloride, sodium, and magnesium, Site U1541. Chloride data points represent the mean of triple measurements. A few chloride measurements were discarded (hence not plotted) due to possible error at the time of measurement. Red square = overlying seawater sample.

Figure F35. Interstitial water iron, manganese, and lithium, Site U1541. Red square = overlying seawater sample.

Figure F36. Interstitial water calcium, bromide, strontium, and silicon, Site U1541. Red square = overlying seawater sample.

Figure F37. Interstitial water phosphate, sulfate, and ammonium, Site U1541. Red square = overlying seawater sample.

Figure F38. Interstitial water potassium, boron, and barium, Site U1541. Red square = overlying seawater sample.

Figure F39. A–D. Solid phase geochemistry of (A) $CaCO_3$, (B) total organic carbon (TOC):total nitrogen (TN), (C) TN, and (D) TOC, Holes U1541A and U1541B. Gray bar = sample overlap.

Figure F40. Bulk sediment elemental (Na, K, Si, P, Mg, Ca, Ti, Mn, and Fe) oxides vs. aluminum oxide (Al_2O_3), Site U1541.

Figure F41. Bulk sediment major and minor element concentrations, Site U1541.

Figure F42. Splice data, Site U1541: Whole-Round Multisensor Logger (WRMSL) magnetic susceptibility (MS) (red) and Section Half Multisensor Logger (SHMSL) point magnetic susceptibility (MSP) (orange). Black vertical lines = lithostratigraphic unit boundaries (see Sedimentology).

Figure F43. Splice data, Site U1541: density-normalized natural gamma radiation (NGR)-derived bulk density (NGR/gamma ray attenuation [GRA]).

Figure F44. Splice data, Site U1541: density-normalized natural gamma radiation (NGR) (NGR/gamma radiation [GRA], black) with Whole-Round Multisensor Logger (WRMSL) magnetic susceptibility (MS) (red) and Section Half Multisensor Logger (SHMSL) point magnetic susceptibility (MSP) (orange). Black vertical lines = lithostratigraphic unit boundaries (see Sedimentology).

Figure F45. Splice data, Site U1541: K (black), U (blue), and Th (red) semiquantitatively derived from natural gamma radiation (NGR). Black vertical lines = lithostratigraphic unit boundaries (see Sedimentology).

Figure F46. Natural gamma radiation (NGR)-derived K (black line) and discrete measurements of K (blue diamonds) from the portable X-ray fluorescence (XRF) spectrometer, Hole U1541C. Top: correlation between NGR and XRF K measurements. Red triangles = first four sections of the hole, blue diamonds = deeper cores. Regression line and equation correspond to the blue dots.

Figure F47. Whole-Round Multisensor Logger (WRMSL) gamma ray attenuation (GRA) bulk density raw (blue dashed line) and processed (blue solid line), Holes U1541A and U1541B. Black/blue diamonds = discrete moisture and density (MAD) measurements. Upper panel: correlation between MAD- and GRA-derived bulk density data.

Figure F48. Splice data, Site U1541: processed gamma ray attenuation (GRA) bulk density (blue) and Whole-Round Multisensor Logger (WRMSL) magnetic susceptibility (MS) (inverted axis, red). Black vertical lines = lithostratigraphic unit boundaries (see Sedimentology).

Figure F49. Top: Whole-Round Multisensor Logger (WRMSL) *P*-wave data (blue dashed line = raw data, blue solid line = processed data) and discrete *P*-wave caliper (PWC) measurements (black/blue dots), Holes U1541B and U1541C. Lower left: WRMSL *P*-wave logger (PWL) and PWC measurements. Lower right: correlation between caliper (*x*-axis) and WRMSL results. Red point = outlier not considered for the correlation.

Figure F50. Splice data, Site U1541: Whole-Round Multisensor Logger (WRMSL) gamma ray attenuation (GRA) bulk density processed (green) and *P*-wave velocity (blue). Black vertical lines = lithostratigraphic unit boundaries (see Sedimentology).

Figure F51. Thermal conductivity data from needle probe measurements, Site U1541. 0.5 W heating power over 80 s interval. Light blue diamonds = mean values, light blue dots = individual measurements, light green dashed line = GRA density record for Hole U1541B.

Figure F52. Advanced piston corer temperature (APCT-3) tool plots of heat flow calculations, Hole U1541B. A. Thermal resistance calculated from heat conductivity measurements against core depth (m CSF-A). B. Downhole needle-point thermal conductivity measurements. Solid diamonds = mean values with standard error, circles = individual measurements. C. In situ sediment temperatures from APCT-3 measurements with average values for Cores 4H, 7H, 11H and 15H (diamonds) and linear fit (stippled line). D. Bullard plot of heat flow calculated from a linear fit of temperature vs. thermal resistance data.

Figure F53. Red-green-blue (RGB) blue data vs. composite depth in 50 m intervals, Holes U1541A–U1541C. Top: red-green-blue (RGB) blue splice constructed by combining data from all holes.

Figure F54. Spliced composite records of red-green-blue (RGB) blue, Whole-Round Multisensor Logger gamma ray attenuation (GRA) and magnetic susceptibility (MS), and natural gamma radiation (NGR) vs. composite depth in 50 m intervals, Site U1541. cps = counts per second. (Continued on next page.)

Figure F54 (continued).

Figure F55. Complete spliced composite records of cleaned red-green-blue (RGB) blue, cleaned Whole-Round Multisensor Logger gamma ray attenuation (GRA) and magnetic susceptibility (MS), and natural gamma radiation (NGR), Site U1541. cps = counts per second.

Figure F56. A. Comparison of core depth and composite depth scales in the Site U1541 splice. B. Comparison of the growth of cumulative depth offset and core depth.