OCEAN DRILLING PROGRAM

LEG 174A PRELIMINARY REPORT

CONTINUING THE NEW JERSEY MID-ATLANTIC SEA-LEVEL TRANSECT

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SCIENTIFIC REPORT

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ABSTRACT

Ocean Drilling Program (ODP) Leg 174A drilled a total of 12 holes at three sites on the New Jersey shelf and slope, recovering almost 1 km of core ranging in age from late Eocene through the Pleistocene. Determining the timing, amplitudes, and causal mechanisms of sea-level variations, as well as their relation to the resulting stratigraphic record, continues to be a fundamental goal of ODP. The major goal of Leg 174A was to investigate the Oligocene-Holocene history of sea-level change as part of a transect of holes from the slope (ODP Leg 150) to the coastal plain (150X and 174AX), which constitutes the Mid-Atlantic Sea-level Transect.

The succession drilled and sampled on the shelf (Sites 1071 and 1072) is divisible into at least four unconformity-bounded sequences of late-middle Miocene to Pleistocene age. The presumed sequence boundaries are characterized in seismic reflection data by pronounced offlap and onlap; the sequences are arranged in a forestepping (overall progradational) pattern. Best estimates of ages for the unconformity surfaces are <0.5 Ma [pp3(s)], >1.1-<7.4 Ma [pp4(s)], 7.4-11.2 Ma [m0.5(s)], and >11.4 Ma [m1(s)]. The abbreviations "pp" and "m" refer to Pliocene-Pleistocene and Miocene, respectively, and the suffix "s" indicates that the surface was identified on the basis of seismic reflection geometry on the shelf. An additional surface, tentatively interpreted as a sequence boundary prior to the cruise [pp5(s)], is tenatively reinterpreted as a marine flooding surface and dated as 5.9-7.4 Ma (that is, Miocene rather than Pliocene-Pleistocene). The major unconformities are thought to represent times/intervals of falling sea level, with higher order cyclicity most likely present but not resolved with existing seismic reflection data. The succession consists largely of sands, silts, and clays with recovery predominantly from muddy intervals; the presence of sands in poorly recovered or unrecovered intervals is inferred from logging data. An unusual distribution of sediment types was observed between unconformity surfaces. The shallow shelf for each sedimentary unit between these surfaces is dominated by sediments that accumulated during overall flooding. Seaward of clinoform breakpoints/rollovers, the deeper shelf is dominated by sediments that accumulated when the shelf was building seaward.

Drilling on the slope (Site 1073) recovered a thick Pleistocene section and condensed Pliocene-late Eocene section with excellent biostratigraphic resolution. Postcruise studies, including detailed biostratigraphy and the tying-in of lithologic variations to the regional sequence stratigraphic framework, should provide additional constraints on the ages of surfaces identified on the shelf and recovered at Site 1073.

High-frequency, sea-level variations have apparently left an imprint on the chemistry of interstitial waters recovered during Leg 174A. On the shelf, observed salinity (Cl^-) minima are consistent with alternate exposure of the shelf during the Pliocene-Pleistocene and then renewed flooding by seawater. On the slope, five well-defined alkalinity maxima and four HPO_4^{2-} maxima in interstitial-water profiles from the thick late Pleistocene succession can be attributed to variations in the amount or type of buried organic matter between glacial and interglacial intervals.

INTRODUCTION

The emergence of seismic/sequence stratigraphy since the late 1970s has led to a revolution in stratigraphy and to a renewal of interest in the stratigraphic response to eustasy (global sea-level change; Vail et al., 1977, 1984, 1991; Vail and Hardenbol, 1979; Loutit and Kennett, 1981; Berg and Woolverton, 1985; Haq et al., 1987, 1988; Vail, 1987, 1992; Cross and Lessenger, 1988; Posamentier et al., 1988; Sloss, 1988; Eberli and Ginsburg, 1989; Fulthorpe and Carter, 1989; Christie-Blick et al., 1990; Van Wagoner et al., 1990; Haq, 1991; Loucks and Sarg, 1993; Posamentier and James, 1993; Weimer and Posamentier, 1993; Christie-Blick and Driscoll, 1995; Fulthorpe and Austin, in press). Two arguments were advanced in support of the eustatic interpretation. One involved widespread seismic evidence for the existence of regional unconformities characterized by apparently abrupt basinward shifts in onlap, which were interpreted to imply relatively rapid falls of sea level with amplitudes of up to several hundred meters. The second was based on the purported global synchroneity of resultant sequence boundaries, which if correct would be difficult to explain by other than a eustatic mechanism.

These arguments were not universally accepted for several reasons (Watts, 1982; Thorne and Watts, 1984; Miall, 1986, 1992, 1994; Burton et al., 1987; Hubbard, 1988; Christie-Blick et al., 1990; Reynolds et al., 1991; Christie-Blick, 1991; Christie-Blick and Driscoll, 1995):

1. Basinward shifts in onlap were shown not to require sea-level changes that were either rapid or of large amplitude. Therefore, there was no reason to assume a eustatic causal mechanism or to exclude possible local tectonic mechanisms for sequence-boundary development.

2. No mechanism was discovered for rapid eustatic change during intervals such as the Mesozoic, for which there is little or no evidence for continental glaciation.

3. Limitations in the resolution with which sequence boundaries could be dated and correlated between basins cast doubt on the level to which global synchroneity had been established.

4. At least prior to 1987, the "sea-level curve" first published by Vail et al. (1977) was based primarily on proprietary data (see Haq et al., 1987). Therefore, at the time of the Second Conference on Scientific Ocean Drilling (COSOD II, 1987), there was a great deal of interest in acquiring public data that might be used to establish a sea-level record independent of the Vail et al. (1977) synthesis.

Following COSOD II, the role of scientific ocean drilling in sea-level studies was advanced by means of a Joint Oceanographic Institutions, Inc. (JOI)/U.S. Scientific Advisory Committee (USSAC) Workshop (Watkins and Mountain, 1990) and a JOIDES working group (JOIDES Sea Level Working Group, 1992). Sea-level studies were also prioritized in the JOIDES Sedimentary and Geochemical Processes Panel (SGPP) White Paper (1994) and in the Ocean Drilling Program (ODP) Long Range Plan (1996). These reports differ in detail and emphasis, but they endorse several broad objectives. These include (1) the dating of stratigraphic "events" and associated surfaces that might be related to sea-level change; (2) investigating how sedimentary architecture is related to sea-level variations (local or global); and (3) estimating the magnitudes and rates of eustatic change through time, if a role for eustasy can be demonstrated. All reports recognized that multiple drilling legs would be required to make comparisons between coeval successions at different locations and that ODP would be able to sample only a small portion of earth's sea-level history. Therefore, three intervals were prioritized within the Mesozoic to Cenozoic span accessible to ocean drilling: (1) the late Oligocene to Holocene "Icehouse" Earth, dominated by the waxing and waning of continental ice sheets; (2) the mid-Cretaceous "Greenhouse" or "Hothouse" Earth, when ice sheets were essentially absent; and (3) the intermediate interval from the latest Paleocene to the middle Eocene, for which the degree of glaciation is unknown or uncertain and the term "Doubthouse" Earth was suggested (Miller et al., 1987, 1991a; Watkins and Mountain, 1990; Barron et al., 1991; Frakes et al., 1992; Browning et al., 1997).

The scientific ocean drilling community tacitly assumed that this approach would lead to insights about possible mechanisms of eustatic change, as well as to a broader understanding of the relationships among eustasy and various phenomena, including changes in continental ice volume (and hence global climate), nearshore ecosystems, particle and nutrient transfer to the deep sea, ocean circulation, biological evolution, and patterns of deposition, erosion and hydrocarbon distribution in sedimentary basins. It is now clear that the main control on short-term eustasy is the continental ice budget, and that during nonglacial times sea-level change is likely to have been influenced significantly by noneustatic mechanisms, including tectonics (e.g., Christie-Blick and Driscoll, 1995). There is no evidence to support the long-held assumption in sea-level studies that tectonic processes act only at long time scales (e.g., Vail et al., 1991). Thinking has also matured about the stratigraphic response to eustatic change. Modeling studies suggest that this may vary from one basin to another, according to such factors as the local rate of subsidence and sediment supply, the relative abundance of siliciclastic vs. carbonate sediment, compaction history, and the physiography of the depositional surface. The locally determined timing of sea-level events is therefore expected to vary, even when the events are global (Jordan and Flemings, 1991; Reynolds et al., 1991; Christie-Blick, 1991; Steckler et al., 1993); strict stratigraphic synchroneity cannot be assumed as a criterion for judging the role of eustasy in the origin of observed sedimentary cyclicity. Instead, precise dating of stratigraphic successions at a number of well-chosen locations may permit predicted leads and lags to be measured. Ocean drilling has been consistently envisioned as a primary tool for such an approach to studying the history of sea-level change.

The JOIDES Sea Level Working Group (1992) endorsed a three-fold approach to sea-level studies, involving: (1) passive continental margins (primarily siliciclastic); (2) carbonate atolls, guyots and platforms, the so-called "dipstick" approach; and (3) the deep-sea oxygen isotopic record, a proxy for the growth and decay of continental ice sheets. This strategy has since been reaffirmed in the SGPP White Paper (1994) and in the JOIDES Long Range Plan (1996). ODP Legs 133 and 166 addressed "Icehouse" sea-level issues at the seaward margins of carbonate platforms off northeastern Australia and the western Great Bahama Bank, respectively. Legs 143 and 144 studied the "Greenhouse" drowning history of western Pacific guyots. Leg 174A is a continuation of the New Jersey Mid-Atlantic Sea-level Transect (MAT), the first concerted effort to evaluate the effects of "Icehouse" glacial-eustatic change at a passive continental margin characterized by predominantly siliciclastic sedimentation. Leg 174A follows successful sampling of the continental slope and rise during Leg 150 (Mountain, Miller, Blum, et al., 1994; Miller et al., 1996b), and continuing studies of the adjacent New Jersey coastal plain (Legs 150X and 174AX; Miller, et al., 1994, 1996a; Miller and Sugarman, 1995; Pekar and Miller, 1996; Figs. 1, 2).

SCIENTIFIC OBJECTIVES

The primary goals of Leg 174A were to (1) date as precisely as possible sequence boundaries of Oligocene to Pleistocene age, and compare this stratigraphic record with the timing of glacial-eustatic changes inferred from deep-sea $\delta^{18}O$ variations; (2) place constraints on the amplitudes and rates of sea-level change that may have been responsible for unconformity development; (3) assess the relationships between depositional facies and sequence architecture; and (4) provide a baseline for future scientific ocean drilling that would address the effects and timing of sea-level changes on this and other passive continental margins. An additional goal for Leg 174A was technical. The leg represented the first attempt by scientific ocean drilling in almost 30 yr to sample a thickly sedimented, continental margin in water less than 150 m deep. Two sites (Sites 1071 and 1072) are located on the outer part of the continental shelf in water depths of 88-90 and 98 mbsl, respectively. An additional site (Site 1073) is located on the uppermost continental slope, part of the Hudson Apron, in a water depth of 638 mbsl.

SITE RESULTS

Site 1071

Site 1071 was one of two sites approved for *JOIDES Resolution* drilling on the New Jersey continental shelf. Holes 1071A-1071E correspond with Site MAT-8B-3 of the Prospectus; Holes 1071F and 1071G were approved during the leg at an alternate location within the MAT-8B hazards survey grid, 1.1 km to the east at the intersection of *R/V Oceanus* seismic Profiles 801 and 814. Together they form part of a transect of holes from the slope (ODP Leg 150; Site 1073) to coastal outcrops (150X and 174AX), which constitute the MAT (Figs. 1, 2). Site 1071 provides information primarily about late-middle Miocene and younger sequences at locations landward of their respective rollovers or breakpoints—the positions at which each sequence boundary steepens into a clinoform. Holes 1071A-1071E are situated close to the rollover or breakpoint for surface m1(s); Holes 1071F and 1071G are located above the clinoform for that surface, but only Hole 1071F penetrated to m1(s) level.

The succession drilled and sampled at Site 1071 is divisible into four unconformity-bounded sequences of late-middle Miocene to Pleistocene age (Fig. 3). The sequence boundaries are characterized in seismic reflection data by offlap and onlap; the sequences are arranged in a forestepping (overall progradational) pattern. Before drilling, the boundaries were informally designated, from youngest to oldest, as pp3(s), pp4(s), m0.5(s), and m1(s), where "pp" refers to Pliocene-Pleistocene and "m" to Miocene. The "s" has been added to indicate interpretation of the boundaries on the shelf and permit fine-tuning of correlations with surfaces identified as possible sequence boundaries on the continental slope (Leg 150). Each of these surfaces has been verified as a sequence boundary. A fifth reflection, pp5(s), tentatively interpreted as a sequence boundary before drilling, is associated with upward fining of sediments and is reinterpreted to be caused by an increase in paleowater depth; it is clearly of late Miocene age, which is older than initially assumed.

The succession consists largely of sands, silts, and clays, with recovery predominantly from muddy intervals. The presence of sands in poorly recovered or unrecovered intervals is inferred by comparison with the gamma-ray log for the Continental Offshore Stratigraphic Test (COST) B2 well, which was drilled ~950 m to the southwest of Holes 1071A-1071E (a direction approximately parallel to depositional strike). These sediments have been divided into three lithostratigraphic units, primarily on the basis of abrupt changes in the vertical arrangement of lithofacies within the succession (Fig. 4). Unit I (0-134.4 mbsf) is significantly less glauconitic overall than Unit II (143.5-261.90 mbsf), but sediments at the bases of both units are particularly glauconitic. Unit II is also characterized by significantly less calcite than Unit I. The recovered succession from Unit III (261.9-424.2 mbsf) is predominately silty and muddy sands. The base of Unit I corresponds with sequence boundary pp4(s), the base of Unit II is thought to lie no more than a few meters above surface m0.5(s), and the base of Subunit III lies at or slightly below surface m1(s). The physical sedimentology, extensive bioturbation in fine-grained sediments, scattered shell fragments, benthic foraminifers, and local abundance of glauconite all suggest that the succession is primarily shallow marine, with cyclicity at several scales related to presumed transgression and regression of the shoreline. An unexpected pattern was observed for a location close to the modern shelf edge; the preserved parts of sequences below both pp3(s) and pp4(s) are predominantly transgressive overall, consistent with pronounced bypassing and erosion at both of these surfaces. Regional seismic data crossing the shelf near the site indicate that transgressive deposits thin seaward across their respective clinoform rollovers/breakpoints, beneath seaward-thickening and offlapping highstand units (regressive). Increasing amounts of offlap of successive sequence boundaries are consistent with increasing amplitudes of glacial-eustatic change from the late Miocene onward (11-0 Ma).

Biostratigraphic resolution at Site 1071 is generally low for calcareous microfossils as a result of strong carbonate dissolution and shallow-water conditions that were unfavorable to these planktonic organisms. Nannofossils provide relatively useful zonations for the late Pleistocene, late Pliocene, and the early Pliocene-late Miocene. Utility of planktonic foraminifers for biostratigraphic zonation is restricted to the earliest Pliocene-middle Miocene. Pleistocene samples examined from Site 1071 yield benthic foraminiferal faunas that vary from inner neritic (0-50 m) assemblages, dominated almost exclusively by *Elphidium excavatum*, to more diverse upper middle neritic (~50-65 m) assemblages. These variations may reflect paleodepth fluctuations, substrate (finer grained vs. sandier sediments), and/or depositional systems. Miocene benthic foraminiferal assemblages indicate middle neritic paleodepths (50-100 m), possibly with fluctuations within this depth zone. Miocene biofacies changes may reflect paleoenvironmental and paleobathymetric changes that occur within a sequence stratigraphic framework. Organic microfossils also constrain the biostratigraphic framework at this site. Pollen is useful for dating middle to late Pleistocene sediments; dinocysts provide biostratigraphic zonation of the early Pleistocene to late-middle Miocene. Dinocysts suggest rapid sedimentation during the middle through late Pleistocene, the late-late Miocene, and the early-late Miocene. In contrast, hiatuses were identified in the Pliocene through early Pleistocene, middle late Miocene, and late middle Miocene, suggesting thathiatuses during these intervals correspond to stratigraphic surfaces pp4(s), m0.5(s), and m1(s). Site 1071 is not optimally located for dating these surfaces, but approximate ages were obtained as follows at Site 1071 (Fig. 5): pp3(s), late Pleistocene (younger than 0.78 Ma); pp4(s), early Pleistocene-possibly latest Miocene (1.1-7.4 Ma); pp5(s)(?), latest Miocene (5.9-7.4 Ma); m0.5(s), late Miocene (7.4-11.2 Ma); and m1(s), late middle Miocene (older than 11.4 Ma).

Magnetic polarity changes downhole from normal to reverse at 61.4 mbsf in Hole 1071B and at 61.5 mbsf in Hole 1071C were confirmed by analyses of discrete-cube samples. Combined with the analysis of nannofossils, this reversal is considered to be the Brunhes/Matuyama (B/M) boundary (0.78 Ma). Magnetic polarity returned to normal at Cores 1071B-6X and 1071C-3X; however, the B/M boundary was not determined because of low recovery in these intervals. A reversed polarity chron was not found downhole. However, this does not necessarily mean that the polarity is normal, but that remagnetization occurred during the Brunhes Chron. Magnetization intensity after 20-mT AF demagnetization drops from 10 to 100 mA/m above the B/M boundary to about 1 mA/m below the boundary. Magnetization intensity increases to more than 10 mA/m below 68 mbsf, fluctuating downhole, and then decreases to less than 1 mA/m below 200 mbsf. This low magnetization intensity may be related to the dissolution of magnetite and the simultaneous formation of pyrite.

Routine squeezing of whole-round sediment samples showed complex and nonsteady-state interstitial water profiles. Pore waters are significantly fresher than seawater in two intervals, with minima at 30 mbsf and between 261 and 321 mbsf (Cl^- to 430 mM, a 23% decrease, and 500 mM, a 11% decrease, respectively; Fig. 6). These salinity minima likely reflect input of fresh (or brackish) water during late Pliocene-Pleistocene drops in sea level and resultant subaerial exposure of the shelf. Pore waters show an abrupt rise in alkalinity, ammonia, and phosphate below 150 mbsf, suggesting that substantial organic-matter diagenesis is occurring in this interval. Operations were highlighted by a spectacular fountain of water that flowed at pressure from the drill pipe upon reaching a depth of ~250 mbsf. The chemistry of fountain water is identical to that of surface seawater and significantly different from that of formation water. This strongly indicates that the fountain was caused by drilling procedures rather than direct drilling of a pressurized aquifer. A plausible explanation is that porous sand intervals were charged with pressurized water when unstable hole conditions caused cave-ins around shallower sections of the drill string.

Hydrocarbon gases were monitored by headspace sampling for every core. Concentrations of C_1 were below 9 ppmv, whereas those for C_2 through C_6 were at or below detection limits. The lack of hydrocarbon gas and the presence of interstitial-water sulfate in cores at depth suggest that significant bacterial gas is not being generated in shallow sediment. Total organic carbon (TOC) increases downhole, averaging 0.3 wt% from 0 to 135 mbsf and 0.65 wt% from 135 mbsf to the base of the sampled section. Organic-matter degradation and siderite precipitation in Units II and III may be related to higher sediment TOC.

Physical properties of primary interest are density and *P*-wave velocity, which will aid in traveltime-depth conversion as well as production of synthetic seismograms for linking coring results to seismic reflection data in both regional and site-specific profiles and logs. Density measurements were acquired at a variety of resolutions. Wet bulk density data in Holes 1071A-1071C show a gradual overall increase consistent with the effects of compaction; the greatest downhole increase in density appears in the upper 10 mbsf of Hole 1071A. Several smaller scale trends in density are approximately coincident with inferred lithologic boundaries. Although the *P*-wave logger (PWL) on the multisensor track (MST) was turned off after the first few cores because of incompletely filled liners, discrete *P*-wave velocity measurements, primarily transverse to the core axis, were made with the same frequency as index properties. Velocities are generally between 1600 and 1800 m/s. Intervals of uniform, or gradually varying, velocity are separated by abrupt changes at lithologic boundaries. The lithified sandstone at the base of Hole 1071C has a *P*-wave velocity in excess of 5000 m/s. It appears to be a thin layer, however, and its potential to generate a strong seismic reflection remains uncertain. In Hole 1071F, between ~359 and ~370 mbsf, velocities increase downhole from 1800 to 1900 m/s, and below 370 mbsf, velocities decrease downhole to 1700-1800 m/s. This velocity change at ~370 mbsf corresponds to the boundary between lithostratigraphic Subunits IIIA and IIIB and lies above the inferred position of sequence boundary m1(s). Natural gamma measurements were made on the MST at intervals of 20 cm. Coupled with discrete resistivity measurements (one to two per section), these will assist with future core-log correlations.

Logging-while-drilling data were acquired at Hole 1071G to a depth of only 88 mbsf, when unstable hole conditions prevented further penetration. However, log data acquired at the COST B2, 950 m SSW of Holes 1071A-1071E, provided valuable indications of unrecovered lithologies and depths to key horizons imaged in site-survey profiles.

Site 1072

Site 1072 (MAT-9B-1) is ~3.5 km seaward of Holes 1071A-1071E, and coincides with the rollover or breakpoint in sequence boundary m0.5(s). It provides information primarily about late Miocene and younger strata and permits a comparison, in the direction of progradation, with the succession at Site 1071.

The succession is divisible into at least three unconformity-bounded sequences of late Miocene to Pleistocene age (Fig. 3). The sequence boundaries are characterized by well-developed seismic offlap and are informally designated pp3(s), pp4(s), and m0.5(s). Core and log data from Site 1072 confirm that seismic reflection pp5(s), tentatively interpreted as a sequence boundary at the beginning of the leg, is related to fining-upward sediments and an increase in paleowater depth. Ages are consistent with those obtained at Site 1071: pp3(s), late Pleistocene (younger than 0.78

Ma); pp4(s), early Pleistocene-possibly latest Miocene (1.1-7.4 Ma), most likely of Pliocene-Pleistocene age; and m0.5(s), late Miocene. Surface pp5(s) is dated as late Miocene (5.9-7.4 Ma). Coring and logging at Site 1072 suggest that the sandy lower intervals above sequence boundaries m0.5(s) and pp4(s) thin in a seaward direction. Each of these units is a composite, including seismically imbricated intervals 10-25 m thick that shoal upwards. Upward coarsening and possible shoaling (from benthic foraminifers) beneath surface pp4(s) are consistent with a larger scale transition from transgressive to highstand sedimentation.

The sedimentologic column at Site 1072 is divided into two units on the basis of accessory components: glauconite, carbonate, and pyrite nodules (Fig. 7). Unit I extends from 0 to 152.13 mbsf, and Unit II extends from 152.13 to 274.38 mbsf. These units are considered close genetic equivalents to Units I and II at Site 1071; the contact between them corresponds to surface pp4(s). Thick, unrecovered intervals in both units suggest that sands are present in these sections. Unit I is characterized by intervals of dark gray to dark greenish gray silty clays, clayey silts, and clays interbedded with olive gray sandy mud, sandy silt, clayey sand, and/or muddy sand. Slumping/microfaulting is common at the top and bottom of the unit. Bioturbation is associated with intervals where clays are interbedded with coarser sediments. The lower boundary of the unit is rich in glauconite, shells, granules, and pebbles. Glauconite is generally present toward the top of Unit II in olive gray sandy silts with scattered granules, shells, and wood fragments. Carbonate and pyrite nodules, wood fragments, and discrete burrows are associated with dark gray to olive gray silty clay from the middle to the base of Unit II. Cemented intervals of poorly sorted, glauconitic, pebbly, medium- to coarse-grained quartz sandstone are present at the base of this unit.

As at Site 1071, biostratigraphic resolution at Site 1072 is limited for calcareous microfossils because of strong carbonate dissolution and shallow-water depths that were unfavorable to these planktonic organisms. Nannofossils provide relatively useful zonations for the Pleistocene and early Pliocene to late Miocene. Planktonic foraminifers have limited use for biostratigraphic zonation at Site 1072, although it was possible to identify late Miocene and late Pliocene to Pleistocene ages based on the presence/absence of rare taxa. Pleistocene benthic foraminiferal faunas vary from assemblages dominated almost exclusively by *Elphidium excavatum* to more diverse assemblages, probably reflecting changing paleodepths or substrates related to glacial/interglacial cycles and/or depositional systems. Benthic foraminiferal species abundances indicate that paleodepths were slightly deeper at Site 1072 than at Site 1071 during the Pleistocene, ranging from inner neritic (0-50 m) to upper middle neritic (~50-65 m) at Site 1072. Miocene biofacies are characterized by *Buliminella gracilis* and *Uvigerina juncea*, indicating middle neritic paleodepths (50-100 m). Organic microfossils are common to abundant in most samples studied, particularly in the pre-Pleistocene sediments. Dinocysts are relatively more abundant in pre-Pleistocene sediments as well, whereas terrestrial palynomorphs (pollen and spores) dominate Pleistocene sediments. Reworking is clearly evident in many samples. In addition, it is possible that some well-preserved organic microfossils are indistinguishable from in situ fossils. Surface pp4(s) can be recognized in a condensed interval of Pliocene-early Pleistocene age (Fig. 8).

Several magnetic polarity boundaries are recorded in sediments recovered from Hole 1072A. The Brunhes/Matuyama boundary was found at 62.3 mbsf within a clayey silt (Subunit IC), which was confirmed by nannofossil biostratigraphy. This boundary coincides with a marked increase both in magnetization intensity and susceptibility downhole. This evidence suggests that the sedimentary environment, which supplied magnetic minerals, changed across the boundary, or that the boundary is a diagenetic front during the Brunhes Chron associated with the sedimentation above. For Subunit IC, below the assumed Brunhes/Matuyama boundary, magnetic polarity is reversed down to pp4(s) (131-145 mbsf), including normal zones at 127.5-135 mbsf and 141.8-144 mbsf, which are associated with slump/sand layers and intervals of low recovery. Below pp4(s), within the upper silty clay layer of Subunit IIA, magnetic polarity is dominantly normal with thin reverse zones at 177-178, 181-182, 206-208, and 215-218 mbsf. For the lower muddy sands of Subunit IIA, near surface pp5(s), magnetic polarity is normal throughout; magnetization intensity and susceptibility in this interval are lower than in the overlying upper silty clay layer.

Downhole profiles of interstitial water at Site 1072 are complex, but somewhat similar to those at Site 1071. Pore waters are significantly fresher than seawater (Cl^- to 469 mM, a 16% decrease) at shallow subsurface depths (< 150 mbsf; Fig. 7). The salinity minimum is a nonequilibrium feature caused by large-amplitude oscillations in the salinity of overlying water, perhaps a proxy for the rise and fall of sea level. Freshwater has access to the sediment column during presumed glacial stages, whereas seawater covers the sediment column during interglacial stages. The salinity minimum at Site 1072 is less pronounced and ~30 m deeper than the minimum at Site 1071. This difference may reflect the elevation offset between the two locations during the last transgression. Decreases in sulfate, with corresponding increases in alkalinity, ammonia, and phosphate, occur at two distinct intervals in the sediment column: at 30 mbsf in the shallow salinity minimum, and below 150 mbsf. Upper and lower zones of significant organic-matter diagenesis also were observed at similar depths at Site 1071. However, changes in pore-water concentrations are more pronounced at Site 1072, suggesting higher overall rates of organic-matter diagenesis at Site 1072. In particular, sulfate drops to 1 mM in the upper zone at Site 1072, but only to 6 mM at Site 1071.

Hydrocarbon gases were monitored by headspace sampling for every core recovered at Site 1072. As at Site 1071, hydrocarbon gases generally are at or near detection limit (C_1< 5 ppmv). Exceptions are three samples near 30 mbsf, where C_1 and C_2 rise to 1056 ppmv and 4 ppmv, respectively. The presence of C_1 at a depth where interstitial-water sulfate approaches zero indicates a thin zone of bacterial methanogenesis at Site 1072, unlike at Site 1071.

A comprehensive set of physical properties measurements was acquired on cores from Hole 1072A, with the exception of the PWL component of the MST, which was not employed because of the presence of incompletely filled core liners. The natural gamma-ray (NGR) component of the MST reaches a local maximum at 57.1 mbsf; this maximum is located immediately above the boundary between Subunits IA/IB and IC and is at the level of sequence boundary pp3(s). The overall maximum NGR value is at 151.6 mbsf; this depth is immediately above the boundary between Subunits IC and IIA and is at or slightly below the inferred level of sequence boundary pp4(s). In recovered intervals, the overall shape of the NGR curve obtained from physical properties measurements is in good agreement with that derived from logging. Wet bulk density values for Hole 1072A average 2.00-2.10 g/cm^3, with generally little variation. The maximum values in wet bulk density are found just above the boundary between Subunits IC and IIA [~157.8 mbsf; near pp4(s)] and from the well-cemented sandstone recovered at 268.79 mbsf. The shape of the physical properties wet bulk density curve is in good agreement with that obtained from logging at Hole 1072D, although logging-derived values are consistently somewhat higher. Discrete P-wave velocities are generally between 1600 and 1800 m/s, with exceptions noted below. Velocities in excess of 5000 m/s are associated with well-cemented sandstones recovered at 165.35 and 268.79 mbsf. Other high-velocity intervals (>2000 m/s) are located at ~36.6 mbsf and between ~147 and 151 mbsf; the latter interval corresponds to the Subunit IC/IIA lithic boundary and is near the inferred depth of pp4(s). In addition, this higher velocity interval appears to be of sufficient thickness and density contrast to be seismically resolvable. Conversely, the highest velocity intervals, associated with indurated sandstones, may be too thin to be seismically resolvable. Resistivity measurements were taken at least once per recovered section; trends in physical properties and logging resistivity data are consistent overall, although physical properties resistivity values are on average ~20%-25% lower. The highest resistivity value measured in recovered cores was 3.23 Ωm at 147.54 mbsf; this is just above the Subunit IC/IIA [pp4(s)] lithic/sequence boundary. Other measurements include porosity, shear strength, thermal conductivity, and magnetic susceptibility. Physical properties data appear to be consistent with logging data and will prove useful in refining velocity models for seismic data in the vicinity of Sites 1071 and 1072.

Hole 1072A was logged to total depth (TD; 300 mbsf) with the triple combo logging string (dual induction resistivity, neutron porosity, and density tools), plus the spectral gamma ray and the Lamont temperature tools. Log data are of good quality, except for washed-out intervals near the bottom of the hole. A repeat run from 110 mbsf to the bottom of the drill pipe (61 mbsf) confirmed the log responses of the main run. The pipe became stuck while rigging down; this forced the severing of the pipe and moving to Hole 1072B to continue logging.

Hole 1072B was washed to 307 mbsf and logged in four wireline runs. The first run was an induction-sonic string (measuring resistivity and sound velocity, with a spectral gamma-ray tool for correlation to other log runs) that failed to pass a bridge at ~90 mbsf. The tool string was pulled out, the hole was reamed, and a repeat run was made with the long-spaced sonic tool (LSS) in place of the sonic-digital tool (SDT). Despite difficulties in passing several bridges on the way down, a successful run was logged from TD up to the pipe at 43 mbsf. Good velocity data were collected, with cycle-skipping observed in only two thin intervals of marked velocity variation corresponding to indurated sandstone. Overall, the LSS tool, despite its lack of a receiver array, performed better than the SDT in the variable diameter, sandy conditions encountered in Hole 1072B. The third wireline run, from 307 to 50 mbsf, utilized the formation microscanner (FMS) tool. Roughly 20% of the hole was washed beyond the maximum opening of the caliper, but images of the remaining 80% provided good detail of bedding features in intervals of poor core recovery. The final logging operation was a vertical seismic profile (VSP) using the Schlumberger well seismic tool (WST) tool. These data provided interval velocities that compared well with the shipboard *P*-wave measurements on discrete samples from Hole 1072A, and yielded a time-to-depth conversion that should give seismic-core-log correlations a high degree of precision.

Logging while drilling (LWD) was conducted at Holes 1072C and 1072D to 100 and 356 mbsf, respectively. Measurements included resistivity, spectral gamma ray, porosity, density, and photoelectric effect. In addition, borehole diameter was statistically derived from the density measurements.

Preliminary shipboard integration of logs and core data has been useful, both in assessing the character of unrecovered intervals and calibrating the log measurements. Log data quality are generally good to excellent, except where sand-rich washed-out intervals are encountered. These unconsolidated, sand-rich layers correlate to zones of low resistivity, velocity, and gamma-ray values. Intermediate resistivity, velocity, and gamma-ray data correspond to silty intervals; clay-rich intervals show high resistivity, velocity, and gamma-ray values. The spectral gamma ray, as well as the photoelectric factor, identify high glauconite concentrations in the upper 154 m (Pliocene-Pleistocene). Of particular note is an incompletely recovered glauconite-rich sand that logs show has variable thickness in each of the three holes it was penetrated (149.5-154 mbsf, Hole 1072A; 149.5-151.5 mbsf, Hole 1072B; 149-154.5 mbsf, Hole 1072D). These holes were a total of 40 m apart; the variable thickness of the sand is interpreted to reflect erosional relief at presumed sequence boundary pp4(s). Two intervals of well-cemented glauconitic quartz sandstone can be detected by especially high resistivity, density, and velocity: one is a few meters above pp4(s), near 150 mbsf; the other is at 275-277 mbsf, ~20 m above surface m0.5(s). Throughout most of Hole 1072B, FMS images delineate bed boundaries and internal structures such as slumping. High as well as low resistive spots in these images may indicate various kinds of nodules, clasts, and burrows.

Site 1073

Site 1073 (MAT-13B) constitutes one of four second-priority sites approved for drilling, to be undertaken in the event that either time allowed or that operations had to be curtailed at both primary shelf sites. With five days remaining on Leg 174A, the decision was made to move to the slope, because it seemed unlikely that it would be possible to reach objectives at Sites 1071 and 1072 deeper than surface m1(s) without unreasonable risk for equipment loss because of unstable hole conditions. Site 1073 was designed to drill as deeply as time would allow into "Icehouse" sediments (Oligocene and younger) at a location where the physical stratigraphy could be related to sequence boundaries traced seaward from the shelf. The objective at Site 1073 is to provide the age and deep-water facies control for surfaces that in shallow water can yield paleowater depth and facies characterization relevant to determining the history and geologic impact of glacial-eustatic change. Seismic data (Fig. 9) indicate that an especially thick and relatively complete Pleistocene succession present at this location could provide information about paleoceanography and depositional and erosional processes at the uppermost slope.

Recovery at Site 1073 was excellent (99.9%; Fig. 10). Sediments range in age from late Eocene to Pleistocene and have been subdivided into three major lithostratigraphic units. Unit I is of Pleistocene age and extends from 0 to 519.8 mbsf. The dominant lithology is silty clay with minor intervals of sandy mud and rare sand beds. The sediment is strongly bioturbated and hydrotroilite stained. The lower portion of this unit is characterized by intervals of soft-sediment deformation and sandy clay with lithic and mud clasts at its base, near seismic reflection pp4(s). Unit II extends from 519.8 to 654.5 mbsf and is late Oligocene to Pliocene in age. The sediment is composed of foraminifer-rich clay, silty clay with numerous discrete burrows, diatomaceous silty nannofossil clay, and clayey to sandy nannofossil chalk. Sand and silt laminae are scattered throughout the unit, and thick beds of glauconite occur toward the base. A major unconformity (late Oligocene to late Eocene) and a sharp contact separates Units II and III. Unit III extends from 654.5 to 663.6 mbsf and is late Eocene in age. The sediment is composed of clay-rich nannofossil chalk and strongly bioturbated nannofossil-rich clay. Tracing of sequence boundaries to Site 1073 permits improved age resolution for boundary pp3(s), which is late Pleistocene (probably less than 0.5 Ma). Shore-based analyses are likely to improve age resolution for the other sequence boundaries. Older surfaces tend to become amalgamated in the slope area. Continued efforts in seismic processing and interpretation, as well as in biostratigraphy, may result in still better estimates.

Biostratigraphic resolution is excellent throughout most of the Pleistocene through late Eocene section. Calcareous nannofossils provide detailed zonations for the stratigraphic interval cored, highlighting the various stratigraphic discontinuities at the base of the cored interval (latest Pliocene through late Eocene). Planktonic foraminifers add to the confidence level of biostratigraphic zonation at Site 1073. Where age calibration is possible using planktonic foraminifers, they are compatible with the nannofossil zonations. Provenance changes indicated by changes in the benthic foraminiferal faunas may be associated with relative sea-level changes in the Pleistocene. When sea level was lowest, the source area of inner neritic benthic foraminifers was closest to Site 1073, facilitating transport of the shallow-water specimens to this location. When sea level was highest, these shallow species migrated landward and may not have been transported across the shelf to the slope. Instead, the source area may have been the outer shelf to upper slope. Early Pleistocene to early Pliocene benthic foraminiferal faunas are dominated by *Uvigerina* spp., analogous to present-day faunas from the northeast U.S. continental margin, where the highest abundances of *U. peregrina* coincide with maxima of organic carbon and silt within slope sediments. The early Miocene section yields a diverse, in situ bathyal benthic foraminiferal assemblage that indicates the paleodepth may have been comparable to the present water depth (~600 m). Late Eocene assemblages at Site 1073 are comparable to coeval faunas from lower-upper to middle bathyal paleodepths (~500-1000 m) reported from the Leg 150 New Jersey slope sites.

Despite many voids caused by gas expansion of the cores, high-resolution continuous records of inclination and magnetization intensity variations were collected for Pleistocene sediments. Two possible short polarity reversals were found within the Brunhes Chron at 15 and 351 mbsf. Magnetic polarity is otherwise normal down to 515 mbsf [close to pp4(s)] with magnetization intensity fluctuating between 0.1 and 20 mA/m. The Brunhes/Matuyama boundary (0.78 Ma) was not found above 515 mbsf. Between 515 and 524 mbsf, the polarity of magnetic inclination shows unstable fluctuations, switching between positive and negative, making it difficult to identify magnetic zones. Between 515 and 519 mbsf, magnetization intensity is ~1 to 5 mA/m. Below 519 mbsf [~pp4(s)], magnetization intensity is generally low, ranging between 0.05 and 1 mA/m, again making it difficult to identify magnetic polarity zones by pass-through measurements on biscuited extended core barrel (XCB) archive sections.

Eighty-three interstitial water samples were taken to examine potential "high-resolution" variability in alkalinity, NH_4^+, and HPO_4^{2-} with depth. Interstitial waters of marine sediment sequences are often characterized by a broad subsurface maximum in alkalinity, NH_4^+, and HPO_4^{2-}, which results from bacterial decomposition of organic matter and subsequent diffusion of ions. However, previous work on the New Jersey slope (ODP Leg 150) noted an unusual (if not unique) observation in scientific ocean drilling: at least four peaks in downhole profiles of alkalinity and HPO_4^{2-}. Limited sampling of interstitial water at Site 903 precluded a detailed investigation of the observation. However, downhole profiles of interstitial water at Site 1073 at significantly higher resolution confirm the observations at Site 903. Five well-defined alkalinity and four HPO_4^{2-} maxima are observed in the upper 500 mbsf (Fig. 11). The maxima appear to exist in interglacial sediment separated by ~90 m and 100 k.y. The maxima indicate that rates of bacterial decomposition of organic matter on the New Jersey slope are highly heterogeneous in time and/or space. The maxima most likely are preserved because extreme sedimentation rates on the New Jersey slope (~900 m/m.y.) prevent diffusive homogenization of interstitial water chemistry.

Gaseous hydrocarbons were monitored in all cores by headspace gas, and, where possible, by analysis of gas voids using the syringe/vacutainer technique. Sediments contain abundant gas below 10 mbsf, and gaseous voids appear below 34 mbsf. Gas contents in cores diminished below 215 mbsf, probably associated with the switch from advanced hydraulic piston corer (APC) to XCB coring. The composition of gas, as expressed by the C_1/C_2 value, shows the expected gradual increase in the relative ethane content with increasing depth and temperature, given the prevailing sedimentation rate and geothermal gradient. Total organic carbon content fluctuates between 0.21 and 0.67 wt%, with peaks at 70, 146, 189, and 239 mbsf.

As at other Leg 174A sites, a number of discontinuities and trends in physical properties measurements coincide with observed lithologic changes, unit boundaries, and interpreted seismic discontinuities. Several sharp changes in density correlate with changes in velocity in the same direction (e.g., both increasing downhole); consequently, they reinforce each other in generating acoustic impedance contrasts. The depths of these physical properties changes are generally consistent with previously estimated depths of seismic discontinuities. Natural gamma radiation measurements include a distinct downward decrease within the early-middle Miocene Subunit IIC, near the predicted level of pp4(s). The Pleistocene section contains several increasing-upward cycles of natural gamma values that may reflect glacial-interglacial cyclicity. Velocity measurements include a strongly increasing interval from 541 to 561 mbsf, which corresponds to an interval of increasing density and thus may define a seismic reflector. Porosity trends may reflect overall depositional cycles associated with Pleistocene glacial-interglacial deposition. Resistivity appears to correlate mainly with porosity, as at other Leg 174A sites. Changes in pore-water chemistry appear to have little influence on resistivity values. At first glance, resistivity measurements from cores appear to correlate well with those obtained by logging, as do velocities and density information.

Acoustic, resistivity, and gamma-ray logging data were obtained successfully to total depth, and a VSP using the WST was conducted to 425 mbsf. Gamma-ray log data show a pronounced cyclicity typified by asymmetric cycles of uphole increases followed by abrupt decreases in natural radioactivity. These cycles in the upper 515 mbsf are interpreted to be a product of sea-level change during the Pleistocene, where the terrigenous contribution to the slope during lowstands favored the accumulation of silts and sands, producing lower gamma-ray values, which were then followed by an increase in clay content and higher gamma-ray values during rising sea levels. The tops of the cycles are attributed to an abrupt coarsening in grain size and a corresponding drop in gamma-ray values. A one-dimensional synthetic seismogram was constructed using sonic log data, which compares favorably to actual seismic data in the upper 425 mbsf. Below 425 mbsf, sonic log values, without corresponding checkshot data, were used, and the correlation between the seismic data and the synthetic decreases.

CONCLUSIONS

The holes drilled on the New Jersey continental shelf and slope on Leg 174A form part of a transect of holes from the slope (ODP Leg 150) to coastal outcrops (150X and 174AX) that constitute the Mid-Atlantic Sea-level Transect. The primary goals of the transect were as follows:

1. *Date sequence boundaries of Oligocene to Holocene age and compare this stratigraphic record with the timing of glacial-eustatic changes inferred from deep-sea $\delta^{18}O$ variations.*
Four prominent seismically imaged unconformity surfaces of middle Miocene to Pliocene-Pleistocene age are probably related to times of falling sea level. Best estimates of ages for these surfaces, from shipboard paleontology and paleomagnetics are: < 0.5 Ma [pp3(s)], >1.1-<7.4 Ma [pp4(s)], 7.4-11.2 Ma [m0.5(s)], and >11.4 Ma [m1(s)]. Higher order cyclicity is most likely present but not resolved with existing seismic reflection data. The precision of ages will improve with postcruise studies, which will include techniques not available on the ship as well as the analysis of additional samples. Older Miocene and Oligocene sequence boundaries were intersected at the slope site, Site 1073, but in an area of marked condensation. Attempts to date these surfaces at geometrically optimal locations on the shelf (Sites 1071 and 1072) were not successful because off the difficulty of maintaining hole stability in unconsolidated sandy sediments in the upper 400 m of the section.

2. *Place constraints on the amplitudes and rates of sea-level change that may have been responsible for unconformity development*.
In the case of the late-middle Miocene to Pleistocene surfaces that were intersected at the shelf sites [pp3(s), pp4(s), m0.5(s) and m1(s)], the water depth fell to close to zero at a point 100 km seaward of the present shoreline. This is indicated by (1) the prominence of offlap (stratal truncation) at these surfaces; (2) the presence of several tens of meters of highstand sand in the

vicinity of clinoform breakpoints/rollovers (points at which the gradient of the shallow paleoshelf steepens seaward from about 0.1° to a slope of about 4-5°), suggesting very shallow-water conditions [m0.5(s) and m1(s)]; and (3) the recovery of probable estuarine/lagoonal sediments in the vicinty of m0.5(s), only 3 km landward of its breakpoint/rollover (Hole 1071F). Sea level probably did not fall significantly below the level of these breakpoints/rollovers. This is indicated primarily by the lack of significant incision/downcutting by rivers at unconformity surfaces (less than 5 m). Lowstand sediments that might have been derived in part by this process are also thin to absent in the vicinity of clinoform toes, although lowstand deposits may be present in deeper water in the vicinity of the continental slope/rise. Lowstand units have been imaged in deep shelf seismic reflection data for several of the older Miocene surfaces. Evidence from benthic foraminifers indicate maximum water depths on the shallow shelf during times of high sea level were around 50-100 m. This implies changes in water depth of ~50-100 m, a figure that can be used to estimate amplitudes of global sea-level change once the local effects of sediment accumulation, compaction, and loading are taken into account.

3. Assess the relationships between depositional facies and sequence architecture.

One of the surprises of Leg 174A was the discovery of an unusual distribution of sediment types between unconformity surfaces related to times of sea-level fall. The shallow shelf for each sedimentary unit between these surfaces is dominated by sediments that accumulated during overall flooding ("transgressive" deposits). Seaward of breakpoints/rollovers, the deeper shelf is dominated by sediments that accumulated during spans in which the shelf was building seaward ("highstand" deposits). One explanation for this arrangement is that the space available for sediment to accumulate was efficiently filled during times of sea-level rise as a result of an abundant supply of sediment during the past 12 million years. The observed distribution departs from the standard conceptual model, widely used in petroleum exploration, in which highstand sediments extend well landward of associated transgressive ones.

4. *Provide a baseline for future scientific ocean drilling that will address the effects and timing of sea-level changes on this and other passive margins*.

For the first time in almost 30 years, scientific ocean drilling attempted to sample a thickly sedimented continental margin in water less than 150 m deep. In challenging drilling conditions, sediments as old as middle Miocene (~12.5 Ma) were sampled on the shelf, and late Eocene (~35 Ma) on the upper slope. A full suite of geophysical logs (including logging while drilling) was obtained from one site on the shelf (Site 1072). Logging data were also acquired in available time at slope Site 1073, including both sonic log and VSP data. The data obtained on Leg 174A represent an important step toward completion of the Mid-Atlantic Sea-level Transect, and they also provide valuable information about the technology that will be needed to drill, core, and log unconsolidated sandy sediments expected beneath the middle and inner shelf.

5. *Relationship between sea-level fluctuations and interstitial-water chemistry: an unexpected result*.

Analyses of interstitial water resulted in two discoveries relevant to the overall sea level and climatic themes of Leg 174A. First, salinity variations with depth observed in pore waters from the shelf are consistent with alternate exposure of the shelf during the Pliocene-Pleistocene and then renewed flooding by seawater. Second, changes in alkalinity and phosphate observed in samples from the thick, late Pleistocene succession of the slope are consistent with variations in the amount or type of buried organic matter, apparently with a periodicity of close to 100,000 yr, and consistent with the time scale of astronomically forced climate change during the Pleistocene.

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FIGURE CAPTIONS

Figure 1. Location of Leg 174A Sites 1071 and 1072 on the outer shelf, and 1073 on the uppermost slope. Also shown are locations of the Leg 174AX Bass River Site on the New Jersey Coastal Plain; Leg 150 Sites 902-906; Leg 150X Island Beach, Atlantic City, and Cape May sites; and proposed MAT Sites 1-13 (offshore) and Corson's Inlet (1998). Ew90-09 multichannel seismic (MCS) lines are shown, along with the location of selected industry seismic profiles.

Figure 2. The high-resolution MCS coverage (collected aboard *R/V Oceanus* in 1995; Oc270) was used to select all sites except MAT-13A, which is located on a Ew90-09 MCS line (see Fig. 1). Swath backscatter/bathymetry data coverage shown was acquired in the Spring of 1996 (Goff et al., 1996); subsequent acquisition (November 1996) is not shown, but now includes the secondary upper slope sites from which Site 1073 was chosen.

Figure 3. Interpreted version of part of Oc270 Profile 885, a dip MCS profile that runs through Site 1071 and within ~150 m of Site 1072. The approximate total depths (TDs) penetrated in Holes 1071A-1071E, 1071F-1071G and Holes 1072A-1072B are indicated (vertical white bars), as are the locations of prominent stratigraphic discontinuities/sequence boundaries (dashed lines), which were identified by tying previously interpreted regional Ew90-09 profiles to the higher resolution Oc270 profiles (Christie-Blick et al., 1992; Mountain et al., 1996; Austin et al., 1996). The "s" designation following the "pp" (provisionally Pliocene-Pleistocene) and "m" (provisionally Miocene) sequence boundary identifications are meant to distinguish the shelf sequence boundaries, targeted for sampling and logging by Leg 174A, from similarly labeled surfaces calibrated on the slope by Leg 150 (Mountain, Miller, Blum, et al., 1994).

Figure 4. Generalized summary for Holes 1071A-1071C and 1071F showing core recovery, lithology, age, lithologic units, and subunits. The column shows the lithology based on recovered cores (data) and inferred for intervals of nonrecovery based on the gamma-ray signature from the first 90 mbsf and a wireline log from the nearby COST-B2 well. B/M = Brunhes/Matuyama boundary.

Figure 5. Age-depth plot, showing the age ranges interpreted from microfossil assemblages at Site 1071. Stratigraphic discontinuities pp3(s), pp4(s), pp5(s), m0.5(s), and m1(s) are also illustrated. Ages quoted in Figure 3 reflect input from this site and from Site 1072.

Figure 6. Interstitial-water Cl^- profiles for Sites 1071 and 1072. Arrow = approximate location of standard seawater Cl^- concentration.

Figure 7. Generalized summary for Hole 1072A showing core recovery, lithology, age, lithologic units and subunits. The columns show the lithology based on recovered cores and inferred lithology for intervals of nonrecovery based on the gamma-ray signature from wireline logs. B/M = Brunhes/Matuyama boundary.

Figure 8. Age-depth plot, showing the age ranges interpreted from microfossil assemblages at Site 1072. Stratigraphic discontinuities pp3(s), pp4(s), and pp5(s) are also illustrated.

Figure 9. Interpreted version of part of Oc270 Profile 32, an approximate strike section running through Site 1073. The approximate TD penetrated in Hole 1073A is indicated (vertical white bar); the approximate depths in mbsf shown on this time section are derived from a velocity function developed from Leg 150 Site 903. The possible locations of prominent stratigraphic discontinuities/sequence boundaries identified on the outer shelf are shown. The "s" designation following the "pp" (provisionally Pliocene-Pleistocene) and "m" (provisionally Miocene) sequence boundary identifications are meant to distinguish the shelf sequence boundaries targeted for sampling and logging by Leg 174A from similarly labeled surfaces calibrated on the slope by Leg 150 (Mountain, Miller, Blum, et al., 1994).

Figure 10. Generalized summary for Hole 1073A showing core recovery, lithology, age, lithologic units and subunits.

Figure 11. Selected concentration depth profiles of interstitial water at Site 1073 with approximate lithostratigraphic boundaries.

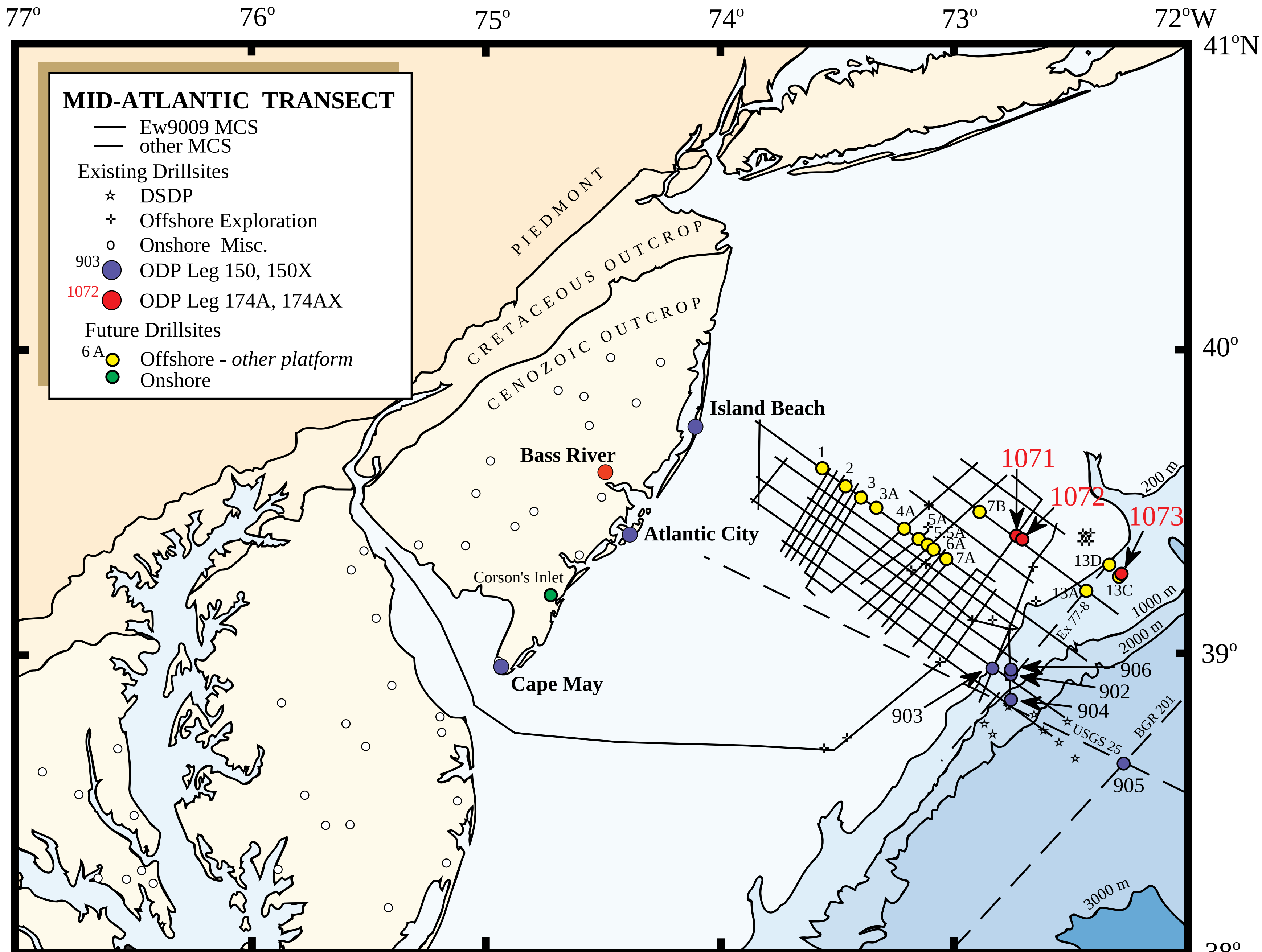

77º
76º
75º
74º
73º
72ºW
41ºN
40º
39º
38º
MID-ATLANTIC TRANSECT
Ew9009 MCS
other MCS
Existing Drillsites
DSDP
Offshore Exploration
Onshore Misc.
903
ODP Leg 150, 150X
1072
ODP Leg 174A, 174AX
Future Drillsites
6 A
Offshore - other platform
Onshore
PIEDMONT
CRETACEOUS OUTCROP
CENOZOIC OUTCROP
Island Beach
Bass River
Atlantic City
Corson's Inlet
Cape May
1071
1072
1073
1
2
3
3A
4A
5A
5.5A
6A
7A
7B
13D
13C
13A
200 m
1000 m
2000 m
3000 m
Ex 77-8
906
902
904
903
905
USGS 25
BGR 201

Figure 1

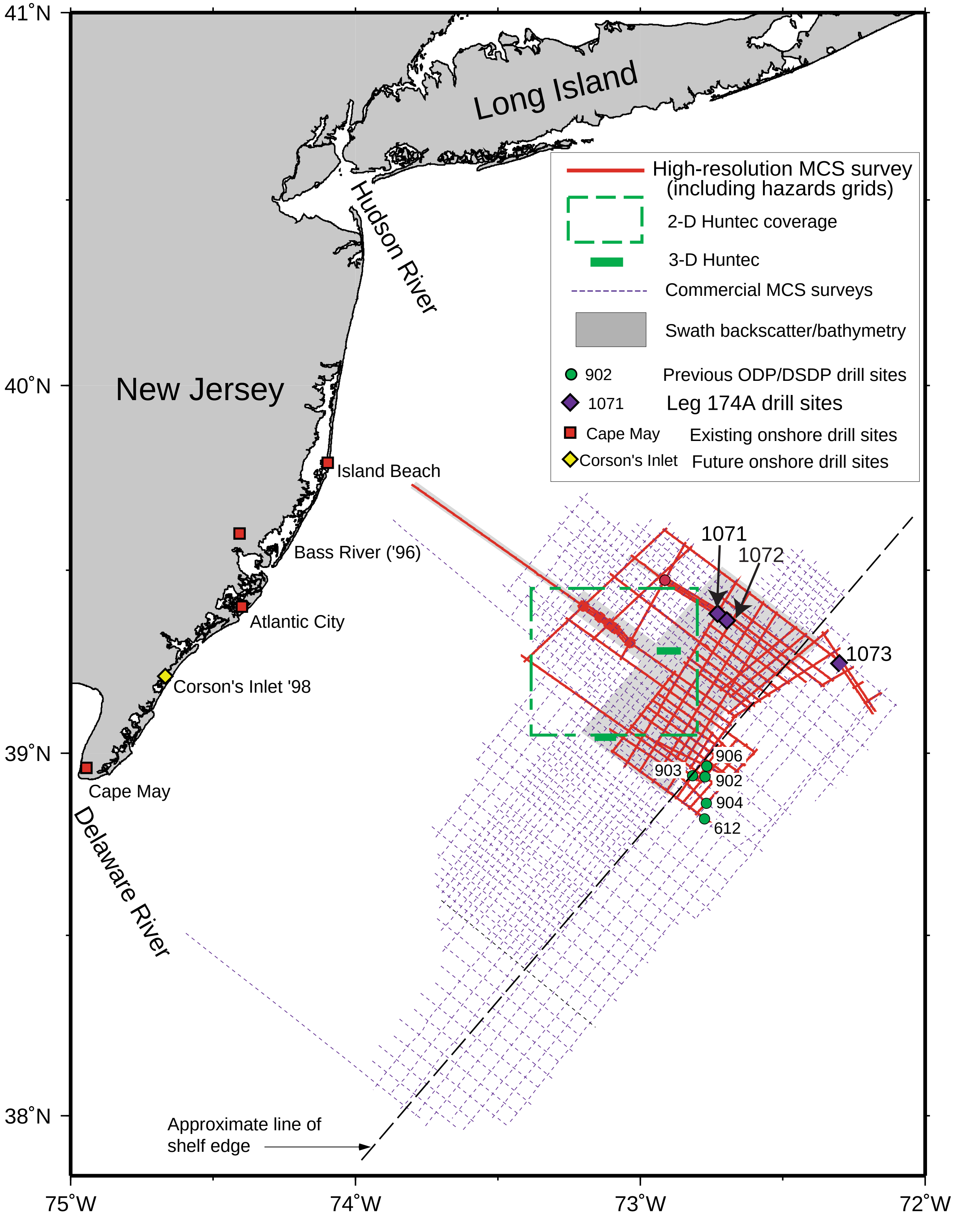

41°N
40°N
39°N
38°N
75°W
74°W
73°W
72°W
Long Island
Hudson River
New Jersey
Island Beach
Bass River ('96)
Atlantic City
Corson's Inlet '98
Cape May
Delaware River
High-resolution MCS survey (including hazards grids)
2-D Huntec coverage
3-D Huntec
Commercial MCS surveys
Swath backscatter/bathymetry
902 Previous ODP/DSDP drill sites
1071 Leg 174A drill sites
Cape May Existing onshore drill sites
Corson's Inlet Future onshore drill sites
1071
1072
1073
906
903
902
904
612
Approximate line of shelf edge

Figure 2

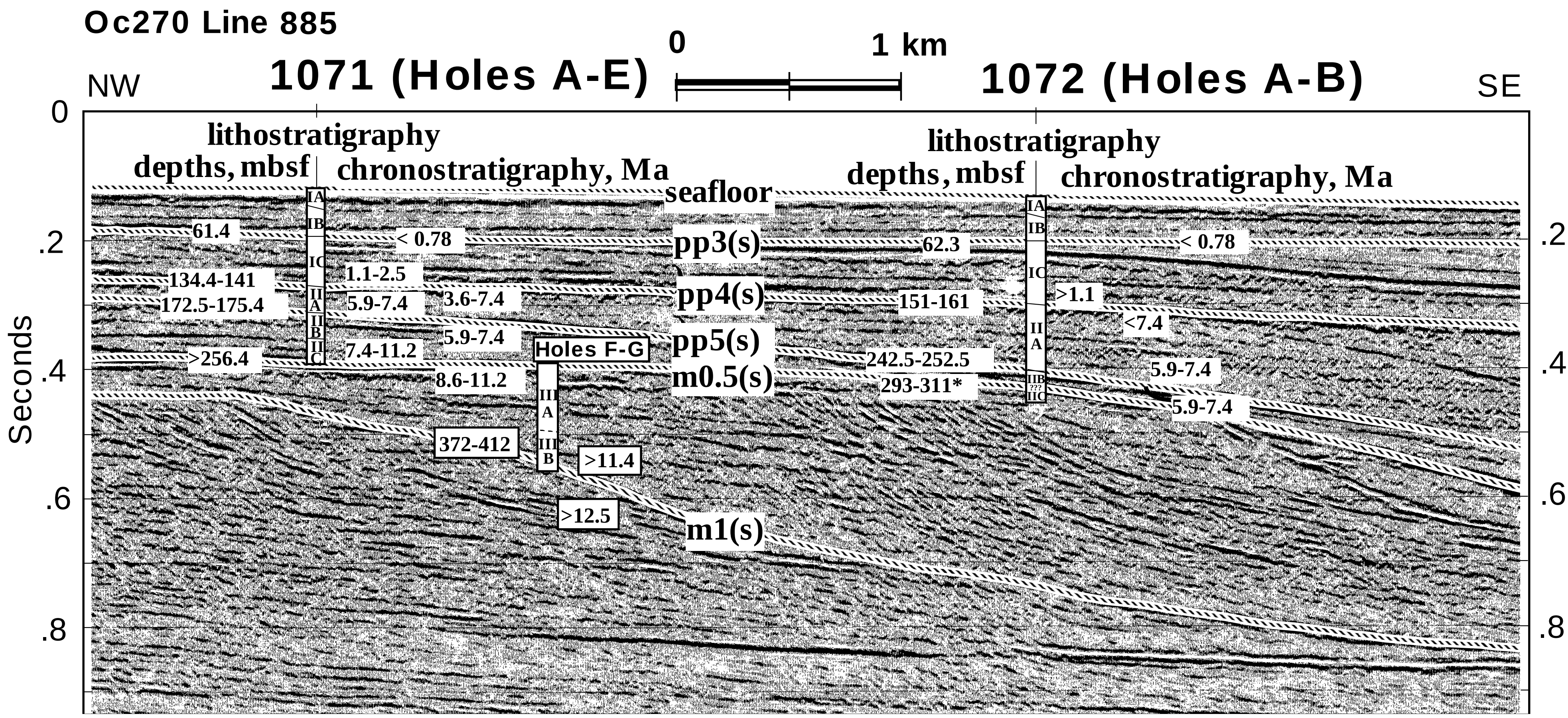

Oc270 Line 885
0
1 km
1071 (Holes A-E)
1072 (Holes A-B)
NW
SE
0
.2
.4
.6
.8
Seconds
lithostratigraphy
depths, mbsf
chronostratigraphy, Ma
seafloor
pp3(s)
pp4(s)
pp5(s)
m0.5(s)
m1(s)
61.4
134.4-141
172.5-175.4
>256.4
IA
IB
IC
II A
II B
II C
< 0.78
1.1-2.5
5.9-7.4
3.6-7.4
5.9-7.4
7.4-11.2
8.6-11.2
Holes F-G
III A
III B
372-412
>11.4
>12.5
62.3
151-161
242.5-252.5
293-311*
II A
IIB
???
IIC
< 0.78
>1.1
<7.4
5.9-7.4
5.9-7.4

Figure 3

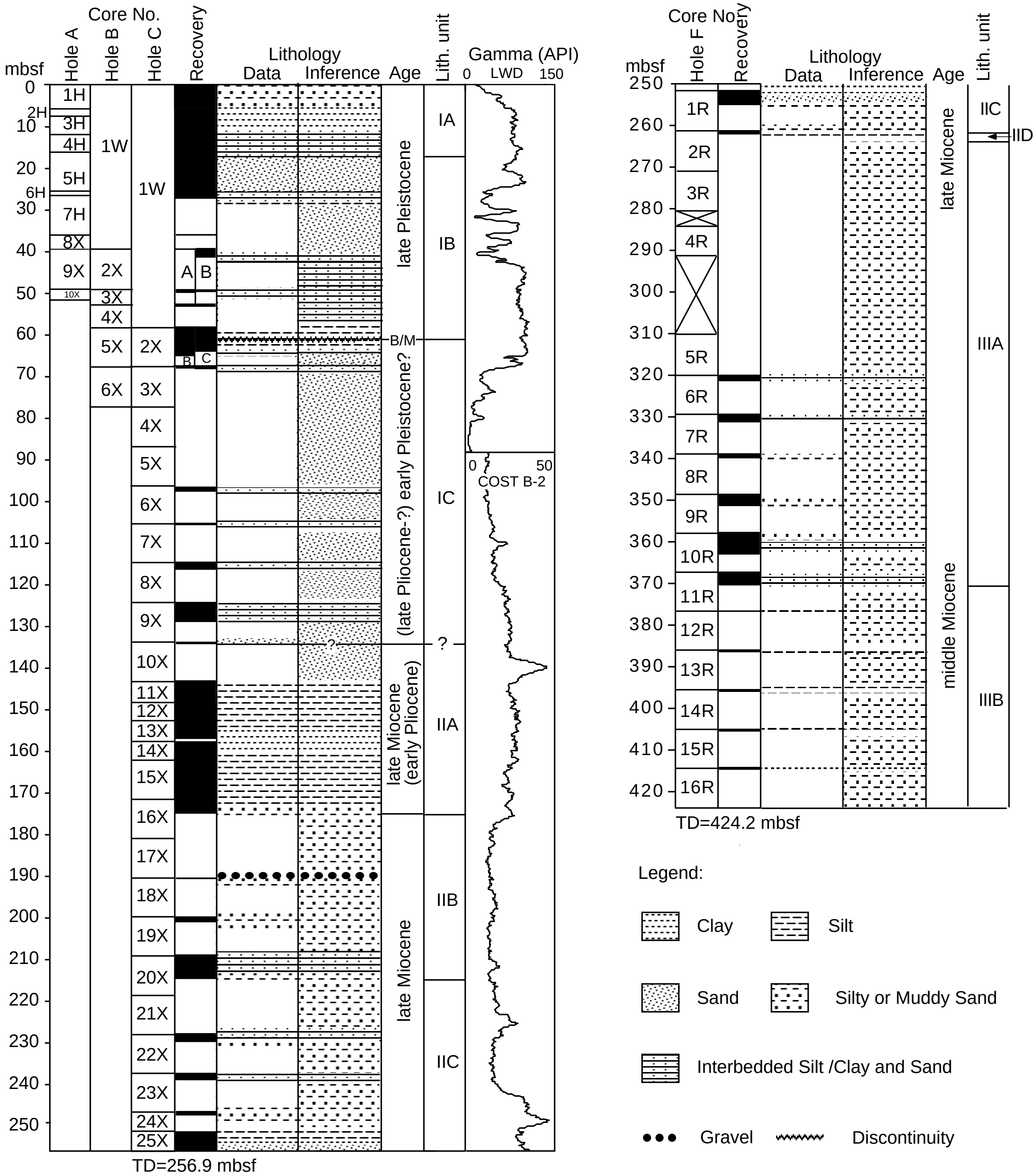

mbsf
Core No.
Hole A
Hole B
Hole C
Recovery
Lithology
Data
Inference
Age
Lith. unit
Gamma (API)
0 LWD 150
0 50
COST B-2
1H
2H
3H
4H
5H
6H
7H
8X
9X
10X
1W
2X
3X
4X
5X
6X
1W
2X
3X
4X
5X
6X
7X
8X
9X
10X
11X
12X
13X
14X
15X
16X
17X
18X
19X
20X
21X
22X
23X
24X
25X
A
B
B
C
late Pleistocene
(late Pliocene-?) early Pleistocene?
late Miocene (early Pliocene)
late Miocene
IA
IB
IC
IIA
IIB
IIC
B/M
?
TD=256.9 mbsf
Core No.
Hole F
Recovery
Lithology
Data
Inference
Age
Lith. unit
1R
2R
3R
4R
5R
6R
7R
8R
9R
10R
11R
12R
13R
14R
15R
16R
late Miocene
middle Miocene
IIC
IID
IIIA
IIIB
TD=424.2 mbsf
Legend:
Clay
Silt
Sand
Silty or Muddy Sand
Interbedded Silt /Clay and Sand
Gravel
Discontinuity

Figure 4

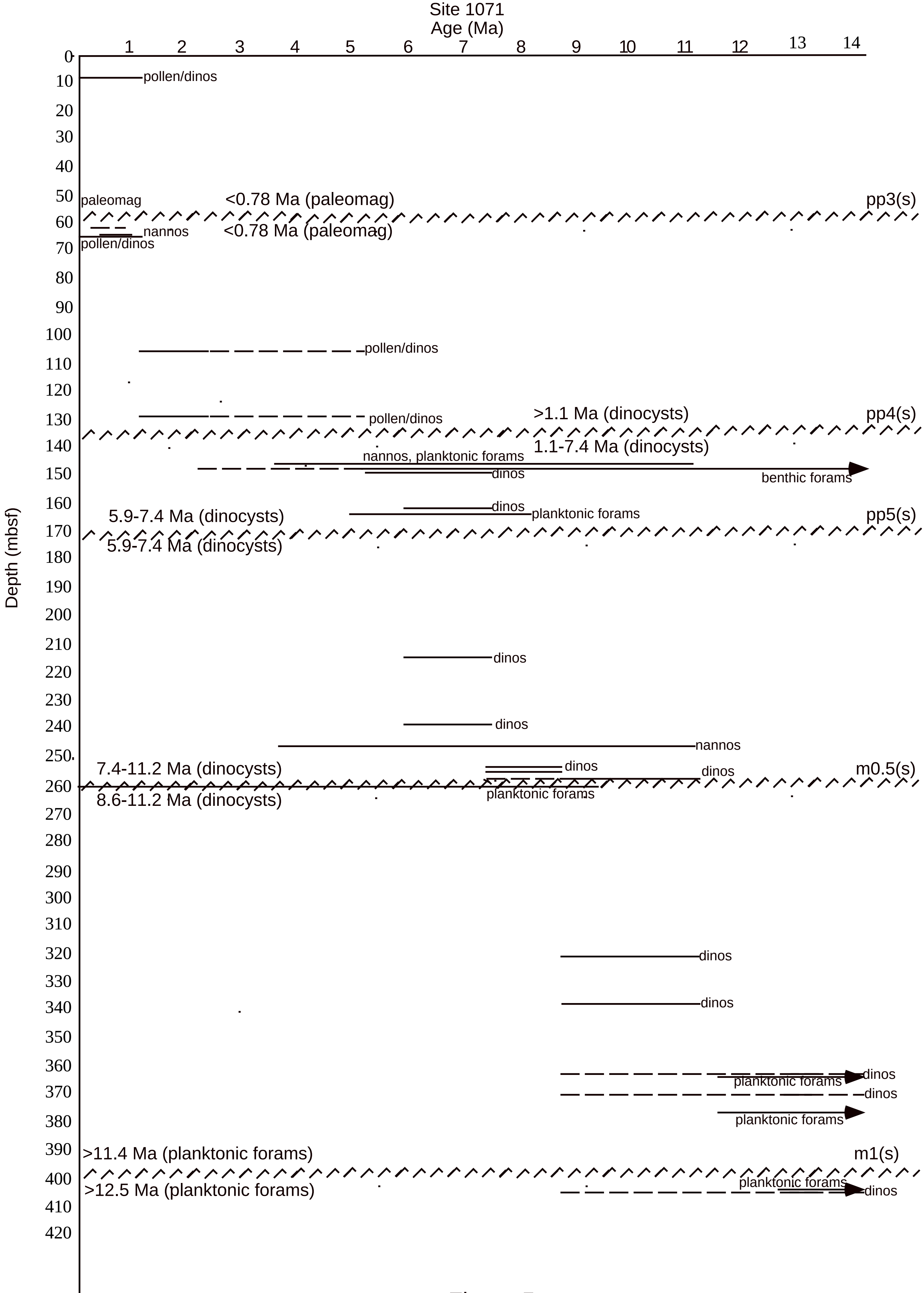

Site 1071
Age (Ma)
Depth (mbsf)
pollen/dinos
paleomag
<0.78 Ma (paleomag)
pp3(s)
nannos
<0.78 Ma (paleomag)
pollen/dinos
pollen/dinos
pollen/dinos
>1.1 Ma (dinocysts)
pp4(s)
1.1-7.4 Ma (dinocysts)
nannos, planktonic forams
dinos
benthic forams
dinos
planktonic forams
5.9-7.4 Ma (dinocysts)
pp5(s)
5.9-7.4 Ma (dinocysts)
dinos
dinos
nannos
7.4-11.2 Ma (dinocysts)
dinos
dinos
m0.5(s)
planktonic forams
8.6-11.2 Ma (dinocysts)
dinos
dinos
dinos
planktonic forams
dinos
planktonic forams
>11.4 Ma (planktonic forams)
m1(s)
>12.5 Ma (planktonic forams)
planktonic forams
dinos

Figure 5

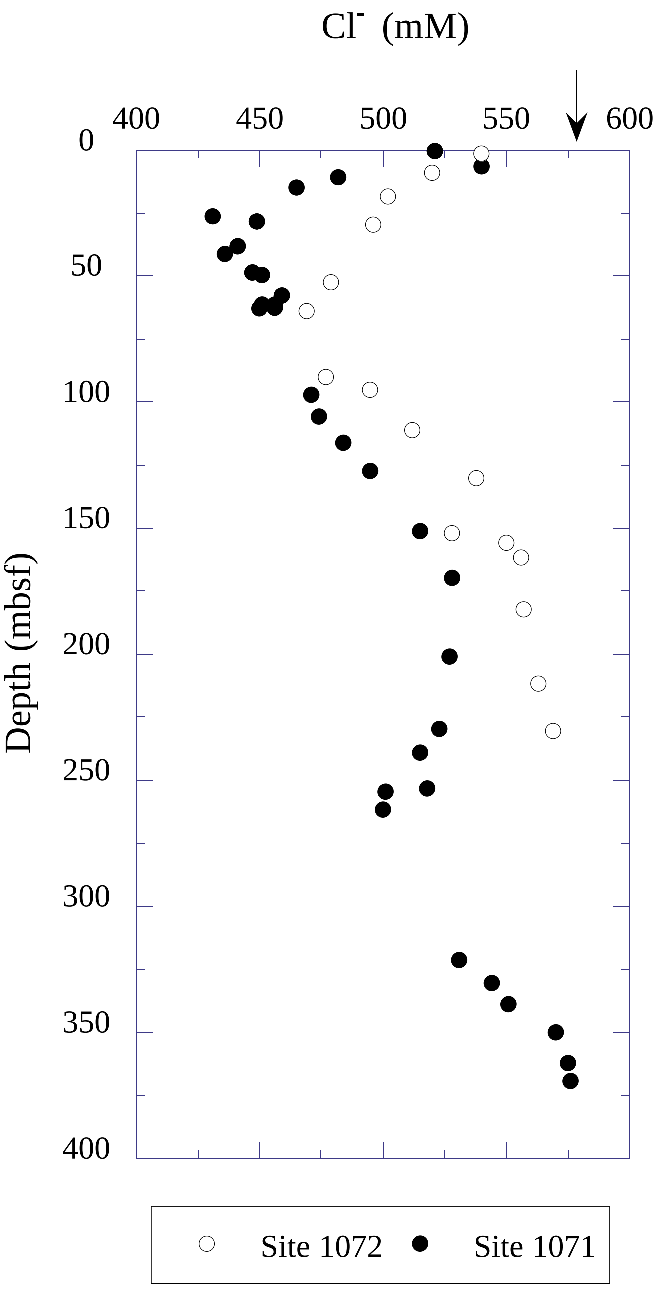
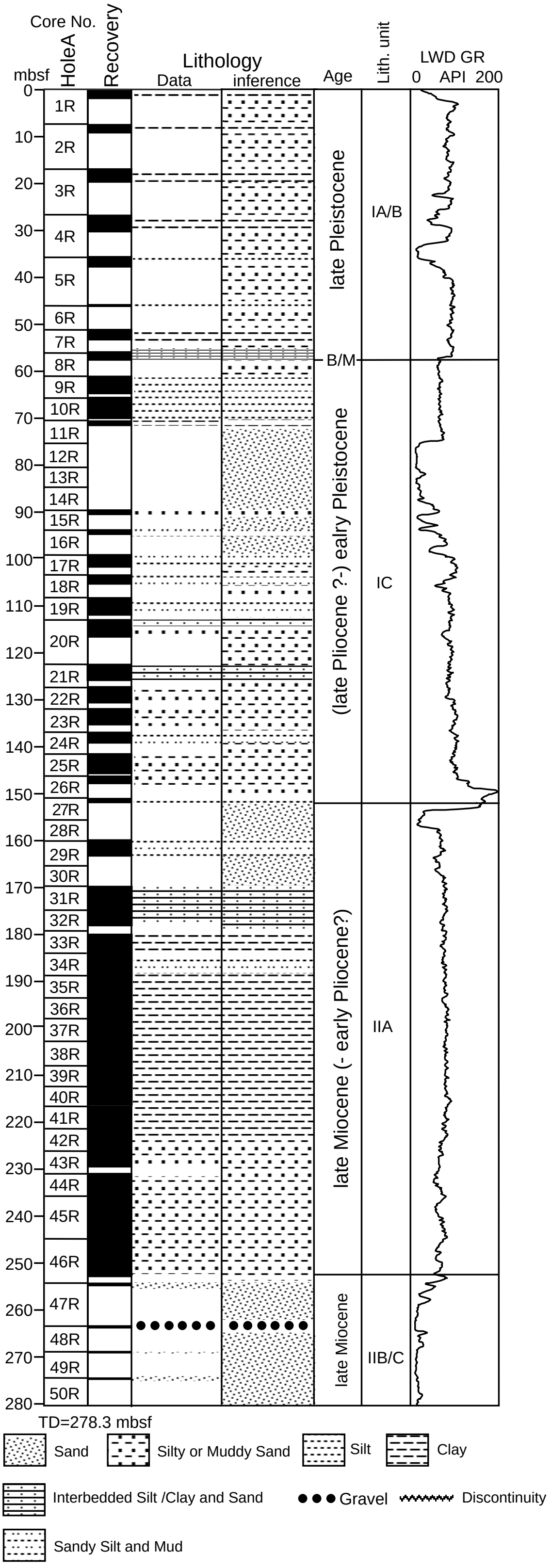

Cl⁻ (mM)
400
450
500
550
600
0
50
100
150
200
250
300
350
400
Depth (mbsf)
Site 1072
Site 1071

Figure 6



Core No.
mbsf
HoleA
Recovery
Lithology
Data
inference
Age
Lith. unit
LWD GR
0 API 200
1R
2R
3R
4R
5R
6R
7R
8R
9R
10R
11R
12R
13R
14R
15R
16R
17R
18R
19R
20R
21R
22R
23R
24R
25R
26R
27R
28R
29R
30R
31R
32R
33R
34R
35R
36R
37R
38R
39R
40R
41R
42R
43R
44R
45R
46R
47R
48R
49R
50R
late Pleistocene
B/M
(late Pliocene ?-) ealry Pleistocene
late Miocene (- early Pliocene?)
late Miocene
IA/B
IC
IIA
IIB/C
TD=278.3 mbsf
Sand
Silty or Muddy Sand
Silt
Clay
Interbedded Silt /Clay and Sand
Gravel
Discontinuity
Sandy Silt and Mud

Figure 7

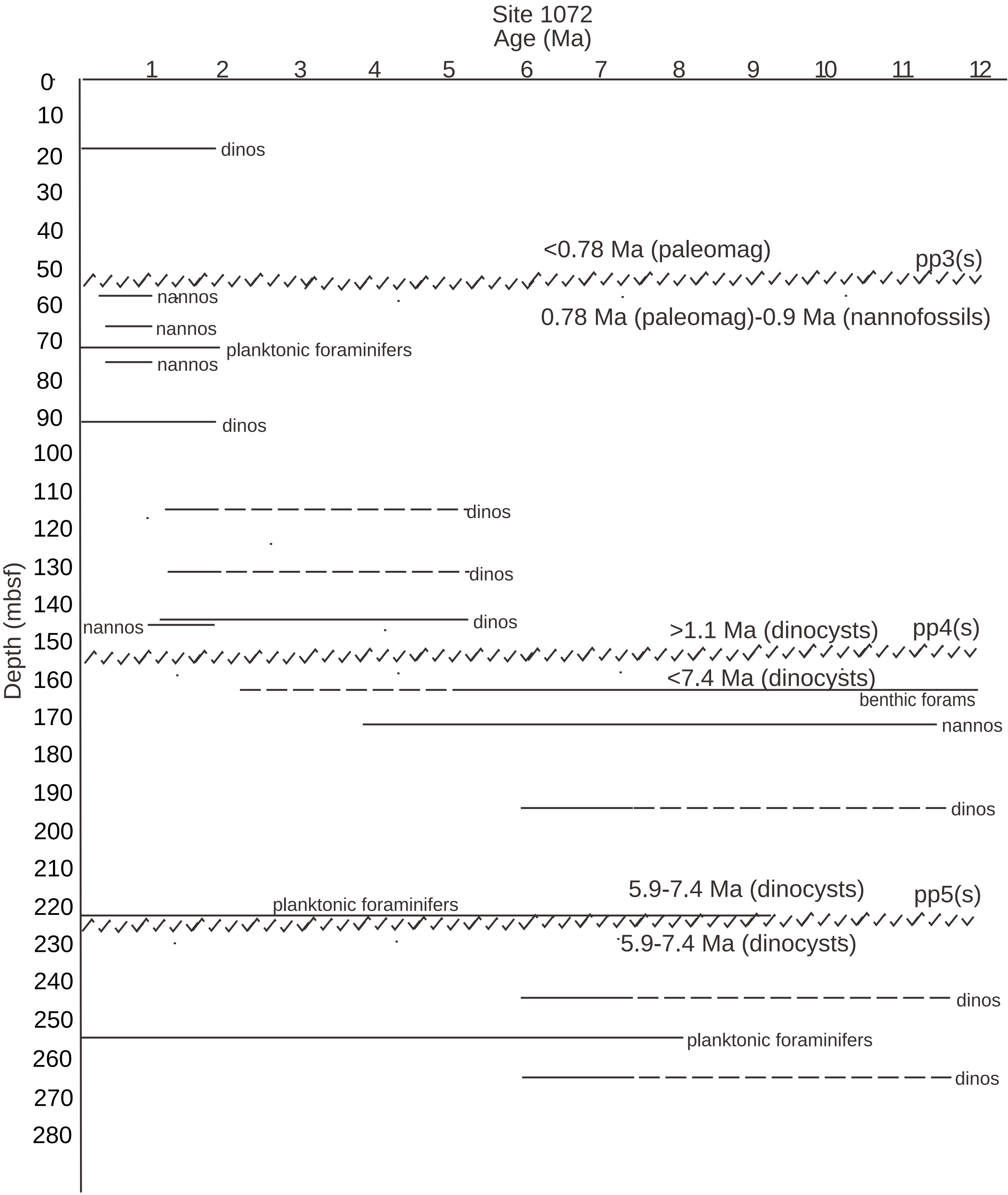

Site 1072
Age (Ma)
1
2
3
4
5
6
7
8
9
10
11
12
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
Depth (mbsf)
dinos
<0.78 Ma (paleomag)
pp3(s)
nannos
0.78 Ma (paleomag)-0.9 Ma (nannofossils)
nannos
planktonic foraminifers
nannos
dinos
dinos
dinos
dinos
nannos
>1.1 Ma (dinocysts)
pp4(s)
<7.4 Ma (dinocysts)
benthic forams
nannos
dinos
5.9-7.4 Ma (dinocysts)
pp5(s)
planktonic foraminifers
5.9-7.4 Ma (dinocysts)
dinos
planktonic foraminifers
dinos

Figure 8

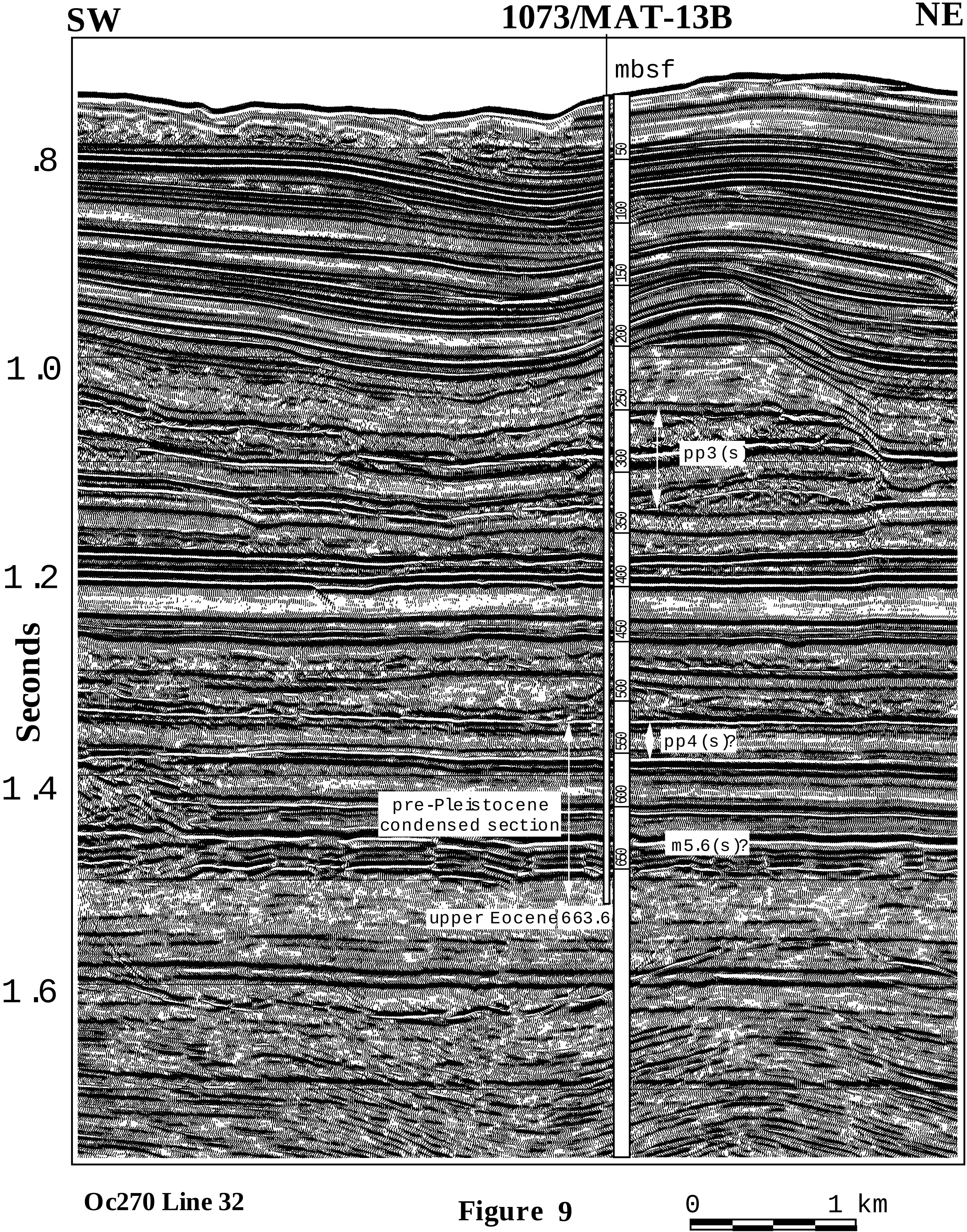

SW
1073/MAT-13B
NE
mbsf
.8
1.0
1.2
1.4
1.6
Seconds
50
100
150
200
250
300
350
400
450
500
550
600
650
pp3(s)
pp4(s)?
m5.6(s)?
pre-Pleistocene
condensed section
upper Eocene
663.6
Oc270 Line 32
0
1 km

Figure 9

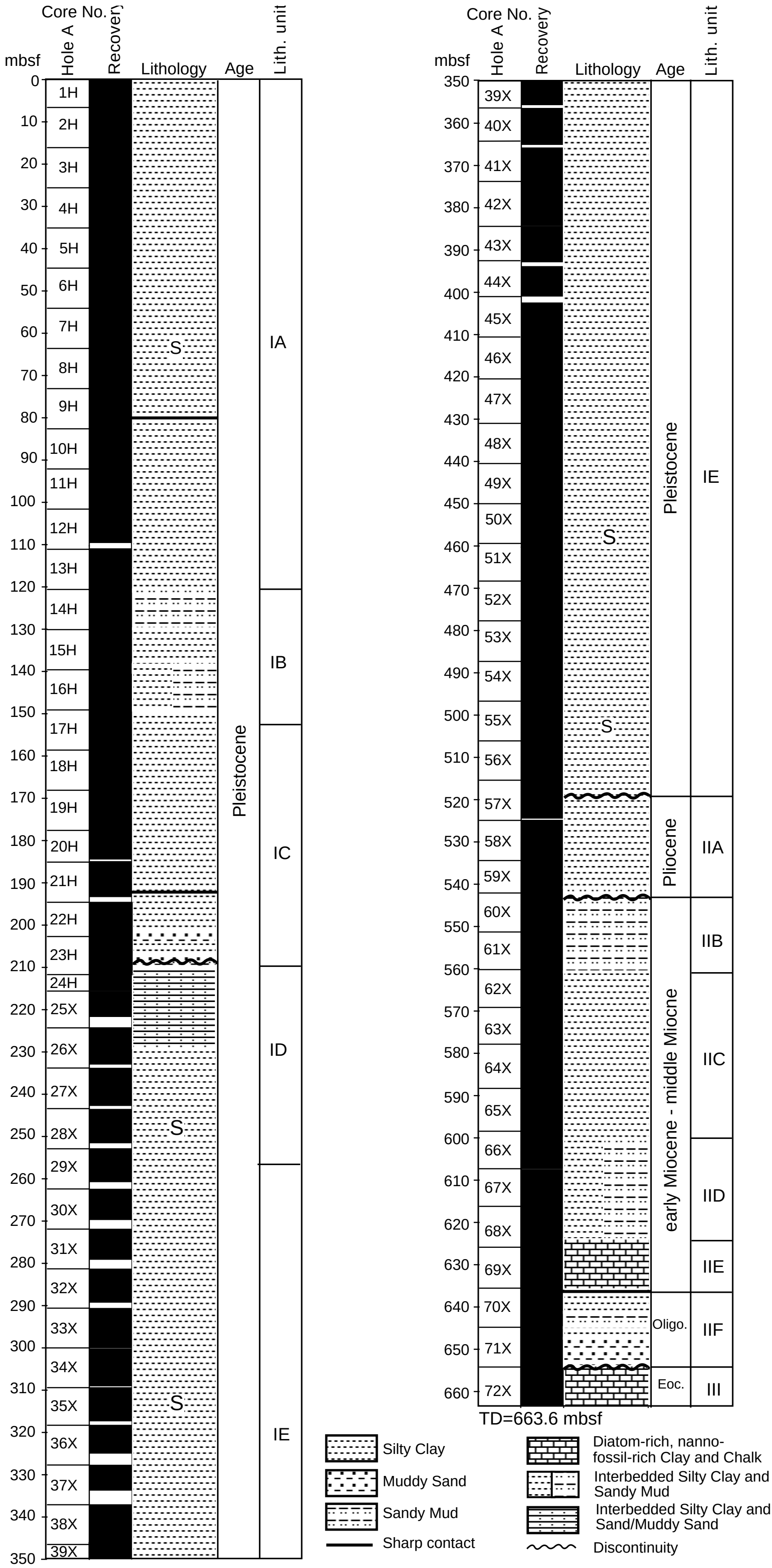

Core No.
Hole A
Recovery
mbsf
Lithology
Age
Lith. unit
1H 2H 3H 4H 5H 6H 7H 8H 9H 10H 11H 12H 13H 14H 15H 16H 17H 18H 19H 20H 21H 22H 23H 24H 25X 26X 27X 28X 29X 30X 31X 32X 33X 34X 35X 36X 37X 38X 39X
39X 40X 41X 42X 43X 44X 45X 46X 47X 48X 49X 50X 51X 52X 53X 54X 55X 56X 57X 58X 59X 60X 61X 62X 63X 64X 65X 66X 67X 68X 69X 70X 71X 72X
S
Pleistocene
Pliocene
early Miocene - middle Miocne
Oligo.
Eoc.
IA
IB
IC
ID
IE
IIA
IIB
IIC
IID
IIE
IIF
III
TD=663.6 mbsf
Silty Clay
Muddy Sand
Sandy Mud
Sharp contact
Diatom-rich, nanno-fossil-rich Clay and Chalk
Interbedded Silty Clay and Sandy Mud
Interbedded Silty Clay and Sand/Muddy Sand
Discontinuity

Figure 10

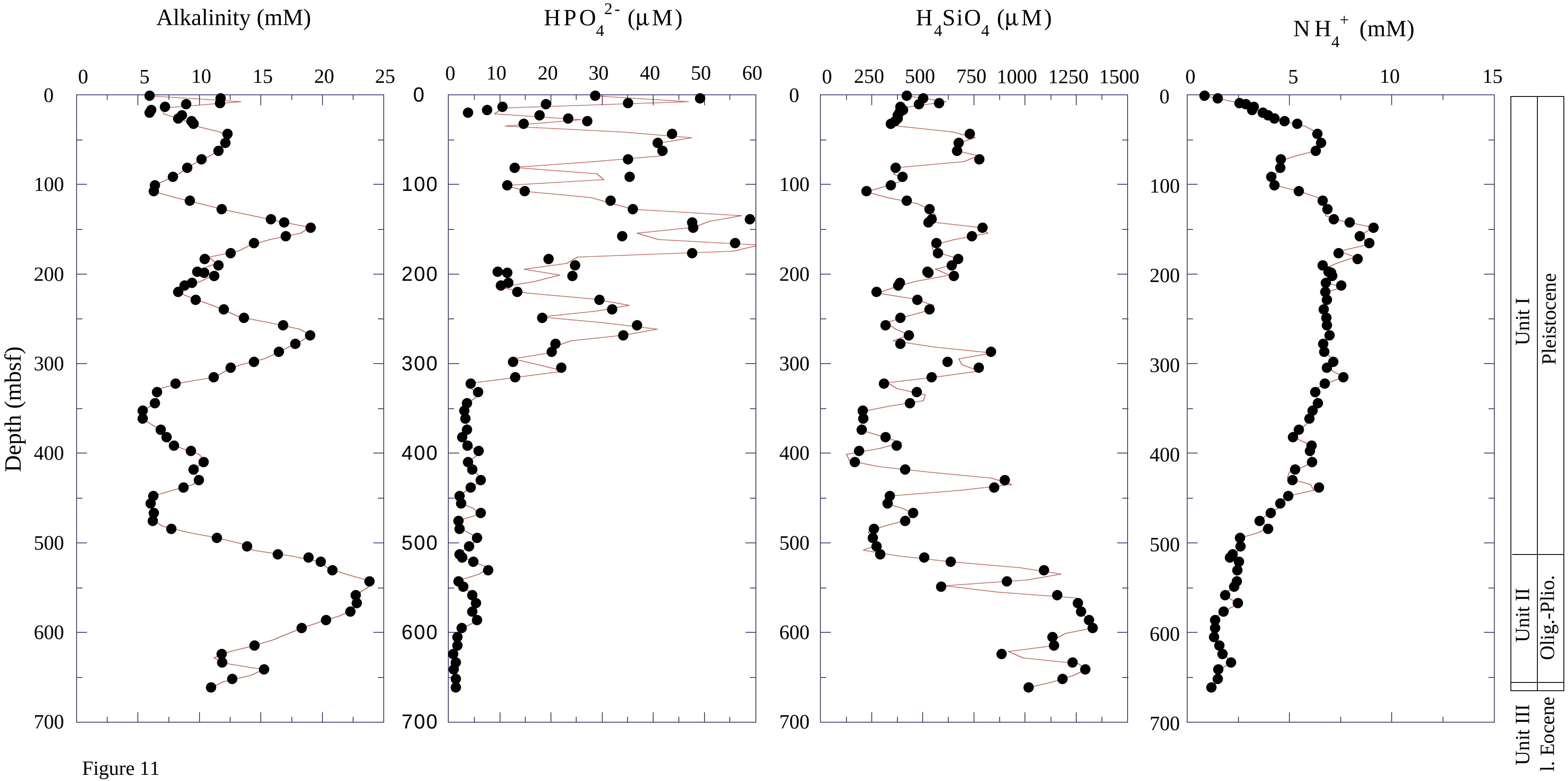

Alkalinity (mM)
HPO4 2- (μM)
H4SiO4 (μM)
NH4 + (mM)
Depth (mbsf)
0 5 10 15 20 25
0 10 20 30 40 50 60
0 250 500 750 1000 1250 1500
0 5 10 15
0 100 200 300 400 500 600 700
Unit I
Pleistocene
Unit II
Olig.-Plio.
Unit III
l. Eocene

Figure 11

OPERATION SYNOPSIS

The drilling and engineering personnel aboard the *JOIDES Resolution* for Leg 174A were:

Operations Manager	Gene Pollard
Operations Engineer	Brian Jonasson
Schlumberger Engineer	Steve Kittredge
Anadrill Engineer	Thomas Horton

TRANSIT TO SITE 1071

The vessel departed Halifax at 1812 hr on Friday, 20 June, 1997. The 578-nmi transit to Site 1071 was accomplished at an average speed of 10.8 kt. The vessel arrived on location at 2330 hr on 22 June, 1997. All times reported are in local time (U.S. Eastern Time Zone; UTC = 4 hr).

SITE 1071
(Proposed Site MAT-8B-3)

Hole 1071A

At 0009 hr on 23 June, the first beacon (14.0 kHz, 193 dB) was dropped on the dynamic global positioning system (dGPS) coordinates for prospectus Site MAT-8B-3. During the process of stabilizing the ship on site, it became apparent that the automatic station keeping (ASK) system was experiencing short, unstable periods. At the time, it was assumed that strong bottom or eddy currents were causing the beacons to drift off location or flutter. Subsequently, it was determined that the beacon was dropped 20.7 m southwest of the intended location; this was assumed to be an artifact of an unstable dGPS signal (±20 m). As the beacon's transmission signal angle provides a signal radius of ~15 m in 90 m water depth, the 20.7-m offset was considered unacceptable for shallow-water operations.

A second beacon (17.0 kHz, 193 dB), equipped with a bar through the anchor weight to prevent rolling, was dropped at 0302 hr; however, its signal was unstable. A third, more powerful beacon

(15.0 kHz, 205 dB) was dropped at 0326 hr, but it had to be turned off because it was interfering with reception of the first beacon's signal. A fourth beacon (16.0 kHz, 198 dB) was dropped at 0720 hr; it landed ~12 m northeast of Hole 1071A, providing a dependable signal relative to previous beacons. The second and third beacons were released and retrieved. However, the ASK system was still experiencing ~1.5 min unstable intervals when beacon signals were poor, which was attributed to beacon motion in changing currents. Consequently, a 1-m high stand with an angle-iron square base and drill-string guide rings was constructed out of scrap casing to place a beacon exactly on site and prevent its fluctuation in currents. A fifth beacon (15.0 kHz, 193 dB) was placed in this stand, and dropped to the seafloor along the pipe with the bit on bottom. Although the ASK system was still experiencing occasional signal losses from the two remaining active beacons, one in the stand and one on a tether, the improvement in the ship's dGPS system stability affected by the ODP technical staff in the meantime allowed coring operations to commence.

The APC/XCB bottom-hole assembly (BHA) was run to 78 meters below rig floor (mbrf), followed by the vibration-isolated television (VIT) frame. A reference survey (video and sonar) was conducted on a 7.6-m square and revealed a clean, flat seafloor. Hole 1071A was spudded at 1300 hr on 23 June, cutting APC Cores 1071A-1H through 7H from 0 to 36.3 mbsf (76.4% recovery). The bit tagged a firm bottom at 98.0 mbrf. The distance between the rig floor and sea level was 11.1 m, thus, the water depth was 88.3 meters below sea level (mbsl). All seven cores were partial strokes with the bit advanced by recovery. Core 6H recovered liquified sand, which is assumed to be mostly suck-in. Core 7H had a shattered liner that had to be heated and pumped out, which required 2 hr.

XCB Cores 1071A-8X through 10X were cut from 36.3 to 51.9 mbsf with 7.0% recovery. The coring parameters were varied in an unsuccessful effort to optimize recovery. A Davis-Villinger Temperature Probe (DVTP) was run after Core 9X at 49.3 mbsf. At 2330 hr on 23 June, a ground fault was detected in the top drive. Further investigation indicated that the motor field windings had burned out. Coring was terminated and the bit was pulled to complete repairs, clearing the rotary at 0355 hr, and ending Hole 1071A. Replacement of the top drive motor with a spare carried on board required 25 hr.

Hole 1071B

During the top drive repairs, the ship was moved 10 m at 35˚ (along seismic Line 806 in the direction of proposed Site MAT-8B-2). The same APC/XCB BHA used at Hole 1071A was rerun with a 10-1/8-in. PDC bit. The bit was set at 93 mbrf, and an APC core was attempted at 0817 hr on 25 June; however, the BHA apparently moved and broke off the APC shoe and core barrel with no recovery. ASK excursion warnings, set at 4% (yellow light) and 8% (red light) of total water depth, shut down operations for 2.75 hr on 25 June.

Hole 1071B was spudded at 0945 hr on 25 June with an XCB core barrel. Although the beacons were now reasonably stable, the ASK system was still experiencing numerous excursions. Therefore, the decision was made to drill ahead to bury the drill collars, and put a more flexible drill pipe in the water column below the ship. Therefore, Hole 1071B was washed from 0 to 39.8 mbsf, and a 1.31 m wash core (1071B-1W) was recovered. Cores 1071B-2X through 3X were cut from 39.8 to 52.9 mbsf, recovering 2.69 m (20.5%).

At 1515 hr on 25 June, the newly installed top drive began smoking. A jammed or dragging air brake was suspected; therefore, the bit was pulled out to the seafloor at 1610 hr on 25 June. The brake recess was cleaned out and the top drive was returned to service after 3.25 hr.

The ship position had not changed, and the bit voluntarily reentered Hole 1071B at 1845 hr. The bit was run to bottom of the hole with very light reaming. A sepiolite mud sweep was conducted at 53 mbsf and XCB coring resumed. Cores 1071B-4X through 6X were recovered from 52.9 to 77.4 mbsf with 33.9% recovery. At 77.3 mbsf at 2200 hr on 25 June, the pipe became stuck when the bit was run to bottom for Core 7X. The pipe was worked to 100,000 lb overpull and 800 amps torque when the top drive failed. Unable to rotate or circulate, the pipe was pulled to 150,000 lb without success. Preparations were made to sever the pipe; however, a final effort to fracture the formation with 3000 psi pump pressure at 500 gpm and 30 bbl of sepiolite mud freed the pipe at 2245 hr. The bit was pulled to the ship for the top-drive repairs, and cleared the rotary at 0115 hr.

Parts were scavenged from the original (now backup) top drive to replace a pinion gear that had slipped down off the draft shaft; repairs were completed at 1845 on 26 June after 17.5 hr downtime.

Hole 1071C

During the third top-drive repair, the ship was moved 6.7 m at 261˚ from Hole 1071B to Hole 1071C to permit time for ASK stability evaluation. Utilizing the same BHA and bit with an XCB core barrel, Hole 1071C was spudded at 2035 hr on 26 June. To get the BHA buried as quickly as possible, the hole was washed to 58.4 mbsf; wash Core 1071C-1W had no recovery.

XCB coring was initiated, but the drill pipe became stuck after Core 1071C-4X (83.3 mbsf), stalling the rotary; the pipe would not move with 60,000 lb overpull. The drill pipe was freed after setting weight down on the BHA and increasing pump pressure and circulation. XCB Cores 2X through 20X were cut from 58.4 to 219.0 mbsf with 29.1% recovery. A 20-bbl precautionary sepiolite mud sweep was circulated on every core to clean out loose coarse sand.

At 2230 hr on June 27, after Core 20X (219.0 mbsf), an ASK red light (8%) alert was sounded when a tidal surge caused a 30.5-m excursion. As a precaution, the pipe was set in the 500-ton elevators with a maximum pull of 10,000 lb. A wiper trip was made to 94 mbrf to examine the pipe located at the seafloor, which was essentially undamaged. The pipe was run back to bottom with no fill.

XCB Cores 1071C-21X through 24X were taken from 219.0 to 251.6 mbsf with 16.1% recovery. A heavy back flow of fluid and coarse sand pushed core barrel 25X back out of the pipe. Fluid flow initially reached the top drive located halfway up the derrick and deposited ~5 cm of coarse sand and shell debris on the rig floor. No hydrocarbons had been noted in the previous core or in the water flowing out of the pipe; therefore, there did not appear to be a safety risk either to equipment or to personnel. Despite the heavy back flow, the drill string seemed to remain free. A precautionary 20-bbl sepiolite mud sweep was circulated in an effort to remove any loose sand bridges, but it had no effect on flow. The initial conclusion was that the lockable float valve (LFV) had failed in the XCB assembly and that a charged aquifer had been penetrated, allowing fluid to vent up the pipe. However, subsequent chemical analyses of both the fluid and surface seawater indicated that the flowing water was in fact drilling fluid.

The bit was pulled to 74.8 mbsf, the core barrel was retrieved, and the VIT was deployed to view the hole at the seafloor. An 8-m wide, round crater with billowing water and sand was observed, but no strong flow was evident. Two 4-m-long pock marks indenting the side of the crater indicated where the drill pipe had been forced into the crater rim during previous ASK excursions. The BHA was then pulled to the ship, and the LFV was replaced with a flapper valve (FV), in which the flapper is normally closed (by a spring) and does not lock open to permit wireline logging. Hole 1071C was reentered easily and cleaned out to 251.6 mbsf through a few minor soft bridges.

XCB Cores 25X through 27X were recovered from 251.6 to 257.4 mbsf. A 0.3-m-thick well-indurated sandstone was recovered in Core 26X; the core barrel was pulled early because of the slow rate of penetration (ROP; 0.4 m/hr). After cutting Core 27X through an estimated 0.25 m of the sandstone and 2-3 m of very soft, presumably sandy, material, the pipe became stuck at 257.4 mbsf at 2115 hr on 28 June. The pipe was moved up 2 m with overpulls of up to 220,000 lb in an unsuccessful attempt to free the drill string. Wireline logging through the pipe was considered, but logging could not be attempted because pipe connection positions above the rig floor were unsuitable for breaking the string to insert logging tools. Efforts to sever the pipe were then delayed for 2.25 hr because eddy currents set off ASK system alerts. At 0225 hr on 29 June, the pipe was severed at 130.2 mbsf, between the top two joints of 5-in drill pipe. The pipe cleared the rig floor at 0500 hr, 7.75 hr after getting stuck, ending Hole 1071C.

Transit back to Site 1071

The ship was moved in dynamic positioning (DP) mode 1.9 nmi west from Site 1072, returning to Hole 1071C. A beacon (18.0 kHz) was deployed through the moonpool at 1910 hr on 7 July, followed by a second beacon (15.0 kHz) at 1940 hr.

Hole 1071D

In previous holes, Site 1071 was cored only with the APC/XCB system, and was plagued by unstable hole problems. However, the upper 350 mbsf at Site 1072 had been successfully cored with the smaller diameter (11-7/16 in. vs. 9-7/8 in.) rotary core barrel (RCB) coring system. We returned to Site 1071 in an attempt to RCB core down through the upper 250 mbsf and deepen the hole. The seafloor was tagged at 88 mbsl (99.4 mbrf), and Hole 1071D was spudded at 2100 hr on 7 July. RCB Cores 1072D-1R through 12R were cut from 0 to 85.7 mbsf; however, recovery was negligible despite taking half-cores. In an effort to improve recovery, the pump rate was reduced by 50%, but the pipe stuck going back to bottom with core barrel 13R. The pipe was worked with up to 150,000 lb overpull and 1100 amps (maximum allowed) without success, and the aft counter-balance sling on the top drive was broken in the process. The core barrel was removed through the top of the blocks, and the pipe was worked in tight hole about 6 m higher. The pipe came free while circulating at 1000 gpm and slacking off weight (until the pipe stood up in the elevators) with 1100 amps torque. The bit was pulled through the rotary at 1240 hr on 8 July.

Hole 1071E

A last attempt was made to drill down through the unstable sands at Site 1071 to log and core the remaining section quickly before hole instability became a problem. The ship was moved 15 m at 125° past hole 1071A, but was moved back 12 m to maintain positioning using two beacons. The seafloor was tagged at 87.6 mbsl (99.0 mbrf), and Hole 1071E was spudded at 1510 hr on 8 July, drilling to 259.8 mbsf using 20-bbl mud sweeps every 19 m. A short trip was made to 45 mbsf and found 15.6 m of soft fill. The hole was displaced with sepiolite mud, and the drilling BHA was pulled to change to a logging BHA rather than drop the bit in the hole. The bit change took 4 hr, and a VIT-TV survey of the seafloor showed a 3-m diameter crater with the beacon container from Hole 1071A in view and still upright. The logging bit was positioned at 45.8 mbsf after reaming fill at 39 m. The digital dual induction tool/long-spaced sonic/natural-gamma spectrometry (DITE/LSS/NGTC) logging tool was unable to pass 60 mbsf (15 m below the bit). The logging bit was washed to 74 mbsf, and another attempt was made to log. The logging tool only got 7 m out of the pipe while the pipe was standing up in the elevators, indicating that it was stuck, with a heavy flow-back of seawater and fine sand indicating the hole was collapsing. The pipe was freed and pulled out, clearing the rotary at 2015 hr on 9 July, ending Hole 1071E.

Hole 1071F

Approval was received to move to two alternate sites in the MAT-8B hazards survey grid, which were projected to have higher silt and clay content in deeper objectives than proposed Site MAT-8B-3. Approval also was given to keep the same Site 1071 designation and drill through the unstable upper section to 250 m. The ship was moved in DP mode about 1 km northeast to proposed Site MAT-8B-4. A bottom survey was conducted over a flat, featureless seafloor.

The seafloor was tagged at 90 mbsl (101.5 mbrf), and Hole 1071F was spudded at 0027 hr on 10 July, drilling from 0 to 230.0 mbsf, where the pipe became stuck. The drill pipe was worked by setting weight down on the BHA, and using high torque (900 amps) and high circulation rates (700 gpm at 175 psi). The hole was reamed to 53.5 mbsf with the top drive, and 12 m of fill was cleaned out. Drilling continued from 230.0 to 233.5 mbsf, where the pipe became stuck again. The pipe was freed as before using high circulation rates and torques. Shortly thereafter, ASK system alarms shut down operations for 2.24 hr, after which the hole was then drilled ahead from 233.5 to 252.0 mbsf. RCB Cores 1071F-1R through 3R were recovered from 252.0 to 280.1 mbsf; however, torque and drag were high through this presumed sandy interval. The pipe was conditioned by reaming out and back in with the top drive, then drilling from 280.1 to 284.9 mbsf. Coring resumed with Core-4R (284.9-291.9 mbsf), but with no recovery. Therefore, the interval from 291.9 to 310 mbsf was drilled after which coring resumed with Cores 1071F-5R through 16R from 310.8 through 424.2 mbsf. Low recovery in Cores 12R to 16R suggested another interval of unconsolidated sands, so we decided it was prudent to cease coring operations and attempt to obtain logs to total depth.

A wiper trip was made to 43 mbrf, experiencing no drag or overpull with 48 m of fill. The bit was released in the hole, the hole was displaced with sepiolite mud, and the pipe was pulled out with the top drive to 53 mbsf for logging. During the first logging run, the LSS/DITE logging tool stopped 21 m below the end of pipe. The open-ended pipe was washed down to 87.7 mbsf;

however, the hole appeared to be closing in rapidly. Therefore, logging was terminated and the pipe cleared the rotary at 0840 hr on 12 July ending Hole 1071F.

Hole 1071G

A final attempt was made to obtain logs using the LWD tools. The ship was moved 15 m at 35°. The seafloor was tagged at 90 mbsl (101.5 mbrf), and Hole 1071G was spudded at 1247 hr on 12 July. The hole was drilled with the LWD assembly to 95.1 mbsf in 4.5 hr; however, the pipe became stuck after making the next connection. Attempts to free the pipe with increased circulation rates, mud sweeps, and use of the jars were unsuccessful; therefore, it was assumed that the top of the hole had collapsed. Consequently, it was necessary to run the LWD Linc tool to retrieve the radioactive sources and download the logging data. Preparations were being made to sever the pipe, when the pipe came free and was retrieved. The bit cleared the rotary at 2315 hr, ending Hole 1071G.

SITE 1072
(Proposed Site MAT-9B-1)

Hole 1072A

The ship was moved in DP mode 1.9 nmi along the trend of site-specific seismic lines bearing ~125° from Site 1071 to the dGPS coordinates for proposed Site MAT-9B-1. Observations of the tethered beacon vs. the constrained beacon at Site 1071 suggested that the beacon signal problem was related to beacon offset distance and not current disturbance of beacon attitude. Two-meter tethers were used again because they were successful at Site 1071; historically, shorter tethers have caused the beacons to collide with the weights on impact. The ship was positioned with the moonpool over Hole 1072A for both beacon drops. The first beacon (15.0 kHz) was dropped at 0723 hr on 29 June and moved 10 m at 161° before settling. A second beacon (17.0 kHz) was dropped at 0750 hr on 29 June and moved 23 m at 187°. A TV and sonar survey was conducted on a 6-m square pattern centered on the site coordinates, with no bottom obstructions observed.

One of the beacons experienced a signal loss when the hole was spudded (about 3 m away), and periodically thereafter during wireline operations, which suggested that, ideally, beacons should be offset about 7 m from the hole to avoid acoustic interference. The one working dGPS unit was more stable than regular GPS; nevertheless, it experienced periods when it drifted despite efforts to stabilize it. Shore-based assistance was sought to get the other dGPS unit to work. The occasional drift in dGPS (±4 m) may have exacerbated apparent beacon drift.

The RCB coring system was selected over APC/XCB to determine if the anticipated increase in ROP and smaller bit diameter might produce a more stable hole and achieve better recovery than was achieved at Site 1071. The seafloor was tagged at 98.2 mbsl (109.5 mbrf), and Hole 1072A was spudded at 1400 hr on 29 June. RCB Cores 1R through 51R were recovered from 0 to 282.8 mbsf. Half-cores (5-m advances) were taken to increase recovery. Mud sweeps were required to keep the hole clean after nearly every core (and sometimes every half-core) over the entire interval, using 920 bbl of sepiolite mud in Hole 1072A (four times the normal usage). After Core 51R, increasing pump pressures and torque indicated possible hole sloughing, but mud sweeps cleared the problem. Coring continued with RCB Cores 52R through 55R from 282.8 to 301.8 mbsf. Again, torque and pressure indicated continuing hole problems; therefore, a wiper trip was made to 229.6 mbsf. Core 56R was recovered from 301.8 to 306.8 mbsf, but hole problems persisted despite additional mud sweeps.

Another wiper trip was made to 214 mbsf, and the hole was displaced with sepiolite mud in an effort to stabilize the sands for logging. The pipe was pulled to the ship with heavy backflow to 91 mbsf. The seafloor was then surveyed with the VIT-TV and sonar; a 4-m-diameter slightly irregular crater at the seafloor was observed. The closer beacon was noted to be on the edge of this crater. The hole appeared to be back-flowing water and sand, possibly from being overpressured during drilling. A wiper trip was made to 296 mbsf, and 20 m of fill was tagged. The hole was displaced with sepiolite mud again, and the RCB bit was pulled to the ship to prepare for logging.

The open hole was reentered with sonar because the crater was obscured by what appeared to be flowing sand and water. The bit was stopped at 63 mbsf for logging. A triple combo

(DITE/HLDT/APS [slim-hole lithodensity tool/accelerator porosity sonde]) log was run to 300 mbsf (9 m off bottom) in 2.75 hr. While preparing for the next logging run, the drill pipe began to stand up out of the elevators, indicating that the pipe was stuck. An unsuccessful effort was made to free the pipe by working it in gradually increasing increments from 20,000 to 200,000 lb overpull and by circulating through the hose at pump pressures from 500 to 2500 psi at 300-1000 gpm. It was not possible to pick up the top drive or break the connection. A string shot was fired below the bit in hopes that the sand bridge could be knocked loose; however, the pipe remained stuck. The pipe was severed with an explosive charge at the top of the tapered drill collar at 23.5 mbsf and was pulled free with 100,000 lb overpull. The pipe cleared the rotary table at 1500 hr on 2 July, ending Hole 1072A.

Hole 1072B

Subsequent discussions concluded that coring delays (from wireline operations) and hole disturbance from the additional circulation required to clean Hole 1072A (so circulation could be stopped to retrieve core barrels) could have aggravated hole stability in sandy intervals. We concluded that a smaller dedicated logging hole could be drilled and logged quickly, with better hole conditions. Therefore, the ship was moved in DP mode 20 m southeast along a seismic line bearing 125° from Hole 1072A. Observations of the beacon farther from Hole 1072A proved that the signal was not adequate for positioning at the new hole; therefore, the beacon was released. The ship was positioned with the moonpool over the intended spud point, and a new beacon (15.0 kHz, 193 dB) was dropped at 1530 hr on 2 July; however, the beacon moved 10 m at 304°, apparently due to current. The initial operational plan was to drill a LWD hole to 300 mbsf, and possibly also run wireline logs; however, a decision was made to drill the hole for wireline logs first, then further evaluate formation stability before attempting a LWD run. Hole 1072B was spudded at 2340 hr on 2 July and drilled to 306.8 mbsf at 20.1 m/hr with sepiolite mud sweeps every other connection (19 m). A wiper trip was made to 71 mbsf, with 10,000 lb maximum overpull and drag and flow-back pressure to 90 mbsf and 10 m fill. A second wiper trip was made to 250 mbsf, and the hole was filled with sepiolite again.

The persistent hole problems may have been due in part to weak and unstable silty sands at 30-40 mbsf, which sloughed and enlarged the hole diameter and/or fractures and resulted in lost circulation. Both effects eventually resulted in reduced annular fluid velocity, which caused cuttings to collect in the upper hole rather than circulate out to the seafloor. The cuttings eventually formed a bridge, impeded vertical flow, increased annular pressure (and lost circulation), and packed-off the hole, causing the pipe to stick.

The seafloor was surveyed with the VIT-TV and sonar on the trip for the logging bit. The open hole was obscured by a boiling cloud (suggesting possible flow-back from drilling operations), but it was reentered in 1 hr using sonar. The bit was positioned at 45 mbsf, because lateral motion there would be confined by unusually stiff clays near the seafloor. The DITE/Sonic/NGT tool was run, but it would not pass 90 mbsf. A wiper trip was made from 30 to 102 mbsf with circulation and light reaming. The hole was displaced with sepiolite mud, and the pipe was positioned again at 45 mbsf. The DITE/Sonic/NGT and FMS/NGT tools were run successfully to 295.5 mbsf (11.3 m off bottom) in 4 hr. A vertical seismic profile (VSP) log was run to the same depth with Schlumberger's well seismic tool (WST) tool in 3 hr. The reentry/logging bit cleared the rotary at 2100 hr on 4 July.

The RCB BHA was rerun, and Hole 1072B was reentered. The bit took weight at 17 mbsf, indicating persistent closure of the upper hole from 20 to 60 mbsf. The hole was reamed through five tight spots and 8.5 m fill to 306.8 mbsf TD. RCB Cores 1072B-1R through 6R were cut from 306.8 to 358.6 mbsf; however, coring was terminated after penetrating nearly 100 m of presumed unconsolidated sand with negligible recovery. Continued penetration of the sands may have endangered another BHA without any significant scientific return, so it was judged prudent by all parties to cease operations at Hole 1072B. The pipe was pulled at 1610 hr on 5 July, ending Hole 1072B.

Hole 1072C

The successful drilling and logging operations conducted in Hole 1072B indicated that a nearly identical hole could safely be drilled using Schlumberger-Anadrill LWD tools. The ship was moved 30 m at a 125° heading from Hole 1072B to assure the best possible hole conditions and avoid any disturbance from lost circulation at the previously drilled holes. A beacon (15.0 kHz, 193 dB) was deployed through the moonpool at 1650 hr on 5 July, which moved 4.3 m at 310°. Another beacon (15.0 kHz, 193 dB) was deployed through the moonpool at 1700 hr and moved 21 m at 265°. The ship was moved another 5 m at a 125° heading to maintain offset distance from the first beacon.

The initial LWD plan called for drilling to 125 mbsf without the jars (to avoid flexing the jars above the seafloor), pulling out of the hole and picking up the jars, then reentering and wiping through the upper hole before continuing. The bit tagged bottom at 99.5 mbsl (111.0 mbrf), and Hole 1072C was spudded at 2030 hr on 5 July and drilled to 106.9 mbsf in 6 hr. The ROP was controlled to 25 m/hr. The bit was pulled above the seafloor to add the jars; an overpull of 30,000 lb up to 91 mbsf and 10K lb up to 29 mbsf was noted, indicating that the upper hole was closing in or packing off. The jars were added to the BHA, and the VIT was deployed for reentry; however, an electrical short was noted in the TV cable. The VIT repair was estimated to take 18 hr; therefore, a decision was made to continue LWD logging, either with a blind reentry into Hole 1072C or by spudding a new hole. The seafloor crater for Hole 1072C was located by offsetting the ship a few feet and feeling for bottom with the bit, but efforts to make a blind reentry were not successful. Hole 1072C officially ended at 0335 hr on 6 July when the bit cleared the seafloor.

Hole 1072D

The ship was moved 14.6 m at a heading of 305° from Hole 1072C, back toward Hole 1072B. The LWD BHA was reconfigured by taking out two drill collars, so the jars could be run at spud-in and no reentry was required. The seafloor was tagged at 99.5 mbsl (111.0 mbrf), and Hole 1072D was spudded at 1030 hr on 6 July. The LWD hole was drilled from 0 to 110.4 m. Previous hole problems dictated that extra precautions be taken with the LWD tools, jars, and BHA. Soft clays from 0 to 30 mbsf had been squeezing into the annulus and packing-off previous holes; therefore, a precautionary wiper trip was made with the top drive to 32.8 mbsf, and the BHA was run back to bottom with 10,000 lb maximum drag and 4 m of fill. Drilling continued in the LWD hole from 110.4 to 233.4 mbsf. A second precautionary wiper trip was made with the top drive to 32.8 mbsf with 10,000 lb maximum overpull, and the BHA was run back to bottom with 5,000 lb maximum drag and 18 m fill. Drilling continued in the LWD hole from 233.4 to 356.0 mbsf. The LWD BHA was pulled and successfully cleared the rotary at 1825 hr on 7 July, officially ending Hole 1072D.

SITE 1073
(Proposed Site MAT-13B)

The ship was moved 23 nmi (42.6 km) to prospectus Site MAT-13B. Hole 1073A was spudded at 1710 hr on 13 July. The calculated depth of the seafloor based on recovery of the mudline core was 639.4 mbsl (650.9 mbrf). APC Cores 1073A-1H through 24H were cut from 0 to 215.7 mbsf in soft gassy sediments. Cores were oriented from Core 3H, and Adara temperature tool heat-flow measurements were taken at Cores 4H, 6H, and 8H (35°C/km). APC coring was terminated following four partial strokes, 40,000 lb overpull, and a shattered liner. XCB Cores 25X through 72X were recovered from 215.7 to 663.6 mbsf. The hole walls appeared to be stable, but it was suspected that soft clays extruded into the wellbore even a few hours after being wiped. Bentonite mud sweeps were circulated about every other core to keep the hole clean.

The hole was circulated and a wiper trip was made in preparation for logging. Soft clay ledges took weight and would not pump off; therefore, five 2- to 5-m-thick intervals from 647 to 568 mbsf had to be reamed. Six meters of fill on bottom was noted, and the hole was circulated; however, the hole was not filled with mud because the sepiolite mud supply had been exhausted by the heavy usage during shelf drilling operations and the hole had been stable throughout operations before logging. The bit was pulled to 87.4 mbsf for logging.

A LSS/DITE/NGT log was obtained in the upper section of hole, when the tool could not be worked past 287 mbsf. The obstruction was in a section of the hole that had just been reamed (with rotation) on the conditioning trip to log the hole; therefore, we chose not to employ the Conical Side Entry Sub in favor of running the bit back down to maintain the ability to rotate. The bit was placed at 359.5 mbsf, and the LSS/DITE/NGT log was rerun to 651 mbsf (12 m off bottom).

It appeared that the hole was rapidly closing as the result of swelling clays, and the WST tool could only be worked down to 424 mbsf. Three VSP/WST stations were obtained. The DITE/HLDT/APS/HNGS log was run to 650 mbsf (13 m off bottom). The bottom of the hole seemed to be closing in again; therefore, the pipe was pulled to 247.4 mbsf. The LSS/DITE/NGT log was run from 384 mbsf, completing that log. The pipe was pulled to 87.4 mbsf, and nine VSP/WST stations were completed in the upper hole from 285 mbsf. Operations were then terminated, as available time was depleted. The pipe was pulled, the bit clearing the rotary at 1535 hr on 17 July, ending Hole 1073A.

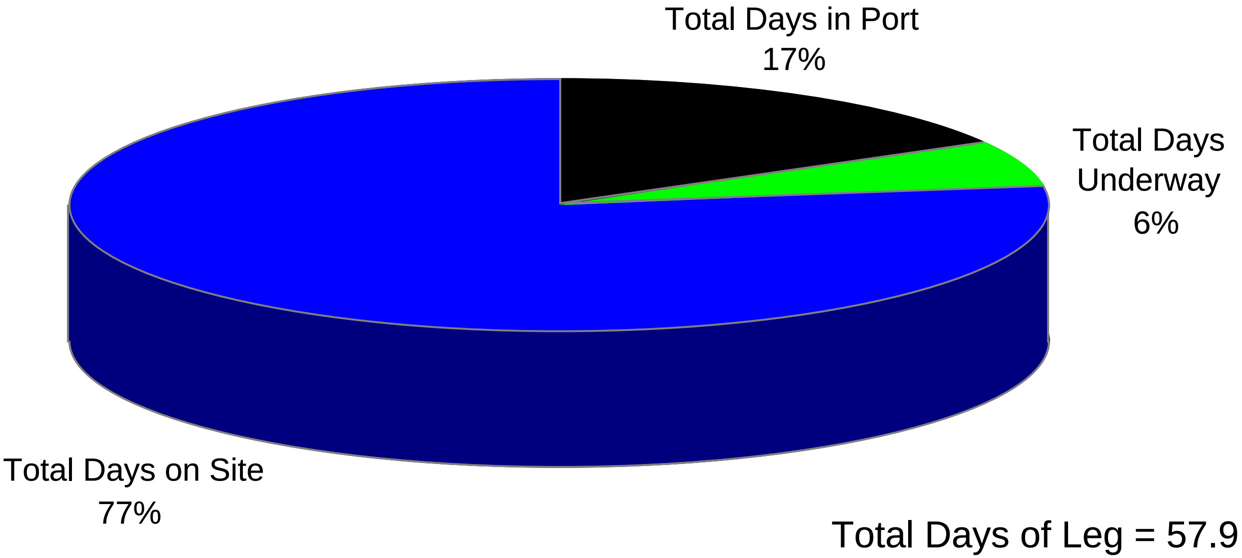
OCEAN DRILLING PROGRAM
OPERATIONS RESUME
LEG 174A

Total Days (15 June 1997 to 19 July 1997)	**34.38**
Total Days in Port	**5.74**
Total Days Underway	**2.00**
Total Days on Site	**26.63**

	days
Coring	**7.86**
Tripping Time	**2.52**
Logging/Downhole Science	**6.28**
Mechanical Repair Time (Contractor)	**2.41**
Stuck pipe/Hole Trouble	**2.48**
Reentry Time	**0.47**
W.O.W.	**0.00**
Drilling	**2.29**
Other	**2.33**

Total Distance Traveled (nautical miles)	
Average Speed Transit (knots):	**720.0**
Number of Sites	**10.8**
Number of Holes	**12**
Number of Cores Attempted	**202**
Total Interval Cored (m)	**1544.4**
Total Core Recovery (m)	**946.5**
% Core Recovery	**61.29**
Total Interval Drilled (m)	**1498.4**
Total Penetration	**3042.8**
Maximum Penetration (m)	**663.6**
Minimum Penetration (m)	**51.9**
Maximum Water Depth (m from drilling datum)	**650.9**
Minimum Water Depth (m from drilling datum)	**99.4**

LEG 174A
TOTAL TIME DISTRIBUTION



OCEAN DRILLING PROGRAM
SITE SUMMARY
LEG 174A

HOLE	LATITUDE	LONGITUDE	WATER DEPTH (mbrf)	NUMBER OF CORES	INTERVAL CORED (meters)	CORE RECOVERED (meters)	PERCENT RECOVERED	DRILLED (meters)	TOTAL PENETRATION (meters)	TIME ON HOLE (hours)	TIME ON SITE (days)
1071A	39°22.9446'N	72°43.6830'W	99.4	10	51.9	28.85	55.6%	0.0	51.9	125.42	5.23
1071B	39°22.9477'N	72°43.6789'W	99.4	5	37.6	11.00	29.3%	39.8	77.4	45.33	1.89
1071C	39°22.9486'N	72°43.6827'W	99.4	25	198.5	67.55	34.0%	58.4	256.9	59.50	2.48
1071D	39°22.9449'N	72°43.6888'W	99.4	12	85.7	3.98	4.6%	0.0	85.7	18.25	0.76
1071E	39°22.9410'N	72°43.6831'W	99.4	drill for logging	-----	-----	-----	259.8	259.8	31.58	1.32
1071F	39°22.9321'N	72°42.9398'W	101.5	16	148.5	20.07	13.5%	275.7	424.2	78.67	3.28
1071G	39°22.9374'N	72°42.9334'W	101.5	LWD	-----	-----	-----	95.1	95.1	19.33	0.81
		SITE 1071 TOTALS:		**68**	**522.2**	**131.45**	**25.2%**	**728.8**	**1251.0**	**378.08**	**15.75**
1072A	39°21.9370'N	72°41.6750'W	109.5	56	306.8	151.87	49.5%	0.0	306.8	82.00	3.42
1072B	39°21.9305'N	72°41.6647'W	109.5	6	51.8	0.03	0.1%	306.8	358.6	73.17	3.05
1072C	39°21.921'N	72°41.644'W	111.0	LWD	-----	-----	-----	106.9	106.9	17.58	0.73
1072D	39°21.9256'N	72°41.6523'W	111.0	LWD	-----	-----	-----	355.9	355.9	32.67	1.36
		SITE 1072 TOTALS:		**62**	**358.6**	**151.90**	**42.4%**	**769.6**	**1128.2**	**205.42**	**8.56**
1073A	39°13.5214'N	72°16.5461'W	650.9	72	663.6	663.00	99.9%	0.0	663.6	131.58	5.48
		SITE 1073 TOTALS:		**72**	**663.6**	**663.00**	**99.9%**	**0.0**	**663.6**	**131.58**	**5.48**
		LEG 174A TOTALS:		**202**	**1544.4**	**946.35**	**61.3%**	**1498.4**	**3042.8**	**715.08**	**29.79**

TECHNICAL REPORT

The ODP technical and logistical personnel aboard *JOIDES Resolution* for Leg 174A were:

Tim Bronk	Marine Lab Specialist (Chemistry)
Roy Davis	Marine Lab Specialist (Photographer)
Sandy Dillard	Marine Lab Specialist (Storekeeper)
John Eastlund	Marine Computer Specialist (System Manager)
Margaret Hastedt	Assistant Lab Officer (Paleomagnetics)
Burney Hamlin	Laboratory Officer
Kuro Kuroki	Assistant Lab Officer (Fantail, Underway Geophysics)
Jaque Ledbetter	Marine Lab Specialist (X-Ray)
Matt Mefferd	Marine Computer Specialist (System Manager)
Erik Moortgat	Marine Lab Specialist (Physical Properties)
Erinn McCarty	Marine Lab Specialist (Curator)
Chris Nugent	Marine Lab Specialist (Downhole Tools)
Anne Pimmel	Marine Lab Specialist (Chemistry)
Matt O'Regan	Marine Lab Specialist
Jo Ribbens	Marine Lab Specialist (Yeoperson)
Bill Stevens	Marine Electronics Specialist
Mark Watson	Marine Electronics Specialist

PORT CALL ACTIVITIES

Halifax, Nova Scotia, Canada

The technical staff was transported to the *JOIDES Resolution* (JR) on 16 June, 1997, from the Hotel Halifax. The JR arrived late the previous night after passage from the previous drilling areas off Iberia.

The morning agenda was full with greetings, annual evaluations for some of the ASPP personnel, crossover, and the introduction of the new director of Science Services, Tom Davies. This gathering was followed by individual introductions.

A seminar was conducted by George Claypool, a Leg 174A participant and Safety Panel member, for the chemists, Operations Managers, and Staff Scientist. George explained some of the background and nomenclature used to interpret and report typical biologic and petro gas analysis.

Freight and cores were moved off and on the ship the second day. Rainy weather deterred progress on some of the planned tasks. The remaining days in port permitted the closure of ship-related pacing items.

Underway from Halifax

The *JOIDES Resolution* sailed on 20 June at 1800 after five days in port. Navigation tapes were initiated upon leaving the dock and watches started the following day, monitoring the 12- and 3.5-kHz depth recorders. The magnetometer sensor was not deployed because of traffic, shallow water on the banks, and knowledge that it is a well-surveyed area. Differential global positioning system (dGPS) navigation service was arranged from OmniStar Houston for the drilling area selected. Differential GPS indicators on the instruments strengthened on both of the Omnistar receivers as the ship progressed south. Clocks were retarded 1 hr from Atlantic Standard time to East Coast Standard Time at 2400 on the 21st. The two-day passage to the drill site off New Jersey was smooth. Once on site, the WinFrog navigation displays showed position scatter leading to the realization that dGPS did not engage automatically as anticipated. By the following day, the procedure to use the differential correction was in place and site fixes were falling in a 10-14 m circle.

Sites 1071 and 1072

The drilling sites selected off the New Jersey coast complemented the set of sites drilled on Leg 150 on the continental slope, continuing the investigation of the records of the changing of sea level on a passive margin. The sites were in very shallow water and this placed tight restraints on the dynamic positioning capabilities of the ship.

The subsea camera was deployed at each site to document the seafloor being drilled and to verify that no debris or cables were present.

The anticipated gassy cores and high recovery were stymied when thick layers of unconsolidated sand and gravel were encountered. Numerous attempts were made to drill through these unconsolidated layers to deeper reflectors and objectives. Mechanical failures in the top drive consumed nearly a week of the operation time available. Several holes were wireline logged, one VSP was generated using Schlumberger triggering and tools, and a GI Gun sound source and two LWD dedicated holes were completed.

Site 1073 (MAT 13B)

After getting the LWD tool stuck for several hours, the decision was made to move to an alternate deeper site, Site 1073. APC coring proceeded in 640 m of water, 22 km from the other two sites. Gassy and expanding cores were recovered to a depth of 660 m. Adara temperature tool heat-flow measurements generated a gradient for the area; TENSOR tool orientation data complemented the cryogenic magnetometer measurements. Wireline logs were collected; a VSP experiment was completed in two segments.

The site was terminated about 1730 on 18 July for the transit to New York City. Only navigation data was collected on the 8-hr approach.

LAB ACTIVITIES

Chemistry Lab

Interstitial water shipboard analysis on Leg 174A included refractometric analysis for salinity; titrations for pHm, alkalinity, and chloride; ion chromatography for sulfate, potassium, sodium, calcium, and magnesium; and colorimetric analyses for silica, phosphate, and ammonium. Atomic absorption spectrophotometry was used to quantify concentrations of Sr in pore waters.

Solid core samples were analyzed for inorganic and total carbon analysis (using the coulometer and the CNS). Based on their organic carbon content, some samples were selected and analyzed with the Rock-Eval. The system was used to determine S_1, S_2, and S_3.

Gas chromatograph (GC)-3 was calibrated and used during this leg to provide real-time monitoring of the volatile hydrocarbons. Problems encountered on Leg 172 with the atomic absorption (AA) flame sputtering when using the air-acetylene/NO_2 burner head were finally solved by lighting the flame without the aspirating water. Once the burner head heated enough to vaporize the aspirated water, it worked fine. Analysis of samples with low Sr levels are now possible. No or few problems were encountered with the remainder of the equipment in the lab.

Numerous suggestions and problems encountered previously with the coulometer program, the C_1/C_2 LabView application, the web, and JANUS have not been addressed.

Computer Services

A JANUS upgrade was installed in Halifax, and the two-way database updates were made. These procedures are time consuming and required the additional manpower that was available for this port call. Future port calls may require that an off-coming computer specialist remain with the ship for additional days to complete the tasks.

Some of the Business Objects User Reports run very slowly and need additional work to decrease their run time.

A Macintosh 840AV was used to broadcast the core log video display as a test. PC hardware has been requested; this is one less task residing on the VAX 3500. The VAXs are being phased out. The migration of MATMAN to FoxPro is in progress but not fast enough for the computer group, which does not want to expend time schooling new computer specialists in equipment that is being surplused. Also in a phase-out mode is the 4D database; Science Services' Equipment Status Report is now the only user.

Core Lab

Available time on this leg was used for some of the maintenance projects that develop over time. Some areas received touch-up painting, new cabinet baseboards, and cabinet repair. Loose faucets, noisy saw bearings, frozen linear bearings—all received attention. H_2S monitors, eye wash stations, and first aid stations were checked.

Curation

The low recovery experienced on this leg caused scientists to revise their sample requests because they were originally designed for high-recovery high-resolution studies. All requests were modified to correspond to the recovery at hand with the exception of the last site, Site 1073, where recovery approached the amount that was expected. This recovery left the plans for a high-resolution postcruise sampling party in limbo.

Time was spent learning why the Business Objects Users reports used by operations/engineering ran so slowly. A "custom view" preference used was found to be unnecessary. Removing this preference solved the problem.

Moving Science Services' leg data into Netscape queries to make them accessible on the ship web site has worked well and satisfied participating scientists. There is a possibility that Operations, which plans to stay with Business Objects Users reports, will still not have computer services support.

There was no problem with the JANUS curatorial applications.

Electronics Support

Daily support was provided to numerous small problems encountered when the systems were turned on, or as scientists became familiar with the equipment. Few major problems were encountered other than the ongoing attempt to get the second goniometer in the X-ray fluorescence (XRF) equipment to function properly. Routine maintenance of the copiers was accomplished. Assistance was provided to evaluate the WSTP Adara recording packages.

An ongoing project to remove TOTCO sensors and wiring from the rig was initiated.

Magnetics Lab

Leg 174A was a very quiet cruise for both paleomagnetics and the Core Lab, in general, because of the low core recovery. The Tensor tool was deployed on the last site.

Special Projects

- Tensor tool #2243 returned to the ship and deployed on Site 1073A.
- De-permed the mu-metal shields on the cryomag.
- Wound an external wire coil at the junction of the cryo dewar and degauss coils to minimize shield leakage.
- Backed up all the old VAX Paleomag account files and programs to the Uservol for future reference (legacy data migration).

Problems Encountered

- D-2000 discrete sample demagnetizer continued having problems detecting completion of the demag cycle. DTECH eventually sent the information needed to null the voltages in a zero field.

Microscope/Photography Labs

Science was supported without problems. Routine maintenance was performed.

Paleontology Lab

The lab accommodated five paleontologists this leg. Hydrofluoric acid was used by the palynologist without incident. An accumulation of sieves and centrifuge components were sorted and inventoried, and some were returned to shore for evaluation. Additional shelves were ordered for one cabinet in the paleo prep area to better organize the sieve collection. Both centrifuges were functioning after being repaired on the previous leg.

It is possible to overload the circuit that the lab dish washer uses, when ovens or hot plates are added. A heavy duty extension cord eliminated the problem, which is listed for attention.

Physical Properties

Physical properties measurements were collected with few problems with the computer controls or hardware. The LabView program controlling the MST worked flawlessly and was well received by its users. Uploads of data from the various instruments to JANUS were successful. Some familiar program problems remain but have been worked around.

Storekeeping

Few problems occurred with the port call in Halifax or the shipments to and from that port. The authoriztion to ship hazardous materials through New York City could not be arranged, so logging sources and batteries remained on board for the next port.

Underway/Fantail

Differential GPS service was contracted for this leg, primarily because of the shallow-water drilling. Support from the lab was to ensure ship position displays were available to DP and the drillers shack. This display was a comforting backup to the beacon display and could be used to maintain position if a beacon failed.

It was noted that the derrick shadowed the dGPS antennas when the ship passed through a heading of 200° to 125°, causing them to revert to GPS mode (and position scatter) and then reacquire the correction when the ship was better positioned.

Support was provided for the VSP experiments that were controlled and recorded by Schlumberger. Seismic Systems, Inc. of Houston provided the loaned GI gun sound source.

A new Ashtech GLONASS/GPS receiver was delivered by helicopter. It will provide better positioning capabilities world wide. See the Special Projects section under Miscellaneous.

The logging scientists utilized the underway plotter to good advantage, running recorded seismic profiles and reprocessing them as necessary.

X-ray Lab

Some X-ray diffraction (XRD) samples were prepared and analyzed for an assortment of clays and minerals. These samples were scanned with the Minolta color scanner to verify that dry photometric scans could provide more or better information than the wet scans done on the cores.

No samples were submitted for XRF analysis. Some standards were run primarily during troubleshooting efforts to get gonio 2 functioning correctly. The effort was frustrating as the problems were intermittent and sometimes seemingly unrelated. A repair call was scheduled for New York City.

The X-ray JANUS module was critiqued and many suggestions and problems were forwarded to Information Services for review.

MISCELLANEOUS

Whereas weather was excellent the whole leg, there were nearly daily delays waiting for tidal currents and Gulf Stream eddies to moderate. Often the edge of the current was visible on radar, looking like a squall front approaching. The eddies were also visible during daylight hours as slicks on the calm water.

Cellular phone service was spotty on site even with the directional antenna. Being positioned 80 km off the New Jersey shore pushed the limits of the cellular phone system. Rain and cloudy weather attenuated the reception to zero. Incoming calls were rarely received as the antenna was pointing in the wrong direction or conditions were bad. System Busy signals were also common. Some e-mail transfers were possible and a few business calls were made.

Special Projects

The replacement air conditioner for the unit that failed on Leg 171 was received and installed in the subsea shop. The engineers found that the unit was 1/4 in. longer than the original unit, resulting in some frame modifications.

The first helicopter full of visitors also delivered an Ashtech GG24 GPS receiver and antenna. The antenna was mounted with the port group of antennas located between the stacks, and the antenna lead was added to previous runs through SEDCO spaces. Using supplied PC software, the unit was immediately displaying position dispersement the same or better than the dGPS display. The unit was integrated into the WinFrog navigation system for a test on the last day on Site 1073. The refined positioning capabilities are possible, because the receiver can use the Russian GLONASS GPS constellation, in addition to the U.S. complement. The Russian positions are also more accurate, as they are not degraded.

Safety

The METS group participated in or was available to contribute to three fire drills. Fire gear was donned, and breathing apparatus were fitted for a fire drill in the lab stack. There was little practice or re-familiarization offered.

Problems

As Site 1073 progressed, the technical staff mentioned that they were tripping on a 3/4 in. differential in the solid fibergrate decking at a seam in the aft third of the core-receiving platform. The problem was the result of one of the supporting cross beams sagging. The fibergrate was removed and two new steel angles welded in place. The pieces replaced were add-ons that were used to accommodate the spacing of the fibergrate.

The Lamont sponsored MARISAT-B communications system that was scheduled for removal in Halifax received a last minute reprieve and was left aboard. The system was not used during the leg and the System Managers see no future use for it aboard the JR. LDEO has not shared their plans with the ship; Las Palmas was said to be the port of disposition for this system.

LEG 174A LABORATORY STATISTICS

General Statistics:	
Sites:	3
Holes:	12
Total Penetration:	3042.8
Meters Cored:	1544.4
Meters Recovered:	946.52
Time on Site (days):	29
Number of Cores :	212
Number of Samples, Total	8801
Number of Core Boxes:	145
Samples Analyzed:	
Magnetics Lab	
Half section measurements:	4000
Discrete measurements:	150
Tensor tool holes	1
Physical Properties	
Index properties:	551
Velocity :	600
Resistivity:	741
Thermcon:	0 (WHOI)
	427 (TK04)
MST:	673
Shear Strength:	110
Chemistry Lab	
Inorganic Carbonates ($CaCO_3$):	112
Water Chemistry (the suite includes pH, Alkalinity, Sulfate, Chlorinity, Silica, Phosphate, Ammonia, Ca, Mg, P, Li, Mn, Fe, Sr, Rb):	142
Headspace gas analysis:	182
Pyrolysis Evaluation, Rock-Eval:	112
X-ray Lab:	
XRD :	152
XRF:	0
Thin Sections:	6
Underway Geophysics (est.)	
Total Transit Nautical Miles:	1653
Bathymetry:	471
Magnetics:	0
Seismic:	0
XBT's Used:	0