Figure F1. Location map, Sites U1610 and U1611 (red dots). Blue dots = Integrated Ocean Drilling Program Expedition 339 sites, yellow dot = Ocean Drilling Program Site 976, green dot = Deep Sea Drilling Project Site 121.

Figure F2. Present-day water mass circulation patterns on either side of Gibraltar Strait in relation to main topographic features and Expedition 401 sites. AMW = Atlantic Mediterranean Water.

Figure F3. Bathymetric map of Alborán Sea with present-day regional circulation model. AW = Atlantic Water, WIW = Western Intermediate Water, LIW = Levantine Intermediate Water, WMDW = Western Mediterranean Deep Water, ShW = shelf water (mixture of AW and WMDW). Thick black lines = locations of Conductivity-Temperature-Depth (CTD) data used for hydrographic sections in Figure F4. Figure from Ercilla et al. (2016).

Figure F4. Seismic–hydrographic intersections of margins and basins, Alborán Sea. Note correlation between highest density contrast between water masses (Atlantic Water [AW], Western Intermediate Water [WIW] + Levantine Intermediate Water [LIW], and Western Mediterranean Deep Water [WMDW]) and main physiographic domains. Types of contourites and water masses are indicated on seismic profiles. ShW = Shelf Water (mixture of AW and WMDW). Black vertical lines in water column = water depth to which Conductivity-Temperature-Depth (CTD) recorder was lowered. Locations of seismic–hydrographic intersections shown in Figure F3. Figure from Ercilla et al. (2016).

Figure F5. Paleogeographic reconstruction of Betic and Rifian Corridors from late Tortonian to Early Pliocene, Site U1611. Corridors and paleocurrent indicators modified after Santisteban and Taberner (1983), Benson et al. (1991), and Martín et al. (2001, 2014).

Figure F6. Seismic Line CAB01-125 showing location and depth of Holes U1611A and U1611B. Location and orientation of seismic profile are shown on Figure F1. CDP = common depth point. M/P = Miocene/Pliocene.

Figure F7. Casing and reentry system, Hole U1611A. mbrf = meters below rig floor. Dimensions are in meters. Not to scale. NA = not applicable.

Figure F8. Lithologic synthesis, Site U1611.

Figure F9. Lithologic summary, Site U1611. Curve variation in sedimentary log indicates relative long-term variations of coarser versus finer grained sediments. Black dashed lines = unit boundaries, gray dashed lines = transition between units, T = transitional boundary. Ages apply to Hole U1611A.

Figure F10. Core and bed thickness by lithology, Hole U1611A. Grouped beds are not plotted. Black dashed lines = unit boundaries, gray dashed lines = transition between units.

Figure F11. Core and bed thickness by lithology, Hole U1611B. Grouped beds are not plotted. Black dashed lines = unit boundaries, gray dashed lines = transition between units.

Figure F12. Example facies description for each unit, Site U1611. Linescan image and red-green-blue (RGB) color are from Section Half Imaging Logger (SHIL), X-ray image is from X-Ray Linescan Logger (XSCAN). Reflectance (L*a*b*) and MS are from SHMSL. NGR data points are shown to note different sampling interval compared to other logs. Vfs = very fine sand, fs = fine sand, Ms = medium sand, Cs = coarse sand, vcs = very coarse sand, Gr = granule, pb = pebble. Ch = Chondrites, Pa = Palaeophycus, Pl = Planolites. cps = counts per second. A. Calcareous mud and calcareous silty mud are dominant, with occasional intercalation of silty sand, Unit I. (Continued on next two pages).

Figure F12 (continued). B. Calcareous mud and calcareous silty mud are dominant and well laminated throughout, with occasional intercalations of silty sand, contorted bed, and cemented carbonate, Unit II. (Continued on next page.)

Figure F12 (continued). C. Silty mud is dominant and often laminated, with frequent intercalations of thin (few millimeters to centimeters thick) silty sand and occasional intercalations of sand and conglomerate, Unit III.

Figure F13. Example trace fossil assemblage, Hole U1611A. Ch = *Chondrites*, Pl = *Planolites*, Th = *Thalassinoides*.

Figure F14. Representative powder XRD patterns of different lithologies in Units I–III, Site U1611. Samples are arranged from shallow (top) to deep (bottom). Patterns are plotted with intensity on logarithmic scale to highlight presence and nature of smaller peaks.

Figure F15. Variation in total carbonate content based on coulometry (see Geochemistry) and XRD data (calcite + dolomite), Hole U1611A. Some samples from same squeeze cake or same stratigraphic interval (i.e., not necessarily on same sample) were analyzed by both XRD and coulometry analyses. Total carbonate content determined on samples by both methods generally show good agreement.

Figure F16. Variations in sediment composition, Hole U1611A. Bulk mineralogy was determined from bulk XRD patterns using Rietveld refinements method (see Lithostratigraphy in the Expedition 401 methods chapter [Flecker et al., 2025a]). Feldspars = plagioclase + K-feldspar.

Figure F17. Miocene/Pliocene boundary in Unit I, Site U1611. Both holes contain conglomerate overlain by calcareous silty mud with parallel and cross lamination.

Figure F18. A–C. Grading and color banding observed in Units I–II, including bigradational sequence, color banding and lamination in calcareous silty mud, and inverse grading, Hole U1611A.

Figure F19. Deformational structures observed in Units I–III, including contorted bedding, microfaulting, and load structures, Site U1611.

Figure F20. Major lithologies for Units I–III, Hole U1611A. Dominant siliciclastic and biogenic components are annotated. Bg = biogenic fragment, Cl = clay, Cn = calcareous nannofossils, Dl = dolomite, Fd = feldspar, Ff = foraminifer fragment, Fm = foraminifer, Gl = glauconite, Hm = heavy mineral, Lith = lithic fragment, Op = opaque mineral, Py = pyrite, Qz = quartz, Sp = sponge spicule. (Continued on next page.)

Figure F21. Average texture (grain size) and mineralogical composition in main lithologies in Units I–III based on averaged data from smear slide analysis, Site U1611.

Figure F22. Texture (sand/silt/clay) of main lithologies in Units I–III for all units and by individual unit (n = 171), Site U1611. Unit III was not broken up by lithology because described lithologies in Unit III were frequently aggregations of multiple lithologies that varied on too fine a scale to be recorded in data capture system.

Figure F23. Trace fossils in breccia in Unit I, Hole U1611A. *Chondrites* (Ch) is present in mud clasts in breccia.

Figure F24. Mineralogical composition of main lithologies in Units I–III for all units and by individual unit (n = 170), Site U1611. Unit III was not broken up by lithology because described lithologies in Unit III were frequently aggregations of multiple lithologies that varied on too fine a scale to be recorded in data capture system.

Figure F25. Conglomerates in Units II and III, Site U1611. A, B. >1 m long. C, D. Containing mud clasts. E. Normal grading. B, F, G. Containing large bioclasts.

Figure F26. Lamination observed in Units II–III, Site U1611. A. Parallel and cross lamination. B. White lamination composed of aragonite observed in both holes that are parallel and deformed (contorted and faulted) C. Lighter colored lamination reflecting variable carbonate content. D. Cross lamination.

Figure F27. (A–D) Calcareous silty mud, (E, F) cemented carbonate (carbonate-stained area), (G, H) aragonite, (I, J) cemented carbonate, and (K, L) coarse-grained sandstone with shells in Unit II, Site U1611 (G: SEM image in backscatter electron mode; star = location of H; H: energy-dispersive X-ray spectroscopy). Note that polishing of thin sections was finished at >30 µm thickness, so birefringence colors of quartz are higher than usual. Qz = quartz, MRF = metamorphic rock fragment, FP = fecal pellet, OM = organic matter, Ca = calcite.

Figure F28. Turbiditic deposits from Unit III for (A) fine sands to sandy silts, (B) fine sands to very fine sands, (C) medium sands to sandy silts, and (D) coarse sands to silty sands, Site U1611. Deposits show sharp basal contacts, normal grading, and parallel and cross lamination. Pl = *Planolites*.

Figure F29. Thin turbidites showing sharp basal contacts, normal grading, and parallel lamination for (A, D) coarse and fine sands, (B, C, E) sandy silts, and (F, G) cross lamination in fine sands, Hole U1611B.

Figure F30. Trace fossil assemblage for Unit III through silty mud, sand, and cemented carbonate intervals, Hole U1611B. Note coarse sandy infill in some trace fossils (yellow arrows). Ch = *Chondrites*, Pl = *Planolites*, Th = *Thalassinoides*.

Figure F31. A–I. Unit III samples, Hole U1611A. Note that polishing of thin sections was finished at >30 µm thickness, so birefringence colors of quartz are higher than usual. Ca = calcite, Dol = dolomite, Mq = metamorphic quartz, Schist = schist fragment, MRF = other metamorphic rock fragment.

Figure F32. Ages of planktonic foraminifer and calcareous nannofossil biostratigraphic events, Site U1611. Events are plotted at mean depth (Table T3). S/D = sinistral/dextral.

Figure F33. Abundance of benthonic foraminifer assemblages in core catcher samples, Hole U1611A. Fine fraction was analyzed for Cores 18R–45R (see Table T8). Common (C) = 5%–20%, rare (R) = 1%–5%, present (P) = 0%–1%. Barren and lithified horizons are marked. Shallow-water benthonic assemblage comprises *Ammonia* spp. and *Elphidium* spp.; epibenthonic assemblage is made up of *Cibicides* spp., *Cibicidoides* spp., *Planulina* spp., and *Textularia* spp.; Bolivinids include all *Bolivina* spp. and *Brizalina* spp.

Figure F34. Paleomagnetic results, Hole U1611A. Red vertical line = GAD inclination at site latitude in normal polarity. Smoothed inclination used 1 m moving window. Orange band = standard deviation of smoothing results. Characteristic remanent magnetization (ChRM) inclination of discrete samples after 20 mT peak field AF demagnetization have α_{95} uncertainties. Blue triangles = discrete sample positions. Chron columns, black = normal polarity, white = reversed polarity, gray = zones of uncertain normal polarity.

Figure F35. Paleomagnetism after 20 mT peak field AF demagnetization, Hole U1611B. Red vertical line = GAD inclination at site latitude in normal polarity. Smoothed inclination used 1 m moving window. Orange band = standard deviation of smoothing results. Chron columns, black = normal polarity, white = reversed polarity, gray = zones of uncertain normal polarity.

Figure F36. AF demagnetization results, Hole U1611A. Left: vector endpoints of paleomagnetic directions measured after each demagnetization treatment on orthogonal projection (Zijderveld) plot. Squares = horizontal projections, circles = vertical projections. Right: intensity variation with progressive demagnetization.

Figure F37. Thermal demagnetization results, Hole U1611A. Left: vector endpoints of paleomagnetic directions measured after each demagnetization treatment on orthogonal projection (Zijderveld) plot. Squares = horizontal projections, circles = vertical projections. Right: intensity variation with progressive demagnetization.

Figure F38. AMS determinations, Hole U1611A. Left: orientation of principal AMS axes K_{max}, K_{int}, and K_{min}. Right: shape factor of AMS ellipsoid versus AMS degree.

Figure F39. Headspace gas methane (Holes U1611A [large dots] and U1611B [small dots]) and ethane, ethene, propane, *iso*-butane, *n*-butane, *iso*-pentane, and *iso*-hexane (Hole U1611A). Gray shading = Hole U1611A methane:ethane ratio, gray dashed lines = guides for comparison across panels for samples with highest abundances of longer chain hydrocarbons.

Figure F40. IW sodium and chloride concentrations and Na/Cl ratios, Site U1611. Dashed line = bottom water values.

Figure F41. IW major cation concentrations (calcium, magnesium, and potassium), Site U1611. Dashed line = bottom water values.

Figure F42. Comparison of several key chemical profiles from IW, Hole U1611A.

Figure F43. IW major anion concentrations (sulfate and bromide) and ammonium concentrations, Site U1611. Dashed line = bottom water values.

Figure F44. Comparison of sodium, chloride, and bromide (or Br + I) concentrations as well as Br/Cl ratios (or [Br + I]/Cl ratios) for 3 drill holes with high-salinity IW: Holes U1611A, 976B, and U1610A. Features of Alborán Sea sites are consistent with evaporative marine brine, whereas chemistry at Site U1610 suggests halite dissolution. Vertical dashed lines = reference values for International Association for the Physical Sciences of the Oceans (IAPSO) seawater.

Figure F45. IW minor element concentrations (Li and Si), Site U1611. Dashed line = bottom water values.

Figure F46. IW minor and trace element concentrations (Ba, B, and Sr), Site U1611. Dashed line = bottom water values.

Figure F47. IW trace element concentrations (Fe and Mn), Site U1611. Fe and Mn concentrations below detection limit are plotted as 0 µM.

Figure F48. IW alkalinity, pH, and salinity, Site U1611. Dashed line = bottom water values.

Figure F49. $CaCO_3$, organic carbon, nitrogen, and C/N in sediments, Site U1611. Arrows = organic-rich sample that plots off axes (organic C = 52 wt%; nitrogen = 0.75 wt%; C/N = 69).

Figure F50. Relationship between carbonate weight percent and raw NGR, as well as interpolated and normalized NGR, Hole U1611A. Raw NGR measurements represent closest analyses to IW whole-round sample (usually within 15 cm). Symbol color indicates lithologies identified in split core or found immediately above and below IW whole-round sample; where they differ, interior color shows lithology above and exterior color shows lithology below. cps = counts per second.

Figure F51. Carbonate Mg/Ca and Sr/Ca, Hole U1611A. Symbol color indicates lithologies identified in split core or found immediately above and below IW whole-round sample; where they differ, interior color shows lithology above and exterior color shows lithology below.

Figure F52. Comparison of carbonate geochemistry results, Hole U1611A. Symbol color indicates lithologies identified in split core or found immediately above and below IW whole-round sample; where they differ, interior color shows lithology above and exterior color shows lithology below.

Figure F53. WRMSL MS, GRA density, and NGR and *P*-wave velocity, Site U1611. Note that Unit I/II boundary occurred at different depth in the two holes. MS, GRA, and NGR: gray dots = original three data sets (with anomalous values removed from MS and GRA), overlying black lines = 10 cm locally weighted nonparametric regression (LOWESS) smooth run on MS, GRA, and NGR to highlight variations and secular trends. *P*-wave velocity: gray dots = WRMSL PWL, red squares = PWC *x*-direction, blue circles = PWC *y*-direction, and green crosses = PWC *z*-direction. cps = counts per second.

Figure F54. WRMSL and SHMSL MS and SRM NRM, Hole U1611A. Note that all three data sets show same trend to ~1120–1285 m CSF-B, below which SHMSL data set lacks high-frequency peaks noted in WRMSL and SRM data sets.

Figure F55. MS tests (401-U1611A-56R-1).

Figure F56. Thermal conductivity, MAD, GRA bulk density, porosity, and grain density, Hole U1611A. Porosity and grain density were obtained during MAD measurements.

Figure F57. Variation of porosity, grain density, and bulk density by lithology based on MAD measurements, Hole U1611A.

Figure F58. NGR measurements on core sections, Site U1611. Three NGR components (potassium, uranium, and thorium) were extracted from total NGR counts using shipboard codes based on method described by De Vleeschouwer et al. (2017). Arrows and circles = two principle shifts in difference between uranium and other signals. cps = counts per second.

Figure F59. MS and L*, a*, and b* color variation, Site U1611. Gray dots = original three data sets (with anomalous values removed from all data sets), overlying black lines = 10 cm locally weighted nonparametric regression (LOWESS) smooth run on all data sets to highlight variations and secular trends.

Figure F60. Downhole logging data summary showing borehole conditions (BS) and inclination, downhole gamma ray log (HSGR) and NGR measured on cores, downhole MS log plotted against core measurements, and downhole resistivity log, Hole U1611A. All downhole data are from triple combo repeat and main upward passes. LCAL = caliper, cps = counts per second, gAPI = American Petroleum Institute gamma radiation units, CALC = calculated.

Figure F61. (A) Depth to TWT conversions and (B) Seismic Line CAB01-125, with locations and depth penetrations of Holes U1611A and U1611B. MD = measured depth, wrt SF = with respect to seafloor, SP = shotpoint. MP = Miocene/Pliocene, TES = Top Erosion Surface.

Figure F62. Age model tie points and sedimentation accumulation rates for each data set, Site U1611.