

Site M0060¹

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Chapter contents

Introduction	1
Operations	1
Lithostratigraphy	3
Biostratigraphy	5
Geochemistry	8
Physical properties	9
Microbiology	11
Stratigraphic correlation	12
Downhole measurements	13
References	14
Figures	16
Tables	40

Introduction

During Integrated Ocean Drilling Program (IODP) Expedition 347, cores were recovered from two holes at Site M0060 (near Anholt Island), with an average site recovery of 90.69%. The water depth was 31.2 m, with a tidal range of <30 cm. Existing data sets, including seismic reflection profiles, were evaluated prior to each site to attempt to guide the initial drilling with an anticipated lithologic breakdown. The total time spent on station was 8.35 days.

Operations

Transit to Hole M0060A

At 0835 h on 22 September 2013, the *Greatship Manisha* sailed from Site M0059 to the second coring site (M0060; proposed Site BSB-1) southeast of Anholt, Kattegat. The vessel arrived at 0100 h on 23 September.

Hole M0060A

Operations in Hole M0060A commenced at 0145 h on 23 September 2013 with a downpipe camera survey of the three proposed holes at this site (M0060A–M0060C) to assess the seabed, in accordance with the permissions required at this site.

Coring operations were then established (Table T1), with a longer setup period than expected due to installation of a new sample wire sealer for the piston corer system (PCS). However, on the second run, the sealer failed, and operations returned to the previous system of using an overshot release. Other technical issues slowed operations throughout 23 September, including breakage of the hydraulic hose to the seabed template, failure of the sample wire requiring the drill string to be retrieved, and cracking of the slips bowl.

Thirteen cores were recovered during the morning of 24 September, with operations running smoothly. Following this, a series of technical issues arose. The sample winch rope snapped, which led to tripping of the pipe following an unsuccessful fishing attempt. Once the overshot was recovered, the rope was tested to assess the cause of the breakage. Coring operations were reestablished but halted again because of damage to the manual roughneck. By 2240 h, the hole had been cleaned and washed down to 75.8 me-

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ters below seafloor (mbsf), and coring operations continued throughout the night.

At 0600 h on 25 September, a decision to switch to the hammer sampler (HS) was made because of difficulties recovering harder lithologies, and a sample of compacted clay was recovered. At 97 mbsf, a lithologic change was noticed, and this change coincided with an overpressurized mudline. Coring continued, with the sampling methodology determined by the lithology encountered. PCS, HS, push coring assembly, and extended coring system coring were all undertaken in an attempt to optimize recovery in unpredictable lithologies. At 1545 h, the overshot was unable to pick up the piston corer because of sand infill, and it was necessary to repeatedly flush the hole before recovery could be achieved. PCS coring continued until 0220 h on 26 September, when the seabed template was recovered to deck because of failure of the clamps. Repairs were then carried out, and coring recommenced.

As drilling progressed, recovery rates varied, primarily because of the presence of sand lithologies. At 1335 h on 26 September, following use of the rotating core barrel, the barrel was recovered with no sample. However, the catchers were inverted and disturbed material was brought up. In order to avoid damage to the core, the coring strategy was changed and a flapper catcher with one basket was used. From 1725 h on 26 September until 0315 h on 27 September, coring continued with good recovery rates. During this period, deformation of the liner due to suction pressure was noted.

At 0315 h on 27 September, the overshot rope snapped, and it was necessary to trip pipe to recover the barrel (despite fishing attempts). Issues arose as a result of overtight joints and stuck drill collars. By 1400 h, it was possible to recommence running pipe back into the hole. The hole was then washed down with the noncoring assembly (NCA) in place to the level of the last sample taken before piston coring restarted (188.60 mbsf).

Coring continued throughout 28 September using a combination of open-hole and push core sampling. At 1715 h, it was noted that the string had become difficult to rotate. One further core was recovered before a sand blockage caused the string to become stuck.

This sand blockage resulted in the termination of Hole M0060A, and efforts were made throughout the evening of 28 September and the early morning of 29 September to free the string. Various options were investigated, which included use of the HS and run-

ning high pressure through the mudline. At 1020 h, it was decided that the best option was to back off the string and recover the remaining pipe. This plan was executed, but unfortunately a stick up of 14 m remained above the seabed (assessed with the remotely operated vehicle [ROV]). This was hammered in as far as possible and then flattened using the seabed template so that ~9 m of pipe was left lying horizontally on the seabed. ROV footage showed 4 m of visible pipe, with the remainder buried in sand at a shallow angle.

A total of 101 coring attempts were made in Hole M0060A to a maximum depth of 232.50 mbsf. Eighteen of these involved use of the NCA, covering 42.49 mbsf. Hole recovery was 83.06% when the open-hole sections were discounted.

Hole M0060B

Operations in Hole M0060B commenced at 1600 h on 29 September 2013. Because of the drilling issues associated with sand in Hole M0060A, it was agreed that the target depth of the hole would be 100 mbsf, with termination determined by the first presence of the sand lithology.

This hole was a designated microbiology hole, and intensive sampling was conducted in accordance with the developed scheme. PCS coring ran smoothly at this hole, with GS550 mud used for stabilization of the loose sand encountered at the seabed. The concentration was reduced as the hole progressed into clayey material to 30 mbsf; seawater was used as the drilling fluid for Cores 10H through 27H. There was excellent recovery throughout the hole until an aquifer was encountered at 82 mbsf (Core 28H). After difficulties in core recovery and a tight drill string, it was decided to terminate the hole slightly shallower than anticipated at 85.70 mbsf. By midnight, coring operations were complete and the drill floor was being prepared for downhole logging.

Downhole logging was completed in Hole M0060B by 0735 h on 1 October, with three successful tool runs to a maximum depth of 67 mbsf. The imaging tool did not appear to be operating correctly, but later investigation showed that despite a black screen data had been recorded by this instrument. The remaining drill string was tripped and the bottom-hole assembly bit cleaned and checked. Once the seabed template was on deck, the drill floor and all containers were prepared for transit.

A total of 28 coring attempts were made in Hole M0060B to a maximum depth of 85.7 mbsf. Hole recovery was 98.32%.

Lithostratigraphy

Two holes were drilled at Site M0060. Hole M0060A reached a total depth of 232.50 mbsf, and Hole M0060B was 85.70 mbsf deep. Hole M0060B was designated for microbiology sampling and was subject to whole-round sampling on board the ship prior to core description at the IODP Bremen Core Repository (Germany). In Hole M0060A, piston coring was used for the uppermost ~83 mbsf, where recovery was >90%. Between 83 and 200 mbsf, a combination of piston coring, nonrotating core barrel, and extended nose coring was used to optimize recovery. At ~100–120 and ~147–162 mbsf, a combination of open holing and extended nose drilling was used to advance through hard lithologies, which affected recovery and core quality. Between ~101 and 117 mbsf, all core material recovered (17 cm) was consumed by shipboard sampling. For this interval, no core descriptions exist and shipboard lithologic descriptions are limited to observations on one ~5 cm portion of a core catcher and some washed paleontology samples. Deeper than 200 mbsf, open holing, hammer sampling, and push coring were used to aid penetration through difficult lithologies; however, this produced limited core recovery (see “[Operations](#)”).

Lithostratigraphic divisions (Units I–VII) (Fig. [F1](#)) are based on descriptions of the cut face of the split core of Hole M0060A, augmented by available sections from Hole M0060B and observations from smear slides (see “[Core descriptions](#)”). Two of the unit boundaries in Hole M0060B were within core sections sampled for microbiology. For these sections, the boundaries were placed at the bottom of the interval that was sampled for microbiology.

Unit I

Intervals: 347-M0060A-3H-1, 0 cm, to 6H-1, 0 cm;
347-M0060B-1H-1, 0 cm, to 4H-1, 0 cm

Depths: Hole M0060A = 0–6.00 mbsf; Hole
M0060B = 0–6.10 mbsf

Unit I is composed of gray, massive, fine to medium thickly bedded sand with common marine bivalve and gastropod shell fragments, including *Cerastoderma* sp., *Macoma baltica*, and *Turritella* sp. Two distinct fining-upward shell-rich beds were found in this unit as well. The sand is generally well sorted, and quartz sand grains are subrounded to rounded.

The sand was deposited in a near-shore marine depositional environment. Fining-upward shell-rich beds signal deposition near the wave base; therefore, the approximate bathymetry would be similar to the modern situation.

Unit II

Intervals: 347-M0060A-6H-1, 0 cm, to 12H-2,
14 cm; 347-M0060B-4H-1, 0 cm, to 9H-2, 60 cm

Depths: Hole M0060A = 6.00–23.84 mbsf; Hole
M0060B = 6.10–24.70 mbsf below microbiology
sample

Unit II consists of dark greenish gray interlaminated sandy clayey silt and fine–medium sand with dispersed clasts. Sand laminae are 0.5–3 cm thick and occur in packages unequally spaced within the silt. The orientation of the laminae is inclined, and they are deformed as a primary sedimentary structure. Quartz sand grains dispersed within the silt are angular to subrounded, and the sediment is moderately well sorted. Reworked mollusk fragments are found throughout, and reworked diatom fragments are common in smear slides from this unit. Sparse bioturbation is observed near the bottom of this unit between black, presumably iron sulfide, laminae. Gypsum was observed macroscopically and in smear slides.

The bottom of the unit is sparsely bioturbated between iron sulfide laminated intervals, possibly due to changing stratification of the water column coupled to salinity changes. The deformation in the upper part of the unit is likely due to slumping and possibly the result of increased sedimentation rate. With the presence of dispersed oversized gravel clasts, the lithologic changes can be interpreted as a prograding, ice-influenced deltaic environment.

Unit III

Subunit IIIa

Intervals: 347-M0060A-12H-2, 14 cm, to 23H-1,
56 cm; 347-M0060B-9H-2, 60 cm, to 19H-2,
125 cm

Depths: Hole M0060A = 23.84–57.46 mbsf; Hole
M0060B = 24.7–58.35 mbsf

Subunit IIIb

Intervals: 347-M0060A-23H-1, 56 cm, to 25H-2,
146 cm; 347-M0060B-19H-2, 125 cm, to 22H-2,
59 cm

Depths: Hole M0060A = 57.46–66.46 mbsf; Hole
M0060B = 58.35–67.59 mbsf

Subunit IIIc

Intervals: 347-M0060A-25H-2, 146 cm, to 30H-1,
42 cm; 347-M0060B-22H-2, 59 cm, to 27H-2,
50 cm

Depths: Hole M0060A = 66.46–79.52 mbsf; Hole
M0060B = 67.59–81.60 mbsf

Unit III is characterized by dark grayish brown to gray parallel laminated clay and silt with dispersed clasts. In Subunit IIIa, discrete millimeter-scale silt and fine sand laminae occur as packages of 2–4 laminae and are either well preserved or disrupted, possibly due to loading or bioturbation. Laminae are irregularly spaced and generally 3–6 mm thick, and their abundance increases upward through the unit. Subunit IIIa locally has a reddish hue. Numerous black, possibly iron sulfide, bands are present throughout the unit and become especially prominent in Subunit IIIb (Fig. F2). Subunit IIIc has a minor interlaminated sand component.

This unit can be interpreted as an ice-influenced lake or marginal marine environment. Silt laminae in Subunit IIIa may represent bottom current activity. The outsized gravel clasts may have originated from ice rafting from a calving glacier at a distance from the drilled location. The presence of iron sulfide bands within the sediment, especially in Subunit IIIb, may be due to periodic oxygen-poor conditions and a stratified water column, where organic matter may have accumulated to form the precursor to the diagenetic sulfides.

Unit IV

Interval: 347-M0060A-30H-1, 42 cm, to 35H-1, 34 cm; 347-M0060B-27H-2, 50 cm, to end of hole

Depths: Hole M0060A = 79.52–95.04 mbsf; Hole M0060B = 81.60–85.70 mbsf

Gray interbedded sand, silt, and clay with dispersed clasts and clast-poor diamicton were identified in Unit IV. Both rock clasts and intraclasts are common in this unit, and the strata are intensely folded or contorted. Clast assemblages are polymict.

The moderately to poorly sorted character of sediments, the polymict clast assemblage, and the abrupt shifts in lithologies may indicate deposition in an ice-proximal depositional environment. The deformation of the sediments may be due to slumping into an aquatic depositional environment.

Unit V

Interval: 347-M0060A-35H-1, 34 cm, to 48H-1, 0 cm

Depth: 95.04–116.7 mbsf

This unit is characterized by black and gray sandy silty clay with dispersed clasts. Mollusk fragments are common, especially *Turritella* sp. Multiple horizons with shell fragments are present. Cores in this interval are poorly recovered and highly disturbed as a result of drilling.

This unit probably represents a shallow-marine depositional environment.

Unit VI

Interval: 347-M0060A-48H-1, 0 cm, to 58H-1, 0 cm

Depth: 116.70–146.10 mbsf

Unit VI consists of gray, fine to medium, massive well-sorted sand. Rare shell fragments occur near the top and the bottom of this unit. The sand is quartz rich, and quartz grains are well rounded. Some decimeter-scale clay and silt-rich interbeds are recorded. At the bottom of the unit, pebbles and intraclasts are found.

Based on the well-sorted nature of the sand, this unit may represent a high-energy fluvial or deltaic depositional environment. The mud interbeds may represent overbank deposits or channel fills. The rare shell fragments are likely locally reworked.

Unit VII

Interval: 347-M0060A-58H-1, 0 cm, to end of hole

Depth: 146.10–229.60 mbsf

Unit VII is dominated by a dark gray clast-poor sandy diamicton (Fig. F3) with dispersed (<1%) to uncommon (1%–5%) charcoal clasts up to 3 cm in diameter. The structure is mostly homogeneous with localized very rare silty to clayey laminae a few centimeters in thickness. Isolated intervals of dispersed (<1%) white carbonate rock fragments, fine mollusk shell hash, and silt intraclasts are present. The uppermost part consists of gray well-sorted clay/silt with locally clast-poor muddy to sandy diamicton. The clay appears mostly homogeneous with some weak lamination by color, especially in the upper part. Higher organic contents and strong odor were common. Fining upward of Unit VII between 158 and 146.1 mbsf was recorded. The base of this moderately sorted unit extends deeper than 229.6 mbsf, as it was not penetrated at the base of the hole. However, on open holing to 232.50 mbsf, the string became stuck and it was not possible to recover a sample to verify the lithology.

Because of the general lack of visible grading and moderate sorting of Unit VII, deposition by mass-transport processes like massive debris flows is possible. The contacts between and thickness of individual debris flow beds are uncertain and potentially macroscopically not visible. The high charcoal content could be related to the outcropping of Jurassic sediments east of Site M0060. During the time of deposition, it is possible that large amounts of reworked Jurassic sediments including fossil soil horizons with coal seams were delivered to this location.

The influence of mass-transport processes decreases to the top of this unit, indicated by increased sorting of clay/silt as a result of a change in the mode of sedimentation.

Biostratigraphy

Diatoms

With the exception of one sample containing chrysophycean cysts, only diatoms were found at Site M0060 (Hole M0060A only), and they were identified to species level. The sampling resolution consisted of one sample at every core top for all recovered intervals. However, some intervals were also sampled at every section top. In order to provide an initial paleoecological framework for Site M0060, diatoms were classified with respect to salinity tolerance. Salinity tolerance classification follows the Baltic Sea intercalibration guides of Snoeijs et al. (1993–1998), which divide taxa into five groups: marine, brackish-marine, brackish, brackish-freshwater, and freshwater.

Overall, diatoms occur in very low abundances. For this reason, only two transects of each slide were viewed for samples that did not contain numerous whole valves. The presence of diatom fragments and whole valves is shown in Figure F4. All analyzed samples were barren to 7.5 mbsf. Diatoms were present at low abundances from 7.5 to 10.5 mbsf. A low-diversity freshwater assemblage comprising diatoms of the genera *Aulacoseira*, *Cocconeis*, and *Martyana* is present at 7.5 mbsf. Only a single valve of the brackish water taxa *Martyana schulzii* was recorded. At 9 and 10.5 mbsf, the assemblage is mainly composed of freshwater taxa from the genera *Amphora*, *Aulacoseira*, and *Stephanodiscus*. Brackish and marine taxa are also present but are fragmentary. This assemblage could be interpreted as freshwater with allochthonous brackish and marine diatom fragments. Alternatively, the assemblage may be brackish with robust freshwater diatoms washed in.

Between 10.5 and 132.9 mbsf, most of the samples are barren of whole and fragmentary diatom fossils. The total number of whole valves found in two slide transects for any sample from this interval did not exceed four. In the interval from 132.9 to 202.5 mbsf, all slides contain rare diatom fragments. Table T2 contains the diatom species, authorities, and habitat information for Site M0060, as well as presence/absence data for the interval between 7.5 and 10.5 mbsf. All Quaternary diatoms found in samples deeper than 10.5 mbsf co-occurred with Cretaceous coccolithophorids and rare fragments of Cretaceous diatoms from the genus *Stephanopyxis* (Table T3).

These diatoms are therefore interpreted as redeposited.

Foraminifers

Results presented here include primarily those from samples taken from split-core sections during the Onshore Science Party (OSP) and supplementary information from core catcher samples studied offshore. A total of 152 samples (90 obtained offshore from core catchers and 62 onshore from split-core sections) were studied for foraminiferal biostratigraphy. Redeposited pre-Quaternary foraminifers occur intermittently throughout the site, indicated by a white, polished, or frosty surface and carbonate infilling (Rasmussen et al., 2005). Intervals with poor core recovery are not discussed in detail.

The shallowest sample (347-M0060A-3H-1, 11–13 cm; 0.13 mbsf) is dominated by *Ammonia beccarii*, *Bulimina marginata*, and *Cibicides lobatulus* (Table T4), which suggests a Holocene boreal marine assemblage (Seidenkrantz and Knudsen, 1993). The remaining upper part (upper 21 mbsf) of Site M0060 contains generally few benthic foraminifers (Fig. F5A), although taxonomic diversity is relatively high (4–13 species; Fig. F5C; Table T4). In this upper interval, the genus *Elphidium* is the most common benthic foraminifer with *Elphidium excavatum clavatum* generally composing the largest fraction of the assemblage (Fig. F5B) and *B. marginata*, *Cassidulina reniforme* (formerly *crassa*), and *Elphidium williamsoni* often present as accessories. Redeposited pre-Quaternary foraminifers occur occasionally. Taxonomic composition of this assemblage in combination with the presence of dropstones in this interval (see “Lithostratigraphy”) suggest cool-water marine conditions (Seidenkrantz, 1993b; Seidenkrantz and Knudsen, 1993). The presence of *E. williamsoni* may suggest shallow or intertidal waters (Knudsen et al., 2012) or transport of foraminifers from a nearby environment of this type.

Between 21 and 76 mbsf, the assemblage is of low diversity, and abundance varies from abundant to barren (Fig. F5A). *E. excavatum clavatum* and *C. reniforme* are often the only species present, with *E. excavatum clavatum* nearly always dominant. Redeposited foraminifers are rarely present. The dominance of *E. excavatum clavatum* and very low diversity suggest brackish and cold conditions (Seidenkrantz, 1993a; Seidenkrantz and Knudsen, 1993).

Between 76 and 99 mbsf, foraminiferal diversity increases (4–13 species; Fig. F5C) and foraminiferal abundance ranges from few to common. *E. excavatum clavatum* still typically composes the largest fraction of the assemblage (Fig. F5B), with *Elphidium ex-*

cavatum selseyensis, *Elphidium* spp., *Haynesina* spp., *B. marginata*, *Islandiella helenae*, *C. reniforme*, and *Hyalinea balthica* occurring frequently in low to moderate abundances. Redeposited pre-Quaternary foraminifers occur in more than half of the samples in this interval. The combination of subarctic (e.g., *I. helenae*) and boreal (e.g., *H. balthica*) species in this interval is an unrealistic combination, suggesting that some foraminifers are redeposited (Seidenkrantz and Knudsen, 1993). The characterization of this unit as slumped sands (see “[Lithostratigraphy](#)”) supports the interpretation that the sediments in this interval are indeed likely redeposited, although it is possible that occasional short periods of deposition in a marginal marine environment did occur.

Between 99 and 117 mbsf, sediment recovery was poor, preventing reliable environmental characterization.

Between 117 and 146 mbsf, foraminifers are very rare or absent, though a small number of *Elphidium* spp. and *I. helenae* specimens are present, as well as some pre-Quaternary redeposited specimens. Redeposition is additionally supported by the generally sandy grain size of the sediments and the occurrence of macroscopic shell fragments, which have been interpreted as derived from a deltaic environment (see “[Lithostratigraphy](#)”), although infrequent periods of sediment deposition in a cold and brackish environment could have occurred.

At 153.7–155.4 mbsf (Cores 347-M0060A-60H through 61H), foraminifers are abundant and the assemblage is among the most diverse found at Site M0060 (Fig. [F5C](#)). This interval contains few or no pre-Quaternary redeposited foraminifers and is dominated by *H. balthica* and *B. marginata*, with *Uvigerina mediterranea*, *I. helenae* (this taxon may possibly include *Cassidulina laevigata*), and *Melonis barleeanus* also occurring frequently. The fauna of this brief interval represents a typical marine boreal to lusitanian (i.e., warmer) assemblage (Seidenkrantz, 1993a; Seidenkrantz and Knudsen, 1993) and occurs in a thin, fine-grained, organic-rich, and weakly laminated subunit surrounded by diamicton; the surrounding diamicton may represent a delta slope environment in which periodic marine clay deposition occurred (see “[Lithostratigraphy](#)”). The thickness of this fine-grained unit is uncertain because of poor recovery and disturbed sediments above and below it. This interval may represent a short interstadial period or a longer warm period that has been partially eroded or poorly recovered at this site.

Between 160 and 190 mbsf, foraminifers are rare to nearly absent, but the assemblage is taxonomically diverse, with *Elphidium tumidum* (formerly *Elphidium*

groenlandicum), *Elphidium* spp., and *I. helenae* dominant and pre-Quaternary redeposited foraminifers intermittently present. The foraminifers in this interval, which has been characterized as debris flow material in a deltaic environment including charcoal potentially of Jurassic age (see “[Lithostratigraphy](#)”), are likely redeposited.

Between 194 and 205 mbsf (Cores 347-M0060A-76H through 82P), foraminiferal abundance increases to generally common (ranging from very rare to abundant; Table [T4](#)) and the assemblage is among the most diverse at this site (Fig. [F5C](#)), although redeposited pre-Quaternary foraminifers occur. This interval is dominated by *E. excavatum clavatum* and *B. marginata*, but *H. balthica*, *Nonionella labradorica*, *I. helenae* (*C. laevigata?*), and *Elphidium* spp. also occur frequently. These species represent a marine boreal to lusitanian (i.e., warmer) assemblage and potentially greater water depths (Seidenkrantz, 1993a). Recovery in this interval is limited, and sediments are disturbed in some intervals. Core 347-M0060A-76H is a diamicton section and thus likely contains recently redeposited foraminifers, but the core below (347-M0060A-82P) is laminated silty sand and appears to contain in situ foraminifers.

Between 212 and 230 mbsf, foraminifers are rare to nearly absent and taxonomic diversity is low, with *E. tumidum* and other *Elphidium* spp. primarily occurring, as well as some redeposited pre-Quaternary specimens.

Ostracods

Ostracods were examined from 147 samples (including 90 core catchers) from Holes M0060A and M0060B during the OSP for Expedition 347. Samples were studied in the >125 μm fraction. Ostracods were present in 40 samples (Table [T5](#)).

Ostracod abundance per sediment volume from both holes is plotted in Figure [F6](#). Ostracods mainly occur in the upper 20 mbsf (Holes M0060A and M0060B). Scattered occurrences of single valves are also observed over the entire record (Table [T5](#)). Ostracod abundance is the highest in the interval of 6–20 mbsf, ranging from 70 to 130 valves/20 cm^3 sample. A high juvenile to adult ratio and good preservation in this interval allows us to assume in situ burial (Fig. [F6](#)). The interval of highest ostracod abundance corresponds to the lithostratigraphic unit of sandy clayey silt and fine–medium sand (see “[Lithostratigraphy](#)” and “[Geochemistry](#)”).

Ostracods of three different ecological groups occur at this site, and their abundance variations suggest that salinity and water depth decreased uphole in the studied interval. The ecological groups distin-

guished are freshwater, shallow-water marine, and North Atlantic taxa.

The samples from 6.08 mbsf (Hole M0060A) and 6.66 mbsf (Hole M0060B) contain a shallow-water brackish-marine assemblage. The most abundant are *Sarsicytheridea punctillata*, *Acanthocythereis dunelmensis*, *Leptocythere* spp., *Elofsonella concinna*, and *Heterocyprideis sorbyana*. These are typical shallow-water species found on Arctic and North Atlantic shelves (Cronin, 1981; Cronin et al., 2010; Stepanova et al., 2007). These samples also include the freshwater taxon *Ilyocypris* sp. The valves are well preserved and include juveniles. This assemblage may indicate that the studied site was located close to the coastline and the freshwater specimens were transported from the continent.

In the interval 10.66–17.27 mbsf (Hole M0060A), a similar shallow-water assemblage comprising the shallow-water marine and brackish water taxa is distinguished.

In the samples containing in situ ostracods at 20.56 mbsf (Hole M0060A) and 15.92 mbsf (Hole M0060B), the assemblage is dominated by marine taxa typical of North Atlantic waters and high salinity ≥ 26 –30 (Cronin et al., 1995; Frenzel et al., 2010), such as *Cytheropteron pseudomontrosiense*, *Cytheropteron arcuatum*, *Cytheropteron biconvexa*, and *Polycoppe* spp.

Palynological results

For Site M0060, palynological analyses focused on Hole M0060A. One sample per 1–2 cores was examined for palynomorphs. In most samples, concentrations of palynomorphs are extremely low and show indications of severe degradation/oxidation. Additionally, most samples from Hole M0060A contain reworked tertiary palynomorphs, sometimes in higher concentrations than the presumably autochthonous/in situ palynomorphs encountered. Only a few samples contained enough palynomorphs in situ to yield statistically relevant results. We therefore do not show a detailed pollen diagram for this site but give a general overview on palynological findings (main pollen types, marine/terrestrial ratio, and pollen concentration; Fig. F7; Table T6; see Palym0060.xls in PALYNOLOGY in “[Supplementary material](#)”). Bisaccate pollen was included in the reference sum used for calculations, but for some samples, this pollen type may be overrepresented because of transportation bias and its particular resistibility to oxidation (Cheddadi and Rossignol-Strick, 1995). Dinocyst content varied depending on the type of sediment. Sediments with marine components (e.g., foraminifers) contained significant numbers of dinoflagellate cysts.

From Hole M0060A, 25 sediment samples were analyzed. With the exception of the uppermost sample (0.75 mbsf), all analyzed samples indicate a relatively high degree of oxidation due to the rarity/absence of taxa particularly susceptible to oxidation-based degradation and the higher percentages of robust pollen types and spores.

0.75 mbsf

This sample is characterized by high pollen concentration (resulting in a relatively high counting sum), whereas freshwater algae and reworked pollen occur in low amounts or are absent (Fig. F7). Pollen types that are generally more susceptible to oxidation are present (e.g., *Quercus*; Cheddadi and Rossignol-Strick, 1995). Thus, this sample may better reflect the original ecosystems than samples from greater depths. *Quercus* is the dominating nonsaccate pollen type in this sample; *Betula* and *Alnus* are also frequent. These findings, in combination with the presence of herbal pollen (e.g., Asteraceae), the absence of *Fagus* and *Tilia* pollen, and low *Corylus* and *Ulmus* pollen percentages, indicate an earlier Holocene age for this sample. It is also the only sample containing enough organic-walled dinoflagellate cysts (dinocysts) to make statistically relevant inferences about the dinocyst assemblages. *Operculodinium centrocarpum*/*Protoceratium reticulatum* is the dominating cyst type (61%). *Spiniferites* sp. cysts are also frequent (26%). *Lingulodinium machaerophorum* is present but only in low percentages (4%). Relatively long spines of the *Lingulodinium* specimens encountered, compared to samples from Site M0059, may indicate either cold or relatively saline conditions (Mertens et al., 2009); however, the number of *Lingulodinium* specimens measured is too low to yield robust results. The sample at 0.75 mbsf is the only one in which the genus *Ataxiodinium* was encountered.

15.69–40.60 mbsf

This interval is characterized by relatively lower percentages of bisaccate (particularly *Pinus*) pollen grains (Fig. F7). High percentages of freshwater algae and a high reworked/in situ pollen ratio may indicate that during the time interval reflected by these samples, tertiary material was transported to the site by freshwater inflow from land. The lower bisaccate pollen percentages compared to the interval immediately deeper may thus be a transport signal indicating that fluvial transport played a more important role for this interval than eolian transport.

48.68–202.67 mbsf

This interval is characterized by high percentages of bisaccate (particularly *Pinus*) pollen grains (Fig. F7),

lower percentages of freshwater algae, and a lower reworked/in situ pollen ratio compared to the interval between 15.69 and 40.60 mbsf. The amount of reworked pollen is still almost as high as, and in some cases even higher than, the amount of in situ pollen. Airborne pollen transport may have been of more importance for the sediments in this interval than for the overlying sediments because bisaccate pollen (particularly well suited for airborne transport) is very common.

Geochemistry

Interstitial water

Pore water data at Site M0060 largely reflect organic matter degradation that varies with lithology, related mineral reactions, and the presence of fresher water in two deeper sand layers at 80–95 mbsf (Unit IV) and 117–146 mbsf (Unit VI) and the return of more saline water in the deepest diamicton (Unit VII) (see “Lithostratigraphy”).

Salinity variations: salinity, chloride, and alkalinity

The shipboard pore water salinity profiles (Fig. F8A; Table T7) indicate differences between Holes M0060A and M0060B. Salinities in the shallowest sections in both holes are ~30, which is consistent with chloride (Cl^-) measurements and calculations of Cl^- based salinity (Fig. F8B–F8C; Table T8). Largely similar salinity values are found to 70 mbsf in Hole M0060B, followed by a slight decrease to 25 between 70 and 85 mbsf. In contrast, shipboard salinity measurements in Hole M0060A evidence a drop from ~30 to 20 in the uppermost 45 mbsf, followed by a general but less steep decrease in salinity from 20 to 10 to ~120 mbsf. Shore-based Cl^- measurements for this interval are too discontinuous to verify the presence of distinct salinities in the two holes. Sediments deeper than 80 mbsf were only recovered from Hole M0060A. The profile indicates a low-salinity interval that corresponds to the sand layers of Units IV and VI. Deeper than 145 mbsf, salinity increases to ~20 in the underlying diamicton, indicating influence of deep and more saline waters.

Alkalinity measurements again indicate some differences between Holes M0060A and M0060B. In general there is a series of peaks in alkalinity. The most pronounced maximum of ~25 meq/L occurs at 15 mbsf, with smaller peaks of 10–15 meq/L at ~65, 85, 140, and 185 mbsf.

Organic matter degradation: methane, sulfate, hydrogen sulfide, ammonium, phosphate, iron, manganese, and pH

Several of the chemical profiles from Site M0060 preserve a record of microbial oxidation of organic matter. No methane is detected shallower than 90 mbsf, but the presence of methane (up to 2.2 mM) at ~100 mbsf and in the diamicton of Unit VII (Fig. F9A; Table T9) points to a deep subsurface zone of methanogenesis. Minima in sulfate (SO_4^{2-}) in the overlying sediment at 15 mbsf (1.7 mM SO_4^{2-}) and 60 mbsf (1.2 mM SO_4^{2-}) suggest two intervals of SO_4^{2-} reduction (Fig. F9B), although no hydrogen sulfide (H_2S) was detected in either hole (Fig. F9C). As expected, the minima in SO_4^{2-} correlate to peaks in the products of SO_4^{2-} reduction, such as alkalinity (Fig. F8D), ammonium (NH_4^+), and phosphate (PO_4^{3-}) (Fig. F9D–F9E). The amplitude of peaks in NH_4^+ and PO_4^{3-} concentration at 15 mbsf are more pronounced than those at 60 mbsf. Low concentrations of SO_4^{2-} , alkalinity, NH_4^+ , and PO_4^{3-} occur from 120 to 140 mbsf in the sand layers of Unit VI, again suggesting a different water composition in this interval. Scattered and relatively low SO_4^{2-} concentrations ranging from 4 to 13 mM were observed below 150 mbsf (Table T7). Higher concentrations of alkalinity, NH_4^+ , and PO_4^{3-} in the diamicton are consistent with evidence of methanogenesis in this layer.

Pore water concentrations of dissolved iron (Fe^{2+}) peak at 50 mbsf (300 μM), decrease to 45–110 μM in the sands of Unit VI, and are quite scattered (e.g., 0–150 μM) in the diamicton of Unit VII (Fig. F9F). Pore water dissolved manganese (Mn^{2+}) concentrations vary generally from 2 to 5 μM with a surface maximum of 10 μM and one high value of 30 μM in the diamicton (Fig. F9G). Variations in pH can be useful for determining the diagenetic reactions leading to the observed variations in pore water concentrations. Shipboard pore water pH is 8 ± 0.25 throughout the cored intervals with a broad minimum of ~7.3 from 20 to 70 mbsf, yet this minimum is only observed in Hole M0060B (Fig. F9H).

Mineral reactions: bromide, boron, sodium, potassium, magnesium, calcium, strontium, lithium, silica, and barium

The most obvious feature in the pore water concentrations of major and minor elements of seawater is the presence of water with a chemical composition distinctly different from seawater in the sand of Unit

VI at ~115–145 mbsf. Within this unit, low salinities are associated with lower concentrations of bromide (Br⁻), boron (B), sodium (Na⁺), potassium (K⁺), magnesium (Mg²⁺), and lithium (Li⁺) and higher concentrations of calcium (Ca²⁺) and strontium (Sr²⁺) than seawater or the overlying and underlying pore waters (Figs. F10, F11, F12). These differences can also be seen to varying degrees in the element/Cl profiles (Fig. F11E–F11H). With the exception of the pore waters from the sand layers of Unit VI, most of the element/Cl ratios (Table T8) plot close to the seawater ratio. There appears to be evidence for a contribution of diagenetic reactions and/or ion exchange to an increase in pore water Na⁺ and decreases in pore water Mg²⁺ and Ca²⁺ in Unit II (6–24 mbsf). The pore water profile of the upper 30 mbsf is also characterized by a decrease in K⁺ (Fig. F11B) and Rb concentrations (Table T7), which might be related to uptake by clay minerals (Gieskes, 1983).

Concentrations of dissolved silica in pore water are generally determined by the amount and the solubility of sedimentary biogenic silica and silicate minerals. The maxima of dissolved silica at 10 and 60 mbsf (Fig. F12D) are likely associated with dissolution of biogenic silica (see “**Biostratigraphy**”). Dissolved silica values ranged from 200 to 700 μM in the diamicton. Peaks in the Ba²⁺ profile at 15 and 65 mbsf correlate well with minima in SO₄²⁻ (Figs. F9B, F12B), suggesting dissolution of barite. As noted for Site M0059, analyses of solid phases will be required to identify the reactions occurring.

Sediment

Carbon content

The total carbon (TC) content at Site M0060 ranges from 0.23 to 3.95 wt% (Table T10; Fig. F13A). Variation in total organic carbon (TOC) content is primarily related to changes in lithology and varies from 0.17 to 0.79 wt% in the greenish gray clays of Units II and III and from 0.01 to 0.21 wt% in the sandy intervals of Units V and VI. Comparatively high TOC values (up to 1.85 wt%) occur in the diamicton of Unit VII and may be caused by the presence of charcoal clasts interbedded in the sandy mineral matrix (see “**Lithostratigraphy**”).

The total inorganic carbon (TIC) ranges from 0.31 to 3.5 wt% in the uppermost 80 m of the profile, with values reaching a maximum between 63 and 78 mbsf (roughly corresponding to lithostratigraphic Subunit IIIc). Deeper than 120 mbsf, coinciding with the deposition of well-sorted sand (Unit VI) and the sandy diamicton (Unit VII), TIC values are generally low (0.5–1.2 wt%) and show only little variation compared to the overlying sections.

Sulfur content

Total sulfur (TS) values could only be determined for a limited number of samples from Site M0060, and the low resolution does not allow any apparent trends with depth to be recognized. In general, TS contents are low throughout the investigated profile, ranging from 0.14 to 0.25 wt% (Fig. F13D).

Physical properties

This section summarizes the preliminary physical property results from Site M0060. Two holes were drilled at this site. Hole M0060A was drilled to 232.50 mbsf, and Hole M0060B was drilled to 85.7 mbsf. A more complete data set of physical properties was produced for Hole M0060A during the OSP (Fig. F14) because Hole M0060B was designated as a microbiology hole (see “**Microbiology**”) and was extensively subsampled onboard. Core recovery was generally good in Hole M0060A, except for a gap between ~101.5 and 117 mbsf and from ~198 mbsf to the base of the hole, where coring alternated between hammer sampling and open-hole intervals. Although all physical property measurements described in “**Physical properties**” in the Methods chapter (Andrén et al., 2015) were conducted for Site M0060, whole-round core shipboard *P*-wave velocity data appear to be highly affected by artifacts, similar to those seen at Site M0059 (Little Belt). Discrete *P*-wave and thermal conductivity data are too sparsely distributed to exhibit any discernable downcore trends, and noncontact electrical resistivity data show little variability. Color reflectance variations do not correspond to other physical properties and lithostratigraphic units.

Natural gamma ray

High-resolution natural gamma ray (NGR) values are <5 cps near the core top in lithostratigraphic Unit I (Fig. F14). These low values reflect high coarse-grained content within lithostratigraphic Unit I (see “**Lithostratigraphy**”). NGR exhibits generally higher (>6 cps) and variable values in lithostratigraphic Unit II. Negative excursions potentially reflect an increase in silt or sand content, whereas positive excursions may result from an increase in clay content (see “**Lithostratigraphy**”). NGR values increase to ~15 cps at ~25 mbsf, near the lithostratigraphic Unit II/Subunit IIIa boundary, continuing at approximately this level downcore to the lithostratigraphic Unit IV/V boundary. High NGR values are interpreted as increased clay-sized sediment in lithostratigraphic Units III and IV (see “**Lithostratigraphy**”). NGR values drop to near zero at ~95 mbsf at the boundary of lithostratigraphic Units IV and V.

NGR values are low (<5 cps) in lithostratigraphic Unit VI from ~115 to ~145 mbsf, which is interpreted to result from increased silt and sand contents in this unit (see “**Lithostratigraphy**”). At ~145 mbsf, near the boundary of lithostratigraphic Units VI and VII, NGR values increase to ~15 cps. NGR is highly variable deeper than this throughout lithostratigraphic Unit VII.

Shipboard magnetic susceptibility

Magnetic susceptibility exhibits slightly increased values in lithostratigraphic Units I and II but near-zero values within all of lithostratigraphic Unit III (Fig. F14). lithostratigraphic Unit IV is characterized by higher and more variable values; this is also evident in the discrete values measured on cubes during the OSP (see “**Paleomagnetism**”). The synchronous increase in dry density suggests a lithologic change is reflected in the physical property measurements (see “**Lithostratigraphy**”). Below the break in recovery, from ~117 mbsf in lithostratigraphic Unit VI, excursions in magnetic susceptibility exhibit the highest magnitude in Hole M0060A. In lithostratigraphic Unit VII, values return to near zero.

Density

Discrete dry density values generally increase with depth and do not exhibit changes that correspond to lithologic boundaries (Fig. F14).

Gamma density was measured at 2 cm intervals during the offshore phase of Expedition 347. Values are not well correlated with the discrete bulk density measurements performed during the OSP (Fig. F15), either above the break in recovery (0–100 mbsf; $r^2 = 0.28$) or below (~117–200 mbsf; $r^2 = 0.19$), but exhibit an overall similar trend.

Paleomagnetism

To achieve the main objectives of the OSP paleomagnetic work, magnetic susceptibility measurements and rudimentary analyses of the natural remanent magnetization (NRM) were made on discrete specimens of known volume and mass (see “**Paleomagnetism**” in the “Methods” chapter [Andrén et al., 2015]). The discrete samples were taken from Hole M0060A, with a gap in sampling between 116 and 101 mbsf in the mid-lower sections of Unit V because of poor core recovery. Magnetic susceptibility (χ) ranged between 0.1×10^{-6} and 7×10^{-6} m³/kg through the sequence, with values $>2 \times 10^{-6}$ m³/kg confined to Unit VI, an interval of fine to medium massive well-sorted sand. Elevated χ values were also observed in an interval between 87 and 83 mbsf in Unit IV, most of Subunit IIIb, and the upper 22.23

mbsf of the hole (Units II and I). The stability of paleomagnetic pilot samples recovered from silt- and sand-rich intervals between the bottom of the hole (232.5 mbsf) and the top of Unit VI (116.7 mbsf) was poor, and this group of samples has very scattered inclinations with an average close to 0°. The majority of samples in Units III, II, and I carried normal polarity NRMs, with inclinations up to 30° shallower than a geocentric axial dipole (GAD) prediction. Samples with relatively high χ taken from Unit III and in particular Subunit IIIa acquired gyroremanent magnetization (GRM) during alternating field (AF) demagnetization above 60 mT, and these samples are associated with initial inclinations that approach the GAD prediction of 71°.

Discrete sample measurements

A total of 297 discrete samples were obtained from Hole M0060A. Samples were recovered at intervals of ~50 cm from within the site splice.

Magnetic susceptibility

The results of the magnetic analyses are shown in Figure F16. Magnetic susceptibility (χ), which was normalized to sample mass, ranges between 0.1×10^{-6} and 7×10^{-6} m³/kg. Samples taken from Unit VII have χ values $<0.5 \times 10^{-6}$ m³/kg. Overlying Unit VI has high χ values that exceed 2×10^{-6} m³/kg in distinct intervals close to the bottom and top. The χ of Units IV and III is variable and includes one interval in Unit IV (87–83 mbsf) and one in Subunit IIIb (66–57.5 meters composite depth [mcd]) in which the values exceed 1×10^{-6} m³/kg. One sample (347-M0060A-18H-1, 61–63 cm) in Subunit IIIa has an anomalously high χ value; otherwise the values are $<0.2 \times 10^{-6}$ m³/kg and constant in the interval between 57.6 and 22.3 mcd. Unit II displays χ values that reach 0.7×10^{-6} m³/kg, which trends upcore toward lower values that are characteristic of Unit I.

Sediment wet density and χ are not related to each other, although χ ranges over half an order of magnitude, which suggests that changes of the magnetic mineralogy and/or grain size are determining χ . Two trends are apparent in the biplot of χ versus NRM intensity, one that indicates high χ /NRM ratios and one that indicates low χ /NRM ratios (Fig. F16). The samples from Subunit IIIb have high χ /NRM ratios.

Natural remanent magnetization and its stability

Results of the pilot sample demagnetization (Fig. F17) indicate that an AF of 5 mT is sufficient to remove a weak viscous remanent magnetization. Three different responses to the sequential AF demagneti-

zation are displayed by samples from Site M0060. Category 1 includes the samples from the relatively coarse grained Units VII and VI, and they lose 50% of their NRM intensity at alternating fields <20 mT, with a small residual component left at 30 mT that is unaffected by more intense demagnetization levels. Category 2, which includes all other samples except those in Subunit IIIb and the interval 87–83 mbsf, is typified by a paleomagnetic vector that is smoothly demagnetized up to the maximum AF demagnetization level of 80 mT, with a vector that trends toward the origin of the orthogonal projection. Category 3 has a more complex behavior, which is characterized by the removal of a significant viscous remanence at the 5 mT demagnetization level. These samples subsequently acquired a GRM at field levels above 60 mT, with the vector moving into a plane perpendicular to the last demagnetization axis.

After removal of the viscous overprint, the NRM intensity of the samples recovered from Site M0060 lies in the range between 0.07×10^{-3} and $\sim 250 \times 10^{-3}$ A/m, with one outlier showing $>500 \times 10^{-3}$ A/m, and displays a general positive relationship with χ (Fig. F16). The relationship between NRM intensity and χ is, however, less obvious in Subunit IIIb, in which large peaks in NRM intensity are not reflected in the χ data.

Paleomagnetic directions

The directions of the paleomagnetic vectors are illustrated by the inclination data in Figure F16. The inclination data from Units VII, VI, and I are scattered, with an approximately equal number of positive and negative values. Only a few samples from these three units approach the GAD prediction for this site location. In contrast, the inclination data from Units IV and III group closer to the GAD prediction, but there is a bias toward lower values and some data points are negative or close to zero. It is notable that the samples taken from Unit IV and Subunit IIIb, which have high χ values and high NRM/ χ , plot within a few degrees of the GAD prediction. The variable magnetic properties downhole and different categories of response to AF demagnetization, which includes samples that acquire GRM, probably preclude using the paleomagnetic data for relative dating purposes. In particular, pilot samples that have high NRM/ χ and acquire GRM are restricted to intervals with inclinations that are close to the GAD prediction. These samples probably contain a secondary chemical remanent magnetization (CRM) carried by authigenic greigite (Fe_3S_4), which is known to acquire GRM (Snowball, 1997). The timing between sediment deposition and greigite precipitation is un-

known and, therefore, the ability to use the paleomagnetic data at Site M0060 for relative dating purposes is very restricted.

Microbiology

Hole M0060B was drilled specifically for microbiology, interstitial water chemistry, and unstable geochemical parameters at Site M0060. Counts of microbial cells were made on board the ship by fluorescence microscopy using the acridine orange direct count (AODC) method and flow cytometry (FCM) using SYBR green DNA stain. Additional AODC counts were made during the OSP. Further counts by fluorescence microscopy will be done after the OSP using both acridine orange and SYBR green staining.

Microbial cells were enumerated at 28 sediment depths from independently taken samples for FCM (27 samples) and AODC (13 samples), both on the ship and during the OSP (Table T11). Microbial cell abundance is relatively low in the upper few meters (Fig. F18) with $\sim 10^7$ cells/cm³ at 2.58 mbsf. The upper 6 mbsf at this site is well-sorted sand with high porosities and a very low TOC content (see “[Geochemistry](#)”), which is usually associated with smaller microbial cell densities. At 7.63 mbsf, microbial cell abundance increases to 3.61×10^8 cells/cm³, and this community size is maintained for all the remaining samples in this hole to 84.43 mbsf with no significant difference between the counts ($t = 0.198$; degree of freedom [df] = 35 [not significant]).

Apart from the upper 6 m of sand, there are no major lithologic changes in the upper 80 m of this hole, which comprises silt-grade material (Fig. F18). It is interesting to note that there appears to be a higher TOC content in the upper parts of Unit II (see “[Geochemistry](#)”) where cell numbers concomitantly increase. The alkalinity profile shows a broad maximum between 7 and 30 mbsf reaching 24 meq/L compared to a background level of 10–12 meq/L for the rest of the hole. This suggests that microbial mineralization of buried organic matter is enhanced in the upper 6–30 m. However, there is no indication of a corresponding enhancement of the microbial community size over this depth range (Fig. F18).

Apart from the upper 6 m of this hole, all cell concentrations measured in Hole M0060B were extremely high, with values far above the upper prediction limit of the global regression of prokaryotic cells with depth (Fig. F18). The maximum deviation from the global regression occurred at 53.83 mbsf, where cell numbers were ~ 110 times greater than the global regression.

Cell counts were made by both AODC and FCM at the same sediment depths in 12 samples from Hole M0060B. A paired sample t-test on these data showed no significant difference between the two techniques ($t = 0.044$; $df = 11$ [not significant]). In Figure F19, FCM counts are plotted against AODC from the same depths. A calculated regression of this data set (data not shown), however, shows poor agreement between the two techniques, and a slope test showed a highly significant deviation from a slope of 1 ($t = 5.735$; $df = 10$; $P < 0.001$). This is not a surprise with this data set. The unvarying nature of the counts with depth means the data are clustered around one area on this graph and the result of the paired sample t-test should be regarded as indicative for the successful methods comparison.

Perfluorocarbon (PFC) contamination tracer was well above detection in the liner fluid and exteriors of all cores, indicating continuous PFC delivery into the borehole (Table T12). Liner fluid PFC concentrations fluctuated over 2–3 orders of magnitude (Fig. F20A), indicating variations in the rates of PFC delivery or mixing into the drilling fluid stream. Generally, the measured PFC concentrations were much below the target concentration of 1 mg PFC/L. Despite the fluctuations, PFC was above detection in the vast majority of core halfway and interior sections (Fig. F20B). Based on the fraction of liner fluid in cores, contamination was highest in the surface core, which consisted of sand, and it remained relatively high in Core 347-M0060B-3H, which consisted of organic-poor clay (Fig. F20C). Below that depth, drilling fluid intrusion (as estimated from liner fluid PFC values) fluctuated greatly with no clear relation to depth or lithology, except that PFC was below detection in the halfway and interior parts of the two lowermost cores (347-M0060B-25H and 27H). In addition to the surface cores, several deeper cores were highly contaminated (347-M0060B-6H, 10H, 17H, and 19H) and were estimated to potentially have 10^3 – 10^5 contaminant cells/cm³ in the interiors (Fig. F20D).

Based on PFC data in core interiors, cores that are suitable for microbiological analyses include, in addition to Cores 347-M0060B-25H and 27H, Cores 5H, 9H, and 11H, in all of which PFC was below detection in the core interiors. Moreover, Cores 21H and 23H show a only moderate level of contamination, estimated to be <100 cells/cm³ of sediment in the interiors (Table T12; Fig. F20D).

Stratigraphic correlation

At Site M0060, two holes were drilled, Holes M0060A (232.5 mbsf) and M0060B (85.7 mbsf). Hole M0060B was heavily subsampled offshore for microbiological

studies, and the remaining core material after whole-round subsampling (see “**Microbiology**”) was limited. Thus, it was not possible to produce a continuous splice record for this site. However, sediment cores from Hole M0060B were logged before subsampling using the Fast-track multisensor core logger (MSCL) (see “**Physical properties**”). Magnetic susceptibility data (4 cm resolution) from the Fast-track MSCL together with standard MSCL magnetic susceptibility measurements from Hole M0060A (2 cm resolution) enable correlation between holes and construction of a composite section for Site M0060 (Fig. F21).

The meters composite depth scale for Site M0060 is based primarily on correlation of magnetic susceptibility between holes (Fig. F21). Before analysis/correlation, all magnetic susceptibility data were cleaned for the top (0–5/20 cm) of each section, removing any outliers from the measurements. The depth offsets that define the composite section for Site M0060 are given in Table T13. Correlation between the susceptibility anomalies/data in Holes M0060A and M0060B is mainly good downhole to the end of Hole M0060B. Because of limited core material from Hole M0060B and the single hole recovery below 85.7 mbsf, there are several gaps in the composite record, and it was not possible to make a single spliced record for this site.

Similar to Site M0059, a compression or expansion correction was not applied to the data, so the offset within each core was equal for all points. Therefore, it might be that some features are not similarly aligned between holes. Thus, the meters composite depth values will approximately, but not precisely, correspond to the same stratigraphic horizons in adjacent holes.

Seismic units

Seismic sequence boundary-sediment core-MSCL log (magnetic susceptibility) correlations are shown in Figure F22. Correlation is based on the integration of seismic data and lithostratigraphy (see “**Lithostratigraphy**”). Two-way traveltime (time elapsed between when the acoustic pulses are sent to seabed and when they are received back at the surface) values were calculated for each lithostratigraphic unit boundary using sound velocity values measured during the OSP and offshore (see “**Physical properties**”; Table T14). Lithostratigraphic units and unit boundaries were examined at these calculated two-way traveltime values to define the extent of agreement between seismic boundaries and actual lithologic transitions and/or where the physical properties data indicate disconformable surfaces. Uncertainties in the time-depth function could have

resulted in minor inconsistencies between seismic features, sedimentological observations from cores, and MSCL logs.

Seismic Unit I

Two-way traveltime: 0.0541 ms

Lithology: fine to medium thickly bedded sand (lithostratigraphic Unit I)

Depth: 0–6.0 mbsf

This unit is characterized by strong reflectors in the seismic profile, as well as in physical properties like high magnetic susceptibility values measured in sediment cores.

Seismic Unit II

Two-way traveltime: 0.0768 ms

Lithology: interlaminated sandy clayey silt and fine-medium sand with dispersed clasts (lithostratigraphic Unit II)

Depth: 6.0–23.84 mbsf

Unit II shows increasing magnetic susceptibility values downcore. In the seismic profile, the lower limit of Unit II is visible, but it is not very clear at Site M0060 because of a strong seabed multiple in the seismic profile. At the lower limit of this unit, magnetic susceptibility values decrease rapidly.

Seismic Unit III

Two-way traveltime: 0.1495 ms

Lithology: laminated clay and silt with dispersed clasts (lithostratigraphic Unit III)

Depth: 23.84–79.52 mbsf

This seismic unit shows faint parallel layering in the seismic profile. Magnetic susceptibility values of this unit show high variability. The lower boundary of this unit corresponds relatively well to a change into a more seismically chaotic unit.

Seismic Unit IV

Two-way traveltime: 0.1683 ms

Lithology: interbedded sand, silt, and clay with dispersed clasts and clast-poor diamicton (lithostratigraphic Unit IV)

Depth: 79.52–95.04 mbsf

At this unit boundary, magnetic susceptibility values increase rapidly downcore.

Seismic Unit V

Two-way traveltime: 0.1947 ms

Lithology: sandy silty clay with dispersed clasts (lithostratigraphic Unit V)

Depth: 95.04–116.7 mbsf

Unit V coincides with a locally (partly) stratified seismic unit.

Seismic Unit VI

Two-way traveltime: 0.2282 ms

Lithology: fine to medium massive well-sorted sand (lithostratigraphic Unit VI)

Depth: 116.7–146.1 mbsf

Unit VI is characterized by a more chaotic seismic structure and relatively high magnetic susceptibility values. At the lower boundary of Unit VI, magnetic susceptibility values decrease rapidly downcore.

Seismic Unit VII

Two-way traveltime: 0.3215 ms

Lithology: sandy diamicton (lithostratigraphic Unit VII)

Depth: 146.1–229.6 mbsf

This unit shows some inclining seismic structures/reflectors. Some strong seismic reflectors occur in the lowermost part of this unit, but they are not seen in the lithology. However, some high magnetic susceptibility values might correspond to these seismic reflectors.

Downhole measurements

Logging operations

Downhole logging measurements in Hole M0060B were made after completion of coring to a total depth of 85.7 m DSF. In preparation for logging, the hole was circulated with seawater and the pipe was pulled back to ~17.5 m WSF.

For downhole logging in Hole M0060B three tool strings were deployed:

- The gamma ray tool (MCG)/array induction tool (MAI) tool string, measuring total gamma ray and electrical resistivity,
- The MCG/spectral gamma ray tool (SGS)/sonic sonde (MSS) tool string, measuring total gamma ray, spectral gamma ray, and sonic velocity, and
- The MCG/microimager (CMI) tool string, with total gamma ray and microimager tools.

The MCG/MAI tool string was lowered and down-logged to 67 m WSF. The hole was then uplogged to the seafloor. The wireline depth to the seafloor was determined from the step increase in gamma ray values.

The MCG/SGS/MSS tool string was lowered to 61 m wireline log depth below seafloor (WSF) and an up-log was started.

The MCG/CMI tool string was lowered to 56 m WSF with the calipers closed. The hole was then uplogged with open calipers at high resolution.

The tools provided continuous and good quality log data.

Logging units

Hole M0060B is divided into two logging units on the basis of the logs (Fig. F23). The uplog was used as the reference to establish the wireline log depth below seafloor depth scale.

Logging Unit 1: base of drill pipe to 23.5 m WSF

This logging unit is characterized by a fluctuation in gamma ray between 40 and 60 gAPI. Gamma ray values are driven by thorium and uranium; no potassium is measured in logging Unit 1. Resistivity values also show fluctuations and infiltration of borehole fluid into the formation (deep, medium, and shallow resistivity show different values). Sonic values are increasing. The fluctuations observed might be due to poor borehole conditions, but in this interval, no caliper data are available. The generally lower NGR values are explained by the sandy clayey silt as described in lithostratigraphic Unit II (see “**Lithostratigraphy**”).

Logging Unit 2: 23.5–67 m WSF

NGR values vary between 80 and 100 gAPI and are higher than in logging Unit 1. This can be explained by the increase in clay content from lithostratigraphic Units II and III (see “**Lithostratigraphy**”). Resistivity is constant throughout this unit, and the sonic log slightly decreases with depth. The caliper data in logging Unit 2 shows good borehole conditions with the hole slightly closing in the top part of the unit.

References

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Figure F1. Graphic lithology log summary, Hole M0060A.

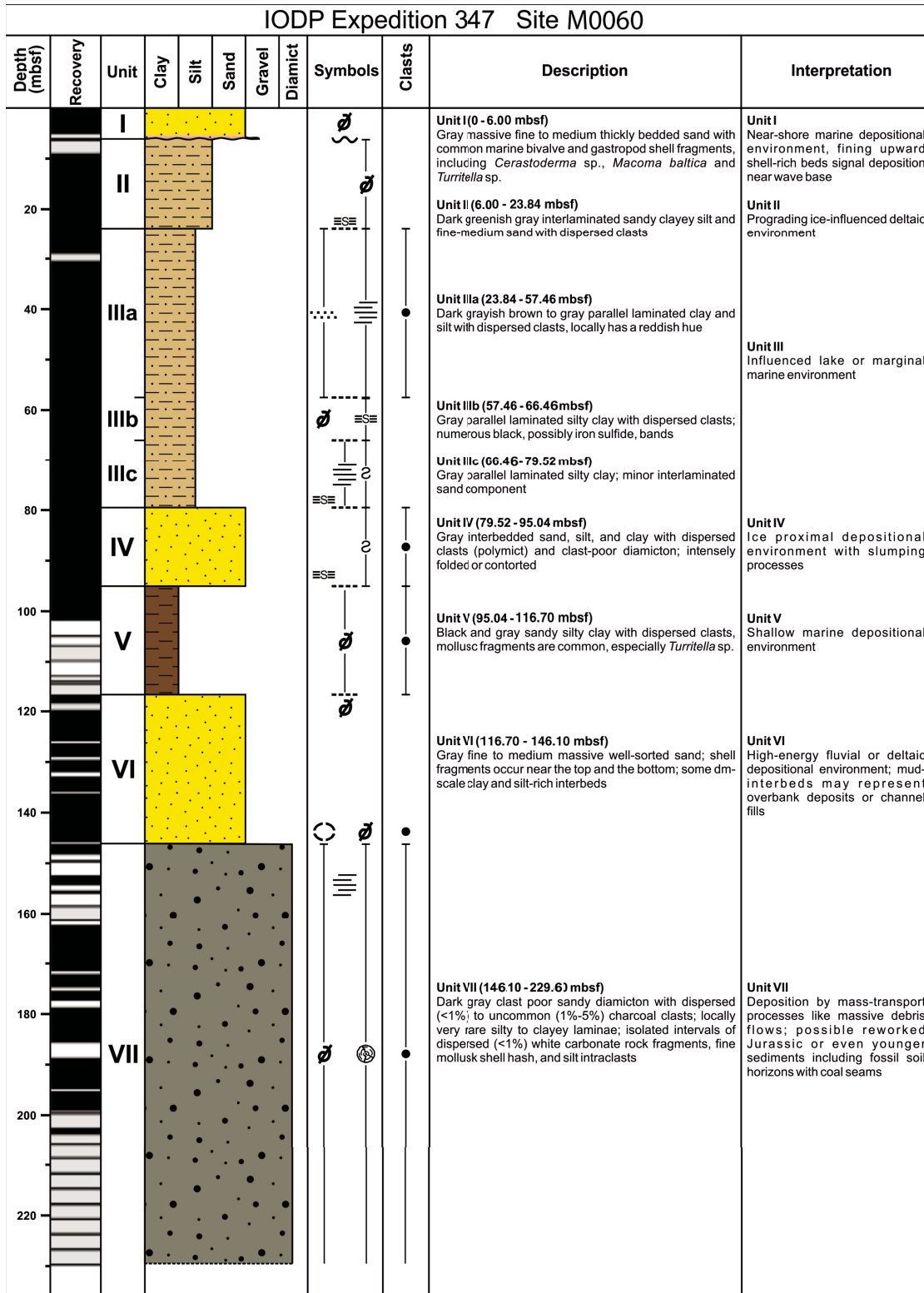


Figure F2. Contact between Subunits IIIa and IIIb (interval 347-M0060A-23H-1, 56–90 cm).

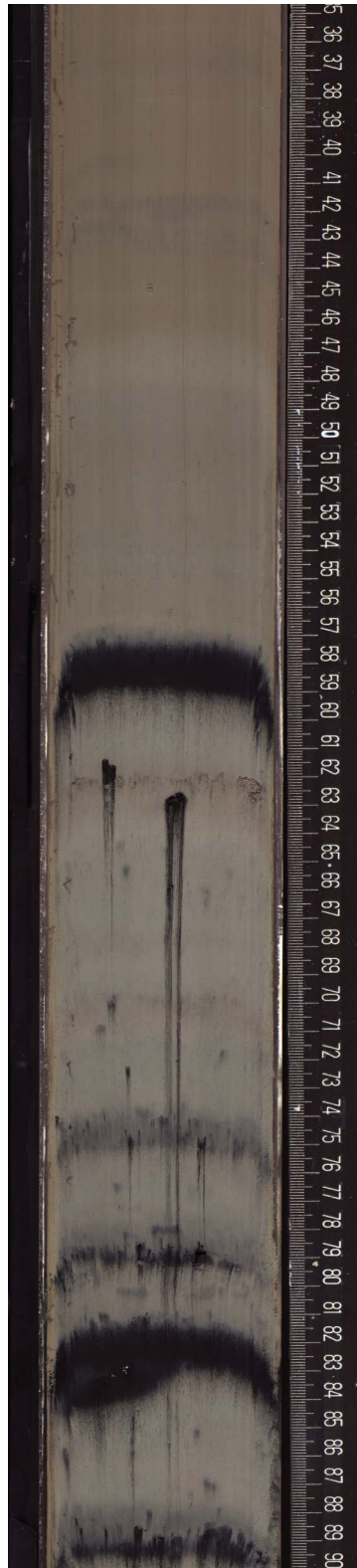


Figure F3. Clast-poor sandy diamicton (interval 347-M0060A-66H-1, 13–40 cm).



Figure F4. Analyzed levels and diatom occurrence, Hole M0060A. Only the upper parts of the core contain in situ diatom deposition. The majority of the core contains rare, reworked diatom fragments and individual valves.

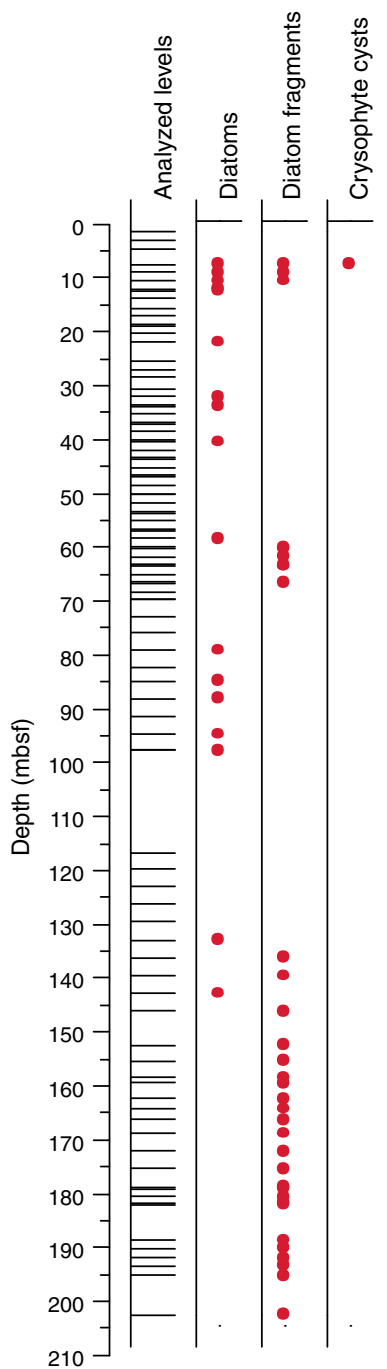


Figure F5. Foraminifers, Site M0060. **A.** Number of foraminifers per cubic centimeter sample (samples of very large volume were not always picked in their entirety). Number of foraminifers for samples with counts exceeding 125 individuals are shown on the right. **B.** Percent of assemblage composed of *Elphidium excavatum clavatum*. Only OSP samples are shown. **C.** Number of foraminiferal species/20 cm³ sample (samples of very large volume were not always picked in their entirety).

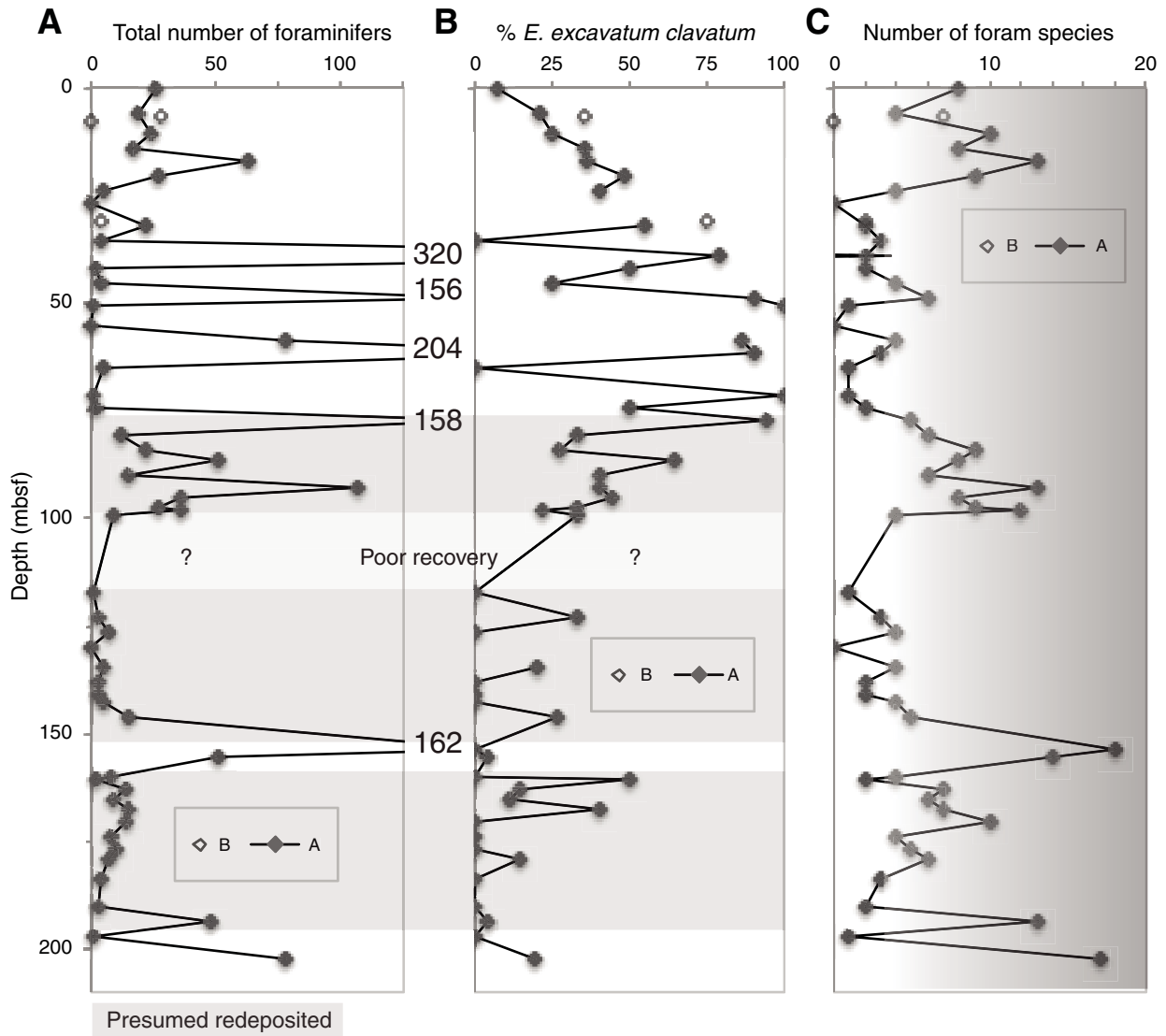




Figure F6. Distribution of ostracod ecological groups and their abundance, Site M0060. Abundance is shown per sediment volume.

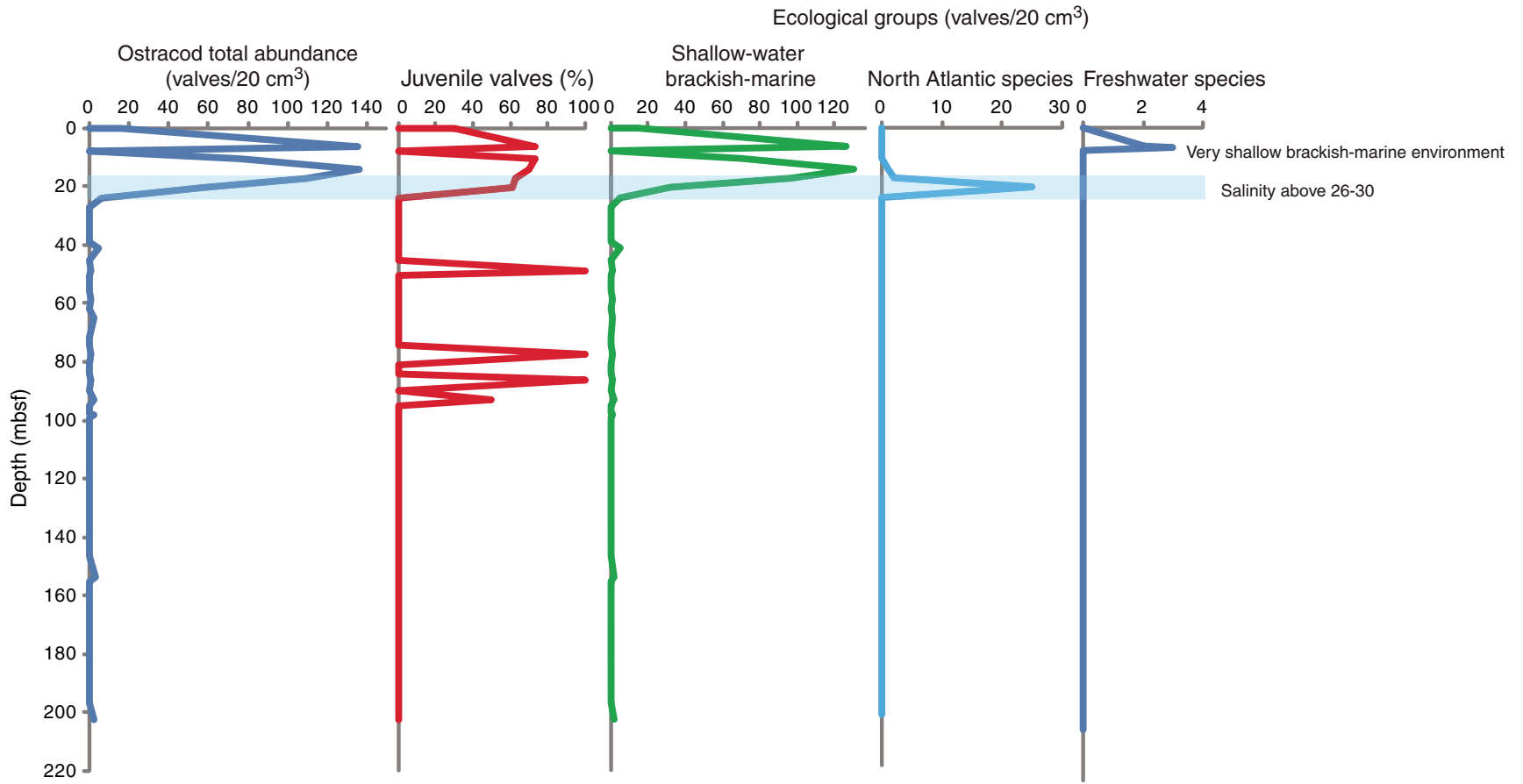


Figure F7. Simplified pollen diagram, dinocyst, and palynomorph data, Site M0060. Pollen and algae percentage calculations are based on the terrestrial pollen sum. Because of generally poor palynomorph preservation, counting sums were too low in some samples to get statistically relevant data (orange bars). The organic-walled-dinoflagellate-cyst/terrestrial-pollen ratio (*) could not be calculated in samples where in situ dinocysts were absent.

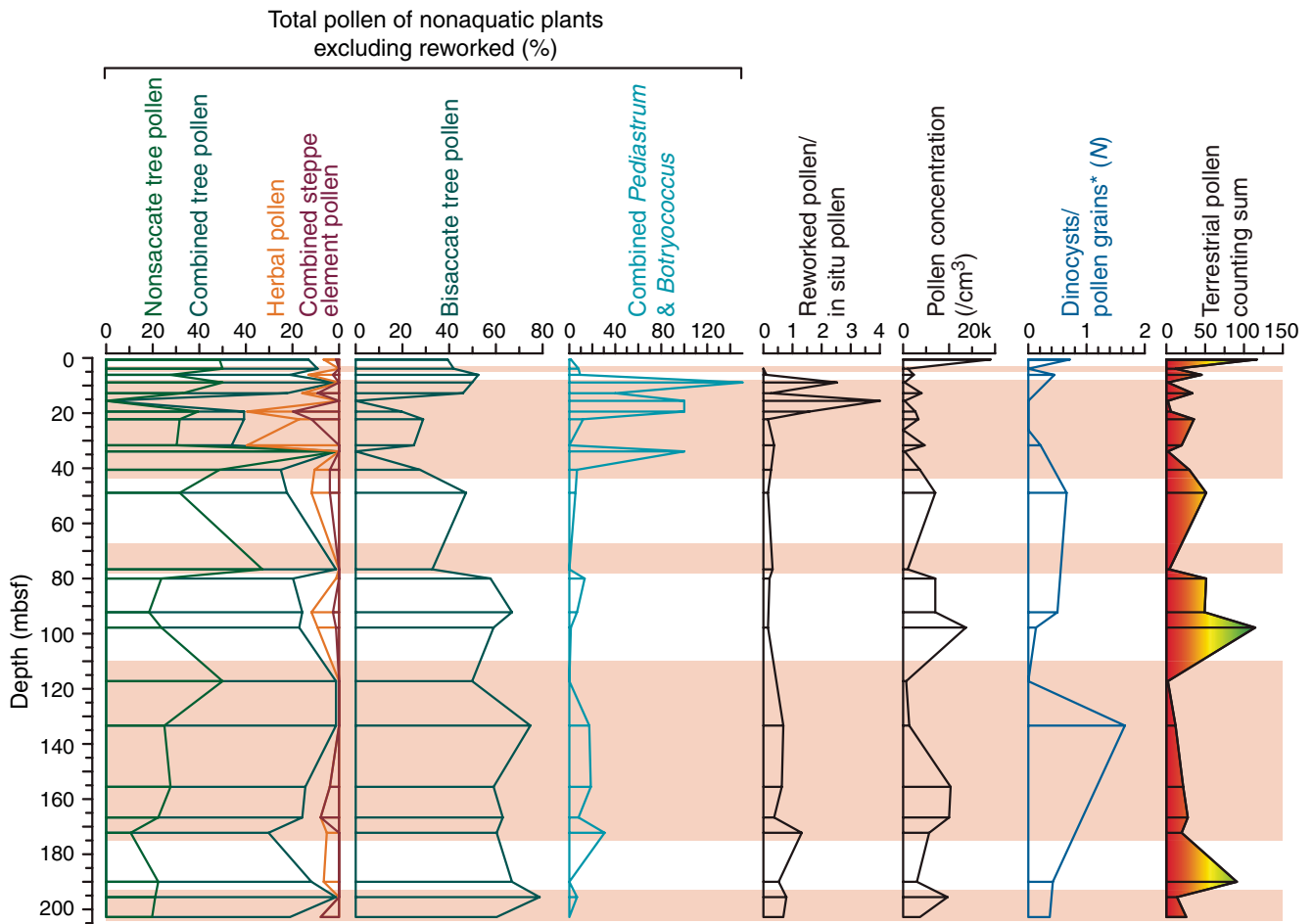




Figure F8. Concentrations of (A) shipboard salinity calculated from refractive index, (B) chloride, (C) chloride-based salinity, and (D) alkalinity in interstitial water samples, Site M0060.

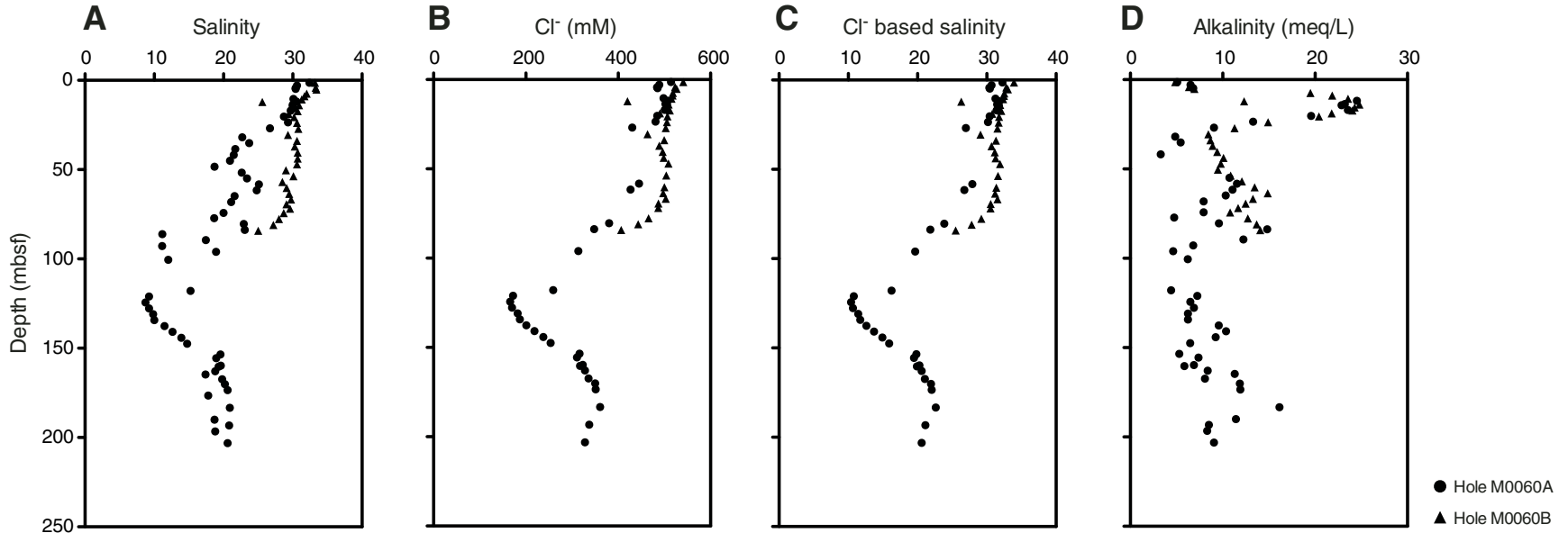




Figure F9. Concentrations of (A) methane, (B) sulfate, (C) hydrogen sulfide, (D) ammonium, (E) phosphate, (F) iron, (G) manganese, and (H) pH from interstitial water samples, Site M0060.

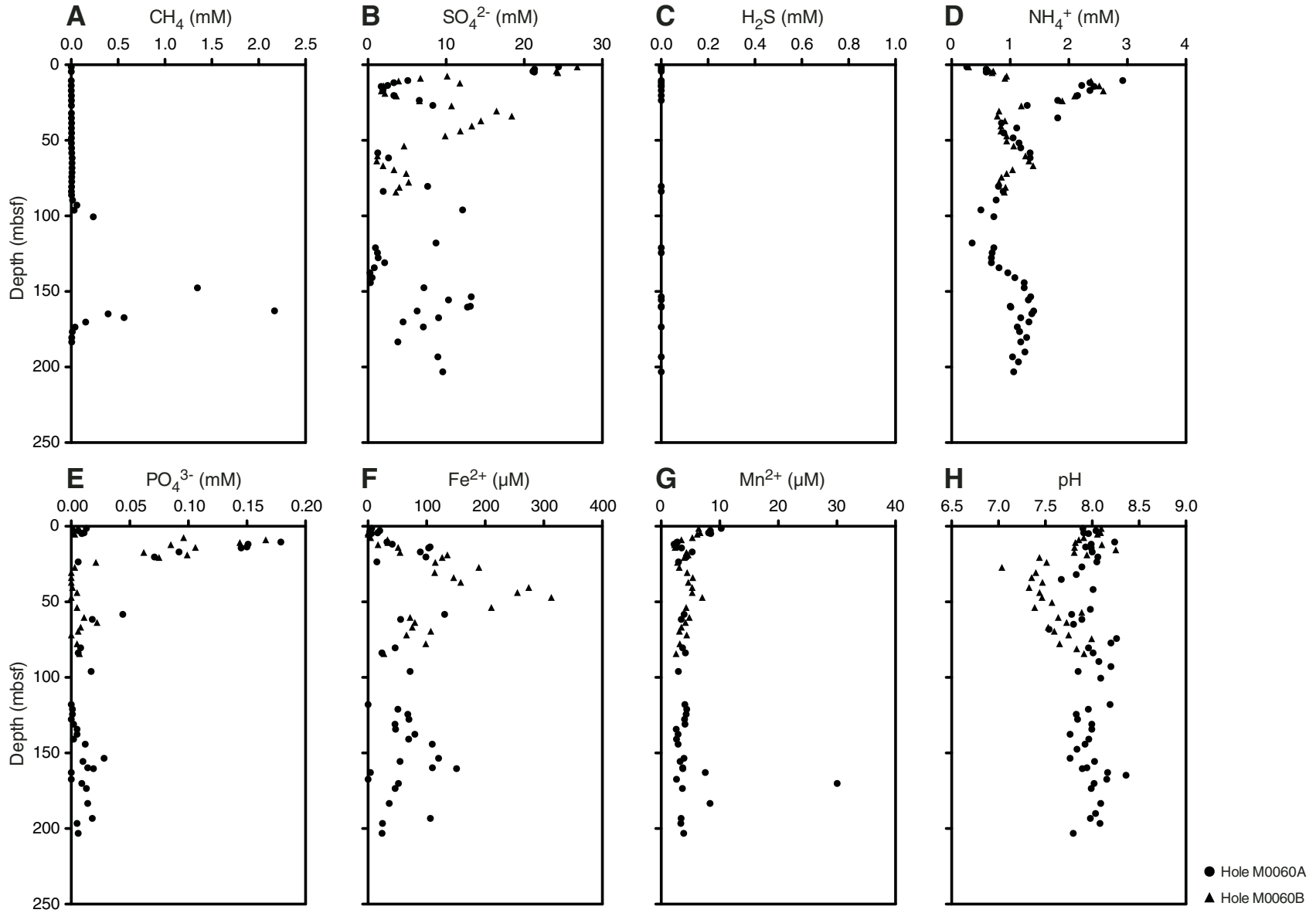




Figure F10. Concentrations of (A) bromide, (B) bromide/chloride, (C) boron, and (D) boron/chloride from interstitial water samples, Site M0060. Dashed lines = seawater ratio.

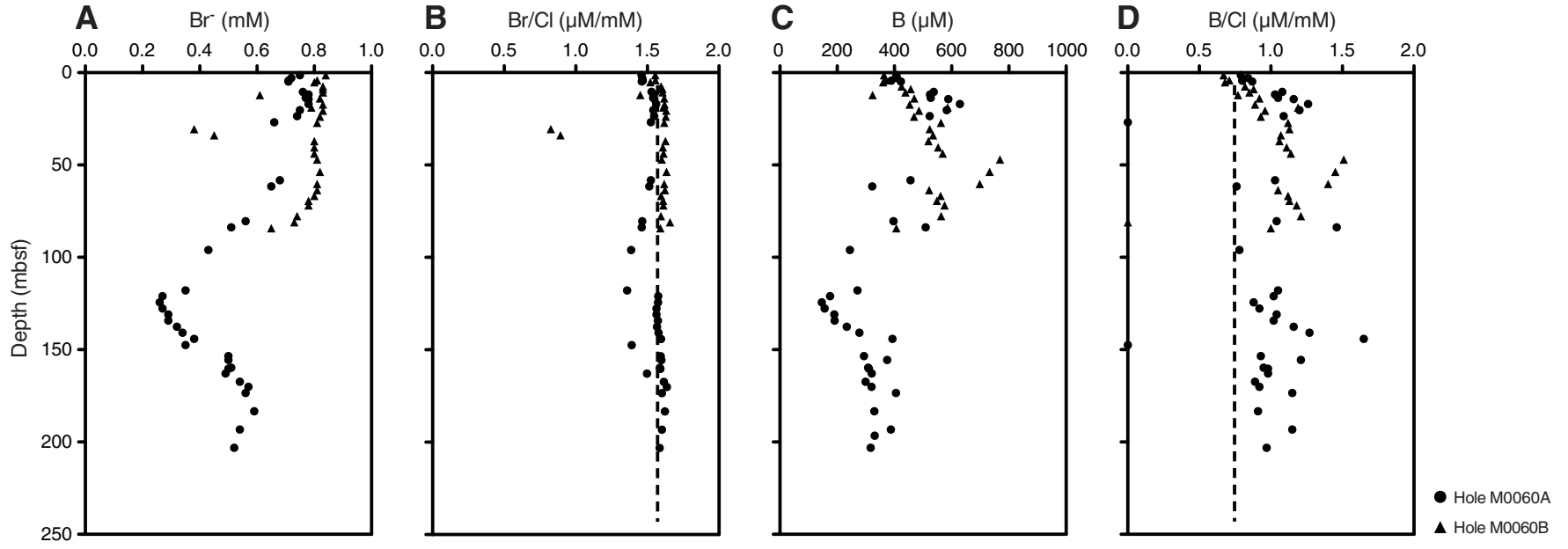


Figure F11. Concentrations of (A) sodium, (B) potassium, (C) magnesium, (D) calcium, (E) sodium/chloride, (F) potassium/chloride, (G) magnesium/chloride, and (H) calcium/chloride from interstitial water samples, Site M0060. Dashed lines = seawater ratio.

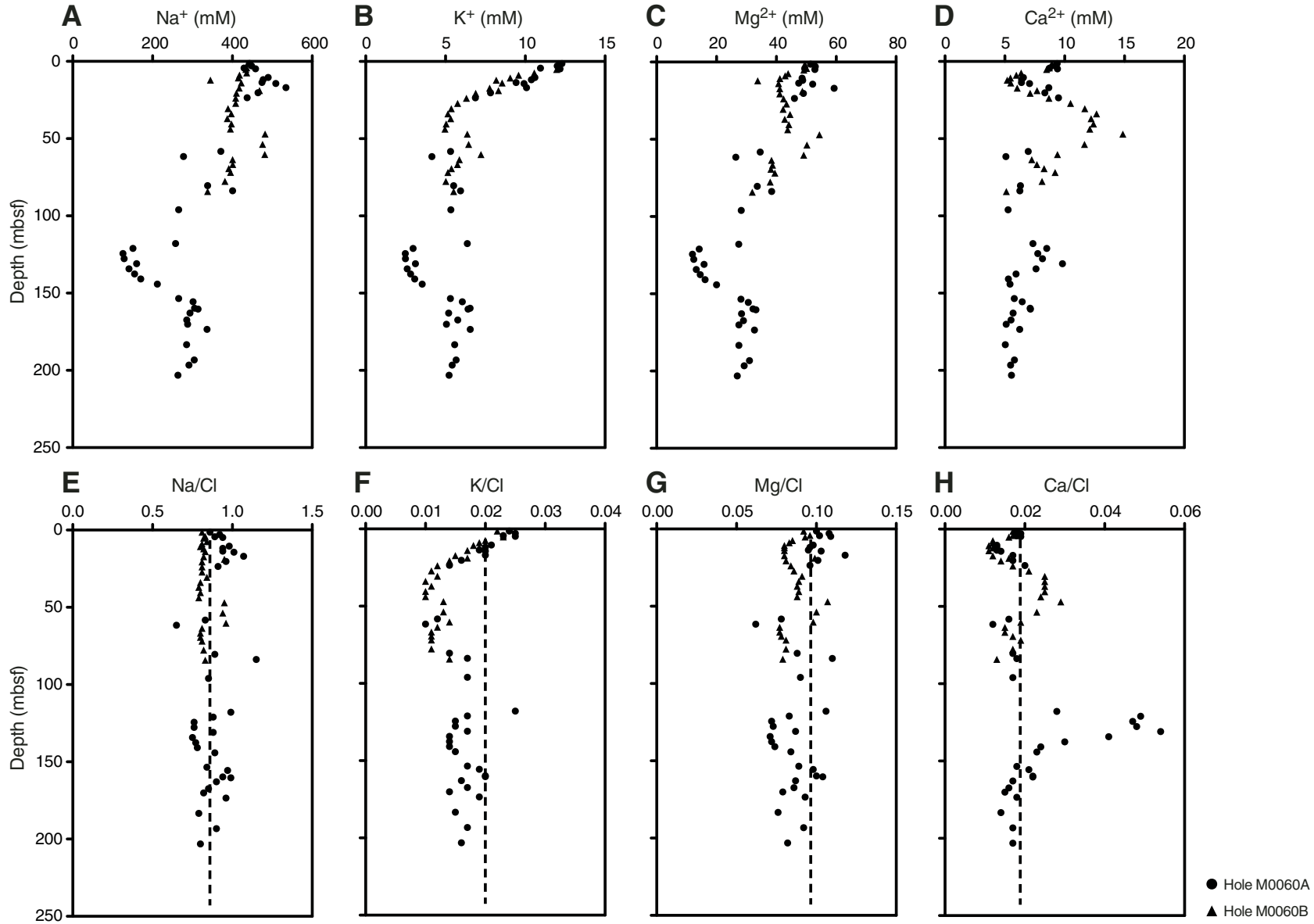




Figure F12. Concentrations of (A) strontium, (B) barium, (C) lithium, and (D) dissolved silica from interstitial water samples, Site M0060.

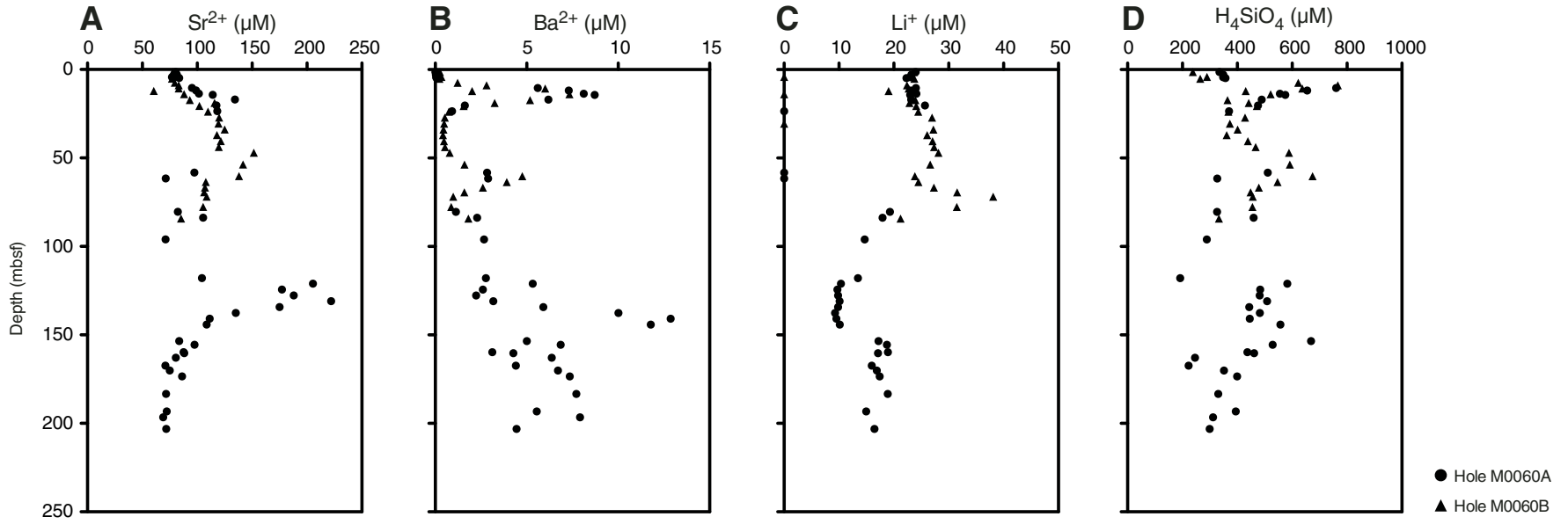




Figure F13. Sedimentary (A) total carbon (TC), (B) total organic carbon (TOC), (C) total inorganic carbon (TIC), and (D) total sulfur (TS), Site M0060.

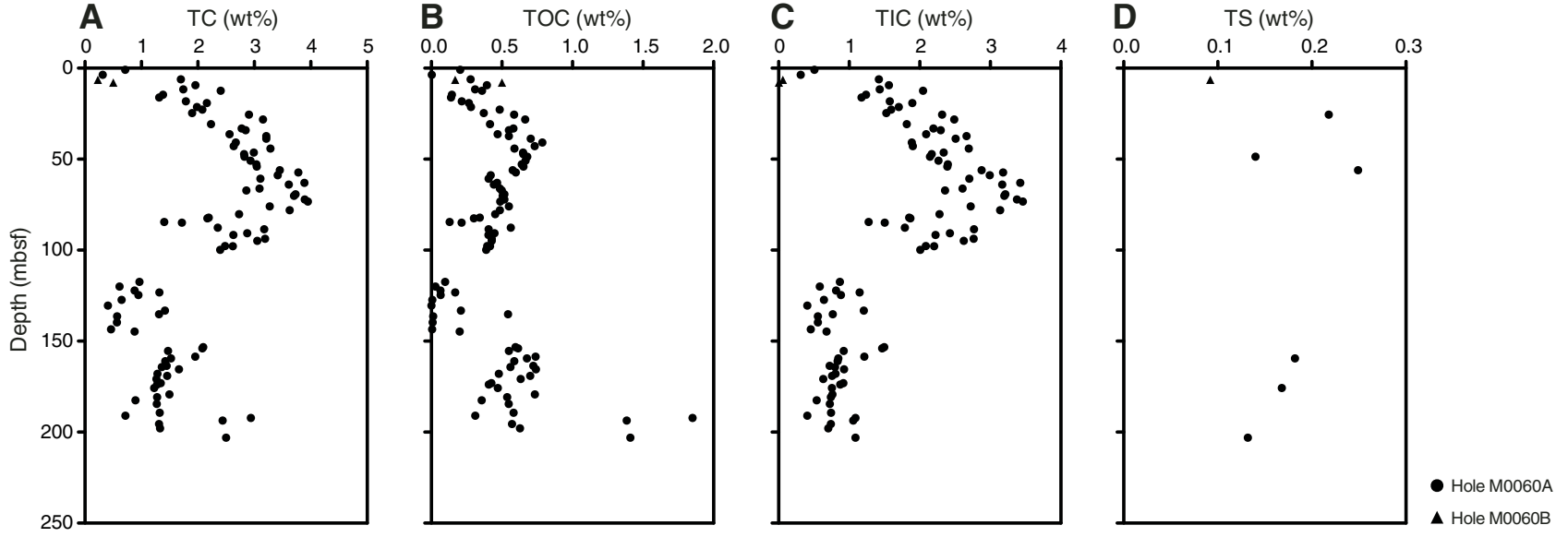


Figure F14. Natural gamma radiation (NGR) (cps), MSCL magnetic susceptibility (MS) (10^{-5} SI), and dry density (g/cm^3) with lithostratigraphic boundaries, Hole M0060A.

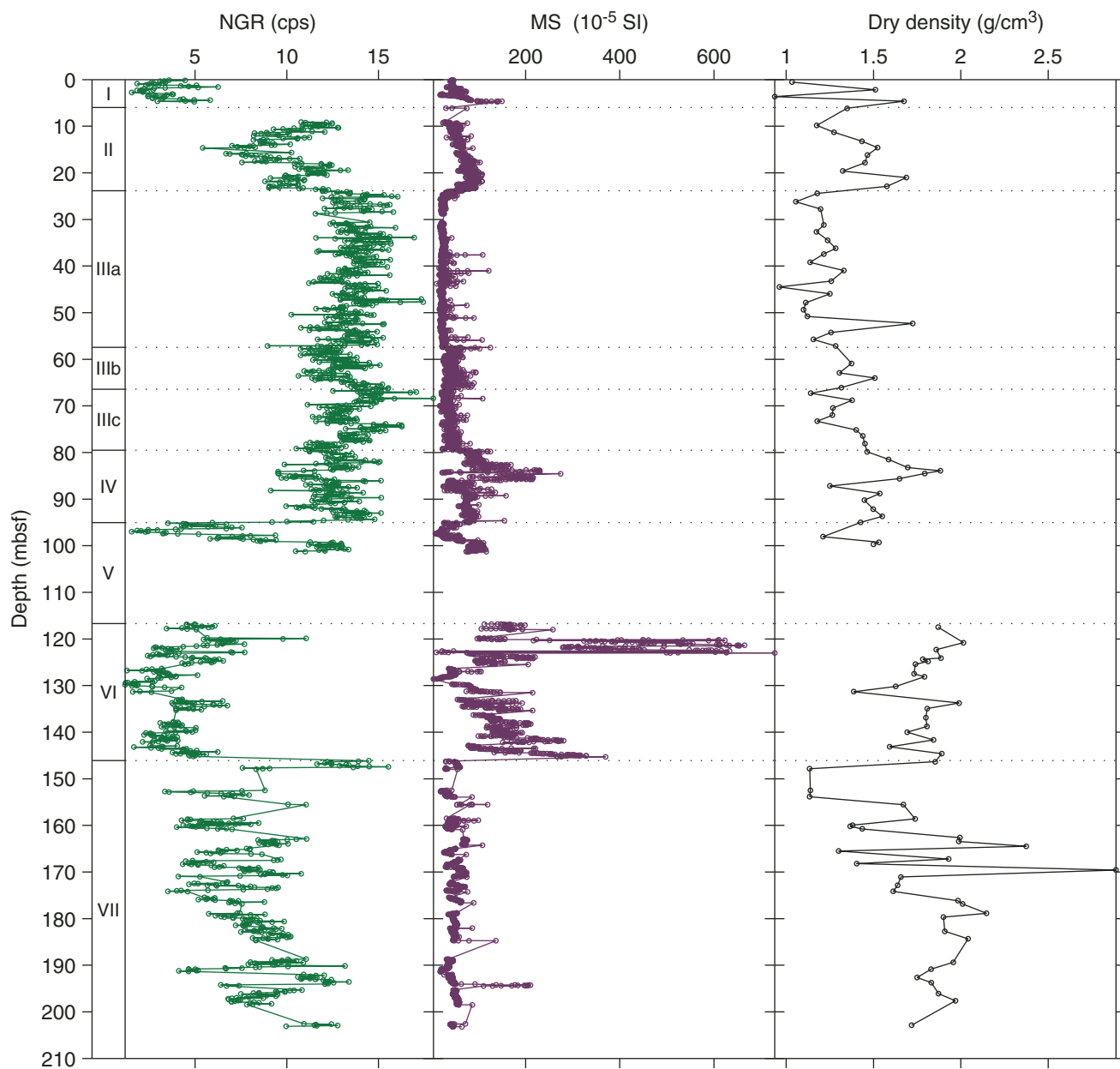


Figure F15. Gamma density (g/cm^3) and discrete bulk density (g/cm^3) measurements derived from pycnometer moisture and density analyses, Hole M0060A.

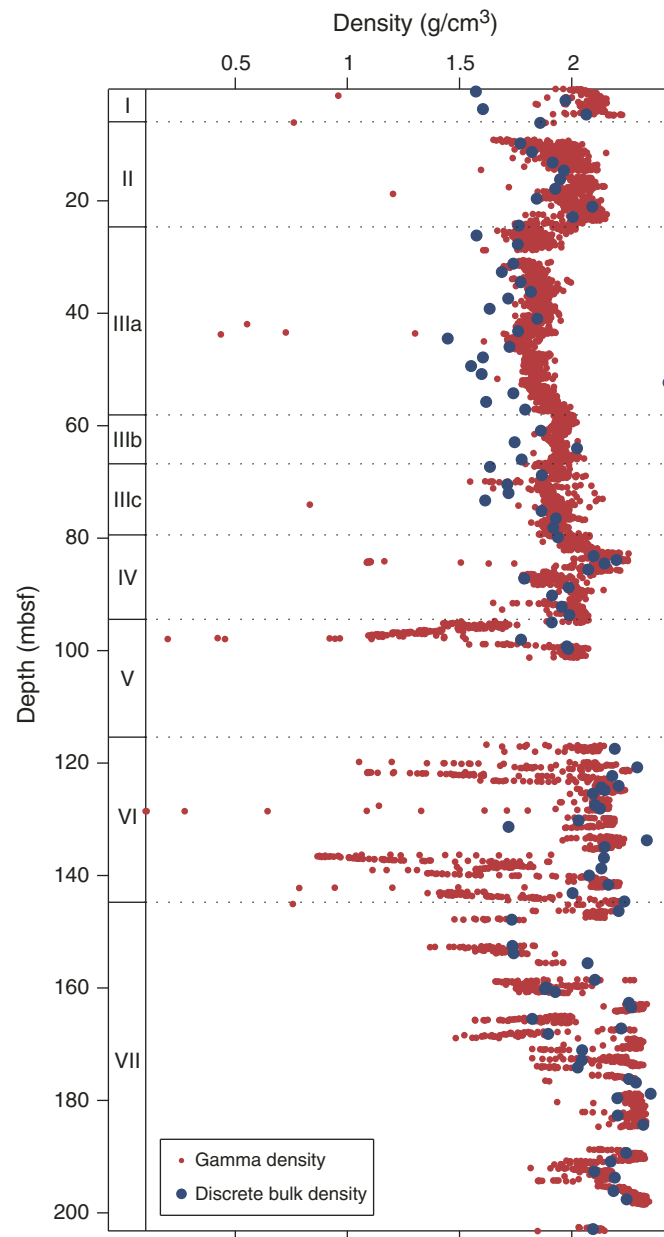




Figure F16. Plots and biplots of magnetic susceptibility (χ), natural remanent magnetization (NRM) intensity, and NRM inclination of discrete palaeomagnetic samples, Hole M0060A. Dashed line = geocentric axial dipole (GAD) prediction of inclination for the site latitude.

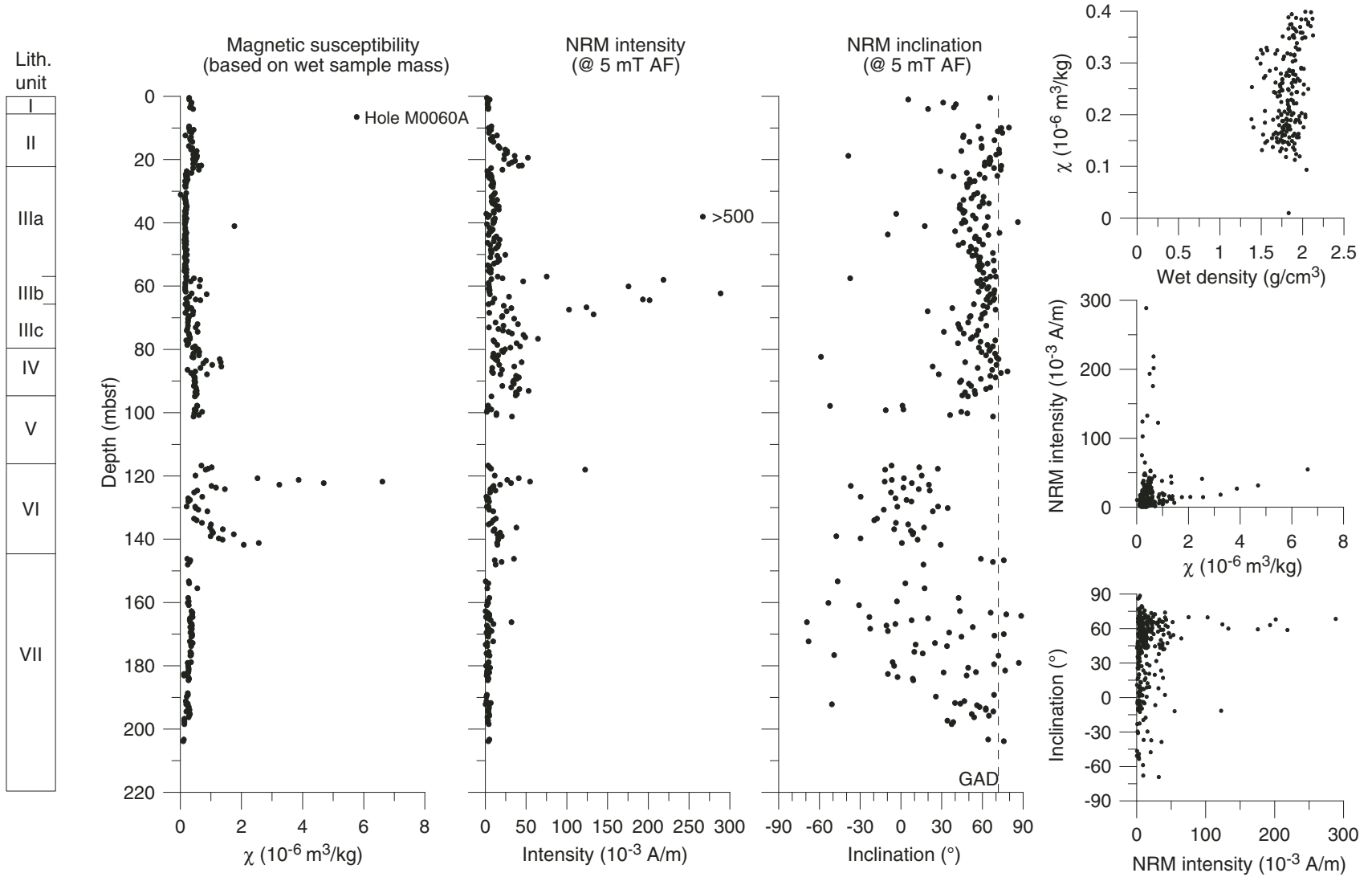


Figure F17. Plots of natural remanent magnetization (NRM) after AF demagnetization to 80 mT. **A.** Sample 347-M0060A-24H-2, 9 cm; 61.79 mcd. **B.** Sample 347-M0060A-15H-3, 26 cm; 33.77 mcd. **C.** Sample 347-M0060A-48H-1, 131 cm; 118.02 mcd. Category 1 and 2 vectors trend toward the origin, whereas Category 3 vectors veer into a plane perpendicular to the last demagnetization axis, which is a sign of gyroremanent magnetization acquisition. Open squares = vertical, solid squares = horizontal.

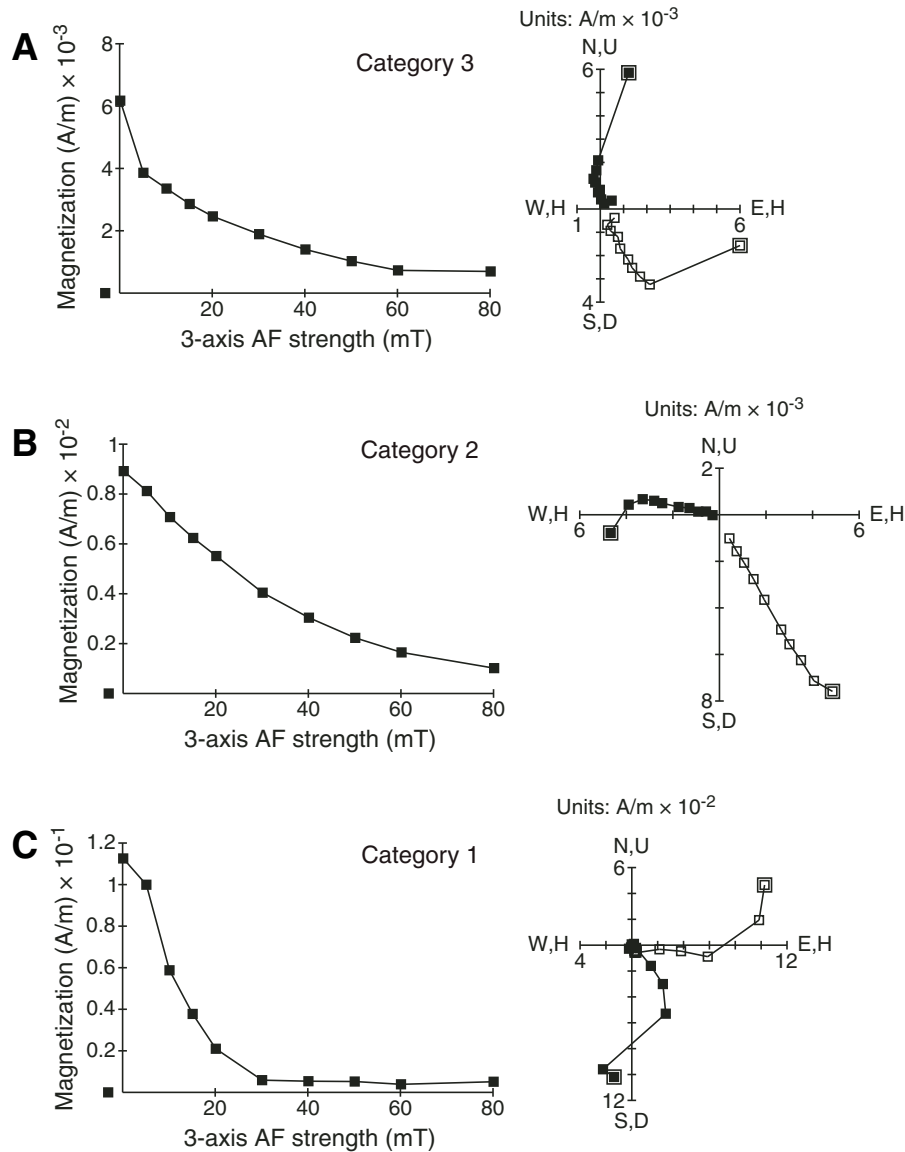




Figure F18. Plot of microbial cell abundances compared to chemical zonation and lithostratigraphy, Hole M0060B. **A.** Interstitial water alkalinity (blue dashed line) and salinity (red line). **B.** Cell numbers obtained by flow cytometry (blue circles) and acridine orange direct count (red diamonds). Solid black line = global regression line of prokaryote cell numbers with depth, dashed lines = upper and lower 95% prediction limits for regression line (Roussel et al., 2008). **C.** Lithology.

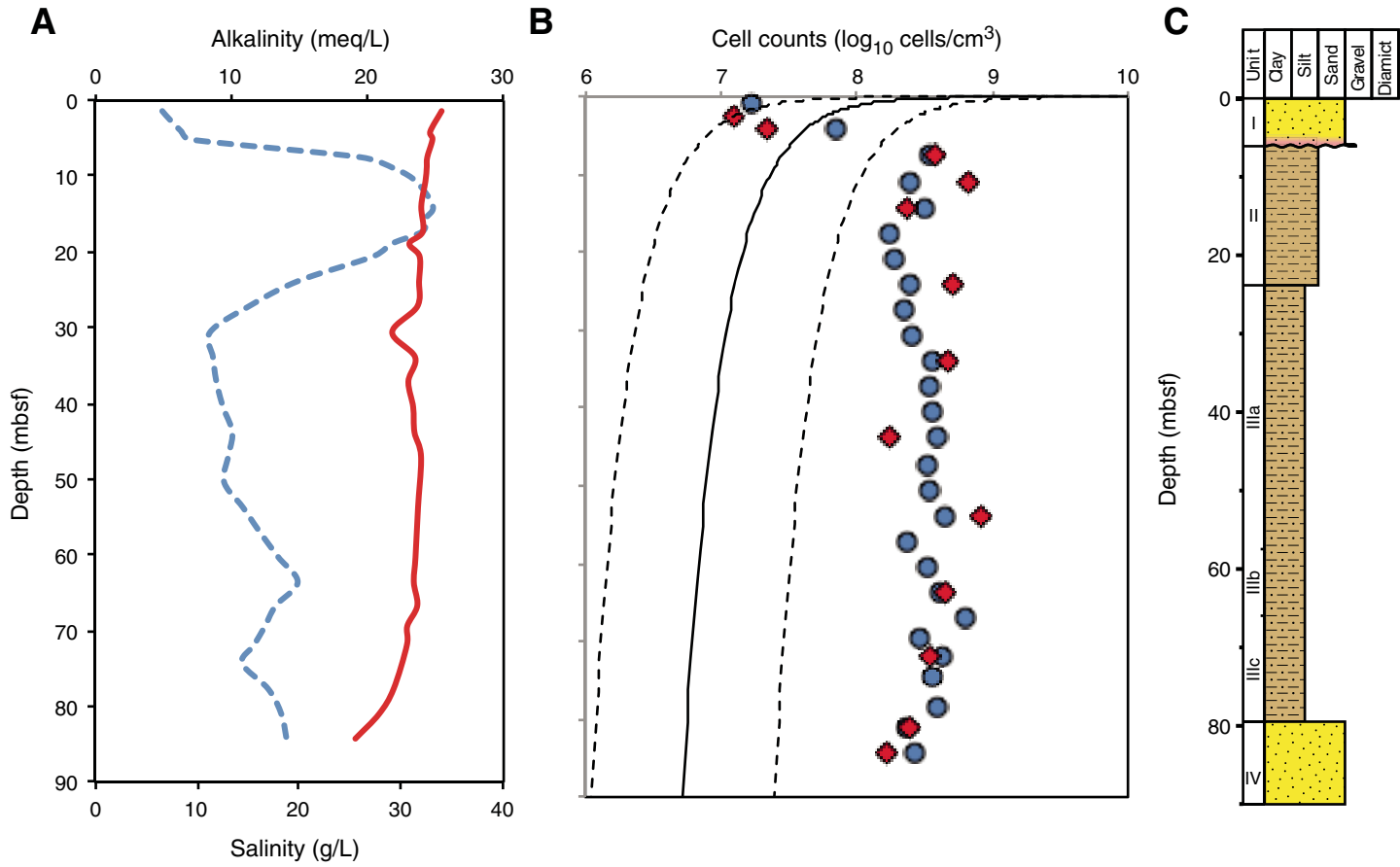


Figure F19. Comparison of paired counts between two methods of cell enumeration, Hole M0060B. Black dashed line = line of unity. FCM = flow cytometry, AODC = Acridine Orange Direct Count.

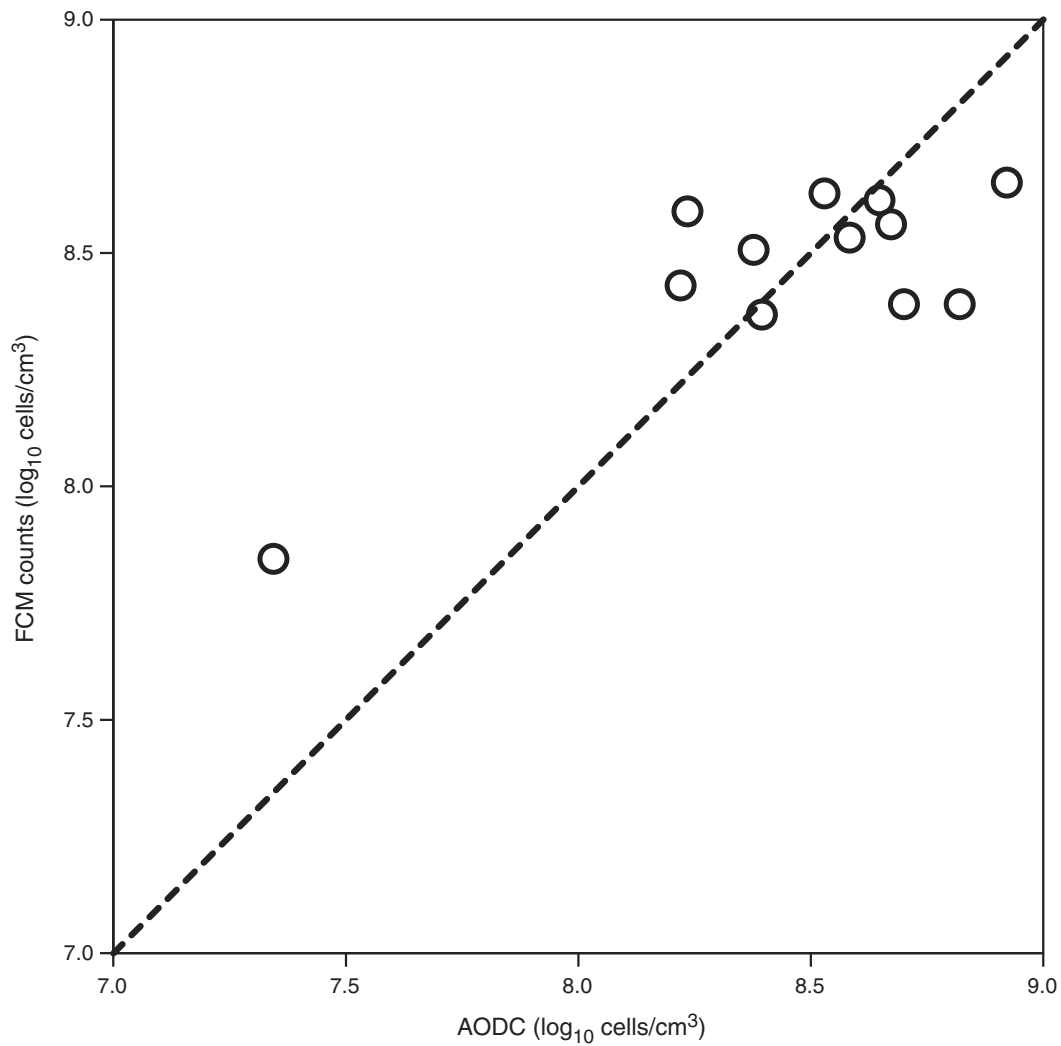


Figure F20. Plots of perfluorocarbon (PFC) tracer concentrations, Hole M0060B. **A.** Core liner fluid. **B.** Sediment core samples. (Continued on next page.)

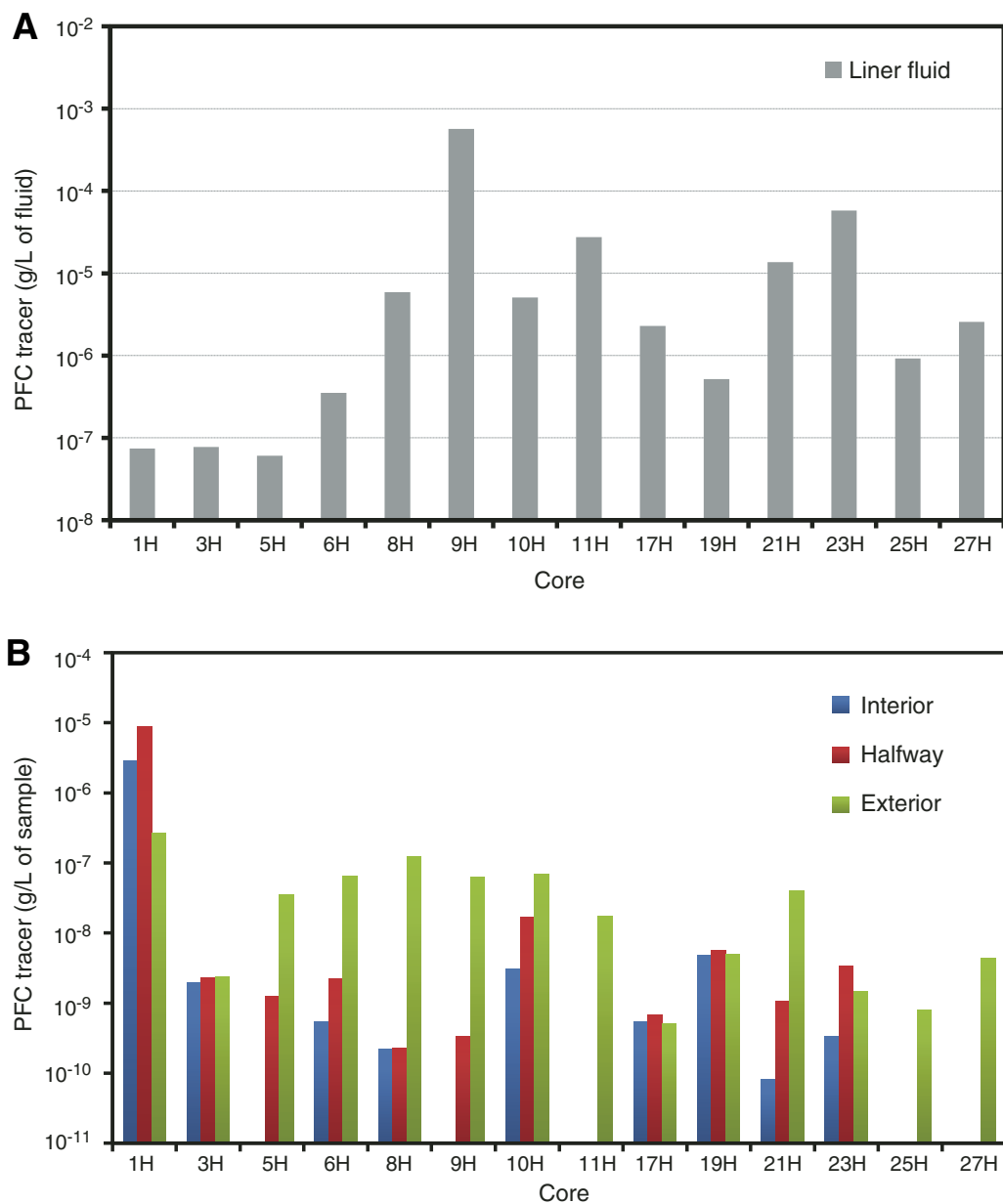


Figure F20 (continued). C. Estimated volume of liner fluid introduced into sediment cores shown as percentage of sediment core volume. D. Estimated potential number of contaminant cells per volume of sediment.

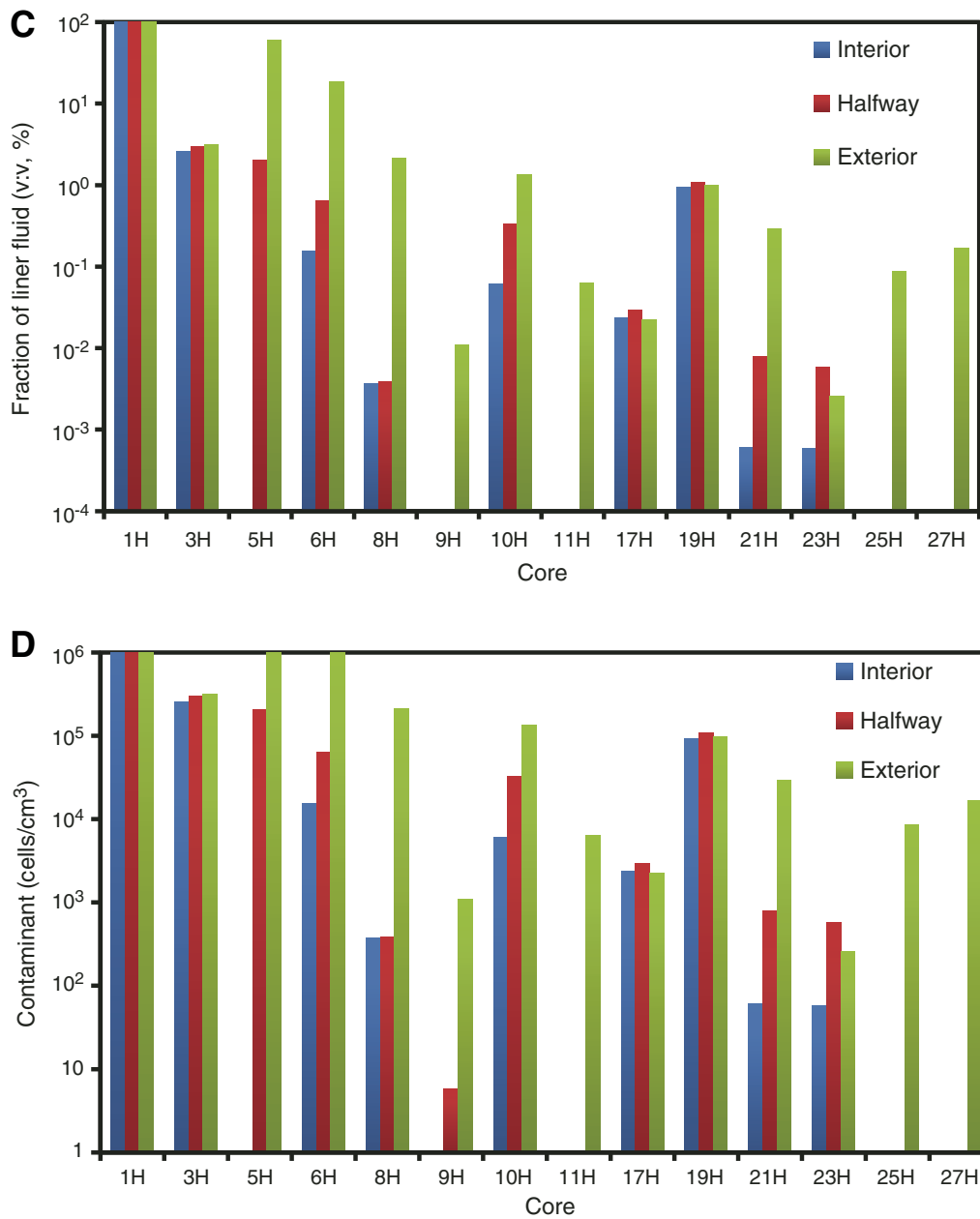




Figure F21. Plot of magnetic susceptibility (MS) data, Site M0060. MSCL = multisensor core logger, FT = Fast-track MSCL. Note that continuous MS data is only displayed for the uppermost 90 mbsf of Hole M0060A and 83 mbsf of Hole M0060B because of the poor recovery deeper than this depth.

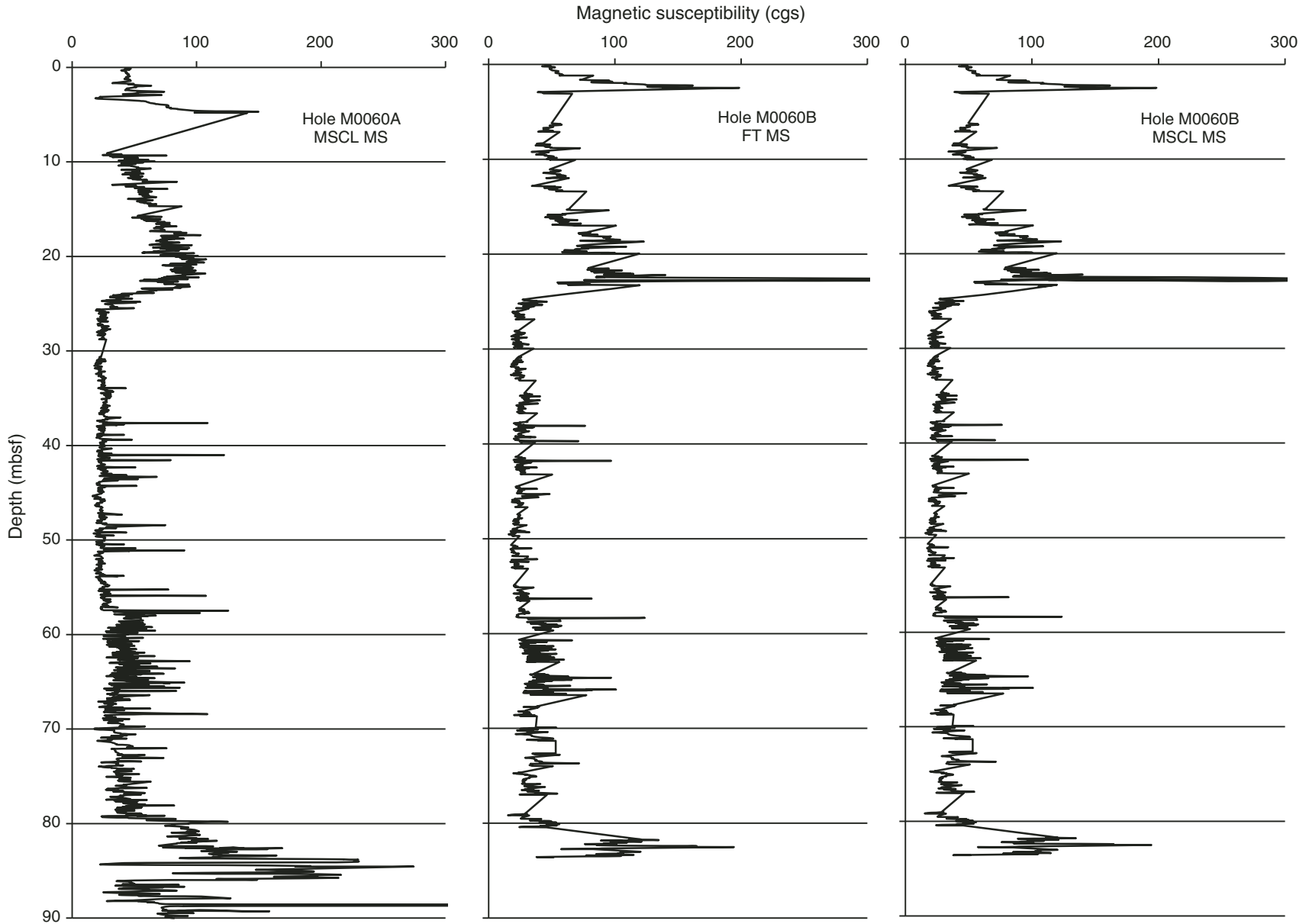




Figure F22. Correlation of the seismic profile with lithologic boundaries and multisensor core logger magnetic susceptibility data. Black arrows = unit boundaries. Precruise interpretation of seismic data is also shown: LG1 = bottom of late glacial Unit I, LG2 = lower boundary of late-glacial clays, BWT = bottom of Weichselian till, BR = bedrock. Seismic profile source: V. Spiess, 2013 (unpubl. data).

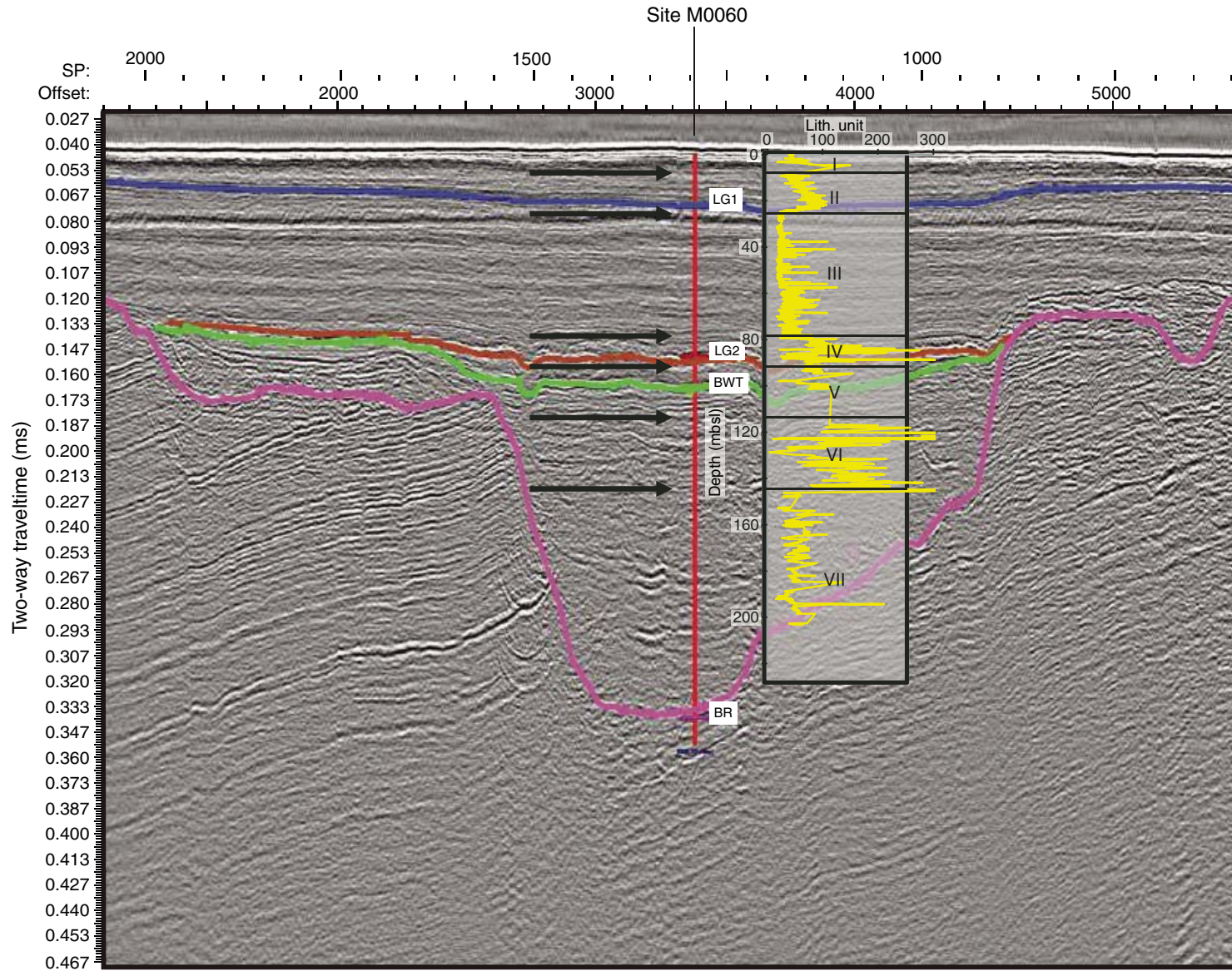


Figure F23. Caliper log, gamma ray log, spectral gamma ray log, resistivity log, and sonic log, Hole M0060B. The pipe set at 17.5 m WSF.

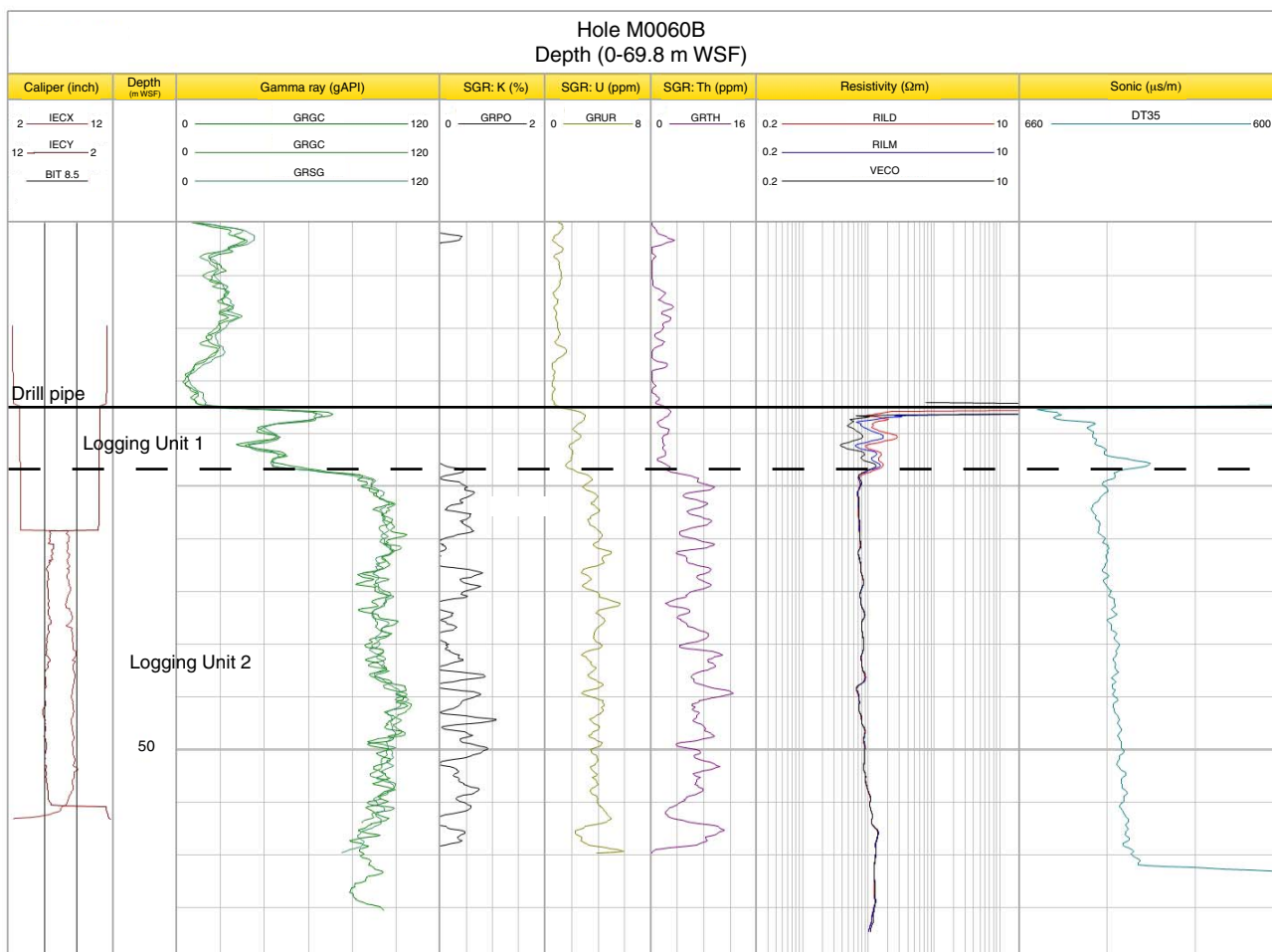




Table T1. Operations, Site M0060. (Continued on next four pages.)

Core	Coring method	Date (2013)	Time (UTC)	Depth (mbsf)		Recovered (m)	Recovery (%)	Mud type	Comments
				Top	Bottom				
347-M0060A-									
		23 Sep	0100						Rigged up and tested downhole camera system; system working but will not pass through the BHA
		23 Sep	0145						Ship on location in new position
		23 Sep	0445						Commenced operations; raised rooster box; checked new valve
		23 Sep	0506						Lowered template
		23 Sep	0600						Ran camera survey from in pipes only
		23 Sep	0745						Camera on deck, secured reel; set seabed template, still in the moonpool; retrieved drill pipe to drill floor; prepared drill floor with mouseholes, etc; made up BHA with core barrel + 2x collars and added pipe; did not use bit from Hole M0059C and fit new 6 cone rock roller
		23 Sep	0825						Reopened moonpool to fit bit into bit guide
		23 Sep	0845						Lowered seabed template to seabed; ready to run BHA and string
		23 Sep	0912						First drill pipe on
1H	PCS	23 Sep	0950	0.00	0.00	0.00	0	Seawater	No penetration, trace of sand on shoe
		23 Sep	1040						Second attempt; new valve (BOP) blew at 40 bar and pins did not shear; deck was sprayed with seawater
									New valve (BOP) broken beyond repair; continued operations with old procedure
2H	PCS	23 Sep	1113	0.00	0.00	0.00	0	Seawater	Pins sheared but string rose, reducing penetration; apparent failure of seabed template clamps; barrel on deck; ~20 cm of sand recovered
		23 Sep	1140						Recovered template to deck to investigate problem
		23 Sep	1155						Template in moonpool and rebuilding the drill floor
		23 Sep	1348						Mouseholes replaced
3H	PCS	23 Sep	1400	0.00	3.00	3.00	100	Seawater	100 bar, pressure did not release, left for 40 s before raising the rooster box
4H	PCS	23 Sep	1450	3.00	4.90	1.90	100	Seawater	65/70 bar then up to 100, again left for 30 s before releasing pressure; both seals missing
5O	NCA	23 Sep	1510	4.90	6.00	0.00	0	Seawater	Open hole by washing down, no insert bit
6H	PCS	23 Sep	1540	6.00	6.20	0.20	100	Seawater	60 bar, pressure released straight away
7O	NCA	23 Sep	1600	6.00	9.00	0.00	0	Seawater	
8H	PCS	23 Sep	1647	9.00	12.30	3.10	93.94	Seawater	Clay: basket catcher removed
9H	PCS	23 Sep	1730	12.30	15.60	2.46	74.55	Seawater	60 bar
10H	PCS	23 Sep	1810	15.60	18.90	3.27	99.09	Seawater	Double fire at 35 bar
11H	PCS	23 Sep	1845	18.90	22.20	3.19	96.67	Seawater	Replaced flapper catcher with a single basket and a spacer; double fire at 35 bar
12H	PCS	23 Sep	1945	22.20	25.50	3.33	100.91	Seawater	60 bar
13H	PCS	23 Sep	2020	25.50	28.80	3.37	102.12	Seawater	Sample winch rope parted; tripped pipe
		23 Sep	2045						Replacing snapped slip bowl
		23 Sep	2330						First collar in slips
14O	NCA	24 Sep	0000	28.80	30.53	0.00	0	Seawater	Open hole
15H	PCS	24 Sep	0045	30.53	33.83	3.53	106.97	Seawater	
16H	PCS	24 Sep	0120	33.83	37.13	3.32	100.61	Seawater	
17H	PCS	24 Sep	0200	37.13	40.43	3.31	100.3	Seawater	
18H	PCS	24 Sep	0240	40.43	43.73	3.39	102.73	Seawater	
19H	PCS	24 Sep	0315	43.73	47.03	3.68	111.52	Seawater	
	PCS	24 Sep	0355	47.03					First attempt failed to pressurize; pressure in hole, possibly did not drill out; flushed hole before reattempting
20H	PCS	24 Sep	0450	47.03	50.33	3.57	108.18	Seawater	
21H	PCS	24 Sep	0535	50.33	53.63	3.60	109.09	Seawater	Fired at 65 bar before dropping, then rising to 85 bar and then 100 bar
22H	PCS	24 Sep	0610	53.63	56.63	3.63	121	Seawater	Fired at 70 bar, then dropped to 50 bar before holding for a short time and then dropping to zero
23H	PCS	24 Sep	0645	56.63	60.23	3.49	96.94	Seawater	Small rounded stone in clay in the shoe
24H	PCS	24 Sep	0720	60.23	63.53	3.56	107.88	Seawater	High pressure: fired at 50 bar, rose to 100 bar, bled off, then pressurized again; on releasing the template clamps the pressure reduced as the rooster box rose
25H	PCS	24 Sep	0800	63.53	66.83	3.40	103.03	Seawater	Full with very hard clay in shoe; drilled ahead to ream hole and clean barrel; very hard then back to more "normal" drilling
26H	PCS	24 Sep	0845	66.83	69.83	3.01	100.33	Seawater	One each brass and steel pin; fired at 80 bar, dropped to 50 and then 40 bar; had to open clamps and let pipe rise to remove pressure fully; 3 m hard clay recovered



Table T1 (continued). (Continued on next page.)

Core	Coring method	Date (2013)	Time (UTC)	Depth (mbsf)		Recovered (m)	Recovery (%)	Mud type	Comments
				Top	Bottom				
27H	PCS	24 Sep	0930	69.83	72.83	3.01	100.33	Seawater	One each brass and steel pin; fired at just under 100 bar, dropped to 50 bar, back up to 60 bar until opened clamps, dropped to 25 bar almost straight away 2x steel pins; string pressurized to 100 bar before pump stalled; pressure dropped steadily to 60 bar before stopping until clamps opened and rooster box raised; tool recovered to deck for examination before running downhole again
		24 Sep	1037						
28H	PCS	24 Sep	1105	72.83	75.80	2.83	95.29	Seawater	Sample winch rope snapped attempting to recover piston core Attempted to fish overshot; tool recovered to deck twice to evaluate progress; on third recovery pulled pipe First collar in the slips Overshot at deck level, assessing damage and possible cause of failing of rope Carried out a pull test on the rope on the deck to determine if it had weakened with time Running pipe; tongs tips cracked, so stopped to repair the IR Realigned damaged IR frame Running pipe IR hydraulics not functioning correctly, working on the tongs Collars on Washed down to 75.8 mbsf
		24 Sep	1125						
		24 Sep	1135						
		24 Sep	1450						
		24 Sep	1500						
		24 Sep	1520						
		24 Sep	1600						
		24 Sep	1935						
		24 Sep	1950						
		24 Sep	2010						
		24 Sep	2030						
24 Sep	2200								
29H	PCS	24 Sep	2240	75.80	79.10	3.62	109.7	Seawater	
30H	PCS	24 Sep	2335	79.10	82.40	3.58	108.48	Seawater	
31H	PCS	25 Sep	0010	82.40	84.80	2.25	93.75	Seawater	Only a partial stroke after double high pressure firing
32H	PCS	25 Sep	0055	84.80	88.10	3.46	104.85	Seawater	
33H	PCS	25 Sep	0135	88.10	91.40	3.22	97.58	Seawater	Note some fingers of basket catcher ripped off and in core
34H	PCS	25 Sep	0245	91.40	94.70	3.30	100	Seawater	Strong backpressure when recovering sample, sand into tools; changed to Guar drill mud Attempted piston core did not fire: returned to deck and flushed; lots of flowback so left out core barrel and flushed with mud; bottom 30 cm of hole seemed to be sand
		25 Sep	0350						
35H	PCS	25 Sep	0450	94.70	97.70	3.00	100	Guar	Fired and then pressured to 100 bar; stayed at that pressure until released the string from the clamps and raised the rooster box; 3 m recovery but some may be reworked as very soft and not "core like" Drilled and added pipe; very fast, no bit weight
		25 Sep	0530						
36H	PCS	25 Sep	0550	97.70	97.70	0.00	0	Guar	Fired to 120 bar and only dropped when rooster box was lifted; attempted hammer sample at same depth
37S	HS	25 Sep	0615	97.70	98.01	0.31	100	Guar	Hard gray clay
38H	PCS	25 Sep	0630	98.70	101.20	2.66	106.4	Guar	2x steel pins; again pressurized to 100 then 120 bar, stayed until lifted rooster box
39H	PCS	25 Sep	0630	101.20	101.20	0.00	0	Guar	No penetration; 2x steel pins, blew pump pressure release valve at 120 bar; released pressure by lifting string
40X	ECS	25 Sep	0815	101.20	104.70	0.00	0	Guar	No recovery; sand on face of core bit
41S	HS	25 Sep	0905	104.70	104.70	0.10	100	Guar	20 blows
42X	ECS	25 Sep	0940	104.70	106.70	0.00	0	Guar	No recovery; shoe destroyed by stones
43O	NCA	25 Sep	1100	106.90	109.70	0.00	0	Guar	
44X	ECS	25 Sep	1120	109.70	112.70	0.00	0	Guar	
45P	PCA	25 Sep	1220	112.70	113.70	0.02	2	Guar	Only 0.5 metric ton required to push ahead Attempted piston core with 2x brass pins; no penetration, no recovery
		25 Sep	1310						
46H	PCS	25 Sep	1400	113.70	114.20	0.10	20	Guar	2x steel pins; fired at 110 bar, stalled pump, pressure only released by raising the rooster box; large granite stone in show with some slightly silty shelly sand with gravel Easy drilling; no torque or pressure
		25 Sep	1535						
47O	NCA	25 Sep	1444	114.20	116.70	0.00	0	Guar	115 bar; cracked pressure release to remove string pressure Overshot unable to pick up sample tube; flushed string; pressure built before eventually going to zero Flushed and rotated to ensure all sand(?) out of string Unable to pick up sample tube; flushed again; several attempts at picking up sample tube eventually paid off
		25 Sep	1545						
		25 Sep	1630						
48H	PCS	25 Sep	1535	116.70	118.20	1.50	100	Guar	Added pipe; breaking pipes at deck, high volume flowing water from string Open hole to 3 m beyond last sample start
		25 Sep	1915						
		25 Sep	2015						
49O	NCA	25 Sep	1950	118.20	119.70	0.00	0	Guar	Stalled pump at 120 bar; not known if pins sheared; pressure dropped to 50 bar before rooster box was raised and took some time to bleed off completely; failed to fire: not a run
		25 Sep	2015						
50H	PCS	25 Sep	2055	119.70	123.00	3.40	103.03	Guar	Stalled pump at 135 bar; not known if pins sheared; pressure dropped to zero when rooster box was raised



Table T1 (continued). (Continued on next page.)

Core	Coring method	Date (2013)	Time (UTC)	Depth (mbsf)		Recovered (m)	Recovery (%)	Mud type	Comments
				Top	Bottom				
51H	PCS	25 Sep	2235	123.00	126.30	2.57	77.88	Guar	
52H	PCS	25 Sep	2350	126.30	129.60	2.43	73.64	Guar	
53H	PCS	26 Sep	0045	129.60	132.90	2.00	60.61	Guar	
54H	PCS	26 Sep	0135	132.90	136.20	2.57	77.88	Guar	150 bar
		26 Sep	0220						Stopped drilling, cleared decks to lift seabed template after clamps on frame ceased working; lifted template, repaired, and tested; ready to be lowered to seabed again
		26 Sep	0530						Drill string rotated to bottom of borehole, less 1 m of infill
55H	PCS	26 Sep	0630	136.20	139.50	3.00	90.91	Guar	Fired and kept pressure to 150 bar and released only when pipe lifted
		26 Sep	0700						No obvious drilling change when drilling down to next sample point
56H	PCS	26 Sep	0710	139.50	142.80	2.83	85.76	Guar	Fired as before; same material
57H	PCS	26 Sep	0800	142.80	146.10	2.60	78.79	Guar	No change in conditions
		26 Sep	0850						Drilled to next sample point, started to get mud pressure and slower drilling for final meter or so; possibly clay
58H	PCS	26 Sep	0900	146.10	149.40	1.93	58.48	Guar	Fired at 80 bar; more of a pause before increasing to 125 bar and holding until pipe was released and lifted
59H	PCS	26 Sep	1025	149.40	152.40	0.15	5	Guar	
60H	PCS	26 Sep	1120	152.40	155.40	1.60	53.33	Guar	Pump stalled at 150 bar
61H	PCS	26 Sep	1220	155.40	155.70	0.30	100	Guar	Apparently reworked clay
62N	NRCB	26 Sep	1335	155.70	158.40	0.00	0	Guar	Because of near zero recovery and apparent reworked/cuttings recovered, cored 3 m using ECS; on recovery there was no sample in the barrel but the catchers were inverted
63H	PCS	26 Sep	1410	158.40	160.30	1.89	99.47	Guar	Piston again recovered 1.89 m of reworked material; possibly the slipped core from the previous run
64O	NCA	26 Sep	1525	158.40	159.40	0.00	0	Guar	Drilled down 1 m to clear dropped core and any possible disturbed ground from piston Core 63H
65H	PCS	26 Sep	1540	159.40	162.40	1.58	52.67	Guar	Apparent reworked material recovered; thought this is damage caused by the basket catchers and changed to flapper catcher and one basket
66H	PCS	26 Sep	1725	162.40	164.20	1.90	105.56	Guar	Liner deformed because of suction pressure
67H	PCS	26 Sep	1910	164.20	166.30	2.12	100.95	Guar	Liner deformed because of suction pressure
68H	PCS	26 Sep	2020	166.30	168.80	2.45	98	Guar	Liner deformed because of suction pressure
69H	PCS	26 Sep	2125	168.80	172.10	2.37	71.82	Guar	Sand jammed piston
70H	PCS	26 Sep	2300	172.10	175.40	2.30	69.7	Guar	Sand jammed piston
71H	PCS	27 Sep	0020	175.40	178.70	1.64	49.7	Guar	
72H	PCS	27 Sep	0115	178.70	182.00	3.48	105.45	Guar	
73H	PCS	27 Sep	0200	182.00	185.30	2.83	85.76	Guar	
74H	PCS	27 Sep	0313	185.30	188.60	0.05	1.52	Guar	PCS overshot wire snapped when trying to retrieve
		27 Sep	0315						Retrieved wireline to deck; ~15 m of rope on it
		27 Sep	0330						Prepared fishing tool with barbs; picked up but too sharp and shredded rope
		27 Sep	0430						Remade with smoother barbs; no success with two attempts
		27 Sep	0555						Prepared to trip pipe
		27 Sep	0615						Tripped pipe
		27 Sep	0710						Heated up pipe joints to free
		27 Sep	0845						Unable to free drill collar joint
		27 Sep	1000						Unable to free collars
		27 Sep	1100						Requested to use BGS Scorpion to free collars; successful on two joints
		27 Sep	1400						Ran pipe
		27 Sep	1530						Flowing water at joints between pipes 8 and 11 and again less so at various intervals down the hole
		27 Sep	1900						Hole sticky from 105 mbsf
		27 Sep	1900						Mouseholes in place, piston corer ready with 2x steel pins
		27 Sep	2010						Worked on sample winch hydraulics; fit diverter/safety valve to avoid snapping rope again
		27 Sep	2045						Tested winch settings
		27 Sep	2100						Washed down to point before last piston sample attempt with NCA in place
75H	PCS	27 Sep	2135	188.60	191.90	2.93	88.79	Guar	Extracted NCA/deployed PCS
									100 bar
76H	PCS	28 Sep	0000	191.90	195.20	2.66	80.61	Guar	Hole caved in while washing down to 191.9 mbsf



Table T1 (continued). (Continued on next page.)

Core	Coring method	Date (2013)	Time (UTC)	Depth (mbsf)		Recovered (m)	Recovery (%)	Mud type	Comments
				Top	Bottom				
77H	PCS	28 Sep	0115	195.20	198.50	3.42	103.64	Guar	
78S	HS	28 Sep	0335	198.50	198.80	0.25	100	Guar	Hammer sample used after two piston corer attempts failed to fire
79O	NCA	28 Sep	0355	198.80	199.50	0.00	0	Guar	
80S	HS	28 Sep	0415	199.50	199.54	0.00	0	Guar	Fired at 50 bar then stopped; started pump again and raised pressure to 150 bar, then lowered to almost zero; prepared insert bit and push sample tube
81O	NCA	28 Sep	0520	199.50	202.50	0.00	0	Guar	
82P	PCA	28 Sep	0600	202.50	203.55	1.05	100	Guar	
83O	NCA	28 Sep	0615	203.55	205.50	0.00	0	Guar	
84P	PCA	28 Sep	0715	205.50	205.60	0.10	100	Guar	
85O	NCA	28 Sep	0738	205.60	208.50	0.00	0	Guar	Insert bit stuck in mud valve
86P	PCA	28 Sep	0743	208.50	208.50	0.00	0	Guar	
87O	NCA	28 Sep	0830	208.80	211.50	0.00	0	Guar	
88S	HS	28 Sep	0900	211.50	211.70	0.20	100	Guar	20 blows with little penetration
89O	NCA	28 Sep	0920	211.70	214.50	0.00	0	Guar	Little pressure 2 m into run but then back into sand
		28 Sep	0955						Stopped operations to investigate mud leak from rotary valve stem when pipe is at lowest point
		28 Sep	1035						String broken in to allow the valve to be fully tightened by clamping it and turning swivel
90S	HS	28 Sep	1135	214.50	214.60	0.10	100		Hard, compacted fine gray sand
91O	NCA	28 Sep	1155	214.60	217.50	0.00	0	Guar	
92S	HS	28 Sep	1245	217.50	217.70	0.20	100		32 blows
93O	NCA	28 Sep	1310	217.70	220.50	0.00	0	Guar	
94S	HS	28 Sep	1355	220.50	220.55	0.05	100		30 blows
95O	NCA	28 Sep	1420	220.55	223.50	0.00	0	Guar	Back of water up pipe at tool change
96S	HS	28 Sep	1500	223.50	223.60	0.10	100		25 blows
97O	NCA	28 Sep	1555	223.55	226.50	0.00	0	Guar	String difficult to rotate following last sample; thought flowing water was bringing sand down with it; reamed entire pipe length to clear and stabbed ground to stop flow up string
98S	HS	28 Sep	1655	226.50	226.60	0.10	100		25 blows
99O	NCA	28 Sep	1715	226.60	229.50	0.00	0	Guar	
100S	HS	28 Sep	1807	229.50	229.60	0.10	100		30 blows
101O	NCA	28 Sep	1925	229.60	232.50	0.00	0	Guar	Water followed NCA through mud valve; mud valve closed with pumping; overshot could not be released from NCA (blocked with sand), so lowered to deck; string became stuck and work commenced to release it
		28 Sep	2015						Gained 5 m of string and small amount of mud flow but no more
		28 Sep	2050						Attempted to hammer sand from string; estimated 24 m of sand in string
		28 Sep	2250						Stopped to repair hydraulics leak
		28 Sep	2330						Recommended hammer sampling in pipe; possibly making progress, but no circulation of mud possible
		29 Sep	0130						Rigged up Pilcon winch to remove need for manual hammering
		29 Sep	0310						Stopped hammering and tried rotation and pulling
		29 Sep	0650						Restarted HS, measured progress: apparently at start position, thought that sand was still flowing in to string
		29 Sep	0750						Investigated running high-pressure air intake to mudline, which might shift sand and allow mud flow
		29 Sep	0910						After discussions of options, investigated decision to look at backing of string
		29 Sep	0920						Raised seabed template to inside the moonpool but below the first tool joint
		29 Sep	1020						Rigged up downhole camera; backed off string using tongs: went well and accomplished on the first attempt
		29 Sep	1120						Weight suggested only 4 or 5 pipes recovered; had a stick up of ~14 m from seabed
		29 Sep	1115						Rigged up ROV to monitor stick up while pushing down with the template
		29 Sep	1515						Successful leveling of stick-up pipe; ROV showed pipe leveled to seafloor with no protrusion
									End of hole
347-M0060B-		29 Sep	1600						Prepared BHA including torquing subs and 6 cone rock roller bit
		29 Sep	1835						Template moved into moonpool and lowered to seafloor
		29 Sep	1925						Ran string with BHA, 2 collars, and drill pipe
1H	PCS	29 Sep	2050	0.00	2.80	2.71	96.79	Guar	First run fired ~0.5 m above mudline



Table T1 (continued).

Core	Coring method	Date (2013)	Time (UTC)	Depth (mbsf)		Recovered (m)	Recovery (%)	Mud type	Comments
				Top	Bottom				
2H	PCS	29 Sep	2140	2.80	2.80	0.00	0	Guar	Uncertain if any sample ever went up into the barrel; may have fired on the way down
3H	PCS	29 Sep	2225	2.80	6.10	2.70	81.82	Guar	
4H	PCS	29 Sep	2305	6.10	9.40	3.29	99.7	Guar	
5H	PCS	30 Sep	0010	9.40	12.70	2.87	86.97	Guar	Used drilling mud to help stabilize sand at top of hole
6H	PCS	30 Sep	0130	12.70	16.00	3.27	99.09	Guar	
7H	PCS	30 Sep	0240	16.00	19.30	3.46	104.85	Guar	Good, clean fire and pressure drop; good sample, catcher partially fell out; changed to flapper/basket catcher
8H	PCS	30 Sep	0325	19.30	22.60	3.41	103.33	Guar	Good fire/pressure drop, required more pressure to go to zero; microbiology mud sample taken at pipe break
9H	PCS	30 Sep	0530	22.60	25.90	3.30	100	Guar	Pressure only ~30 bar, but piston stroked out
10H	PCS	30 Sep	0615	25.90	29.20	3.66	110.91	Guar	Good fire and pressure but hole beginning to stick, so changed to water for drilling
11H	PCS	30 Sep	0715	29.20	32.50	3.66	110.91	Guar	Drilled down to next sample point and circulated for 20 min as hole still tightening; flushed, allowing seawater to fill the hole rather than mud, which may be causing the clay to swell
									Hole stable; circulated again after pipe addition and reaming down
12H	PCS	30 Sep	0835	32.50	35.80	3.29	99.7	Guar	Good firing sequence
13H	PCS	30 Sep	0910	35.80	39.10	3.55	107.58	Guar	50 bar then dropped before rising to 80 bar and dropping away
14H	PCS	30 Sep	0940	39.10	42.40	3.60	109.09	Guar	Good fire and dropped to zero right away
15H	PCS	30 Sep	1040	42.40	45.70	3.46	104.85	Guar	Could not recover the piston corer at first attempt; overshot brought back to the rooster box and pipe flushed, second attempt successful; very stiff clay
16H	PCS	30 Sep	1200	45.70	49.00	3.71	112.42	Guar	
17H	PCS	30 Sep	1200	49.00	52.30	3.62	109.7	Guar	75 bar straight down to zero
18H	PCS	30 Sep	1340	52.30	55.60	3.62	109.7	Guar	75 bar straight down to zero
19H	PCS	30 Sep	1430	55.60	58.90	3.57	108.18	Guar	
20H	PCS	30 Sep	1520	58.90	62.20	3.49	105.76	Guar	70 bar then down to 50 before up again
21H	PCS	30 Sep	1635	62.20	65.50	3.43	103.94	Guar	60 bar then down before up to 70 bar
22H	PCS	30 Sep	1705	65.50	68.00	2.50	100	Guar	
23H	PCS	30 Sep	1805	68.00	70.50	2.50	100	Guar	"Soft fire": low fire level with drop in pressure before rising, only dropped to zero with raising of the string
24H	PCS	30 Sep	1910	70.50	73.00	2.40	96	Guar	Liner collapsed top 75 cm; reverted to 2 brass pins
25H	PCS	30 Sep	2000	73.00	76.30	3.30	100	Guar	
26H	PCS	30 Sep	2100	76.30	79.60	3.33	100.91	Guar	
27H	PCS	30 Sep	2210	79.60	82.90	3.19	96.67	Guar	Strong artesian backflow when retrieving PC barrel
28H	PCS	30 Sep	2300	82.90	85.70	2.82	100.71	Guar	Overshot failed to pick up core barrel on two attempts; much pumping of mud required to free barrel
		1 Oct	0100					Guar	End of hole; reamed out to 85.5 mbsf and filled with thick mud ready for logging
		1 Oct	0240					Guar	Lifted string to ~20 mbsf
		1 Oct	0340					Guar	Completed first downhole log, maximum depth 64 mbsf
		1 Oct	0554					Guar	Completed second downhole log, maximum depth 62 mbsf
		1 Oct	0635						Lifted logging wire; calipers not working properly on tool or in formation; on deck found clay behind them
		1 Oct	0635						Logging tools clear of deck
		1 Oct	0659						First collar in slips
		1 Oct	0735						Template on deck, doors closed, and BHA in template

ECS = extended coring system, HS = hammer sampler, NCA = noncoring assembly, NRCB = nonrotating core barrel, PCA = push coring assembly, PCS = piston coring system. BHA = bottom-hole assembly, BOP = blowout preventer, IR = iron roughneck, BGS = British Geological Survey, ROV = remotely operated vehicle, PC = piston core.

Table T2. Diatom taxa species and authorities with presence/absence data for selected depths, Site M0060.

Affinity	Life form	Diatoms	7.5 mbsf	9 mbsf	10.5 mbsf
F	Epipellic and epilithic	<i>Amphora copulata</i> (Kützing) Schoeman and Archibald		x	x
F	Pelagic	<i>Aulacoseira ambigua</i> (Grunow) Simonsen		x	
F	Pelagic	<i>Aulacoseira granulata</i> (Ehrenberg) Simonsen			
F	Pelagic	<i>Aulacoseira islandica</i> (O. Müller) Simonsen	x	c	x
F	Epipsammic	<i>Cocconeis disculus</i> (Schumann) Cleve	x		
BF	Epiphytic and epilithic	<i>Cocconeis placentula</i> Ehrenberg	x	x	
B	Pelagic	<i>Coscinodiscus granii</i> Gough			x
M		<i>Fragilaria capensis</i> Grunow		x	
BM	Epiphytic	<i>Gomphonemopsis exigua</i> (Kützing) L.K. Medlin		x	
F	Epipsammic	<i>Karayevia clevei</i> (Grunow) Bukhtiyarova			
M	Epiphitic	<i>Licmophora abbreviata</i> C. Agardh		x	
F	Epipsammic	<i>Martyana martyii</i> (Héribaud-Joseph) Round	x		x
B	Epipsammic	<i>Martyana schulzii</i> (Brockmann) Snoeijis	x	c	
B	Epipellic	<i>Navicula peregrina</i> (Ehrenberg) Kützing		x	
B	Epipsammic and epiphytic	<i>Opephora mutabilis</i> (Grunow) Sabbe and Wyverman			x
B	Tychoplanktonic	<i>Paralia sulcata</i> (Ehrenberg) Cleve			
M	Epipellic	<i>Pinnularia cruciformis</i> (Donkin) Cleve		x	
B	Epipellic	<i>Pinnularia halophila</i> Krammer		x	
M	Benthic	<i>Plagiogramma staurophorum</i> (W. Gregory) Heiberg			x
BF	Episammic and epilithic	<i>Planothidium delicatulum</i> (Kützing) Round and Bukhtiyarova			x
BM	Epiphytic and epilithic	<i>Rhabdonema arcuatum</i> (Lyngbye) Kützing			
BF	Epipellic and epilithic	<i>Rhopalodia gibba</i> (Ehrenberg) O. Müller		x	
F	Pelagic	<i>Stephanodiscus neostraea</i> Håkansson and Hickel		x	
B	Pelagic	<i>Thalassiosira hyperborea</i> var. <i>lacunosa</i> Hasle			x
M?	Pelagic	<i>Thalassiosira oestrupii</i> (Ostenfeld) Hasle			

F = freshwater, BF = brackish-freshwater, B = brackish, BM = brackish-marine, M = marine. x = present, c = common.

Table T3 (continued).

			Depth (mbsf):	182	188.6	190.1	191.9	193.4	195.2	202.5
			Core, section:	73H-1	75H-1	75H-2	76H-1	76H-2	77H-1	82H-1
			Interval (cm):	0–1	0–1	0–1	0–1	0–1	0–1	0–1
Affinity	Life form	Diatoms	Fragments	Fragments	Fragments	Fragments	Fragments	Fragments	Fragments	Fragments
F	Epipelagic and epilithic	<i>Amphora copulata</i> (Kützing) Schoeman and Archibald								
F		<i>Aulacoseira ambigua</i> (Grunow) Simonsen								
F		<i>Aulacoseira granulata</i> (Ehrenberg) Simonsen								
F	Pelagic	<i>Aulacoseira islandica</i> (O. Müller) Simonsen								
F	Epipsammic	<i>Cocconeis disculus</i> (Schumann) Cleve								
BF	Epiphytic and epilithic	<i>Cocconeis placentula</i> Ehrenberg								
B	Pelagic	<i>Coscinodiscus granii</i> Gough								
M		<i>Fragilaria capensis</i> Grunow								
BM	Epiphytic	<i>Gomphonemopsis exigua</i> (Kützing) L.K. Medlin								
F	Epipsammic	<i>Karayevia clevei</i> (Grunow) Bukhtiyarova								
M	Epiphytic	<i>Licmophora abbreviata</i> C. Agardh								
F	Epipsammic	<i>Martyana martyii</i> (Héribaud-Joseph) Round								
B	Epipsammic	<i>Martyana schulzii</i> Brockmann) Snoeijs								
B	Epipelagic	<i>Navicula peregrina</i> (Ehrenberg) Kützing								
B	Epipsammic and epiphytic	<i>Opephora mutabilis</i> (Grunow) Sabbe and Wyverman								
B	Tycho planktonic	<i>Paralia sulcata</i> (Ehrenberg) Cleve								
M	Epipelagic	<i>Pinnularia cruciformis</i> (Donkin) Cleve								
B	Epipelagic	<i>Pinnularia halophila</i> Krammer								
M	Benthic	<i>Plagiogramma staurophorum</i> (W. Gregory) Heiberg								
BF	Episammic and epilithic	<i>Planothidium delicatulum</i> (Kützing) Round and Bukhtiyarova								
BM	Epiphytic and epilithic	<i>Rhabdonema arcuatum</i> (Lyngbye) Kützing								
BF	Epipelagic and epilithic	<i>Rhopalodia gibba</i> (Ehrenberg) O. Müller								
F	Pelagic	<i>Stephanodiscus neoastreae</i> Håkansson and Hickel								
B	Pelagic	<i>Thalassiosira hyperborea</i> var. <i>lacunosa</i> Hasle								
M?	Pelagic	<i>Thalassiosira oestrupii</i> (Ostenfeld) Hasle								
		Cryosphyte cysts								
		Dots								

Table T4 (continued).

Core, section, interval (cm)	Depth (mbsf)		Abundance	Pre-Quaternary redeposited tests	Number of species	Total foraminifers	% <i>Elphidium excavatum clavatum</i>	<i>Ammonia beccarii</i>	<i>Buccella frigida</i>	<i>Bulimina marginata</i>	<i>Cassidulina reniforme</i> (formerly <i>crassa</i>)	<i>Cibicides lobatulus</i>	<i>Elphidium excavatum clavatum</i>	<i>Elphidium excavatum selseyensis</i>	<i>Elphidium albiumbilicatum</i>	<i>Elphidium williamsoni</i>	<i>Elphidium groenlandicum</i>	Other <i>Elphidium</i> and <i>Haynesina</i> spp.	<i>Hyalinea balthica</i>	<i>Islandiella helenae</i> (formerly <i>terretis</i>) *	<i>Melonis barleeanum</i>	<i>Nonionella labradorica</i>	<i>Planulina ariminensis</i>	<i>Pyrgo williamsoni</i>	<i>Quinqueloculina</i> sp.	<i>Stainforthia feylingia</i>	<i>Uvigerina mediterranea</i>	Agglutinated (all species)	Other species, total
	Top	Bottom																											
M0060A-46HCC-bottom	113.70	113.80	V		2														x						x				
M0060A-48HCC-bottom		118.20	V		1																								
M0060A-50HCC-bottom	123.09	123.19	V		1																								
M0060A-51HCC-bottom	125.53	125.57	C x		13			x		x	x								x	x	x		x					x	
M0060A-52HCC-bottom	128.71	128.73	F x		4														x	x	x				x			x	
M0060A-53HCC-bottom	131.58	131.60	R x		3			x				x								x									
M0060A-54HCC-bottom	135.43	135.48	F		5					x									x	x	x		x						
M0060A-55HCC-bottom	139.15	139.20	C x		9					x	x								x	x	x		x			x		x	
M0060A-56HCC-bottom		142.33	V x		1														x										
M0060A-57HCC-bottom	145.37	145.40	R x		2			x											x										
M0060A-58H1-bottom	147.60	147.61	R		2														x										
M0060A-59HCC-bottom		149.55	R		5					x	x								x	x								x	
M0060A-60H2-bottom		154	A		13			x	x	x									x	x	x		x		x		x	x	
M0060A-61H1-bottom		155.7	F		5			x	x										x	x	x								
M0060A-63HCC-bottom	160.27	160.29	F		3														x	x			x						
M0060A-66H2-bottom		164.30	V x		4					x									x	x	x								
M0060A-67H2-bottom		166.32	R		6						x								x	x	x					x			
M0060A-68H2-bottom		168.75	R		7				x	x									x	x	x					x			
M0060A-69HCC-bottom	171.13	171.17	V		3						x								x	x									
M0060A-70HCC-bottom	175.35	175.40	R x		7					x	x								x	x	x							x	
M0060A-71HCC-bottom	176.98	177.04	R		8														x	x	x					x		x	
M0060A-72HCC-bottom	182.11	182.18	R		6					x									x	x			x						
M0060A-73HCC-bottom	184.81	184.83	R		5					x									x	x	x							x	
M0060A-74HCC-bottom	185.30	185.35	V		2														x										
M0060A-75HCC-bottom	191.48	191.53	V		4														x	x									
M0060A-76HCC-bottom	194.51	194.56	C x		9				x	x	x								x	x								x	
M0060A-77HCC-bottom	198.55	198.62	R x		8					x	x								x	x								x	
M0060A-78S1-bottom		198.80	R x		5														x	x	x							x	
M0060A-80HCC-bottom	199.50	199.54	F x		8					x									x	x	x		x	x					
M0060A-82PCC-bottom	203.25	203.35	C x		18			x	x	x	x								x	x	x			x	x			x	
M0060A-84P1-bottom	205.50	205.56	C		10				x	x	x								x	x	x							x	
M0060A-88SCC-bottom	211.60	211.66	V x		2														x	x									
M0060A-90SCC-bottom		214.60	V		1																							x	
M0060A-92SCC-bottom		217.72	B x		0																								
M0060A-94SCC-bottom		220.55	R		6																								
M0060A-96SCC-bottom		223.60	R x		3					x									x		x								
M0060A-98SCC-bottom		226.60	B		0																							x	
M0060A-100SCC-bottom		229.60	R		1																								

* = possibly including *Cassidulina laevigata* in some intervals. Abundance: A = abundant, C = common, F = few, R = rare, V = very rare, B = barren.



Table T5. Distribution and abundance of ostracods, Site M0060. (Continued on next three pages.)

Core, section, interval (cm)	Depth (mbsf)	Abundance (offshore samples, 5–30 cm ³)	Abundance (onshore samples, 20 cm ³)	<i>Acanthocythereis dunelmensis</i>	<i>Baffinicythere</i> sp.	<i>Bythocythere constricta</i>	<i>Cluthia cluthae</i>	<i>Cythere lutea</i>	<i>Cythereis</i> spp.	<i>Cytheropteron arcuatum</i>	<i>Cytheropteron biconvexa</i>	<i>Cytheropteron latissimum</i>	<i>Cytheropteron nodosolatum</i>	<i>Cytheropteron pseudomontrouxiense</i>	<i>Cytheropteron</i> spp.	<i>Cytherura</i> spp.	<i>Elosonella concinna</i>	<i>Finmarchinella</i> sp.	<i>Heterocyprideis sorbyana</i>	<i>Hirschmania viridis</i>	<i>Ilyocypris</i> sp.	<i>Jonesia acuminata</i>	<i>Krithe</i> sp.	<i>Leptocythere</i> spp.	<i>Normanicythere leioderma</i>	<i>Palmenella limicola</i>	<i>Polycypris</i> sp.	<i>Pontocypris</i> sp.	<i>Rabillimis mirabilis</i>	<i>Robertsonites tuberculatus</i>	<i>Roundstonia globulifera</i>	<i>Sarsicytheridea bradlii</i>	<i>Sarsicytheridea punctillata</i>	<i>Sclerochilus</i> sp.	<i>Semicytherura</i> sp.	Redeposited	Undetermined					
347-M0060A-																																										
3H-1, 11–13	0.12	F	R					R																																		
3H-2, 138–148	2.88	B																																								
4H-2, 28–38	4.78	B																																								
6H-CC, 0–20	6.00	F																																								
6H-1, 7–9	6.08	A	A					R																																		
8H-2, 15–17	10.66	A	R																																							
8H-CC, 0–14	12.16	F													R	F	F			R							R												R			
9H-CC, 0–96	13.80	F											R			R	R																									
9H-2, 15–17	13.96	A	R	R	R				R			R				R	C			R																						
10H-2, 15–17	17.27	A	R	F				R							R	F	C		R																							
10H-3, 0–27	18.61	R												R					F																							
11H-2, 15–17	20.56	A	F						R	R	R	F	R		F		F		R																							
11H-CC, 0–20	22.07	R	R																																							
12H-2, 15–17	23.86	F																																								
12H-3, 0–33	25.20	B																																								
13H-2, 15–17	27.16	B																																								
13H-3, 35–37	28.85	B																																								
15H-2, 15–17	32.16	B																																								
15H-3, 51–53	34.01	B																																								
16H-2, 16–18	35.47	B																																								
16H-CC, 0–4	37.18	B																																								
17H-2, 22–24	38.83	B																																								
17H-CC, 0–4	40.37	B																																								
18H-2, 10–12	40.99	R																																								
18H-CC, 0–2	43.77	R													R																											
19H-1, 100–102	45.36	R																																								
19H-CC, 19–21	47.36	R																																								
20H-2, 15–17	48.66	R																																								
21H-1, 14–16	50.43	B																																								
20H-3, 54–57	50.54	R																																								
21H-CC, 18–20	53.88	B																																								
22H-2, 27–29	55.36	B																																								
22H-CC, 0–5	57.18	B																																								
23H-2, 15–17	58.54	R																																								
23H-CC, 13–15	60.37	R																																								
24H-2, 16–18	61.85	B																																								
24H-CC, 11–13	63.74	R																																								



Table T5 (continued). (Continued on next page.)

Core, section, interval (cm)	Depth (mbsf)	Abundance (offshore samples, 5–30 cm ³)	Abundance (onshore samples, 20 cm ³)	<i>Acanthocythereis dunelmensis</i>	<i>Baffinicythere</i> sp.	<i>Bythocythere constricta</i>	<i>Cluthia cluthae</i>	<i>Cythere lutea</i>	<i>Cythereis</i> spp.	<i>Cytheropteron arcuatum</i>	<i>Cytheropteron biconvexa</i>	<i>Cytheropteron latissimum</i>	<i>Cytheropteron nodosolatum</i>	<i>Cytheropteron pseudomontrouziense</i>	<i>Cytheropteron</i> spp.	<i>Cytherura</i> spp.	<i>Elosonella concinna</i>	<i>Finnarchinella</i> sp.	<i>Heterocyprideis sorbyana</i>	<i>Hirschmania viidlis</i>	<i>Ilyocypris</i> sp.	<i>Jonesia acuminata</i>	<i>Krithe</i> sp.	<i>Leptocythere</i> spp.	<i>Normanicythere leioderma</i>	<i>Palmenella limicola</i>	<i>Polycope</i> sp.	<i>Pontocypris</i> sp.	<i>Rabilimis mirabilis</i>	<i>Robertsonites tuberculatus</i>	<i>Roundstonia globulifera</i>	<i>Sarsicytheridea bradlii</i>	<i>Sarsicytheridea punctillata</i>	<i>Sclerochilus</i> sp.	<i>Semicytherura</i> sp.	Redeposited	Undetermined				
25H-2, 17–19	65.16	R																																							
25H-3, 37–40	66.87	B																																							
26H-3, 19–21	69.79	B																																							
27H-2, 15–17	71.44	B																																							
28H-2, 15–17	74.44	B																																							
28H-2, 131–133	75.61	B																																							
29H-2, 15–17	77.46	R													R																										
29H-CC, 15–18	79.39	B																																							
30H-3, 14–16	80.87	B																																							
30H-4, 44–46	82.66	B																																							
31H-2, 15–17	84.06	B																																							
31H-2, 72–75	84.62	R																					R																		
32H-2, 15–17	86.46	R													R																										
32H-CC, 20–22	88.24	R	R																																						
33H-2, 15–17	89.76	B																																							
33H-CC, 21–24	91.29	B																																							
34H-2, 15–17	93.06	R													R																										
34H-3, 28–30	94.68	R																																							
35H-1, 26–28	94.97	B																																							
35H-CC, 0–5	97.66	R																																							
36H-1, 4–6	97.75	B																																							
37H-1, 21.5–23.5	97.925	R											R																												
37S-1	98.01	B																																							
38H-2, 15–17	99.29	B																																							
39H-CC, 0–3	101.20	B																																							
38H-CC, 0–20	101.34	B																																							
41S-CC, 0–8	104.70	B																																							
45P-CC, 0–2	112.70	B																																							
46H-CC, 0–10	113.70	B																																							
48H-1, 20–22	116.91	B																																							
48H-CC, 13–15	118.18	B																																							
50H-CC, 0–10	123.09	B																																							
51H-1, 15–17	123.16	B																																							
51H-CC, 0–4	125.53	R																																							
52H-1, 20–22	126.51	B																																							
52H-CC, 6–8	128.71	B																																							
53H-1, 12–14	129.73	B																																							
53H-CC, 0–2	131.58	B																																							
54H-2, 15–17	134.56	B																																							



Table T5 (continued). (Continued on next page.)

Core, section, interval (cm)	Depth (mbsf)	Abundance (Offshore samples, 5–30 cm ³)	Abundance (Onshore samples, 20 cm ³)	<i>Acanthocytherideis dunelmensis</i>	<i>Baffinicythere</i> sp.	<i>Bythocythere constricta</i>	<i>Cluthia cluthae</i>	<i>Cythere lutea</i>	<i>Cytherois</i> spp.	<i>Cytheropteron arcuatum</i>	<i>Cytheropteron biconvexa</i>	<i>Cytheropteron latissimum</i>	<i>Cytheropteron nodosolatum</i>	<i>Cytheropteron pseudomontrosiense</i>	<i>Cytheropteron</i> spp.	<i>Cytherura</i> spp.	<i>Elosonella concinna</i>	<i>Finmarchinella</i> sp.	<i>Heterocyprideis sorbyana</i>	<i>Hirschmania viivids</i>	<i>Ilyocypris</i> sp.	<i>Jonesia acuminata</i>	<i>Krithe</i> sp.	<i>Leptocythere</i> spp.	<i>Normanicythere leioderma</i>	<i>Palmenella limicola</i>	<i>Polycopse</i> sp.	<i>Pontocypris</i> sp.	<i>Rabilimys mirabilis</i>	<i>Robertsonites tuberculatus</i>	<i>Roundstonia globulifera</i>	<i>Sarsicytheridea bradlii</i>	<i>Sarsicytheridea punctillata</i>	<i>Sclerochilus</i> sp.	<i>Semicytherura</i> sp.	Redeposited	Undetermined				
54H-CC, 0–5	135.43	B																																							
55H-2, 15–17	137.86	B	B																																					R	
55H-CC, 0–5	139.15	B																																							
56H-2, 12–14	141.13	B	B																																						
56H-CC, 3–5	142.31	B																																							
57H-1, 2–4	142.83	B	B																																						
57H-CC, 5–8	145.37	B																																							
58H-1, 27–29	146.38	B	B																																						
58H-1, 150–151	147.60	B																																							
59H-CC, 13–15	149.53	B																																							
60H-2, 13–15	153.75		R																							R															
60H-2, 37–39	153.98	B	B																																						
61H-1, 0–2	155.41		B																																						
61H-2, 28–30	155.68	B																																							
63H-2, 18–20	160.09		B																																						
63H-CC, 0–2	160.27	B	B																																						
66H-2, 148–150	164.28	B																																							
67H-2, 15–17	165.02	B	B																																						
67H-2, 144–146	166.30	B																																							
68H-2, 15–17	167.40	B	B																																						
68H-2, 149–151	168.73	B																																							
69H-2, 15–17	170.46	B	B																																						
69H-CC, 0–4	171.13	B																																							
70H-2, 15–17	173.75	B	B																																						
70H-CC, 0–5	174.35	B																																							
71H-2, 15–17	176.84	B	B																																						
71H-CC, 0–6	176.98	B																																							
72H-2, 15–17	179.20	B	B																																						
72H-CC, 0–7	182.11	B																																							
73H-2, 14–16	183.65	B	B																																						
73H-CC, 0–2	184.81	B																																							
74H-CC, 0–5	185.30	B																																							
75H-2, 12–14	190.23	B	B																																						
75H-CC, –	191.53	B																																							
76H-2, 15–17	193.56	B	B																																						
76H-CC, 0–5	194.51	B																																							
77H-2, 15–17	196.86	B	B																																						
77H-CC, 0–7	198.55	B																																							
78S-1	198.80	B																																							



Table T5 (continued).

Core, section, interval (cm)	Depth (mbsf)	Abundance (offshore samples, 5–30 cm ³)	Abundance (onshore samples, 20 cm ³)	<i>Acanthocytherideis dunelmensis</i>	<i>Baifiniythere</i> sp.	<i>Bythocythere constricta</i>	<i>Cluthia cluthae</i>	<i>Cythere lutea</i>	<i>Cythereis</i> spp.	<i>Cytheropteron arcuatum</i>	<i>Cytheropteron biconvexa</i>	<i>Cytheropteron latissimum</i>	<i>Cytheropteron nodosolatum</i>	<i>Cytheropteron pseudomontronsiense</i>	<i>Cytheropteron</i> spp.	<i>Cytherura</i> spp.	<i>Eofsonella concinna</i>	<i>Finmarchinella</i> sp.	<i>Heterocytherideis sorbyana</i>	<i>Hirschmania viridis</i>	<i>Ilyocypris</i> sp.	<i>Jonesia acuminata</i>	<i>Krithe</i> sp.	<i>Leptocythere</i> spp.	<i>Normaniythere leioderma</i>	<i>Palmenella limicola</i>	<i>Polycyope</i> sp.	<i>Pontocypris</i> sp.	<i>Rabillimis mirabilis</i>	<i>Robertsonites tuberculatus</i>	<i>Roundstonia globulifera</i>	<i>Sarsicytheridea bradlii</i>	<i>Sarsicytheridea punctillata</i>	<i>Sclerochilus</i> sp.	<i>Semicytherura</i> sp.	Redeposited	Undetermined						
80H-CC, 0–4	199.50	B																																									
82P-1, 7–9	202.58	R																																									
82P-CC, 0–10	203.25	B																																									
84P-1, 5–6	205.55	B																																									
88S-CC, 0–6	211.60	B																																									
90S-CC, 8–10	214.58	B																																									
92S-CC, 20–22	217.70	B																																									
94S-CC, 3–5	220.53	R																																									
96S-CC, 8–10	223.58	B																																									
98S-CC, 8–10	226.58	B																																									
100S-CC, 8–10	229.58	B																																									
347-M0060B-3H-2, 118–120	5.48	B																																									
4H-1, 44–46	6.55	A						R								F	F		R		R			F																			
4H-2, 15–17	7.75	B																																									
4H-CC, 0–10	9.29	F						R																																			
6H-CC, 0–5	15.92	A			R	F	R	R	R			R	F											F			R	R															
7H-CC, 0–20	19.26	F			R									R																													
8H-CC, 0–22	22.49	F										R		R																													
9H-CC, 0–13	25.77	R												R																													
11H-2, 15–17	30.86	B																																									
12H-3, bottom	35.79	B																																									
13H-3, 53–55	39.33	B																																									
14H-CC, 0–15	42.55	B																																									
15H-CC, 0–19	45.67	B																																									
16H-CC, 67–71	49.37	B																																									
17H-CC, 0–5	52.48	B																																									
18H-CC, 63–70	55.93	B																																									
19H-CC, 0–15	59.02	B																																									
20H-CC, 0–18	62.21	B																																									
21H-CC, 0–4	65.57	B																																									
25H-CC, 0–5	76.22	B																																									
26H-3, 30–33	79.60	B																																									

Abundance: A = abundant, C = common, F = few, R = rare, V = very rare, B = barren.

Table T6. Occurrences of tertiary pollen types in samples, Site M0060A.

Tertiary pollen type	Core	Depth (mbsf)	Tertiary pollen type	Core	Depth (mbsf)
Tertiary pollen taxa				61H	155.42
<i>Pinus</i> (mostly haploxylon type)	8H	9.15		68H	166.92
	9H	12.65		70H	172.34
	10H	15.69		76H-CC	
	11H	19.38		77H	194.40
	12H	22.35		82P	202.67
	15H	31.40	<i>Sequoia</i>	61H	155.42
	18H	40.60			
	20H	48.68	<i>Sciadopitys</i>	9H	12.65
	29H	76.48		54H	133.54
	30H	80.10			
	37H-CC		<i>Tsuga</i>	9H	12.65
	54H	133.54		11H	19.38
	61H	155.42	<i>Ginkgo</i>	82P	202.67
	68H	166.92			
	70H	172.34	<i>Tilia</i>	6H	6.10
	76H-CC				
	77H	194.40	<i>Carya</i>	37H-CC	
82P	202.67	54H		133.54	
		76H-CC			
		82P		202.67	
<i>Picea</i>	9H	12.65	<i>Nyssa</i>	37H-CC	
	11H	19.38		76H	194.40
	20H	48.68			
	30H	80.10	<i>Quercus/Quercoidites</i>	15H	31.40
	37H-CC				
	61H	155.42	<i>Tricolporopollenites</i>	11H	19.38
	70H	172.34			
	76H-CC		<i>Loranthus</i> type	37H-CC	
	77H	194.40			
	82P	202.67	Tertiary Triletae spores	9H	12.65
		12H		22.35	
		29H		76.48	
		30H		80.10	
		54H		133.54	
		61H		155.42	
		68H		166.92	
		70H	172.34		
		77H	194.40		
		82P	202.67		
Taxodiaceae/Cupressaceae	9H	12.65			
	10H	15.69			
	11H	19.38			
	12H	22.35			
	15H	31.40			
	18H	40.60			
	20H	48.68			
	30H	80.10			
	37H-CC				

Table T7. Interstitial water geochemistry, Site M0060. This table is available in [oversized format](#).

Table T8. Calculated Cl⁻ based salinity and elemental ratios of interstitial waters, Site M0060. (Continued on next page.)

Core, section, interval (cm)	Type	Depth (mbsf)	Cl ⁻ based salinity	Na/Cl (mM/mM)	Ca/Cl (mM/mM)	Mg/Cl (mM/mM)	K/Cl (mM/mM)	Br/Cl (μM/mM)	B/Cl (μM/mM)
347-M0060A-									
3H-1, 135-140	Rh	1.38	32.26	0.86	0.02	0.10	0.02	1.46	0.79
3H-2, 133-138	Rh	2.86	30.68	0.92	0.02	0.11	0.02	1.46	0.84
4H-1, 135-140	Rh	4.38	30.37	0.89	0.02	0.10	0.02	1.47	0.80
4H-2, 28-28	Rh	4.78	30.43	0.94	0.02	0.11	0.03	1.46	0.87
8H-1, 135-140	Rh	10.38	31.25	0.98	0.01	0.10	0.02	1.53	1.08
8H-2, 135-140	Rh	11.88	31.82	0.94	0.01	0.10	0.02	1.54	1.03
9H-1, 135-140	Rh	13.68	31.50	0.94	0.01	0.09	0.02	1.54	1.05
9H-2, 50-60	Rh	14.35	31.74	1.01	0.01	0.10	0.02	1.55	1.16
10H-1, 135-140	Rh	16.98	31.41	1.07	0.02	0.12	0.02	1.56	1.26
11H-1, 135-140	Rh	20.28	30.40	0.96	0.02	0.10	0.02	1.54	1.20
12H-1, 135-140	Rh	23.58	30.16	0.91	0.02	0.10	0.01	1.55	1.09
13H-1, 135-140	Rh	26.88	26.98	—	—	—	—	—	—
23H-1, 135-140	Rh	58.28	27.91	0.83	0.02	0.08	0.01	1.52	1.03
24H-1, 135-140	Rh	61.58	26.76	0.65	0.01	0.06	0.01	1.51	0.76
30H-1, 133-138	Rh	80.46	23.86	0.89	0.02	0.09	0.01	1.46	1.04
31H-1, 135-140	Rh	83.78	21.83	1.15	0.02	0.11	0.02	1.46	1.46
35H-1, 135-140	Rh	96.08	19.66	0.85	0.02	0.09	0.02	1.39	0.78
48H-1, 120-125	Rh	117.93	16.24	0.99	0.03	0.11	0.02	1.36	1.05
50H-1, 135-140	Rh	121.08	10.80	0.88	0.05	0.08	0.02	1.58	1.02
51H-1, 135-140	Rh	124.38	10.40	0.76	0.05	0.07	0.01	1.57	0.88
52H-1, 135-140	Rh	127.68	10.66	0.76	0.05	0.07	0.01	1.56	0.92
53H-1, 135-140	Rh	130.98	11.43	0.88	0.05	0.09	0.02	1.56	1.04
54H-1, 135-140	Rh	134.28	11.73	0.75	0.04	0.07	0.01	1.57	1.02
55H-1, 135-140	Rh	137.58	12.61	0.77	0.03	0.07	0.01	1.57	1.16
56H-1, 135-140	Rh	140.88	13.71	0.78	0.02	0.07	0.01	1.58	1.27
57H-1, 135-140	Rh	144.18	14.92	0.89	0.02	0.08	0.01	1.60	1.65
58H-1, 135-140	Rh	147.48	15.91	—	—	—	—	—	—
60H-1, 105-110	Rh	153.48	19.84	0.84	0.02	0.09	0.02	1.59	0.93
61H-1, 15-20	Rh	155.58	19.49	0.97	0.02	0.10	0.02	1.60	1.21
63H-1, 135-140	Rh	159.78	20.27	0.94	0.02	0.10	0.02	1.59	0.95
65H-1, 95-100	Rh	160.38	19.91	0.99	0.02	0.10	0.02	1.59	0.98
66H-2, 10-15	Rh	162.93	20.55	0.90	0.02	0.09	0.02	1.50	0.98
68H-2, 10-15	Rh	167.37	21.06	0.85	0.02	0.09	0.02	1.61	0.89
69H-1, 135-140	Rh	170.18	21.95	0.82	0.01	0.08	0.01	1.64	0.92
70H-1, 135-140	Rh	173.48	22.03	0.96	0.02	0.09	0.02	1.60	1.15
73H-1, 135-140	Rh	183.38	22.63	0.79	0.01	0.08	0.02	1.62	0.91
76H-1, 135-140	Rh	193.28	21.14	0.90	0.02	0.09	0.02	1.60	1.15
82P-1, 60-65	Rh	203.13	20.58	0.80	0.02	0.08	0.02	1.59	0.97
347-M0060B-									
1H-1, 135-145	Sq	1.40	33.92	0.81	0.02	0.09	0.02	1.55	0.67
3H-1, 125-135	Sq	4.10	32.82	0.83	0.02	0.10	0.02	1.56	0.71
3H-2, 80-90	Sq	5.15	33.03	0.82	0.02	0.09	0.02	1.52	0.68
4H-1, 135-145	Sq	7.50	32.52	0.84	0.01	0.08	0.02	1.60	0.82
4H-2, 125-135	Sq	8.90	32.47	0.81	0.01	0.08	0.02	1.60	0.88
5H-1, 125-135	Sq	10.70	32.34	0.80	0.01	0.08	0.02	1.61	0.85
5H-2, 122-132	Sq	12.17	26.33	0.82	0.01	0.08	0.02	1.45	0.77
6H-1, 120-130	Sq	13.95	31.93	0.83	0.01	0.08	0.02	1.62	0.92
7H-1, 125-135	Sq	17.30	32.09	0.82	0.01	0.08	0.02	1.62	0.89
7H-2, 135-145	Sq	18.90	30.77	0.95	0.02	0.10	0.02	1.61	1.19
8H-1, 125-135	Sq	20.60	31.77	0.81	0.01	0.08	0.01	1.63	0.96
9H-2, 120-130	Sq	23.85	31.72	0.81	0.02	0.08	0.01	1.63	0.93
10H-1, 125-135	Sq	27.20	31.55	0.81	0.02	0.09	0.01	1.62	1.12
11H-1, 135-145	Sq	30.60	29.09	0.84	0.03	0.09	0.01	0.83	1.13
12H-1, 135-145	Sq	33.90	31.33	0.80	0.03	0.09	0.01	0.89	1.07
13H-1, 125-135	Sq	37.10	30.67	0.79	0.02	0.09	0.01	1.63	1.06
14H-1, 135-140	Sq	40.48	31.14	0.80	0.02	0.09	0.01	1.61	1.11
15H-1, 135-145	Sq	43.80	31.27	0.79	0.02	0.09	0.01	1.61	1.14
16H-1, 125-135	Sq	47.00	31.91	0.95	0.03	0.11	0.01	1.60	1.51
18H-1, 135-145	Sq	53.70	31.62	0.94	0.02	0.10	0.01	1.63	1.45
20H-1, 135-145	Sq	60.30	31.37	0.96	0.02	0.10	0.01	1.62	1.40
21H-1, 135-145	Sq	63.60	31.20	0.81	0.01	0.08	0.01	1.62	1.05
22H-1, 115-125	Sq	66.70	31.54	0.80	0.02	0.08	0.01	1.60	1.12
23H-1, 135-145	Sq	69.40	30.56	0.80	0.02	0.08	0.01	1.61	1.13
24H-1, 135-145	Sq	71.90	30.53	0.81	0.02	0.08	0.01	1.61	1.18
26H-1, 135-145	Sq	77.70	29.22	0.82	0.02	0.08	0.01	1.59	1.21
27H-1, 135-145	Sq	81.00	27.80	—	—	—	—	—	—

Table T8 (continued).

Core, section, interval (cm)	Type	Depth (mbsf)	Cl ⁻ based salinity	Na/Cl (mM/mM)	Ca/Cl (mM/mM)	Mg/Cl (mM/mM)	K/Cl (mM/mM)	Br/Cl (μM/mM)	B/Cl (μM/mM)
28H-1, 130–140	Sq	84.25	25.49	0.83	0.01	0.08	0.01	1.59	1.00
347-M0060B-									
1H-1, 108–113	Rh	1.11	—	—	—	—	—	—	—
1H-2, 86–91	Rh	2.39	—	—	—	—	—	—	—
3H-1, 18–23	Rh	3.01	—	—	—	—	—	—	—
4H-1, 90–95	Rh	7.03	—	—	—	—	—	—	—
4H-2, 55–60	Rh	8.18	—	—	—	—	—	—	—
5H-1, 56–61	Rh	9.99	—	—	—	—	—	—	—
6H-1, 59–64	Rh	13.32	—	—	—	—	—	—	—
7H-1, 90–95	Rh	16.93	—	—	—	—	—	—	—
8H-1, 54–59	Rh	19.87	—	—	—	—	—	—	—
9H-1, 60–65	Rh	23.23	—	—	—	—	—	—	—
10H-1, 89–94	Rh	26.82	—	—	—	—	—	—	—
11H-1, 65–70	Rh	29.88	—	—	—	—	—	—	—
12H-1, 76–81	Rh	33.29	—	—	—	—	—	—	—
13H-1, 89–94	Rh	36.72	—	—	—	—	—	—	—
14H-1, 65–70	Rh	39.78	—	—	—	—	—	—	—
15H-1, 75–80	Rh	43.18	—	—	—	—	—	—	—
16H-1, 88–93	Rh	46.61	—	—	—	—	—	—	—
17H-1, 63–68	Rh	49.66	—	—	—	—	—	—	—
18H-1, 76–81	Rh	53.09	—	—	—	—	—	—	—
19H-1, 87–92	Rh	56.50	—	—	—	—	—	—	—
20H-1, 65–70	Rh	59.58	—	—	—	—	—	—	—
21H-1, 71–76	Rh	62.94	—	—	—	—	—	—	—
22H-1, 88–93	Rh	66.41	—	—	—	—	—	—	—
23H-1, 63–68	Rh	68.66	—	—	—	—	—	—	—
24H-1, 70–75	Rh	71.23	—	—	—	—	—	—	—
25H-1, 87–92	Rh	73.90	—	—	—	—	—	—	—
26H-1, 63–68	Rh	76.96	—	—	—	—	—	—	—
27H-1, 75–80	Rh	80.38	—	—	—	—	—	—	—
28H-1, 59–64	Rh	83.52	—	—	—	—	—	—	—

Rh = Rhizon sample, Sq = squeezed sample. — = no data are reported for samples with insufficient pore water volumes.

Table T9. Concentration of methane in interstitial water, Site M0060.

Core, section, interval (cm)	Depth (mbsf)	CH ₄ (mM)
347-M0060A-		
3H-1, 145–150	1.48	0.00
4H-1, 145–150	4.48	0.00
8H-1, 145–150	10.48	0.00
9H-1, 145–150	13.78	0.00
10H-1, 146–151	17.09	0.00
11H-1, 145–150	20.38	0.00
12H-1, 145–150	23.68	0.00
13H-1, 145–150	26.98	0.00
15H-1, 145–150	31.98	0.00
16H-1, 145–150	35.28	0.00
17H-1, 145–150	38.58	0.00
18H-1, 145–150	41.88	0.00
19H-1, 145–150	45.18	0.00
20H-1, 145–150	48.48	0.00
21H-1, 145–150	51.78	0.00
22H-1, 145–150	55.08	0.00
23H-1, 145–150	58.38	0.01
24H-1, 145–150	61.68	0.01
25H-1, 145–150	64.98	0.01
26H-1, 145–150	68.28	0.01
27H-1, 145–150	71.28	0.01
28H-1, 145–150	74.28	0.01
29H-1, 145–150	77.28	0.01
30H-2, 9–14	80.70	0.00
31H-1, 145–150	83.88	0.00
32H-1, 145–150	86.28	0.00
33H-1, 145–150	89.58	0.01
34H-1, 145–150	92.88	0.06
35H-1, 145–150	96.18	0.03
38H-2, 145–150	100.61	0.24
58H-1, 145–150	147.58	1.35
66H-2, 0–5	162.83	2.17
67H-1, 61–66	164.84	0.39
68H-2, 0–5	167.27	0.56
69H-1, 145–150	170.28	0.15
70H-1, 145–150	173.58	0.04
71H-1, 123–128	176.66	0.01
72H-2, 145–150	180.52	0.01
73H-1, 145–150	183.48	0.01

Table T10. Total carbon (TC), total organic carbon (TOC), total inorganic carbon (TIC), and total sulfur (TS) in sediment, Site M0060. (Continued on next page.)

Core, section, interval (cm)	Depth (mbsf)	TC (wt%)	TOC (wt%)	TIC (wt%)	TS (wt%)
347-M0060A-					
3H-1, 90–91	0.90	0.71	0.20	0.51	—
4H-1, 70–71.5	3.70	0.32	0.00	0.31	—
6H-1, 11–12	6.11	1.70	0.28	1.42	—
8H-1, 40–41	9.40	1.96	0.39	1.56	—
8H-2, 111–112	11.61	1.74	0.31	1.43	—
9H-1, 10–11	12.40	2.41	0.36	2.05	—
9H-2, 78–79	14.58	1.38	0.15	1.24	—
10H-1, 51–52	16.11	1.31	0.14	1.17	—
10H-2, 115–117	18.26	1.79	0.21	1.57	—
11H-1, 23.5–24.5	19.14	2.16	0.27	1.89	—
11H-2, 96.5–97.5	21.37	1.98	0.28	1.70	—
12H-2, 96–97.5	22.79	1.90	0.37	1.53	—
12H-1, 58.5–60	24.66	2.08	0.48	1.60	—
13H-1, 8–9	25.58	2.23	0.41	1.82	—
13H-2, 124–125	28.24	2.77	0.58	2.19	—
15H-1, 25–26	30.75	2.90	0.59	2.32	—
15H-2, 115–116	33.15	3.15	0.67	2.49	0.22
16H-1, 30–31	34.10	2.85	0.55	2.30	—
16H-2, 100–111	36.30	2.56	0.47	2.09	—
17H-1, 20–21	37.30	3.21	0.55	2.66	—
17H-2, 20–21	38.80	3.21	0.70	2.51	—
18H-1, 46–47	40.86	3.29	0.59	2.70	—
18H-2, 96–97	42.86	2.99	0.65	2.34	—
19H-1, 52–53	44.22	2.67	0.79	1.89	—
19H-2, 116–117	46.36	2.63	0.73	1.90	—
20H-1, 20–21	47.20	2.82	0.65	2.17	—
20H-2, 20–21	48.70	2.82	0.68	2.14	—
21H-1, 50–51	50.80	2.93	0.67	2.27	0.14
21H-2, 100–101	52.80	3.04	0.64	2.40	—
22H-1, 46–47	54.06	3.04	0.65	2.39	—
22H-2, 102–103	56.12	3.45	0.58	2.88	—
23H-1, 42–43	57.32	3.78	0.60	3.18	0.25
23H-2, 42–43	58.82	3.41	0.42	2.99	—
24H-1, 54–55	60.74	3.11	0.41	2.70	—
24H-2, 132–133	63.02	3.89	0.47	3.42	—
25H-1, 48–49	63.98	3.61	0.44	3.17	—
25H-2, 119–120	66.19	3.09	0.49	2.61	—
26H-1, 42–43	67.22	2.86	0.50	2.36	—
26H-2, 100–101	69.30	3.73	0.52	3.21	—
27H-1, 35–36	70.15	3.70	0.50	3.20	—
27H-2, 90–91	72.20	3.89	0.52	3.38	—
28H-1, 54–55.5	73.34	3.95	0.49	3.46	—
29H-1, 20–21	76.00	3.27	0.55	2.72	—
29H-2, 80–81	78.10	3.63	0.49	3.14	—
30H-1, 110.5–112	80.21	2.73	0.45	2.28	—
30H-3, 138.5–140	82.11	2.19	0.34	1.85	—
31H-1, 10–11	82.50	2.17	0.30	1.87	—
31H-2, 65–66	84.55	1.40	0.13	1.27	—
32H-1, 11–12.5	84.91	1.72	0.21	1.50	—
32H-2, 135–136.5	87.65	2.35	0.56	1.79	—
33H-1, 45–47	88.55	3.18	0.41	2.77	—
33H-2, 112–113.5	90.72	3.19	0.43	2.76	—
34H-1, 30–31	91.70	2.87	0.45	2.43	—
34H-2, 84–85	93.74	2.63	0.40	2.22	—
35H-1, 23–24	94.93	3.05	0.43	2.62	—
36H-1, 18–20	97.88	2.62	0.42	2.20	—
38H-2, 73–74	97.79	2.40	0.39	2.01	—
37S-1, 9–10	99.86	2.48	0.40	2.09	—
48H-1, 69–70	117.39	0.96	0.10	0.87	—
50H-1, 30–31	120.00	1.32	0.17	1.15	—
50H-2, 100–101	122.19	0.95	0.07	0.88	—
51H-1, 21–22	123.21	0.61	0.03	0.58	—
51H-2, 21–22	124.71	0.88	0.06	0.81	—
52H-1, 100–101	127.30	0.65	0.01	0.64	—
53H-1, 90–91	130.50	0.41	0.00	0.41	—
54H-1, 37–38	133.27	1.31	0.54	0.77	—

Table T10 (continued).

Core, section, interval (cm)	Depth (mbsf)	TC (wt%)	TOC (wt%)	TIC (wt%)	TS (wt%)
54H-2, 78–79	135.18	0.57	0.01	0.56	—
55H-1, 21–22	136.41	1.42	0.21	1.21	—
56H-1, 17–18	139.67	0.57	0.01	0.56	—
57H-2, 45–46	143.47	0.88	0.20	0.68	—
57H-1, 67–68	144.75	0.46	0.01	0.46	—
60H-1, 88–89	153.28	2.09	0.60	1.50	—
60H-2, 35–36	153.96	2.08	0.61	1.47	—
61H-1, 2–3	155.42	1.95	0.74	1.21	—
63H-1, 14–15	158.54	1.47	0.55	0.92	—
65H-1, 7–8	159.47	1.52	0.68	0.85	—
65H-2, 44.5–45.5	160.96	1.42	0.59	0.84	0.18
66H-2, 73.5–75	163.54	1.45	0.72	0.72	—
67H-1, 8–9	164.28	1.36	0.56	0.80	—
67H-2, 60–61	165.46	1.67	0.74	0.93	—
68H-2, 70–72	167.94	1.28	0.48	0.81	—
69H-1, 25–26	169.05	1.46	0.70	0.76	—
69H-2, 50–51	170.80	1.27	0.63	0.63	—
70H-1, 99–100	173.09	1.28	0.41	0.87	—
70H-2, 23–24	173.83	1.22	0.47	0.75	—
71H-1, 35–36.5	175.75	1.34	0.42	0.92	—
72H-2, 26–27	179.30	0.90	0.36	0.54	—
72H-3, 24.5–25.5	180.79	1.27	0.55	0.73	—
73H-1, 55–56	182.55	1.50	0.73	0.76	0.17
73H-2, 99–100	184.49	1.28	0.54	0.74	—
75H-1, 80–81	189.40	1.33	0.58	0.74	—
75H-2, 87–88	190.97	0.72	0.31	0.41	—
76H-1, 28–29	192.18	2.94	1.85	1.09	—
76H-2, 28–29	193.68	2.44	1.38	1.06	—
77H-1, 38–39	195.58	1.31	0.57	0.74	—
77H-2, 122–123	197.92	1.33	0.63	0.70	—
82P-1, 53–54	203.03	2.50	1.41	1.09	—
347-M0060B-					
4H-1, 31–32	6.41	0.23	0.17	0.06	0.13
4H-2, 31–32	7.91	0.50	0.50	0.00	0.09

Table T11. Samples taken for cell counts by flow cytometry and acridine orange direct count (AODC), Hole M0060B.

Core, section	Top depth (mbsf)	Cytometer counts (log cells/cm ³)	AODC (log cells/cm ³)
347-M0060B-			
1H-1, 100	1.00	7.22	
1H-2, 108	2.58		7.10
3H-2, 2	4.33	7.84	7.35
4H-2, 2	7.63	8.53	8.58
5H-2, 2	10.93	8.39	8.82
6H-2, 2	14.23	8.51	8.38
7H-2, 2	17.53	8.25	
8H-2, 2	20.83	8.28	
9H-2, 2	24.13	8.39	8.70
10H-2, 2	27.43	8.36	
11H-2, 2	30.73	8.40	
12H-2, 2	34.03	8.56	8.67
13H-2, 2	37.33	8.54	
14H-1, 2	40.63	8.55	
15H-2, 2	43.93	8.59	8.24
16H-2, 2	47.23	8.52	
17H-2, 2	50.53	8.54	
18H-2, 2	53.83	8.65	8.92
19H-2, 2	57.13	8.36	
20H-2, 2	60.43	8.53	
21H-2, 2	63.73	8.61	8.65
22H-2, 2	67.03	8.81	
23H-2, 2	69.53	8.47	
24H-2, 2	72.03	8.63	8.53
25H-2, 2	74.52	8.56	
26H-2, 55	78.36	8.60	
27H-2, 2	81.13	8.37	8.40
28H-2, 2	84.43	8.43	8.22

Respective count data are presented in the last two columns in logarithmic format.

Table T12. Drilling fluid contamination, Hole M0060B. (Continued on next page.)

Core	Depth (mbsf)	PFC (g/L)	LF fraction in sample	Contaminant (cells/cm ³)
347-M0060B-				
Core interior				
1H	1.45	2.91E-06	3.94E+01	3.94E+08
3H	4.20	1.99E-09	2.58E-02	2.58E+05
5H	10.85	BD	BD	BD
6H	14.15	5.41E-10	1.54E-03	1.54E+04
8H	20.75	2.19E-10	3.71E-05	3.71E+02
9H	24.05	BD	BD	BD
10H	27.35	3.10E-09	6.11E-04	6.11E+03
11H	30.65	BD	BD	BD
17H	50.45	5.39E-10	2.36E-04	2.36E+03
19H	57.05	4.80E-09	9.31E-03	9.31E+04
21H	63.65	8.28E-11	6.05E-06	6.05E+01
23H	69.45	3.37E-10	5.84E-06	5.84E+01
25H	74.44	BD	BD	BD
27H	81.05	BD	BD	BD
Core halfway				
1H	1.45	8.85E-06	1.20E+02	1.20E-09
3H	4.20	2.31E-09	3.00E-02	3.00E+05
5H	10.85	1.24E-09	2.04E-02	2.04E+05
6H	14.15	2.25E-09	6.40E-03	6.40E+04
8H	20.75	2.26E-10	3.84E-05	3.84E+02
9H	24.05	3.32E-10	5.83E-07	5.83E+00
10H	27.35	1.67E-08	3.29E-03	3.29E+04
11H	30.65	BD	BD	BD
17H	50.45	6.72E-10	2.94E-04	2.94E+03
19H	57.05	5.59E-09	1.08E-02	1.08E+05
21H	63.65	1.08E-09	7.90E-05	7.90E+02
23H	69.45	3.35E-09	5.80E-05	5.80E+02
25H	74.44	BD	BD	BD
27H	81.05	BD	BD	BD
Core exterior				
1H	1.45	2.72E-07	3.68E-00	3.68E+07
3H	4.20	2.40E-09	3.12E-02	3.12E+05
5H	10.85	3.59E-08	5.92E-01	5.92E+06
6H	14.15	6.57E-08	1.87E-01	1.87E+06
8H	20.75	1.25E-07	2.12E-02	2.12E+05
9H	24.05	6.25E-08	1.10E-04	1.10E+03
10H	27.35	6.86E-08	1.35E-02	1.35E+05
11H	30.65	1.75E-08	6.34E-04	6.34E+03
17H	50.45	5.09E-10	2.23E-04	2.23E+03
19H	57.05	5.05E-09	9.80E-03	9.80E+04
21H	63.65	3.99E-08	2.91E-03	2.91E+04
23H	69.45	1.49E-09	2.58E-05	2.58E+02
25H	74.44	7.94E-10	8.61E-04	8.61E+03
27H	81.05	4.34E-09	1.69E-03	1.69E+04
Liner fluid				
1H	1.45	7.39E-08	NA	NA
3H	4.20	7.69E-08	NA	NA
5H	10.85	6.07E-08	NA	NA
6H	14.15	3.51E-07	NA	NA
8H	20.75	5.89E-06	NA	NA
9H	24.05	5.69E-04	NA	NA
10H	27.35	5.07E-06	NA	NA
11H	30.65	2.76E-05	NA	NA
17H	50.45	2.28E-06	NA	NA
19H	57.05	5.16E-07	NA	NA
21H	63.65	1.37E-05	NA	NA
23H	69.45	5.78E-05	NA	NA
25H	74.44	9.22E-07	NA	NA
27H	81.05	2.56E-06	NA	NA
Drilling fluid				
1H	1.45	1.30E-04	NA	NA
2H	2.80	8.00E-04	NA	NA
3H	4.20	1.01E-04	NA	NA
4H	6.10	1.75E-03	NA	NA
6H	14.15	5.77E-08	NA	NA

Table T12 (continued).

Core	Depth (mbsf)	PFC (g/L)	LF fraction in sample	Contaminant (cells/cm ³)
7H	16.00	4.61E-07	NA	NA
8H	20.75	8.80E-07	NA	NA
10H	27.35	8.17E-07	NA	NA
11H	30.65	1.83E-06	NA	NA
22H	65.50	2.46E-06	NA	NA

The contaminant cell numbers in samples represent an estimated potential maximum. PFC = perfluorocarbon tracer, LF = liner fluid, BD = below detection, NA = not applicable.

Table T13. Composite depth scale, Site M0060.

Core	Offset (m)	Top depth		Core	Offset (m)	Top depth	
		(mbsf)	(mcd)			(mbsf)	(mcd)
347-M0060A-				60H	0.00	152.4	152.4
3H	0.00	0	0	61H	0.00	155.4	155.4
4H	0.00	3	3	63H	0.00	158.4	158.4
6H	0.00	6	6	65H	0.00	159.4	159.4
8H	0.00	9	9	66H	0.00	162.4	162.4
9H	0.00	13.8	13.8	67H	0.00	164.2	164.2
10H	0.00	15.6	15.6	68H	0.00	166.3	166.3
11H	0.00	18.9	18.9	69H	0.00	168.8	168.8
12H	0.00	22.2	22.2	70H	0.00	172.1	172.1
13H	0.00	25.5	25.5	71H	0.00	175.4	175.4
15H	0.00	30.5	30.5	72H	0.00	178.7	178.7
16H	0.00	33.8	33.8	73H	0.00	182	182
17H	0.00	37.1	37.1	74H	0.00	185.3	185.3
18H	0.00	40.4	40.4	75H	0.00	188.6	188.6
19H	0.00	43.7	43.7	76H	0.00	191.9	191.9
20H	0.00	47	47	77H	0.00	195.2	195.2
21H	0.00	50.3	50.3	78S	0.00	198.5	198.5
22H	0.00	53.6	53.6	80S	0.00	199.5	199.5
23H	0.00	56.9	56.9	82P	0.00	203.25	203.25
24H	0.00	60.2	60.2	347-M0060B-			
25H	0.00	63.5	63.5	1H	0.35	0	0.35
26H	0.00	66.8	66.8	2H	0.35	0	0.35
27H	0.00	69.8	69.8	3H	0.84	2.8	3.64
28H	0.00	72.8	72.8	4H	1.09	6.1	7.19
29H	0.00	75.8	75.8	5H	0.87	9.4	10.27
30H	0.00	79.1	79.1	6H	0.31	12.7	13.01
31H	0.00	82.4	82.4	7H	0.70	16	16.70
32H	0.00	84.8	84.8	8H	-0.18	19.3	19.12
33H	0.00	88.1	88.1	9H	-0.52	22.6	22.08
34H	0.00	91.4	91.4	10H	-0.55	25.9	25.35
35H	0.00	94.7	94.7	11H	-0.33	29.2	28.87
36X	0.00	97.7	97.7	12H	-0.42	32.5	32.08
37S	0.00	97.7	97.7	13H	-0.42	35.8	35.38
38H	0.00	98.7	98.7	14H	-0.21	39.1	38.89
39H	0.00	101.2	101.2	15H	-0.45	42.4	41.95
41S	0.00	104.7	104.7	16H	-0.51	45.7	45.19
45P	0.00	112.7	112.7	17H	-0.40	49	48.60
46H	0.00	113.7	113.7	18H	-0.49	52.3	51.81
48H	0.00	116.7	116.7	19H	-1.04	55.6	54.56
50H	0.00	119.7	119.7	20H	-0.84	58.9	58.06
51H	0.00	123	123	21H	-0.72	62.2	61.48
52H	0.00	126.3	126.3	22H	-0.84	65.5	64.66
53H	0.00	129.6	129.6	23H	-1.02	68	66.98
54H	0.00	132.9	132.9	24H	-0.50	70.5	70.00
55H	0.00	136.2	136.2	25H	-0.74	73	72.26
56H	0.00	139.5	139.5	26H	-0.63	76.3	75.67
57H	0.00	142.8	142.8	27H	-0.82	79.6	78.78
58H	0.00	146.1	146.1	28H	-0.35	82.9	82.55
59H	0.00	149.4	149.4				

Table T14. Sound velocity data for lithostratigraphic units, Site M0060.

Unit	Thickness of unit (m)	Sound velocity (m/s)*	TWT (ms)	Depth (m)	Depth (mbsf)
Seafloor	34	1450	0.0468	34.00	0.00
I	6	1663	0.0541	40.00	6.00
II	17.84	1569	0.0768	57.84	23.84
III	55.68	1532	0.1495	113.52	79.52
IV	15.52	1654	0.1683	129.04	95.04
V	21.66	1643	0.1946	150.70	116.70
VI	29.4	1752	0.2282	180.10	146.10
VII	83.4	1789	0.3214	263.50	229.50

* = sound velocities are based on values measured during the OSP. TWT = two-way traveltime.