Shipley, T.H., Ogawa, Y., Blum, P., et al., 1995
Proceedings of the Ocean Drilling Program, Initial Reports, Vol. 156

5. SITE 947[1]

Shipboard Scientific Party[2]

HOLE 947A

Date occupied: 28 May 1994

Date departed: 30 May 1994

Time on hole: 2 days, 1 hr, 15 min

Position: 15°31.477′N, 58°44.875′W

Bottom felt (drill-pipe measurement from rig floor, m): 4891.0

Distance between rig floor and sea level (m): 10.6

Water depth (drill-pipe measurement from sea level, m): 4880.4

Total depth (from rig floor, m): 5475.0

Penetration (m): 584.0

Total core recovered (m): 0

Logged (mbsf): 0–574

Comments: Dedicated for logging-while-drilling. No coring done.

Principal results: The northern Barbados Ridge drilling program focuses on the décollement: its physical, chemical, and acoustic properties. Leg 156 benefits from substantial previous geological and geophysical investigations, including DSDP Leg 78A and ODP Leg 110. Site 947 was positioned, in part, to explore the high-amplitude negative-polarity fault reflection for comparison to the seismic character at Site 948, where the décollement exhibits positive polarity. For the first time in the history of ODP, we deployed a logging-while-drilling (LWD) system. This logging system was necessary because hole instability had prevented wireline logging during both Legs 78A and 110. The LWD program at Hole 947A obtained logs from the seafloor to 574 mbsf. Drilling conditions stopped the LWD about 60 m above the seismically identified décollement after drilling through a fault splay.

The principal results at this site are from interpretation of the logging data. The primary logs include dual resistivity with natural gamma-ray spectroscopy and compensated density-neutron. Consistency and quality-control parameters show that the density and resistivity logs are very reliable. Because of the high rates of penetration, the total gamma-ray counts are of good quality, but the spectral data are not. Neutron porosity logs are noisy and show significantly higher values than those calculated from the density log. Without cores, the logging data interpretations use "electrofacies" (boundaries, internal shape, and log character). Seven identified log "units" define subtle depositional variations and commonly have sharp boundaries related to compaction trend offsets. Four primary intervals having a downhole decrease in density relate to two different processes. Two intervals may result from discrete thrust packages that bring higher density sections over lower density ones, given the sharp nature of the boundaries. Two other intervals are more diffuse at their boundaries and could result from natural lithologic variations or faulting. Whether the result of faulting or lithologic variations, the density trend reversals indicate the elevated pore pressures necessary to arrest compaction.

Near the base of the hole, density decreases to low values, which, when using Site 671 grain densities, yields a porosity of 70%, essentially the same value found at the surface and at the incipient décollement at Site 672. The high porosity at this depth must be supported by high fluid pressures. These high fluid pressures and undercompaction may explain our difficulty in drilling 60 to 80 m above the décollement.

We planned to return to Site 947 after completing Site 948 to core, obtain wireline logs, and conduct vertical seismic profiling (VSP), packer, and borehole seal (CORK) experiments. Unfortunately, after completion of Site 948, we had insufficient time to return and complete the operational and experimental program. In its place, Site 949 examines a similar objective at a shallower sub-bottom depth. Thus, for now, Site 947 consists of logs and no cores, an unusual event in scientific ocean drilling.

BACKGROUND AND SCIENTIFIC OBJECTIVES

The northern Barbados Ridge accretionary prism was sampled during DSDP Leg 78A (Biju-Duval, Moore, et al., 1984) and ODP Leg 110 (Mascle, Moore, et al., 1988; Moore, Mascle, et al., 1990). Our goal was to use this previous work as a guide for more specific studies of the relationship of fluids, structures, and physical properties at the décollement. The site is about 1 km east of the outcrop of the first major north-northeast-trending, out-of-sequence thrust, 6 km west of the trench thrust front and about 1.8 km to the west of Site 671 (Figs. 1 and 2). At Site 671, during Leg 110, drilling was successful to 691 m, which included the 40-m-thick fault and 151 m into the underthrust section. The 500-m-thick prism is lower Miocene to lower Pleistocene offscraped hemipelagic mud-mudstone, calcareous mud-mudstone, and marl-marlstone. Paleontologic and structural analyses documented large-scale overthrusting. Small-scale deformation was evident by steep dips and folding, pervasive scaly fabric, and stratal disruptions characteristic of shear bands. Bedding dips of less than about 20° were limited to the underthrust section. The section thrust beneath the prism and décollement is mostly Oligocene claystones and mudstones, with the hole bottoming in a fine-grained sand. Evidence from this site, along with other sites drilled on the lower part of the trench slope, relate anomalous temperature and fluid concentration profiles to active fluid flow.

The specific location for Site 947 was chosen because of the nature of the décollement in the seismic reflection data. In a three-dimensional seismic survey, the fault is a discrete seismic reflection that is commonly a compound-negative-polarity waveform, modeled as a thick fault zone of low impedance (Shipley et al., 1994). Thus, in part, Site 947 was planned to explore the negative-polarity fault reflection for comparison to the seismic character at Site 671, where the fault exhibits positive polarity. Areas such as Site 671 that have normal-polarity waveforms may represent increasing impedance with depth.

We deployed for the first time in ODP history the logging-while-drilling system. This logging system was chosen because of the failure of wireline logging during both Legs 78A and 110 from hole instability and because of similar wireline-logging experiences in other accretionary prisms. With the LWD program at Hole 947A we obtained logs from the seafloor to about 574 mbsf. The LWD system stopped about 60 m above the seismically identified décollement in a fault splay. After completing Site 948, we had planned to return to Site 947 to core, to obtain wireline logs, and to conduct VSP, packer, and

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[1] Shipley, T.H., Ogawa, Y., Blum, P., et al., 1995. *Proc. ODP, Init. Repts.,* 156: College Station, TX (Ocean Drilling Program).

[2] Shipboard Scientific Party is as given in list of participants preceding the contents.

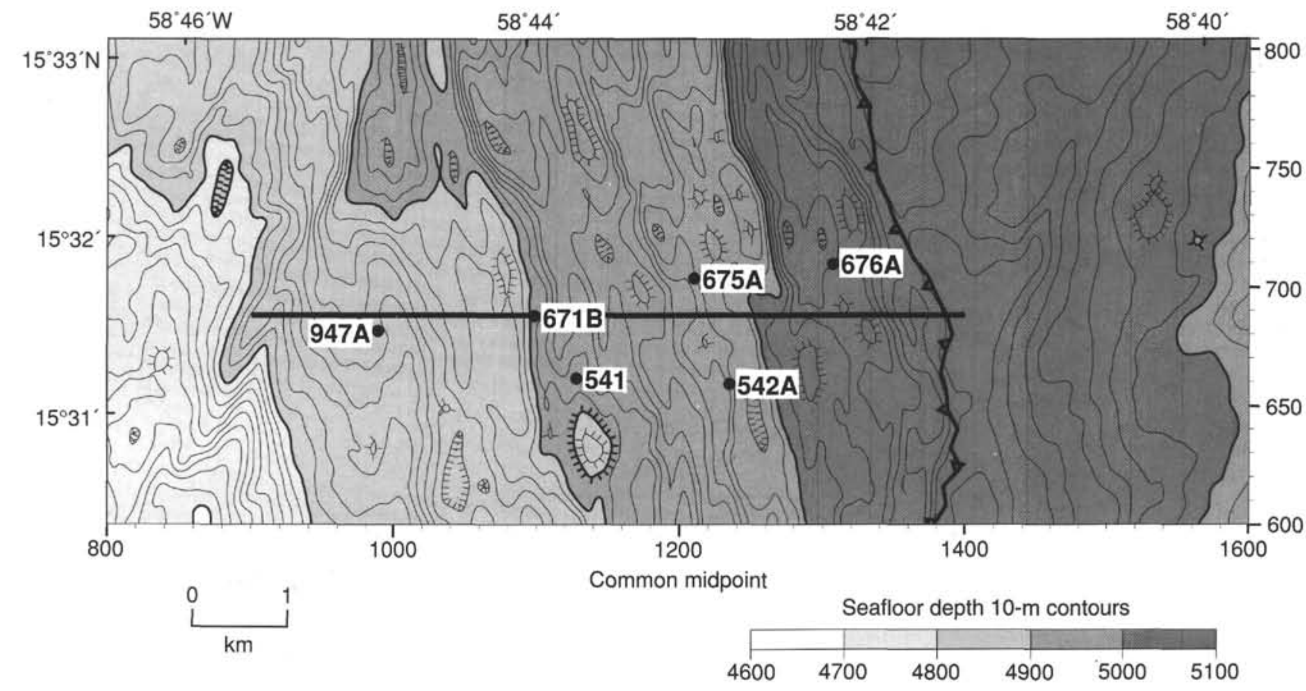

Figure 1. Location map showing the area around the drill site. Bathymetry based on digitizing the three-dimensional seismic data and assuming a water velocity of 1500 m/s. The frontal thrust (barbed line) and DSDP and other drill sites are shown. The black line locates the seismic section shown in Figure 2.

CORK experiments. Unfortunately, after completion of Site 948, we had insufficient time to return, and thus chose to explore these same objectives at Site 949.

OPERATIONS

Barbados Port Call

Leg 156 began at Bridgetown Harbor, Barbados, on 24 May 1994. The port call entailed a heavy logistical workload, with the loading of casing and other major supplies for the hardware-intensive Leg 156 drilling program. Special drilling hardware loaded for Leg 156 included 215 joints of 10¾- and 13⅜-in. casing; mud motors; underreamers; a reentry cone assembly; three instrumented borehole seal (CORK) assemblies; three submersible vehicle landing platforms; LWD tools; and various drill collars, casing hangers, and casing-handling equipment. Other work items related to the Leg 156 scientific program included the installation and America Bureau of Shipping (ABS) inspection of an auxiliary explosives magazine and pressure-testing of the mud recirculation and shearing piping.

We departed from Barbados at 2300 (local time) on 27 May.

Bridgetown to Site 947

Leg 156 operations were in a small area on the northern Barbados Ridge, about 260 km north-northeast of the northern tip of Barbados and 240 km east-northeast of the island of Martinique. The transit of about 315 km was made at an average speed of 21.7 km/hr (11.7 kt). After the ship had navigated to a waypoint about 9 km east of the operating area, a turn to the west was made and speed was reduced for precision navigation across the three proposed drill sites. Positioning beacons were launched, in order, as the positions of proposed site NBR-1, Site 948 (NBR-2), and Site 947 (NBR-3) were crossed. That approach was taken to minimize site-location time and to expedite the drilling of a transect of holes dedicated to LWD logging. No seismic gear had been streamed; thus, the vessel was able to turn quickly and to take up a station on the beacon at NBR-3 (Hole 947A), which was dropped at 1445 hr on 28 May.

Site 947

The first LWD log was run on the westernmost site of the transect, which was located on the thicker portion of the accretionary prism and was suspected to have high pore-fluid pressures at depth.

A bottom-hole assembly (BHA) composed of the LWD tool string, all new drill collars, and a new drilling jar was assembled to begin the pipe trip. Progress was relatively slow because of the standard practices of measuring and passing a drift through the drill string on the initial pipe trip of an ODP leg. A float valve was installed above the bit, making it necessary to stop the trip on several occasions to fill the pipe.

Shortly after the pipe trip began, the acoustic release of the positioning beacon was activated by the pulses of the precision depth recorder (PDR), while a check was made of water depth. A backup beacon was launched immediately to prevent loss of position. The original beacon eventually was recovered by carefully maneuvering the ship without interruption of the trip. Recovery operations and subsequent positioning were complicated by the presence of a strong southwest-to-northeast surface current—the explanation for the exceptional transit speed.

After the top drive was deployed, the Anadrill depth-tracking system was calibrated vs. block travel and circulating pressure was recorded for varying pump rates. The bit then was lowered without rotation or circulation to "feel for bottom." Contact with the seafloor was registered by the rig weight indicator at 4891 m from the driller's datum (dual elevator stool, or DES). The drill-pipe measurement was 7 m deeper than the PDR reading of 4884 m.

Drilling then proceeded with only some minor problems associated with depth control on a floating platform. In the soft upper sediments, the rate of penetration (ROP) was faster than optimum for data density, but the high rate was necessary to keep the bit in contact with the bottom of the hole and to maintain depth control. Below about 70 mbsf, the sediment firmed and the desired ROP of 60 m/hr was maintained well to total depth.

Though no hole-cleaning problems were experienced, the hole was swept with sepiolite "pills" each 100 m, beginning at 300 mbsf. Elevated circulating pressure and torque after a connection at 555 mbsf

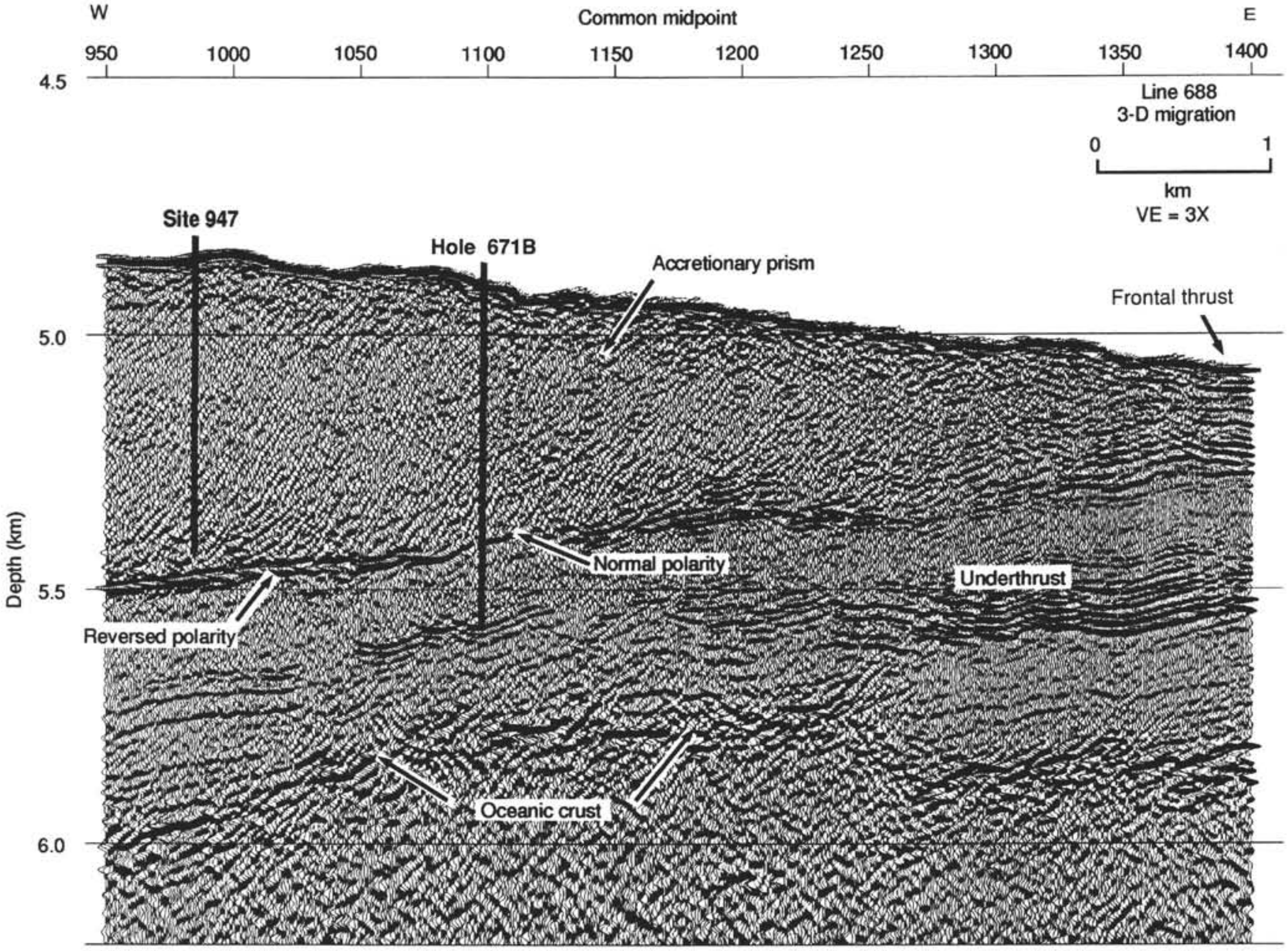

Figure 2. Seismic section illustrates reflection characteristics of the décollement. Section was converted to depth using a velocity function derived from Site 671 (Shipley et al., 1994). At Site 671, velocities used were 1740 and 1799 m/s for the prism and underthrust section, respectively. At Site 947, the prism velocity used in the depth conversion was 1777 m/s and the velocity in the underthrust section 1811 m/s. Section gain was equalized with a 500-ms symmetric moving window. VE = vertical exaggeration.

were the first signs of hole problems. A sepiolite pill was circulated while the ensuing two joints were drilled to 574 mbsf, but it was ineffective in reducing either pressure or torque. An additional connection was made, but the pipe became stuck in the process. After a few minutes of working the pipe, it was freed by a single blow of the drilling jar. Torque returned to near normal, but continued high circulating pressure indicated that the annulus had packed off and that circulation was into the formation. That indication was supported when additional mud sweeps failed to alleviate the situation. An attempt was made to drill down the last joint of pipe in the string, but penetration was halted at 583.7 mbsf by hydraulic resistance and high torque. A short trip then was made up into stable hole at 525 mbsf and then back to about 540 mbsf, where increased circulating pressure again was noted. Attempts to ream the apparently constricted hole and to regain normal drilling parameters were unsuccessful, despite mud sweeps and repeated passes of the bit through the interval.

A repeat section of the LWD log then was made by back-reaming the hole section from 554 to 496 mbsf at a rate of 60 m/hr before the top drive was racked and the pipe was tripped. Because the unstable zone was identified as a thrust fault well above the décollement, we did not consider it necessary to plug the hole. When the LWD tools reached the surface, the radioactive source was removed and the log data downloaded to a laptop computer. The drill bit cleared the rig floor at 1600 hr on 30 May.

DOWNHOLE LOGGING

Site 947 was explored solely by logging-while-drilling with the compensated dual resistivity (CDR) plus natural gamma-ray spectroscopy and compensated density-neutron (CDN) LWD tools (see "Explanatory Notes" chapter, this volume). We collected LWD logs from the seafloor to 574 mbsf, where hole conditions precluded further logging.

The hole was spudded at 4880.4 mbsl (4891 mbrf). Observed ship's heave was about 1 m on the rig floor. Below 100 mbsf, the average penetration rate ranged between 50 and 105 m/hr. In response to sticking of the bottom hole assembly at 570.5 mbsf, we back-reamed to 562 mbsf; as sticking persisted, we back-reamed to 557 mbsf. Hole conditions continued to deteriorate, and the drill pipe became stuck at 570 mbsf. The drill pipe was jarred free, and drilling continued. At a total depth of 584 mbsf, circulation was lost and the cumulative hole problems caused us to end drilling operations. A repeat section was obtained while back-reaming to 534 mbsf. The total time for LWD operations for Hole 947A was 48 hr.

Quality of Data

The consistency and an internal quality-control parameter ($\Delta\rho$) suggest that the density, photoelectric, and resistivity logs are reliable.

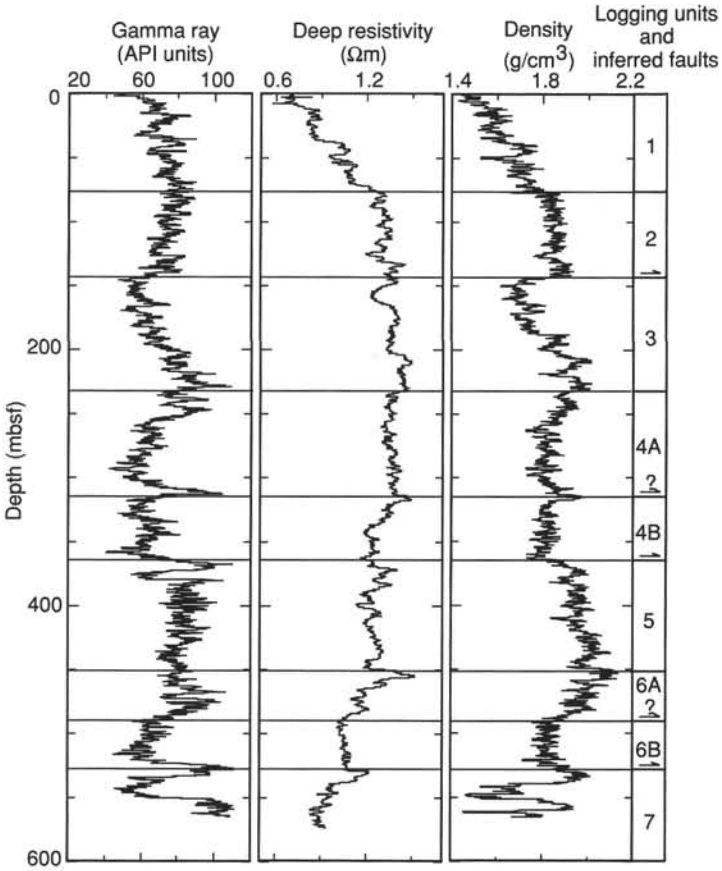

Figure 3. Plots of gamma-ray, resistivity, and bulk-density logs, showing log unit divisions and interpreted faults.

While total gamma-ray counts seem reliable, their component spectral data are not because the rate of penetration was higher than optimum. Intermittent problems with one of four neutron detectors affected the upper 80 m of the log; neutron porosity plots are noisy and show significantly higher values than porosity calculated from the density log. Accordingly, we have not used neutron porosity in our preliminary analyses. Further post–Leg 156 data quality control and depth shifting have been conducted at Schlumberger/Anadrill in Houston and the Borehole Research Group at Lamont-Doherty Earth Observatory.

Characterization of Logging Units

Although Site 947 was not cored, the high-quality LWD logs and information from adjacent sites allow for specification of seven logging units. We depict the "physical stratigraphy" by analyzing the electrofacies (boundaries, internal shape, and log character). Sharp changes in log characteristics mark the boundaries of all of the logging units (Fig. 3). Electrofacies and log shape are also used to infer possible sedimentary or tectonic features within the drilled interval.

Logging Unit 1 (0–78 mbsf)

This logging unit displays interlayering characterized in this case by the recurrent sequences (5–10 m) of gradual variations more evident in natural gamma-ray radioactivity (Fig. 3). The sequences may represent alternation of clay interlayered with clay mixed with carbonate or ash. A normal compaction trend appears as a systematic increase in density.

Logging Unit 2 (78–140 mbsf)

The spiky character of the natural gamma-ray radioactivity, density, and resistivity logs indicates that this unit comprises meter-scale interbeds. The spiky log character may also reflect slight changes in mineral composition of the clays. The density of logging Unit 2 is relatively high and uniform, suggesting overcompaction relative to the basinal sequence at Site 672, 6.8 km east of the deformation front (Figs. 3 and 4).

Logging Unit 3 (140–238 mbsf)

Downsection increases in gamma-ray and density values indicate a normal compaction trend and perhaps increasing clay content. This change occurs over five 10-m sequences showing gradual (increasing and decreasing) variations in radioactivity, bulk density, and resistivity (Fig. 3). These sequences display sharp upper and lower boundaries and are interpreted as depositional features. The electrofacies in logging Unit 3 is similar to that of logging Unit 1, perhaps the result of repetition by faulting.

Logging Unit 4 (238–362 mbsf)

The response of logging Unit 4 suggests a relatively homogeneous lithology with gradual changes reflected by increasing and decreasing radioactivity and bulk density. Resistivity displays only slight variations. These variations probably reflect slight changes in composition within dominantly clayey sediment. High gamma-ray and bulk-density values characterize the uppermost part of this unit (238–264 mbsf).

A striking interval of high radioactivity, resistivity, and density occurs at about 318 mbsf, separating logging Subunits 4A and 4B. This "hard streak" does not mark major changes in lithology or facies. The hard streak may represent a volcaniclastic layer, an unconformity, or a fault zone. The absence of well-defined boundaries supports its interpretation as a fault zone. The similarity in log response above and below this hard streak is consistent with repetition by faulting.

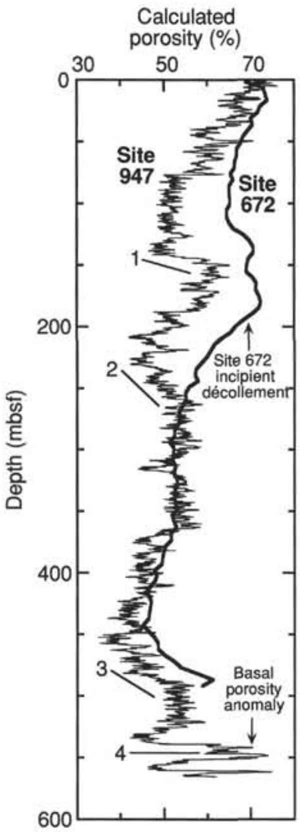

Figure 4. Site 947 porosity calculated from bulk-density using mean grain density of 2.73 g/cm^3 from Site 671 (Shipboard Scientific Party, 1988a). The Site 672 porosity curve is smoothed from discrete sample measurements from cores (Shipboard Scientific Party, 1988b). Because Site 672 is located on the abyssal plain, it shows the variation inherent in the incoming sedimentary section. The entire section at Site 947 was probably created by structural repetition of the sediment above incipient décollement at Site 672. Thus, only the upper portion of the porosity curve from Site 672 should be compared to the Site 947 curve. Values of porosity below the incipient décollement at Site 672 are included for completeness. The pointers labeled 1 through 4 indicate reversals in compaction trends.

Logging Unit 5 (362–450 mbsf)

Logging Unit 5 is characterized by a sharp increase in natural radioactivity, bulk density, and resistivity values, relative to logging Unit 4. This abrupt change in log response may represent a fault. The decrease in the natural gamma-ray, bulk-density, and resistivity values at 385 to 389 m may result from a transition to coarser grained material or to a local band of deformation. The lowermost part of logging Unit 5 (405–450 mbsf) is homogeneous, and the density curve may reflect gradual changes in compaction state with depth over the whole unit. Toward the base of the logging unit (443–448 mbsf) a slight increase in natural radioactivity accompanied by decreases in resistivity and density might correspond to either a lithologic change (e.g., clay-rich interval) or to a higher porosity zone (e.g., fault zone).

Logging Unit 6 (450–525 mbsf)

Within this logging unit two logging subunits are identified which are characterized by a gradual transition in physical properties recorded by the logs (Subunit 6A) and an interval of homogeneous physical properties (Subunit 6B). In logging Subunit 6A, the downsection decrease in natural gamma-ray, density, and resistivity values may correspond to a gradual decrease in potassium-rich minerals (including clay), perhaps replaced by carbonate or siliciclastic minerals. Alternatively, this log response could reflect increasing porosity with depth. In logging Subunit 6B, natural gamma-ray values decrease with depth, while no major change is recognized in the density and resistivity logs in logging Subunit 6B.

Logging Unit 7 (525–570 mbsf)

Logging Unit 7 shows a change from an upper interval (525–535 mbsf) with relatively high natural gamma-ray radioactivity, resistivity, and bulk density, to an interval (530–550 mbsf) of low natural gamma-ray radioactivity, low bulk density, and low resistivity. Below 550 mbsf, density and gamma-ray intensity increase again, suggesting a lower porosity interval. Thus, logging Unit 7 comprises a high-porosity zone flanked by intervals of lower porosity. The upper boundary of this unit is interpreted as a thrust plane.

Discussion and Correlation of Log Units

The sharp boundaries between many of the logging units and their adjacent petrophysical properties suggest fault contacts (Figs. 3 and 4). A fault may also occur between Subunits 4A and 4B. Total gamma-ray, bulk-density, and resistivity data indicate that the sedimentary deposits at Site 947 are mainly clays. Variations in log character, other than faults, are probably related to compositional changes. Silty, sandy, or carbonate-rich clays and claystones probably occur where natural gamma-ray values are low and bulk-density values are high. No sand-sandstone or carbonate beds can be positively identified from log characteristics.

The spiky variations of density-log values, Units/Subunits 1, 3, 4A, 5, and 6A, may be similar to the carbonate and ash-bearing portions of the upper 360 m of Site 671 (Shipboard Scientific Party, 1988a). Logging Unit 2 and Subunits 4B and 6B show a uniformity in density values similar to that observed in the clay-rich section 400 to 500 mbsf at Site 948.

Compaction Trends

Normally pressured homogeneous sedimentary sections show a systematic decrease in porosity and increase in bulk density with depth. Reversals in this normal porosity trend indicate undercompaction and overpressure (Serra, 1986). Because the LWD bulk-density log is of very high quality and mean grain density (2.73 Mg/m^3) is known from Site 671, bulk density can be used to calculate porosity. The density and calculated porosity logs provide a sound basis for interpreting compaction trends qualitatively.

The density and calculated porosity curves for Site 947 show reversals in the normal compaction trends beginning at 140, 225, 450, and 535 mbsf (labeled 1 through 4, respectively, in Fig. 4). Reversals 1 and 4 are very sharp and probably represent thrust faults that emplace originally more deeply buried material over less compacted sediment. The sharpness of the discontinuities indicates lack of drainage, probably due to the low permeability of the sediment overall (Taylor and Leonard, 1990) and the recent nature of the deformation. Reversals 2 and 3 are less sharp than 1 and 4 and could result from changes in porosity resulting from lithologic variations. Comparisons of the porosity-depth variations from Leg 110 Site 672 support this hypothesis (Shipboard Scientific Party, 1988b) (Fig. 4). Part of the changes in compaction state in reversals 2 and 3 could also be the result of distributed faulting and/or a sufficient time to permit drainage since thrust faulting.

The compaction trend reversal at 540 to 560 mbsf reaches a maximum porosity exceeding 70%, comparable to porosity within a few meters of the seafloor at this site and similar to the porosity in a clay-rich unit just above the incipient décollement at Site 672 (Fig. 4). The very high porosity at this depth probably reflects high fluid pressures, perhaps approaching lithostatic values. Drilling difficulties, including sticking and plugging in this high-porosity interval, are consistent with

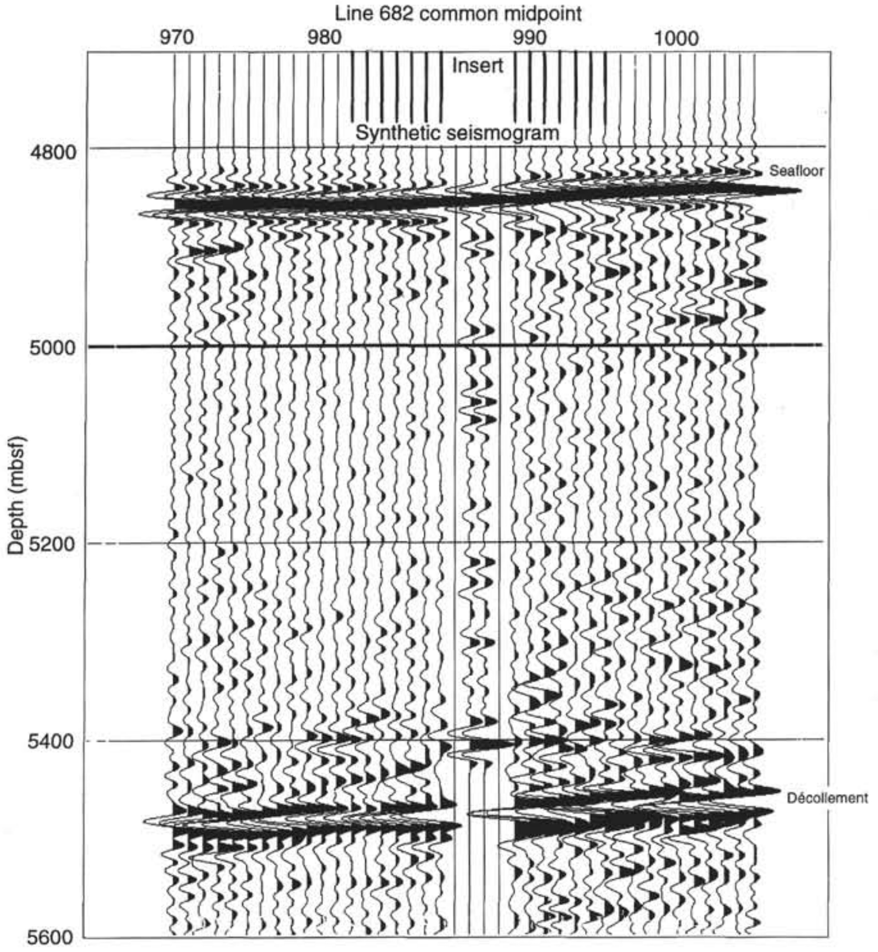

Figure 5. Synthetic seismogram inserted in seismic Line 682. Note that the large change in physical properties at the base of the cored hole corresponds to a highly reflective section that extends up about 80 m from the décollement. The synthetic seismogram extends only to the maximum depth of logging, well above the décollement.

this hypothesis. We interpret this high-porosity zone as an interval of clay-rich sediment whose porosity has been maintained by rapid loading, impeded drainage, and perhaps a continuing supply of fluid leaking from the subjacent décollement. As this high-porosity zone is within 60 to 80 m above the décollement, it may be a thrust splay of this basal detachment surface.

Synthetic Seismogram

We created a synthetic seismogram (Fig. 5) from the LWD density log and a linearly increasing velocity function. The resulting acoustic impedance log was convolved with the source wavelet extracted from the three-dimensional seismic data set, as described by Shipley et al. (1994). The synthetic seismogram extends only to the depth of the logged section and does not reach the décollement. To compare these reflections to the three-dimensional seismic reflection data, we shifted the synthetic seismogram to align the seafloor reflection with the same reflection on three-dimensional Line 682 at common midpoint (CMP) 988. The synthetic trace was duplicated and inserted into the seismic section for comparison with observed traces (Fig. 5).

The high-amplitude reflections at the base of the synthetic seismogram are generated by the large density changes associated with the basal porosity anomaly (Figs. 4 and 5). This physical-property anomaly stopped drilling about 60 m above the décollement at Site 947. The reflection in the synthetic section matches high-amplitude reflections at about 5400 mbsl on seismic Line 682 and may represent a fault splaying from the décollement. Other isolated reflections in the synthetic seismogram are correlated with westward-dipping reflections on seismic Line 682 and are probably reflections from thrust faults. In particular, density reversal 1 (Fig. 4) may be a fault that generated a discrete reflection on the synthetic, which may correlate with reflections to the west at about 4980 mbsl on seismic Line 682.

SUMMARY AND CONCLUSIONS

Site 947 was positioned, in part, to explore the high-amplitude negative-polarity fault reflection for comparison to the seismic character at Site 948, where the décollement exhibits positive polarity. For the first time in the history of ODP we deployed a logging-while-drilling system. We used this logging system because hole instability prevented wireline logging on both Leg 78A and Leg 110. The LWD program in Hole 947A obtained logs from the seafloor to 574 mbsf. Drilling conditions stopped the LWD about 60 m above the seismically identified décollement after drilling through a fault splay. Interpretation of the logging data is the basis for the principal results of this site. The geologic section at Site 947 should be similar to the drilled section at Site 671 about 1700 m to the east. However, structural dip is so steep that few sections above the décollement are structurally connected between the sites (see Moore et al., this volume).

In the absence of cores, seven "electrofacies" were defined. These relate to subtle depositional variations and usually have sharp boundaries from compaction trend offsets. Four primary intervals having downhole decreases in density result either from discrete thrust packages bringing higher density sections over lower density ones or from natural lithologic variations such as those observed at Site 672 on the oceanic plate east of the thrust front. Whatever the case, the log trends are more evidence for partially elevated pore pressures which slowed the compaction process.

Near the base of the hole the porosity is about the same as at the seafloor, 70%. This high porosity at about 550 mbsf must be supported by high fluid pressures. High fluid pressures and undercompaction may explain our difficulty in drilling ahead the 60 m into the décollement.

Site 947, our number one objective for Leg 156, was centered on a bright negative-polarity seismic reflection. The plan involved using the triple casing string and very heavy muds to keep the formation open long enough to set the final casing string. Unfortunately we did not have time and we depleted our heavy-mud supply earlier at Hole 948C. We did have an operational plan that should have allowed us to successfully core and case through the décollement, or at least into it with our packer and CORK. Site 949 was chosen instead to explore the same objectives where the seismic reflection is not so bright and is closer to the seafloor. So for now, Site 947 consists of logs and no cores, an unusual event in scientific ocean drilling.

REFERENCES*

Biju-Duval, B., Moore, J.C., et al., 1984. *Init. Repts. DSDP,* 78A: Washington (U.S. Govt. Printing Office).

Mascle, A., Moore, J.C., et al., 1988. *Proc. ODP, Init. Repts.,* 110: College Station, TX (Ocean Drilling Program).

Moore, J.C., Mascle, A., et al., 1990. *Proc. ODP, Sci. Results,* 110: College Station, TX (Ocean Drilling Program).

Serra, O., 1986. *Fundamentals of Well Log Interpretation* (Vol. 2): *The Interpretation of Logging Data:* Amsterdam (Elsevier).

Shipboard Scientific Party, 1988a. Site 671. *In* Mascle A., Moore, J.C., et al., *Proc. ODP, Init. Repts.,* 110: College Station, TX (Ocean Drilling Program), 67–204.

————, 1988b. Site 672. *In* Mascle A., Moore, J.C., et al., *Proc. ODP, Init. Repts.,* 110: College Station, TX (Ocean Drilling Program), 204–310.

Shipley, T.H., Moore, G.F., Bangs, N.L., Moore, J.C., and Stoffa, P.L., 1994. Seismically inferred dilatancy distribution, northern Barbados Ridge décollement: implications for fluid migration and fault strength. *Geology,* 22:411–414.

Taylor, E., and Leonard, J., 1990. Sediment consolidation and permeability at the Barbados forearc. *In* Moore, J.C., Mascle, A., et al., *Proc. ODP, Sci. Results,* 110: College Station, TX (Ocean Drilling Program), 289–308.

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* Abbreviations for names of organizations and publication titles in ODP reference lists follow the style given in *Chemical Abstracts Service Source Index* (published by American Chemical Society).

Ms 156IR-105

NOTE: LWD logs for Site 947 are presented on CD-ROM (back pocket).

SHORE-BASED LOG PROCESSING

Hole 947A

Bottom felt: 4891 mbrf
Total penetration: 584 mbsf

Logging Runs

Logging string 1: CDR/CDN

These logs were recorded using the LWD (logging-while-drilling) tools. The LWD employs tools that differ from the standard wireline logging tools (see "Downhole Logging" section, "Explanatory Notes" chapter, this volume). The following tracks are presented:

CDR = compensated dual resistivity
CDN = compensated density-neutron
R_{ad} = deep resistivity (m)
R_{ps} = shallow resistivity (m)
ROP = rate of penetration (ft/hr)

Processing

Depth shift: The LWD data have been shifted to reference the seafloor datum.

Note: Details on LWD can be found in the "Explanatory Notes" chapter, this volume. For further information about the logs, please contact:

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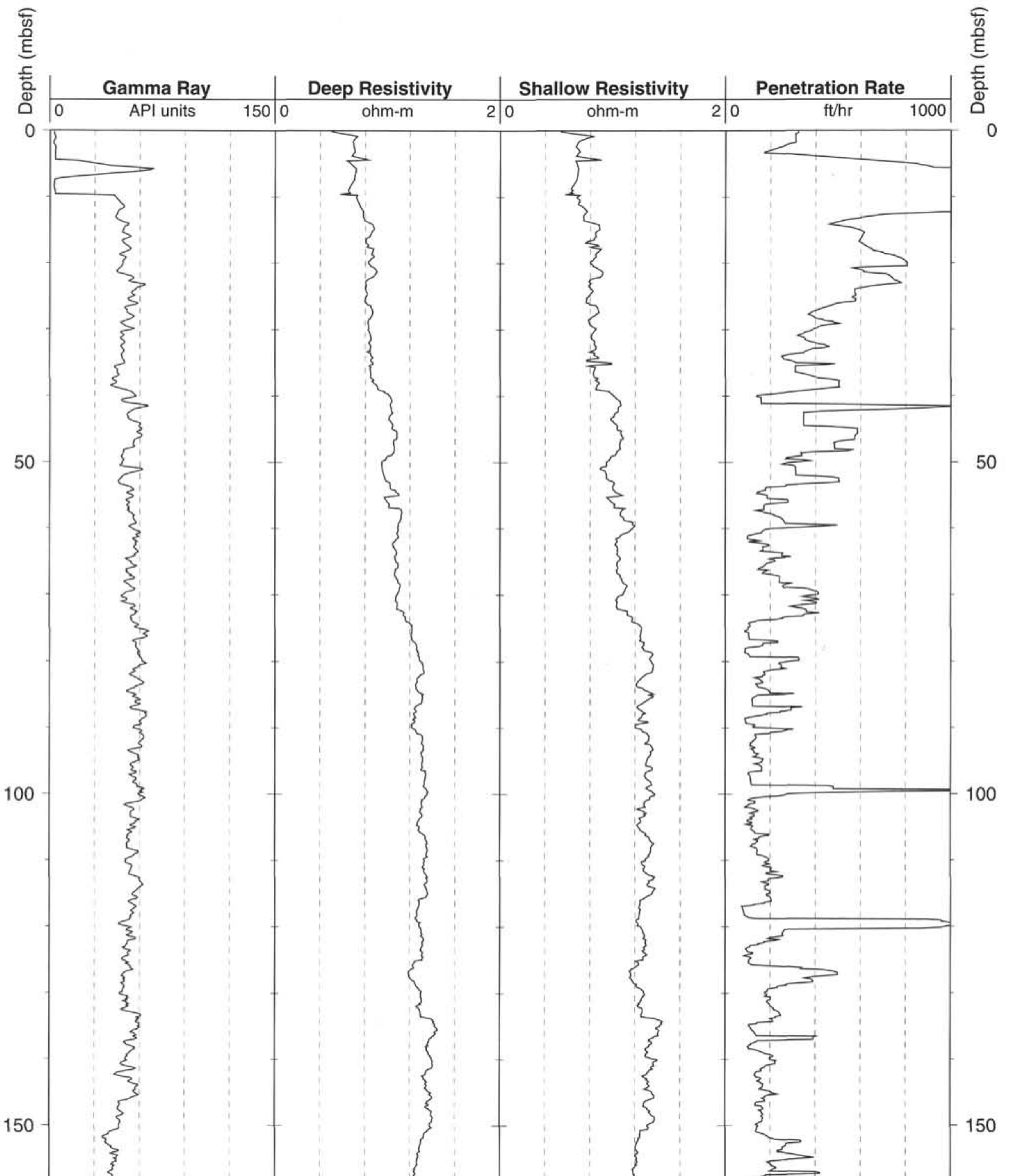
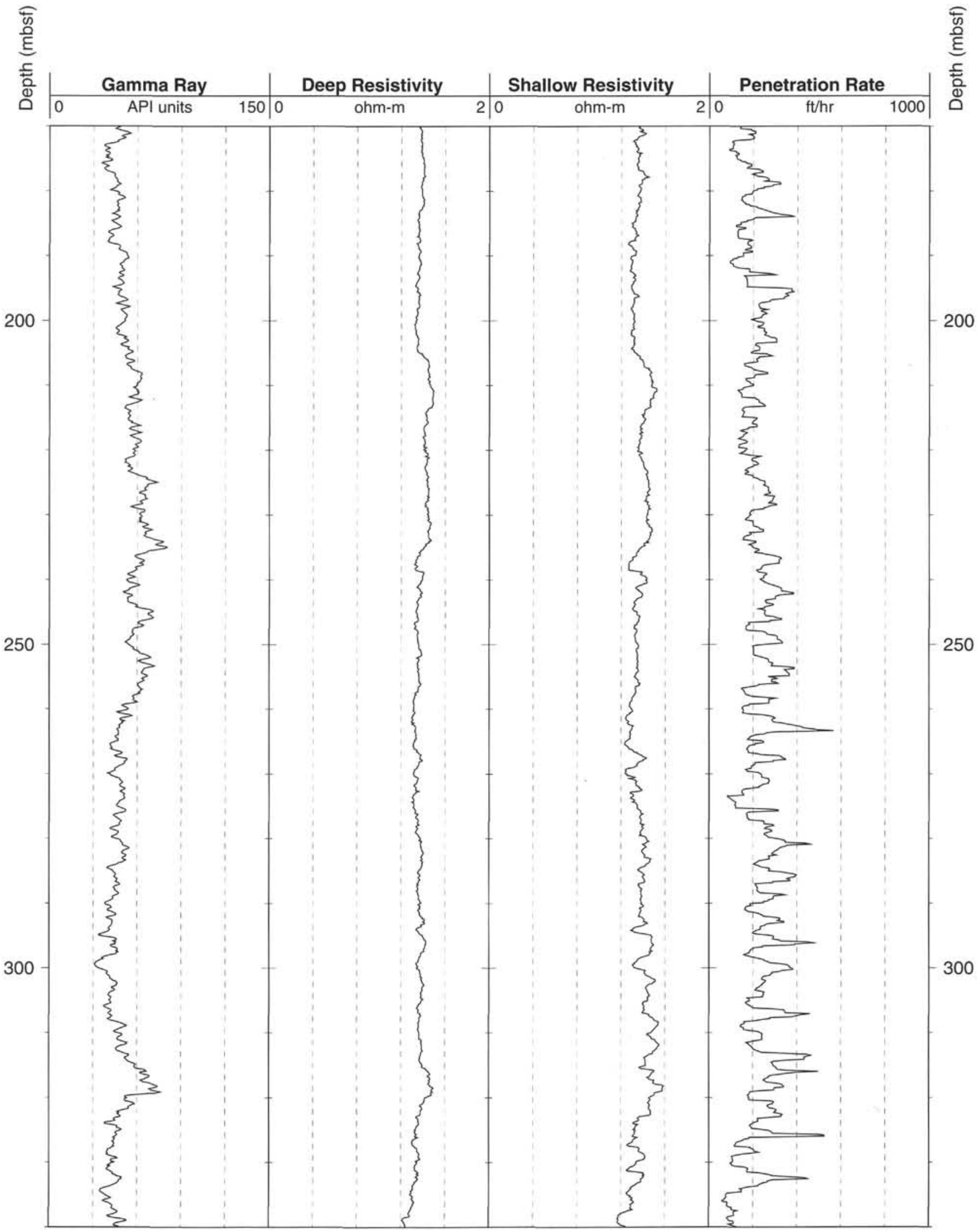
Fax: 914-365-3182
E-mail: chris@ldeo.columbia.edu

Elizabeth Pratson
Phone: 914-365-8313
Fax: 914-365-3182
E-mail: beth@ldeo.columbia.edu

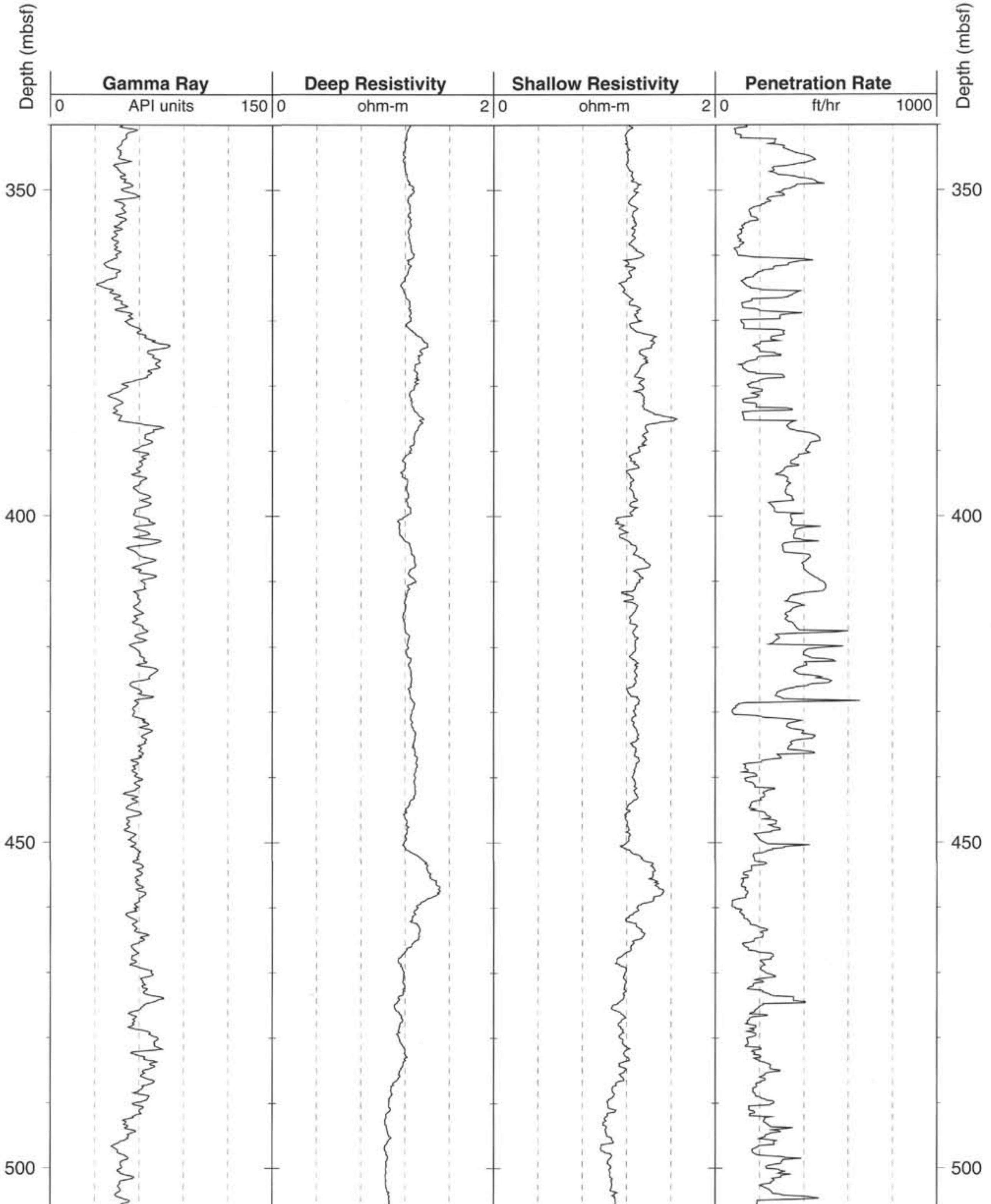
Hole 947A: Natural Gamma Ray-Resistivity-Rate of Penetration Logging Data



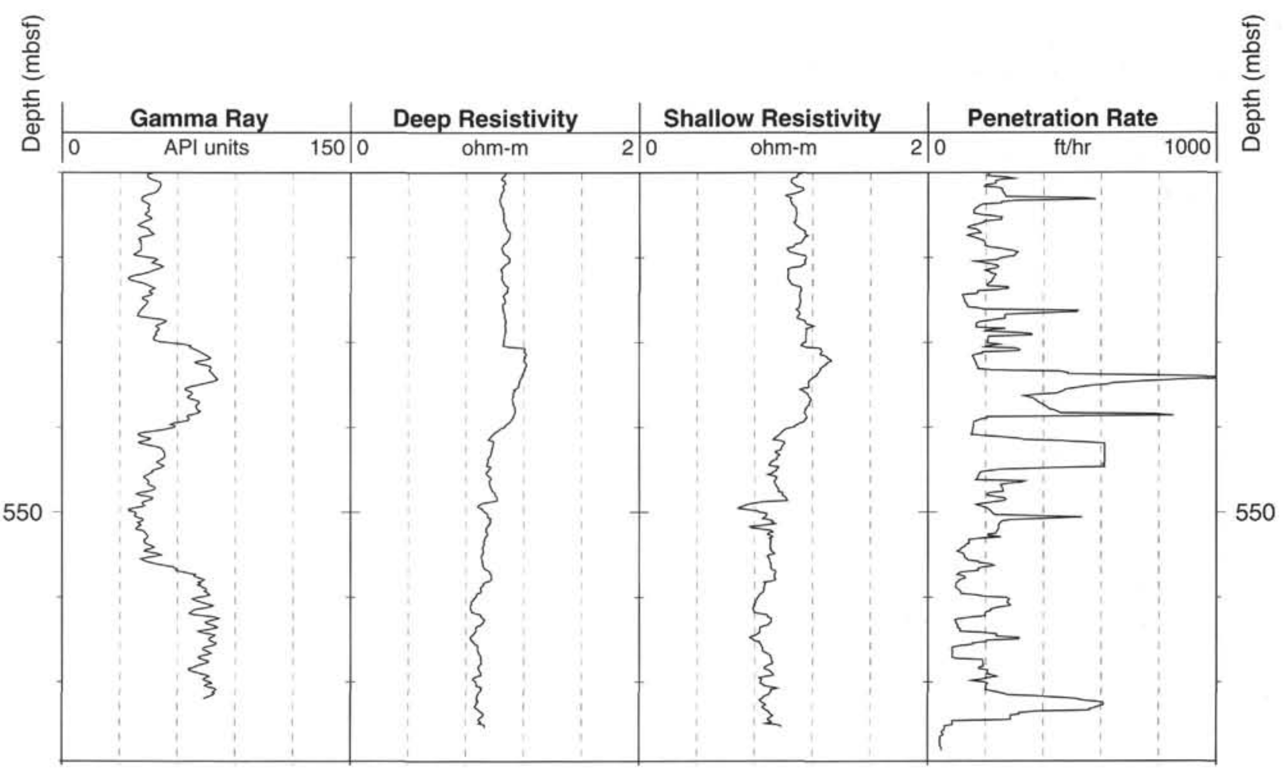
Hole 947A: Natural Gamma Ray-Resistivity-Rate of Penetration Logging Data (cont.)



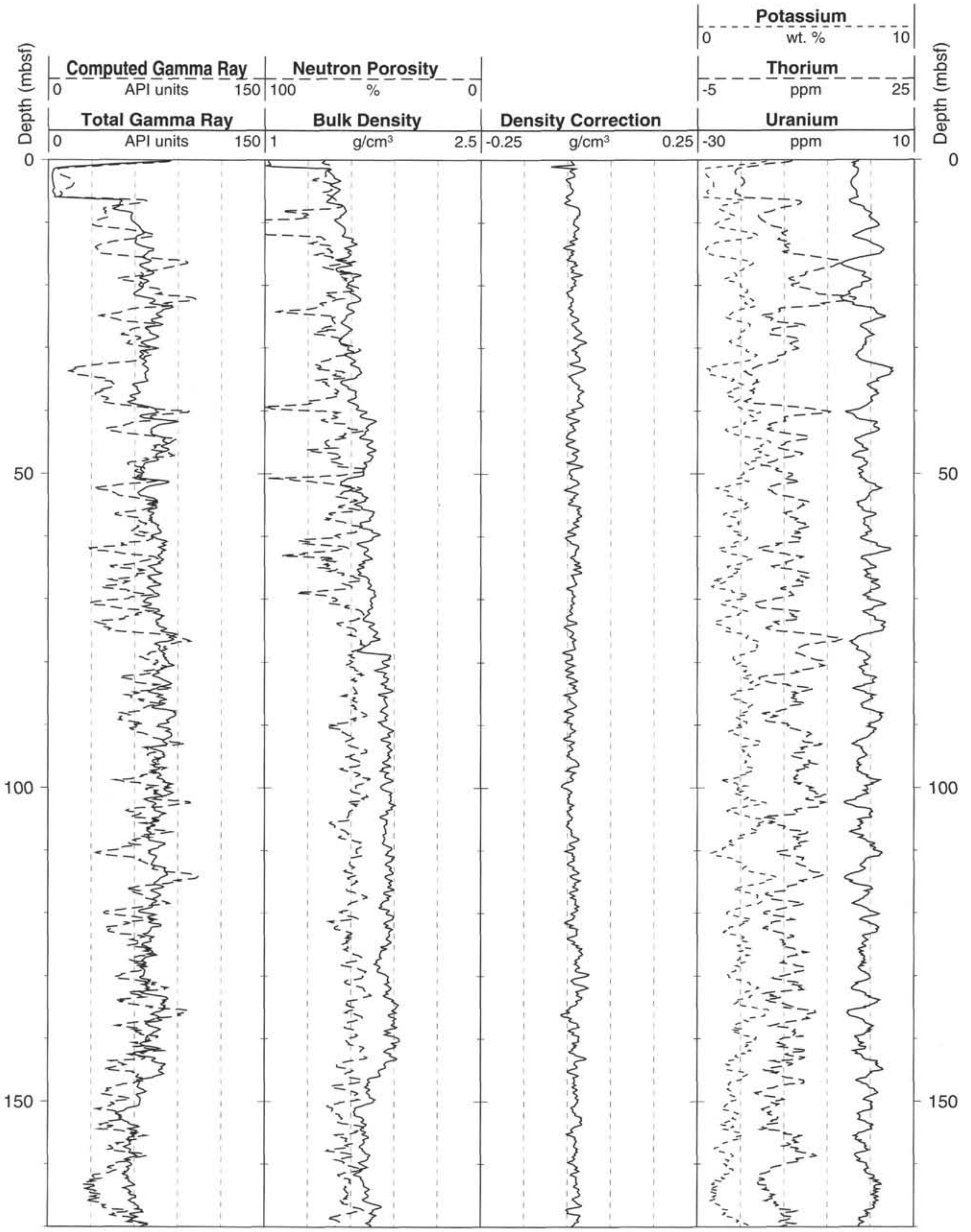
Hole 947A: Natural Gamma Ray-Resistivity-Rate of Penetration Logging Data (cont.)



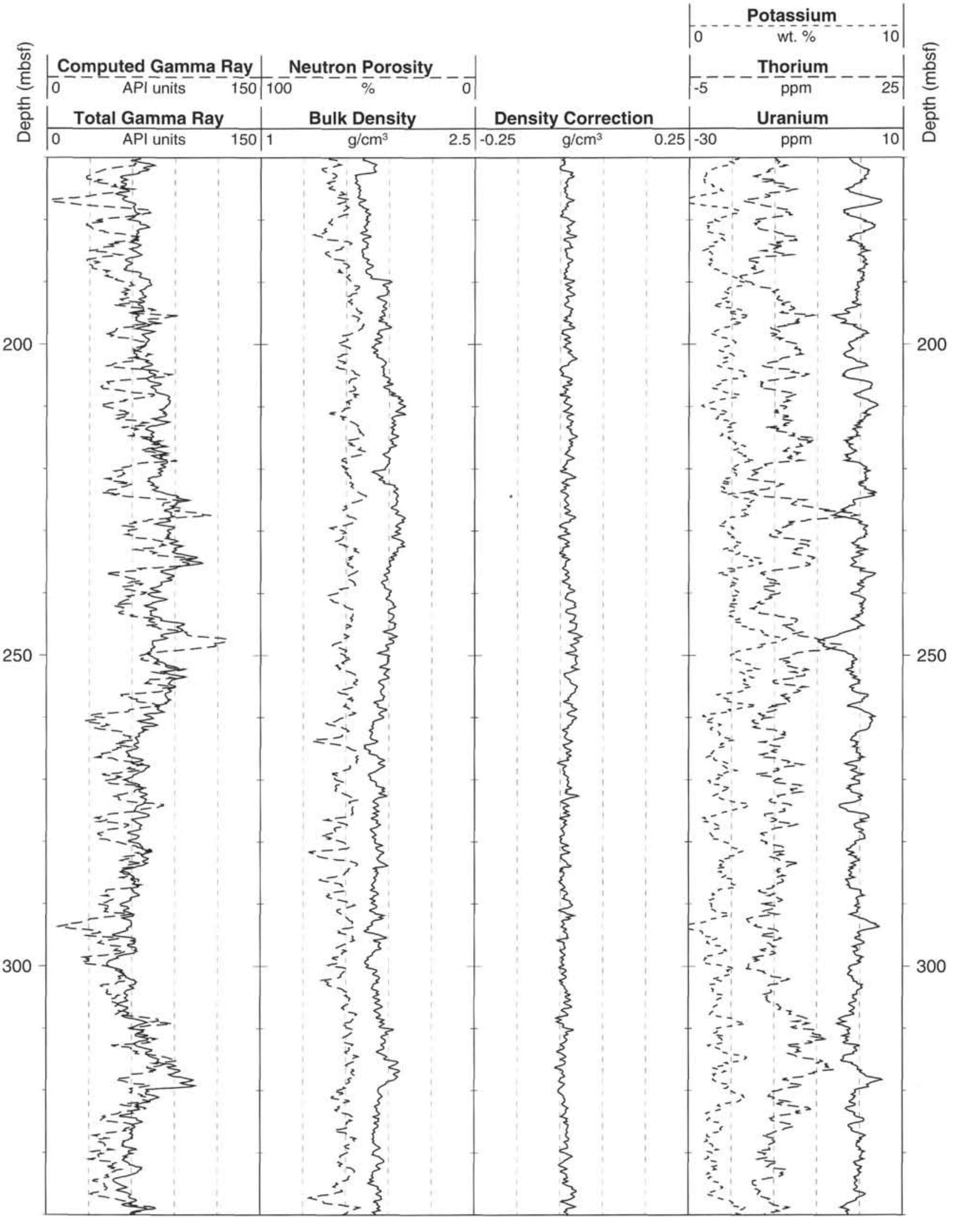
Hole 947A: Natural Gamma Ray-Resistivity-Rate of Penetration Logging Data (cont.)



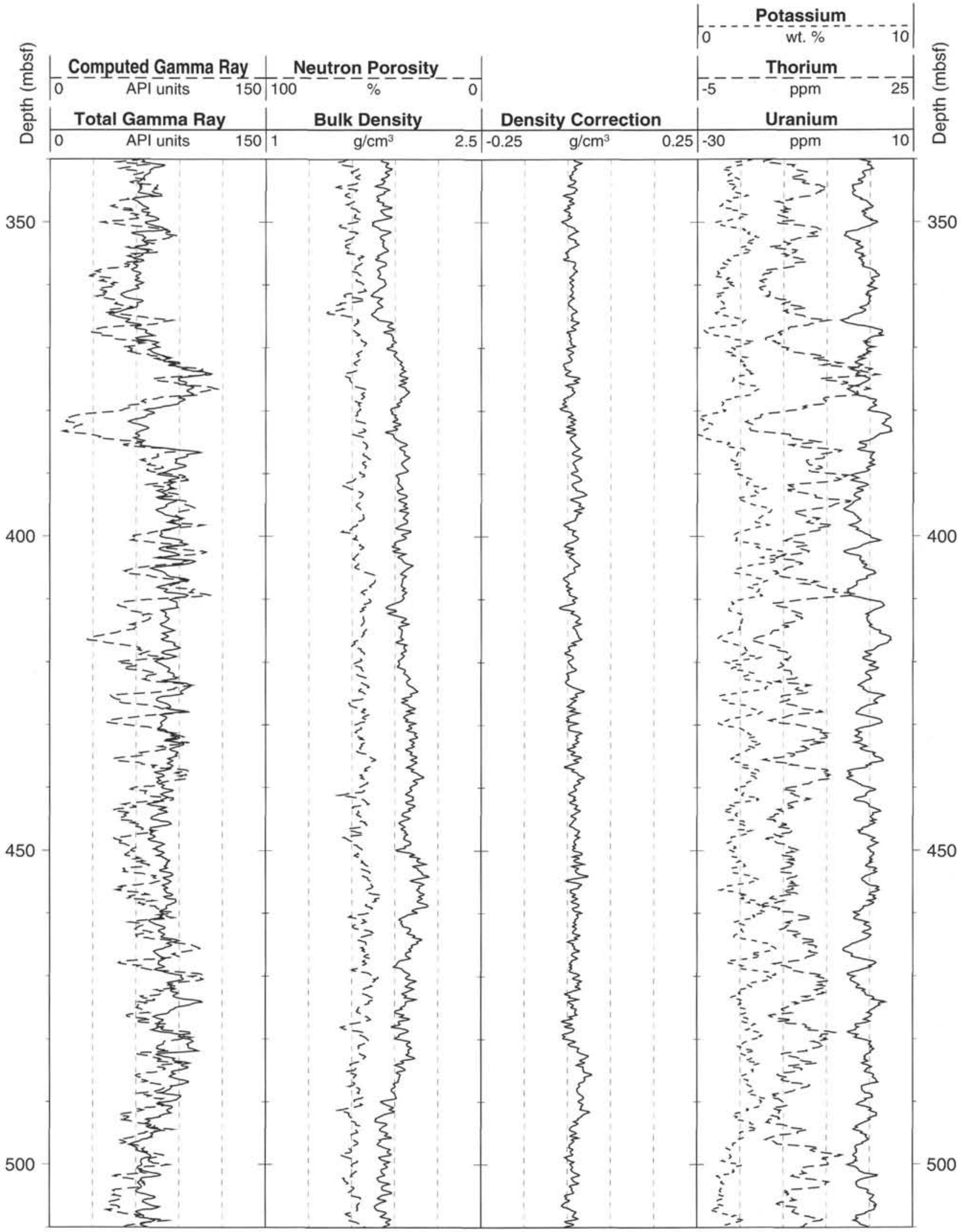
Hole 947A: Natural Gamma Ray-Density-Porosity Logging Data



Hole 947A: Natural Gamma Ray-Density-Porosity Logging Data (cont.)



Hole 947A: Natural Gamma Ray-Density-Porosity Logging Data (cont.)



Hole 947A: Natural Gamma Ray-Density-Porosity Logging Data (cont.)