Figure F1. Northern SCS margin with seismic coverage of 2-D, time-migrated multichannel seismic reflection data and ocean-bottom seismometer data. Seismic profiles across Site U1501 are shown in Figures F5 and F6. Magnetic chron number after Briais et al. (1993). Thick blue lines and red lines = key seismic lines used to plan drilling transect, orange lines (in A) and pink rectangles (in B) = magnetic lineations within ocean crust, white stars = Expedition 367/368 drill sites, orange square = ODP Leg 184 Site 1148, yellow squares = IODP Expedition 349 Sites U1432 and U1435.

Figure F2. Deep crustal time-migrated seismic reflection data without and with interpretation. Note the rather thin lower crust (two layers) above a strong Mohorovicic seismic discontinuity (Moho) reflector that can be followed oceanward. Moho reflection is weak to absent seaward from around the interpreted COT. Wide-angle seismic data (Yan et al., 2001) confirm ~6 km thick ocean crust (OC) seaward of COT. Large detachment fault ~150 km inland of COT separates more stable crust landward from that of highly extended crust seaward. OMH is a fairly consistent feature margin along this margin segment. Key seismic unconformities are shown in purple (T70; ~32 Ma breakup unconformity?) and blue (T60; ~23 Ma regional basin event). These ages are inferred from long distance (>100 km) correlation of seismic unconformities with industry holes and ODP Leg 184 Site 1148 (T60); ages need confirmation by coring and are only tentative. Tg reflector (green) is basement. Arrows = approximate positions of seafloor magnetic anomalies with chron numbers. Seismic data are from Line 04ec1555-08ec1555 (courtesy of Chinese National Offshore Oil Corporation [CNOOC]). Location of line is shown in Figure F1. C11n, C10n, and C9n = possible chrons. MSB = midslope basin.

Figure F3. Two-way traveltime to (A) basement (Tg reflector) and (B) T60 unconformity. Proposed drilling transect (thick black line) is approximately at the center of a margin segment bounded to the southwest by a transform fault. Northeastern boundary of margin segment around Site U1435. At this location, OMH and Ridge A seem to coalesce, and Ridges B and C in COT become indistinct toward the northeast within the next margin segment. Note that OMH is slightly oblique to more parallel Ridges A, B, and C.

Figure F4. Bathymetry with seismic lines, Site U1501. Note that site is not at the exact crossing of seismic Lines 15ecLW8 and 15ecLW1.

Figure F5. Original and predrilling interpretation of seismic dip Line 15ecLW1 crossing with seismic Line 15ecLW8 (red tick mark) and CDPs (CDP distance = 6.25 m). Seismic stratigraphic Unconformities T20 (2.6 Ma), T30 (5.3 Ma), T32 (10.0 Ma), T40 (16 Ma), T50 (19.1 Ma), T60 (23.0), T80 (38.0 Ma), and T83 (unknown age) and acoustic basement Reflector Tg are shown. The clear but not extensively coherent seismic reflectors below Tg to ~4.7 s TWT are semiconcordant to highly discordant to Tg and interpreted as pre-Cenozoic sediments. Origin of deep, quite strong reflectors (~5 s TWT) is not interpreted.

Figure F6. Original and predrilling interpretation of seismic strike Line 15ecLW8 crossing with seismic Line 15ecLW1 (red tick mark) and CDPs (CDP distance = 6.25 m). See Figure F5 for description of seismic interpretations. Dashed lines = unconformities, red solid lines = faults.

Figure F7. Lithostratigraphic summary of Site U1501 with simplified lithology and unit description of combined Holes U1501A–U1501C and U1501D. Upper cores are from Hole U1501C (1H through 61X); lower cores are from Hole U1501D (4R through 27R).

Figure F8. (A) Bulk mineralogy (XRD) and (B) carbonate content, Holes U1501C and U1501D.

Figure F9. Simplified lithology and unit description overview, Unit I.

Figure F10. Diverse burrows, Hole U1501C. A. *Thalassinoides*. B, C. Pyritized burrows. D. *Ophiomorpha* or *Cylindrichnus concentricus*. E. Burrow filled with coarser sand.

Figure F11. A. Pale brownish ash layer (368-U1501A-1H-7, 45–51 cm), Subunit IA. B. Magnetic susceptibility of core interval with ash layer, Hole U1501A. The ash layer has a significantly higher magnetic susceptibility than the nannofossil ooze. C. Smear slide image of ash layer. The ash is compositionally dominated by transparent glass shards and rare colored minerals (feldspar and ferromagnesian minerals). D. Pale brownish ash patch (368-U1501C-3H-1, 29 cm), Subunit IA.

Figure F12. Subunit IC. A. Core composite image. Red stars = thin fining-upward intervals. These intervals are interpreted as distal turbidites. B. Fining-upward interval with sharp bottom contact and diffuse top.

Figure F13. A. Clay-rich nannofossil ooze, Subunit IE. Monotonous sedimentation with pyrite patches. B. Close-up image (red square in A) of pyrite patches. C. Smear slide image of clay-rich nannofossil ooze with pyrite grains.

Figure F14. Contact between Units I and II (368-U1501C-45X-1. 50 cm). Nannofossil ooze with clay dominates Subunit IF with centimeter-sized concretions at the lower boundary and rip-up clasts. Subunit IIA is dominated by nannofossil-rich clay. Photomicrographs show (top) nannofossil ooze with clay, (middle) concretions, and (bottom) nannofossil-rich clay.

Figure F15. Simplified lithology and unit description overview, Unit II.

Figure F16. Special features, Subunits IIA and IIB. A. Thin parallel laminations. B. Gastropod shell filled with pyrite. C. Calcite concretion. D. Pyrite nodule. E. Coral fragment.

Figure F17. Glauconite sand, Unit II. A. Glauconite-rich sand, Subunit IIA. Rounded green glauconite grains in smear slide image. B. Glauconite-rich sand, Subunit IIB. Thin section is dominated by quartz and glauconite grains.

Figure F18. A. Calcite-rich sandstone with calcite-filled veins, Subunits IIC and IIE. B. Close-up image (red square in A) of calcite veins. C. Smear slide image of sandstone that is dominated by quartz crystals and calcite matrix.

Figure F19. A. Subunit IID is characterized by the presence of thin layers of organic matter within a clayey silt. Red square = location of B. B, C. Close-up images of organic-rich layers and bedding structures. Layers of organic-rich material are intercalated with clayey silt layers. D. 5 cm of lignite-rich silt.

Figure F20. A. Glauconite-rich coarse sandstone, Subunit IIF. The interval fines upward from very coarse sand to medium sand. B. Thin section image of glauconite sandstone dominated by quartz and glauconite. C. Glauconite-rich sandstone with burrows and blotches.

Figure F21. Composite of core section images showing the lithologic change from greenish gray medium coarse sand with glauconite in Subunit IIF to gray lithified coarse sandstone in Subunit IIIA, Hole U1501D. Lower part of Subunit IIF (19R-2) shows irregular brown to ochre and purple patches inferred to be related to diagenetic alteration.

Figure F22. Simplified lithology and unit description overview, Unit III.

Figure F23. A–D. Diverse lithologies of pebble- to cobble-sized clasts in Unit III sandstone.

Figure F24. Sandstone, Unit III. A. Subunit IIIA is dominated by gray coarse-grained sandstone rich in feldspar. B. Thin section image of heterolithic feldspar-rich sandstone showing rounded sedimentary, volcanic, and metamorphic (mica-bearing quartzite) lithic grains. Subunit IIIB is dominated by gray sandstone with (C) very thin laminae, (D) calcite clasts, and (E) bituminous clasts.

Figure F25. Preliminary model for deposition and sedimentary environments at Site U1501 showing deposition of prerift sediment and formation of the different units during and after rifting of the SCS.

Figure F26. Deformation structures, Unit I. Normal fault affecting nannofossil oozes (368-U1501C-19F-1, 108-127 cm).

Figure F27. Deformation structures, Subunits IIA and IIB. A. Millimeter-scale normal faults and fractures. B. En echelon millimeter-scale normal faults and fractures. C. Millimeter-scale normal fault offsetting black layers from about 5 mm within the nannofossil-rich clay. D. Slickenslide on an exposed polished fault surface.

Figure F28. Distinct uniform calcite and quartz vein shapes and structures, Subunit IIC. A, D. Single. B, C. Branched.

Figure F29. Deformation structures, Unit III. A. Straight fracture associated with a green alteration pattern. B. Fine-grained cataclastic fault gouge developing along a straight fracture. C. Single uniform quartz vein. D. Straight fracture associated with an alteration zone. E. En echelon uniform calcite vein. F. Convolute bedding associated with centimeter-scale slump fold.

Figure F30. Age-depth model, Site U1501. Plotted event data are in Tables T6, T7, and T13 (see Paleomagnetism; Figure F40).

Figure F31. Statistics of benthic foraminifers (368-U1501C-41X-CC to 62X-CC and 368-U1501D-2R-CC to 4R-CC). B = barren, P = present, R = rare, F = few, A = abundant, D = dominant.

Figure F32. Percentage of NRM loss between stepwise thermal demagnetization of NRM as a function of demagnetization temperature. Magnetization normalized to NRM (78 samples from Hole U1501C) carry the same statistical weight. Samples from Holes U1501A and U1501B were excluded to avoid statistically over representing the upper part of Unit I. Most magnetization is lost between 200° and 300°C, which shows that either greigite or pyrrhotite carry the NRM.

Figure F33. SEM image of greigite cube (3 µm length), Hole U1501A. Material was magnetically separated with a rare earth magnet from a slurry prepared from core catcher sample.

Figure F34. Variation of percentage of NRM left above 575°C, upper part of Hole U1501C (1H through 9H). Note the significant increase in the percentage below 60 m, which suggests an increasing contribution of maghemite or hematite.

Figure F35. Magnetization normalized to NRM as a function of AF demagnetization, Hole U1501C. This behavior shows initially low coercivity below 30 mT followed by coercivity inversion (or plateau), generally attributed to magnetic self-reversal of greigite (e.g., Krs et al., 1992; Horng et al., 1998). Complete demagnetization requires AF fields >100 mT.

Figure F36. Demagnetization plots of (A, D, E, G, H) archive-half sections and (B, C, F, I) discrete samples, Holes U1501C and U1501D. A, B, D, E, F, G, H: AF demagnetized; C, I: thermally demagnetized. Zijderveld plots: solid squares = declination, open squares = inclination. Stereographic plots: solid squares = positive (down) inclination, open squares = negative (up) inclination. Calculated ChRM (blue line; red squares = measurements used in calculation) using PCA are in good agreement for samples coming from same section and subjected to different treatments. Unit I: (A) reversed polarity, (B) normal polarity but with last step indicating a tendency to reversal, (C) reversed polarity. Unit II: (D) normal polarity, (E) reversed polarity, (F) normal polarity. Unit III: (G) normal polarity, (H) reversed polarity, (I) normal polarity.

Figure F37. Magnetic measurements, Holes (A) U1501A and (B) U1501B. Inclination was used to determine polarity. AFD = AF demagnetization, TD = thermal demagnetization. Discrete samples are yellow and green.

Figure F38. Magnetic measurements, Hole U1501C. Inclination was used to determine polarity. Discrete samples are yellow and green.

Figure F39. Magnetic measurements, Hole U1501D. Inclination was used to determine polarity. Magnetostratigraphic features are referred to as n1, etc., in a sequential manner for convenience and have no bearing on chrons. GTS2016 = geomagnetic polarity timescale of Ogg et al. (2016). Green circles = discrete samples.

Figure F40. Magnetic measurements and correlation to magnetostratigraphy (368-U1501C-1H through 17H). Age-depth model constructed from shipboard paleomagnetic analysis. Magnetostratigraphy converted to time and plotted against standard geologic timescale (GPTS2016; Ogg et al., 2016). Magnetostratigraphic features are referred to as n1, etc., in a sequential manner for convenience and have no bearing on chrons. B/M = Brunhes/Matuyama Chron boundary, M/G = Matuyama/Gauss Chron boundary. Discrete samples are yellow and green.

Figure F41. Magnetic measurements and correlation to magnetostratigraphy (U1501C-18F through 40X-2). Age-depth model constructed from shipboard paleomagnetic analysis. Magnetostratigraphy converted to time and plotted against standard geologic timescale (GPTS2016; Ogg et al., 2016). Magnetostratigraphic features are referred to as n1, etc., in a sequential manner for convenience and have no bearing on chrons. Discrete samples are yellow and green.

Figure F42. Gas chromatograms showing low levels of methane present in headspace samples, Hole U1501C. Detection of hydrocarbon gases in a drilling-disturbed sample obtained from a core catcher is shown for comparison. Relatively high proportions of ethene are consistent with generation of hydrocarbons by frictionally induced flash pyrolysis.

Figure F43. (A) Methane, (B) TOC and TS, and (C) carbon/nitrogen ratio and carbonate.

Figure F44. Crossplot of organic geochemical parameters: carbonate vs. carbon/nitrogen ratio and TS vs. TOC. Black circles = lithostratigraphic Subunit IA, open triangles = Subunits IB–IF, crosses = Unit II, green circles = Unit III.

Figure F45. Raman spectra of carbonaceous materials collected from reference materials and Holes U1501C and U1501D. AU = arbitrary units.

Figure F46. Surface-enhanced Raman spectra of sediment extracts: asphaltene (residual oil), a core sample rich in SOM, a blank, and a sample containing both SOM and residual petroleum.

Figure F47. Interstitial water alkalinity, pH, chloride, bromide, sulfate, phosphate, ammonium, sodium, potassium, calcium, and magnesium concentration profiles.

Figure F48. ICP-AES iron, manganese, silica, strontium, boron, and lithium concentration profiles.

Figure F49. (A) Major element oxide abundances and lithostratigraphic unit–normalized (B) CaO/SiO_2, (C) K_2O/SiO_2, and (D) Al_2O_3/SiO_2. B–D: solid black circles = Subunit IA, open circles = Subunits IB–IF, red circles = Unit II, green circles = Unit III.

Figure F50. Geochemical parameters correlated with sedimentological processes. A. (Mg + Na)/K ratio as proxy for smectite and illite. B. Ti/Ca ratio normalized by lithostratigraphic unit. Solid black circles = Subunit IA, open circles = Subunits IB–IF, red circles = Unit II, green circles = Unit III.

Figure F51. Variations in diagenetic history, Site U1501. A. Interstitial water Zones 1–4 and redox state of early stage diagenesis (green = reducing, red = dysoxic). B. Rescaled (from 0 to 1) interstitial water sulfate concentrations. AU = arbitrary units. C. Elemental and oxide abundances (Fe as Fe_2O_3). D. TOC and TS.

Figure F52. Physical properties, Holes U1501A and U1501B. cps = counts per second.

Figure F53. Physical properties, Holes U1501C and U1501D. Note logarithmic scales used for magnetic susceptibility and *P*-wave velocity.

Figure F54. NGR measurements, Hole U1501C. K, U, and Th concentrations are derived from NGR and GRA density measurements using method of De Vleeschouwer et al. (2017).

Figure F55. GRA bulk density and MAD bulk density, dry density, grain density, and porosity, Holes U1501C and U1501D.

Figure F56. Sediment color reflectance parameters L*, a*, and b* and $CaCO_3$ content, Holes U1501C and U1501D.

Figure F57. RGB values, Holes U1501C and U1501D.

Figure F58. Logging operations summary, Hole U1501D.

Figure F59. Tools used in triple combo run, Site U1501. LEH-QT = logging equipment head-q tension, EDTC = Enhanced Digital Telemetry Cartridge.

Figure F60. Downhole logs, Hole U1501D. HSGR = total spectral gamma ray, HCGR = computed gamma ray (U-free). Downhole logs were taken in Hole U1501D, and lithology and core recovery data are from Hole U1501C.

Figure F61. Heat flow calculations, Site U1501. A. Sediment temperatures. B. Thermal conductivity data, Hole U1501C. C. Calculated thermal resistance. D. Bullard plot of heat flow calculated from a linear fit of temperature data.

Figure F62. Comparison of a subset of physical properties with seismic waveform (converted to depth scale using best-fitting TDR model) and seismic image (in timescale).

Figure F63. TDR curves, Site U1501. U1501_preliminary_model was primarily based on PWC velocity data for depths shallower than ~450 m, an interval where PWC data are available. U1501_modified_model was based on the preliminary model with additional constraints from three reference points (RP1–RP3).

Figure F64. Site U1501 TDR curves, including U1501_preliminary_model and U1501_modified_model, compared to TDRs for Sites U1499, U1500, and 1148 (Li et al., 2008).

Figure F65. Seismic section at Site U1501 with thin strip of synthetic seismogram and lithostratigraphic units overlain at drill hole location. Also shown are selected core and downhole logging measurements converted to depth scale using best-fitting TDR model, including magnetic susceptibility (core), thorium (logging), uranium (logging), PWL (core), density (core and logging), and NGR (core and logging).

Figure F66. Synthetic seismogram, Site U1501. Left to right: smoothed velocity and MAD density used in the calculation, resultant RC, real seismic traces with synthetic seismogram inserted in the center, and seismic source function "Ricker 2_30 Hz" used in modeling. TVD = true vertical depth from Petrel software.

Plate P1. Principal planktonic foraminifers from Hole U1501C used in biostratigraphy analyses for Site U1501. 1: optical; 2–14: SEM. Scale bar = 100 µm. 1. *Globigerinoides ruber* pink (1H-CC). 2. *Globigerinoides fistulosus* (5H-CC). 3. *Globorotalia multicamerata* (7H-CC). 4. *Dentoglobigerina altispira* (9H-CC). 5. *Globoturborotalita nepenthes* (8H-CC). 6. *Globoquadrina dehiscens* (11H-CC). 7. *Fohsella fohsi* (15H-CC). 8. *Praeorbulina sicana* (23F-CC). 9. *Catapsydrax dissimilis* (26F-CC). 10. *Globoquadrina binaiensis* (28H-CC). 11. *Paragloborotalia kugleri* (32F-CC). 12. *Globigerina ciperoensis* (51X-CC). 13. *Paragloborotalia opima* (44X-CC). 14. *Globigerinatheka subconglobata* (54X-CC).

Plate P2. Representative Miocene to Pleistocene abyssal ostracods, Hole U1501C. 1. *Henryhowella* sp. (1H-CC). 2. *Legitimocythere* sp. (1H-CC). 3. *Krithe* sp. (3H-CC). 4. *Poseidonamicus* cf. *Poseidonamicus pintoi* Benson, 1972 (6H-CC). 5. *Pennyella* sp. (12H-CC). 6. *Cytheropteron* cf. *Cytheropteron uchioi* Hanai, 1957 (13H-CC). 7. *Bradleya* cf. *Bradleya metamorphica* Whatley et al. (14H-CC). 8. *Arcacythere* sp. (43X-CC).

Plate P3. Representative late Eocene shallow-water marine ostracods, Hole U1501D. 1. *Cytherelloidea* sp. C (4R-CC). 2. *Cytherelloidea* cf. *Cytherelloidea asatoensis* Nohara (4R-CC). 3. *Schizocythere*? sp. (4R-CC). 4. *Paijenborchella sinensis* (Liu, 1989) (4R-CC). 5. *Paranesidea* sp. (4R-CC). 6. *Coquimba* sp. (4R-CC).