Figure F1. Lithostratigraphy of Hole C0023A, showing major formations, and core observations used to constrain formation boundaries.

Figure F2. Sand unit, illustrating debris flow with graded bedding amalgamation of smaller turbidites at the top, Hole C0023A. Only the muddiest turbidites preserved internal structures, and most were fluidized during coring. Inset: Volcaniclastic gravel that includes pumice and other volcaniclastics with mineralized vesicles and phenocrysts.

Figure F3. Bar charts illustrating formation characteristics based on smear slide description, Site C0023. ATW = axial trench wedge, OTW = outer trench wedge, Trans = trench-to-basin transition, U Shik = upper Shikoku Basin, L Shik = lower Shikoku Basin. Left: Relative abundance of silt and sand. Right: Relative abundance of silt types. Q = quartz, F = feldspar, L = lithic, V = volcanic, M/C = mud and clay. Bottom: Fraction of each formation containing a given component.

Figure F4. Muddy turbidites, Hole C0023A.

Figure F5. Tuff bed, Hole C0023A. Lithology is cemented and hard. Fine tuff passes vertically into a bioturbated volcaniclastic mudstone and then into a tuff-bearing mudstone. At the base of the tuff, low-angle parallel lamination is present and the contact undulates slightly; in some beds there is evidence of scouring.

Figure F6. Thin section images of (A, B) volcaniclastic sandstone (C0023A-18R-CC, 22–25 cm; A: plane-polarized light [PPL], B: cross-polarized light [XPL]) and (C, D) tuff (39R-6, 4–8 cm; C: PPL, D: XPL). 7

Figure F7. Heavily bioturbated volcaniclastic mudstone in which original bedforms are lost and ash content redistributed by bioturbation, Hole C0023A.

Figure F8. Heavily indurated tuff that vertically passes upward into a bioturbated volcaniclastic mudstone, Hole C0023A.

Figure F9. Heavily bioturbated Shikoku Basin mudstone with burrows, shell fragments, and wispy green bentonite laminae, Hole C0023A.

Figure F10. Ichnofabrics found in Unit V similar to those found in Units III and IV except for red and green alteration colors, Hole C0023A.

Figure F11. Contact between Unit V and an underlying hyaloclastite deposit, Hole C0023A.

Figure F12. Thin section image of heavily chloritized basalt (C0023A-110R-4, 25–28 cm; XPL). Chlorite can be observed pseudomorphing after olivine and amphibole. Groundmass is plagioclase rich and contains both acicular blades of twined plagioclase and euhedral phenocrysts. Field of view (FOV) = 2 mm across.

Figure F13. Thin section image of heavily altered basalt (C0023A-111R-1, 28–38 cm; XPL). Groundmass is plagioclase rich and contains both acicular blades of twined plagioclase and euhedral phenocrysts as for basalt sample in Figure **F12**. Replacement includes clay minerals (saponite) pseudomorphing after olivine (yellow and low relief). FOV = 2 mm across.

Figure F14. Chloritized pillow basalt (C0023A-111R-1, 20–25 cm).

Figure F15. XRD profiles of 6 representative types of mudstone, Hole C0023A. Mineral compositions are superimposed to show each peak position. S = smectite, I = illite, Ch = chlorite, Q = quartz, A = anorthite, C = calcite, P = pyrite.

Figure F16. Relative abundances of total clay minerals, quartz, feldspar, and calcite in Hole C0023A based on XRD analysis of random oriented bulk powders (solid circles) compared with spot samples (open colored circles) and Leg 190 Hole 1174B (gray circles). Triangles = 21 mud rock samples from Hole 1174B remeasured on the *Chikyu* during Expedition 370.

Figure F17. XRF relative abundance of major element oxides compared to total number of visual core description (VCD) observations of given type, Hole C0023A. Dashed lines = lithostratigraphic unit boundaries, gray bar = décollement. LOI = loss on ignition.

Figure F18. Bedding and deformation structure dip angles as a function of depth, Hole C0023A.

Figure F19. Bedding dip examples. A. C0023A-24R-6, 106–116 cm (~492 mbsf). B. 97R-7, 23–36 cm (~1007 mbsf). C. 110R-3, 85–97 cm (~1101 mbsf). Note the variation of bedding dips (also refer to Figure **F18**).

Figure F20. Core-scale healed faults. (A, C) Core photograph and (B, D) X-ray CT image of a healed fault (A, B: C0023A-33R-5, 95–108 cm [~565 mbsf]; C, D: 36R-2, 67–78 cm [~585 mbsf]). Note that ash layers (red arrows; dark color in D), are cut by the healed fault, representing normal fault sense (split arrow).

Figure F21. Core photographs (left in each pair) and X-ray CT images (right in each pair) of first major fault zone in décollement zone (~758 mbsf), Hole C0023A. Marked intervals in section images (1–3) show locations of close-up photographs. 1–3. Although the shear zones are characterized by intense fragmentation in split core images (top), they are relatively intact and show jigsaw-puzzle structure in X-ray CT images (bottom).

Figure F22. (A) Close-up core photograph and (B) X-ray CT image of a damage zone apparently corresponding to base of décollement zone (C0023A-71R-3, 85–107 cm [796 mbsf]). Note that damage zone shows greenish color (mostly composed of smectite) and lower CT numbers.

Figure F23. Mineral veins observed. A. Calcite vein (C0023A-103R-6, 101–111 cm [~1068 mbsf]) representing crosscutting relationship to minor normal faults (split arrows): vein cut the normal faults and vice versa. B. Close-up core photograph of barite (red arrows) (104R-5, 60–71 cm [~1075 mbsf]). C, D. Barite vein developed along the normal fault (77R-2, 78–89 cm [~821 mbsf]; C: split surface, D: X-ray CT image).

Figure F24. A–C. X-ray CT images of crystallized minerals along faults (A: C0023A-56R-3, 29–33 cm [~727 mbsf], B: 82R-1, 19–31 cm [~852 mbsf], C: 79R-3, 99–101 cm [~832 mbsf]; top: vertical sections, bottom: conical sections). Lines = position of conical section, arrows = position and direction of fault surface. Note that A and B represent scattered mineralization of barite along normal faults, whereas C shows architecture of vein along fault. D. Core photograph of normal fault (101R-4, 30–39 cm [~1043 mbsf]). Slickenlines and steps representing normal fault sense were identified along the fault surface.

Figure F25. Occurrence of deformation bands. A. Mudstone (C0023A-7X-5, 135–140 cm [~311 mbsf]); top: photograph of split core surface, bottom: X-ray CT image. Deformation band corresponds to higher CT number, indicative that consolidation occurred along the band. B. Volcanic ash (35R-2, 32–45 cm [~575 mbsf]); top: photograph of split core surface, middle: PPL photomicrograph, bottom: crossed nicols. Arrows = position and direction of deformation band. No grain breakages occurred along the band.

Figure F26. Split core surface images, showing (A) sand dikes and (B) a hydrofracture (A: C0023A-24R-5, 51–61 cm [~489 mbsf], B: 100R-5, 35–46 cm [~1034 mbsf]). Arrows = position and direction of dikes and contact between hydrofractured material and the host rocks, respectively.

Figure F27. Downhole mineralization trends, Hole C0023A. CT number = ($[\mu_t - \mu_w]/\mu_w$) × 1000, where μ_t = linear attenuation coefficient (LAC) for the target material and μ_w = LAC for water.

Figure F28. Calcite and pyrite in early-stage diagenesis. A. Polycrystalline carbonate in smear slide (C0023A-22R-4, 61 cm; XPL). B. Framboidal pyrite (30R-2, 115–129 cm; SEM).

Figure F29. Core sections recovered from different mineralization zones. A. 5 cm long pyrite nodule (C0023A-36R-1, 63–68 cm). B. Green mineralization at décollement zone (71R-3). C. Green mineralization in zone of normal faulting below the décollement (108R-3). D. Red and yellow burrows filled with rhodochrosite (87R-5). E. Red clay above basement with magnetite, hematite, and goethite; green mineralization is also present (110R-4).

Figure F30. XRD data confirming the presence of (A) anhydrite and (B) rhodochrosite, Hole C0023A.

Figure F31. Vein and strata-bound sulfate mineralization. A. Barite crystals in a vein (C0023A-77R-2, 79–90 cm). B. Barite (white) in a burrow (87R-4, 6–7 cm; SEM [backscatter mode]).

Figure F32. Site summary diagram of X-ray CT images for Hole C0023A from 0 to 1200 mbsf. CT number = $([\mu_t - \mu_w]/\mu_w) \times 1000$, where μ_t = LAC for the target material and μ_w = LAC for water.

Figure F33. Comparison of Hole C0023A lithostratigraphic units to Sites 808 and 1174.

Figure F34. Downhole profile of magnetic intensity (after 20 mT demagnetization) in Hole C0023A compared to Holes 1174A and 1174B.

Figure F35. Paleomagnetic inclination and declination after 20 mT demagnetization, Hole C0023A. Intensity value: open circles = $1.0 \times 10^{-6} \sim 1.0 \times 10^{-3}$ A/m, solid circles = $1.0 \times 10^{-3} \sim 1.0$ A/m.

Figure F36. A, B. AF demagnetization of discrete samples. Solid circles = projection onto horizontal plane, open circles = projection onto either vertical *X-Z* or *Y-Z* planes.

Figure F37. A, B. AF demagnetization of discrete samples. Some samples do not show stable component. Solid circles = projection onto horizontal plane, open circles = projection onto either vertical *X-Z* or *Y-Z* planes.

Figure F38. MSCL-W measurements, Hole C0023A. A. GRA density. B. Magnetic susceptibility. C. NGR.

Figure F39. MAD measurements, Hole C0023A. A. Bulk density. B. Grain density. C. Porosity.

Figure F40. A. *P*-wave velocity, Hole C0023A. B. Anisotropy of *P*-wave velocity in the horizontal (*x*- and *y*-axes) and vertical (*z*-axis) planes. The horizontal plane anisotropy that compares velocity of *x*- and *y*-directions should average zero because cores are randomly rotated.

Figure F41. A. Apparent formation factor, Hole C0023A. Carbonate concretion at 931 mbsf and basaltic rock at 1127 mbsf exhibit a formation factor of ~70 and ~155, respectively, and are not shown. 4 pin = determined on working half sections along the *y*-direction with a 4-pin electrode. B. Anisotropy of formation factor in the horizontal (*x*- and *y*-axes) and vertical (*z*-axis) planes.

Figure F42. Thermal conductivity, Hole C0023A.

Figure F43. Temperatures obtained in situ by APCT-3 measurements during short HPCS coring, Hole C0023A. Least-squares fit yields an average thermal gradient of 111°C/km and intercept temperature of 8.5°C at the seafloor. Circles = temperature data used for calculating thermal gradient and heat flow, crosses = poor quality temperature data (see Table **T11**).

Figure F44. Temperatures projected to the bottom of Hole C0023A, using estimated heat flow of 140 mW/m^2 and measured thermal conductivity data. Estimated temperatures at top of the décollement and bottom of hole are 86° and 120°C, respectively. Circles = measured temperatures.

Figure F45. Volume of IW recovered from WRCs, Hole C0023A. Data not corrected for squeezing time and applied force.

Figure F46. Major cations, Cl^-, and salinity (calculated from refractive index), Hole C0023A (black circles). Gray circles = data for Site 1174 (Shipboard Scientific Party, 2001b). Site 1174 data were clipped off at 25 and 10 mM for Mg^+ and K^+, respectively.

Figure F47. IW composition (sulfate, sulfide, alkalinity, dissolved inorganic carbon [DIC], and ammonium), Hole C0023A (black circles). Green diamonds = methane data from **Organic geochemistry** and were clipped at 10 mM here, gray circles = Site 1174 data. SO_4^{2-} and alkalinity data were clipped at 10 and 30 mM, respectively. Last plot: close-up of Site C0023 ammonium profile, showing slight offsets at lithostratigraphic boundaries.

Figure F48. Minor cations in IW determined by inductively coupled plasma–atomic emission spectrometry (ICP-AES) analyses (black circles), Hole C0023A. Orange circles = Fe^{2+} determined photospectrometrically.

Figure F49. Downhole hydrogen and carbon monoxide concentrations measured in interior WRC samples, Hole C0023A. DL = detection limit.

Figure F50. Downhole hydrogen and carbon monoxide concentrations measured in liner fluid and interior and exterior WRC samples, Hole C0023A.

Figure F51. Solid phase contents of $CaCO_3$, TOC, TS, TN, and corresponding TOC/N ratios. Red = Hole C0023A data, gray = adjacent Site 1174 data (Shipboard Scientific Party, 2001b).

Figure F52. Mole fraction of hydrocarbon gases in headspace gas samples from Sites C0023 (see also Table **T7**), 808 (Shipboard Scientific Party, 1991), and 1174 (Shipboard Scientific Party, 2001b).

Figure F53. Concentrations of dissolved hydrocarbon gases, Hole C0023A. Data are from samples taken directly from the core catcher (HS) and gas voids (VAC) in core cutting area and from COMGAS WRC slices (370HS) taken on core processing deck. C_1 from headspace analyses of safety gas samples (HS) taken in core cutting area immediately after arrival on catwalk is also shown. All data are from Table **T22**.

Figure F54. Methane/ethane (C_1/C_2) molar ratios vs. temperature, Hole C0023A. In situ temperatures were adopted from Figure **F44**. The underlying diagram was modified from Pimmel and Claypool (2001).

Figure F55. Depth profiles of dissolved sulfate concentrations (see **Inorganic geochemistry** and Figure **F47**), dissolved methane concentrations, and C_1/C_2 molar ratios, Hole C0023A. Hydrocarbon gas data are from core catcher headspace samples (HS) and vacutainer samples from gas voids (VAC) taken in core cutting area and from headspace sample COMGAS WRC slices (370HS) taken on core processing deck. Hole C0023A measured (APCT-3) and estimated in situ temperatures were adopted from Figure **F44**. Site 1174 C_1/C_2 depth profile is shown for comparison (Shipboard Scientific Party, 2001b).

Figure F56. Monitoring of airborne contamination potential during microbiology sample processing on the *Chikyu* core processing deck, particle counts in 0.3 µm size fraction during coring operations of Expedition 370. Top: Clean bench with air filtration system and ionizer compared to microbiology laboratory. Bottom: Anaerobic chamber with air filtration system and ionizer compared to core processing laboratory. Blue = laboratory air, red = clean bench or anaerobic chamber air, gray diamonds (*x*-axes) = time of "core on deck."

Figure F57. PFC tracer concentrations in core liner fluid (LCL) sampled in Falcon tubes (FAL-L) and headspace vials (CCA-L) when Hole C0023A cores were cut into sections in the *Chikyu* core cutting area. Open diamonds = FAL-L samples, solid diamonds = CCA-L samples, blue = highest values recorded per core when multiple FAL-L or CCA-L samples were collected from different sections of same core, gray = duplicate samples from same core with lower PFC concentrations, red line = assumed minimal PFC concentration supplied into the system (0.084 mg/L) as calculated based on PFC dosing rate and maximum drilling fluid pumping rate, black line = saturation of PFC in water (1.8 mg/L) (value assumed as maximum PFC concentration present).

Figure F58. Concentrations of PFC tracer sampled along cross sections of sediment cores (shown in inset) in relation to distance from core margin. Dashed line = limit of quantification (LOQ) defined by lowest concentration in calibration curve. Blue crosses = median of the measurements. The corresponding data are reported in Table **T27**.

Figure F59. Impact of core quality on contamination of drilling cores with drilling fluid during Expedition 370. X-ray CT-images and PFC concentrations along cross sections are shown for WRCs taken from a section with microfractures (red) and an undisturbed section (blue). Presence of fractures within 23R-5 is clearly correlated with a higher PFC concentration further into core interior (i.e., present in MD sample). A PFC concentration below the LOQ at a similar radial depth (MD) in 78R-2 is consistent with the absence of apparent fractures in the X-ray CT image.

Figure F60. Preliminary cell count data obtained during Expedition 370, Hole C0023A. Cell counts will be reevaluated postcruise in light of QC assessments and uncertainty analysis. BD = below detection (red dashed line).

Figure F61. Transmission electron micrographs of microorganisms separated and sorted from C0023A-6F-2.

Figure F62. Phylum-level microbial composition of sediments, Site C0023. Hypervariable Region V3–V4 of 16S rRNA gene was amplified and sequenced by MiSeq sequencing. In total, 10,327,751 sequences were obtained from 115 sediment samples (for detailed sample information, see Table **T29**).