Figure F1. Mean annual sea-surface temperature within the IPWP with locations of sites cored during Expedition 363 (yellow circles). Black arrows mark the path of the Indonesian Throughflow. Red arrow = Leeuwin Current. Blue arrow = South Equatorial Current. Data source: ODV World Ocean Atlas (**https://odv.awi.de/de/data/ocean/world_ocean_atlas_2013**).

Figure F2. (A) Winter and (B) summer precipitation for 1979–2009 and (C) winter and (D) summer precipitation anomalies during the 1997–1978 El Niño event. DJF = December, January, February; JJA = June, July, August. Data source: IRI Climate Data, Lamont Doherty Earth Observatory, Columbia University (**http://iridl.ldeo.columbia.edu/maproom/Global/Precipitation/index.html**).

Figure F3. Bathymetric map showing locations of the three main areas cored during Expedition 363: northwest Australian shelf (yellow box), Papua New Guinea/Manus Basin (red box), and the Eauripik Rise (green box). Yellow circles = Expedition 363 sites, purple circles = previously cored DSDP sites, green circles = previously cored ODP sites. Bathymetric data from Amante and Eakins (2009).

Figure F4. Coring and logging operations summary and temporal resolution of Expedition 363 drill sites.

Figure F5. Hydrographic profiles from (A) the southern Eauripik Rise and (B) northeast Papua New Guinea. NPSTW = North Pacific Subtropical Water, SPSTW = South Pacific Subtropical Water, NPIW = North Pacific Intermediate Water, AAIW = Antarctic Intermediate Water, UCDW = Upper Circumpolar Deep Water, LCDW = Lower Circumpolar Deep Water. From Y. Rosenthal (unpubl. data).

Figure F6. Climatic impact of the Indonesian Throughflow (ITF). The ITF flows from the WPWP through the Indonesian seaways and exits to the Indian Ocean primarily through the Timor Sea. From there, part of the ITF flows southward. joining the Leeuwin Current and bringing heat and moisture to Western Australia. However, most of the ITF enters the westward flowing South Equatorial Current (SEC) across the Indian Ocean, where it joins the southward-flowing Agulhas Current. With major contribution from ITF water, some of the Agulhas Current flows around the Cape of Africa into the Atlantic Ocean as part of the global thermohaline circulation. At present, the ITF receives water from the North Pacific Ocean and to a lesser extent from the South Pacific Ocean through the New Guinea Coastal Current (NGCC), although the relative contributions of these end-members vary seasonally and interannually. On longer timescales, the contribution likely depends on changes in climate conditions and tectonic adjustments of the Indonesian Gateway (e.g., Cane and Molnar, 2001). NECC = North Equatorial Countercurrent, EC = Equatorial Current. Comparing records from Expedition 363 drill sites at the heart of the WPWP and southwestern edge of the IPWP (marked by yellow circles) will allow us to assess changes in the ITF on different temporal scales. Figure modified from Oppo and Rosenthal (2010).

Figure F7. Northwest Australian margin (yellow box in Figure F3) showing the location of Sites U1482 and U1483 (yellow circles) on the Scott Plateau. Also indicated are the three main exit passages of the ITF into the eastern Indian Ocean: Lombok Strait (sill depth = 350 m), Ombai Strait (sill depth = 3250 m), and Timor Strait (sill depth = 1890 m). Contour interval = 500 m. Bathymetric data from Amante and Eakins (2009).

Figure F8. Site U1482 results summary. NGR = natural gamma radiation, cps = counts per second, MS = magnetic susceptibility, WRMSL = Whole-Round Multisensor Logger.

Figure F9. Age-depth plot for calcareous nannofossil and planktonic foraminifer (PF) biohorizons, Site U1482. Average sedimentation rates were ~5.9 cm/ky during the late Miocene, ~3.3 cm/ky in the early Pliocene, and ~7 cm/ky in the Pleistocene. Vertical error bars represent the interval between the two samples that defines the biohorizon (often obscured by the biohorizon symbol).

Figure F10. Site U1483 results summary. cps = counts per second.

Figure F11. Age-depth plot for Site U1483 showing integrated biomagnetochronology for Hole U1483A. Average sedimentation rates were ~10 cm/ky during deposition of the entire sequence. Two disturbed intervals were observed (gray boxes). These disturbed intervals are associated with intervals of mixed PF assemblages, calcareous nannofossil reworking, and intervals of lithologic disturbance.

Figure F12. Northern margin of Papua New Guinea (red box in Figure F3) showing the location of Sites U1484–U1487 (yellow circles). Sites U1484 and U1485 are located ~15 and ~19 km offshore Papua New Guinea, respectively. Contour interval = 500 m. Data source: Amante and Eakins (2009).

Figure F13. Site U1484 results summary. cps = counts per second.

Figure F14. Age-depth plot for calcareous nannofossil and planktonic foraminifer biohorizons, Site U1484. Dashed line shows the mean long-term sedimentation rate. The age at the bottom of Hole U1484A is estimated to be 0.29 Ma based on the average linear sedimentation rate of 75 cm/ky.

Figure F15. Site U1485 results summary. cps = counts per second.

Figure F16. Age-depth plot for calcareous nannofossil and planktonic foraminifer biohorizons, Site U1485. Dashed line shows the mean long-term sedimentation rate of ~62.5 cm/ky. The age at the bottom of Hole U1485A is constrained between 0.44 and 0.60 Ma and is estimated as >0.50 Ma based on the nannofossil evidence.

Figure F17. Site U1486 results summary. cps = counts per second, SHMSL = Section Half Multisensor Logger.

Figure F18. Age-depth plot for Site U1486 showing integrated biomagnetochronology for Hole U1486A. Sedimentation rates were ~6 cm/ky for most of the Pleistocene (0–125 mbsf) and 14 cm/ky in the Pliocene and earliest Pleistocene (below 125 mbsf). The base of the hole (203 mbsf) is assigned a latest Pliocene age, ~2.72 Ma, assuming a constant sedimentation rate of 14 cm/ky for the basal 20 m section.

Figure F19. Site U1487 results summary. cps = counts per second.

Figure F20. Age-depth plot for Site U1487 showing integrated biomagnetochronology for Hole U1487A. Sedimentation rates averaged ~3.5 cm/ky through much of the Pleistocene (0–60 mbsf) and ~15 cm/ky in the Pliocene and earliest Pleistocene (deeper than 60 mbsf). The age of the oldest recovered sediment is estimated at 2.65 Ma based on extrapolation of the age-depth trend.

Figure F21. Eauripik Rise and Caroline Basin map (green box in Figure F3) showing the location of Sites U1488–U1490 (yellow circles) and DSDP Site 62 (purple circle). Contour interval = 500 m. Bathymetric data are from Amante and Eakins (2009).

Figure F22. Site U1488 results summary. cps = counts per second.

Figure F23. Age-depth plot for Site U1488 showing integrated biomagnetochronology for Hole U1488A. Magnetochron reversals from Hole U1488C are shown where they extend below those reliably recorded in Hole U1488A. Age of the oldest recovered sediment at Site U1488 is constrained to ~10.47 Ma by the absence of the PF *Paragloborotalia mayeri* and >9.69 Ma by the presence of the calcareous nannofossil *Catinaster coalitus* at 314.52 mbsf. Sedimentation rates averaged ~2–3 cm/ky in the Pleistocene (0–50 mbsf) and ~4 cm/ky in the late Miocene to Pliocene (below 50 mbsf).

Figure F24. Site U1489 results summary. cps = counts per second.

Figure F25. Age-depth plot for Site U1489 showing integrated biomagnetochronology for Hole U1489C. 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 varied from ~0.3 to 5 cm/ky.

Figure F26. Site U1490 results summary. cps = counts per second.

Figure F27. Age-depth plot for Site U1490 showing integrated biomagnetochronology for Hole U1490A. An age of ~24 Ma was reached at the base of the sedimentary sequence based on extrapolation through Oligocene/Miocene boundary biohorizons and the presence of common *Cyclicargolithus abisectus* (~24 Ma) at ~382 mbsf. Average sedimentation rates varied from ~0.9 to 5 cm/ky.

Figure F28. A. Bathymetric map with locations of sites (red circles) cored during Expedition 363. B. Regional tectonic setting. Locations of volcanoes (red triangles) from **http://volcano.si.edu**. Bathymetry from **http://topex.ucsd.edu/marine_topo**. Blue lines = strike-slip faults, green lines = extensional faults, black lines = unknown fault type. Large black triangles = subduction zones, small black triangles = thrusts. Maps courtesy of Robert Hall.

Figure F29. Lithologic summary of Expedition 363 sites grouped by region. Main lithologic characteristics are displayed along with MS for eight sites and reflectance spectroscopy and colorimetry (RSC) parameter L* for Site U1483. Blue, gray, green, brown, and red colors represent biocarbonate-, clay mineral–, biosilica-, siliciclastic-, and volcanogenic-dominated lithologies, respectively. Boundaries between background-colored fields represent isochrons for late Oligocene to recent subepochs based on shipboard bio- and magnetostratigraphic age models. This figure is available in an oversized format.

Figure F30. Summary age-depth relationships for Expedition 363 sites color-coded according to geographic area and summary climate history of the Neogene, including global benthic foraminifer oxygen isotope stack (Zachos et al. 2001). More negative isotope ratios represent warmer deep-water temperatures and/or lower global ice volume. The Middle Miocene Climate Optimum and the early Pliocene Warm Period are highlighted, together with an indication of Antarctic and Northern Hemisphere ice sheet extent.

Figure F31. Calcareous nannofossils from selected Expedition 363 sites. A. *Emiliania huxleyi*; U1485A-1H-CC. B. *Gephyrocapsa oceanica*; U1485A-1H-CC. C. *Gephyrocapsa* >5.5 µm; U1486B-8H-CC. D, E. *Pseudoemiliania lacunosa*; (D) U1489C-2H-6, 60 cm, (E) U1489B-2H-6, 75 cm. F. *Reticulofenestra asanoi*; U1483A-9H-6, 50 cm. G. *Helicosphaera sellii*; U1486B-10H-CC. H, I. *Calcidiscus macintyrei*; (H) U1486B-12H-CC, (I) U1486B-19H-CC. J. *Coccolithus pelagicus*; U1486B-15H-CC. K. *Discoaster triradiatus*; U1482A-18H-CC. L. *Discoaster pentaradiatus*; U1489C-8H-4, 60 cm. M. *Discoaster brouweri*; U1482A-12H-2, 75 cm. N. *Discoaster variabilis*; U1489B-12H-CC. O. *Discoaster surculus*; U1482B-38H-CC. P. *Sphenolithus abies*; U1483A 31H-CC. Q, R. *Reticulofenestra pseudoumbilicus*; (Q) U1483A-31H-CC, (R) U1489B-10H-CC. S. *Scyphosphaera globulata*; U1488A-14H-2, 60 cm. T, U. *Ceratolithus cristatus*; (T) U1489B-3H-CC, (U) U1482B-18H-CC. V, W. *Ceratolithus armatus*; (V) U1482B-27H-4, 50 cm, (W) U1482B-27H-CC. X. *Amaurolithus tricorniculatus*; U1482A-22H-6, 75 cm. Y. *Amaurolithus delicatus*; U1482B-27H-CC. Z. *Amaurolithus primus*; U1489C-22H-CC. AA. *Triquetrorhabdulus carinatus*; U1489C-31F-CC. AB. *Discoaster* sp.; U1486B-22H-6, 81 cm. AC. *Discoaster tamalis*; U1489B-6H-CC. AD. *Discoaster asymmetricus*; U1483A-31H-CC. AE. *Cyclicargolithus floridanus*; U1489C-38X-6, 40 cm. AF. *Coronocyclus nitescens*; U1489C-42X-4, 30 cm. AG. *Triquetrorhabdulus carinatus*; U1489C-41X-CC. AH. *Sphenolithus heteromorphus*; U1489C-41X-CC. AI. *Sphenolithus belemnos*; U1489C-41X-CC. AJ. *Nicklithus amplificus*; U1482B-33H-CC. AK. *Discoaster quinqueramus*; U1489C-24H-CC. AL. *Discoaster berggrenii*; U1482C-41X-CC. AM. *Catinaster calyculus*; U1489C-31F-CC. AN. *Catinaster coalitus*; U1489C-30F-CC.

Figure F32. NRM intensity (Int.; blue) and azimuthally corrected declination (Dec.; red) after peak AF demagnetization for Expedition 363 sites. Higher intensity values at Sites U1484–U1487 are influenced by greater terrigenous flux (Sites U1484 and U1485) and volcanogenic inputs (Sites U1486 and U1487). Downhole reductions in intensity, most evident at Sites U1488 and U1489 but also occurring at Sites U1482 and U1483, reflect the influence of sediment diagenesis and the dissolution of magnetite at depth. Where NRM intensity values are low and approach the sensitivity of the magnetometer (10^{-5} A/m), declination becomes increasingly scattered and uninterpretable. In the higher NRM intensity intervals, magnetostratigraphic interpretations are made and age is assigned through correlation of declination to the geomagnetic polarity timescale (Cande and Kent, 1995) of the geologic timescale (Hilgen et al., 2012). This figure is available in an oversized format.

Figure F33. NGR data (orange) plotted on core photos (generated using CODD; Wilkens et al., 2017; **https://www.codd-home.net**) for all Expedition 363 sites. Dashed black bars indicate close-ups only available in the site reports. Solid black bars indicate close-ups (see Figure F34) selected as representative of the different site characteristics. Boundaries between background-colored fields represent isochrons for late Oligocene to recent subepochs based on shipboard bio- and magnetostratigraphic age models. This figure is available in an oversized format.

Figure F34. Close-ups of intervals of holes chosen as representative for different sites (see Figure F33) with major physical property measurements overlaid on the composite core photos (generated using CODD; Wilkens et al., 2017; **https://www.codd-home.net**). V_P = *P*-wave velocity.

Figure F35. Foraminifer (F) and calcareous nannofossil (N) preservation at Expedition 363 sites. Clay-rich sediment from northwest Australia Sites U1482 and U1483, Papua New Guinea Sites U1484 and U1485, and Manus Basin Sites U1486 and U1487 are characterized by excellent to very good preservation. Carbonate-rich sediment at Eauripik Rise Sites U1488, U1489, and U1490 generally exhibit very good preservation becoming moderate to poor at the ooze-to-chalk transition. This figure is available in an oversized format.

Figure F36. Strategic locations of Sites U1482 and U1483 designed to monitor the short-and long-term variability of the Australian monsoon. Intensification of the Pilbara Heat Low and its eastward extension to the Kimberleys (indicated by dotted orange lines in large map) during austral summer drive the onset of the wet austral summer monsoon. Wind direction reverses over northwest Australia during the dry austral winter monsoon (small map), when trade winds intensify. Yellow arrows = main eolian dust paths in September (from Hesse and McTainsh, 2003). Figure modified from Kuhnt et al. (2015). Base map was generated with GeoMapApp (**http://www.geomapapp.org**) using the Global Multi-Resolution Topography synthesis database (Ryan et al., 2009). Drainage basins of the Fitzroy and Ord Rivers (**https://data.gov.au/dataset/australias-river-basins-1997**) are marked with a black line. Approximate extensions of the Fitzroy and Ord Rivers on the northwest Australian shelf during the LGM are indicated by blue dashed lines. Generalized wind patterns (white arrows) from Gentilli (1971).