Figure F1. Map of the northwest shelf showing major basins and location of modern and "fossil" reefs. Stars = Expedition 356 sites, green circles = Deep Sea Drilling Project/Ocean Drilling Program sites and other core locations referred to in text, yellow circles = industry well locations (Angel = Angel-1; G2/6/7 = Goodwyn-2, Goodwyn-6, Goodwyn-7; A1 = Austin-1; M/MN1 = Maitland/Maitland North-1; TR1 = West Tryal Rocks-1). WA = Western Australia, NT = Northern Territory, SA = South Australia, QLD = Queensland, NSW = New South Wales.

Figure F2. Bathymetric map showing the seafloor around Sites U1463 and U1464. Bathymetric data are derived from the Geoscience Australia Australian bathymetry and topography grid, June 2009. The positions of multichannel seismic profiles are shown. Red dots = locations of preexisting industry wells.

Figure F3. Multichannel seismic profile across Site U1463. Top of green shading = inferred top of the Miocene. SP = shotpoint.

Figure F4. Lithostratigraphic summary, Holes U1463A–U1463D. See Figure **F7** in the Expedition 356 methods chapter (Gallagher et al., 2017a) for lithology key.

Figure F5. Summary of synthetized correlation of lithostratigraphy at Site U1463 with data from smear slides (peloids, quartz content, and grain size), geochemistry (calcium carbonate content), physical properties (MS, NGR, grain density, *P*-wave velocity, and porosity), and biostratigraphy. Data from Holes U1463A and U1463B are plotted for MS (blue) and NGR (orange). See Figure **F7** in the Expedition 356 methods chapter (Gallagher et al., 2017a) for lithology key. WRMSL = Whole-Round Multisensor Logger. cps = counts per second.

Figure F6. Representative smear slide photomicrographs of units, Hole U1463B. A. Unit I: sediment rich in small peloids (p) with abundant miliolid benthic and planktonic foraminifers (f), well-preserved mollusk shell fragments (m), a single siliceous sponge spicule (s); note very fine-grained authigenic glauconite (black arrow) and mica (white arrows) (7H-2, 71 cm). B. Unit II: dominant planktonic and benthic foraminifers (f) with fewer well-preserved shell fragments (m); quartz (q), ascidian spicules (blue arrow), and mica (white arrow) are common accessory to minor components; note small authigenic glauconite grains, often in aggregates with clay-sized sediment (black arrows) (3H-2, 71 cm). C. Subunit IIIa: benthic and planktonic foraminifers (f) and shell fragments (m) in a coarse (fine silt sized) matrix; accessory echinoderm spine (e) and sponge spicule (s) fragments; note common quartz (q), mica (white arrows), and accessory authigenic glauconite (black arrows) (17H-2, 71 cm). D. Cross-polarized light (XPL) image of C, illustrating silt-sized quartz (q) in a carbonate matrix with sand-sized bioclasts. E. Subunit IIIb: benthic and planktonic foraminifers (f) with poorly preserved shell fragments (m); note increased siliciclastic components dominated by quartz (q) and feldspar (fsp), with mica (white arrow) and rare chlorite (cl); authigenic glauconite and glauconitized foraminifers are also common (black arrows) (40X-2, 71 cm). F. Unit V: large anhydrite (a) grains in a dolomite matrix (white arrows) (59X-CC); XPL.

Figure F7. Representative thin section photomicrographs, Hole U1463B. A. Unit II: skeletal packstone with abundant medium sand–sized benthic and planktonic foraminifers (f) and few echinoderm fragments (e) (9H-1); XPL. B. Subunit IIIa: skeletal packstone with abundant planktonic and benthic foraminifers (f) and pore space filled by large bluish to grayish single celestite crystals (arrows) (31F-1); XPL. C. Subunit IIIb: foraminiferal grainstone with abundant benthic foraminifers *Amphistegina* (a) and *Cibicidoides* (c) and rare echinoderm fragments (e); planktonic foraminifers are rare; note abundant greenish glauconitic and brownish iron oxide staining and high interparticle porosity (46X-3). D. Unit IV: foraminiferal packstone with abundant LBFs and rare planktonic foraminifers (f), common echinoderm fragments (e), and abundant glauconitization (white arrows) as well as brownish iron oxide staining (47X-3). E. Unit V: skeletal packstone with abundant small benthic foraminifers (f) and echinoderm fragments, and euhedral dolomite (d); pore space is cemented mainly with calcite and partly with celestite (blue arrows) (54X-CC). F. Unit V: dolomitic limestone with intensive anhydrite (a) replacement, micrite (m), dolomite (d) and celestite (white arrow) (55X-6).

Figure F8. Nannofossil preservation (1 = poor [P], 2 = moderate, 3 = good [G], 4 = very good) and abundance (0 = barren [B], 1 = rare, 2 = few, 3 = common, 4 = abundant, 5 = dominant [D]) data, Holes U1463B and U1463C. See **Biostratigraphy and micropaleontology** in the Expedition 356 methods chapter (Gallagher et al., 2017a) for preservation and abundance definitions. Biozonation scheme is that of Martini (1971), see Figure **F9** for details on biostratigraphic datums.

Figure F9. Ranges of late Miocene to Late Pleistocene calcareous nannofossil age markers, Holes U1463B and U1463C (no shipboard analyses were done on Hole U1463D). Green bars = age-depth tie points and robust correlations between holes. Pliocene/Pleistocene boundary (2.58 Ma) lies within Biozone NN16, approximated by the top of *Discoaster surculus* (2.49 Ma). Early Pliocene/late Pliocene boundary lies between the top of *Sphenolithus* spp. (3.54 Ma) and top of *Reticulofenestra pseudoumbilicus* (3.7 Ma). The base of *Pseudoemiliania lacunosa* (4.2 Ma) is used to denote the base of early Pliocene Biozone NN14. Miocene/Pliocene boundary (5.33 Ma) lies within Biozone NN12 but is difficult to constrain because of the lack of marker species. The top of *D. quinqueramus* indicates late Miocene (Messinian) age (Biozone NN11).

Figure F10. SEM and plane-polarized light (PPL) photomicrographs of calcareous nannofossils, Site U1463. A. *Emiliania huxleyi*. B. *Pseudoemiliania lacunosa*. C. *Reticulofenestra asanoi*. D. *Calcidiscus macintyrei*. E. *Discoaster brouweri*. F. *Discoaster pentaradiatus*. G. *Discoaster surculus*. H. *Discoaster tamalis*. I. *Sphenolithus* spp. J. *Reticulofenestra pseudoumbilicus*. K. *Discoaster quinqueramus*. L. *Reticulofenestra rotaria*.

Figure F11. SEM photomicrographs of typical preservation states of planktonic foraminifers, Site U1463. The depicted species is *Globigerinoides sacculifer* (or closely related to *G. sacculifer*). Depths are in CSF-A.

Figure F12. Planktonic foraminiferal abundance, Site U1463. 0 = barren, 1 = very rare, 2 = rare, 3 = few, 4 = common, 5 = abundant (see **Biostratigraphy and micropaleontology** in the Expedition 356 methods chapter [Gallagher et al., 2017a] for definitions).

Figure F13. Planktonic foraminiferal marker species ranges, Holes U1463B and U1463C. Ages are based on published values (Gradstein et al., 2012).

Figure F14. Variation in the coiling direction of planktonic foraminiferal genus *Pulleniatina*, Site U1463. Samples to 265 m CSF-A are *P. obliquiloculata*, samples deeper than 308 m CSF-A are *P. primalis*, and samples in between are a mixture of both species. Note that specimens of *P. finalis* were included with *P. obliquiloculata* (Kennett and Srinivasan, 1983). Ages are based on Saito (1976) and Pearson (1995) and recalibrated following Wade et al. (2011).

Figure F15. Optical and SEM photomicrographs of dominant benthic foraminiferal species and assemblages at Site U1463 together with paleodepth based on planktonic/benthic ratio (%P) and bathymetric zone interpretation. Assemblage bathymetric zones were smoothed to generate a synthesis, resulting in slight differences from hole summary data. For raw bathymetric zonation see Table **T11**. This figure is available in an **oversized format**.

Figure F16. Benthic foraminifer diversity (number of species) and benthic percentage of total foraminifers, Site U1463. Analyzed samples from Holes U1463A–U1463C are combined by CSF-A.

Figure F17. Hydrocarbons present in headspace gases, Site U1463.

Figure F18. Alkalinity, pH, salinity, sodium, chloride, and the sodium to chloride ratio, Site U1463.

Figure F19. Major element interstitial water geochemistry (bromide, magnesium, calcium, sulfate, potassium, ammonium, and phosphate), Site U1463.

Figure F20. Minor element interstitial water geochemistry (barium, boron, iron, lithium, manganese, silicon, and strontium), Site U1463. Manganese was not detected at depths shallower than 150 m CSF-A.

Figure F21. Bulk sediment geochemistry (calcium carbonate, TOC, and TN), Site U1463.

Figure F22. Magnetostratigraphic data set, Hole U1463B. Magnetic inclination and intensity data from archive-half sections measured on the SRM after background and tray correction. Measurements from the tops and bases of sections were omitted (see **Paleomagnetism** in the Expedition 356 methods chapter [Gallagher et al., 2017a]).

Figure F23. Magnetostratigraphic data set, Hole U1463C. Magnetic inclination, declination, and intensity data with different color data points representing different demagnetization steps of measurements from the same hole. Results are from archive-half sections measured on the SRM after background and tray correction with polarity (black = normal, white = reversed, gray = unidentified) and shown with biostratigraphic datums for reference. Measurements from the tops and bases of sections were omitted (see **Paleomagnetism** in the Expedition 356 methods chapter [Gallagher et al., 2017a]).

Figure F24. IRM acquisition curves for four discrete samples from Hole U1463B and their respective backfield curves. Inset shows enlarged view of negative *x*-axis, showing the coercivity of remanence estimation for each sample.

Figure F25. IRM curve and corresponding AF demagnetization trend, Sample 356-U1463B-37X-1, 86–88 cm (311.96 m CSF-A).

Figure F26. AF demagnetization results for discrete samples from 4 depths, Hole U1463B. Orthogonal projection (Zijderveld diagram) and equal area projection of NRM vector measured after each demagnetization treatment. Horizontal = declination, vertical = inclination. Equal area projection: solid circles = positive inclination, open circles = negative inclination. Normalized magnetization behavior plots show highest magnetization intensity (M_{max}) = 1 on *y*-axis with AF demagnetization strengths shown after each measurement on *x*-axis.

Figure F27. WRMSL MS, SHMSL point magnetic susceptibility (MSP), and NGR results, Site U1463. SHMSL data are raw MS from Hole U1463A and drift-corrected MS from all the other holes.

Figure F28. A. *P*-wave velocity, Site U1463 (dots = WRMSL, open circles = measured in liner, triangles = measured without liner; solid circles = MAD cubes with error bars showing ranges of their measurements taken in three orthogonal directions). Note that Hole U1463B was cored using APC shallower than 284 m CSF-A and XCB deeper than 284 m CSF-A, and Holes U1463C and U1463D were cored using APC and HLAPC only. Black = Hole U1463A, red = Hole U1463B, green = Hole U1463C, blue = Hole U1463D. Expanded view of (B) Hole U1463C and (C) Hole U1463D showing high-frequency discrete *P*-wave velocity measurements compared to WRMSL measurements. For B and C, dots = WRMSL, open circles = discrete measurements.

Figure F29. Bulk density (dots = GRA, open circles = MAD), grain density, and porosity, Site U1463. Black = Hole U1463A, red = Hole U1463B, green = Hole U1463C, blue = Hole U1463D.

Figure F30. Penetrometer strength and Torvane shear strength results, Hole U1463B.

Figure F31. Reflectance spectroscopy and colorimetry (L*, a*, and b*), Site U1463. Hole U1463C data were corrected by rescanning affected core sections (see text for details).

Figure F32. A. In situ temperatures measured with APCT-3, Hole U1463C. B. Thermal conductivity (*k*) measured on Hole U1463B (red) and U1463C (blue) cores and used in heat flow calculation. C. Thermal resistance (Ω) vs. temperature (*T*) (Bullard plot). D. Thermal conductivities as measured throughout entire cored interval. In B and D, only data with standard deviations <0.1 W/(m·K) are shown. Symbol width indicates standard deviation of each measurement.

Figure F33. Hole U1463B diameter (caliper) and HSGR measured by triple combo, NGR from Hole U1463B–U1463D whole-round cores, and elemental uranium, thorium, and potassium concentrations estimated from Hole U1463B HSGR spectra.

Figure F34. Hole U1463B diameter (caliper; black) and smoothed standoff distance (×10; blue) inferred from APS on triple combo with bulk density and porosity (lines = smoothed Hole U1463B wireline HLDS/APS, circles = Hole U1463A–U1463C discrete MAD measurements).

Figure F35. FMS images processed with dynamic method, Hole U1463B Passes 1 and 2.

Figure F36. Hole U1463B diameter (caliper) measured by FMS-sonic caliper and sonic velocities from Hole U1463B wireline and Hole U1463B–U1463D discrete core measurements.

Figure F37. Timing of coring and quality of core recovery linked to position in the tidal cycle. Colors in the core recovery columns for Holes U1463B–U1463D identify zones of high (red) and moderate disturbance (orange). The level of disturbance is derived from visual core descriptions (see **Core descriptions**) and lithologic descriptions (see **Lithostratigraphy**). Operations timing is shown by H (start APC), F (start HLAPC), X (start XCB), and EOH (end of hole) relative to tides calculated for latitude 18°57.918′S, longitude 117°37.4220′E. Blue = portions of tidal cycle with no coring activity.

Figure F38. Correlation of the upper ~350 m between Holes U1463B, U1463C, and U1463D. The correlation is defined in Table **T17** and graphically identifies features used to correlate between holes. Cores are mapped to the CCSF-A depth scale. Solid lines = tie points used in the correlation to align cores, short dashed lines = points that support the correlation but were not used to align cores, long dashed lines = uncertain correlations, arrows = splice tie points. Circles suggest intervals of core expansion. A. 0–50 m CCSF-A. B. 50–100 m CCSF-A. (Continued on next three pages.)

Figure F38 (continued). C. 100–150 m CCSF-A. D. 150–200 m CCSF-A. (Continued on next page.)

Figure F38 (continued). E. 200–250 m CCSF-A. F. 250–300 m CCSF-A. (Continued on next page.)

Figure F38 (continued). G. 300–350 m CCSF-A. Gray shading = zone of low certainty in correlation. H. 350–400 m CCSF-A.

Figure F39. Spliced NGR record compared to NGR records from the individual holes, Site U1463. Tie points for the splice are shown in Figure **F38**. A. 0–100 m CCSF-A. B. 100–200 m CCSF-A. (Continued on next page.)

Figure F39 (continued). C. 200–300 m CCSF-A.

Figure F40. Hole U1463B summary showing core recovery, graphic lithology, lithostratigraphic units, age, and biostratigraphic data plotted against MS, NGR, and wireline HSGR. Biostratigraphic zone boundary ages are shown. Age-depth model was produced from biostratigraphic datums only (see **Biostratigraphy and micropaleontology**) and assumes a linear sedimentation rate between datums (solid circles = calcareous nannofossils, open circles = planktonic foraminifers). See Figure **F7** in the Expedition 356 methods chapter (Gallagher et al., 2017a) for lithology key. BF = benthic foraminifer, PF = planktonic foraminifer, NN = calcareous nannofossil. IS = inner shelf, MS = middle shelf, OS = outer shelf, UB = upper bathyal. Gray bar = casing depth.

Figure F41. Hole U1463C summary showing core recovery, graphic lithology, lithostratigraphic units, age, and magnetostratigraphic and biostratigraphic data plotted against MS and NGR. Magnetostratigraphy and biostratigraphic zone boundary ages are shown. Age-depth model was produced from biostratigraphic datums only (see **Biostratigraphy and micropaleontology**) and assumes a linear sedimentation rate between datums (solid circles = calcareous nannofossils, open circles = planktonic foraminifers). See Figure **F7** in the Expedition 356 methods chapter (Gallagher et al., 2017a) for lithology key.

Figure F42. Hole U1463D summary showing core recovery, graphic lithology, and lithostratigraphic units, plotted against MS and NGR. No biostratigraphy or magnetostratigraphy was performed on this hole. See Figure **F7** in the Expedition 356 methods chapter (Gallagher et al., 2017a) for lithology key.

Figure F43. Site U1463 summary showing core recovery, lithostratigraphic units, age, magnetostratigraphy biostratigraphy, MS, and wireline HSGR. Biostratigraphic zone boundary ages are shown. Age-depth model was produced from select biostratigraphic datums (see Table **T6**) (solid circles = calcareous nannofossils, open circles = planktonic foraminifers). Sedimentation rates assume a linear sedimentation rate between datums. Benthic foraminiferal assemblages were smoothed to generate this synthesis, resulting in slight differences from data presented in hole summaries. Gray bar = pipe depth.