

6. SITE 370: DEEP BASIN OFF MOROCCO

The Shipboard Scientific Party^{1,2}

SITE DATA

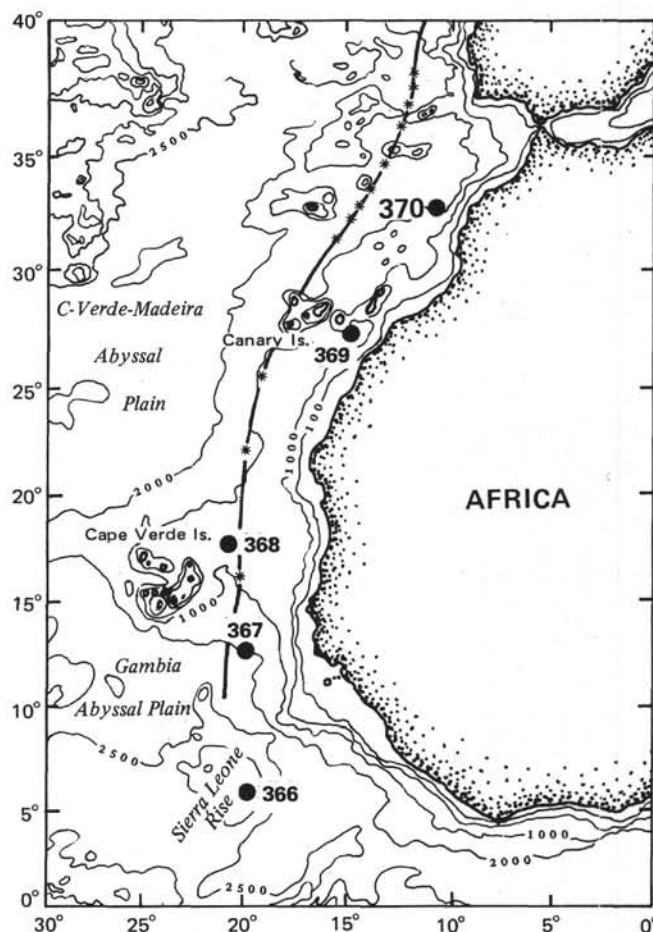
Date Occupied: 29 March 1975 (0100Z)
Date Departed: 8 April 1975 (0110Z)
Time on Site: 10 days and 10 minutes
Position: 32°50.2'N, 10°46.6'W
Water Depth (sea level): 4214 corrected meters (echo sounding)
Bottom Felt With Drill Pipe at: 4226 meters (below rig floor)
Penetration: 1176.5 meters
Number of Holes: 1
Number of Cores: 51
Total Length of Cored Section: 483 meters
Total Core Recovered: 202.7 meters

BACKGROUND AND OBJECTIVES

Background

The deep basin off the Atlantic coast of Morocco offers a particularly good opportunity to sample old sediments very close to the continental margin because of the almost complete absence of a continental rise along that margin. A survey conducted by Lamont-Doherty's *Vema* (Vema 30) showed that sediment possibly as old as Middle Jurassic should be within reach of the *Glomar Challenger*.

The site is located well within the magnetic quiet zone (≈ 300 km from the boundary) and very close to the base of the Moroccan continental slope (Figure 1).



If we assume the basement to be oceanic, and if we extrapolate the Upper Jurassic spreading rate derived from the Mesozoic anomalies, then the age of the basement at Site 370 could be as old as Lower Jurassic (≈ 165 to 170 m.y.). Without "re-entry" capability, there was no chance to reach the lowermost sediments and the basement. However, there were good reasons to believe that Upper to Middle Jurassic sediments could lie at depths of about 1300-1400 meters subbottom.

Seismic-reflection profiles recorded in the area north of the Canary Islands display a succession of roughly parallel reflectors over a very faint rough reflector that may be interpreted as basement (Figure 2a). The reflectors observed above the basement can only be tentatively correlated with reflectors from the basins south of the Canary Islands, because correlations are very difficult across that volcanic massif or across the tectonic zone that possibly links the Canary Islands to the Atlas area on the African margin and continent south of Agadir. Holes drilled during Leg 14 (Sites 135

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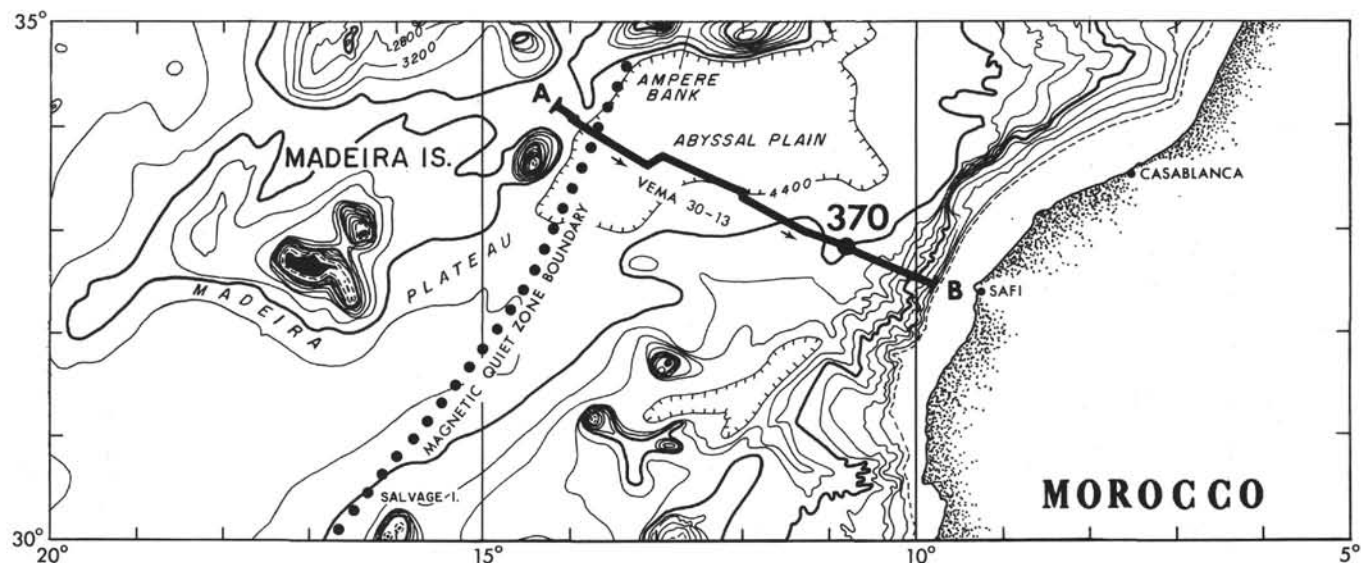


Figure 1. Location of Site 370 in the Morocco Basin. Bathymetry from Uchupi (1971) and magnetic quiet zone boundary from Hayes and Rabinowitz, 1975.

and 136, Hayes, Pimm, et al., 1972) do not provide a good control for the nature and age of these reflectors because they cannot be directly tied to these drill sites. Furthermore, Site 135 was drilled on a topographic high which resulted from an early Eocene uplift that considerably influenced the sedimentation. The oldest part of the Mesozoic magnetic anomaly pattern just west of the quiet zone is still incompletely mapped and complicated by the occurrence of a linear anomaly (anomaly J) that might be related to basement features instead of a field reversal. It was therefore particularly important to try to obtain a good record of the sedimentary evolution of that part of the Atlantic in order to compare it with the results of Site 367 drilled south of the Canary Islands-Atlas tectonic zone as well as Site 105 drilled south of the New England seamount lineament in the western basin. The objectives for this site had a dual aspect: (1) to determine the nature and age of the oldest sediments that could be reached by drilling; and (2) to identify the overlying sedimentary units and the nature and age of the reflectors.

On both sides of the North Atlantic, the oldest sediments recovered are of Middle to Late Jurassic age. As for Site 367, our assumption was that reflector C, observed as the first major reflector below a reflector believed to correspond with Horizon β (Figure 2a), corresponds with sediments of Oxfordian age (see discussion in Site 367 report). At Site 367 that reflector was rather badly defined and was found to correspond with Jurassic limestones just overlying basaltic basement. At Site 370 several reflectors are present below the level of what is believed to be reflector C and the only factor that would prevent recovery of Middle or Lower Jurassic sediment should have been the technical limitations of the drilling equipment.

The seismic profile from which Site 370 was selected (profile Vema 30, Figures 2a and 2b) shows a series of reflectors that have been tentatively correlated with the major reflector observed in the basins south of the Canary Islands. The uppermost of these reflectors might

correspond to the reflector identified at Sites 368 and 369 as well as at Sites 139 and 140 (Leg 14, Hayes, Pimm, et al., 1972) as the base of carbonate-rich layers of Miocene age. Precise correlations, however, are difficult as the age of that reflector appears to vary from site to site. On the other hand, this reflector might also be the equivalent of Horizon A and correspond with Eocene silicified layers as at previous sites drilled south of the Canary Islands. The age of the lower reflectors can be only estimated in an indirect way by trying to determine on the profiles where they come into contact with basement. On that basis we can tentatively observe reflector C reaching basement in the vicinity of the quiet magnetic zone boundary and therefore it can be assumed to be of approximately Late to Middle Jurassic age by comparison with the results of Sites 105 (Leg 11) and 367 (this leg). The reflector or reflectors lying between the uppermost reflector and reflector C could correspond to β or possibly A*. Because the seismic profile shows only a low frequency record (an attempt to achieve better penetration), the definition is not very good and only broad reflecting zones can be observed.

Site 370 is located in a slight depression between the Moroccan margin and a broad elevation located just east of the margin that reaches depths of about 4000 meters whereas the nearby Seine Abyssal Plain shows average depths of 4600 meters. The depression does not appear to be filled with ponded terrigenous sediments so that the sediment thicknesses appear most favorable for an attempt at reaching the level of reflector C. The site is located in a synclinal structure and well seaward of the zone of diapiric features along the margin so that no possible accumulations of hydrocarbons were expected.

Objectives

Our first priority objective at this site was to try to reach reflector C and determine the nature and age of the sediments immediately below that level. Oxfordian

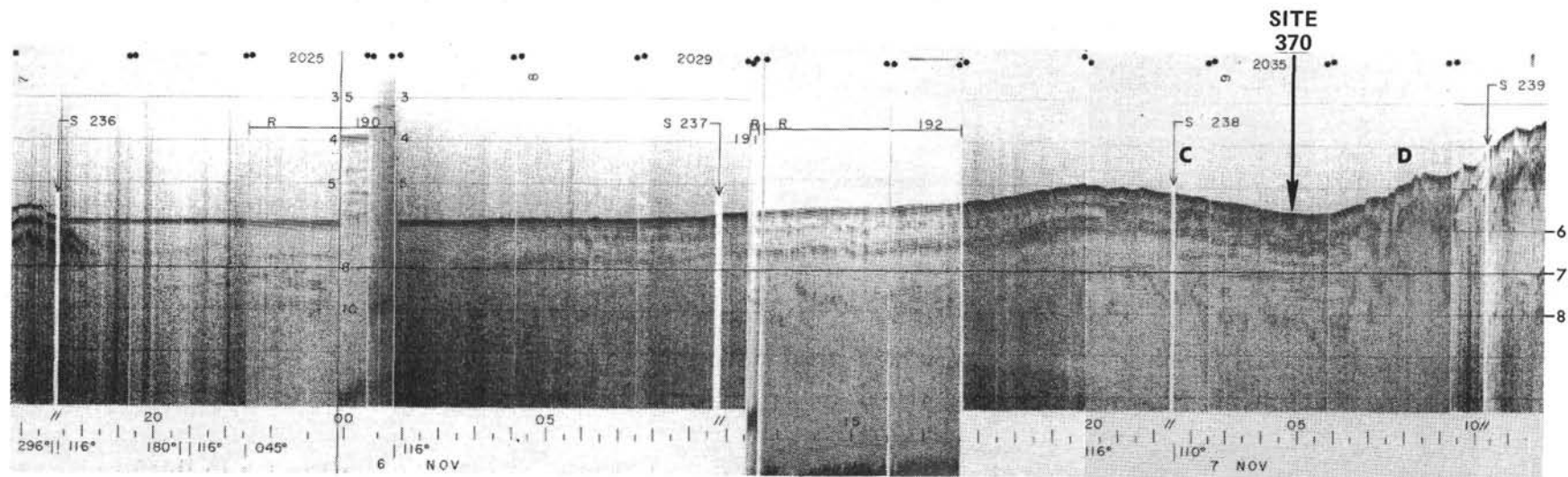


Figure 2a. Vema 30-13 seismic-reflection profile in the Morocco Basin. See location in Figure 1.

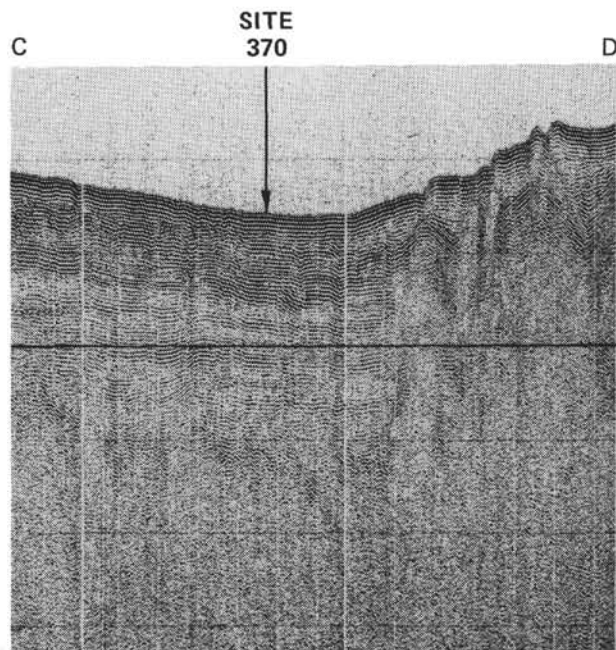


Figure 2b. Closeup of Figure 2a in area around Site 370.

ammonite-rich limestones have been recovered by dredging the nearby continental slope (Renz et al., 1975). The Oxfordian rocks at Site 367 and on the slope are open marine facies showing strong affinities with the "Ammonitico Rosso" facies of the Tethyan realm. The middle Oxfordian in Morocco is marked by a very abrupt transgression where open marine conditions suddenly replace continental to lagoonal environments (Haha Basin). In the same region, the shallow water marine facies of the Lower Jurassic are indicative of relatively restricted environments and do not show good connections with the open marine Tethyan environments. It is therefore particularly interesting to try to understand what could be the significance of the Oxfordian transgression in the Atlantic basin itself. If the pre-Oxfordian facies in the basins are of the Tethys type, then the implication would be that the connection between Tethys and the young Atlantic was already well established but restricted to the deep basin. If, however, the connection did not exist prior to the Oxfordian, then the sediments found below reflector C should reflect a different environment, possibly very restricted and characteristic of the more or less isolated young Atlantic Ocean. Because the evaporites found on the margin could be of early Jurassic age and because diapiric structures that closely resemble salt domes are observed in the deep basin, it might be speculated that their origins lie in these restricted environmental conditions.

Our second objective was to obtain as complete a sedimentary record from the deep basin as possible and compare the evolution of this area with that of the Canary and Cape Verde basins as well as of the western Atlantic. The history of this deep basin is still unknown because the only two previous drilling attempts were located either on the outer edge of the deep basin (Site 136, Leg 14) or on an uplifted piece of oceanic crust (Site 135, Leg 14).

Strategy

Because this site is located only about 2 days of steaming time from Malaga, the end point of this cruise, the drilling program for this site had to receive special consideration. Because the major objective lay at great depth, it was aimed at first, therefore only intermittent coring was performed in the upper part of the hole down to a level at which closely spaced coring became both a technical and safety oriented necessity. Then, coring would be continuous or semicontinuous down to the maximum depth that could be achieved before the bit was destroyed. The drill string would be pulled out of the hole and, if time permitted the bit would be brought on deck, exchanged for a new one, and an "A" hole would be drilled and cored down to the level where closely spaced coring was initiated. The density of coring would be dictated by the amount of time remaining before the site had to be abandoned in order to meet our ETA in Malaga. If only a small amount of time was available and if, although damaged, the first bit was not plugged, then punch-coring of the uppermost section would be attempted directly without bringing the old bit on deck.

OPERATIONS

The area of Site 370 was approached from the southwest and, using the same procedure as for the previous sites, it was decided to intercept the Lamont-Doherty *Vema 30* track at a point located about 16 km from the site in order to match the *Glomar Challenger* profile with the Lamont-Doherty reference profile. The intercept point was reached at 2151 on 28 March 1975, and the ship headed toward the site on a 104° course (Figure 3). The seismic record (Figure 4) was comparable to the Lamont-Doherty profile (Figure 2) but with a lesser penetration. At 2203 the speed was reduced to approximately 5 knots in order to increase the penetration on the seismic record. Still the penetration was not sufficient for suitable comparisons with the Lamont-Doherty record for the deeper part of the section and the site had to be recognized from the morphology of the upper reflectors. After a suitable location was selected the ship executed a Williamson turn to make a second pass over the site and drop the beacon. At 0006 on 29 March, an ORE 16-kHz beacon was dropped, and the seismic and magnetic gear were immediately retrieved. The ship executed a second turn and came back toward the beacon. By that time, weather conditions had deteriorated and strong winds of about 40 knots, gusting to 55 knots, made the final approach difficult. The "lock on" was effective at about 0100, but running in the drill pipe was delayed because of the weather conditions. The ship had to use almost all the power available to stay over the beacon which left only marginal power for the draw works. The roll and pitch motion generally was exceeding 5°. Both factors prevented safe operations on the rig floor and more than 18 hours were spent waiting for better weather conditions. At 1945 on 29 March, the wind and swell had reduced sufficiently to allow for running the drill pipe and operations began. The sea bottom was felt by the driller at 0625 on 30 March when the total length of drill pipe reached 4226 meters from the rig

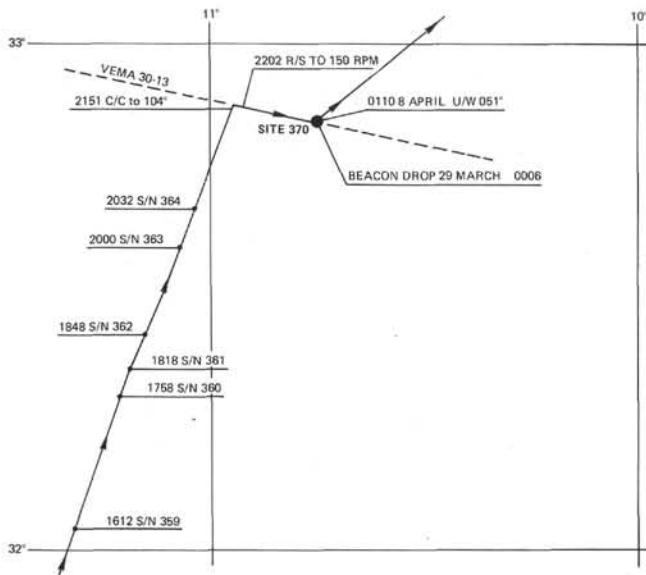


Figure 3. Glomar Challenger tracks (solid line) approaching and departing Site 370 and Vema 30 tracks (dashed line).

floor. The water depth from sea level was officially considered to be 4216 meters. This depth shows relatively good agreement with the PDR depth of 4214 meters corrected (from sea level).

The drilling and coring program consisted of spot coring as far down as technically possible (see Table 1). After taking a surface core the bit was lowered by washing down to a subbottom depth of 103 meters and a core was punched from 103 to 112.5 meters. Because the core barrel was in place at the end of the drill string during the washing operation, it is probable that some sediments might have accidentally entered the barrel

between 8 and 103 meters subbottom. The same operation was repeated from 112.5 to 207.5 meters and Core 3 was cut from 207.5 meters to 217 meters. Because Cores 2 and 3 showed evidence of possible admixture of different lithologies, we felt that the cores might not be truly representative of the level at which they were taken. Therefore, we decided to revert to the technique used on previous sites when spot coring. That technique consists of taking a core before washing an interval so that the barrel would be already full when washing operations begin. Cores 4, 5, and 6 were obtained this way and after the sediments became firmer, closely spaced coring began with Core 6 at 426 meters below the bottom. Coring was closely spaced to continuous and relatively slow down to about 750 meters. Very sticky clays proved to be difficult to penetrate with the medium length insert bit and drilling/coring became extremely slow below 768 meters. Pulling out of the hole and exchanging the bit was considered but, because of time constraints at the end of the leg, we thought this operation would not improve the total penetration. Alternating drilling and coring, with very slow rate of penetration, continued down to a total depth of 1176.5 meters below the sea floor. After recovering the last core (Core 51) time constraints for meeting the scheduled arrival date at Malaga dictated our decision to abandon the hole. The drill string was recovered and the drill bit was on deck at 0047 on 8 April. That bit had drilled for a record time of 121 hr. and 59 min. The ship was under way at 0110 on 8 April and the post-site survey consisted only in a run at slow speed over the beacon on a course approximately perpendicular to the approach track. Fifteen minutes after passing over the beacon, speed was increased and course was set toward the Gibraltar straits and Malaga.

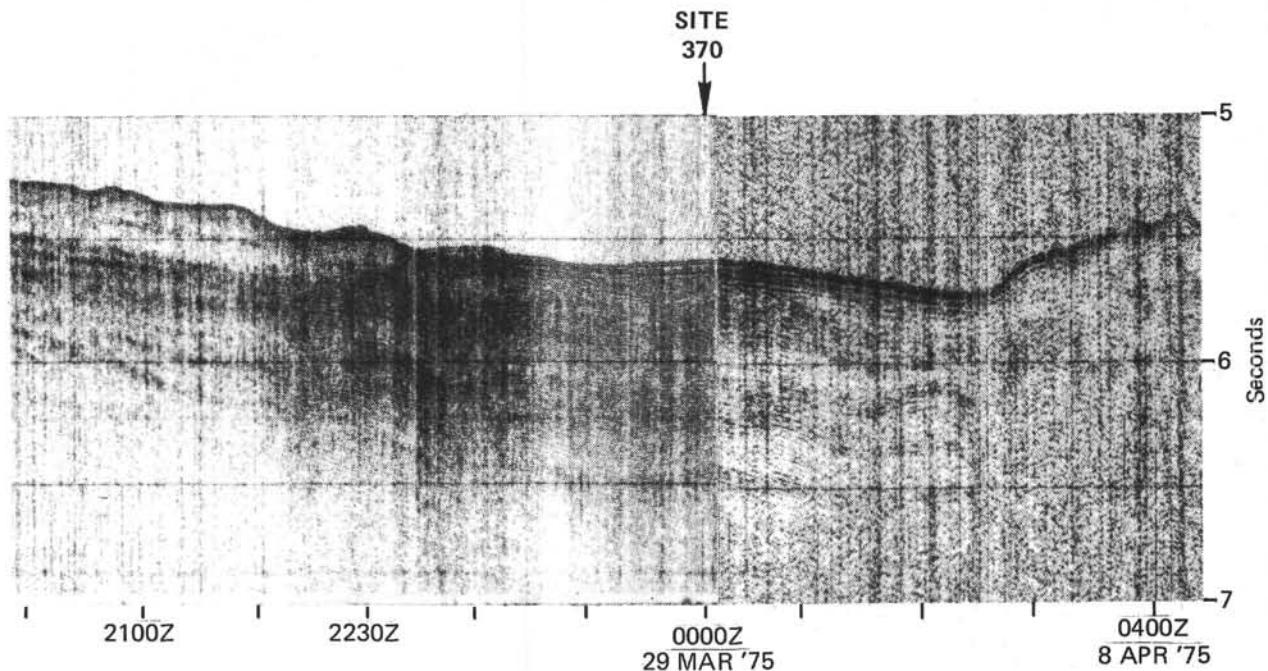


Figure 4. Glomar Challenger seismic-reflection profile approaching and leaving Site 370.

TABLE 1
Coring Summary for Site 370

| Core | Date (March 1975) | Time | Depth From Drill Floor (m) | Depth Below Sea Floor (m) | Cored (m) | Recovered (m) | Recovered (%) |
|-------|----------------------|------|-------------------------------|------------------------------|--------------|------------------|------------------|
| 1 | 30 | 0714 | 4226.0-4234.0 | 0.0-8.0 | 8.0 | 6.5 | 81 |
| 2 | 30 | 1115 | 4329.0-4338.5 | 103.0-112.5 | 9.5 | 2.5 | 26 |
| 3 | 30 | 1400 | 4433.5-4443.0 | 207.5-217.0 | 9.5 | 3.1 | 33 |
| 4 | 30 | 1650 | 4443.0-4452.5 | 217.0-226.5 | 9.5 | 5.1 | 54 |
| 5 | 30 | 2117 | 4547.5-4557.0 | 321.5-331.0 | 9.5 | 8.5 | 90 |
| 6 | 31 | 0021 | 4652.0-4661.5 | 426.0-435.5 | 9.5 | 2.3 | 24 |
| 7 | 31 | 0317 | 4671.0-4680.5 | 445.0-454.5 | 9.5 | 2.0 | 21 |
| 8 | 31 | 0610 | 4690.0-4699.5 | 464.0-473.5 | 9.5 | 1.9 | 20 |
| 9 | 31 | 0915 | 4709.0-4718.5 | 483.0-492.5 | 9.5 | 1.0 | 11 |
| 10 | 31 | 1239 | 4728.0-4737.5 | 502.0-511.5 | 9.5 | 1.8 | 19 |
| 11 | 31 | 1628 | 4747.0-4756.5 | 521.0-530.5 | 9.5 | 0.1 | 1 |
| 12 | 31 | 1945 | 4766.0-4775.5 | 540.0-549.5 | 9.5 | 2.3 | 24 |
| 13 | 31 | 2223 | 4775.5-4785.0 | 549.5-559.0 | 9.5 | 1.8 | 19 |
| April | | | | | | | |
| 14 | 1 | 0107 | 4794.5-4804.0 | 568.5-578.0 | 9.5 | 4.8 | 51 |
| 15 | 1 | 0339 | 4813.5-4823.0 | 587.5-597.0 | 9.5 | 4.2 | 44 |
| 16 | 1 | 0600 | 4832.5-4842.0 | 606.5-616.0 | 9.5 | 5.0 | 53 |
| 17 | 1 | 0953 | 4842.0-4851.5 | 616.0-625.5 | 9.5 | 2.5 | 26 |
| 18 | 1 | 1318 | 4861.0-4870.5 | 635.0-644.5 | 9.5 | 2.8 | 30 |
| 19 | 1 | 1711 | 4880.0-4889.5 | 654.0-663.5 | 9.5 | 1.2 | 13 |
| 20 | 1 | 2036 | 4899.0-4908.5 | 673.0-682.5 | 9.5 | 4.1 | 43 |
| 21 | 1 | 2245 | 4908.5-4918.0 | 682.5-692.0 | 9.5 | 2.9 | 31 |
| 22 | 2 | 0101 | 4918.0-4927.5 | 692.0-701.5 | 9.5 | 6.0 | 63 |
| 23 | 2 | 0326 | 4927.5-4937.0 | 701.5-711.0 | 9.5 | 5.4 | 57 |
| 24 | 2 | 0542 | 4937.0-4946.5 | 711.0-720.5 | 9.5 | 6.5 | 68 |
| 25 | 2 | 0800 | 4946.5-4956.0 | 720.5-730.0 | 9.5 | 2.1 | 22 |
| 26 | 2 | 1133 | 4956.0-4965.5 | 730.0-739.5 | 9.5 | 5.8 | 61 |
| 27 | 2 | 1537 | 4975.0-4984.5 | 749.0-758.5 | 9.5 | 4.0 | 42 |
| 28 | 2 | 1846 | 4994.0-5003.5 | 768.0-777.5 | 9.5 | 5.1 | 54 |
| 29 | 3 | 0352 | 5013.0-5022.5 | 787.0-796.5 | 9.5 | 0.8 | 8 |
| 30 | 3 | 1145 | 5032.0-5041.5 | 806.0-815.5 | 9.5 | 6.1 | 64 |
| 31 | 3 | 1601 | 5051.0-5060.5 | 825.0-834.5 | 9.5 | 6.1 | 64 |
| 32 | 3 | 1953 | 5060.5-5070.0 | 834.5-844.0 | 9.5 | 5.2 | 55 |
| 33 | 3 | 2313 | 5079.5-5089.0 | 853.5-863.0 | 9.5 | 0.2 | 2 |
| 34 | 4 | 0237 | 5098.5-5108.0 | 872.5-882.0 | 9.5 | 7.1 | 75 |
| 35 | 4 | 0740 | 5108.0-5117.5 | 882.0-891.5 | 9.5 | 7.1 | 75 |
| 36 | 4 | 1316 | 5127.0-5136.5 | 901.0-910.5 | 9.5 | 0.2 | 2 |
| 37 | 4 | 1648 | 5146.0-5155.5 | 920.0-929.5 | 9.5 | 0.2 | 2 |
| 38 | 4 | 2112 | 5165.0-5174.5 | 939.0-948.5 | 9.5 | 6.7 | 71 |
| 39 | 5 | 0159 | 5174.5-5184.0 | 948.5-958.0 | 9.5 | 6.0 | 63 |
| 40 | 5 | 0607 | 5193.5-5203.0 | 967.5-977.0 | 9.5 | 5.7 | 60 |
| 41 | 5 | 1059 | 5212.5-5222.0 | 986.5-996.0 | 9.5 | 7.7 | 81 |
| 42 | 5 | 1503 | 5231.5-5241.0 | 1005.5-1015.0 | 9.5 | 4.7 | 50 |
| 43 | 5 | 2030 | 5250.5-5260.0 | 1024.5-1034.0 | 9.5 | 5.2 | 55 |
| 44 | 5 | 2329 | 5269.5-5279.0 | 1043.5-1053.0 | 9.5 | 4.4 | 46 |
| 45 | 6 | 0343 | 5288.5-5298.0 | 1062.5-1072.0 | 9.5 | 5.5 | 58 |
| 46 | 6 | 0915 | 5307.5-5317.0 | 1081.5-1091.0 | 9.5 | 6.4 | 67 |
| 47 | 6 | 1445 | 5326.5-5336.0 | 1100.5-1110.0 | 9.5 | 4.1 | 43 |
| 48 | 6 | 2038 | 5345.5-5355.0 | 1119.5-1129.0 | 9.5 | 3.2 | 34 |
| 49 | 7 | 0227 | 5364.5-5374.0 | 1138.5-1148.0 | 9.5 | 4.0 | 42 |
| 50 | 7 | 0726 | 5383.5-5393.0 | 1157.5-1167.0 | 9.5 | 2.8 | 30 |
| 51 | 7 | 1210 | 5393.0-5402.5 | 1167.0-1176.5 | 9.5 | 2.0 | 21 |
| Total | | | | | 483.0 | 202.7 | 42 |

LITHOLOGY

We subdivided the section into five units based on changes in color and composition (Table 2).

Unit 1: Nanno-foram bearing clay (Core 1)

Unit 1 consists of yellowish brown (10YR6/2), soupy clay containing common nannofossils and foraminifers, and rare quartz silt, carbonate rhombs, and ferromanganese or iron sulfide micronodules.

Unit 2 consists of two subunits:

Subunit 2a: Clayey nanno ooze (Cores 1 through 2, Section 2).

Subunit 2b: Silty nanno marl interbedded with calcareous silt and sand (Core 2, Section 2, 30 cm through Core 3, Section 1, 84 cm):

Subunit 2a is light greenish gray (5GY6/1) clayey nannofossil ooze composed of dominant nannofossils, common clay, rare foraminifers and carbonate rhombs, and traces of zeolites and heavy minerals. The nannofossil ooze is homogeneous, soft, sticky, and highly disturbed by drilling so that primary sedimentary structures are not preserved. The base of the subunit is an 80-cm-thick bed of grayish orange nannofossil ooze.

TABLE 2
Lithostratigraphy at Site 370

| Unit | Lithology | Cores | Age |
|------|---|---|---|
| 1 | Nannofossil-foraminiferous-bearing clay | 1 | Quaternary |
| 2a | Clayey nannofossil ooze and marls | 1 through 2, Section 2 to 30 cm (0? to 106.3 m) | Pliocene |
| 2b | Clayey nannofossil ooze with silt and sand beds | 2, Section 2 to 30 cm, Section 1 to 84 cm (106.3 to 208.46 m) | Middle Miocene to Pliocene |
| 3a | Nannofossil radiolarian-bearing clay | 3, Section 1 to 84 cm through 4 (208.46 to 226.5 m) | Middle to early Miocene |
| 3b | Calcareous silty clay with porcellanite | 5 through 11 (321.5 to 530.5 m) | Oligocene to middle Eocene |
| 3c | Calcareous silty claystone with silt, sand, porcellanite, and chert | 12 through 18 (540 to 644.5 m) | Middle Eocene to early Eocene |
| 4 | Nannofossil marl and nannofossil-bearing clay | 18, CC through 19 (644.5 to 663.5 m) | Late Paleocene |
| 5a | Nannofossil-bearing claystone grading into claystone | 20 through 26 (673 to 739.5 m) | Late Albian to early Cenomanian |
| 5b | Calcareous silty claystone, nannofossil-bearing claystone, siltstones, and sandstones | 27 through 51 (740 to 1176.5 m) | Albian to not older than late Valanginian |

The silty nannofossil marl of subunit 2b is dark greenish gray (5Y4/1) and composed of abundant nannofossils, and clay, common quartz and detrital carbonate, rare feldspars, heavy minerals, and carbonate rhombs, and traces of zeolites. Laminae and thin beds (up to 5 cm thick) of light olive to grayish olive foram-bearing clayey silty sand and clayey silt occur within the marl. The coarser beds have sharp lower contacts and usually have gradational upper contacts with the surrounding marl. Foraminifers are frequently concentrated at the bases of the coarse beds. The silty and sandy beds are composed of moderately sorted, subangular quartz grains, with abundant clay, common foraminifers (with some chambers filled with iron monosulfide [?]) and nannofossils, rare pyrite, and traces of fish debris, plant fragments, mollusk fragments, carbonate rhombs, glauconite, and heavy minerals. The nannofossil ooze of Subunit 2a is interpreted as a pelagic deposit, based on composition and texture, and the coarser sand and silt beds of Subunit 2b are turbidites. The top of Subunit 2b is the top of the turbidite sequence, and the base is marked by the appearance of siliceous fossils of Unit 3.

Unit 3 is subdivided into three subunits mainly on the occurrence of siliceous fossils, porcellanite and chert, and coarse clastics.

Subunit 3a: Nanno-rad-bearing clay interbedded with nanno-ooze and marl (Core 3, Section 1, 84 cm through Core 4):

Subunit 3b: Clay with porcellanite, chert and rare beds of fine- to coarse-grained clastics (Cores 5 through 11):

Subunit 3c: Calcareous silty claystone with clastic beds, porcellanite, and chert (Cores 12 through 18):

The nanno-rad-bearing clay of Subunit 3a is light olive-gray (5Y5/2) and pale green (10G6/1), and composed of abundant clay, common radiolarians, rare sponge spicules, diatoms, quartz, and carbonate rhombs, and traces of fish debris and zeolites. The

nannofossil ooze is light greenish gray (5G8/1), composed of abundant nannofossils and rare radiolarians and the rest of the constituents are the same as in the nanno-rad-bearing clay. Thin beds of glauconitic sandy clay, clayey silt, and occasional beds of glauconitic sand with gravel-size material occur within the nanno-rad-bearing clays. The lower contact of these coarser beds with the underlying clay is sharp. The coarse sand and pebbles in the gravelly sand consist of brownish gray claystone, shale, and argillaceous siltstone with rare quartz. The first porcellanite occurs in Core 3, Section 2, and is scattered throughout the subunit. The porcellanite is nodular, brownish gray, and is formed by cementation of the host sediment by opaline silica. The sediments in Subunit 3a are firm and intensely bioturbated with abundant *Zoophycos*. The lower boundary of Subunit 3a is marked by the strong decrease in the abundance of siliceous microfossils.

The clay of Subunit 3b is olive-gray (5Y6/1) and is composed of dominant clay, rare quartz, glauconite, nannofossils, fish debris, and traces of foraminifers and pyrite. Nannofossils are very rare in Cores 9 and 10. Rare clayey silt and sand beds, 1 to 30 cm thick, are interbedded with the clay. The contact between sand beds and underlying clay is sharp. The bases of the sand beds are coarse, often with pebbles of brownish mudstone and silty dolomite up to 1 cm in diameter, the beds become finer upwards, and grade into the overlying clay bed. A slump about 80 cm thick occurs in Core 9, Section 1. The slump contains fine laminae which may indicate that deposition was by mass flow. Occasional chert nodules and porcellanite occur throughout Subunit 3b. Bioturbation is comparatively rare, and is represented by three main types of burrows: (1) *Zoophycos*, present only in the upper part of the subunit; (2) more common burrows 1 to 2 mm in diameter; and (3) burrows about 6 mm in diameter.

The boundary between Subunits 3a and 3b is placed at the top of the zone characterized by frequent

turbidites and a slight increase in feldspars and heavy minerals.

Subunit 3c is composed of the same sediments as Subunit 3b, but with an increase in abundance of porcellanite and chert, and the addition of abundant coarse clastic beds. The dominant lithology is calcareous silty claystone, grayish olive at the top, grading to dark yellowish brown in the lower part of the subunit. The claystone is composed of abundant clay, common quartz, rare feldspar, glauconite, nannofossils, foraminifers, and carbonate rhombs, and traces of radiolarians, sponge spicules, pyrite, clinoptilolite, and ferro-manganese or iron monosulfide micronodules. Pale blue-green calcareous silty claystone laminae occur in Cores 16 and 17 within the olive nanno-bearing claystone. These laminae contain only traces of calcareous fossils and are less indurated than the surrounding olive claystone.

Beds of coarser clastics, interpreted as turbidites and slump deposits, include silty and sandy claystone, clayey siltstone and sandstone and occasional pebbly coarse sand and gravel. The grains of the coarser clastics are composed mainly of argillaceous rock fragments, glauconite, porcellanite fragments, foraminifers, and occasional mollusk fragments, crinoid fragments, and oolites, all in a mud matrix and cemented by sparry calcite. Porcellanite and nodules of blackish brown chert are very common in the lower part of Subunit 3c, where about six chert horizons occur in every 1.5 meters. The last occurrence of chert is in Core 18, the base of Subunit 3c. Bioturbation is rare throughout the subunit.

Unit 4: Nanno marl and nanno-bearing clay (Sample 18, CC and Core 19):

This unit is not well defined because of poor core recovery. Most of the unit, about 80% of Core 19, is a slump. The sediment in Sample 18, CC and a thin bed at the top of Core 19 is very light gray (N7), soft nanno marl, with rare carbonate rhombs and grains. The bulk of Core 19 is composed of greenish gray nanno-bearing clay with thin laminae of light gray nannofossil marl. The green clay consists of common nannofossils, rare zeolites, volcanic glass(?), glauconite, and fish debris. Inclined laminations suggest that 110 cm of Core 19 represents a single slump. The lower boundary of Unit 4 is marked by the disappearance of light gray marl and by a color change from greenish gray to dark greenish gray at the top of Core 20. Sediments of Unit 4 are soft, whereas the underlying unit is firm.

Unit 5 is subdivided into two subunits on the basis of more nannofossils in Subunit 5a and an increase in the amounts of clastic material in Subunit 5b.

Subunit 5a: Nanno-bearing claystone grading downward into claystone (Cores 20 through 26):

Subunit 5b: Calcareous silty claystone, nanno-bearing claystone, and interbedded argillaceous siltstone, argillaceous sandstone, gravelly claystone, and conglomerate (Cores 27 through 51):

The nanno-bearing claystone of Subunit 5a is homogeneous dark greenish gray (5G4/1), and contain common nannofossils, rare quartz, carbonate rhombs, and grains, and traces of zeolites, heavy minerals,

glauconite, pyrite, and barite. Subunit 5a is distinguished from overlying Unit 4 by its darker color and an increase in clastic material. The basic lithology changes between Cores 22 and 26 to olive-black (5Y2/1) and brownish gray (5YR4/1) claystone with thin beds of a greenish gray (5G6/1) claystone. Nannofossils decrease slowly throughout the subunit and, by Cores 25 and 26, they are very rare to absent. Brownish, opaque to semitranslucent, round palynomorphs(?) are present in trace amounts in Cores 22 through 26. Bioturbation is very rare, and the diameter of burrows are generally less than 1 mm. Barite rosettes occur in Core 20, Section 2, Core 22, Section 3, and a microcrystalline limestone bed underlies the barite in Core 20, Section 2. The base of this subunit is placed at the top of the appearance of coarser clastics in Core 27.

The upper contact of Subunit 5b is placed at the first occurrence of argillaceous siltstone in Core 27, Section 1. The dominant lithology is claystone with rare to common nannofossils, rare to abundant silt-size quartz, and rare feldspars, heavy minerals, carbonate rhombs and grains, glauconite, pyrite, palynomorphs, fish remains, and foraminifers. Colors of the claystone vary from olive-black (5Y2/1), grayish green (5G5/2), pale green (10G6/2), to bluish green (5BG5/2). Several zones within the claystone contain pebbles, up to 3 cm in cross-section, floating in a clay matrix.

The coarser components of Subunit 5b consist of reddish, brownish, and greenish siltstone, mudstone, calcareous siltstone, limestone fragments, and rounded grains of quartz, feldspar, glauconite, fragments of mollusks and fish, and rare oolites(?), all cemented by ferroan calcite. The coarser clastic interbeds frequently show graded bedding, laminations, and sharp basal contacts with occasional scour features. The first sandstone bed occurs in Core 32. Nannofossils increase in abundance below Core 33. Thick interbeds (1 to 20 cm) of calcareous argillaceous siltstone occur below Core 35. Sandstone is very rare. The siltstones are finely laminated, and often have contorted bedding, low angle cross-bedding, and current ripples with amplitudes on the order of 1 cm. Both upper and lower contacts of the siltstone with surrounding claystone are sharp. Cores 40 through 51 show a further decrease in grain size, with thin beds of reddish brown claystone, containing organic matter and pyrite interbedded with olive-gray (5Y3/2) and dark greenish gray (5Y4/1) nannofossil-bearing claystone, and marlstone, and pale yellowish brown (5YR6/1) calcareous siltstone.

Summary

Site 370 is located in a 400-meter abyssal depression between the Moroccan continental margin on the east, and a broad elevation to the west. The existence of this depression may help to explain some of the sedimentary features observed. Pelagic sediments are present only in the Pleistocene part of the section. The major lithologies throughout the remainder of the section are hemipelagic nannofossil-bearing clay and marl, with variable amounts of coarse clastics, siliceous biogenic material, chert, and porcellanite. The entire sequence

shows a very low degree of bioturbation. Slumping, as evidenced by contorted bedding, is also common.

The sedimentary sequence from middle Miocene to the Lower Cretaceous (106 to 1176.5 m) is probably a submarine fan (see Gardner et al., this volume), with minor thin beds of coarse clastics in a predominantly clay section. The dominant coarse-clastic lithologies are silty, sandy, and gravelly claystone and mudstone. We expected to find some features indicating the presence of deep submarine channels, but the thickest bed of coarse clastics found in the entire sequence is only about 1 meter thick.

Two intervals of maximum coarse clastic deposition occur: one in the Neocomian and another in the lower and middle Eocene. The Eocene coarse clastics are composed mainly of clasts of argillaceous and calcareous sediment with some glauconite, foraminifers, mollusk fragments, and occasional oolites. The Neocomian coarse clastics are mainly composed of a mixture of sand-size quartz and carbonate intraclasts.

GEOCHEMICAL MEASUREMENTS

The analytical techniques used in the geochemical determinations are described in the Introduction to this volume.

Organic Carbon and C/N Ratios

Samples were taken at regular intervals throughout the entire hole in order to establish a good profile on organic carbon content. Organic carbon values ranged from less than 0.1% to 6.1%. C/N ratios varied from 3.2 to 23.2. C/N was high; however, some samples having 1% to 2% C had higher C/N ratios than samples with 3% to 6% C. Complete results are given in Table 3.

Interstitial Gas

No ethane was encountered at this site. Methane was generally low; however, this may be attributed to dilution by air at the time of sampling. Complete results are in Table 4.

Carbonate Analyses

Carbonate analyses using the carbonate bomb method are given in Table 5. No relationship is apparent between percent CaCO_3 and percent organic carbon. At previous sites where carbonate was high, organic carbon was low, and vice versa.

Interstitial Water

Calcium, salinity, and chlorinity increase steadily with depth, whereas alkalinity decreases. The maximum salinity was 59.4‰ in Core 24, Section 3 (800 m). Results are given in Table 6 and Figure 5.

PHYSICAL PROPERTIES

Tabulations of all physical property measurements are in Trabant (this volume).

Bulk Properties

Bulk property measurements were made for bulk density, water content, void ratio, porosity, and specific

TABLE 3
Carbon and Nitrogen Analyses for Site 370

| Sample (Interval in cm) | Depth (m) | % Organic C (total dry wt. basis) | | C/N (atomic ratio) | | Remarks |
|----------------------------|--------------|--------------------------------------|-------|-----------------------|------|------------|
| | | x | SD | x | SD | |
| 1-1, 94-95 | 8 | 0.601 | 0.057 | 9.7 | 0.5 | |
| 2-2, 60-61 | 110 | 0.076 | 0.001 | 3.4 | 0.2 | |
| 3-1, 96-97 | 210 | 0.697 | 0.001 | 11.1 | 0.1 | |
| 5-5, 70-71 | 325 | 0.162 | 0.024 | 3.5 | 0.4 | |
| 6-2, 40-41 | 430 | 0.527 | 0.000 | 10.3 | 0.02 | |
| 7-2, 80-81 | 450 | 0.389 | 0.100 | 6.2 | 0.1 | |
| 8-2, 40-41 | 470 | 0.730 | 0.013 | 15.7 | 0.1 | |
| 9-1, 90-91 | 490 | 0.684 | 0.007 | 12.3 | 0.8 | |
| 10-2, 24-25 | 510 | 1.477 | 0.008 | 20.0 | 0.7 | |
| 14-3, 54-55 | 575 | 1.119 | 0.078 | 18.7 | 0.6 | |
| 16-2, 37-38 | 610 | 0.323 | 0.005 | 7.2 | 0.1 | |
| 17-2, 44-45 | 620 | 3.931 | 0.038 | 23.1 | 0.01 | |
| 18-1, 72-73 | 640 | 1.986 | 0.063 | 22.1 | 0.1 | |
| 22-2, 130 | 700 | 1.269 | 0.068 | 18.1 | 0.9 | |
| 22-2, 146-150 | 700 | 1.190 | — | — | — | Leco-Shell |
| 21-2, 60-61 | 690 | 0.617 | 0.006 | 13.0 | 0.4 | |
| 23-2, 81-83 | 710 | 0.400 | 0.043 | 12.7 | 1.8 | |
| 24-3, 88-89 | 715 | 0.068 | 0.008 | 4.6 | 0.2 | |
| 26-3, 92-93 | 735 | 0.391 | 0.023 | 14.9 | 0.2 | |
| 27-1, 130 | 755 | 0.083 | 0.100 | 5.6 | 0.3 | |
| 28-4, 136-139 | 775 | 1.641 | 0.023 | 19.3 | 1.4 | |
| 30-4, 113-114 | 810 | 1.299 | 0.033 | 19.6 | 0.1 | |
| 31-3, 128-129 | 830 | 2.500 | 0.009 | 18.8 | 0.2 | |
| 32-4, 11-12 | 840 | 1.333 | 0.062 | 17.9 | 1.0 | |
| 34-4, 130 | 880 | 1.397 | 0.036 | 17.8 | 0.2 | |
| 34-4, 146-150 | 880 | 1.770 | — | — | — | Leco-Shell |
| 35-5, 3-4 | 890 | 6.068 | 0.116 | 20.4 | 0.4 | |
| 38-4, 106-107 | 945 | 1.964 | 0.014 | 18.6 | 0.8 | |
| 39-3, 150 | 955 | 0.312 | 0.008 | 11.9 | 0.2 | |
| 46-5, 20-21 | | 0.759 | — | 16.7 | — | TAMU |
| 47-2, 50-51 | | 0.456 | — | 11.3 | — | TAMU |

TABLE 4
Interstitial Gas Analyses for Site 370

| Core- Section | Depth (m) | N ₂ +O ₂ | CH ₄ | CO ₂ | C ₂ H ₆ (Carle) | C ₂ H ₆ (Bendix) | C ₃ H ₈ |
|------------------|--------------|--------------------------------|-----------------|------------------|--|---|-------------------------------|
| | | | | | | | |
| % of total | | | | ppm of total gas | | | |
| 14-2 | 578 | 20.7 | 79.0 | 0.27 | | | |
| 20-3 | 683 | 95.1 | 3.5 | 1.4 | | | |
| 25-2 | 731 | 95.7 | 2.8 | 0.14 | | | |
| 26-4 | 740 | 87.0 | 11.8 | 0.12 | | | |
| 27-3 | 759 | 40.0 | 59.8 | 0.30 | | | |
| 30-3 | 815 | 16.6 | 82.7 | 0.67 | | | |
| 32-4 | 844 | 98.0 | 0.0 | 2.0 | No Ethane Detected At This Site | | |
| 35-4 | 892 | 86.7 | 12.6 | 0.78 | | | |
| 38-4 | 948 | 97.5 | 0.0 | 2.5 | | | |
| 42-4 | 1015 | 90.4 | 8.9 | 0.65 | | | |
| 43-3 | 1034 | 92.2 | 7.1 | 0.68 | | | |
| 44-2 | 1053 | 97.0 | 2.3 | 0.65 | | | |
| 48.2 | 1129 | 99.9 | 0.05 | 0.03 | | | |

gravity. Several irregularities are apparent in the general trend of porosity with depth (Figure 6). A notable decrease in porosity, to values below 46%, occurs at about 460 meters and correlates with both an increase in sonic velocity and the presence of a strong seismic reflector. This decrease in porosity occurs within lithologic Subunit 3b (calcareous silty clay with porcellanite) and appears due to an increase in cementation within the silty clays as well as the presence of porcellanite. Both of these factors are indicative of diagenetic cementation. A net increase in porosity values is seen within lithologic Subunit 3c (calcareous silty clay with silt, sand, porcellanite, and chert). This could reflect a decrease in the effects of cementation as well as an influx of unsorted sediments

TABLE 5
Carbonate Analyses Using Carbonate Bomb Method for Site 370

| Sample (Interval in cm) | Depth Subbottom (m) | % Ca CO ₃ | Lithology |
|----------------------------|---------------------------|----------------------|-------------------------|
| 1-3, 86-87 | 6 | 46 | Clayey nanno marl |
| 2-2, 75-76 | 110 | 54 | Silty nanno marl |
| 3-1, 64-65 | 210 | 23 | Nanno ooze |
| 3-1, 109-110 | 210 | 60 | Nanno rad-bearing clay |
| 4-3, 49-50 | 225 | 24 | Silty clay |
| 5-3, 87-88 | 330 | 24 | Silty claystone |
| 6-2, 73-74 | 430 | 6 | Claystone |
| 8-2, 82-83 | 470 | 19 | Claystone |
| 9-1, 122-123 | 490 | 13 | Claystone |
| 10-2, 50-51 | 510 | 15 | Silty claystone |
| 12-1, 81-82 | 545 | 21 | Claystone |
| 13-2, 75-76 | 555 | 9 | Silty claystone |
| 13-2, 101-102 | 555 | 70 | Limestone |
| 14-1, 98-99 | 575 | 20 | Silty claystone |
| 15-3, 121-122 | 595 | 47 | Marlstone |
| 17-2, 14-15 | 625 | 30 | Silty clay |
| 19-1, 88-89 | 660 | 32 | Nanno marl |
| 20-2, 72-73 | 680 | 11 | Nanno-bearing claystone |
| 21-2, 26-27 | 690 | 15 | Nanno-bearing claystone |
| 22-3, 55-56 | 700 | 14 | Nanno-bearing shale |
| 23-3, 85-86 | 710 | 8 | Nanno-bearing shale |
| 24-3, 85-86 | 720 | 9 | Nanno-bearing shale |
| 25-2, 65-66 | 730 | 3 | Shale |
| 26-3, 65-66 | 740 | 23 | Shale |
| 27-3, 92-93 | 755 | 5 | Silty claystone |
| 28-3, 51-52 | 775 | 0 | Silty clay |
| 30-3, 70-71 | 795 | 0 | Silty clay |
| 42-4, 31-32 | 1015 | 23 | Nanno-bearing marlstone |
| 42-4, 38-39 | 1015 | 0 | Claystone |

deposited by turbidity flows and slumps. Porosities decrease linearly below a depth of approximately 700 meters, with very low values (less than 30%) occurring within the frequent sandstone layers of lithologic Unit 5 below 900 meters.

Shear Strengths

Shear strength data could be taken only for the few intervals cored above a depth of 326 meters. Below this depth all values are above 5.0 km/cm², the limit of onboard shear strength apparatuses. These values are tabulated in Trabant (this volume).

Acoustic Velocities

Acoustic velocity data indicate a linear increase in velocity down to about 460 meters, below which a notable increase occurs, associated with the low porosity values discussed above (Figure 7). This zone of higher velocity is marked by a prominent seismic reflector which may be correlated with the velocity change at approximately 475 meters. Acoustic velocities decrease below 475 meters and do not appear to increase until a depth of approximately 825 meters. The clay, which is the major lithologic component, has velocities between 1.56 and 2.69 km/sec. They are cohesive but become increasingly more cemented below a depth of 250 meters which produces velocities which reach values of over 5.5 km/sec within the fine-grained sandstones. Acoustic anisotropy is quite noticeable, although not always in the same direction. In general, vertically measured velocities are lower than those measured horizontally.

Summary

Physical properties data indicate two anomalous zones, one at 500 meters and another at 775 meters. These two zones are most likely the result of diagenetic effects of cementation and rapid sedimentation caused by turbidity flow and slumps. These features are possibly responsible for two prominent seismic reflectors. Low velocities and high porosities below 670 meters may be associated with a series of Paleocene unconformities.

BIOSTRATIGRAPHIC SUMMARY

The sediments at Site 370 range in age from Pleistocene to Early Cretaceous. Planktonic foraminifers are abundant and well preserved only in the Pleistocene, Paleocene, and lower Cenomanian sediments. They are less abundant to absent in the Miocene, Oligocene, Eocene, and Lower Cretaceous, and very often poorly preserved; thus they allow only an approximate age determination. Benthic foraminifers are less frequent than the planktonics, but they play an important role for age determination in the

TABLE 6
Summary of Interstitial Water Analyses for Site 370

| Sample (Interval in cm) | Subdepth (m) | pH | Alkalinity (meq/kg) | Salinity (°/°°) | Ca ⁺⁺ (mmoles/l) | Mg ⁺⁺ (mmoles/l) | Cl ⁻ (°/°°) |
|----------------------------|-----------------|------|------------------------|--------------------|--------------------------------|--------------------------------|---------------------------|
| 1-4, 144-150 | 6.0 | 7.50 | 2.47 | 35.2 | 10.45 | 51.54 | 17.41 |
| 2-1, 144-150 | 104.5 | 7.21 | 2.41 | 36.0 | 13.31 | 42.26 | 20.59 |
| 3-1, 144-150 | 209.0 | 7.28 | 2.46 | 36.6 | 16.12 | 36.39 | 21.87 |
| 5-5, 144-150 | 329.0 | 8.06 | 1.34 | 39.9 | 23.76 | 29.18 | 24.44 |
| 6-2, 144-150 | 429.0 | — | — | 41.8 | 25.11 | 30.61 | 25.32 |
| 12-2, 144-150 | 543.0 | — | 1.26 | 47.6 | 30.43 | 39.29 | 29.23 |
| 17-2, 144-150 | 620.0 | 7.17 | 0.37 | 49.2 | 31.06 | 44.20 | 30.44 |
| 20-2, 144-150 | 680.0 | 7.83 | 0.18 | 49.8 | 38.39 | 37.82 | 30.98 |
| 25-1, 144-150 | 725.0 | 7.67 | 0.23 | 50.9 | 39.32 | 40.18 | 30.98 |
| 30-2, 144-150 | 810.0 | 7.82 | 0.51 | 58.6 | 52.31 | 43.38 | 36.45 |
| 34-3, 144-150 | 880.0 | 8.02 | 0.22 | 59.4 | 51.28 | 41.19 | 36.18 |
| 38-4, 144-150 | 945.0 | 7.79 | 0.18 | 54.7 | 43.76 | 31.94 | 33.28 |
| 41-4, 144-150 | 995.0 | 6.62 | 0.12 | 56.7 | 46.40 | 33.46 | 33.92 |
| 44-2, 144-150 | 1050.0 | — | 0.12 | 56.7 | 45.27 | 30.72 | 32.96 |
| 47-1, 144-150 | 1105.0 | 7.53 | 0.12 | 59.1 | 47.96 | 31.39 | 36.72 |

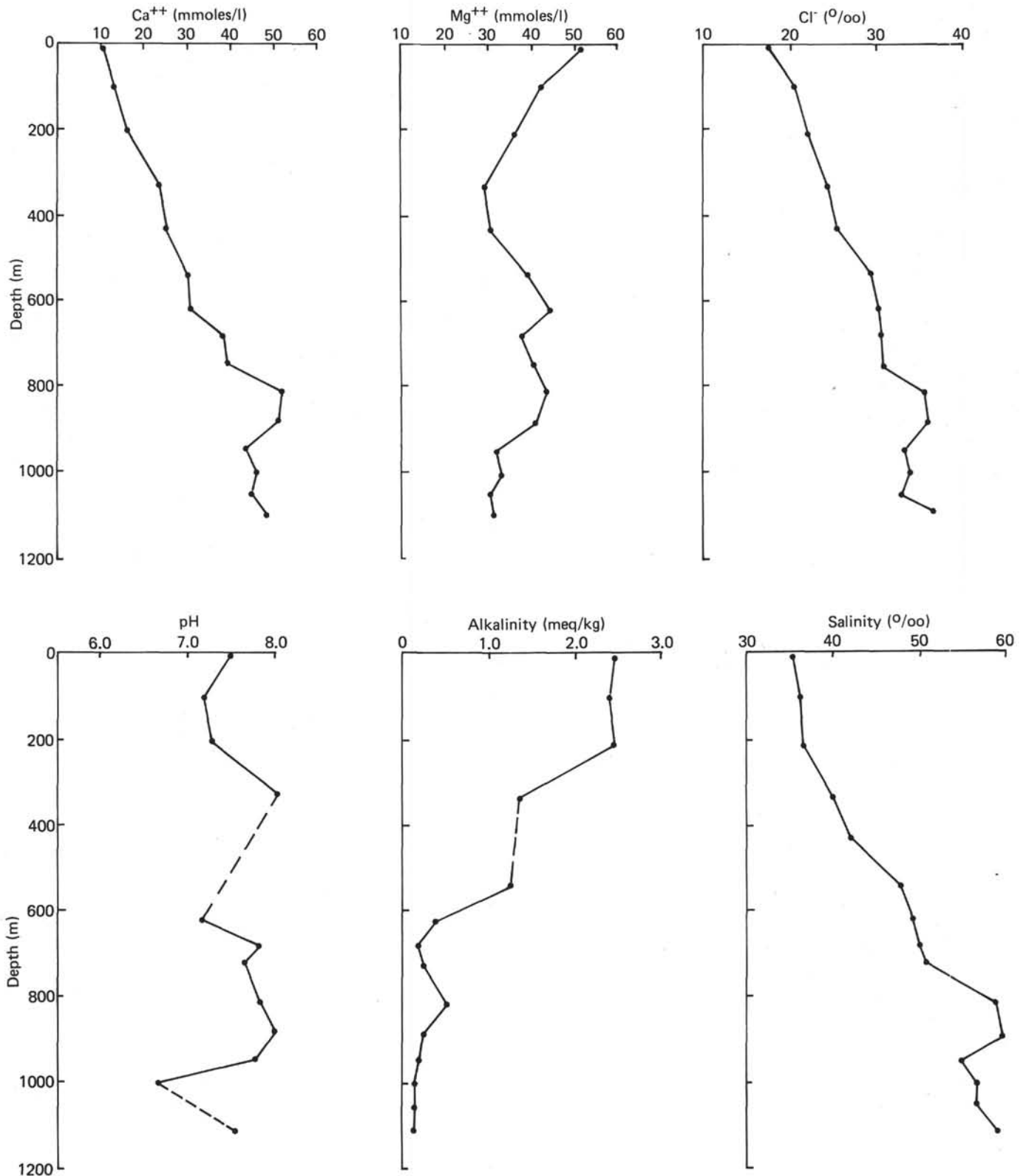


Figure 5. Plots of interstitial water analyses for Site 370.

Lower Cretaceous. The abundance of calcareous nannoplankton is high in Pliocene, upper Miocene, Paleocene, and Cretaceous sediments, however, in the other intervals this group is generally less abundant, and are absent from Cores 15, 26, and 29.

Radiolarians are present only in the middle Eocene through middle Miocene (cores 3 through 12). Preservation is good in the Miocene, moderate in the Oligocene, and poor in the Eocene. No identifiable radiolarians were observed in cores below Core 12.

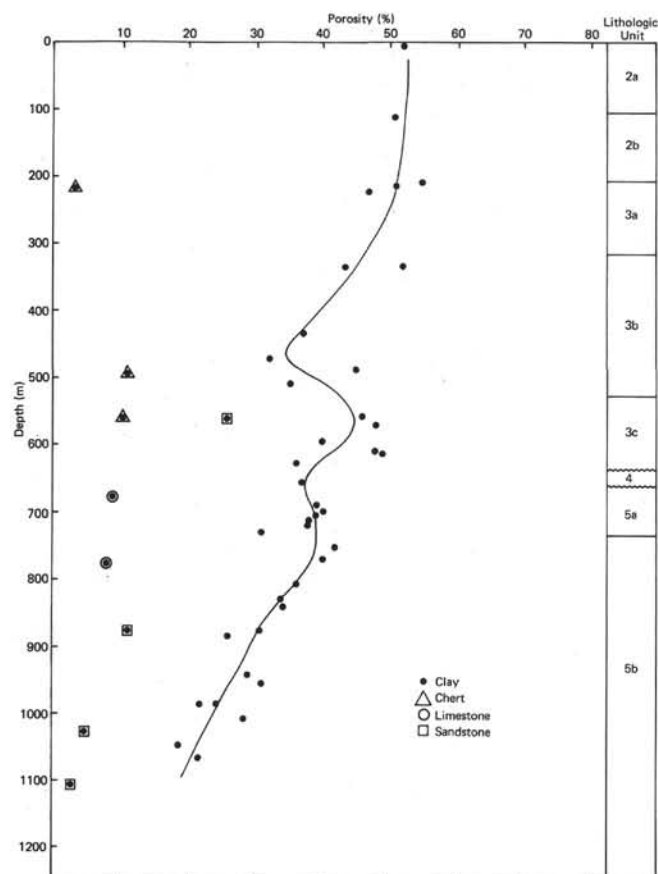


Figure 6. Plot of porosity versus depth for Site 370.

Cores 1 through 3 are characterized by mixed assemblages of all three principal microfossil groups. Admixtures of Miocene age are especially common. The microfossils in this unit show no signs of dissolution. Because of extensive mixing, the age of the sediments in this unit is based on the youngest identifiable forms.

Foraminifers

The biostratigraphy of the uppermost 430 meters of the section is poorly known because of spot coring. The intervals between the cored sections from 430 meters to the final depth of 1176.5 meters are small, and therefore a more detailed stratigraphic outline is given for this interval.

Cenozoic

Cores 1 through 3 are characterized by mixed foraminiferal assemblages of different ages and paleoenvironments. The ages therefore are determined by the findings of the youngest forms. Core 1 is Pleistocene in age as determined by the presence of *Globorotalia truncatulinoides*, *G. hessi*, *G. inflata*, *Globigerina rubescens* (pink), and *Globigerinoides ruber* (pink). The upper Miocene (or younger) is represented in Core 2 by *Globorotalia dutertrei*, *G. humerosa*, *G. acostaensis*, *Globigerina nepenthes*, and *Globigerinoides extremus*. The upper part of middle Miocene (or younger) is indicated in Core 3 by *Globigerina druryi*, *G. nepenthes*, *Globorotalia continuosa*, *G. siakensis*,

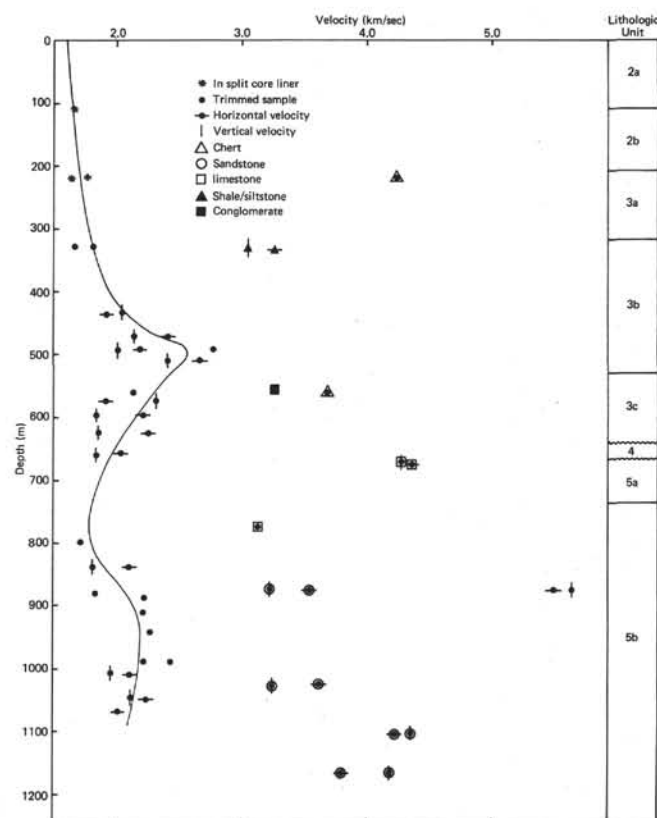


Figure 7. Plot of acoustic velocity versus depth for Site 370.

Orbulina suturalis, *Globigerinoides bisphaericus*. High abundance and good preservation occur in these cores and are probably associated with rapid burial of the foraminiferal shells. The benthic component of the foraminiferal fauna is less abundant, but contains representatives of different facies, including shallow-water inhabitants such as *Ammonia beccarii*. The lower Miocene (Sample 4, CC) is represented by *Globorotalia siakensis*, *Globigerina venezuelana*, *Globigerinita unicava*, and *Globoquadrina dehiscens*. The *Globorotalia opima opima* Zone of the upper Oligocene occurs in Core 5. Abundance and preservation of benthic species vary greatly in Core 6. They are common and well preserved in upper Oligocene sediments but they are missing in lower Miocene and upper Eocene sediments. Planktonic and benthic foraminifers are few to rare and mostly moderately preserved in Cores 7 through 18. The specific composition of middle Eocene planktonic foraminifers is poor and prevents a precise zonal subdivision of Cores 7 through 12. The assemblage in Cores 7 and 8 indicate the upper part of middle Eocene. Cores 9 through 12 contain *Globigerina boweri*, *G. senni*, *Acarinina bullbrookii*, *A. broedermanni*, *A. pentacamerata*, indicating an age of lower part of middle Eocene. The lower Eocene (Cores 13 through 18) is represented by its upper part *Globorotalia palmerae*-*Globorotalia aragonensis* zones. A hiatus occurs within Sample 18, CC corresponding to the lower part of the lower Eocene (*Globorotalia subbotinae*/*G. formosa formosa* zones).

Paleocene sediments of Sample 18, CC through Core 19 contain common foraminifers with moderate

preservation. Benthic foraminifers are common to few and diverse. Two zones are differentiated within the upper Paleocene: Core 18 has the *Globorotalia velascoensis* Zone and Core 19 has the *Globorotalia pseudomenardii* Zone. The middle Paleocene (Sample 19, CC) is represented by the upper part of the *Globorotalia pusilla* Zone. There is a pronounced hiatus between the lower Paleocene and the lower Cenomanian.

Mesozoic

A diverse and well-preserved assemblage of lower Cenomanian planktonic foraminifers occurs in Cores 20 through 26. The assemblage belongs to the *Rotalipora appeninica* Zone of the lower Cenomanian. Both calcareous and agglutinated species of benthic foraminifer are rare to few, but their generic composition is relatively diverse. Calcisphaerulids are also present. The main paleontological features of Cores 27 through 32 are planktonic foraminifers, benthic foraminifers, fish debris, and Calcisphaerulids. The amount of planktonic foraminifera is variable, some samples are extremely rich (i.e., Cores 36 and 37) whereas others are barren of planktonic foraminifers (i.e., Samples 27, CC and 28, CC) or contain only a few (i.e., Cores 29, 30, 33 through 35). Two stratigraphic subdivisions can be made. The Albian to upper Aptian is present in Cores 29 through 30 with *Hedbergella infracretacea*, *H. globigerinelloides*, *H. sp. Globigerinelloides gyroidinaeformis*, and Heterohelids. The lower Aptian? to Hauterivian? occurs in Cores 33 through 37 with *Hedbergella* aff. *infracretacea*, *H. aff. simplicissima*, *H. aff. ultramicra*, and some primitive species of *Hedbergella* and *Gubkinella*. The benthic foraminiferal fauna consists mainly of agglutinated and small-sized calcareous forms. Planktonic foraminifers are absent in Cores 38 through 51 with one exception; Sample 50, CC. All samples examined contain fish debris and rare benthic foraminifers with poor preservation. The benthic foraminifers in Core 44 are common and the preservation is moderate. The benthic foraminifers observed include: *Dorothia pre-hauteriviana*, some representatives of Lagenids (*Lenticulina*, *Astacolus*, *Dentalina*, *Nodosaria*, *Marginulina*, *Tristix*, *Fronicularia*, and *Saracenaria*), *Spirillina* and some species of agglutinated forms. Sample 50, CC contains a few pyritic casts of "*Globigerina*" cf. *oxfordiana*; a species which has been reported from the Oxfordian to lower Neocomian.

Calcareous Nannoplankton

The preservation of coccoliths in the upper part of Site 370 is generally poor to moderate and the abundances are few to common. The lower part shows generally moderate to good preservation and the abundances range from common to abundant.

Cenozoic

Core 1 contains the upper Pliocene *Discoaster tamalis* Subzone. Lower middle Miocene assemblages indicated by *Cyclococcolithina macintyreii*, *Discoaster exilis*, and *Sphenolithus heteromorphus* occur in Cores 2

and 3. The coccoliths of Core 4 are poorly diagnostic. Upper Oligocene floras were recovered in Core 5 which contains *Sphenolithus ciperoensis* and in Core 6 which contains rare *S. distentus*. Cores 7 through 14 contain *Reticulofenestra umbilica* and *Chiasmolithus solitus*, and belong to the middle Eocene *Reticulofenestra umbilica* Zone. *Discoaster lodoensis* and *Discoaster* sp. cf. *D. sublodoensis* (5- and 6-rayed) occur in Cores 16 to 18 which correlate with the upper lower Eocene. The *Discoaster multiradiatus* Zone was recognized in Sample 18, CC. Three coccolith zones were recognized in Core 19: *Heliolithus klempellii* Zone; *Fasciculithus tympaniformis* Zone with *Ericsonia supertusa* and *Chiasmolithus bidens*, and a level which is not older than the *Crucioplacolithus tenuis* Zone.

Mesozoic

The Cretaceous sediments in Samples 20-1, 70-71 cm through 51, CC can be divided into three intervals. Core 20 through Sample 26-3, 80-81 cm contain the *Eiffellithus turrisseiffeli* Zone which limits the age to not older than late Albian. The upper boundary is probably Turonian, based on the occurrence of *Parhabdololithus asper*, but the typical species for this age is missing. The second interval is the *Parhabdololithus angustus* Zone (late Aptian to early Albian), where *Parhabdololithus angustus* and *Lithastrinus floralis* were observed in Cores 28 through 31 and *Chiasozygus litterarius* Zone in Core 32; early Aptian in age. A Neocomian assemblage of coccoliths comprises the third interval (Cores 33, CC to 51). This 400-meter section of Neocomian is divided into three intervals:

- a) Barremian with *Nannoconus colomi* in Core 33 through Sample 34, CC;
- b) Late Hauterivian in Cores 35, Section 3, 70-71 cm to 38, Section 1, 91-92 cm with *Cruciellipsis cuvillieri* (upper level) and *Parhabdololithus infinitus* (lower level); and
- c) Late Valanginian to early Hauterivian in Sample 38, CC through Core 51. This interval has *Parhabdololithus dietzmannii* (lower level), *Parhabdololithus asper*, *Cruciellipsis cuvillieri*, and *Lithraphidites carniolensis*, but *Parhabdololithus infinitus* is missing.

Radiolarians

Site 370 contains identifiable radiolarians only within sediments of middle Eocene through middle Miocene (Cores 3 through 12) age. Early Cenozoic sediments (Paleocene and lower Eocene) contain poorly preserved radiolarian tests; almost all of the silica has been remobilized into chert, with only rare fragments remaining which resemble the original morphologies of the radiolarian skeletal material. Mesozoic sediments appear devoid of biogenous silica, or else the silica has been totally replaced.

Cenozoic

Radiolaria are absent in Cores 1 and 2. Core 3 contains sediments of probable middle Miocene age. A diverse and well-preserved radiolarian assemblage is present, but assignment of a precise zonal age is difficult because of extensive mixing of taxa whose

stratigraphic ranges do not overlap, but extend throughout the entire lower and middle Miocene. This apparent mixing may be either a result of processes of erosion and redeposition, or may be an artifact produced if sediment were allowed to enter the empty core barrel inadvertently within a "washed" interval. In either case the faunal assemblages in the Miocene cores at this site have no biostratigraphic significance, and the age assignments are only approximate. Core 3 is assigned to the *Stichocorys wolffii* Zone. Numerous Miocene species are present, including one specimen each of *Calocyclus costata* and *Dorcadospyrus alata*. These two middle Miocene forms are presumed to be down-hole contaminants because of their low abundance, although the possibility cannot be ruled out that they are in place. Core 4 contains abundant diatoms, with a few well-preserved radiolarians which suggest a lower Miocene age (*Stichocorys delmontensis* Zone). The calcite-free coarse fraction in Core 5 is principally sponge spicules but rare radiolarians of upper Oligocene age (*Dorcadospyrus ateuchus* Zone) are present. Cores 6 through 9 contain very poorly preserved radiolarian fragments of middle to late Eocene age, including the genera *Theocampe*, *Lithocyclia*, and *Stylosphaera*. Core 10 belongs to the middle Eocene *Theocampe triacantha* Zone. Core 12 is of earliest middle Eocene age, based on rare specimens of *Theocampe amphora* and one specimen resembling the early morphotype of *Theocampe mongolfieri*. Numerous poorly preserved spongidiscids were also observed in Core 12, but none were sufficiently preserved for exact identification. No identifiable radiolarians were observed in core-catcher samples from below Core 12. The Cenozoic silica accumulation record closely resembles that of the other Leg 41 sites and the Leg 14 sites: rare to common siliceous microfossils in middle Eocene to middle Miocene sediments; chert and poorly preserved radiolarian debris in Paleocene and lower Eocene sediments; and no biogenous silica in upper Miocene through upper Pleistocene sediments.

Conclusions

The following interpretation can be drawn from the biostratigraphic record at Site 370:

- 1) There is a comparatively low abundance of calcareous microfossils, except for the Cenomanian, which indicates deep-water conditions. Many species of calcareous fossils, but particularly the foraminifers, are partially dissolved.
- 2) Substantial hiatuses are present in Sample 18, CC, where two lower Eocene foraminiferal zones are absent. Another unconformity exists between the lower Cenomanian and Paleocene, where practically the entire Upper Cretaceous and lower Paleocene are missing. Other significant gaps may be present in the sparsely cored interval of Eocene through Pleistocene age, but these gaps, if present, cannot be resolved with the limited number of cores available.
- 3) Pleistocene turbidites contain a mixture of planktonic foraminifers of different ages and the benthic foraminifers represent different paleoenvironments. Tertiary and Cretaceous turbidites contain no

mixed assemblages of the planktonic and of the benthic foraminiferal faunas.

ACCUMULATION RATES

The calculations of accumulation rates are based on the stratigraphy by planktonic foraminifers, nannofossils, and radiolarians and on the absolute age scales mentioned in previous site chapters (366, 367). Due to large uncored intervals, and due to turbidites in the few cores drilled, relevant accumulation rates cannot be given for the topmost 450 meters of the hole, i.e., Pleistocene to latest Miocene. No attempt has been made to correct the accumulation rates for the effects of compaction.

Accumulation rates during nearly the entire Eocene are as high as 35 m/m.y. (Figure 8). The mean accumulation rate for the middle Paleocene is as low as about 4 m/m.y. There is a hiatus between Samples 19, CC and 20, CC, representing a time interval from Paleocene to upper Cenomanian of about 35 m.y. The accumulation rates during the Cenomanian were at least 18 m/m.y., because the top of the Cenomanian is missing. There is a decrease in mean accumulation rates during the Aptian to Albian time interval to 12 m/m.y., whereas the Neocomian mean accumulation rates were much higher. They cannot be accurately determined in the absence of any significant change in age in the lowermost part of the hole. Therefore the rate of 25 m/m.y. indicated on the figure is a minimum.

CORRELATION OF SEISMIC REFLECTION PROFILES WITH DRILLING RESULTS

The correlation of the seismic data with the drilling results is established from a combined use of the Lamont-Doherty *Vema 30* reference profile (see Figure 2) and the *Glomar Challenger* profile recorded while approaching the site (see Figure 4). The *Glomar Challenger* profile was recorded at higher frequency settings than the Lamont one and shows a better definition in the upper layers. The penetration, however, does not exceed about 0.9 sec, whereas it reaches about 3 sec on the Lamont profile. On the other hand, because of the very low frequency used on the latter, the upper section is very difficult to decipher. Figure 9 integrates the data of both profiles.

The acoustic section at the site consists of the following reflectors: a double reflector at 0.2 and 0.3 sec below the sea floor, another double reflector at 0.5 and 0.6 sec, a relatively sharp but faint reflector at 0.85 sec, and a series of 4 to 5 deep, badly defined reflectors corresponding to layers that could not be reached by drilling. The uppermost of these deep reflectors, at 1.2 sec is believed to be reflector C, one of the primary targets for Site 370. The lowermost very faint reflector at about 3.0 sec exhibits a rough topography and is tentatively interpreted as oceanic basement.

The first two reflectors, at 0.2 and 0.3 sec, respectively, fall into unsampled intervals. If interval velocities of about 1.6 to 1.7 km/sec are assumed for the overlying sediments, the first reflector should correspond with layers lying at about 160 to 170 meters. If we apply velocities of about 1.65 to 1.8 km/sec for the sediments between the sea floor and the second

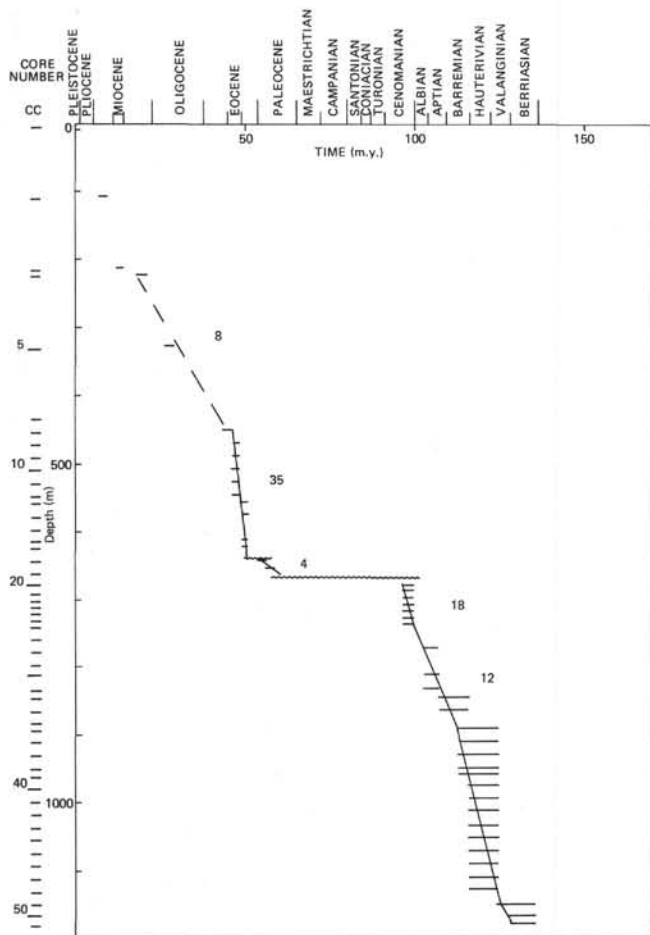


Figure 8. Plot of average accumulation rates for Site 370.

reflector, then the latter should correspond with sediments at 250 to 270 meters below the bottom.

The third reflector, at 0.5 sec, correlates well with an abrupt change in sound velocities and porosities recorded at about 460 meters below the sea floor. At the same level (Figures 6 and 7), an increase in porcellanite content and the occurrence of several cemented conglomerate layers might also be correlated with the reflector. This correlation implies average interval velocities of about 1.84 km/sec for the overlying sediments (from the sea floor) which are in good agreement with the values measured on samples.

The fourth reflector, at 0.6 sec, correlates with a substantial increase in chert and porcellanite recorded at about 580 meters subbottom. Such a correlation implies velocities of 1.93 km/sec for the layers between the fourth and the third reflector. Again these values are in good agreement with the one measured on the samples.

The last reflector present in the interval sampled at this site lies at 0.85 sec. It appears to correlate with the youngest occurrence of well-cemented, several centimeters thick, sandstone and siltstone beds. The first of these beds are recorded at about 835 meters but the thickest one lies at about 860 meters below the sea floor. Therefore the correlation cannot be established too precisely. Such a correlation gives interval average

velocities of 1.96 to 2.02 km/sec for the complete overlying section and 2.04 to 2.24 km/sec for the interval between the fourth reflector and this one, which is in acceptable agreement with the measured values if we consider that this interval exhibits several values below 2.0 km/sec (Figure 7).

The reflector at about 1.2 sec was not reached and might correspond with layers as deep as 1260 meters if a velocity of 2.3 km/sec is applied to the interval between the fifth reflector and this lowermost one.

SUMMARY AND CONCLUSIONS

Site 370 is located at the base of a relatively poorly developed continental rise, in the deep-water basin off Cape Santin, Morocco.

The thick sedimentary section visible on the seismic profiles (Figures 2 and 4) was sampled down to a total penetration of 1176.5 meters. The upper part, down to about 420 meters was very sparsely cored and, from that level down to the total depth, coring was regularly spaced by alternating coring and drilling every 9.5 meters. A total of 51 cores were recovered representing 202.7 meters out of the 483 meters attempted (41.2%).

The operations were plagued by a succession of minor incidents, such as a one-day delay due to bad weather, occasional plugging of the bit that had to be freed twice with the use of a center bit, malfunction of the flapper valve, weakening beacon signal, extremely low rates of penetration in sticky clays and cemented siltstone and sandstones. Nevertheless, the drill bit performed well during a record time of 121.59 hr of actual rotation on the bottom of the hole. The hole had to be abandoned only because of time constraints at the end of this cruise, after having reached sediments of lower Cretaceous age.

The section as a whole is monotonous and consists predominantly of marls and clays with abundant coarser terrigenous detritus almost constantly present throughout (Figure 10). The nature of the sediments was somewhat unexpected and reflects an evolution different from the basin located south of the Canary Islands-Atlas zone.

MOST SIGNIFICANT RESULTS

Terrigenous Character of the Sediments

The sediments display regular successions of turbidite sequences occasionally separated by pelagic intervals. Other redeposition features probably of more proximal character, are flow and current structures, and slumps (up to 80 cm thick) particularly in the Lower Cretaceous layers. Associated with the slump structures and the current structures are convoluted silt and sand beds, 'floating' pebbles in fine-grained slumped sediments, and current ripples. All these structures suggest deposition on a deep-sea fan and are typical of lower continental rise environments.

The composition of the terrigenous components does not seem constant throughout the section. During the Cretaceous and during the Neogene, siltstones and sandstones are mainly composed of quartz, possibly reflecting very active erosion on land. During the

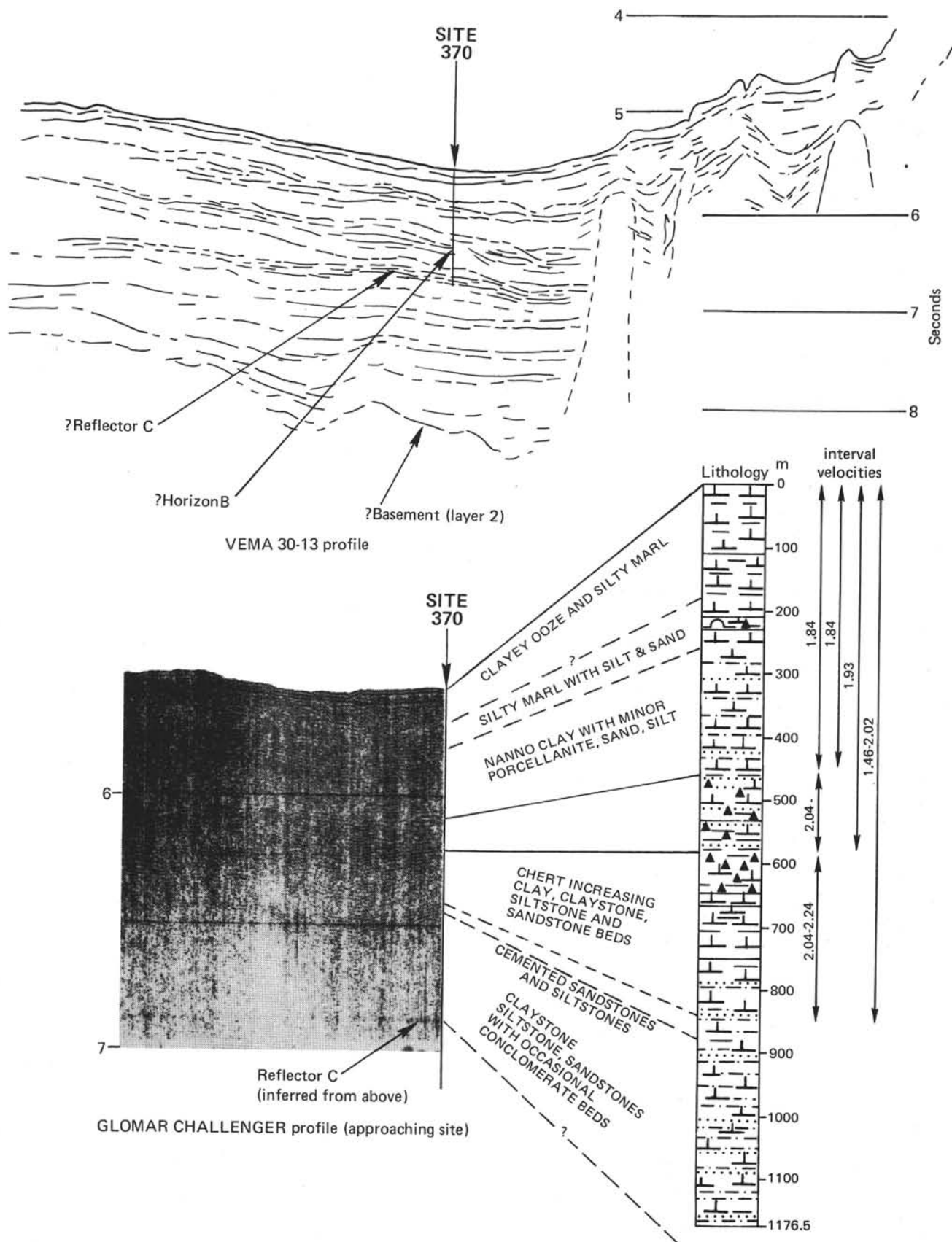


Figure 9. Correlation of seismic-reflection profile with drilling results at Site 370. Top profile is from Vema 30 and lower one is Glomar Challenger 41.

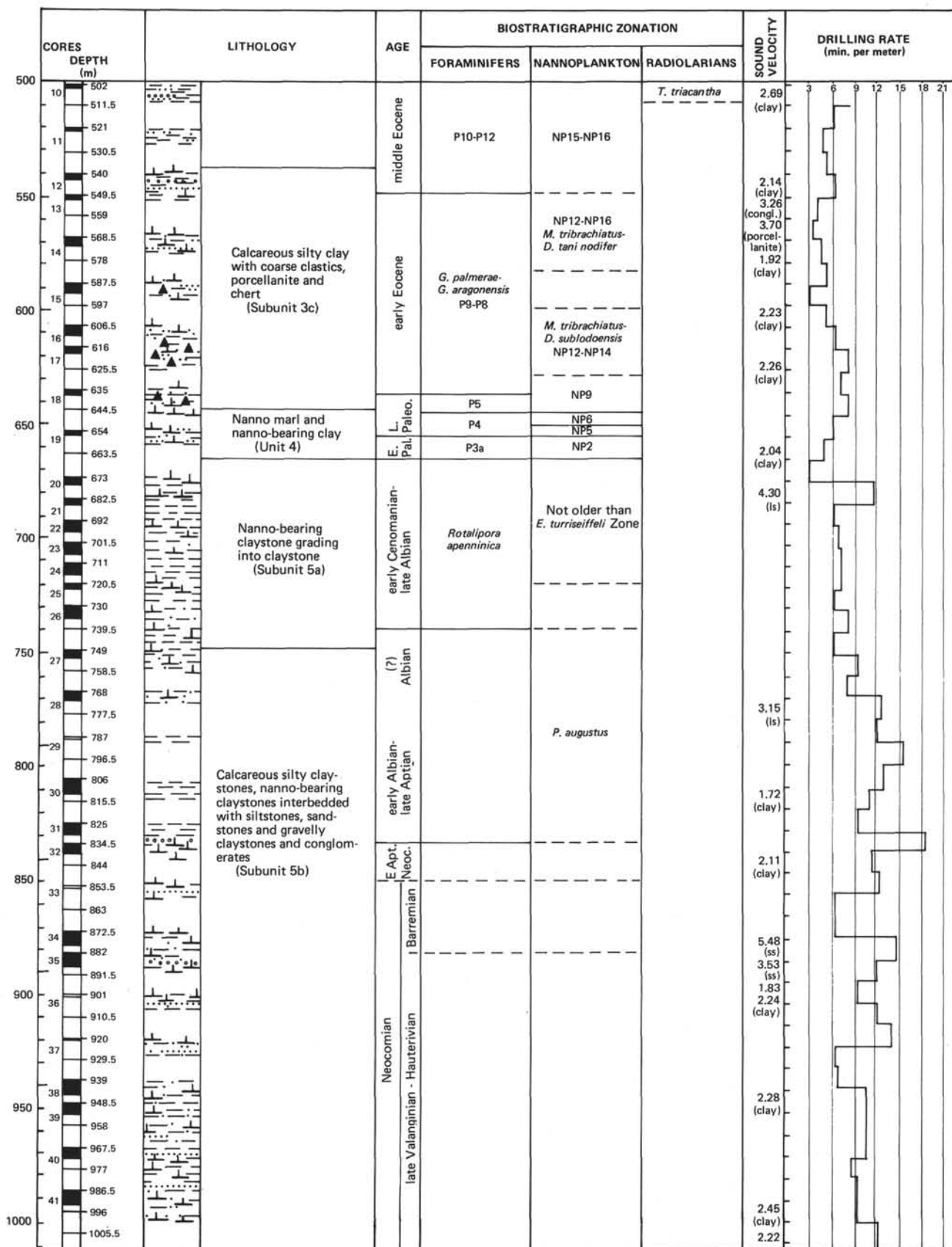


Figure 10. (Continued)

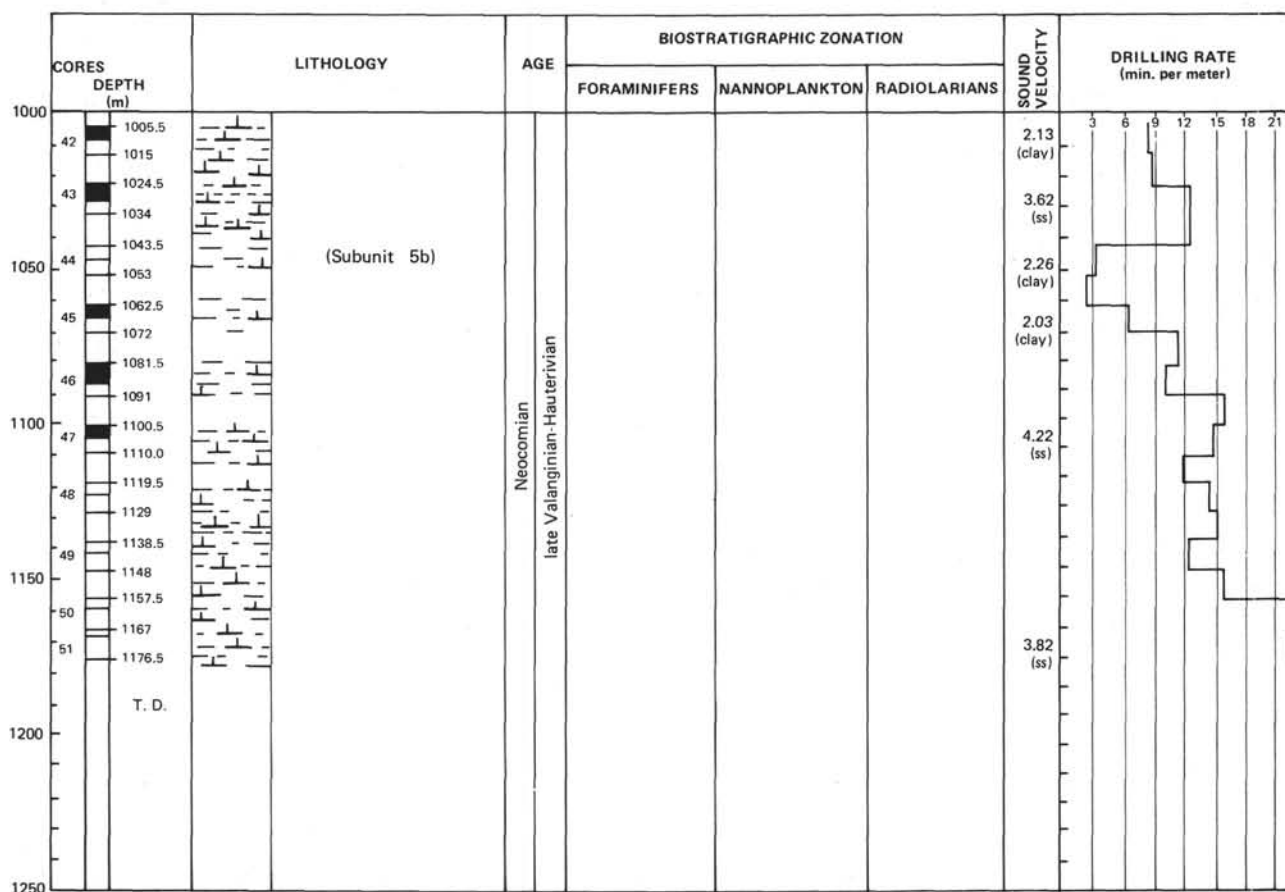


Figure 10. (Continued).

Eocene the composition of the coarse-grained sandstones and conglomerates is different and consists mainly of redeposited clay and mud pebbles, porcellanite fragments, detrital biogenic material and very abundant glauconite. The origin of this material is not clear. It might have come from the nearby continental rise, slope, or shelf, and redeposition could have been triggered by the orogenic phase responsible for the building of the Atlas Mountain in the Eocene. However, it might also be related to the Eocene uplift of seamounts northwest and west of Site 370 associated with active tectonics in the Azores-Gibraltar zone (see Site 135, Leg 14, Hayes, Pimm, et al., 1972).

The sedimentary section at this site, especially the lower part, is different from that sampled in the Cape Verde Basin at Site 367. The most striking difference is the permanence at Site 370 of coarse terrigenous deposits. At Site 367 these sediments were only represented by silty clays in the Late Cretaceous and Tertiary and coarse terrigenous material was essentially restricted to the Pliocene and Pleistocene. This main difference might be explained by the proximity of the Atlas zone, and its tectonic history; the absence or small size of coastal basins in western Morocco; or different climatic environments. It seems that the combination of tectonics and erosion in the Atlas zone could have played a major role in the supply of terrigenous material. Because Site 370 lies close to the westernmost end of the west-southwest-east-northeast

trending Atlas parallel mountain ranges and troughs, we might invoke lateral transportation of the coarse-grained terrigenous material parallel to this trend as is observed for the flysch basins in the Alps and in the western north and eastern south Pyrenean chain. The terrigenous deposits of Site 370 might represent the western lateral equivalent of the Early Cretaceous deep water marls and marly limestones of the Tell and Atlas "geosyncline" facies.

A hiatus of 35 m.y. is observed between the late Cenomanian and the middle Paleocene so that most of the Late Cretaceous is missing. The absence of facies change between the layers found above and below the hiatus suggests that erosion might be largely responsible for this gap. If we assume that during the time corresponding to the hiatus the rates of accumulation were the same as the ones observed above and below, a total of approximately 200-400 meters of sediments might have been removed. No physical property changes, hence no seismic reflector was found to account for the hiatus, possibly because sediment overburden erased these effects through compaction and diagenetic lithification of the sediments. It is interesting to note that a very comparable hiatus was observed in the North American Basin (Site 105, Hollister, Ewing, et al., 1972) where it is attributed to erosion by bottom currents. Naturally, if erosion was the main factor, it might have been aggravated by low sediment input in the basin during the Late Cretaceous.

Because of the great water depth and to a probable high level of the CCD (suggested, at least in the North American Basin, by absence of carbonate in the sediments resting directly on oceanic crust of Early-Late Cretaceous age at Site 9, Leg 2), the biogenous input should have been greatly reduced. The terrigenous input might also have been reduced as suggested by the occurrence of Late Cretaceous pelagic calcareous shales devoid of coarse terrigenous detritus in the Tethyan Trough.

As at previous sites, an increase in the carbonate content of the sediment occurs around the middle Miocene. It is not very well documented at this site, however, because the upper part of the hole was only poorly sampled.

The early Cretaceous sediments are also different from those sampled in the Cape Verde Basin and Rise areas as well as in the North American Basin. The black shales are absent in the basins off Morocco. The clays and silty clays, however, are dark colored in the Aptian-Cenomanian interval and the organic carbon content reaches 5% in some samples. This difference might only reflect the larger terrigenous input observed at this site. It is also possible that bottom circulation and/or supply of organic material were different in the Moroccan area. This would imply some basin differentiation possibly caused by the presence of physiographical barriers between the northern and southern basins. More detailed studies of these sediments will be required in order to establish if the darker layers at this site represent merely a diluted counterpart of the black shales or if different environmental conditions did exist in that northern area during the Early Cretaceous.

Diagenesis

Diagenesis in the sediments shows two interesting peculiarities: first the cementation of sandstone and siltstone layers by calcite, and second, the occurrence of barite rosettes, partially replaced by calcite, in Cenomanian claystones (see Dean and Schreiber, this volume). The cementation of sandstone beds by calcite is a very general phenomenon on land and is generally attributed to circulation of CO₂-rich meteoric waters. Deep-sea sandstones are often poorly lithified or cemented by silica when found under moderate overburden. Here, they are cemented by well-crystallized calcite. These well-cemented beds occur below about 850 meters subbottom. It is particularly interesting to note that, under the same overburden in carbonate sediments, sparry calcite recrystallization has been observed at other DSDP sites (see for example Site

167, Leg 17, Schlanger et al., 1973). The origin of the calcite cement is not clearly determined. It might result from partial dissolution of calcareous microfossils and preferential recrystallization in the more porous beds. The source of the calcite, however, might, as proposed for calcite cementation at Site 369, result from upward or lateral migration of solutions rich in calcium carbonate originating from nearby evaporites. The presence at this site, as at Site 369, of barite rosettes partially replaced by calcite might also be related to similar processes.

Reflectors

The correlation between drilling results and the seismic reflection profile is relatively well established at this site (Figure 9). It indicates that one of our major objectives at this site, reflector C, lying at about 1.2 sec below the bottom proved to be out of reach because of time limitations. The overlying reflectors correlate with slight changes in lithology that are well documented by physical property variations. No reflector was found to correspond with the major Cenomanian-Paleocene hiatus, and this might come from diagenetic equilibration of the physical properties above and below the hiatus because of relatively high overburden. Because no limestones were encountered in the Neocomian layers, it is possible that the top of basal carbonate layers correspond with reflector C at 1.2 sec. This would tentatively indicate an approximate Late Jurassic age for the time at which subsidence would have brought the sea floor into higher dissolution environments.

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* = minor lithology

SMear SLIDE SUMMARY

SITE 370

Page 1 of 4

KEY | RARE
COMMON
ABUNDANT
DOMINANT

5 - 25
25 - 75
75 - 100

< 5 %

| HOLE | EXOGENIC | | | | | AUTHIGENIC-DIAGENETIC | | | | | | | | | | BIOGENIC | | | | | | | | | |
|------|-----------------------------------|--------------------|-----------|-------------------|----------------|-----------------------|------------|-----------------|------------|----------|--------|-------------------------|-------------------|--------|-----------------------|--------------------------|---------------------|-------------------|--------|------------|---------|--------------------|-------------|------------------------|----------------------|
| | CORE SECTION INTERVAL cm | Detrital QUARTZ | FELDSPARS | HEAVY MINERALS | LIGHT GLASS | DARK GLASS | GLAUCONITE | CLAY MINERAL | PALAGONITE | ZEOLITES | GYPSUM | amorphous IRON OXIDE | MICRO- NODULES | PYRITE | recrystall. SILICA | Carbonate unspecified | Carbonate rhombs | FORAM- INIFERS | NANNOS | RADIOLARIA | DIATOMS | SPONGE SPICULES | FISH DEBRIS | SILICOFLAG- ELLATES | Pollen and Spores |
| * | 1-1, 120 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1-2, 30 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1, CC | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2-1, 120 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2-2, 50 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2-2, 73 | | | | | | | | | | | | | | | | | | | | | | | | |
| * | 2-2, 120 | | | | | | | | | | | | | | | | | | | | | | | | |
| * | 2-2, 130 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2, CC | | | | | | | | | | | | | | | | | | | | | | | | |
| | 3-1, 11 | | | | | | | | | | | | | | | | | | | | | | | | |
| * | 3-1, 23 | | | | | | | | | | | | | | | | | | | | | | | | |
| * | 3-1, 87 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 3-2, 65 | | | | | | | | | | | | | | | | | | | | | | | | |
| * | 3-2, 110 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 3, CC | | | | | | | | | | | | | | | | | | | | | | | | |
| | 4-1, 128 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 4-1, 139 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 4-2, 106 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 4-4, 67 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 5-1, 110 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 5-2, 60 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 5-4, 20 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 5-4, 50 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 6-1, 63 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 6-2, 73 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 7-2, 70 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 7, CC | | | | | | | | | | | | | | | | | | | | | | | | |
| | 8-1, 125 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 8-2, 114 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 8, CC | | | | | | | | | | | | | | | | | | | | | | | | |
| | 9-1, 93 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 9, CC | | | | | | | | | | | | | | | | | | | | | | | | |
| | 10-2, 20 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 10, CC | | | | | | | | | | | | | | | | | | | | | | | | |
| * | 12-2, 10 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 12-2, 100 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 13-2, 50 | | | | | | | | | | | | | | | | | | | | | | | | |
| * | 13-2, 56 | | | | | | | | | | | | | | | | | | | | | | | | |
| * | 13-2, 97 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 13, CC | | | | | | | | | | | | | | | | | | | | | | | | |
| | 14-1, 76 | | | | | | | | | | | | | | | | | | | | | | | | |
| * | 14-2, 122 | | | | | | | | | | | | | | | | | | | | | | | | |
| * | 14-4, 108 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 15-2, 93 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 16-1, 138 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 16-1, 146 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 16-2, 98 | | | | | | | | | | | | | | | | | | | | | | | | |

* = minor lithology

SMEAR SLIDE SUMMARY

SITE 370

Page 2 of 4

KEY RARE
COMMON
ABUNDANT
DOMINANT

25%
50%
75%
100%

< 5%
5-25%
25-75%
75-100%

| HOLE | | EXOGENIC | | | | | AUTHIGENIC-DIAGENETIC | | | | | | | | | | BIOGENIC | | | | | | | | | |
|--------------|----------------|--------------------|-----------|-------------------|----------------|------------|-----------------------|-----------------|------------|----------|--------|-------------------------|-------------------|--------|-----------------------|------------------------|---------------------|-------------------|--------|------------|---------|--------------------|-------------|------------------------|----------------------|--|
| CORE SECTION | INTERVAL cm | Detrital QUARTZ | FELDSPARS | HEAVY MINERALS | LIGHT GLASS | DARK GLASS | GLAUCONITE | CLAY MINERAL | PALAGONITE | ZEOLITES | GYPSUM | amorphous IRON OXIDE | MICRO- NODULES | PYRITE | recrystall. SILICA | recrystall. CALCITE | Carbonate rhombs | FORAM- INIFERS | NANNOS | RADIOLARIA | DIATOMS | SPONGE SPICULES | FISH DEBRIS | SILICOFLAG- ELLATES | Pollen and Spores | |
| 17-1, 147 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 17-2, 16 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 18-2, 93 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 18-2, 100 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 18, CC | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * 19-1, 84 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * 19-1, 92 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 19-1, 132 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 20-1, 126 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * 20-2, 115 | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 21-1, 131 | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 22-2, 48 | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 23-2, 50 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * 23-4, 64 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * 23-4, 109 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 23-4, 129 | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 24-1, 114 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 24-2, 102 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * 24-3, 28 | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 25-2, 63 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25-2, 126 | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 26-2, 127 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * 26-3, 70 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 26-4, 108 | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 28-1, 110 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * 28-3, 94 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * 28-3, 142 | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 29-1, 117 | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 30-1, 85 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * 30-1, 105 | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 31-4, 42 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 31-1, 68 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * 31-1, 87 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * 31-1, 146 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * 31-2, 52 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * 31-4, 59 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 32-1, 108 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 32-4, 25 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * 32-2, 82 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * 32-4, 97 | | | | | | | | | | | | | | | | | | | | | | | | | | |
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SMEAR SLIDE SUMMARY

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| * | 34-2, 65 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 34-2, 80 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | 35-2, 56 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * | 35-2, 105 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 35-3, 70 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 35-4, 74 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 35-5, 64 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | 38-3, 26 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * | 38-3, 70 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * | 38-4, 24 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| * | 39-1, 102 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * | 39-2, 27 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 39-2, 47 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | 41-1, 37 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 41-1, 54 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| * | 42-4, 38 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| * | 43-2, 82 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * | 43-2, 111 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * | 43-3, 41 | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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Site 370 Hole Core 3 Cored Interval: 207.5-217.0 m

| AGE | ZONES | FOSSIL CHARACTER | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|----------------|-------------------------|------------------|---------|--------|-----------|-------------|---------------|---|
| | FORMS NANNOS RADS | FOSSIL ABUND. | PRES. | | | | | |
| MIDDLE MIOCENE | | | | 0 | | | | |
| | | | | 0.5 | VOID | | 11 | INTERBEDDED NANNO MARL AND CALCAREOUS PYRITIC GLAUCONITIC SANDY CLAY WITH LAYERS OF NANNO-RAD-BEARING CLAY. |
| | | | | 1.0 | N R | | 23 | NANNO MARL, greenish gray (5G 6/1), stiff, slight drilling disturbance, bioturbated with light gray (N7). At the base of each nanno marl layer is a CALCAREOUS PYRITIC GLAUCONITIC SANDY CLAY, grayish olive (10Y 6/2), soft, slight drilling disturbance, probably TURBIDITES. |
| | | | | 1.0 | N R | | 87 | |
| | | | | 1.0 | N R | | 10Y 6/2 | |
| | | | | 1.0 | N R | | 10Y 6/2 | |
| | | | | 2 | N R | | 65 | NANNO-RAD-BEARING CLAY, greenish gray (5G 6/1). |
| | | | | 2 | N R | | 110 | Interbeds are 20 to 30 cm thick with the turbidites about 5 cm thick. |
| | | | | 2 | N R | | CC | SS at 1-23 (minor lithology) |
| | | | | | | | | Quartz C Carbonate rhombs R |
| | | | | | | | | Clay A Forams, Nannos R |
| | | | | | | | | Glaucinite R Carbonate R |
| | | | | | | | | Pyrite C unspecified C |
| | | | | | | | | Rads R |
| | | | | | | | | SS at 1-87 (dominant lithology) |
| | | | | | | | | Quartz R Clay A |
| | | | | | | | | Glaucinite R Micronodules R |
| | | | | | | | | Zeolites R Carbonate R |
| | | | | | | | | Carbonate rhombs R unspecified R |
| | | | | | | | | Forams R Nannos C |
| | | | | | | | | Diatoms R Rads C |
| | | | | | | | | Sponge spicules R Silicoflagellates R |
| | | | | | | | | SS at 2-65 (dominant lithology) |
| | | | | | | | | Quartz R Clay C |
| | | | | | | | | Glaucinite R Carbonate R |
| | | | | | | | | Carbonate rhombs R unspecified R |
| | | | | | | | | Nannos D Rads R |
| | | | | | | | | Sponge spicules R Silicoflagellates R |
| | | | | | | | | SS at CC |
| | | | | | | | | Quartz R Heavy minerals R |
| | | | | | | | | Clay A Micronodules R |
| | | | | | | | | Carbonate R Forams R |
| | | | | | | | | unspecified C Nannos C |
| | | | | | | | | Rads C Diatoms R |
| | | | | | | | | Sponge spicules C |
| | | | | | | | | Carbonate Bomb: 1-64 to 65 cm = 23% |
| | | | | | | | | 1-109 to 110 cm = 60% |
| | | | | | | | | CARBON-CARBONATE |
| | | | | | | | | 1-61 (5.6-0.2-45) |
| | | | | | | | | 1-103 (8.0-0.1-66) |
| | | | | | | | | GRAIN SIZE |
| | | | | | | | | 1-70 (3.1-35.8-61.1) Silty clay |
| | | | | | | | | 1-111 (0.8-33.1-66.1) Silty clay |

Site 370 Hole Core 4 Cored Interval: 217.0-226.5 m

| AGE | ZONES | FOSSIL CHARACTER | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---------------|-------------------------|------------------|---------|--------|-----------|-------------|---------------|---|
| | FORMS NANNOS RADS | FOSSIL ABUND. | PRES. | | | | | |
| EARLY MIOCENE | | | | 0 | | | | INTERBEDDED NANNO RAD BEARING CLAY, RAD BEARING CLAY, AND NANNO MARL WITH MINOR SILT SAND AND CHERT. |
| | | | | 0.5 | VOID | | | NANNO-RAD-BEARING CLAY, light olive gray (5Y 5/2), stiff, slight drilling disturbance, burrowed. |
| | | | | 1.0 | N R | | 128 | RAD-BEARING CLAY, pale green (10G 6/2), firm, slight drilling disturbance. |
| | | | | 1.0 | N R | | 139 | NANNO MARL, light greenish gray (5GY 8/1), firm, slight drilling disturbance, bioturbated. |
| | | | | 1.0 | N R | | 106 | Interbedded SILT and SAND - probably turbidites in Section 3. CHERT nodules occur near the top of the core. |
| | | | | 2 | N R | | 5Y 5/2 | SS at 1-128 (dominant lithology) |
| | | | | 2 | N R | | 5Y 5/2 | Quartz R Heavy minerals R |
| | | | | 2 | N R | | 5Y 5/2 | Clay A Micronodules R |
| | | | | 2 | N R | | 5Y 5/2 | Zeolites R Carbonate R |
| | | | | 2 | N R | | 5Y 5/2 | Carbonate rhombs R unspecified R |
| | | | | 2 | N R | | 5Y 5/2 | Nannos C Diatoms R |
| | | | | 2 | N R | | 5Y 5/2 | Rads C Sponge spicules R |
| | | | | 3 | N R | | 5Y 5/2 | SS at 1-139 (dominant lithology) |
| | | | | 3 | N R | | 5Y 5/2 | Quartz R Heavy minerals R |
| | | | | 3 | N R | | 5Y 5/2 | Clay A Glaucinite R |
| | | | | 3 | N R | | 5Y 5/2 | Zeolites R Carbonate R |
| | | | | 3 | N R | | 5Y 5/2 | Carbonate rhombs R unspecified R |
| | | | | 3 | N R | | 5Y 5/2 | Nannos R Diatoms R |
| | | | | 3 | N R | | 5Y 5/2 | Rads C Sponge spicules R |
| | | | | 3 | N R | | 5Y 5/2 | Fish debris R |
| | | | | 4 | N R | | 5Y 5/2 | SS at 2-106 (dominant lithology) |
| | | | | 4 | N R | | 5Y 5/2 | Quartz R Zeolites R |
| | | | | 4 | N R | | 5Y 5/2 | Clay A Carbonate rhombs R |
| | | | | 4 | N R | | 5Y 5/2 | Glaucinite R Nannos A |
| | | | | 4 | N R | | 5Y 5/2 | Micronodules R Diatoms R |
| | | | | 4 | N R | | 5Y 5/2 | Carbonate R Rads R |
| | | | | 4 | N R | | 5Y 5/2 | unspecified R Sponge spicules R |
| | | | | 4 | N R | | 5Y 5/2 | SS at 4-67 (dominant lithology) |
| | | | | 4 | N R | | 5Y 5/2 | Quartz R Clay A |
| | | | | 4 | N R | | 5Y 5/2 | Glaucinite R Micronodules R |
| | | | | 4 | N R | | 5Y 5/2 | Zeolites R Carbonate R |
| | | | | 4 | N R | | 5Y 5/2 | Fish debris R unspecified R |
| | | | | 4 | N R | | 5Y 5/2 | Carbonate rhombs R Forams R |
| | | | | 4 | N R | | 5Y 5/2 | Nannos C Diatoms R |
| | | | | 4 | N R | | 5Y 5/2 | Rads C Sponge spicules R |
| | | | | 4 | N R | | 5Y 5/2 | Carbonate Bomb: 3-49 to 50 cm = 24% |
| | | | | 4 | N R | | 5Y 5/2 | CARBON-CARBONATE |
| | | | | 4 | N R | | 5Y 5/2 | 3-51 (4.3-0.9-28) |

Explanatory notes in Chapter 1

Site 370 Hole Core 5 Cored Interval: 321.5-331.0 m

| AGE | ZONES | | | FOSSIL CHARACTER | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---------------|--------|--------|------|------------------|---------|--------|-----------|-------------|---------------|---|
| | FORAMS | NANNOS | RADS | | | | | | | |
| OLIGOCENE | | | | | | 0 | | | | INTERBEDDED CALCAREOUS SILTY CLAY, SILTY CLAY, AND SANDY NANNO MARL WITH OCCASIONAL TURBIDITES. |
| | | | | | | 0.5 | VOID | | | |
| | | | | | 1 | 1.0 | | | | CALCAREOUS SILTY CLAY, olive gray (5Y 4/1), firm, slight drilling disturbance, bioturbated, laminated. |
| | | | | F | R | P | | | | 5Y 4/1 |
| | | | | | | | | | 110 | |
| | | | | | | | | | | 5G 6/1 |
| | | | | | | | | | | 5Y 4/1 |
| | | | | | | | | | | 5G 6/1 |
| | | | | F | R | P | | | 60 | SANDY NANNO MARL, greenish gray (5G 6/1), firm, slight drilling disturbance, massive, basal A units of TURBIDITE. |
| | | | | | | | | | | 5Y 4/1 |
| | | | | | | | | | | Glauconitic SAND (1 to 2 cm thick) occur at Section 5-30 cm and Section 6-5 cm. |
| | | | | | | | | | | 5G 6/1 |
| ? LATE EOCENE | | | | | | | | | | SS at 1-110 (dominant lithology) |
| | | | | | | | | | | Quartz R Heavy minerals R |
| | | | | | | | | | | Clay A Glauconite R |
| | | | | | | | | | | 5Y 4/1 |
| | | | | | | | | | | 5G 6/1 |
| | | | | | | | | | | Micronodules R Carbonate |
| | | | | | | | | | | 5Y 4/1 |
| | | | | | | | | | | Carbonate rhombs R unspecified C |
| | | | | | | | | | | 5G 6/1 |
| | | | | | | | | | | Forams R Nannos R |
| | | | | | | | | | | Rads R Sponge spicules R |
| | | | | | | | | | | Fish debris R |
| MIDDLE EOCENE | | | | | | | | | | SS at 2-60 (dominant lithology) |
| | | | | | | | | | | Quartz R Clay D |
| | | | | | | | | | | Carbonate R Carbonate rhombs R |
| | | | | | | | | | | unspecified F Nannos R |
| | | | | | | | | | | 5G 6/1 |
| | | | | | | | | | | Sponge spicules R Fish debris R |
| | | | | | | | | | | 5Y 4/1 |
| | | | | | | | | | | SS at 4-20 (minor lithology) |
| | | | | | | | | | | Quartz R Heavy minerals R |
| | | | | | | | | | | Clay A Glauconite R |
| | | | | | | | | | | 5G 4/1 |
| | | | | | | | | | | Micronodules R Carbonate |
| MIDDLE EOCENE | | | | | | | | | | Carbonate rhombs R unspecified R |
| | | | | | | | | | | Forams R Nannos A |
| | | | | | | | | | | INTERBEDDED |
| | | | | | | | | | | 5G 4/1 |
| | | | | | | | | | | and |
| | | | | | | | | | | 5Y 6/1 |
| | | | | | | | | | | SS at 4-50 (dominant lithology) |
| | | | | | | | | | | Quartz R Clay A |
| | | | | | | | | | | Glauconite R Micronodules R |
| | | | | | | | | | | Carbonate R Carbonate rhombs R |
| | | | | | | | | | | unspecified R Nannos A |
| | | | | | | | | | | Sponge spicules R Fish debris R |
| MIDDLE EOCENE | | | | | | | | | | Carbonate Bomb: 3-87 to 88 cm = 24% |
| | | | | | | | | | | CARBON-CARBONATE |
| | | | | | | | | | | 3-90 (4.3-0.9-28) |
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Site 370 Hole Core 6 Cored Interval: 426.0-435.5 m

| AGE | ZONES | | | FOSSIL CHARACTER | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---------------|--------|--------|------|------------------|---------|--------|-----------|-------------|---------------|---|
| | FORAMS | NANNOS | RADS | | | | | | | |
| OLIGOCENE | | | | | | 0 | | | | CALCAREOUS NANNO-BEARING SILTY CLAY AND SILTY CLAY WITH MINOR PORCELLANITE. |
| | | | | | | 0.5 | VOID | | | |
| | | | | | | 1.0 | | | | CALCAREOUS NANNO-BEARING SILTY CLAY, olive gray (5Y 4/1), firm, slight to moderate drilling disturbance, laminated with greenish gray (5G 6/1). |
| | | | | N | A | M | | | 63 | 5Y 4/1 |
| | | | | | | | | | | SILTY CLAY, dark greenish gray (5G 4/1), firm to semilithified, slight drilling disturbance, parallel and irregular faint laminations. |
| | | | | | | | | | | 5G 4/1 |
| | | | | | | | | | | PORCELLANITE, dark gray (N3), occurs in the upper part of the core. |
| | | | | | | | | | | SS at 1-63 (dominant lithology) |
| | | | | | | | | | | Quartz R Feldspar R |
| | | | | | | | | | | Clay A Glauconite R |
| | | | | | | | | | | Micronodules R Carbonate |
| | | | | | | | | | | Carbonate rhombs R unspecified C |
| ? LATE EOCENE | | | | | | | | | | Nannos C Rads R |
| | | | | | | | | | | Sponge spicules R Fish debris R |
| | | | | | | | | | | SS at 2-73 (dominant lithology) |
| | | | | | | | | | | Quartz R Feldspar R |
| | | | | | | | | | | Clay D Carbonate |
| | | | | | | | | | | Carbonate rhombs R unspecified R |
| | | | | | | | | | | Nannos R |
| | | | | | | | | | | Carbonate Bomb: 2-73 to 74 cm = 6% |
| | | | | | | | | | | CARBON-CARBONATE |
| | | | | | | | | | | 2-70 (1.3-0.4-7) |
| | | | | | | | | | | |
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Site 370 Hole Core 7 Cored Interval: 445.0-454.5 m

| AGE | ZONES | | | FOSSIL CHARACTER | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---------------|--------|--------|------|------------------|---------|--------|-----------|-------------|---------------|--|
| | FORAMS | NANNOS | RADS | | | | | | | |
| MIDDLE EOCENE | | | | | | 0 | | | | SILTY CLAY WITH MINOR PORCELLANITE. |
| | | | | | | 0.5 | VOID | | | |
| | | | | | | 1.0 | | | | SILTY CLAY, dark greenish gray (5G 4/1), firm to semilithified, slight drilling disturbance, parallel and irregular faint laminations. |
| | | | | | | | | | | PORCELLANITE, olive gray (5Y 4/1), at 2-110 to 115. |
| | | | | | | | | | | CONGLOMERATE at 2-130 to 135 consists of rounded pebbles (up to 1 cm) of brown mudstone with forams, mollusc shells, and glauconite. |
| | | | | | | | | | | SS at 2-70 (dominant lithology) |
| | | | | | | | | | | Quartz R Feldspar R |
| | | | | | | | | | | Clay D Glauconite R |
| | | | | | | | | | | Micronodules R Carbonate |
| | | | | | | | | | | Carbonate rhombs R unspecified R |
| | | | | | | | | | | Nannos R |
| | | | | | | | | | | SS at CC |
| MIDDLE EOCENE | | | | | | | | | | Quartz R Clay D |
| | | | | | | | | | | Glauconite R Micronodules R |
| | | | | | | | | | | Carbonate R Carbonate rhombs R |
| | | | | | | | | | | unspecified R Forams R |
| | | | | | | | | | | Nannos R Fish debris R |
| | | | | | | | | | | |
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Explanatory notes in Chapter 1

Site 370 Hole Core 8 Cored Interval: 464.0-473.5 m

| AGE | ZONES | FOSSIL CHARACTER | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---------------|--------------------------|---------------------------|---------|--------|-----------|-------------|---------------|--|
| | FORAMS NANNOS RADS | FOSSIL ABUND. PRES. | | | | | | |
| MIDDLE EOCENE | | | | 0 | | | | SILTY CLAY OVERLYING CLAYSTONE WITH MINOR PORCELLANITE THROUGHOUT. |
| | | | | | | | | PORCELLANITES, olive gray (5Y 4/1). |
| | | | | 0.5 | VOID | | | |
| | | | | 1.0 | | | | SECTION 1: SILTY CLAY, dark greenish gray (5G 4/1), firm to semilithified, no drilling disturbance, parallel and irregular faint laminations. |
| | | | | | | | | SECTION 2: CLAYSTONE, olive gray (5Y 3/2), lithified, no drilling disturbance, massive, bioturbated, streaks and laminae of pale green (10G 6/2). |
| | | | | | | | | MICROCONGLOMERATE, at Section 2-14 cm consists of grains of brownish mudstone (up to 2 mm). Basalt contact is sharp with scouring. |
| | | | | | | | | NANNO-BEARING CLAYSTONE at Section 2-112 to 115 cm, yellowish gray (5Y 8/1), lithified, bioturbated, sharp boundaries. |
| | | | | | | | | SS at 1-125 (dominant lithology) |
| | | | | | | | | Quartz R Clay D |
| | | | | | | | | Glaucinite R Micronodules R |
| | | | | | | | | Carbonate R Carbonate rhombs R |
| | | | | | | | | unspecified R Nannos R |
| | | | | | | | | Rads R Fish debris R |
| | | | | | | | | SS at 2-114 (minor lithology) |
| | | | | | | | | Quartz R Clay D |
| | | | | | | | | Carbonate R Carbonate rhombs R |
| | | | | | | | | unspecified R Forams R |
| | | | | | | | | Nannos C |
| | | | | | | | | SS at CC |
| | | | | | | | | Quartz R Feldspar R |
| | | | | | | | | Clay D Micronodules R |
| | | | | | | | | Carbonate R Carbonate rhombs R |
| | | | | | | | | unspecified R Nannos R |
| | | | | | | | | Fish debris R Plant debris R |
| | | | | | | | | Carbonate Bomb: 2-82 to 83 cm = 19% |
| | | | | | | | | CARBON-CARBONATE |
| | | | | | | | | 2-80 (3.1-0.5-21) |

Site 370 Hole Core 9 Cored Interval: 483.0-492.5 m

| AGE | ZONES | FOSSIL CHARACTER | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---------------|--------------------------|---------------------------|---------|--------|-----------|-------------|---------------|--|
| | FORAMS NANNOS RADS | FOSSIL ABUND. PRES. | | | | | | |
| MIDDLE EOCENE | | | | 0 | | | | CLAYSTONE WITH MINOR PORCELLANITE. |
| | | | | | | | | CLAYSTONE, grayish olive green (5GY 3/2), lithified, laminated, very rare bioturbation, a chevron fold occurs at ~90 cm. |
| | | | | | | | | PORCELLANITE, olive gray (5Y 4/1). |
| | | | | | | | | SS at 93 |
| | | | | | | | | Quartz R Feldspar R |
| | | | | | | | | Clay D Glaucinite R |
| | | | | | | | | Pyrite R Micronodule R |
| | | | | | | | | Zeolites R Carbonate R |
| | | | | | | | | Carbonate rhombs R unspecified R |
| | | | | | | | | Nannos R Fish debris R |
| | | | | | | | | SS at CC |
| | | | | | | | | Quartz R Clay D |
| | | | | | | | | Glaucinite R Pyrite R |
| | | | | | | | | Micronodule R Carbonate R |
| | | | | | | | | Carbonate rhombs R unspecified R |
| | | | | | | | | Fish debris R |
| | | | | | | | | Carbonate Bomb: 1-122 to 123 cm = 13% |
| | | | | | | | | CARBON-CARBONATE |
| | | | | | | | | 1-119 (2.0-0.5-12) |
| | | | | | | | | CC (2.4-0.5-16) |

Site 370 Hole Core 10 Cored Interval: 502.0-511.5 m

| AGE | ZONES | FOSSIL CHARACTER | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---------------|--------------------------|---------------------------|---------|--------|-----------|-------------|---------------|--|
| | FORAMS NANNOS RADS | FOSSIL ABUND. PRES. | | | | | | |
| MIDDLE EOCENE | | | | 0 | | | | SILTY CLAYSTONE WITH MINOR PORCELLANITE. |
| | | | | | | | | SILTY CLAYSTONE, olive gray (5Y 4/1), lithified, fine horizontal laminations. Scattered pebbles (0.5 to 1 cm diameter) of brownish mudstone. Silt and sand laminae and floating pebbles occur throughout. Silt content increases below 2-30. |
| | | | | | | | | PORCELLANITE, at top of core, olive gray (5Y 4/1), encloses some sub-rounded pebbles of brown mudstone (up to 2 cm in size). |
| | | | | | | | | SS at 2-20 (dominant lithology) |
| | | | | | | | | Quartz C Clay D |
| | | | | | | | | Pyrite R Micronodules R |
| | | | | | | | | Carbonate R Carbonate rhombs R |
| | | | | | | | | unspecified R Forams R |
| | | | | | | | | Fish debris R |
| | | | | | | | | SS at CC |
| | | | | | | | | Quartz R Clay D |
| | | | | | | | | Glaucinite R Pyrite R |
| | | | | | | | | Micronodules R Zeolites R |
| | | | | | | | | Carbonate R Carbonate rhombs R |
| | | | | | | | | unspecified R Nannos R |
| | | | | | | | | Fish debris R |
| | | | | | | | | Carbonate Bomb: 2-50 to 51 cm = 15% |
| | | | | | | | | CARBON-CARBONATE |
| | | | | | | | | 2-53 (3.0-0.6-20) |

Explanatory notes in Chapter 1

Explanatory notes in Chapter 1

Site 370 Hole Core 14 Cored Interval: 568.5-578.0 m

| AGE | ZONES | FOSSIL CHARACTER | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|-----|--------|------------------|---------|--------|-----------|-------------|---------------|---|
| | FORAMS | NAUROS | FOSSIL | ABUND. | PRES. | | | |
| | | | | 0 | | | | |
| | | | | 0.5 | | | | VOID |
| | | | | 1.0 | | | 76 | CALCAREOUS SILTY CLAYSTONE WITH MINOR CHERT, OVERLYING CALCAREOUS CLAYEY SILTSTONE TO SANDSTONE. |
| | | | | 1.5 | | | | CALCAREOUS SILTY CLAYSTONE, olive gray (5Y 3/2), moderately bioturbated with occasional Zoophycos, thin silt laminae with sharp basal contacts. More siliceous at 2-35 to 40, 2-60 to 63, 2-115 to 123. |
| | | | | 2.0 | | | | CHERT, olive gray (5Y 3/2). |
| | | | | 2.5 | | | 122 | CALCAREOUS CLAYEY SILTSTONE AND SANDSTONE below 4-80, dark yellowish brown (10YR 4/2), consists of brownish grains of claystone with rare forams, cemented by calcite. |
| | | | | 3.0 | | | | SS at 1-76 (dominant lithology) |
| | | | | 3.5 | | | | Quartz C Feldspar R |
| | | | | 4.0 | | | | Heavy minerals R Clay A |
| | | | | 4.5 | | | | Chalcedony R Glauconite R |
| | | | | 5.0 | | | | Sponge spicules R Pyrite R |
| | | | | 5.5 | | | | Micronodules R Carbonate R |
| | | | | 6.0 | | | | Carbonate rhombs C unspecified C |
| | | | | 6.5 | | | | Forams R Nannos R |
| | | | | 7.0 | | | | Fish debris R |
| | | | | 7.5 | | | | SS at 2-122 (minor lithology) |
| | | | | 8.0 | | | | Quartz C Feldspar R |
| | | | | 8.5 | | | | Clay A Chalcedony C |
| | | | | 9.0 | | | | Pyrite R Carbonate R |
| | | | | 9.5 | | | | Carbonate rhombs R unspecified C |
| | | | | 10.0 | | | | Nannos R |
| | | | | 10.5 | | | | VOID |
| | | | | 11.0 | | | | SS at 4-108 (minor lithology) |
| | | | | 11.5 | | | | Quartz C Feldspar R |
| | | | | 12.0 | | | | Clay A Mudstone clasts C |
| | | | | 12.5 | | | | Chalcedony R Glauconite R |
| | | | | 13.0 | | | | Sponge spicules R Fish debris R |
| | | | | 13.5 | | | | Pyrite R Micronodules R |
| | | | | 14.0 | | | | Zeolites R Carbonate R |
| | | | | 14.5 | | | | Carbonate rhombs R unspecified C |
| | | | | 15.0 | | | | Forams R Nannos R |
| | | | | 15.5 | | | | Carbonate Bomb: 1-98 to 99 cm = 20% |
| | | | | 16.0 | | | | CARBON-CARBONATE |
| | | | | 16.5 | | | | T-96 (3.8-1.3-21) |

Site 370 Hole Core 15 Cored Interval: 587.5-597.0 m

| AGE | ZONES | FOSSIL CHARACTER | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|-----|--------|------------------|---------|--------|-----------|-------------|---------------|--|
| | FORAMS | NAUROS | FOSSIL | ABUND. | PRES. | | | |
| | | | | 0 | | | | |
| | | | | 0.5 | | | | VOID |
| | | | | 1.0 | | | 5Y | CALCAREOUS MARLSTONE, light olive gray (5Y 5/2), with thin beds of CLAYEY SILTSTONE, slightly bioturbated. |
| | | | | 1.5 | | | | CHERT, light gray (N3) and black (N8). |
| | | | | 2.0 | | | 5Y 6/1 | At 2-10 to 22 cm and at 2-135 to 145 cm coarse pebbly siltstone with chert pebbles. |
| | | | | 2.5 | | | 5Y 5/2 | SS at 2-93 (dominant lithology) |
| | | | | 3.0 | | | | Quartz R Clay D |
| | | | | 3.5 | | | | Pyrite R Micronodules R |
| | | | | 4.0 | | | | Zeolites R Carbonate C |
| | | | | 4.5 | | | | Carbonate rhombs R unspecified R |
| | | | | 5.0 | | | | Forams R Nannos R |
| | | | | 5.5 | | | | Fish debris R |
| | | | | 6.0 | | | | Carbonate Bomb: 3-121 to 122 cm = 47% |
| | | | | 6.5 | | | | CARBON-CARBONATE |
| | | | | 7.0 | | | | 3-117 (7.7-1.5-51) |

Explanatory notes in Chapter 1

Site 370 Hole Core 16 Cored Interval: 606.5-616.0 m

| AGE | ZONES | | | FOSSIL CHARACTER | | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|--------------|--|--------|------|------------------|--------|---------|--------|-----------|-------------|---------------|---|
| | FORAMS | NANNOS | RADS | FOSSIL | ABUND. | | | | | | |
| EARLY EOCENE | Globorotalia aragonensis - Globorotalia palmerae P8-P9 Discoasteroides kuepperi | | | F | R | P | 0 | | | | |
| | | | | | | | 0.5 | VOID | | | |
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| | | | | | | | | | | | INTERBEDDED MARLSTONE AND SILT- STONE, WITH CHERT. MARLSTONE, grayish brown (5YR 3/2) with thin wispy laminae of pale blue green (5BG 7/2) CLAY. Thin SILTSTONE laminae occur scattered throughout. CHERT, blackish brown (5YR 2/1). SS at 1-138 (dominant lithology) Quartz C Heavy minerals R Clay A Pyrite R Carbonate Carbonate rhombs C unspecified C Nannos R SS at 1-146 (dominant lithology) Quartz C Feldspar R Heavy minerals R Clay A Chalcedony C Pyrite R Carbonate Carbonate rhombs C unspecified C SS at 2-98 (minor lithology) Quartz C Feldspar R Heavy minerals R Clay A Mudstone clasts C Sponge spicules R Fish debris R Chalcedony R Glauconite R Carbonate R Carbonate rhombs R unspecified C Forams R Nannos R CARBON-CARBONATE 3-37 (7.6-2.5-43) 5YR 3/2 5Y 5/2 5YR 3/2 |
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Site 370 Hole Core 18 Cored Interval: 635.0-644.5 m

| AGE | ZONES | FOSSIL CHARACTER | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|----------------|--|---------------------------|---------|--------|--------------|-------------|---------------|--|
| | FORAMS NANNOS RADS | FOSSIL ABUND. PRES. | | 0 | | | | |
| EARLY EOCENE | GLOBOROTALIA palmerae Discoasteroides kuepert | F R M | 1 | 0.5 | VOID | | | 10YR 4/2 to 5Y 5/2 5G 6/1 |
| | | | | 1.0 | | | | CLAYSTONE, dark yellowish brown (10YR 4/2) to light olive gray (5Y 5/2) with thin laminae and one bed (at 1-55 to 60 cm) of greenish gray (5G 6/1) CALCAREOUS CLAY. Thin beds of graded bedded coarse SANDSTONE. |
| LATE PALEOCENE | GLOBOROTALIA pusilla Discoaster multiradiatus & D. lodoensis | F N R | 2 | | | | | 10YR 4/2 to 5Y 5/2 |
| | | | | | | | | CLAYSTONE, dark yellowish brown (10YR 4/2) to light olive gray (5Y 5/2) with thin laminae and one bed (at 1-55 to 60 cm) of greenish gray (5G 6/1) CALCAREOUS CLAY. Thin beds of graded-bedded COARSE SANDSTONE with sharp lower contacts occur throughout. Sandstone grains consist of brown claystone, pyrite, glauconite and rare forams. |
| | | | | | Core Catcher | | | CHERT beds and nodules scattered throughout the core. |
| | | | | | | | | SS at 2-93 (dominant lithology) Quartz R Clay D Glauconite R Pyrite R Micronodules R Zeolites R Carbonate R Carbonate rhombs C unspecified R Fish debris R |
| | | | | | | | | SS at 2-100 (dominant lithology) Quartz R Heavy minerals R Clay D Pyrite R Plant debris R Carbonate rhombs R Carbonate R Forams R unspecified R Nannos R Fish debris R |
| | | | | | | | | SS at CC Quartz R Clay A Carbonate R Carbonate rhombs R unspecified R Nannos A |

Site 370 Hole Core 19 Cored Interval: 654.0-663.5 m

| AGE | ZONES | FOSSIL CHARACTER | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|-----------------|---|---------------------------|---------|--------|--------------|-------------|---------------|--|
| | FORAMS NANNOS RADS | FOSSIL ABUND. PRES. | | 0 | | | | |
| LATE PALEOCENE | GLOBOROTALIA pseudonard Fasciculithus tympaniformis | F N N | 1 | 0.5 | VOID | | | NANNO MARL WITH MINOR CHERT. |
| | | | | 1.0 | | | | Section 1, 30 to 45 NANNO MARL, very light gray (N7), soft. |
| EARLY PALEOCENE | GLOBOROTALIA pusilla not older than Cruciplacolithus tenuis | F N R | 2 | | | | | Remainder of core: NANNO MARL, dark greenish gray (5G 4/1) with very light gray (N7) NANNO MARL laminae, wavy, flame structures, firm. |
| | | | | | Core Catcher | | | SS at 1-84 (minor lithology) Clay A Zeolites R Carbonate R Carbonate rhombs R unspecified R Nannos A |
| | | | | | | | | SS at 1-92 (minor lithology) Quartz R Clay A Volcanic glass R Zeolites R Carbonate R Carbonate rhombs R unspecified R Nannos C Fish debris R |
| | | | | | | | | SS at 1-132 (dominant lithology) Quartz R Clay A Volcanic glass C Glauconite R Pyrite R Zeolites R Carbonate R Carbonate rhombs R unspecified R Nannos C Fish debris R |
| | | | | | | | | Carbonate Bomb: 1-88 to 89 cm = 32% |
| | | | | | | | | CARBON-CARBONATE 1-89 (4.9-0.5-37) |

Explanatory notes in Chapter 1

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Explanatory notes in Chapter 1

| Site 370 | | Hole | | Core 23 | | Cored Interval: 701.5-711.0 m | | | | | | |
|---------------------------------|--|--------|------------------------------------|---------|------------------|-------------------------------|-------------|---------------|---|--------|--------------|-------|
| AGE | FOSSIL CHARACTER | | | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION | | | |
| | FORAMS | NANNOS | RADS | | | | | | | FOSSIL | ABUND. | PRES. |
| LATE ALBIAN TO EARLY CRETACEOUS | Rotalipora apenninica Elphidium turrisseffeli | R | N | C | M | 0 | | | NANNO-BEARING SHALE, olive black (5Y 2/1), homogeneous, rare horizontal mm thick laminae. | | | |
| | | | | | | 0.5 | VOID | | | | | |
| | | | | | | 1 | | | SS at 2-50 (dominant lithology) | | | |
| | | | | | | | | | Quartz | R | Clay | D |
| | | | | | | | | | Fe/Mn | R | Pyrite | R |
| | | | | | | | | | Gypsum/barite | R | Carbonate | |
| | | | | | | | | | Carbonate rhombs | R | unspecified | R |
| | | | | | | | | | Forams | R | Nannos | |
| | | | | | | | | | Fish debris | R | Plant debris | R |
| | | | | | | | | | SS at 4-64 (minor lithology) | | | |
| | | | Quartz | R | Heavy minerals | R | | | | | | |
| | | | Clay | A | Gypsum | R | | | | | | |
| | | | Pyrite | R | Fe/Mn | R | | | | | | |
| | | | Carbonate | R | Carbonate rhombs | R | | | | | | |
| | | | unspecified | R | Nannos | C | | | | | | |
| | | | Plant debris | R | | | | | | | | |
| | | | SS at 4-109 (minor lithology) | | | | | | | | | |
| | | | Quartz | R | Clay | A | | | | | | |
| | | | Fe/Mn | R | Carbonate | | | | | | | |
| | | | Carbonate rhombs | C | unspecified | C | | | | | | |
| | | | Nannos | C | | | | | | | | |
| | | | 5Y 2/1 | | | | | | | | | |
| | | | SS at 4-129 (dominant lithology) | | | | | | | | | |
| | | | Quartz | R | Clay | D | | | | | | |
| | | | Fe/Mn | R | Carbonate | | | | | | | |
| | | | Carbonate rhombs | C | unspecified | R | | | | | | |
| | | | Nannos | R | | | | | | | | |
| | | | Carbonate Bomb: 3-85 to 86 cm = 8% | | | | | | | | | |
| | | | CARBON-CARBONATE | | | | | | | | | |
| | | | 3-80 (2.0-0.4-13) | | | | | | | | | |
| | | | 64 | | | | | | | | | |
| | | | 109 | 5YR 4/1 | | | | | | | | |
| | | | 129 | 5G 6/1 | | | | | | | | |
| | | | Core Catcher | | | | | | | | | |

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Explanatory notes in Chapter 1

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| AGE | ZONES | | FOSSIL CHARACTER | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---------|---------|-------|------------------|---------|--------|-----------|-------------|--------------------|--|
| | FOSSILS | BANDS | | | | | | | |
| | | | | | 0 | | | | |
| ALBANY? | | | | | 1 | VOID | 77 | | INTERBEDDED SILTY CLAYSTONE AND CARBONACEOUS SILTY CLAY. |
| | | | | | | 0.5 | | | SILTY CLAYSTONE, pale green (10G 6/2), firm, slightly bioturbated, siltstone pebbles, at 1-70 to 73 cm. Becomes clayey silt in places, pyrite nodule at 3-72 to 73 cm. |
| | | | | | | 1.0 | | | Fish fragment at 1-70 cm. |
| | | | | 2 | | | | 10G 6/2 and 5Y 2/1 | SILTY CLAY, olive black (5Y 2/1), with grayish brown (5YR 3/2) laminae, organic rich unit. Rounded siltstone pebble at 3-28 to 30 cm (3 cm in diameter). |
| | | | | 3 | | | | | SS at 1-77 (dominant lithology) Quartz C Clay D Pyrite R Carbonate Carbonate rhombs C unspecified R Sponge spicules R Fish debris R |
| | | | | | | | | | SS at 3-104 (minor lithology) Quartz C Clay A Pyrite R Carbonate Carbonate rhombs C unspecified R Plant debris C |
| | | | | | | | 104 | | Carbonate Bomb: 3-92 to 93 cm = 5% |
| | | | | | | | | | CARBON-CARBONATE 3-87 (1.8-0.8-8) |

Explanatory notes in Chapter 1

| Site 370 | | | Hole | | Core 28 | | Cored Interval: 768.0-777.5 m | | | | |
|-----------------------------|------------------|--------|------|--------|---------|---------|-------------------------------|-----------|-------------|---------------|--|
| AGE | FOSSIL CHARACTER | | | | | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
| | FORMS | NANNOS | RADS | FOSSIL | ABUND. | | | | | | |
| LATE APTIAN TO EARLY ALBIAN | | | | | | | 0 | | | | ALTERNATIONS OF SILTY CLAY AND CARBONACEOUS SILTY CLAY. |
| | | | | | | | 0.5 | VOID | | | |
| | | | | | | | 1 | | 101 | 10G 6/2 | SILTY CLAY, pale green (10G 6/2), bioturbated with dark gray (N3), pyrite concretion occurs at 1-40, smaller concretions are scattered in Section 4. |
| | | | | | | | 1.0 | | 110 | 5Y 2/1 | CARBONACEOUS SILTY CLAY, olive black (5Y 2/1), homogeneous, locally bioturbated with very thin burrows, lower boundary usually sharp, upper boundary usually bioturbated. Light gray carbonate lenses at 2-124, 129 and 143. |
| | | | | | | | | | 117 | 10G 6/2 | The carbonaceous silty clay is usually 5 to 30 cm thick whereas the silty clay is 15 to 60 cm thick and typically dominant. |
| | | | | | | | 2 | | | 5Y 2/1 | Section 3-94 to 95 cm ARGILLACEOUS MICROCRYSTALLINE LIMESTONE, greenish gray (5GY 6/1), laminated bladed calcite. |
| | | | | | | | | | | 10G 6/2 | |
| | | | | | | | | | | 5Y 2/1 | |
| | | | | | | | 3 | | | 10G 6/2 | <u>SS at 1-101</u> (dominant lithology) |
| | | | | | | | | | | | Quartz C Clay A |
| | | | | | | | | | | | Volcanic glass R Gypsum/Barite R |
| | | | | | | | | | | | Glauconite R Pyrite R |
| | | | | | | | | | | | Carbonate Carbonate rhombs R |
| | | | | | | | | | | | unspecified R Fish debris R |
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| Site 370 Hole | | | | Core 29 | | Cored Interval: 787.0-796.5 m | | | | | |
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| AGE | ZONES | | | FOSSIL CHARACTER | | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
| | FORAMS | NANIDS | BANDS | FOSSIL | ABUND. | | | | | | |
| | | | | | | | 0 | | | | |
| LATE ALBION TO EARLY ALBION | | | | | | | 0.5 | VOID | | | SILTY SHALE, dark gray (N3) with olive black and dark brownish gray laminae. |
| | | | | | | | 1 | | | | |
| | | | | N | F | R | P | Core Catcher | | | N3 |

| Site 370 | | | Hole | | Core 30 | | Cored Interval: 806.0-815.5 m | | | | | | | | | |
|-----------------------------|--------------------------|-------|------------------|--------|---------|--------|-------------------------------|-------------|--------------|------------------------|--|--|--|--|--|--|
| AGE | ZONES | | FOSSIL CHARACTER | | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO SAMPLE | LITHOLOGIC DESCRIPTION | | | | | | |
| | FORAMS | NANNO | FOSSIL | ABUND. | | | | | | | PRES. | | | | | |
| LATE APTIAN TO EARLY ALBIAN | Parahoplolithus angustus | | N | C-A | G | 0 | | | | | ALTERNATING NANNO-BEARING CLAYSTONE AND SILTY CLAYSTONE. | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | 0.5 | | | | | | | | | | |
| | | | | | | 1.0 | | | | | | | | | | |
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Site 370 Hole Core 31 Cored Interval: 825.0-834.5 m

| AGE | ZONES | FOSSIL CHARACTER | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|-----|--------|------------------|---------|--------|-----------|-------------|---------------|---|
| | FORAMS | NANNOS | BAUS | | | | | |
| | | FOSSIL | ABUND. | | | | | |
| | | | PRES. | | | | | |
| | | | | 0 | | | | ALTERNATING NANNO-BEARING CLAYSTONE AND SILTY CLAYSTONE, olive black (5Y 2/1) with varying silt content, in places bioturbated, some intervals thinly laminated with silt and sand occasionally graded. A slump occurs at 1-75 to 100 cm. |
| | | | | 0.5 | | | 68 | 5GY 4/1 |
| | | | | 1 | | | 87 | 5Y 2/1 and 5GY 4/1 |
| | | | | 1.0 | | | 140 | 5Y 2/1 and 5GY 4/1 |
| | | | | 2 | | | 52 | SS at 1-68 (dominant lithology) Quartz C Feldspar R Heavy minerals R Clay D Pyrite R Carbonate R Carbonate rhombs R unspecified R Fish debris R |
| | | | | 3 | | | | SS at 1-81 (minor lithology) Quartz C Feldspar R Heavy minerals R Clay A Glauconite R Pyrite R Fe/Mn R Carbonate R Carbonate rhombs R unspecified R Nannos R Fish debris R Plant debris R |
| | | | | 4 | | | 42 | 5Y 2/1 |
| | | | | 5 | | | 59 | 5GY 4/1 |
| | | | | 6 | | | | 5Y 2/1 |
| | | | | 7 | | | | SS at 1-140 (minor lithology) Quartz C Clay A Pyrite R Carbonate R Carbonate rhombs R unspecified R Nannos C Plant debris R |
| | | | | 8 | | | | SS at 2-52 (minor lithology) Quartz A Feldspar R Heavy minerals R Clay A Glauconite R Pyrite R Carbonate R Carbonate rhombs R unspecified R Forams R Nannos R Fish debris R |
| | | | | 9 | | | | SS at 4-42 (dominant lithology) Quartz R Feldspar R Clay D Pyrite R Carbonate R Carbonate rhombs R unspecified R Forams R Nannos C Fish debris R Plant debris R |
| | | | | 10 | | | | SS at 4-59 (minor lithology) Quartz A Clay A Glauconite R Pyrite R Carbonate R Carbonate rhombs R unspecified R Forams R Fish debris R |
| | | | | 11 | | | | CARBON-CARBONATE 3-19 (1.8-1.5-2) |

Site 370 Hole Core 32 Cored Interval: 834.5-844.0 m

| AGE | ZONES | FOSSIL CHARACTER | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|-----|--------|------------------|---------|--------|-----------|-------------|---------------|--|
| | FORAMS | NANNOS | BAUS | | | | | |
| | | FOSSIL | ABUND. | | | | | |
| | | | PRES. | | | | | |
| | | | | 0 | | | | SILTY SHALE AND NANNO-BEARING SHALE WITH SMALL SLUMPS AND MUD CONGLOMERATE, olive black (5Y 2/1), homogeneous. At base is 5 cm thick ARGILLACEOUS SILTSTONE, medium light gray (N6), laminated, both contacts sharp, pyrite. Shale is laminated with thin silty beds and occasionally sandstone ripples and cross-bedding are common in Section 4. |
| | | | | 0.5 | | | | VOID |
| | | | | 1 | | | 108 | 5Y 2/1 |
| | | | | 1.0 | | | | NANNO-BEARING SHALE, grayish brown (5YR 3/2), clasts, include flat claystone, calcareous siltstone, fossil fragments. Probably a slump. |
| | | | | 2 | | | 82 | CONGLOMERATE at 4-116 to 123, fragments of argillaceous rocks, angular, glauconite. |
| | | | | 3 | | | | Brownish siltstone pebble at 4-89 to 90, pebble rounded, 4 cm diameter and a wood fragment. |
| | | | | 4 | | | 25 | SS at 1-108 (dominant lithology) Quartz C Feldspar R Heavy minerals R Clay D Pyrite R Zeolites R Fe/Mn R Carbonate R Carbonate rhombs R unspecified R Nannos R Fish debris R Plant debris R |
| | | | | 5 | | | 97 | SS at 2-82 (minor lithology) Quartz R Feldspar R Heavy minerals R Clay D Glauconite R Pyrite R Fe/Mn R Carbonate R Carbonate rhombs R unspecified R Nannos C Fish debris R Plant debris R |
| | | | | 6 | | | | SS at 4-25 (dominant lithology) Quartz C Clay D Pyrite R |
| | | | | 7 | | | | SS at 4-97 (minor lithology) Quartz A Feldspar R Heavy minerals R Clay A Volcanic glass R Glauconite R Pyrite C Zeolites R Carbonate R Carbonate rhombs R unspecified R Nannos R Fish debris R Plant debris R |
| | | | | 8 | | | | CARBON-CARBONATE 3-38 (7.0-4.8-18) 4-52 (0.3-0.1-1) |

Site 370 Hole Core 33 Cored Interval: 853.5-863.0 m

| AGE | ZONES | FOSSIL CHARACTER | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|-----|--------|------------------|---------|--------|-----------|-------------|---------------|---|
| | FORAMS | NANNOS | BAUS | | | | | |
| | | FOSSIL | ABUND. | | | | | |
| | | | PRES. | | | | | |
| | | | | 0 | | | | CLAYSTONE, grayish olive (10Y 4/2) and QUARTZ SILTSTONE, light yellowish brown (10YR 6/2) probably siderite cemented. |
| | | | | 1 | | | CC | SS at CC Quartz R Clay D Pyrite R Carbonate rhombs R Nannos R Fish debris R Plant debris R |
| | | | | 2 | | | | SS at CC Quartz A Feldspar R Heavy minerals R Glauconite R Carbonate A Dolomite R unspecified A |

Explanatory notes in Chapter 1

Site 370 Hole Core 34 Cored Interval: 872.5-882.0 m

| AGE | ZONES | | FOSSIL CHARACTER | | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|------------------|--------|--------|------------------|--------|---------|--------|-----------|-------------|---------------|---|
| | FORAMS | NANNOS | FOSSIL | ABUND. | | | | | | |
| BARREMIAN | | | | | 0 | | VOID | | | NANNO-BEARING SHALE WITH INTERBEDS OF CALCAREOUS SILTSTONE TO VERY SILTY CALCAREOUS SHALE. |
| | | | | | 0.5 | | | | | |
| | | | | | 1 | | | | | NANNO-BEARING SHALE, olive black (5Y 2/1) to dark greenish gray (5G 4/1), homogeneous, rare pyrite concretions. |
| | | | | | 1.0 | | | | | |
| | | | | | 2 | | | | | |
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| LATE HAUTERIVIAN | | | | | | | | | | |
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
Site 370 Hole Core 35 Cored Interval: 882.0-891.5 m

| AGE | ZONES | | FOSSIL CHARACTER | | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|------------------|--------|--------|------------------|--------|---------|--------|-----------|-------------|---------------|--|
| | FORAMS | NANNOS | FOSSIL | ABUND. | | | | | | |
| BARREMIAN | | | | | 0 | | VOID | | | NANNO MARLSTONE WITH INTERBEDDED VERY SILTY NANNO-BEARING CLAY. |
| | | | | | 0.5 | | | | | |
| | | | | | 1 | | | | | NANNO MARLSTONE, olive gray (5Y 4/1), homogeneous, with laminae and beds of light gray CALCAREOUS SILTSTONE, occasional cross bedding and scour marks. Becomes shaly in 3-65 to 90 cm. |
| | | | | | 1.0 | | | | | |
| | | | | | 2 | | | | | VERY SILTY NANNO-BEARING CLAY, light gray (N7), laminated, some cross bedding in silts. |
| | | | | | | | | | | At 2-105 to 110, 4-123 to 130, 5-90 to 102, GLAUCONITIC CALCAREOUS SANDSTONE, medium grained, grading into laminated siltstone, lower boundary sharp, upper boundary gradation (turbidites). |
| | | | | | | | | | | SS at 2-56 (dominant lithology) |
| | | | | | | | | | | Quartz R Clay A |
| | | | | | | | | | | Pyrite R Carbonate R |
| | | | | | | | | | | Carbonate rhombs R unspecified R |
| LATE HAUTERIVIAN | | | | | | | | | | |
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Site 370 Hole Core 36 Cored Interval: 901.0-910.5 m

| AGE | ZONES | | FOSSIL CHARACTER | | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|------------------|--------|--------|------------------|--------|---------|--------|-----------|-------------|---------------|------------------------|
| | FORAMS | NANNOS | FOSSIL | ABUND. | | | | | | |
| LATE HAUTERIVIAN | | | | | 0 | | | | | |
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Explanatory notes in Chapter 1

| AGE | ZONES | | FOSSIL CHARACTER | | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------------------|-------|------------------|------------------|---------------|---------------|-----------------|---|-------------|--|---|--------|-------|--------|---|-----------|--|------------------|---|-------------|---|--------|---|--------|---|------|---|------------|---|--------|---|-----------|--|------------------|---|-------------|---|--------|---|-------------|---|--|--|--------|---|----------------|---|------|---|--------|---|-----------|--|------------------|---|-------------|---|--------|---|--------------|---|--|--|
| | FORMS | NANNOS | RHIZO | FOSSIL | | | | | | | ABUND. | PRES. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| LATE HAUTERIVIAN | | | N m R | C-A C I | M-G P I | Core Catcher |  | | N5 5Y 3/2 5G 6/1 CC CC CC | <p>CALCAREOUS SANDY SILTSTONE, medium gray (N5), with fine grained laminae.</p> <p>NANNO MARLSTONE, olive gray (5Y 3/2), with dark greenish gray (5GY 4/1) laminae, bioturbated, some burrows filled with pyrite.</p> <p>CALCAREOUS CLAYSTONE, greenish gray (5G 6/1).</p> <p><u>SS at CC</u> (Calcareous claystone)</p> <table><tr><td>Clay</td><td>A</td><td>Pyrite</td><td>R</td></tr><tr><td>Carbonate</td><td></td><td>Carbonate rhombs</td><td>R</td></tr><tr><td>unspecified</td><td>A</td><td>Nannos</td><td>R</td></tr></table> <p><u>SS at CC</u> (Nanno marlstone)</p> <table><tr><td>Quartz</td><td>R</td><td>Clay</td><td>A</td></tr><tr><td>Glaucinite</td><td>R</td><td>Pyrite</td><td>R</td></tr><tr><td>Carbonate</td><td></td><td>Carbonate rhombs</td><td>R</td></tr><tr><td>unspecified</td><td>R</td><td>Nannos</td><td>A</td></tr><tr><td>Fish debris</td><td>R</td><td></td><td></td></tr></table> <p><u>SS at CC</u> (Nanno marlstone)</p> <table><tr><td>Quartz</td><td>R</td><td>Heavy minerals</td><td>R</td></tr><tr><td>Clay</td><td>A</td><td>Pyrite</td><td>R</td></tr><tr><td>Carbonate</td><td></td><td>Carbonate rhombs</td><td>R</td></tr><tr><td>unspecified</td><td>R</td><td>Nannos</td><td>A</td></tr><tr><td>Plant debris</td><td>R</td><td></td><td></td></tr></table> | Clay | A | Pyrite | R | Carbonate | | Carbonate rhombs | R | unspecified | A | Nannos | R | Quartz | R | Clay | A | Glaucinite | R | Pyrite | R | Carbonate | | Carbonate rhombs | R | unspecified | R | Nannos | A | Fish debris | R | | | Quartz | R | Heavy minerals | R | Clay | A | Pyrite | R | Carbonate | | Carbonate rhombs | R | unspecified | R | Nannos | A | Plant debris | R | | |
| Clay | A | Pyrite | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Carbonate | | Carbonate rhombs | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| unspecified | A | Nannos | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Quartz | R | Clay | A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Glaucinite | R | Pyrite | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Carbonate | | Carbonate rhombs | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| unspecified | R | Nannos | A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fish debris | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Quartz | R | Heavy minerals | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Clay | A | Pyrite | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Carbonate | | Carbonate rhombs | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| unspecified | R | Nannos | A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Plant debris | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| AGE | ZONES | | FOSSIL CHARACTER | | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|------------------|--------|--------|------------------|---------------|---------|--------------|-----------|-------------|---------------|------------------------|
| | FORAMS | NANNOS | RADS | FOSSIL ABUND. | | | | | | |
| LATE HAUTERIVIAN | | | | | | 0 | | | | |
| | | | | | | 0.5 | VOID | | | |
| | | | | | | 1 | | | | |
| | | | | | | 1.0 | | | | |
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Explanatory notes in Chapter 1

| Site 370 | | Hole | | Core 39 | | Cored Interval: 948.5-950.0 m | | | | | |
|---------------------------------------|-------|-------|------|------------------|---------|-------------------------------|-----------|-------------|---------------|------------------------|---|
| AGE | ZONES | | | FOSSIL CHARACTER | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION | |
| | FORMS | NANOS | RADS | | | | | | | | FOSSIL ABUND. |
| LATE VALANGINIAN TO EARLY HAUTERIVIAN | | | | | | 0 | | | | | NANNO MARLSTONE WITH INTERBEDDED CALCAREOUS ARGILLACEOUS SILTSTONE/SANDSTONE NANNO-BEARING CLAY AND MINOR ORGANIC-RICH SHALE. |
| | | | | | | 0.5 | | | | | |
| | | | | | | 1 | | | 5Y 3/2 | | NANNO MARLSTONE, olive gray (5Y 3/2), thin interbeds of CALCAREOUS ARGILLACEOUS SILTSTONE AND SANDSTONE, rippled in places. |
| | | | | | | 1.0 | | | 102 | 106 6/2 | NANNO-BEARING CLAY, pale green (106 6/2) at 1-63 to 65, 1-100 to 103, 1-135 to 150, 2-6 to 9, 2-70 to 74, 3-4 to 8, 3-108 to 110, 4-24 to 27. |
| | | | | | | | | | 27 | | ORGANIC-RICH SHALE, grayish brown (5YR 2/2) at 3-26 to 32. |
| | | | | | | 2 | | | 47 | | SS at 1-102 (minor lithology) Quartz R Clay A Pyrite R Carbonate Carbonate rhombs R unspecified R Nannos C Plant debris R |
| | | | | | | | | | 27 | | SS at 2-27 (minor lithology) Quartz C Feldspar R Heavy minerals R Clay A Volcanic glass R Spheres(?) R Pyrite R Carbonate Carbonate rhombs R unspecified C Nannos R |
| | | | | | | 3 | | | | | |
| | | | | | | | | | | | |
| | | | | | | 4 | | | | | |
| | | | | | | | | | | | SS at 3-27 (minor lithology) Quartz R Clay A Pyrite R Carbonate Carbonate rhombs R unspecified R Nannos R Plant debris C |
| | | | | | | | | | | | CARBON-CARBONATE 4-30 (1.9-0.5-12) |

| Site 370 Hole | | | Core Interval: 967.5-977.0 m | | | | | | |
|---------------------------------------|------------------|----------|------------------------------|----------------|-----------|--------------|---------------|--|--|
| AGE | FOSSIL CHARACTER | | | SECTION METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION | |
| | FORAMS | NANNOS | BADS | | | | | | FOSSIL ABUND. |
| LATE VALANGINIAN TO EARLY HAUTERIVIAN | | | | | 0 | | | NANNO MARLSTONE INTERBEDDED WITH SILTY MARLSTONE AND SILTSTONE/SANDSTONE WITH MINOR ORGANIC-RICH SHALE. | |
| | | | | | 0.5 | VOID | | | |
| | | | | | 1 | | | NANNO MARLSTONE, grayish green (SG 5/2), interbedded with 2 to 10 cm thick beds of SILTY MARLSTONE, grayish olive (SGY 3/2) and SILTSTONE AND SANDSTONE beds, pale yellowish brown (10YR 6/2), finely laminated. Common contorted laminations and cross bedding at 1-73 to 76, 1-131 to 138, 2-0 to 5, 2-30 to 32, 2-50 to 54, 2-70 to 73, 2-125 to 132, 3-2 to 4, 2-14 to 17, 3-30 to 32, 3-41 to 43, 3-93 to 100, 3-119 to 122, 3-133 to 135, 3-140 to 144, 4-0 to 10, 4-18 to 23, 4-30 to 32, 4-35 to 36, 4-122 to 126, 4-133 to 140. Belemnite fragments at 1-135 to 140 cm. Rare bioturbations. | |
| | | | | | 2 | | 40 | 57 | ORGANIC-RICH SHALE, grayish brown (SYR 5/2) at 2-95 to 1003, 3-61 to 67, 4-74 to 90. |
| | | | | | 3 | | | | SS at 2-40 (dominant lithology) Quartz R Clay A Pyrite R Carbonate Carbonate rhombs R unspecified R Nannos A |
| | | | | | 4 | | | SS at 2-57 (dominant lithology) Quartz R Heavy minerals R Clay A Pyrite R Carbonate R Carbonate rhombs R unspecified R Nannos C Fish debris R Plant debris R | |
| | R NF | - C-A | - R | G P | | Core Catcher | | | |

Explanatory notes in Chapter 1

Site 370 Hole Core 41 Cored Interval: 986.5-996.0 m

| AGE | ZONES | | FOSSIL CHARACTER | | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---------------------------------------|--------|--------|------------------|---------------|---------|--------|-----------|-------------|---------------|---|
| | FORAMS | NANNOS | RADIS | FOSSIL ABUND. | | | | | | |
| LATE VALANGINIAN TO EARLY HAUTERIVIAN | | | | | 0 | | | | | |
| | | | | | 1 | 0.5 | | | 37 | NANNO MARLSTONE INTERBEDDED WITH THIN LAYERS OF ARGILLACEOUS CALCAREOUS SILTSTONE/SANDSTONE. |
| | | | | | 1 | 1.0 | | | 54 | NANNO MARLSTONE, grayish green (SG 5/2), interbedded with grayish olive (SGY 3/2). |
| | | | | | 2 | | | | 64 | Thin laminae of pale yellowish brown (10YR 6/2) ARGILLACEOUS CALCAREOUS SILTSTONE and SANDSTONE, rare bioturbation. |
| | | | | | 2 | | | | | SS at 1-37 (dominant lithology) |
| | | | | | | | | | | Quartz R Clay A |
| | | | | | | | | | | Pyrite R Carbonate |
| | | | | | | | | | | Carbonate rhombs R unspecified R |
| | | | | | | | | | | Nannos A |
| | | | | | | | | | | |
| LATE VALANGINIAN TO EARLY HAUTERIVIAN | | | | | 3 | | | | 27 | SS at 1-54 (dominant lithology) |
| | | | | | | | | | | Quartz R Feldspar R |
| | | | | | | | | | | Clay A Pyrite R |
| | | | | | | | | | | Carbonate R Carbonate rhombs R |
| | | | | | | | | | | unspecified R Nannos A |
| | | | | | | | | | | Fish debris R Plant debris R |
| | | | | | 3 | | | | | SS at 2-64 (minor lithology) |
| | | | | | | | | | | Quartz C Feldspar R |
| | | | | | | | | | | Heavy minerals R Clay A |
| | | | | | | | | | | Glaucinite R Pyrite R |
| LATE VALANGINIAN TO EARLY HAUTERIVIAN | | | | | 4 | | | | | Carbonate R Nannos R |
| | | | | | | | | | | unspecified A |
| | | | | | 4 | | | | | SS at 4-27 (minor lithology) |
| | | | | | | | | | | Quartz C Clay A |
| | | | | | | | | | | Volcanic glass R Pyrite R |
| | | | | | | | | | | Nannos C Plant debris R |
| | | | | | 4 | | | | | CARBON-CARBONATE |
| | | | | | | | | | | 2-35 (2.5-0.2-20) |
| | | | | | 5 | | | | | |
| | | | | | | | | | | |
| | R | N | F | | | | | | | Core Catcher |

Site 370 Hole Core 42 Cored Interval: 1005.5-1015.0 m

| AGE | ZONES | | FOSSIL CHARACTER | | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---------------------------------------|--------|--------|------------------|---------------|---------|--------|-----------|-------------|---------------|--|
| | FORAMS | NANNOS | RADIS | FOSSIL ABUND. | | | | | | |
| LATE VALANGINIAN TO EARLY HAUTERIVIAN | | | | | 0 | | | | | NANNO-BEARING MARLSTONE INTERBEDDED WITH CALCAREOUS SILTSTONE/SANDSTONE AND CLAYSTONE. |
| | | | | | 1 | 0.5 | VOID | | | NANNO-BEARING MARLSTONE, olive gray (SY 4/1), with a few thin CALCAREOUS |
| | | | | | 1 | 1.0 | | | | SILTSTONE AND SANDSTONE which are laminated and cross-bedded, rare convolute laminations. |
| | | | | | 2 | | | | 74 | CLAYSTONE, pale brown (SYR 5/2), organic matter scattered throughout parallel to bedding planes. |
| | | | | | | | | | | Claystone occurs at: |
| | | | | | | | | | | 2-65 to 70, 2-120 to 126, 3-23 to 25, 3-36 to 42, 3-74 to 76, 3-126 to 130, 4-38 to 45, 4-71 to 76, 4-90 to 100. |
| | | | | | 2 | | | | | SS at 2-74 (dominant lithology) |
| | | | | | | | | | | Quartz R Heavy minerals R |
| | | | | | | | | | | Clay A Carbonate |
| | | | | | | | | | | Carbonate rhombs R unspecified R |
| LATE VALANGINIAN TO EARLY HAUTERIVIAN | | | | | 3 | | | | | SS at 4-38 (minor lithology) |
| | | | | | | | | | | Quartz R Heavy minerals R |
| | | | | | | | | | | Clay D Pyrite R |
| | | | | | | | | | | Carbonate R Carbonate rhombs R |
| | | | | | | | | | | unspecified R Nannos R |
| | | | | | | | | | | Fish debris R |
| | | | | | 3 | | | | | SS at 4-80 (dominant lithology) |
| | | | | | | | | | | Quartz R Heavy minerals R |
| | | | | | | | | | | Pyrite R Carbonate |
| | | | | | | | | | | Clay A unspecified R |
| LATE VALANGINIAN TO EARLY HAUTERIVIAN | | | | | 4 | | | | 38 | Carbonate rhombs R Nannos C |
| | | | | | | | | | | Fish debris R Plant debris R |
| | | | | | 4 | | | | 80 | SS at 4-93 (minor lithology) |
| | | | | | | | | | | Quartz C Feldspar R |
| | | | | | | | | | | Heavy minerals R Clay A |
| | | | | | | | | | | Glaucinite R Pyrite R |
| | | | | | | | | | | Carbonate R Nannos R |
| | | | | | | | | | | unspecified R Fish debris R |
| | | | | | 4 | | | | 93 | CARBON-CARBONATE |
| | | | | | | | | | | 3-116 (2.0-0.5-13) |
| | R | N | F | | | | | | | Core Catcher |

Explanatory notes in Chapter 1

Site 370 Hole Core 43 Cored Interval: 1024.5-1034.0 m

| AGE | ZONES | FOSSIL CHARACTER | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|-----|--------|------------------|---------|---------------------|-----------|-------------|---------------|---|
| | FORAMS | NANNOS | BADS | FOSSIL ABUND. PRES. | | | | |
| | | | | 0 | | | | INTERBEDDED CLAYSTONES of three colors, each 5 to 15 cm thick. |
| | | | | 0.5 | VOID | | | NANNO-BEARING CLAYSTONE, olive gray (5Y 4/1), firm. |
| | | | | 1 | | | | CLAYSTONE, pale brown (5YR 5/2), laminated in part. |
| | | | | 1.0 | | | | CLAYSTONE, grayish blue green (5BG 5/2), thinly laminated. |
| | | | | 2 | | | 127 | CALCAREOUS ARGILLACEOUS SILTSTONE, medium light gray (N6), occurs scattered as 2 to 5 cm thick beds in Sections 2, 3 and 4. |
| | | | | | | | 5 | Occasional convolute laminations and cross-bedding. Rare pyrite. |
| | | | | | | | 82 | SS at 1-127 (dominant lithology) |
| | | | | | | | 111 | Quartz R Heavy minerals R |
| | | | | | | | | Clay A Pyrite R Carbonate R |
| | | | | | | | | Carbonate rhombs R unspecified R |
| | | | | | | | | Nannos C |
| | | | | 3 | | | 41 | SS at 2-82 (minor lithology) |
| | | | | | | | | Quartz R Heavy minerals R |
| | | | | | | | | Clay A Pyrite R Carbonate R |
| | | | | | | | | Fish debris R Pyrite R Carbonate rhombs R |
| | | | | | | | | unspecified R Nannos R |
| | | | | 4 | | | | SS at 2-111 (minor lithology) |
| | | | | | | | | Quartz C Feldspar R |
| | | | | | | | | Heavy minerals R Clay A |
| | | | | | | | | Glaucinite R Carbonate A |
| | | | | | | | | Carbonate rhombs R unspecified A |
| | | | | | | | | Nannos R Fish debris R |
| | | | | | | | | Plant debris R |
| | | | | | | | | SS at 3-41 (minor lithology) |
| | | | | | | | | Quartz A Feldspar R |
| | | | | | | | | Heavy minerals R Clay C |
| | | | | | | | | Glaucinite R Pyrite R |
| | | | | | | | | Carbonate R Carbonate rhombs R |
| | | | | | | | | unspecified R Nannos R |
| | | | | | | | | Fish debris R Plant debris A |
| | | | | | | | | SS at 2-5 (minor lithology) |
| | | | | | | | | Quartz R Heavy minerals R |
| | | | | | | | | Clay A Pyrite R |
| | | | | | | | | Carbonate R Carbonate rhombs R |
| | | | | | | | | unspecified R Nannos C |
| | | | | | | | | Fish debris R |

LATE VALANGINIAN TO EARLY HAUTERIVIAN

R N F
C-A-M-G
R MCore
Catcher

Site 370 Hole Core 44 Cored Interval: 1043.5-1053.0 m

| AGE | ZONES | FOSSIL CHARACTER | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|-----|--------|------------------|---------|---------------------|-----------|-------------|------------------|--|
| | FORAMS | NANNOS | BADS | FOSSIL ABUND. PRES. | | | | |
| | | | | 0 | VOID | | | SILTY NANNO-BEARING CLAYSTONE WITH INTERBEDDED CALCAREOUS ARGILLACEOUS SILTSTONE. |
| | | | | 0.5 | | | 38 | SILTY NANNO-BEARING CLAYSTONE, grayish green (5G 5/2) to olive gray (5Y 4/1), laminated. |
| | | | | 1 | | | | CALCAREOUS ARGILLACEOUS SILTSTONE, medium gray (N5). |
| | | | | 1.0 | | | | SS at 1-38 (dominant lithology) |
| | | | | 2 | | | 5G 5/2 to 5Y 4/1 | Quartz C Heavy minerals R |
| | | | | | | | | Clay A Pyrite R |
| | | | | | | | | Carbonate unspecified R Carbonate rhombs R |
| | | | | | | | | Fish debris R Nannos R |
| | | | | | | | N5 | SS at 1-50 (dominant lithology) |
| | | | | | | | | Quartz C Feldspar R |
| | | | | | | | | Heavy minerals R Clay A |
| | | | | | | | | Glaucinite R Pyrite R |
| | | | | | | | | Carbonate unspecified R Carbonate rhombs R |
| | | | | | | | | unspecified R Nannos C |
| | | | | 3 | | | 5G 5/2 to 5Y 4/1 | SS at 1-107 (minor lithology) |
| | | | | | | | | Quartz A Clay A |
| | | | | | | | | Glaucinite R Pyrite R |
| | | | | | | | | Carbonate unspecified R Carbonate rhombs R |
| | | | | | | | | Fish debris R Nannos R |
| | | | | | | | | SS at 3-31 (minor lithology) |
| | | | | | | | | Quartz C Feldspar R |
| | | | | | | | | Heavy minerals R Clay A |
| | | | | | | | | Carbonate unspecified R Carbonate rhombs R |
| | | | | | | | | unspecified R Nannos R |
| | | | | | | | | Fish debris R |
| | | | | | | | | CARBON-CARBONATE 3-66 (1.2-0.2-8) |

Explanatory notes in Chapter 1

LATE VALANGINIAN TO EARLY HAUTERIVIAN

R N F
C-A-M-G
R MCore
Catcher

Site 370 Hole Core 47 Cored Interval: 1100.5-1110.0 m

| AGE | ZONES | FOSSIL CHARACTER | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|-----|-------|------------------|---------|--------|-----------|-------------|---------------|---|
| | | | | 0 | | | | CLAYSTONE WITH INTERBEDDED SILTSTONE. |
| | | | | 0.5 | VOID | | | CALCAREOUS SILTY CLAYSTONE AND SILTSTONE, medium gray (N6) and brownish gray (5YR 4/1), laminated, contorted, becomes pale yellowish brown (10YR 6/2) in Section 3. |
| | | | | 1.0 | N | | | NANNO-BEARING CLAYSTONE, olive gray (5Y 4/1), with thin interbeds of dark greenish gray (5G 4/1), laminated. |
| | | | | 1.5 | N | | | SS at 2-3 (minor lithology) Quartz R Heavy minerals R Clay D Glauconite R Pyrite R Zeolites R Carbonate R Carbonate rhombs R unspecified R Nannos R Fish debris R Plant debris R |
| | | | | 2.0 | N | | | SS at 3-48 (dominant lithology) Quartz R Heavy minerals R Clay A Glauconite R Pyrite R Carbonate R Carbonate rhombs R unspecified R Nannos C Fish debris R Plant debris R |
| | | | | 2.5 | N | | | SS at 3-51 (minor lithology) Quartz R Heavy minerals R Clay A Glauconite R Pyrite R Zeolites R Carbonate R Carbonate rhombs R unspecified R Nannos C Fish debris R |
| | | | | 3.0 | N | | | SS at 3-56 (minor lithology) Quartz R Heavy minerals R Clay A Pyrite R Carbonate R Carbonate rhombs R unspecified R Nannos C Fish debris R Plant debris R |
| | | | | 3.5 | N | | | CARBON-CARBONATE 3-139 (3.9-0.2-31) |

Site 370 Hole Core 48 Cored Interval: 1119.5-1129.0 m

| AGE | ZONES | FOSSIL CHARACTER | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|-----|-------|------------------|---------|--------|-----------|-------------|---------------|--|
| | | | | 0 | | | | INTERBEDDED NANNO MARL, SILTY NANNO MARL AND CALCAREOUS ARGILLACEOUS SILTSTONE. |
| | | | | 0.5 | N | | 55 | NANNO MARL, grayish olive (10Y 4/2). |
| | | | | 1.0 | N | | 106 | SILTY NANNO MARL, pale blue green (5B6 5/2), laminated. |
| | | | | 1.5 | N | | 113 | CALCAREOUS ARGILLACEOUS SILTSTONE, light brownish gray (5YR 6/1), cross bedded, contorted, rippled. |
| | | | | 2.0 | N | | 140 | SS at 1-55 (dominant lithology) Quartz R Heavy minerals R Clay A Pyrite R Carbonate R Carbonate rhombs R unspecified R Nannos A Fish debris R Plant debris R |
| | | | | 2.5 | N | | | SS at 1-106 (minor lithology) Quartz C Heavy minerals R Clay A Pyrite R Carbonate R Carbonate rhombs R unspecified R Nannos A |
| | | | | 3.0 | N | | | SS at 1-113 (minor lithology) Quartz C Feldspar R Heavy minerals R Clay A Volcanic glass R Fish debris R Glauconite R Pyrite R Carbonate R Carbonate rhombs R unspecified R Nannos R Fish debris R Plant debris R |
| | | | | 3.5 | N | | | SS at 1-140 (minor lithology) Quartz R Heavy minerals R Clay A Glauconite R Pyrite R Carbonate R Carbonate rhombs R unspecified R Nannos A Fish debris R Plant debris R |

Explanatory notes in Chapter 1

Site 370 Hole Core 49 Cored Interval: 1138.5-1148.0 m

| AGE | ZONES | | | FOSSIL CHARACTER | | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION | |
|---------------------------------------|--------|--------|-----|------------------|--------|---------|--------|--------------|---|--|---|-------|
| | FORAMS | NANNOS | BOS | FOSSIL | ABIND. | | | | | | | PRES. |
| LATE VALANGINIAN TO EARLY HAUTERIVIAN | | | | | | | 0 | | | | | |
| | | | | | | | | VOID | | | | |
| | | | | | | | 0.5 | N | | 5Y 3/2 5YR 6/1 | INTERBEDDED NANNO-BEARING CLAYSTONE AND CALCAREOUS ARGILLACEOUS SILTSTONE. | |
| | | | | | | | 1 | N | | 5Y 3/2 | NANNO-BEARING CLAYSTONE, olive gray (5Y 3/2), laminated with grayish green (10G 5/2) nanno-bearing claystone. | |
| | | | | | | | 1.0 | N | | 5YR 6/1 5Y 3/2 5YR 6/1 | CALCAREOUS ARGILLACEOUS SILTSTONE, pale yellowish brown (5YR 6/1), thinly laminated, some cross bedding. | |
| | | | | | | | 2 | N | | SS at 1-87 (dominant lithology) | | |
| | | | | | | | | | | Quartz R Volcanic glass R Pyrite R Carbonate rhombs R Nannos C | Clay A unspecified R Plant debris R | |
| | | | | | | | | | | 5Y 3/2 | SS at 2-101 (minor lithology) | |
| | | | | | | | | | | Quartz R Clay D Carbonate R unspecified R | Heavy minerals R Pyrite R Carbonate rhombs R Nannos C | |
| | | | | | | | | | | | SS at 2-112 (minor lithology) | |
| | | | | | | | | | Quartz R Clay A Carbonate R unspecified R Fish debris R | Heavy minerals R Pyrite R Carbonate rhombs R Nannos C Plant debris R | | |
| | | | | N | -C-M-G | P | | Core Catcher | | | | |

Site 370 Hole Core 51 Cored Interval: 1167.0-1176.5 m

| AGE | FOSSIL CHARACTER | | | | | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|----------------------------------|------------------|--------|------|--------|--------|---------|--------|-----------|-------------|---------------|---|
| | FORAMS | NANNOS | RAOS | FOSSIL | ABUND. | | | | | | |
| not older than UPPER VALANGINIAN | | | | | | | 0 | | | | INTERBEDDED NANNO-BEARING CLAYSTONE AND CALCAREOUS ARGILLACEOUS SILTSTONE. |
| | | | | | | | 0.5 | VOID | | | NANNO-BEARING CLAYSTONE, olive gray (5Y 3/2), laminated with grayish green (10G 5/2) nanno-bearing claystone. |
| | | | | | | | 1.0 | | | | CALCAREOUS ARGILLACEOUS SILTSTONE, pale yellowish brown (5YR 6/1), thinly laminated, some cross bedding. |
| | | | | | | | | | | | SS at 2-14 (dominant lithology) |
| | | | | | | | | | | | Quartz R Heavy minerals R |
| | | | | | | | | | | | Clay A Spheres? R |
| | | | | | | | | | | | Pyrite R Carbonate |
| | | | | | | | | | | | Carbonate rhombs R unspecified R |
| | | | | | | | | | | | Nannos C Fish debris R |
| | | | | | | | | | | | |
| | | | | | | | 2 | | | 14 | 5Y 3/2 and 5YR 6/1 interbedded |
| | | | | | | | | | | | |
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Explanatory notes in Chapter 1

Site 370 Hole Core 50 Cored Interval: 1157.5-1167.0 m

| AGE | ZONES | | | FOSSIL CHARACTER | | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---------------------------------------|--------|--------|------|------------------|--------|---------|--------|--------------|-------------|----------------------------------|---|
| | FORAMS | NANNOS | RADS | FOSSIL | ABUND. | | | | | | |
| LATE VALANGINIAN TO EARLY HAUTERIVIAN | | | | | | | 0 | | | | |
| | | | | | | | 1 | VOID | | 60 | INTERBEDDED NANNO-BEARING CLAYSTONE AND CALCAREOUS ARGILLACEOUS SILTSTONE. |
| | | | | | | | 0.5 | N | | | NANNO-BEARING CLAYSTONE, olive gray (5Y 3/2), laminated with grayish green (10G 5/2) nanno-bearing claystone. |
| | | | | | | | 1.0 | N | | | CALCAREOUS ARGILLACEOUS SILTSTONE, pale yellowish brown (5YR 6/1), thinly laminated, some cross bedding. |
| | | | | | | | | N | | 5YR 6/1 and 5Y 3/2 interbedded | |
| | | | | | | | 2 | N | | 56 | SS at 1-60 (minor lithology) |
| | | | | | | | | N | | | Quartz R Heavy minerals R |
| | | | | | | | | N | | | Clay A Volcanic glass R |
| | | | | | | | | N | | | Pyrite R |
| | | | | | | | | N | | | Zeolites R Carbonate R |
| | | | | | | | N | | | Carbonate rhombs R unspecified R | |
| | | | | | | | N | | | Nannos C Plant debris R | |
| | | | | | | | | N | | | SS at 2-56 (dominant lithology) |
| | | | | | | | | N | | | Quartz R Heavy minerals R |
| | | | | | | | | N | | | Clay A Pyrite R |
| | | | | | | | | N | | | Plant debris R Carbonate R |
| | | | | | | | | N | | | Carbonate rhombs R unspecified R |
| | | | | | | | | N | | | Nannos C Fish debris R |
| | R | N | | C | M | | | Core Catcher | | | |
| | F | | | P | | | | | | | |

