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 U1461 and U1462. Bathymetric data are derived from the Geoscience Australia Australian bathymetry and topography grid, June 2009. The positions of multichannel seismic profiles are shown. Red circles = locations of preexisting industry wells.

Figure F3. Multichannel seismic profile across Site U1462. Top of green shading = inferred top of the Miocene and the Bare Formation. SP = shotpoint.

Figure F4. Lithostratigraphic and smear slide summary, Holes U1462A (0–843.03 m CSF-A), U1462B (0–47.80 m CSF-A), and U1462C (47.80–946.09 m CSF-A). Although this figure shows Hole U1462A core recovery, it composites data from Holes U1462B and U1462C only. L* and NGR: red = Hole U1462B, black = Hole U1462C. See Figures **F6** and **F7** in the Expedition 356 methods chapter (Gallagher et al., 2017a) for lithology, boundary, structure, and diagenesis keys. cps = counts per second.

Figure F5. Representative smear slide photomicrographs of each unit, Site U1462. A. Unit I: coarse bioclastic sediment with poorly preserved mollusk fragments (m), cemented bioclasts, and nonskeletal grains in a sparite matrix (black arrows) (356-U1462C-15R-CC, 24 cm). B. Unit I: well-preserved skeletal and nonskeletal components including abundant ooids (o) with multiple layers and peloids (p), mollusk fragments (m), and a foraminiferal test fragment (f) with evidence of common sparitic cementation (black arrows; 356-U1462B-1X-CC, 20 cm). C. Upper Unit II: glauconitized sediment including grains of detrital glauconite (g), foraminifers (f) with evidence of glauconitization, clear sparite (sp), and altered mollusk shell fragments (m) (40X-4, 71 cm). D. Lower Unit II: sediment with fine sand–sized quartz grains (q), small planktonic and benthic foraminifers (f), rare mollusk fragments (m), authigenic glauconite (g), and sparite (arrows); some foraminifers are heavily glauconitized (72X-1, 63 cm). E. Unit III: common large quartz grains (q) and mollusk fragments (m) with benthic and planktonic foraminifers (f) and an accessory echinoderm spine (e) (83X-2, 71 cm); cross-polarized light (XPL). F. Unit IV: abundant anhydrite crystals (a) in a fine crystalline dolomite matrix; note lack of microfossils (356-U1462C-161R-CC, 8 cm); XPL.

Figure F6. Thin section photomicrographs. A. Unit I: skeletal packstone with abundant cemented bioclasts including benthic foraminifers (f), echinoderm fragments (e), peloids (p), and a coralline algal fragment (c); note isopachous fibrous cement (arrows) cementing the bioclasts (356-U1462A-10X-CC, 18–20 cm). B. Unit I: oolitic grainstone with abundant tangential ooids (o) and a few uncoated peloids (p) cemented by isopachous microspar cement (arrows) (14X-1, 9–22 cm); XPL. C. Unit II: foraminiferal packstone with abundant small benthic and planktonic foraminifers (f) (e.g., *Globigerinoides* and *Cibicides*), angular silt-sized quartz grains (3%; arrows), and moderate intraparticle porosity; remaining pore space (black) is partially cemented by sparite (1%) (62X-1, 81–84 cm); XPL. D. Unit II: packstone rich in silt-sized quartz with abundant fine sand–sized small benthic and rare planktonic foraminifers; note scattered prismatic crystals of anhydrite with high interference colors (arrows) (72X-3, 33–36 cm); XPL. E. Unit III: wackestone with abundant fine sand–sized angular quartz grains (q), rare foraminifers (f), echinoderm fragments (e), and glauconite (g); note replacive celestite (arrows) with low interference colors (88X-1, 24–27 cm); XPL. F. Unit IV: interlocked prismatic anhydrite with high interference colors; note rare angular relict quartz grains (arrows) (100X-CC, 6–10 cm); XPL.

Figure F7. Textures of nonskeletal ooid- and peloid-rich grainstones in Unit I, Hole U1462A. A. Sharp contact separates fine (center) from coarse sand–sized grains. B. Normally graded bed with gravel-sized shells at the base. C. Abundant gravel-sized macrofossils (mainly bivalve fragments) in a massive bed. D. Parallel laminae. E. Massive coarse sand–sized grainstone. F. Cross section of a well-preserved pectinid shell.

Figure F8. A. Nonskeletal ooid- and peloid-rich packstone in Unit I, Hole U1462C. Coarse sand–sized dark gray packstone infilling possible solution cavities in cream nonskeletal packstone. B. Example of massive ooid-rich nonskeletal packstone (oolite) recovered in Unit I with inclined bedding planes, indicating transport and winnowing. C. Examples of shell-rich beds with well-preserved macrofossils (mainly bivalve and gastropod shells).

Figure F9. Examples of gravitational flows in Units II and III, Hole U1462C. A. Normally graded bed separated by a scoured contact from an underlying fine sand–sized olive-gray packstone. B. Bioturbated contact at 109–115 cm, sharp basal and top contacts at 120 and 125 cm, and laminae at 129 cm are indicators of sediment transport. C. Example of reworked sediment showing sharp wavy contacts and diffuse bedding. Imbricated mud clasts present in the coarser sediment.

Figure F10. Summary of synthetized correlation of lithostratigraphy at Site U1462 with data from smear slides (total foraminifers, quartz content, and grain size), geochemistry (calcium carbonate content; data from **Geochemistry**, Figure **F26**), physical properties (MS, NGR, porosity, and grain density), and biostratigraphy. Graphic lithology is a composite record from Holes U1462B and U1462C (see Figure **F7** in the Expedition 356 methods chapter [Gallagher et al., 2017a] for lithology key). WRMSL = Whole-Round Multisensor Logger.

Figure F11. Unit II/III boundary at 777.88 m CSF-A, Hole U1462C. A. The boundary (red line) is represented by a sharp contact at the top of a 20 cm cemented interval. Unit II is characterized by olive-gray packstone with fine sand–sized grains, whereas Unit III is a dark greenish-gray grainstone with very coarse sand–sized grains. B. Example of Unit III dark greenish-gray grainstone with coarse sand–sized grains.

Figure F12. Examples of Unit IV lithology, Hole U1462C. A. Anhydrite nodules (1–2 cm diameter) typical of light brown dolomitic packstone near top of Unit IV. B. Beige dolostone containing quartz, common bioturbation, and bivalve macrofossils. C. Light brown dolostone containing quartz. Bioturbation, macrofossils, anhydrite nodules, and sharp contact surfaces are also visible.

Figure F13. Examples of Unit IV lithofacies, Hole U1462C. A. Light gray coarse-grained sandstone and a light brown dolostone dominated by sand-sized grains below a sharp contact at 32 cm. B. Light brown dolomitic rudstone with abundant gravel-sized macrofossils (bivalves, gastropod, and coral fragments) and dense moldic porosity. Light gray areas may be relics of original rock. Note the separate scale bar below B. C. Example of a dolostone with anhydrite crystals in a chickenwire texture.

Figure F14. Correlation between Sites U1461 and U1462 based on calcareous nannofossil biostratigraphy. An arbitrary color scheme is used to highlight main biostratigraphic datums and follows the biozonation scheme of Martini (1971). Pliocene/Pleistocene boundary (2.58 Ma) lies within Biozone NN16, approximated by the top of *Discoaster surculus* (2.49 Ma). Early Pliocene (olive-green)/late Pliocene (blue) boundary lies between the top of *Sphenolithus* spp. (3.54) and the 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 lies within Biozone NN12 (brown) but is difficult to constrain because of the lack of marker species. The top of *Discoaster quinqueramus* indicates late Miocene (Messinian) age (Biozone NN11).

Figure F15. Planktonic foraminiferal marker species ranges for the earliest Pleistocene–Pliocene interval. A. Holes U1462A and U1462C. Ages are based on published values (Gradstein et al., 2012). Note that the top of *P. primalis* indicates the sinistral form and not the general top of the species. (Continued on next page.)

Figure F15 (continued). B. Comparison between Sites U1461 and U1462, based on biozone definitions in Table **T6** in the Site U1461 chapter (Gallagher et al., 2017b) and Table **T7**.

Figure F16. Depth ranges of late Miocene to Middle Pleistocene calcareous nannofossil age markers, as recorded between Holes U1462A, U1462B, and U1462C. Green bars = age-depth tie points and robust correlations between holes. Nannofossil preservation: 1 = poor (P), 2 = moderate, 3 = good, 4 = very good (VG). Nannofossil abundance: 0 = barren (B), 1 = rare, 2 = few, 3 = common, 4 = abundant, 5 = dominant (D). See **Biostratigraphy and micropaleontology** in the Expedition 356 methods chapter (Gallagher et al., 2017a) for preservation and abundance definitions.

Figure F17. Plane-polarized light (PPL) photomicrographs of calcareous nannofossils, Site U1462. A. *Pseudoemiliania lacunosa*. B. *Reticulofenestra asanoi*. C. *Calcidiscus macintyrei*. D. *Discoaster brouweri*. E. *Discoaster pentaradiatus*. F. *Discoaster surculus*. G. *Sphenolithus abies*. H. *Reticulofenestra bisecta*. I. *Catinaster coalitus*. J. *Cyclicargolithus floridanus*. K. *Cyclicargolithus abisectus*. L. *Reticulofenestra pseudoumbilicus*. M. *Amaurolithus tricorniculatus*. N, O. *Discoaster* sp. P. *Discoaster* sp. Q. *Helicosphaera carteri*. R. *Syracosphaera pulchra*. S. *Coccolithus pelagicus*. T. *Discoaster quinqueramus*. U. *Reticulofenestra rotaria*. V. *Umbilicosphaera rotula*. W. *Scyphosphaera apsteinii*.

Figure F18. Scanning electron microscope (SEM) photomicrographs of typical preservation states of planktonic foraminifers, Site U1462. The depicted species is *Globigerinoides sacculifer* (or closely related to *G. sacculifer*, except 356-U1462A-99X-CC). Apart from 1X-CC top, all samples were treated with hydrogen peroxide and ultrasonication to improve cleaning. Foraminifers in 91X-CC and 99X-CC are glauconitized and dolomitized, respectively. Depths are in CSF-A.

Figure F19. Planktonic foraminifer abundance, Holes U1462A–U1462C. 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). Dotted line = abundance curve for planktonic foraminifers from nearby Site U1461.

Figure F20. Optical and SEM photomicrographs of dominant benthic foraminiferal species and assemblages at Site U1462 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 F21. Benthic foraminifer diversity (number of species) and benthic percentage of total foraminifers, Site U1462. Analyzed samples from Holes U1462A–U1462C are combined by CSF-A.

Figure F22. Hydrocarbons present in headspace gases, Site U1462.

Figure F23. Alkalinity, pH, salinity, sodium, and chloride, Site U1462.

Figure F24. Major element interstitial water geochemistry (bromide, magnesium, calcium, sulfate, potassium, phosphate, and ammonium), Site U1462.

Figure F25. Minor element interstitial water geochemistry (boron, barium, silicon, lithium, strontium, and manganese), Site U1462.

Figure F26. Bulk sediment geochemistry (calcium carbonate, TOC, and TN), Site U1462.

Figure F27. Magnetostratigraphic data set, Hole U1462C. Magnetic inclination and intensity data from archive-half AF demagnetization measurements (20 mT AF demagnetization step) after background and tray correction with polarity interval correlations (black = normal, white = reversed, gray = unidentified). Measurements from the top and base of sections were omitted (see **Paleomagnetism** in the Expedition 356 methods chapter [Gallagher et al., 2017a]).

Figure F28. IRM acquisition curves for four discrete samples and their respective backfield IRM curves of discrete samples, Hole U1462A. Inset shows enlarged view of negative *x*-axis, showing the coercivity of remanence estimation for each sample.

Figure F29. IRM curve and corresponding AF demagnetization trend (356-U1462A-85X-4, 63–65 cm; 763.0 m CSF-A), showing the median destructive field.

Figure F30. AF demagnetization results for discrete samples at 6 different depths, Hole U1462A. Orthogonal projection (Zijderveld diagram) and equal area projection of NRM vector measured after each demagnetization treatment. Horizontal = declination (D), vertical = inclination (I). 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 F31. Magnetic inclination data provided by PCA for selected discrete samples from Hole U1462A with biostratigraphic datums for reference.

Figure F32. WRMSL MS, drift-corrected SHMSL point magnetic susceptibility (MSP), and NGR results, Site U1462.

Figure F33. SHMSL MSP (356-U1462A-81X-1 through 82X-2). Black = before installation of the electronic device, gray = after installation of the electronic device (see text for discussion).

Figure F34. *P*-wave velocity (dots = WRMSL). For MAD cube measurements, error bars show range of minimum and maximum values found among measurements along the *x*-, *y*-, and *z*-axes; open circle is plotted at the arithmetic mean of the three measurements. Blue line = second wireline logging pass of Hole U1462C sonic velocities (see **Downhole measurements**).

Figure F35. Bulk density (dots = GRA, open circles = MAD), grain density, and porosity Site U1462. Black = Hole U1462A, green = Hole U1462B, red = Hole U1462C.

Figure F36. Correlations between discrete measurements, Site U1462. A. MAD bulk density vs. *P*-wave sonic velocity. Black line = Gardner relation, blue line = best-fit power-law relation. B. Porosity vs. *P*-wave sonic velocity with best-fit linear relationship. C. MAD grain density vs. grain density calculated from XRD mineral proportions. Plotted are densities for which assumed clay content best matches MAD results. Blue line = best-fit linear relationship; however, linear fits to all estimates of clay content are indistinguishable.

Figure F37. High-resolution MAD and smear slide sampling of Cores 356-U1462C-112R through 115R compared to NGR and WRMSL MS data. Red = MAD bulk density, blue = grain density, green = smear slide clay content estimates (see scale on top plot).

Figure F38. Reflectance spectroscopy and colorimetry (L*, a*, and b*), Site U1462.

Figure F39. Site U1462 thermal conductivity measurements, Holes U1462A (black) and U1462C (red).

Figure F40. Hole diameter (caliper) and HSGR measured by triple combo, NGR from whole-round cores, and elemental uranium, thorium, and potassium concentrations estimated from HSGR spectra, Holes U1462A and U1462C.

Figure F41. Hole U1462C diameter (caliper; black) and standoff distance (×10; blue) inferred from APS on triple combo and bulk density and porosity (lines = Hole U1462C wireline, circles = Site U1462 discrete samples).

Figure F42. FMS images between 624 and 654 m WMSF (dynamic processing method), Holes U1462A and U1462C.

Figure F43. A. Hole U1462C VSP interval velocities (solid black line) compared against Hole U1462A (pink) and U1462C (blue) wireline compressional sonic velocities from Pass 2. Lithostratigraphic Units I–III are shown (see **Lithostratigraphy**). B. Directly measured Hole U1462C VSP downhole (squares) traveltimes compared against sonic log inferred two-way traveltimes from Holes U1462A (red) and U1462C (blue). TWT = two-way traveltime.

Figure F44. Core recovery plotted against NGR measured on cores and wireline HSGR, Holes U1462A (blue) and U1462C (red). Dashed lines = tie points between holes. Some ties are not clear between HSGR and NGR (e.g., ~740 m CSF-A Hole U1462C HSGR correlates with Cores 139R and 140R [NGR] and ties to a peak in Hole U1462A HSGR, but there is no clear connection with NGR in Hole U1462A). Green blocks = intervals with high recovery in both holes.

Figure F45. Hole U1462A summary showing core recovery, graphic lithology, lithostratigraphic units, age, magnetostratigraphic and biostratigraphic data plotted against NGR and color reflectance b*. 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 calcareous nannofossil (solid circles) and planktonic foraminiferal (open circles) datums. See Figure **F7** in the Expedition 356 methods chapter (Gallagher et al., 2017a) for lithology key. Benthic foraminiferal assemblages were smoothed to generate this synthesis, resulting in slight differences from data presented in hole summaries. BF = benthic foraminifer, PF = planktonic foraminifer, NN = calcareous nannofossil. IS = inner shelf, MS = middle shelf, OS = outer shelf, UB = upper bathyal. Diagonal lines in PF zonation indicate uncertainty in depth of stratigraphic data.

Figure F46. Hole U1462C summary showing core recovery, graphic lithology, lithostratigraphic units, age, and magnetostratigraphic and biostratigraphic data plotted against NGR and color reflectance b*. 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 calcareous nannofossil (solid circles) and planktonic foraminiferal (open circles) datums. See Figure **F7** in the Expedition 356 methods chapter (Gallagher et al., 2017a) for lithology key. Diagonal lines in PF zonation indicate uncertainty in depth of stratigraphic data.

Figure F47. Site U1462 summary showing core recovery, lithostratigraphic units, age, magnetostratigraphy, biostratigraphy, NGR, and wireline HSGR. Biostratigraphic zone boundary ages are shown. Age-depth model was produced from select biostratigraphic datums (see Table **T7**) (solid circles = calcareous nannofossils, open circles = planktonic foraminifers). Sedimentation rates are calculated separately for planktonic foraminiferal (blue dashed line) and calcareous nannofossil (green line) datums and 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.