4. SITE 496: MIDDLE AMERICA TRENCH UPPER SLOPE[1]

Shipboard Scientific Party[2]

HOLE 496

Date occupied: 30 May 1979

Date departed: 1 June 1979

Time on hole: 55.4 hr.

Position: 13°03.82′N; 90°47.71′W

Water depth (sea level; corrected m, echo sounding): 2049

Water depth (rig floor; corrected m, echo sounding): 2059

Bottom felt (m, drill pipe): 2064

Penetration (m): 378

Number of cores: 40

Total length of cored section (m): 378

Total core recovered (m): 199.35

Core recovery (%): 52.7

Oldest sediment cored:
Depth sub-bottom (m): 378
Nature: Mudstone
Age: Early Miocene

Basement: Not reached

Principal results: Drilling penetrated only 378 meters in the Guatemalan midslope, about 500 meters short of target—a landward-dipping reflector at the top of a high-velocity body (Ladd et al., 1978; Ibrahim et al., 1979). Samples from Site 496 indicate two lithostratigraphic sequences. The uppermost 226 meters of sediment comprise a Quaternary biogenic mud that drapes the underlying section of semilithified sandy mudstone deposited in the Pliocene to Miocene. Both units are rich in terrigenous detritus and contain some volcanic ash and lignite. Sediments of the upper unit are underconsolidated, whereas those of the lower unit are overconsolidated. Gaseous hydrocarbons are abundant at the site; the methane/ethane ratio decreased abnormally fast, and in the last three cores heavier components appeared. That evidence for proximity to petroleum and the possibility of encountering high *in situ* gas pressure forced us to abandon the hole.

BACKGROUND AND OBJECTIVES

Site 496 is on the upper part of the Middle America Trench slope in about 2050 meters of water, 4000 meters above and 47 km landward from the trench axis (Fig. 1). Multichannel seismic record GUA-13 (Fig. 2) shows two strong reflectors at this site. The upper one, about 0.05 s below the seafloor, parallels the slope topography and is interpreted as the base of the slope deposits. The lower one, sloping landward, could be related to the top of a landward-dipping igneous rock layer, because it is associated with a high magnetic anomaly and a seismic velocity of 5.3 km/s.

A major objective at Site 496 was to sample the landward-dipping reflector D (Fig. 2). High seismic velocity suggests that rock lies beneath that reflector. Site 496 is one of the few places where high velocities were recorded in the available network of seismic records. Although other sites were supposed to serve as a continental reference section, loss of time at the beginning of the leg dictated that Site 496 serve this purpose.

The stratigraphic sequence expected from the information at hand was conjectural. The age of the layered slope deposits should be Neogene. The amplitude and dip of seismic reflections suggested division into a Pliocene–Pleistocene sequence and a Miocene sequence; the base of the lower sequence is discordant and seems transgressive. The Upper Cretaceous, perhaps an equivalent to the Cretaceous rocks covering the Nicoya Complex in Costa Rica, was expected below an unconformity. Information about the Cretaceous facies would have been very helpful in interpreting the Cretaceous rock found at Site 494.

If igneous rock had been recovered at this site, we might have established the relation of the present slope and trench to the past episode of subduction. Moreover, if the lowest strong reflector is the top of a mafic–ultramafic rock analogous to the Nicoya Complex, land geology might have been more precisely related to continental slope structure. Even if the rock were not of Nicoya affinity, we would have gained a better understanding of the relations between the tectonic edifice known on land, the active continental margin, and the ocean crust—in short, the relations between subduction and orogenesis.

OPERATIONS

Glomar Challenger departed from Site 495 on May 30, at 0246L (Local Time), steaming over the beacon at Site 494 to get a position. Seismic line GUA-13 was used as the reference for navigation during steaming and site location.

[1] Aubouin, J., von Huene, R., et al., *Init. Repts. DSDP*, 67: Washington (U.S. Govt. Printing Office).

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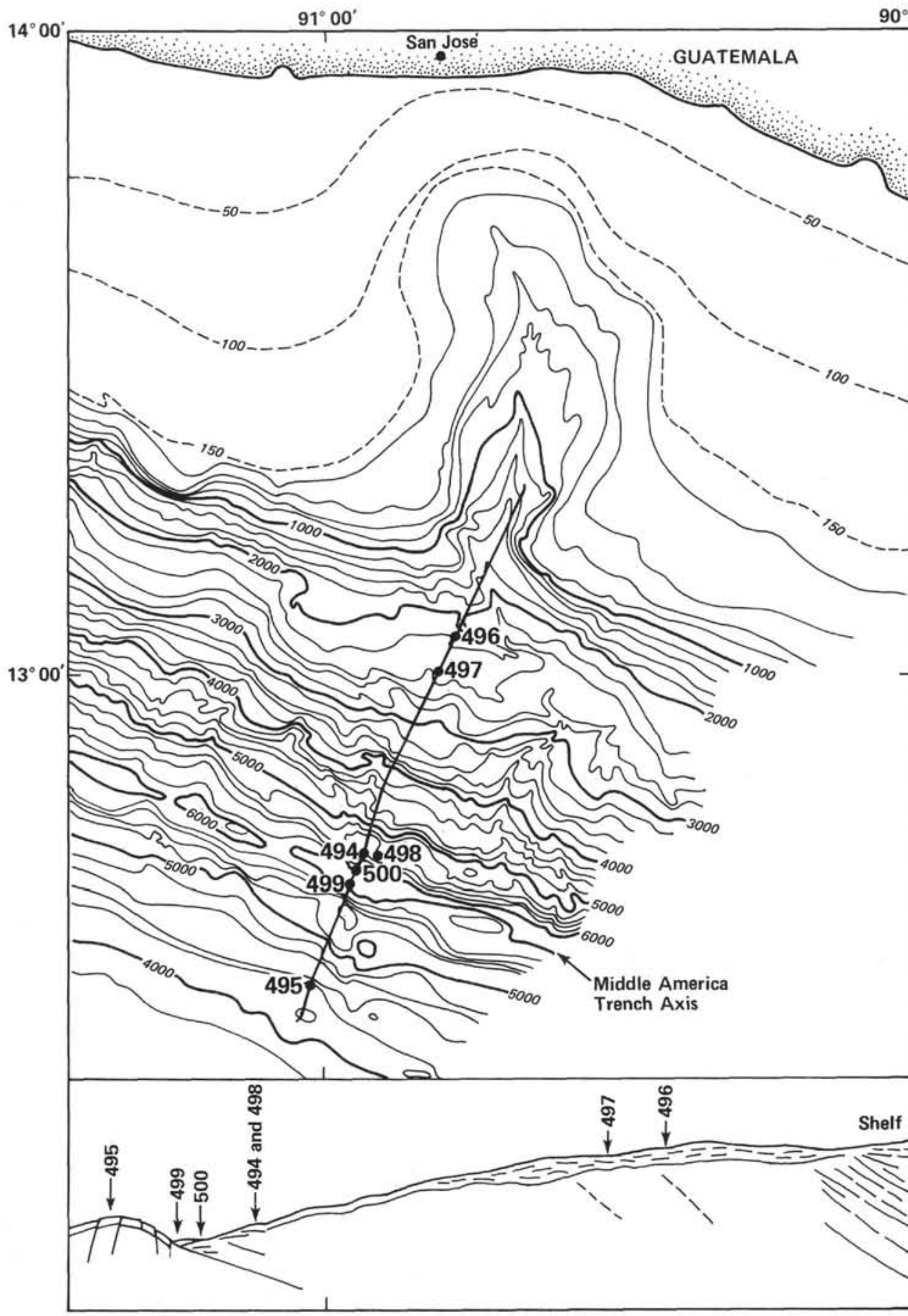

Figure 1. Location map and cross section showing position of Site 496.

Site 496 is located on the trench upper slope. That slope dips seaward at 4°, just enough relief to allow positioning using PDR (precision depth recorder) bathymetry and the seismic records. The beacon was dropped on 30 May, 0806L, but the ship continued on the same course in order to complete the seismic record and to find the best position for the hole. *Glomar Challenger* turned back and took its position 1500 feet north of the beacon on May 30, 0920L.

Forty cores were recovered (Table 1) before the hole was abandoned and cemented due to quantities of gas at the safety limit. No logging was accomplished, and, after pulling the drill string, we proceeded seaward to Site 497.

LITHOSTRATIGRAPHY

At Site 496 we intended to sample both an apron of slope sediments and underlying sediment and rock represented by landward-dipping seismic reflectors. The site was terminated in lower Miocene mudstone at a sub-bottom depth of 378.0 meters, 500 meters short of our goal. The section penetrated has been divided into two litho-

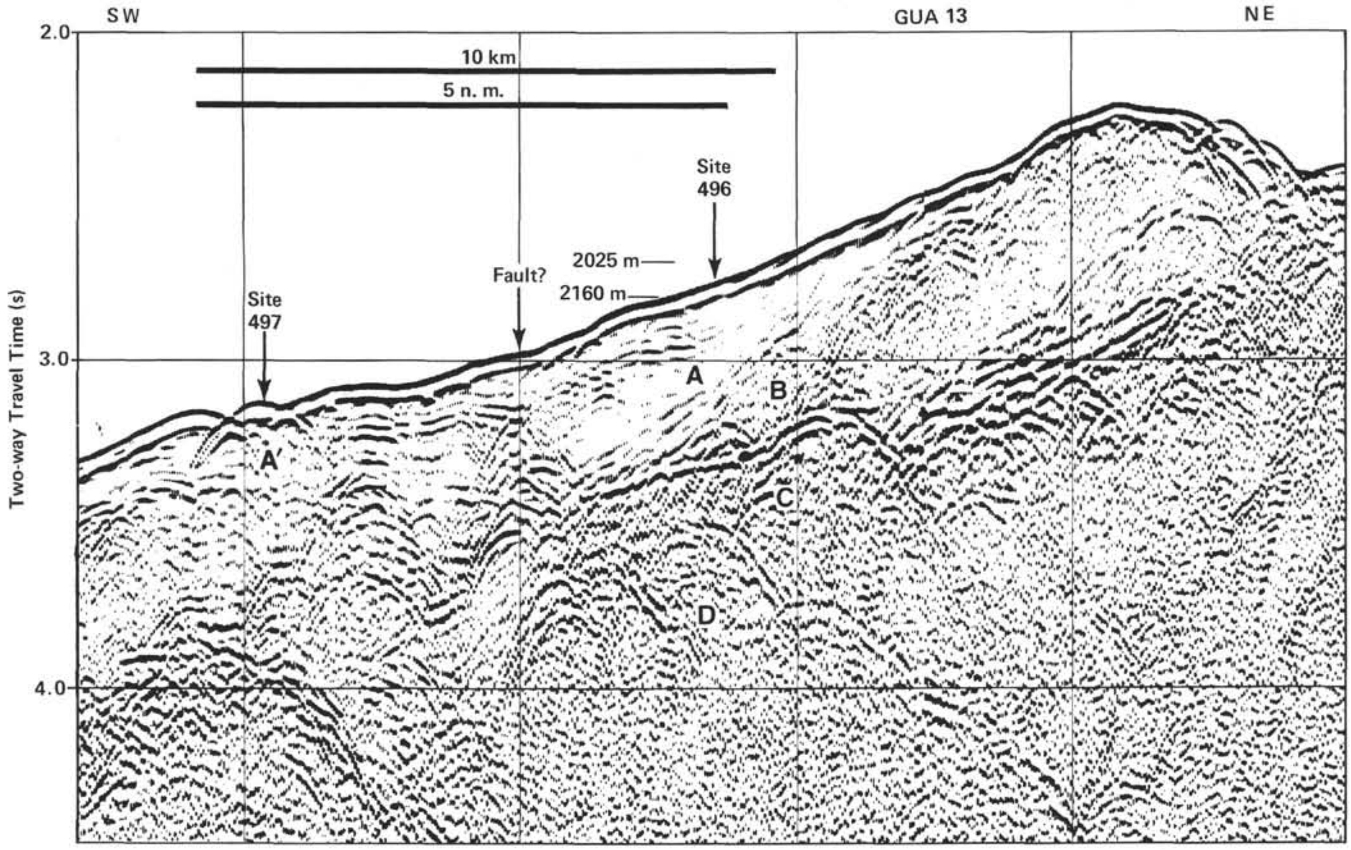

Figure 2. Portion of multichannel seismic profile GUA-13 showing location of Site 496. (See the Geophysics section for an explanation of letters A–D.)

Table 1. Coring summary for Hole 496.

Core No.	Date (May–June, 1979)	Local Time (L)	Depth from Drill Floor (m; top–bottom)	Sub-bottom Depth (m; top–bottom)	Length Cored (m)	Length Recovered (m)	Recovery (%)
1	30	1653	2064.0–2071.5	0.0–7.5	7.5	7.2	96
2	30	1737	2071.5–2081.0	7.5–17.0	9.5	7.64	80
3	30	1817	2081.0–2090.5	17.0–26.5	9.5	6.88	72
4	30	1905	2090.5–2100.0	26.5–36.0	9.5	0.0	0
5	30	1958	2100.0–2109.5	36.0–45.5	9.5	5.69	60
6	30	2048	2109.5–2119.0	45.5–55.0	9.5	6.20	65
7	30	2132	2119.0–2128.5	55.0–64.5	9.5	3.90	41
8	30	2218	2128.5–2138.0	64.5–74.0	9.5	2.84	30
9	30	2311	2138.0–2147.5	74.0–83.5	9.5	5.51	58
10	31	0000	2147.5–2157.0	83.5–93.0	9.5	7.95	84
11	31	0100	2157.0–2166.5	93.0–102.5	9.5	3.57	37
12	31	0145	2166.5–2176.0	102.5–112.0	9.5	4.84	51
13	31	0235	2176.0–2185.5	112.0–121.5	9.5	3.58	38
14	31	0330	2185.5–2195.0	121.5–131.0	9.5	3.08	32
15	31	0425	2195.0–2204.5	131.0–140.5	9.5	5.07	53
16	31	0510	2204.5–2214.0	140.5–150.0	9.5	1.36	14
17	31	0551	2214.0–2223.5	150.0–159.5	9.5	2.30	24
18	31	0630	2223.5–2233.0	159.5–169.0	9.5	0.12	1
19	31	0730	2233.0–2242.5	169.0–178.5	9.5	2.38	25
20	31	0820	2242.5–2252.0	178.5–188.0	9.5	2.57	27
21	31	0910	2252.0–2261.5	188.0–197.5	9.5	9.38	99
22	31	1000	2261.5–2271.0	197.5–207.0	9.5	6.42	68
23	31	1056	2271.0–2280.5	207.0–216.5	9.5	5.89	62
24	31	1200	2280.5–2290.0	216.5–226.0	9.5	5.54	58
25	31	1307	2290.0–2299.5	226.0–235.5	9.5	6.50	68
26	31	1359	2299.5–2309.0	235.5–245.0	9.5	6.28	66
27	31	1453	2309.0–2318.5	245.0–254.5	9.5	7.91	83
28	31	1554	2318.5–2328.0	254.5–264.0	9.5	4.78	50
29	31	1649	2328.0–2337.5	264.0–273.5	9.5	8.85	93
30	31	1753	2337.5–2347.0	273.5–283.0	9.5	9.53	100
31	31	1855	2347.0–2356.5	283.0–292.5	9.5	3.17	33
32	31	1958	2356.5–2366.0	292.5–302.0	9.5	0.0	0
33	31	2115	2366.0–2375.5	302.0–311.5	9.5	8.45	89
34	31	2221	2375.5–2385.0	311.5–321.0	9.5	6.47	68
35	31	2324	2385.0–2394.5	321.0–330.5	9.5	7.09	75
36	1	0057	2394.5–2404.0	330.5–340.0	9.5	8.65	82
37	1	0200	2404.0–2413.5	340.0–349.5	9.5	0.43	4
38	1	0330	2413.5–2423.0	349.5–359.0	9.5	1.93	20
39	1	0625	2423.0–2432.5	359.0–368.5	9.5	4.04	42
40	1	0815	2432.5–2442.0	368.5–378.0	9.5	4.56	48

stratigraphic units (Fig. 3). Clay- and silt-rich muds give way downhole to sandier mudstone locally containing granule- and small-pebble-size clasts of glauconite grains.

Unit 1 (Cores 1 to 24; 0.0–226.0 m sub-bottom depth; Quaternary)

This massive unit is predominantly dark olive gray (5Y 3/2) biogenic mud, soft enough that drilling transforms layers into swirls and mottles. The terrigenous component of the sediment is dominant and consists of clay minerals and minor contributions of volcanic glass; the biogenous contribution is secondary and consists of nearly 50% diatoms and nannofossils. The total amount of biogenic debris (including foraminifers and sponge spicules) varies, but diatoms predominate above Core 13 and nannofossils below. Cores 9, 10, and 12 each contain spotty concentrations of foraminifers. Light to dark gray and pale olive layers of vitric ash are common in Cores 1 to 12 and less abundant below, but all have been deformed into streaks and irregular blobs.

When split, Cores 1 to 3 and 21 smelled of H_2S. Most of the other cores showed degassing phenomena, such as small tension cracks and broken and unbroken bubbles on slices surfaces.

The contact of Units 1 and 2 is placed at the top of Core 25, although it cannot be precisely located because of poor recovery and drilling disturbance in Sections 1 to 3 of Core 25. The lithologic change used as a basis for differentiating these units is gradational. The proportion of sand-size grains increases in those sections of Core 25, and sand is particularly abundant in Section 3 where it constitutes up to 60% of the mud. The remainder of the sediment is mostly pebble-size grains of glauconite. The proportion of biogenic debris decreases below Core 23, but this trend is reversed in Unit 2.

Unit 2 (Cores 25 to 40; 226.0–378.0 m sub-bottom depth; Pliocene to early Miocene)

This unit comprises biogenic, olive gray (5Y 4/2) and dark olive gray (5Y 3/2) mud and sandy mud. Overall, Unit 2 resembles Unit 1 in color, but its average grain size is slightly coarser. It contains biogenic, authigenic, eolian, and terrigenous components. The total amount of diatoms and nannofossils and their relative proportions vary from core to core. Dark bluish green (5G 4/2), subrounded clasts or fragments of glauconite up to 5 mm in diameter are distinctive constituents of the sandy mud in Cores 25 to 31, 33, and 34. Medium to dark gray ash patches and a few hard, light gray, pumiceous clasts are distributed sporadically through Unit 2; the biogenic mud itself typically contains 15% or less vitric ash. The only unusual sediment in this unit is an intraformational conglomerate in Section 1 of Core 31. This pebbly mudstone contains clasts up to 1 cm of glauconitic mudstone, dark olive mudstone, and light gray limestone. It appears to be normally graded and has a sharp lower contact with grayish olive mud. Other notable features in Unit 2 include a thin lignite lamina in mudstone of Core 38 and baked wood fibers in Core 39. The only sedimentary structures noted in the unit are minor burrowing and bioturbation, and there are fine parallel laminations in Core 34 and 40. However, drilling deformation is moderate to intense throughout Unit 2, and it is unlikely that many sedimentary structures would have survived. Degassing features were again noted in Cores 38, 39, and 40. Gas pressures were so high in Core 39 that much of its contents blasted out of the liner, prompting the decision to terminate the hole.

The Quaternary/Pliocene boundary at Site 496 cannot be located precisely, therefore the uppermost part of Unit 2 in Core 25 may be Pleistocene. Paleontologic evidence (see the section on Biostratigraphy) suggests that there may be hiatuses in Unit 2, but, as emphasized above, the only distinctive or abrupt lithologic change is from ordinary mud to pebbly mudstone in Core 31.

In summary, Units 1 and 2 both consist predominantly of dark olive gray biogenic mud and minor layers of vitric ash; Unit 2 is locally sandier and contains glauconite. Sedimentary structures diagnostic of depositional environments and mechanisms are not present, but the terrigenous, volcanogenic, and pelagic biogenic constituents are compatible with a landward trench-slope environment since the early Miocene. Upwelling is indicated by abundant diatoms and glauconite and contents of organic carbon as high as 4% (see the Geochemistry section).

Cores from Hole 496 display the typical downward progression of drilling-induced structures that can be used as an arbitrary measure of the degree of lithification or induration of sediment. Soft mud in Cores 1 thru 28 is swirled and mottled, drilling biscuits of more consolidated mudstone first appear in Section 5 of Core 29 (about 270 m sub-bottom depth), and well-developed biscuits are abundant in Cores 30 to 40. An *in situ*, semipenetrative, deformational structure — "veining" — is preserved in biscuits in Cores 29 to 37. Individual veins are typically less than 1 mm thick and separated from adjacent, subparallel veins by 1 to several millimeters. Veins are generally oriented vertically, and some are sigmoidal. The sediment filling veins is darker than the surrounding mud, but postcruise petrographic analyses did not reveal any obvious mineralogical differences. Platy phyllosilicates within veins have an imperfect preferred orientation subparallel to vein walls. These structures are interpreted as recording the brittle response of partially lithified mud to *in situ* postdepositional stresses. They probably facilitated further dewatering of the sediment. Similar structures occur in cores from Site 497.

PHYSICAL PROPERTIES

Bulk Density and Water Content

Bulk density began at 1.42 Mg/m^3, decreased to 1.25 Mg/m^3 (Core 5), then gradually increased through the next 200 meters to 1.40 Mg/m^3. A sudden increase in density occurred between Core 24 and Core 25 (corresponding with the Quaternary/Pliocene boundary). The increase, although abrupt, was hardly spectacular, going from 1.40 Mg/m^3 to about 1.54 Mg/m^3 and remaining at that value to the bottom of the hole (Fig. 4).

Water content (Fig. 5) shows a rapid and expectable decrease within the first 20 meters, followed by a slow

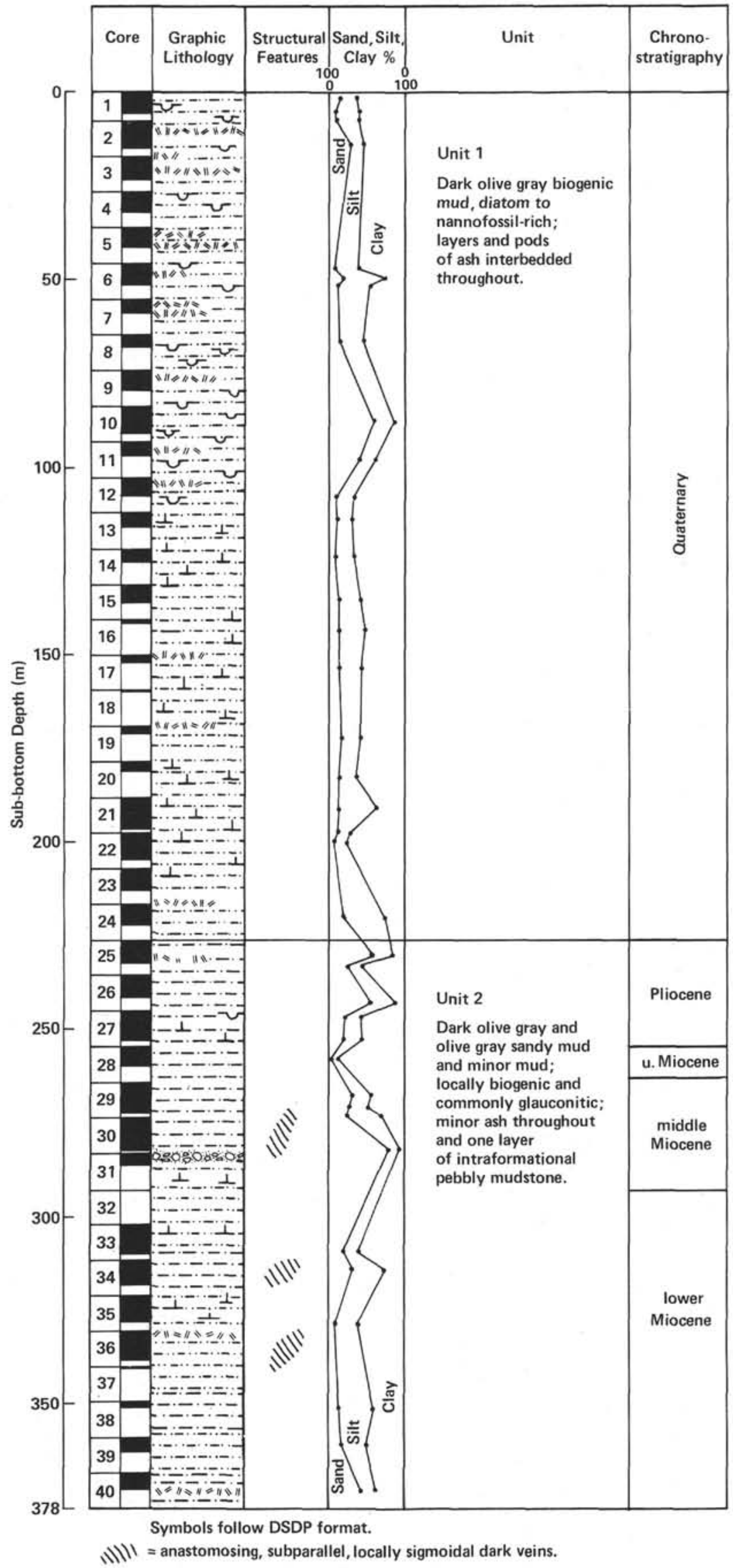

Figure 3. Summary lithologic column for Site 496.

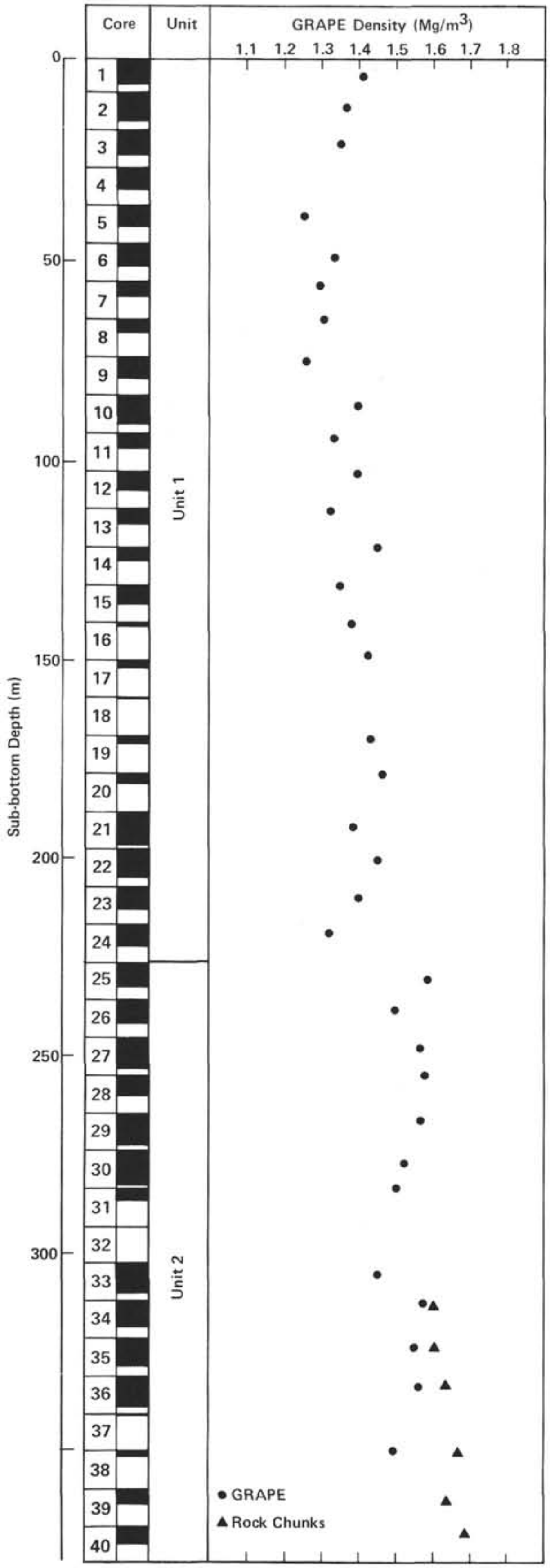

Figure 4. Bulk density versus sub-bottom depth at Site 496.

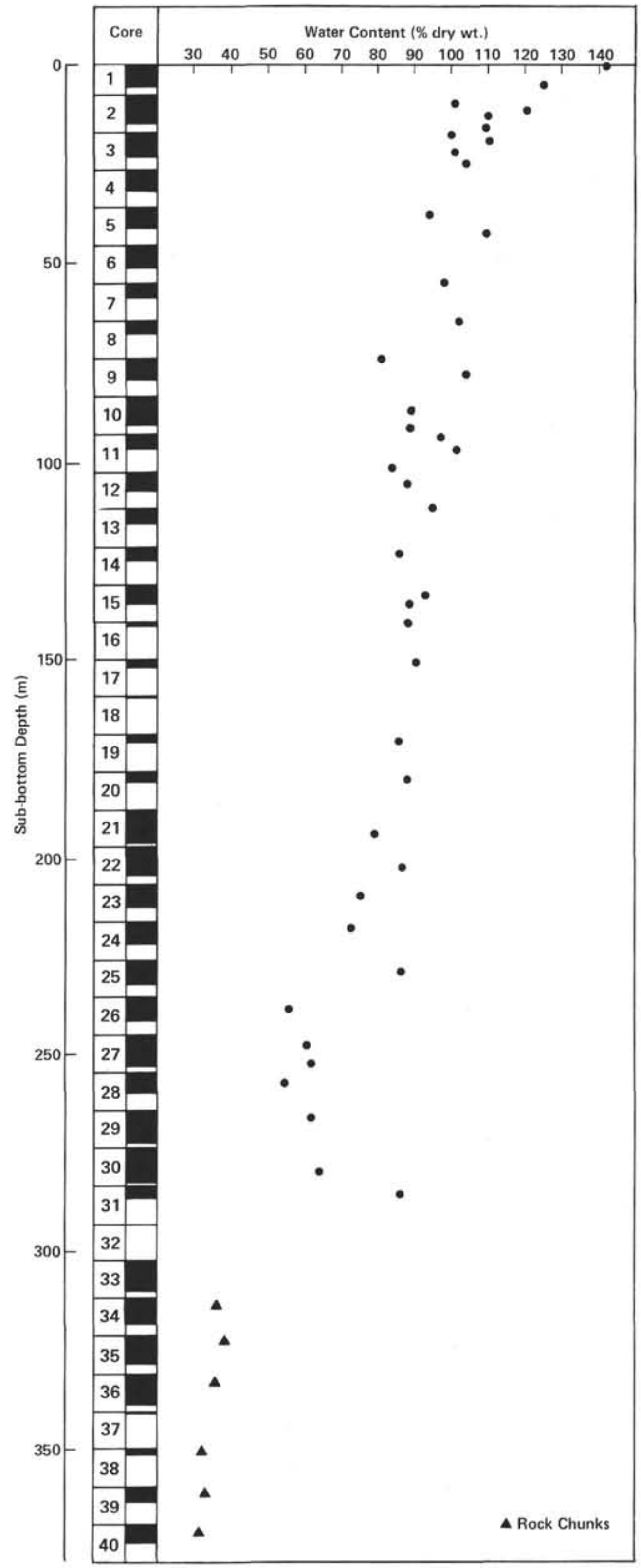

Figure 5. Water content measured as percent dry weight versus sub-bottom depth at Site 496.

and gradual decrease to 225 meters (Core 24). Across the Quaternary/Pliocene boundary, water content decreases to about 60%, and beyond 240 meters little variability is noted.

Bulk density and water content were determined from rock chunks when it became impractical to sample using standard gravimetric techniques. In the measurement of bulk density, rock-chunk samples provide a higher value than the GRAPE. This disparity is to be expected, inasmuch as the GRAPE value represents the density of the mass within the core liner (including voids and fractures), whereas the rock-chunk technique uses samples selected specifically for their lack of such features.

An even larger difference is shown in the water contents. The rock-chunk technique provides a much lower value than the GRAPE. However, it is believed that the rock-chunk technique is a conservative measure, due to the inability of the technique to remove all the interstitial water from the sample. The true water content probably lies somewhere between the rock-chunk and GRAPE values.

Two lithologies are shown by variations in bulk density and water content. They are Unit 1, an upper diatom to nannofossil ooze extending to 240 meters, and Unit 2, a coarser-grained, organic semilithified sandy mudstone.

Sound Velocity

Sound velocity measurements could not be made because of attenuation within gas voids and fractures.

Shear Strength

Figure 6 is a plot of shear strength for Hole 496. Data plotted include the average value for each core and the largest value, usually obtained from the base of the last core section.

From the mud line to 50 meters sub-bottom depth, shear strength remained nearly constant and exhibited little variation. Shear strength increased irregularly at 60 meters (Core 7) to an average of 35 kPa at 130 meters (Core 14), which was maintained to 240 meters (Core 25). Large variations of shear strength characterize the interval, which was composed entirely of gas-charged sediments. The overall impression that emerges is that complete disturbance of varying degrees exists throughout the entire gassy interval, and all values of shear strength should be considered as remolded, with the possible exception of the maximum values taken at the base of the last cored section. The increase in shear strength across the lower/upper Pliocene interval at 240 meters is real, however, and indicates that either an unconformity or a surface of nondeposition exists at that level. Table 2 summarizes Site 496 physical properties.

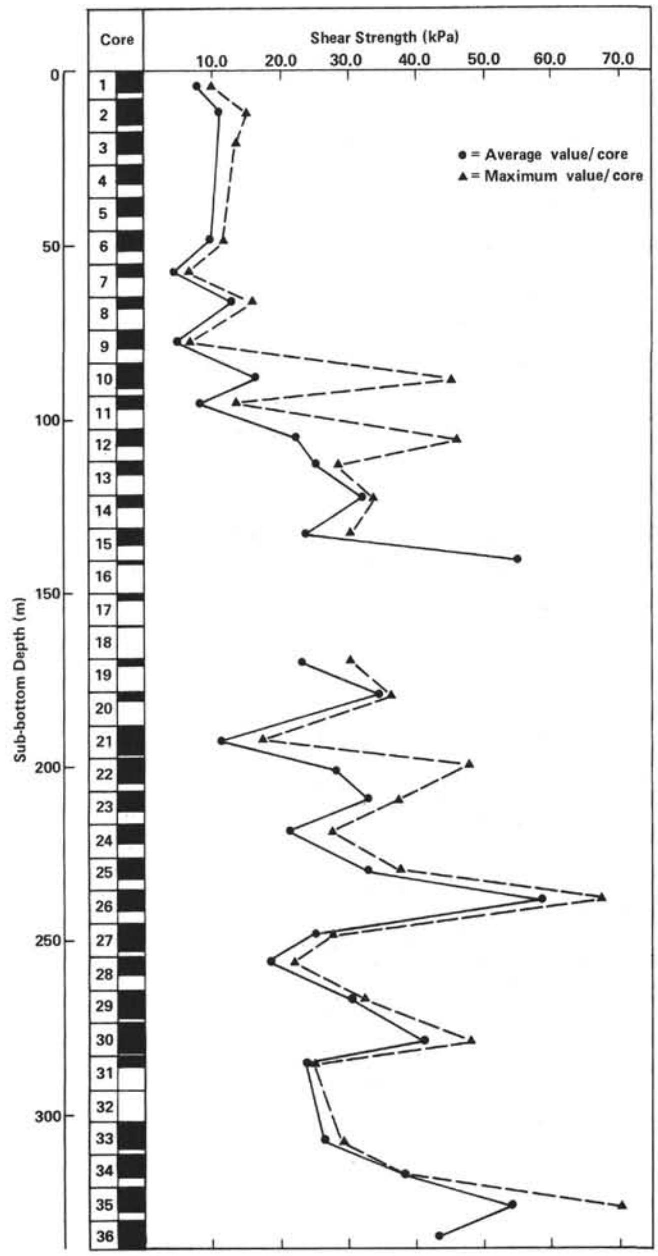

Figure 6. Shear strength versus sub-bottom depth at Site 496.

GEOPHYSICS

The purpose of drilling at Site 496 was to sample rock from a landward-dipping reflection seen in seismic reflection record GUA-13. This reflection coincides with the top of a seismic refraction unit having a velocity of 5.8 km/s—a velocity common in igneous rock. The presence of such a landward-dipping body of igneous rock raises the interesting possibility that an imbricate slice had accreted oceanic crust to the margin. Drilling at Site 496 was an opportunity to test this possibility.

We may interpret seismic record GUA-13 by examining Figure 2. Above the landward-dipping reflection, D, is a wedge of poorly reflective material, C. Both C and D appear to be truncated and are overlain by B, which is in turn unconformable with A.[3] Using a velocity of 1800 m/s, we see that drilling to a sub-bottom depth of 378 meters penetrated 0.42 s sub-bottom on the seismic section. The upper Miocene zone of slow sedimentation or hiatus at the sub-bottom depth of 270 meters would

[3] Since this study, the record in Figure 2 has been reprocessed and the boundary between B and C is shown to be a reflection from the base of the gas hydrate zone (see von Huene et al., this volume).

Table 2. Physical properties, Site 496.

Sample (core-section, interval [cm])	GRAPE Wet-Bulk Density (Mg/m^3)	*P*-Wave Velocity (km/s)	Acoustic Impedance ($\times 10^5 g/cm^2 \cdot s$)	Shear Strength (kPa)	Water Content (% dry wt.)	Porosity (vol. %)
1-1, 96-99	1.46	—	—	8.04	141.2	78.5
1-4, 80-84	1.40	—	—	9.58	125.2	76.3
2-1, 130-132	—	—	—	9.67	101.0	72.4
2-2, 130-134	1.38	—	—	14.74	125.7	75.7
2-3, 130-134	—	—	—	11.87	110.3	74.1
2-4, 108-110	1.42	—	—	12.06	109.7	74.0
2-5, 128-132	—	—	—	14.17	100.7	72.3
3-1, 90-92	—	—	—	9.95	110.8	74.2
3-3, 98-102	1.37	—	—	11.49	101.6	72.4
3-5, 135-137	1.40	—	—	13.60	103.8	72.9
6-4, 138-140	1.36	—	—	10.24	—	—
6-5, 110-112	—	—	—	11.01	90.9	70.2
7-1, 116-120	1.33	—	—	5.43	98.5	71.8
7-2, 90-94	1.30	—	—	3.83	—	—
8-1, 70-74	1.45	—	—	9.96	102.0	72.4
8-2, 70-74	1.40	—	—	16.27	—	—
9-1, 108-110	—	—	—	5.93	80.7	67.7
9-2, 20-24	1.36	—	—	4.30	—	—
9-5, 70-75	—	—	—	5.36	104.4	72.9
10-2, 103-106	1.44	—	—	9.19	89.9	69.8
10-3, 10-14	—	—	—	7.27	—	—
10-5, 80-84	1.40	—	—	5.93	89.4	69.9
11-1, 100-103	1.41	—	—	13.40	97.0	71.5
11-2, 100-103	1.35	—	—	5.74	—	—
11-3, 30-33	—	—	—	5.36	101.0	72.4
12-2, 22-26	1.44	—	—	9.76	84.0	68.5
12-5, 20-25	1.48	—	—	12.92	89.5	69.9
12-6, 90-95	1.47	—	—	40.69	—	—
13-2, 70-72	1.41	—	—	23.94	94.8	71.1
14-2, 100-102	1.57	—	—	33.51	86.2	69.0
15-2, 100-102	—	—	—	12.45	92.9	70.6
15-5, 95-97	—	—	—	28.72	89.3	69.8
16-1, 120-122	1.52	—	—	55.54	89.4	69.8
17-1, 80-82	1.44	—	—	9.58	90.9	70.2
19-3, 75-78	—	—	—	30.64	86.2	68.9
20-2, 102-104	1.47	—	—	35.91	89.7	69.9
21-5, 80-82	—	—	—	9.00	105.9	73.2
21-6, 138-140	—	—	—	8.80	99.9	67.3
22-6, 100-102	1.53	—	—	47.88	87.0	69.2
23-4, 118-120	—	—	—	28.73	75.6	66.3
24-5, 138-140	1.42	—	—	15.32	73.4	65.5

have occurred 0.34 s sub-bottom on the seismic section, or at the contact between A and B on seismic section GUA-13. Drilling indicates that A is an unconsolidated Quaternary and Pliocene section that overlies a similar, but semiconsolidated, Miocene section, B. Other correlations cannot be ruled out until better velocity data are available.

Two single-channel records were made from the *Challenger*, the first as the ship came on site and the second as it departed (Figs. 7 and 8, respectively). The first profile indicates the disconformable contact between A and B, the same pattern recorded in multichannel profile GUA-13 (Fig. 7). The second record was made along a line 400 ft. east of the beacon and resembles profile GUA-18 except that diffractions obscure the B area (Fig. 8). These observations suggest that Site 496 penetrated the side of a local high composed of Miocene and perhaps Pliocene sediment.

BIOSTRATIGRAPHY

Drilling at slope Site 496 recovered a thick sedimentary sequence ranging from lower Miocene to the Quaternary (Fig. 9). Cores 1 through 24 contain hemiterrigenous diatomaceous nannofossil mud with Quaternary foraminifers, radiolarians, and nannofossils. Pliocene microfossils were found in Cores 25 to 26. Typical upper Miocene assemblages were identified only in Core 28, whereas Cores 29 through 31 have been placed in the middle Miocene. Cores 33 through 40 are assigned to the upper part of the lower Miocene.

A hiatus possibly exists in the lower Pliocene of Core 26 (Fig. 10). A change in physical properties in Section 496-26-3 is accompanied by abrupt truncation of foraminiferal ranges.

Benthic foraminiferal indications of paleodepths suggest shelf depths in Cores 40 and 39, upper bathyal depths in Cores 38 to 34, and middle and lower bathyal depths above Core 33 (see Fig. 11 and Table 1). Nannofossil preservation is in accord with these data.

Foraminifers

The first 225 meters of Hole 496 (Cores 1 to 24) consist of a monotonous Pleistocene foraminiferal fauna, occasionally showing a weak response to Quaternary climatic fluctuation. Planktonic faunas are dominated by abundant *Neogloboquadrina eggeri, N. subcretacea*, and *Globorotalia menardii*, along with common *Globigerinoides ruber, G. sacculifer*, and lesser abundances of other tropical species. Pink *G. ruber* occurs first in Core 7, Section 3, providing an approximate age of 130,000 yr. (on the basis of the disappearance of the species 120,000 yr. ago). Cool climatic conditions are inferred by the presence of *Neogloboquadrina pachyderma, Globorotalia inflata*, and by generally good preservation of the samples (interglacial stages depict relatively greater dissolution of foraminiferal sediments than glacial stages). Coiling directions of *Pulleniatina* are dextral until Core 22, Section 3, indicating the separation of Brunhes from Matuyama. Benthic foraminifers are typical of lower bathyal depths (1600–3000 m), suggesting that the observed fauna is in place. Common members of the fauna include *Globobulimina pacifica, Uvigerina peregrina, U. senticosa, Planulina ornata, Bulimina affinis, B. barbata, B. pagoda, Cibicides mckannai, Melonis* spp., and *Hoeglundina elegans*.

Cores 25 to 27 are placed in the Pliocene. Core 26, Section 3 contains a representative lower Pliocene assemblage, identified by *Globorotalia exilis, Neogloboquadrina humerosa, Globoquadrina altispira*, and *Pulleniatina primalis* (dextral). The benthic fauna is similar to that of the Quaternary.

Core 28 is identified as upper Miocene because of the presence of *Globorotalia plesiotumida* and *Globoquadrina venezuelana;* the benthic fauna resembles those above but also contains the agglutinated form *Martinottiella communis. M. communis* was the only individual found in Core 29, Section 3 dated by radiolarians and nannofossils as middle Miocene. The persistence of this agglutinated deep-water species where no calcareous shells occur suggest lower bathyal or abyssal conditions below the CCD at the time of deposition.

Martinottiella is also present in Core 30, Section 3, dated as middle Miocene. Here, however, it is accompanied by lower bathyal forms such as *U. hispida, U. senticosa*, and *Stilostomella*. Middle Miocene planktonic foraminifers include *Globorotalia continuosa, Orbulina suturalis*, and *Globoquadrina langhiana*.

The remaining samples from Hole 496, Cores 31 through 40, are placed in the lower Miocene. Typical planktonic species include abundant *G. langhiana, G. altispira, G. ruber, G. venezuelana*, and *Globigerinoides trilobus sacculifer*, and *Globorotalia siakensis*. As

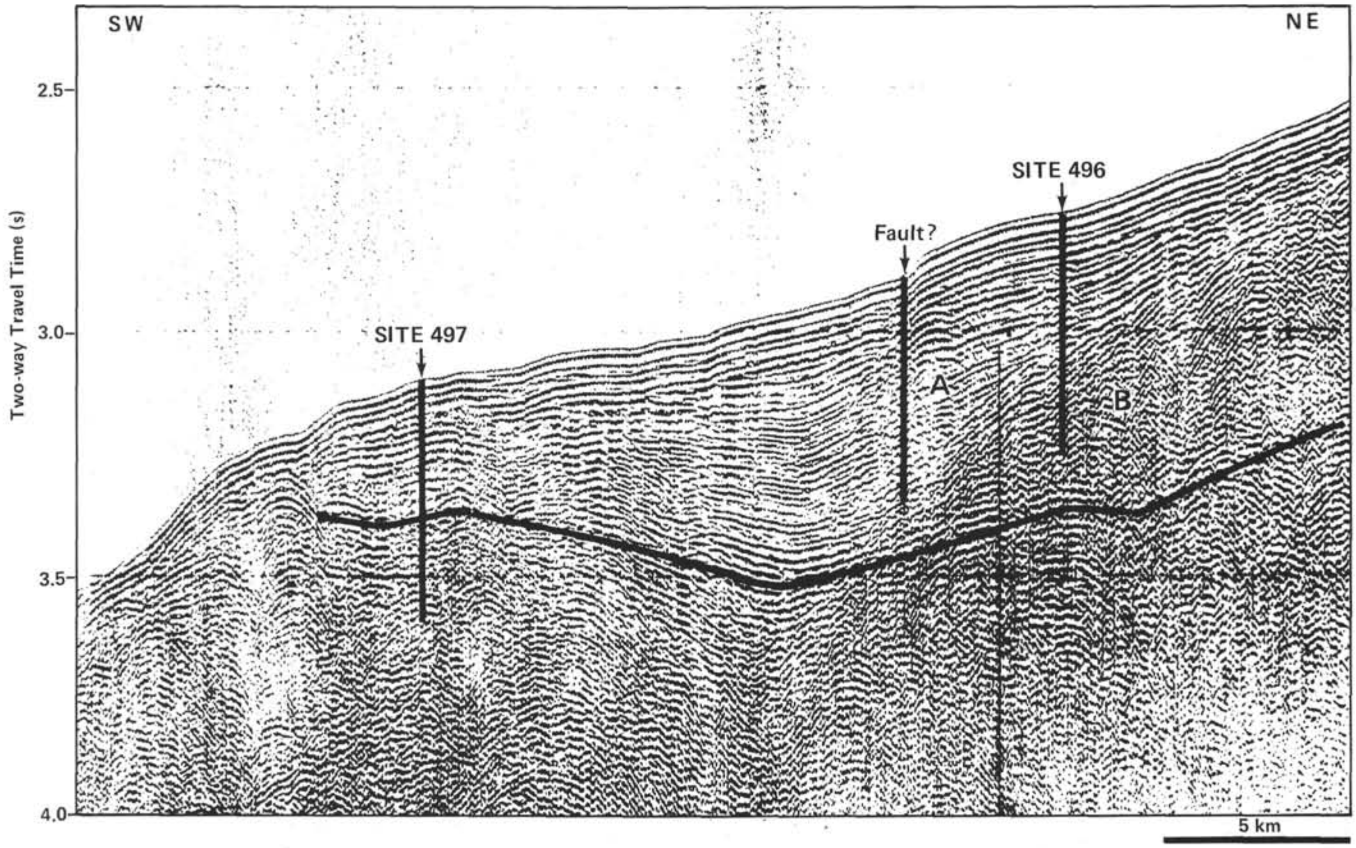

Figure 7. Seismic reflection profile across Site 496.

previously outlined, benthic foraminifers show a progressive shoaling downsection: Cores 31, Section 3, through 33, Section 5, contain middle bathyal (600–1300 m) indicators such as *Lenticulina, Sphaeroidina bulloides, Valvulineria, Bolivina*, and *Rectuvigerina;* below Core 34, Section 1, upper bathyal (150–600 m) species occur such as *Textularia, Siphonina, Stainforthia, Angulogerina*, and *Nonionella labradorica;* Samples 496-39,CC and Section 496-40-1 contain the shelf species *Rectobolivina hancocki* and *Frondicularlia* sp. along with abundant plant debris and ostracodes.

Radiolarians

Radiolarians are moderately well preserved in all cores of Hole 496, although the assemblages were often very diluted by terrigenous mud. Cores 1 through 23 contain Quaternary radiolarians. *Axoprunum angelinum*, extinct 400,000 yr. ago, was first noted in Sample 496-16-1, 30–32 cm. Cores 22 and 23 are considered to be in the lower Quaternary *Anthocyrtidium angulare* Zone because of the presence of *A. angulare* and *Theocorythium vetulum*.

Radiolarians are rare in Cores 24 through 26, but there are occurrences of *Didymocyrtis penultima, D. laticonus*, and *Stichocorys delmontensis;* these are Miocene to Pliocene forms and are probably reworked.

The presence of *D. penultima, D. avita*, and *S. peregrina* places Core 27 in the upper Pliocene *Spongaster pentas* Zone.

A sample from Core 29 contains a sparse assemblage, but the specimens present are in good numbers and are diagnostic of the middle Miocene *Diartus petterssoni* Zone. This short zone includes the interval from 10.7 to 11.2 Ma. The diagnostic species are: *D. petterssoni* in greater numbers than *D. hughesi, D. laticonus* in greater numbers than *D. antepenultima*, and *Stichocorys delmontensis*.

Sample 496-30-3, 45–47 cm contains several specimens of *Lithopera thornburgi*, a short-ranged species from the upper part of the middle Miocene. In this sample, radiolarians are common and well preserved and indicate the *Dorcadospyris alata* Zone.

Cores 31 through 40 are all probably from the *Calocycletta costata* Zone of the lower Miocene. Although *C. costata* is rare, the presence of *Dorcadospyris dentata, Liriospyris stauropora, Eucyrtidium diaphanes, Carpocanopsis cingulata*, and *Didymocyrtis violina* in greater numbers than *D. tubarius* and the absence of *Lychnocanoma elongata* indicate the *D. costata* Zone.

Nannoplankton

Hole 496 nannoplankton are well preserved. The amount of nannoplankton ranges from rare to abundant; the usual abundance is few to common.

The interval from Core 1 to Core 24 contains typical Quaternary assemblages. In Cores 13, 16, and 19 very rare reworked Neogene discoasters are present (*Discoaster brouweri, D. quinqueramus, D. deflandrei*).

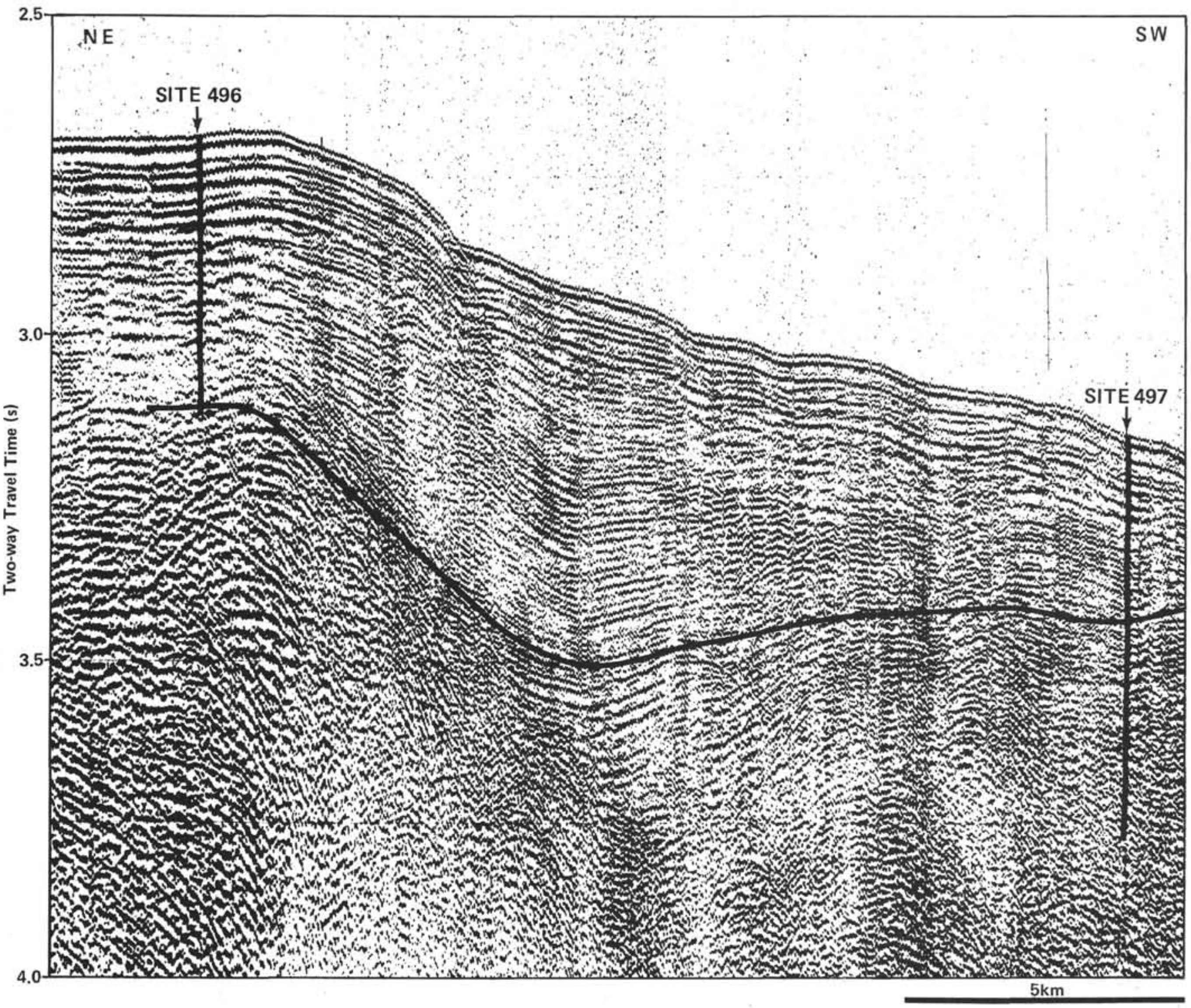

Figure 8. Seismic reflection profile across Site 496.

Core 25 to Sample 496-26-3, 30–32 cm are placed in the lower Pliocene *Discoaster brouweri* Zone. That assemblage includes *D. brouweri, D. pentaradiatus, D. variabilis, C. rugosus*, and others. The assemblage of Sample 496-26-3, 67–69 cm belongs to *Reticulofenestra pseudoumbilica* Zone and is remarkable for the presence of small sphenoliths.

Assemblages of Cores 27 to 28 contain *D. intercalaris, D. berggrenii, D. quinqueramus, D. variabilis, D. brouweri, D. surculus*, and other species of the upper Miocene *D. quinqueramus* Zone.

The interval from Cores 29 to 30 contains a single sample (496-30-2, 40–42 cm) with pure nannoflora. This sample may belong to the *Discoaster exilis* Zone (middle Miocene).

The lowermost part of Core 30 (Sections 7, 8 and the core-catcher sample) corresponds to the *Sphenolithus heteromorphus* Zone.

Beginning with Core 31 and continuing downhole to Core 40, assemblages have a nearshore character. Nannoplankton of this interval include *Helicosphaera ampliaperta, S. heteromorphus, D. deflandrei, D. signus*, and other species of upper lower Miocene *H. ampliaperta* Zone. In Cores 37 and 40 rare, reworked upper middle Eocene *Reticulofenestra umbilica, Cruciplacolithus delus, D. barbadiensis* occur.

GEOCHEMISTRY

Organic Geochemistry

The location of Site 496 with respect to both water and proximity to previous exploration made it mandatory that the shipboard hydrocarbon monitoring program be conducted in a thorough and expedient manner. The program consisted of three independent measurements. Gas samples were taken through the core liners and analyzed with the Carle and Hewlett-Packard chromatographs. An Imco fluoroscope was used to check possible petroleumlike material for fluorescence. The Rock-Eval was used to check for samples with unusually

Series	Sample (hole-core-section, interval in cm)	Approximate Sub-bottom Depth of Boundary (m)	Basis for Boundary Position
Quaternary	496-1 → 24		
		226	Top of *D. brouweri* Zone
upper Pliocene	496-25-1 → 26-3, 70 cm		
		239.2	Top of *R. pseudoumbilica* Zone
lower Pliocene	496-26-3, 70 cm → 26, CC		
		245	Nannofossils: *D. quinqueramus* Zone
lower Pliocene/ upper Miocene	496-27-1 → 28,CC		
		264	Radiolarians: *S. pentas* Zone Nannofossils: *?D. exilis* Zone
middle Miocene	496-29-1 → 31,CC		
		300	Bottom of N9 *Sphenolithus heteromorphus* Zone (nannofossils)
lower Miocene	496-33-1 → 40		
		T.D. 378	

Figure 9. Stratigraphic series at Site 496.

high indigenous hydrocarbon concentrations. Gas samples were collected from every core that had suitable recovery, whereas fluoroscope and Rock-Eval determinations, both of which require hand-picked samples from slabbed core, were made only at irregular intervals.

Figure 12 shows the methane/ethane ratios for Site 496 samples. The ratio values are greater than 100,000 for sub-bottom depths of 0 to 100 meters. Ratios decrease with depth until, at about 320 meters, the values are less than 5500. Finally, gas samples taken from core material at approximately 350, 360, and 370 meters sub-bottom depth have C_1/C_2 (methane/ethane) ratios of 1200, 1650, and 1050, respectively. The last three samples also contain hydrocarbons up to pentane (C_5). The C_2 and heavier hydrocarbon species are taken as evidence of proximity to petroleum; thus at approximately 370 meters sub-bottom depth, drilling at Site 496 was terminated for both safety and environmental considerations.

Figure 13 shows the methane and ethane concentrations as a function of depth. The methane content gradually increases from about 75% at 100 to 120 meters (average of four samples in 96–123-meter interval is 74.4%) to about 85% at 315 to 350 meters (average of four samples in the 316–350-meter interval is 85.3%). Deviations from this systematic increase appear to be the result of sampling problems. Ethane concentrations are very low (less than 15 ppm) from sub-bottom depths of 0 to 150 meters. At about 170 meters, concentrations of ethane begin to increase. Between 170 meters and T.D. (total depth of the hole), ethane levels undergo an average increase of about 30 ppm per 10 meters of penetration. Thus evidence provided by the gas-monitoring program indicates that continued drilling at Site 496 might have resulted in penetration of the stratigraphic horizon that is the source of the ethane.

Figure 14 shows the distribution of neopentane (a C_5 isomer) and isobutane (a C_4 isomer). Analyses of Site 494 samples suggest a diagenetic relationship between these two species. It was postulated that neopentane, by loss of a methyl group, might be converted to isobutane. Isobutane levels are greater than those of neopentane throughout most of the hole, although the greatest differences exist at 40 to 80 meters, 150–190 meters, and 230–360 meters. Greater differences in the lower one-third of the borehole may provide subtle evidence that the relation suggested at Site 494 is in effect. However, lack of neopentane concentrations that are greater than isobutane levels in the upper portion of the hole constitutes a problem for the proposed relation. Alternatively, the neopentane-to-isobutane conversion may have already occurred or the species are unrelated in this particular setting.

Inorganic Geochemistry

Figure 15 shows the results of shipboard *p*H, salinity, chlorinity, alkalinity, calcium, and magnesium determinations. The *p*H values are essentially uniform from the top to the bottom of the hole. Salinity, alkalinity, chlorinity, and magnesium concentrations show increases (or remain constant) from 0 to 80 meters and then all four parameters decrease drastically with depth. Calcium content remains fairly constant from about 8 meters to T.D. (total depth).

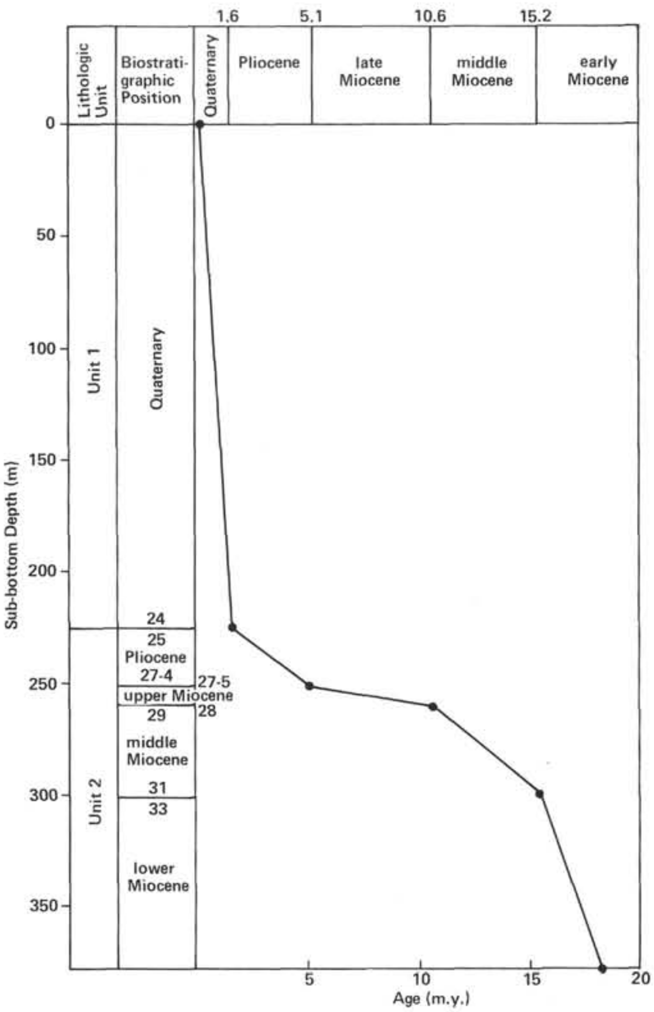

Figure 10. Sedimentation rate at Site 496. (Numbers in Biostratigraphic Position column refer to cores and sections of Hole 496.)

SUMMARY AND CONCLUSIONS

Drilling at Site 496 ended 500 meters short of the target, a landward-dipping reflector at the top of a high-velocity body thought to be ocean crust (Ladd et al., 1978; Ibrahim et al., 1979). The sediments above the dipping reflector appear to drape unconformably the sediments and rock that make up the bulk of the continental margin. Drill samples from Site 496 show that the cover includes an upper sequence of Quaternary biogenic mud (0–226 m), and a lower sequence of similar but semilithified Pliocene to Miocene sandy mudstone (226–387 m). Both units are rich in terrigenous detritus and contain some volcanic ash and rare lignite.

All microfossil groups were recovered from this section. Radiolarians are diluted by terrigenous debris, and reworked older species indicate a source of older rock. Nannoplankton are rare to abundant. Above 283 meters, the calcareous nannoplankton assemblages are oceanic; below 283 meters, they are typical of shallow water. Benthic foraminifers also indicate subsidence of this area in the Miocene, from shelf to lower bathyal depths. A well-defined reduction in rates of sedimentation or perhaps a hiatus occurs in the upper Miocene and Pliocene. Alternatively, a buried slump block may have been penetrated.

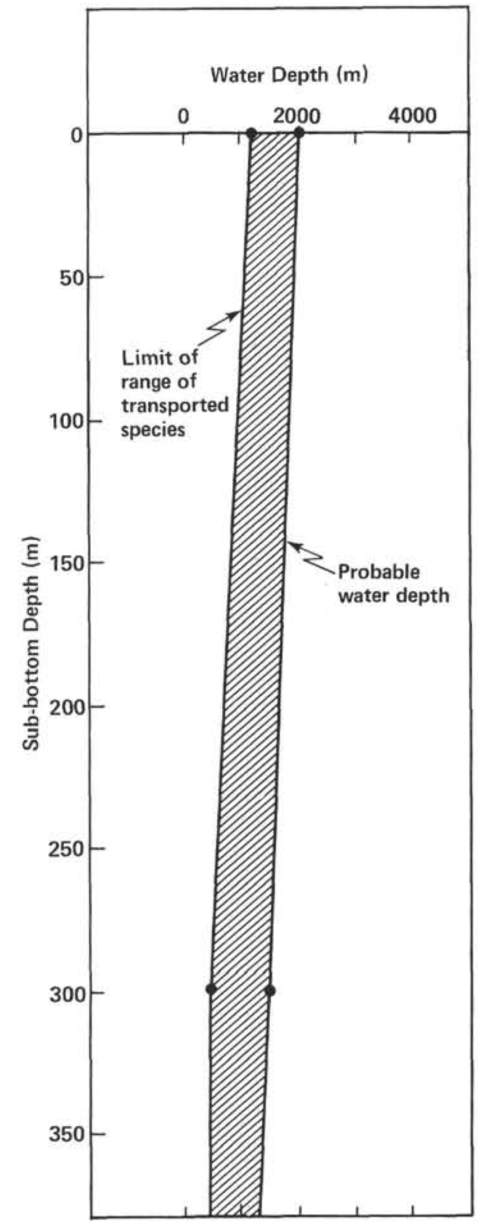

Figure 11. Paleobathymetry on the basis of benthic foraminifers at Site 496.

Physical-properties measurements show a clear difference between the upper, soft mud and the lower, semilithified mudstone. No velocity measurements were possible because of gas content. The upper sediment appears underconsolidated, whereas the lowermost sediment appears overconsolidated.

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Ladd, J. W., Ibrahim, A. K., McMillen, K. J., Latham, G. V., von Huene, R. E., Watkins, J. E., Moore, J. C., and Worzel, J. L., , 1978. Tectonics of the Middle America Trench off-shore Guatemala. *Int. Symp. of the Guatemala 4 February Earthquake and Reconstruction Process* (Vol. 1), Guatemala City, May 1978.

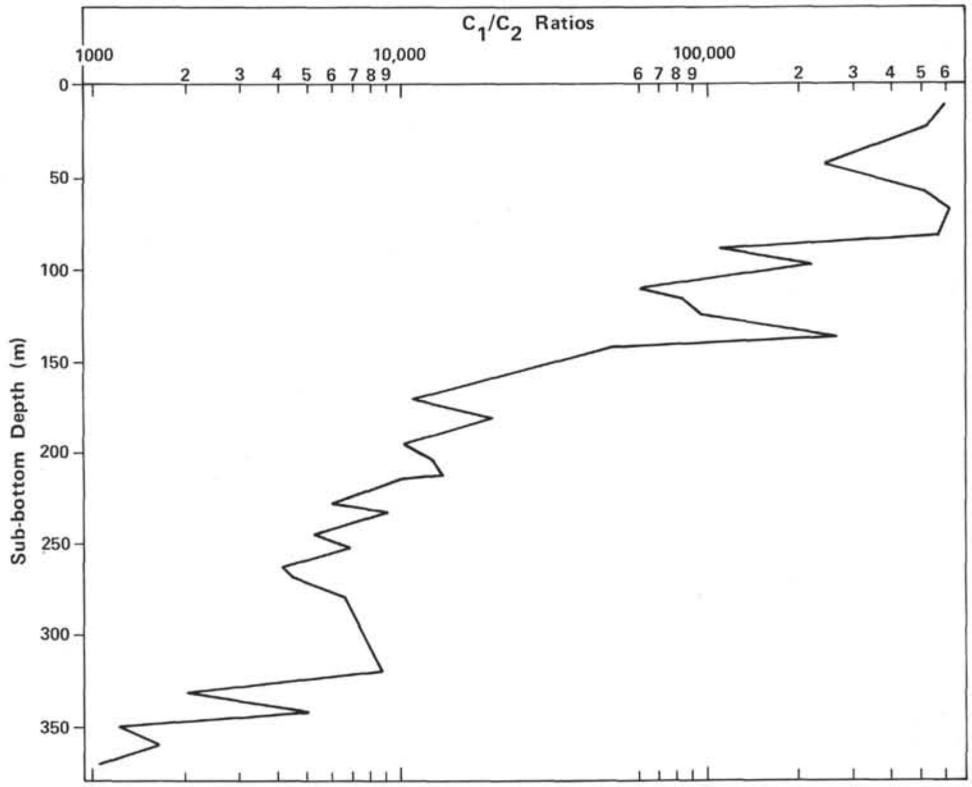


Figure 12. Methane/ethane ratios at Site 496.

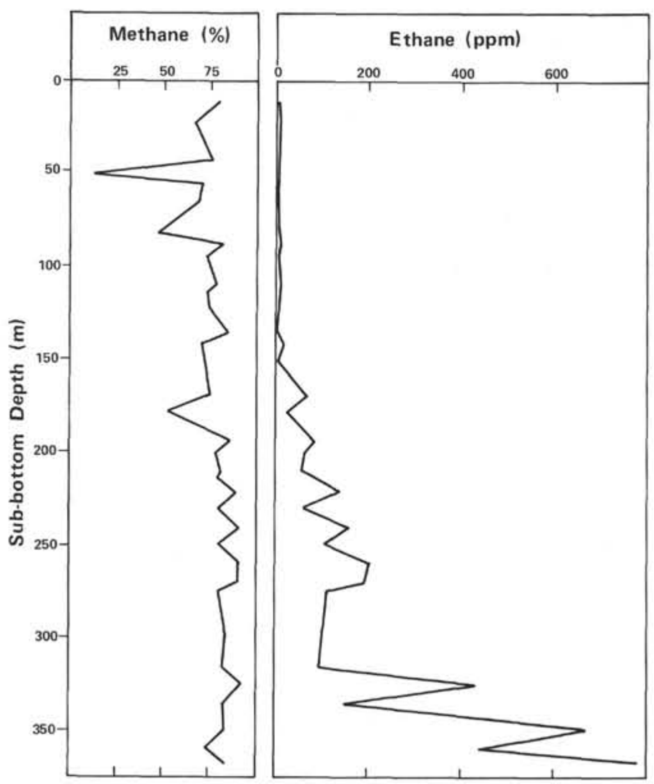


Figure 13. Methane and ethane concentrations at Site 496.

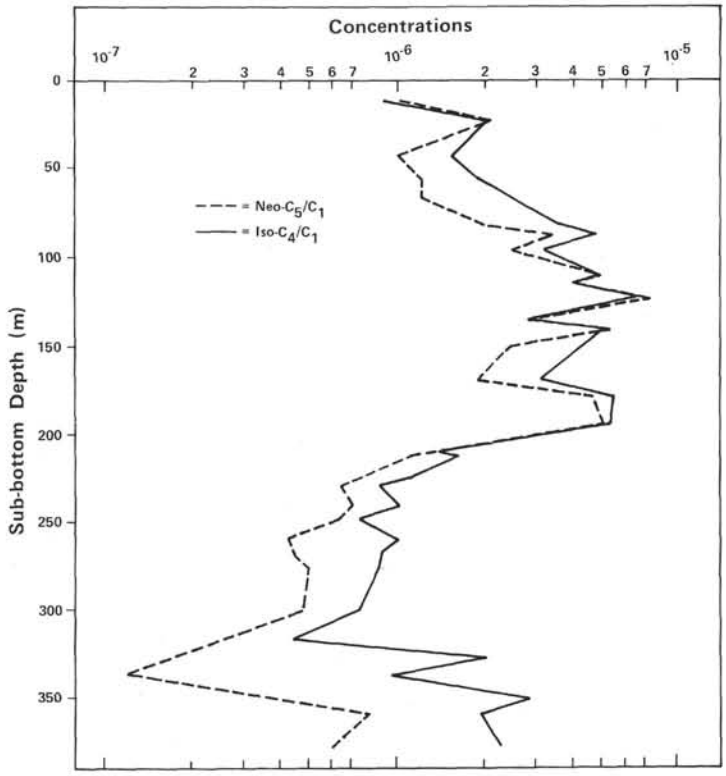


Figure 14. Neopentane and isobutane concentrations at Site 496.

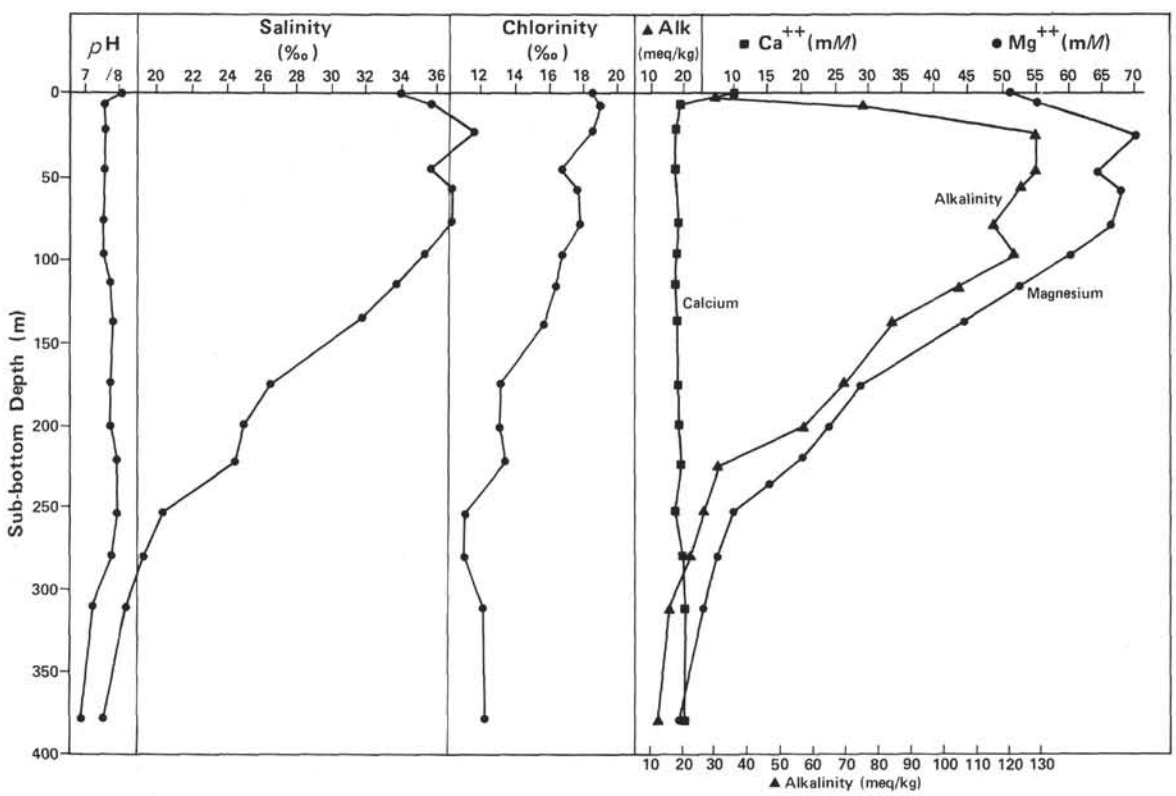


Figure 15. Interstitial water data at Site 496.

SITE 496 HOLE CORE 1 CORED INTERVAL 0.0–7.5 m

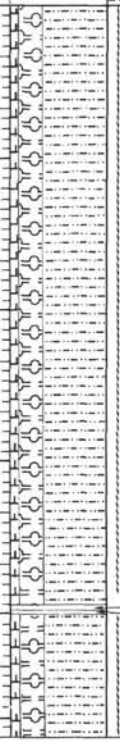
TIME – ROCK UNIT: QUATERNARY

BIOSTRATIGRAPHIC ZONE: *N. eggeri* (F); *C. tuberosa* (R); *C. doronicoides–E. huxleyi* (N)

FOSSIL CHARACTER: FORAMINIFERS: AM; NANNOFOSSILS: FG; RADIOLARIANS: CG

SECTION: 1, 2, 3, 4, 5, CC

METERS: 0.5, 1.0



LITHOLOGIC DESCRIPTION

5Y 5/1–3/2

5Y 4/1–4/2

5Y 3/2–4/1

OG

IW

5Y 3/2

DIATOMACEOUS MUD

Very dark gray to olive gray (5Y 4/1–3/2) and olive gray to olive (5Y 4/2–4/3). Intense H_2S order and bubbles on surface.

Section 1: Pyrite at 120 and 140 cm.

Section 2: Degassing bubbles at surface.

SMEAR SLIDE SUMMARY

	1-12	5-74
TEXTURE:		
Sand	10	5
Silt	22	30
Clay	68	65
COMPOSITION:		
Quartz	3	1
Feldspar	1	1
Pyrite	2	2
Other heavy minerals	–	2
Clay minerals	31	27
Volcanic glass	8	16
Glauconite	3	3
Zeolite	8	10
Calc.-Dolo.-Arag.	–	TR
Foraminifers	2	5
Calc. nannofossils	12	10
Diatoms	25	15
Radiolarains	1	2
Sponge spicules	3	1
Organic matter	TR	3
Silicoflagellates	1	2

CARBON-CARBONATE (%)

	3, 64–66
Organic Carbon	2.29
Total Carbonate	8.0

SITE 496 HOLE CORE 2 CORED INTERVAL 7.5–17.0 m

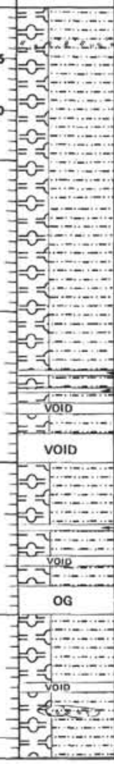
TIME – ROCK UNIT: QUATERNARY

BIOSTRATIGRAPHIC ZONE: *A. ypsilon* (R); *N. eggeri* (F); *C. doronicoides–E. huxleyi* (N)

FOSSIL CHARACTER: FORAMINIFERS: AM; NANNOFOSSILS: FG; RADIOLARIANS: RG

SECTION: 1, 2, 3, 4, 5, CC

METERS: 0.5, 1.0



LITHOLOGIC DESCRIPTION

5Y 3/2

5Y 3/2–4/2

5Y 4/2

VOIDS

VOID

5Y 4/2

5Y 3/2

5Y 5/3

5Y 4/2

DIATOMACEOUS MUD

Some ash layers and intense H_2S odor and many small voids induced by degassing in all the core.

SMEAR SLIDE SUMMARY

	1-125	5-37	5-90	CC-6
TEXTURE:				
Sand	6	40	10	15
Silt	29	30	40	65
Clay	65	30	50	20
COMPOSITION:				
Quartz	3	10	2	1
Feldspar	1	15	TR	1
Pyrite	3	5	5	1
Other heavy minerals	–	3	–	–
Clay minerals	30	30	30	2
Volcanic glass	12	5	25	90
Glauconite	2	1	–	1
Zeolite	2	5	1	–
Calc.-Dolo.-Arag.	–	3	–	1
Foraminifers	1	–	1	–
Calc. nannofossils	6	1	6	1
Diatoms	36	–	25	1
Radiolarians	TR	–	1	–
Sponge spicules	3	–	2	–
Silicoflagellates	1	–	2	–
Organic matter	TR	–	TR	–
Micronodules	–	–	1	–
Palagonite	–	2	–	–
Unknown sediment minerals	–	20	–	–

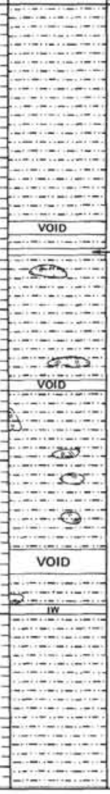
CARBON-CARBONATE (%)

	3, 100–105
Organic Carbon	3.18
Total Carbonate	5.0

SITE 496 HOLE CORE 3 CORED INTERVAL 17.0–26.5 m

TIME-ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS
QUATERNARY	N. eggeri (F)	AM		CG		1, 2, 3, 4	0.5, 1.0
	A. ypsilon (R)					5, CC	

GRAPHIC LITHOLOGY



DRILLING DISTURBANCE / SEDIMENTARY STRUCTURES / SAMPLES

LITHOLOGIC DESCRIPTION

5Y 3/2

5Y 3/2 and 5Y 4/2

VOID

Ash patch

5Y 3/2

Ash patches

Ash patches

5Y 3/2
Ash layers 5Y 7/1

5Y 3/2
Ash layers 5Y 7/1

HEMIPELAGIC MUD
Predominant color dark olive gray (5Y 3/2) with 5Y 4/2 and ash patches 5Y 7/1 and 5Y 2/2. Intense H_2S ordor and little fractures induced by degassing.

SMEAR SLIDE SUMMARY

	3-115	5-129
TEXTURE:		
Sand	50	80
Silt	40	15
Clay	10	5
COMPOSITION:		
Quartz	20	–
Feldspar	10	20
Pyrite	3	–
Other heavy minerals	2	65 (Opaques)
Clay minerals	10	2
Volcanic glass	45	5
Glauconite	1	–
Calc.-Dolo.-Arag.	5	2
Foraminifers	–	2
Calc. nannofossils	–	3
Diatoms	2	–
Sponge spicules	1	–
Palagonite	1	–

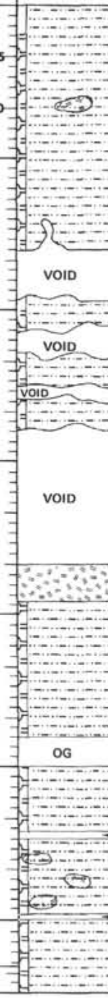
CARBON-CARBONATE (%)

	3, 80–84
Organic Carbon	2.74
Total Carbonate	5.5

SITE 496 HOLE CORE 5 CORED INTERVAL 36.0–45.5 m

TIME-ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS
QUATERNARY	C. doronicoides–E. huxleyi (N); N. eggeri (F)	AM				1, 2, 3, 4, 5	0.5, 1.0
	A. ypsilon (R)		FG			6, 7, CC	

GRAPHIC LITHOLOGY



DRILLING DISTURBANCE / SEDIMENTARY STRUCTURES / SAMPLES

LITHOLOGIC DESCRIPTION

SITE 496, CORE 4, 26.5–36.0 m: NO RECOVERY.

5Y 4/2 (mud in general)
5Y 3/1 (ash layer)

5Y 8/1 ash layer

5Y 3/1
groundmass

5Y 6/1–5/1
ash

VOID

IW

5Y 3/1–2/1

HEMIPELAGIC MUD
H_2S odor and degassing voids throughout.

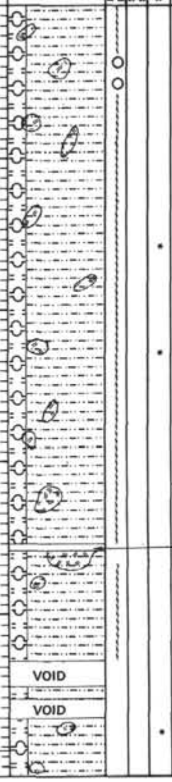
SMEAR SLIDE SUMMARY

	2-80	CC-25
TEXTURE:		
Sand	80	5
Silt	14	35
Clay	6	60
COMPOSITION:		
Quartz	5	5
Feldspar	2	5
Pyrite	3	5
Other heavy minerals	2	–
Clay minerals	4	45
Volcanic glass	82	15
Foraminifers	TR	1
Calc. nannofossils	–	5
Diatoms	TR	3
Radiolarians	–	3
Sponge spicules	1	5
Others	–	8

CARBON-CARBONATE (%)

	3, 54–58
Organic Carbon	3.60
Total Carbonate	4.0

SITE 496 HOLE CORE 6 CORED INTERVAL 45.5–55.0 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES	LITHOLOGIC DESCRIPTION
QUATERNARY	N. eggeri (F) / A. ypsilon (R)	AM		RG		1, 2, 3, 4, 5, CC	0.5, 1.0					5Y 3/2; 5Y 4/2–3/2; 5Y 4/2; VOID

DIATOMACEOUS MUD

Ash beds deformed into ball-like aggregates.
Note: disturbed by drilling and degassing throughout.

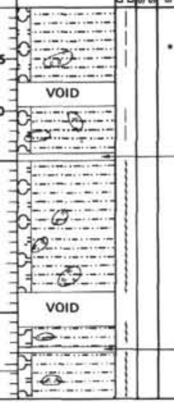
SMEAR SLIDE SUMMARY

	2-81	3-44	5-114
TEXTURE:			
Sand	3	15	8
Silt	30	55	42
Clay	65	30	50
COMPOSITION:			
Quartz	15	5	4
Feldspar	10	2	2
Pyrite	5	2	2
Other heavy minerals	–	–	1
Clay minerals	15	20	35
Volcanic glass	25	40	20
Glauconite	3	–	1
Zeolite	5	5	1
Foraminifers	3	5	TR
Calc. nannofossils	2	5	1
Diatoms	5	5	28
Radiolarians	2	5	–
Sponge spicules	3	2	2
Silicoflagellates	7	4	1
Organic matter	–	–	TR

CARBON-CARBONATE (%)

	3, 65–69
Organic Carbon	2.67
Total Carbonate	2.5

SITE 496 HOLE CORE 7 CORED INTERVAL 55.0–64.5 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES	LITHOLOGIC DESCRIPTION
QUATERNARY	N. eggeri (F) / C. doronicoides–E. huxleyi (N)	AG	CG			1, 2, 3, CC	0.5, 1.0					5Y 4/2; IW; VOID

HEMIPELAGIC MUD

Dark olive gray (5Y 4/2) and ash clasts 5Y 3/1 to 10Y 2.5/0. Disturbed by drilling and degassing throughout. Small fractures induced by degassing.

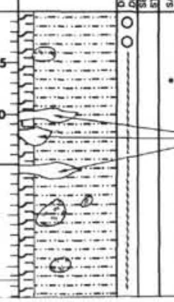
SMEAR SLIDE SUMMARY

	1-39 (ash patch)
TEXTURE:	
Sand	60
Silt	30
Clay	10
COMPOSITION:	
Quartz	2
Feldspar	3
Pyrite	2
Volcanic glass	90
Calc.-Dolo.-Arag.	1
Sponge spicules	2

CARBON-CARBONATE (%)

	3, 19–23
Organic Carbon	3.03
Total Carbonate	7.5

SITE 496 HOLE CORE 8 CORED INTERVAL 64.5–74.0 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES	LITHOLOGIC DESCRIPTION
QUATERNARY	A. ypsilon (R) / N. eggeri (F) / C. doronicoides–E. huxleyi (N)	AM	CG			1, 2, CC	0.5, 1.0					5Y 4/2; VOIDS

HEMIPELAGIC MUD

Dark olive gray (5Y 4/2) with 5Y 3/2 ashy clasts. Disturbed by drilling and degassing throughout.

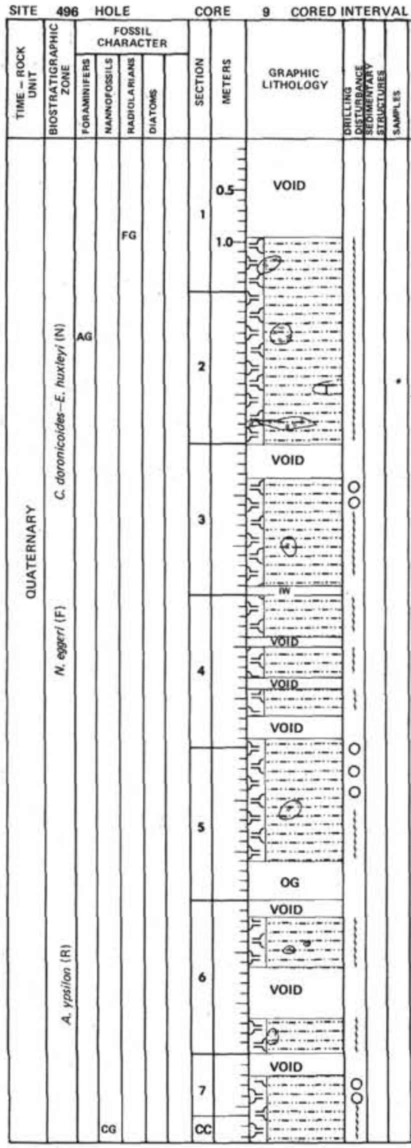
SMEAR SLIDE SUMMARY

	1-67
TEXTURE:	
Sand	10
Silt	30
Clay	60
COMPOSITION:	
Quartz	5
Feldspar	3
Pyrite	4
Clay minerals	50
Volcanic glass	10
Zeolite	1
Calc.-Dolo.-Arag.	2
Foraminifers	5
Calc. nannofossils	3
Diatoms	5
Radiolarians	5
Sponge spicules	5
Silicoflagellates	2

CARBON-CARBONATE (%)

	2, 100–105
Organic Carbon	4.26
Total Carbonate	5.0

SITE 496 HOLE CORE 9 CORED INTERVAL 74.0–83.5 m



LITHOLOGIC DESCRIPTION

5Y 3/2

5Y 3/1 ashy patches

← Benthic foraminifera

DIATOMACEOUS MUD
Degassing voids throughout.

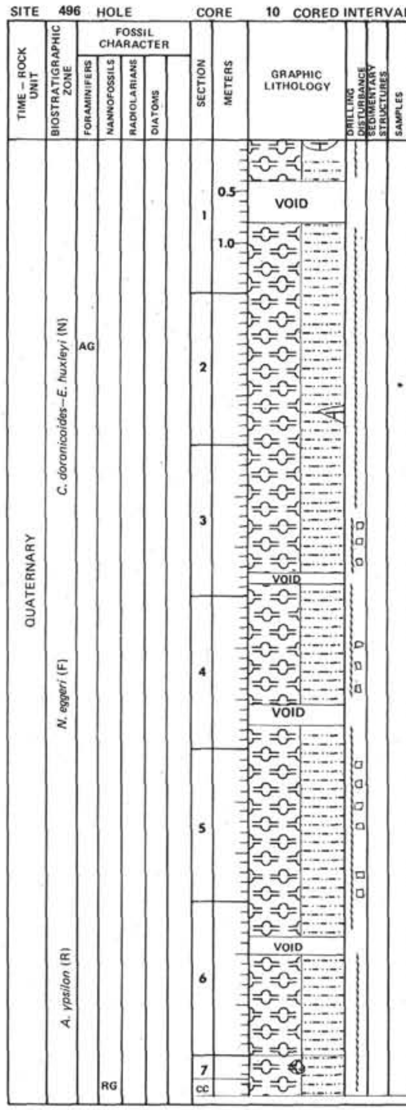
SMEAR SLIDE SUMMARY

	2-82 (foraminifera-rich patch)
TEXTURE:	
Sand	75
Silt	15
Clay	10
COMPOSITION:	
Quartz	10
Feldspar	5
Clay minerals	10
Glauconite	20
Foraminifers	55

CARBON-CARBONATE (%)

	2, 102–104
Organic Carbon	2.39
Total Carbonate	5.0

SITE 496 HOLE CORE 10 CORED INTERVAL 83.5–93.0 m



LITHOLOGIC DESCRIPTION

← Foraminifera-rich patch

5Y 3/2

← Patch of benthic foraminifers

Intermittent voids

← 5Y 7/3 ash patch

Intermittent voids

DIATOMACEOUS MUD
Degassing voids throughout. Some drill laminations beginning to form in Section 2.

SMEAR SLIDE SUMMARY

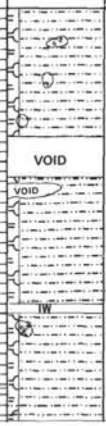
	2-96
TEXTURE:	
Sand	58
Silt	24
Clay	18
COMPOSITION:	
Quartz	5
Pyrite	1
Clay minerals	10
Volcanic glass	5
Glauconite	10
Calc.-Dolo.-Arag.	3
Foraminifers	2
Calc. nannofossils	5
Diatoms	44
Radiolarians	3
Sponge spicules	5
Silicoflagellates	5
Ostracods	2

CARBON-CARBONATE (%)

	2, 31–34
Organic Carbon	2.44
Total Carbonate	8.0

SITE 496 HOLE CORE 11 CORED INTERVAL 93.0–102.5 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FOSSIL CHARACTER: FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS
QUATERNARY	*N. eggeri* (F)			RM		1	0.5, 1.0
						2	
	A. ypsilon (R)	AM				3	
			RM			CC	



Patches of volcanic glass

LITHOLOGIC DESCRIPTION

DIATOMACEOUS MUD
Dark olive gray (5Y 3/2). Section 2: mottled aspect; 100–115 cm degassing fractures. Section 3, 0–45 cm: degassing fractures.

SMEAR SLIDE SUMMARY

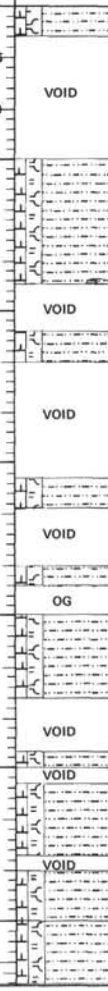
	CC-15
TEXTURE:	
Sand	37
Silt	23
Clay	40
COMPOSITION:	
Quartz	2
Pyrite	2
Clay minerals	40
Volcanic glass	25
Glauconite	3
Calc.-Dolo.-Arag.	8
Foraminifers	5
Diatoms	10
Radiolarians	3
Sponge spicules	1
Silicoflagellates	1

CARBON-CARBONATE (%)

	1, 72–75
Organic Carbon	2.83
Total Carbonate	5.5

SITE 496 HOLE CORE 12 CORED INTERVAL 102.5–112.0 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FOSSIL CHARACTER: FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS
QUATERNARY	*C. doronicoides–E. huxleyi* (N)					1	0.5, 1.0
		AG				2	
						3	
						4	
	N. eggeri (F)					5	
	A. ypsilon (R)					6	
			CG			7	
						CC	



5Y 3/2

Foraminifera-rich patch: unusual concentration of planktonic foraminifers

5Y 3/2–4/2

LITHOLOGIC DESCRIPTION

DIATOMACEOUS MUD
Dark olive gray (5Y 3/2). Section 2, 43–70 cm: degassing fractures. At 20 cm in Section 6: wood fragment.

SMEAR SLIDE SUMMARY

	2-120	7-20
TEXTURE:		
Sand	30	5
Silt	20	25
Clay	50	70
COMPOSITION:		
Quartz	–	4
Feldspar	1	TR
Pyrite	2	5
Other heavy minerals	1	–
Clay minerals	35	50
Volcanic glass	–	5
Glauconite	6	1
Foraminifers	35	TR
Calc. nannofossils	20	12
Diatoms	–	18
Radiolarians	–	TR
Sponge spicules	TR	3
Silicoflagellates	–	1

CARBON-CARBONATE (%)

	2, 40–43
Organic Carbon	2.22
Total Carbonate	21.0

SITE 496 HOLE CORE 13 CORED INTERVAL 112.0–121.5 m

TIME – ROCK UNIT: QUATERNARY

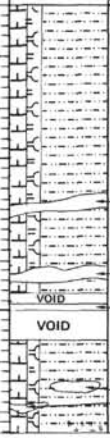
BIOSTRATIGRAPHIC ZONE: *C. doronicoides–E. huxleyi* (N); *A. ypsilon* (R); *N. eggeri* (F)

FOSSIL CHARACTER: FORAMINIFERS: CG, CG; NANNOFOSSILS; RADIOLARIANS: FG; DIATOMS

SECTION: 1, 2, 3, CC

METERS: 0.5, 1.0

GRAPHIC LITHOLOGY



DRILLING DISTURBANCE / SEDIMENTARY STRUCTURES / SAMPLES

LITHOLOGIC DESCRIPTION

5Y 2/2

VOID

VOID

IW

5Y 3/2

VOID

NANNOFOSSIL MUD
Black (5Y 2/2) and many small degassing voids. Biogenic components variable with no corresponding color change.

SMEAR SLIDE SUMMARY

	1-130
TEXTURE:	
Sand	6
Silt	20
Clay	74
COMPOSITION:	
Quartz	3
Feldspar	TR
Pyrite	3
Clay minerals	46
Volcanic glass	6
Glauconite	2
Zeolite	1
Foraminifers	5
Calc. nannofossils	18
Diatoms	6
Radiolarians	5
Sponge spicules	3
Silicoflagellates	TR

CARBON-CARBONATE (%)

	2, 32–34
Organic Carbon	3.15
Total Carbonate	15.0

SITE 496 HOLE CORE 14 CORED INTERVAL 121.5–131.0 m

TIME – ROCK UNIT: QUATERNARY

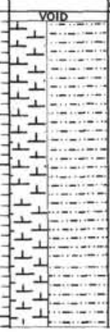
BIOSTRATIGRAPHIC ZONE: *A. ypsilon* (R); *N. eggeri* (F)

FOSSIL CHARACTER: FORAMINIFERS: AG; NANNOFOSSILS; RADIOLARIANS: FG; DIATOMS

SECTION: 1, 2, CC

METERS: 0.5, 1.0

GRAPHIC LITHOLOGY



DRILLING DISTURBANCE / SEDIMENTARY STRUCTURES / SAMPLES

LITHOLOGIC DESCRIPTION

5Y 3/1

NANNOFOSSUL MUD
Very dark gray (5Y 3/1). Foraminifera show up as white spots against dark background.

SMEAR SLIDE SUMMARY

	2-70
TEXTURE:	
Sand	5
Silt	25
Clay	70
COMPOSITION:	
Quartz	2
Pyrite	1
Clay minerals	30
Volcanic glass	5
Glauconite	2
Calc.-Dolo.-Arag.	5
Foraminifers	5
Calc. nannofossils	40
Diatoms	2
Radiolarians	3
Sponge spicules	2
Silicoflagellates	1
Plant debris	2

CARBON-CARBONATE (%)

	2, 32–34
Organic Carbon	2.02
Total Carbonate	12.0

SITE 496 HOLE CORE 15 CORED INTERVAL 131.0–140.5 m

TIME – ROCK UNIT: QUATERNARY

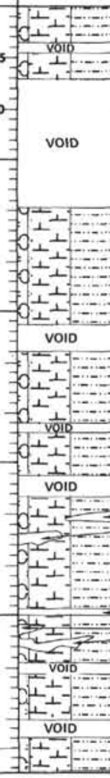
BIOSTRATIGRAPHIC ZONE: *C. doronicoides–E. huxleyi* (N); *N. eggeri* (F); *A. ypsilon* (R)

FOSSIL CHARACTER: FORAMINIFERS: AG, CG; NANNOFOSSILS; RADIOLARIANS: RG; DIATOMS

SECTION: 1, 2, 3, 4, 5, CC

METERS: 0.5, 1.0

GRAPHIC LITHOLOGY



DRILLING DISTURBANCE / SEDIMENTARY STRUCTURES / SAMPLES

LITHOLOGIC DESCRIPTION

5Y 3/2

VOID

IW

VOID

NANNOFOSSIL MUD
Dark olive gray (5Y 3/2). Section 1: isolated concentrations of foraminifera. Section 4: nannofossil-rich, glauconitic mud.

SMEAR SLIDE SUMMARY

	4-96
TEXTURE:	
Sand	10
Silt	30
Clay	60
COMPOSITION:	
Quartz	2
Mica	1
Pyrite	1
Clay minerals	22
Volcanic glass	2
Glauconite	8
Foraminifers	5
Calc. nannofossils	43
Diatoms	5
Radiolarians	1
Sponge spicules	10

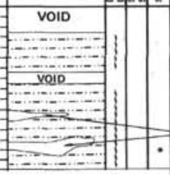
CARBON-CARBONATE (%)

	2, 76–78
Organic Carbon	2.04
Total Carbonate	11.0

SITE 496 HOLE CORE 16 CORED INTERVAL 140.5–150.0 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS
QUATERNARY	*A. ypsilon* (R) *N. eggeri* (F)	AM		FG		1, CC	0.5, 1.0

GRAPHIC LITHOLOGY — DRILLING DISTURBANCE — SEDIMENTARY STRUCTURES — SAMPLES



5Y 3/2

VOID

LITHOLOGIC DESCRIPTION

HEMIPELAGIC MUD
Not ooze because of important terrigenous component. Degassing voids and H_2S odor throughout. Smear slide from relatively stiff portion of core (representative of groundmass).

SMEAR SLIDE SUMMARY

	1-140
TEXTURE:	
Sand	8
Silt	40
Clay	52
COMPOSITION:	
Quartz	2
Feldspar	3
Pyrite	5
Clay minerals	50
Volcanic glass	6
Glauconite	1
Zeolite	2
Calc.-Dolo.-Arag.	20
Diatoms	TR
Radiolarians	1
Sponge spicules	8
Plant debris	2

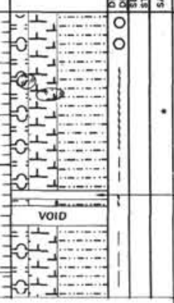
CARBON-CARBONATE (%)

	1, 112–116
Organic Carbon	3.98
Total Carbonate	7.0

SITE 496 HOLE CORE 17 CORED INTERVAL 150.0–159.5 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS
QUATERNARY	*A. ypsilon* (R) *N. eggeri* (F)	CM		FG		1, 2, CC	0.5, 1.0

GRAPHIC LITHOLOGY — DRILLING DISTURBANCE — SEDIMENTARY STRUCTURES — SAMPLES



5Y 3/2

VOID

LITHOLOGIC DESCRIPTION

NANNOFOSSIL MUD
Gassy sequence – degassing voids common. H_2S odor. Smear slide representative of groundmass.

SMEAR SLIDE SUMMARY

	1-91
TEXTURE:	
Sand	10
Silt	30
Clay	60
COMPOSITION:	
Feldspar	1
Mica	2
Pyrite	5
Clay minerals	20
Volcanic glass	2
Glauconite	5
Calc.-Dolo.-Arag.	10
Foraminifers	4
Calc. nannofossils	30
Diatoms	8
Radiolarians	5
Sponge spicules	8

CARBON-CARBONATE (%)

	2, 7–9
Organic Carbon	2.02
Total Carbonate	6.0

SITE 496 HOLE CORE 18 CORED INTERVAL 159.5–169.0 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS
	C. doronicoides–E. huxleyi (N)	FR				CC	

GRAPHIC LITHOLOGY — DRILLING DISTURBANCE — SEDIMENTARY STRUCTURES — SAMPLES

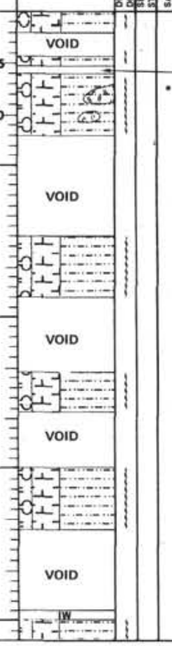
LITHOLOGIC DESCRIPTION

NANNOFOSSIL MUD
Dark olive gray (5Y 4/2). Total recovery approximately 12 cm. Odor of H_2S.

SITE 496 HOLE CORE 19 CORED INTERVAL 169.0–178.5 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS
QUATERNARY	*A. ypsilon* (R) *N. eggeri* (F) *C. doronicoides–E. huxleyi* (N)	CM, CG, CG		FG		1, 2, 3, 4, CC	0.5, 1.0

GRAPHIC LITHOLOGY — DRILLING DISTURBANCE — SEDIMENTARY STRUCTURES — SAMPLES



VOID

5Y 3/2–4/2

5Y 3/2

LITHOLOGIC DESCRIPTION

BIOGENIC-NANNOFOSSIL MUD
Gas-charged voids and H_2S odor.

SMEAR SLIDE SUMMARY

	1-73
TEXTURE:	
Sand	12
Silt	24
Clay	64
COMPOSITION:	
Quartz	2
Feldspar	1
Mica	2
Pyrite	2
Other heavy minerals	3
Clay minerals	18
Volcanic glass	5
Glauconite	7
Zeolite	5
Calc.-Dolo.-Arag.	3
Foraminifers	2
Calc. nannofossils	31
Diatoms	10
Radiolarians	1
Sponge spicules	5
Plant debris	3

CARBON-CARBONATE (%)

	1, 67–69
Organic Carbon	2.01
Total Carbonate	9.0

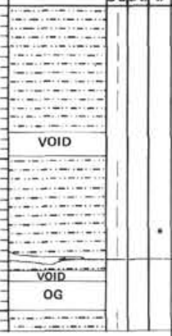
SITE 496 HOLE CORE 20 CORED INTERVAL 178.5–188.0 m

TIME – ROCK UNIT: QUATERNARY

BIOSTRATIGRAPHIC ZONE: *N. eggeri* (F); *A. ypsilon* (R)

FOSSIL CHARACTER: Foraminifers CM; Nannofossils FG; Radiolarians RM

SECTION: 1, 2, CC — METERS: 0.5, 1.0



LITHOLOGIC DESCRIPTION

5Y 3/1

VOID

HEMIPELAGIC MUD

More coherent intervals generally contain much reduced biogenic components.

SMEAR SLIDE SUMMARY

	2-70
TEXTURE:	
Sand	8
Silt	22
Clay	70
COMPOSITION:	
Quartz	1
Feldspar	2
Pyrite	4
Other heavy minerals	1
Clay minerals	68
Volcanic glass	8
Glauconite	2
Calc.-Dolo.-Arag.	3
Calc. nannofossils	4
Diatoms	5
Radiolarians	1
Sponge spicules	1

CARBON-CARBONATE (%)

	2, 70–76
Organic Carbon	2.67
Total Carbonate	3.0

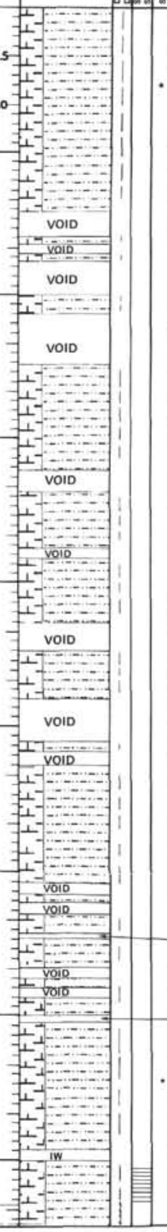
SITE 496 HOLE CORE 21 CORED INTERVAL 188.0–197.5 m

TIME – ROCK UNIT: QUATERNARY

BIOSTRATIGRAPHIC ZONE: *C. doronicoides–E. huxleyi* (N); *A. ypsilon* (R); *N. eggeri* (F)

FOSSIL CHARACTER: Foraminifers AG; Nannofossils FG; FG

SECTION: 1, 2, 3, 4, 5, 6, 7, 8, 9, CC — METERS: 0.5, 1.0



LITHOLOGIC DESCRIPTION

5Y 2/1

5Y 2/2

5Y 3/2

Dark olive nannofossil mud

5Y 3/2–4/2 with 5Y 2/2 streaks

VOID

VOID

Parallel laminations

NANNOFOSSIL MUD

Section 3, 0 cm–Section 4, 150 cm: Benthic foraminifera scattered throughout. White tests highlighted against black matrix.

SMEAR SLIDE SUMMARY

	1-76	8-70
TEXTURE:		
Sand	10	5
Silt	50	20
Clay	40	75
COMPOSITION:		
Quartz	3	3
Fedlspar	–	2
Pyrite	2	1
Other heavy minerals	2	1
Clay minerals	22	48
Volcanic glass	3	5
Glauconite	5	–
Zeolite	–	2
Calc.-Dolo.-Arag.	3	–
Foraminifers	5	5
Calc. nannofossils	29	25
Diatoms	5	–
Radiolarians	5	2
Sponge spicules	15	2
Plant debris	1	4

CARBON-CARBONATE (%)

	4, 30–32
Organic Carbon	2.45
Total Carbonate	8.0

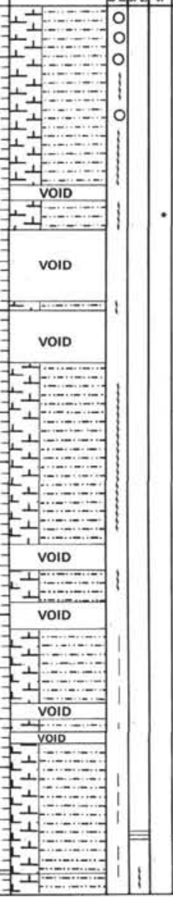
SITE 496 HOLE CORE 22 CORED INTERVAL 197.5–207.0 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS
QUATERNARY	*A. angulare* (R)	AG		RM	

SECTION: 1, 2, 3, 4, 5, 6, CC

METERS: 0.5, 1.0

GRAPHIC LITHOLOGY · DRILLING DISTURBANCE · SEDIMENTARY STRUCTURES · SAMPLES



5Y 3/2

5Y 3/2–4/2

Drilling induced?? parallel laminations 5Y 5/2–4/3

LITHOLOGIC DESCRIPTION

NANNOFOSSIL MUD
Dark olive gray (5Y 3/2) and H_2S odor. Rather homogeneous throughout core.

SMEAR SLIDE SUMMARY

	2-55
TEXTURE:	
Sand	5
Silt	15
Clay	80
COMPOSITION:	
Quartz	2
Pyrite	3
Clay minerals	40
Glauconite	1
Zeolite	4
Foraminifers	1
Calc. nannofossils	35
Diatoms	5
Sponge spicules	2
Others	7

CARBON-CARBONATE (%)

	2, 107–111
Organic Carbon	1.96
Total Carbonate	6.5

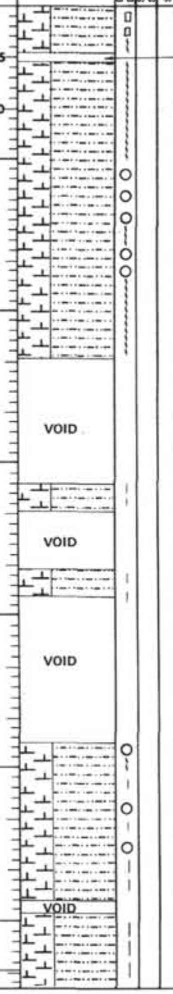
SITE 496 HOLE CORE 23 CORED INTERVAL 207.0–216.5 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS
QUATERNARY	*N. eggeri* (F) *A. angulare* (R)	AG	CG	RM	

SECTION: 1, 2, 3, 4, 5, 6, 7, CC

METERS: 0.5, 1.0

GRAPHIC LITHOLOGY · DRILLING DISTURBANCE · SEDIMENTARY STRUCTURES · SAMPLES



VOID

5Y 3/2

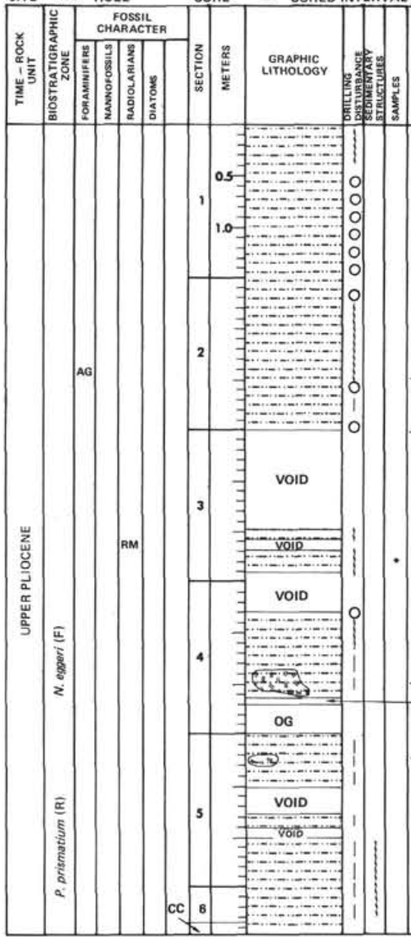
LITHOLOGIC DESCRIPTION

NANNOFOSSIL MUD
Dark olive gray (5Y 3/2) and H_2S odor. Degassing features (blebs and fractures). Hemipelagic mud in Section 7 and Core-Catcher.

CARBON-CARBONATE (%)

	2, 82–86
Organic Carbon	1.78
Total Carbonate	14.0

SITE 496 HOLE CORE 24 CORED INTERVAL 216.5–226.0 m



LITHOLOGIC DESCRIPTION

5Y 3/2

5Y 4/3–4/4
in soupy portions

Mostly void

5Y 4/2–3/2

5Y 8/1 ash

IW

Pale olive ash

Tuffaceous mud

Hemipelagic mud
black (5Y 2/1)

HEMIPELAGIC MUD
Degassing voids throughout and H_2S odor.

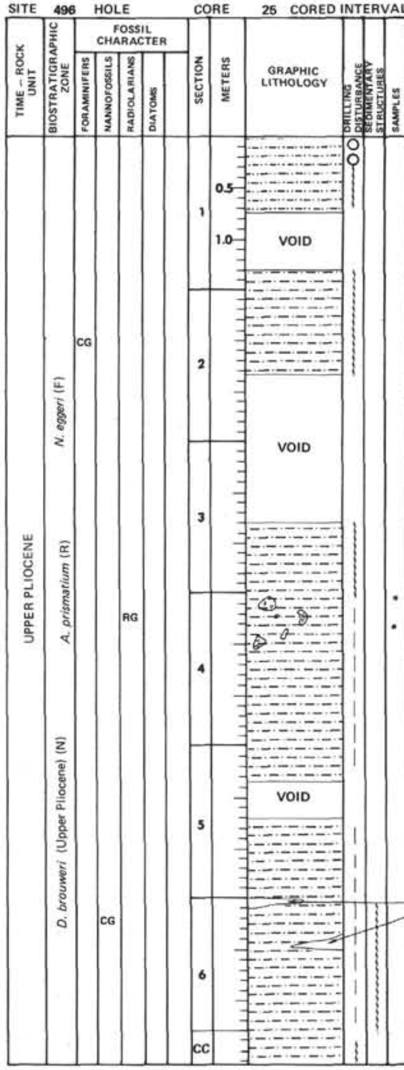
SMEAR SLIDE SUMMARY

	3-130
TEXTURE:	
Sand	20
Silt	55
Clay	25
COMPOSITION:	
Quartz	3
Pyrite	2
Clay minerals	40
Volcanic glass	15
Zeolite	5
Calc.-Dolo.-Arag.	5
Foraminifers	5
Calc. nannofossils	2
Diatoms	3
Radiolarians	3
Sponge spicules	2
Others	15

CARBON-CARBONATE (%)

	3, 126–131
Organic Carbon	2.64
Total Carbonate	9.0

SITE 496 HOLE CORE 25 CORED INTERVAL 226.0–235.5 m



LITHOLOGIC DESCRIPTION

5Y 3/2

5Y 6/3–5/3
sandy mud

Dark tuffaceous sand

Pumice at 32 cm
Sandy mud

VOID

SANDY MUD
Dark olive gray (5Y 3/2). Degassing voids throughout and H_2S odor. Section 4: green (5G 4/2) patches scattered throughout.

SMEAR SLIDE SUMMARY

	4-15	4-34
TEXTURE:		
Sand	60	25
Silt	25	15
Clay	15	60
COMPOSITION:		
Quartz	5	2
Feldspar	15	8
Pyrite	25	2
Other heavy minerals	–	3
Clay minerals	5	55
Volcanic glass	–	5
Glauconite	2	2
Zeolite	3	–
Calc.-Dolo.-Arag.	5	10
Foraminifers	–	3
Calc. nannofossils	TR	2
Fecal pellets	15	5
Plant debris	–	2

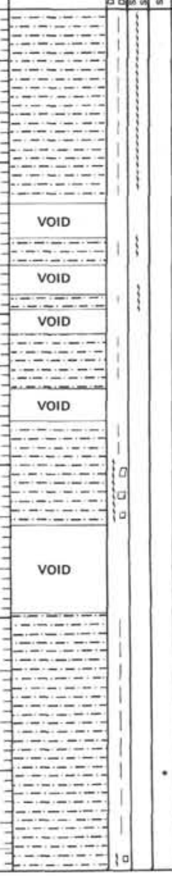
CARBON-CARBONATE (%)

	4, 127–133
Organic Carbon	1.05
Total Carbonate	8.0

SITE 496 HOLE CORE 26 CORED INTERVAL 235.5–245.0 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS
UPPER PLIOCENE	*P. prismatium* (R)					1	0.5, 1.0
	R. pseudoumbilica (Lower Pliocene) (N)	CG	EG	RM		2, 3, 4	
LOWER PLIOCENE	*G. fistulosus* (F)					5, 6, CC	

GRAPHIC LITHOLOGY · DRILLING DISTURBANCE · SEDIMENTARY STRUCTURES · SAMPLES



LITHOLOGIC DESCRIPTION

5Y 4/2

5Y 4/2–3/2

SANDY MUD
Olive gray (5Y 4/2) and degassing voids.

SMEAR SLIDE SUMMARY

	6-8
TEXTURE:	
Sand	60
Silt	30
Clay	10
COMPOSITION:	
Quartz	2
Feldspar	5
Other heavy minerals	2
Clay minerals	10
Glauconite	80

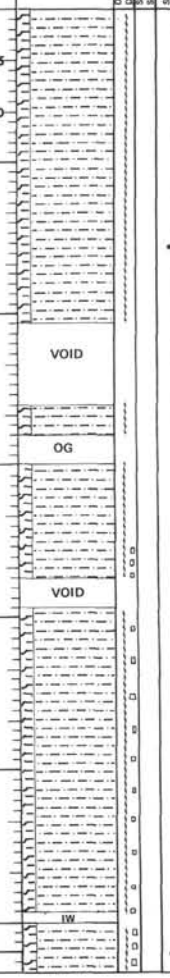
CARBON-CARBONATE (%)

	4, 38–40
Organic Carbon	1.14
Total Carbonate	4.0

SITE 496 HOLE CORE 27 CORED INTERVAL 245.0–254.5 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS
UPPER MIOCENE TO LOWER PLIOCENE	*S. pentas* (R)	CG		FM		1, 2, 3, 4, 5	0.5, 1.0
	UPPER MIOCENE *D. quinqueramus* (N)		AG			6, 7, CC	

GRAPHIC LITHOLOGY · DRILLING DISTURBANCE · SEDIMENTARY STRUCTURES · SAMPLES



LITHOLOGIC DESCRIPTION

5Y 3/2–4/2

5Y 3/2

DIATOMACEOUS SANDY MUD
Dark olive gray (5Y 3/2) with 5Y 4/3 patches. Glauconite grains scattered throughout.

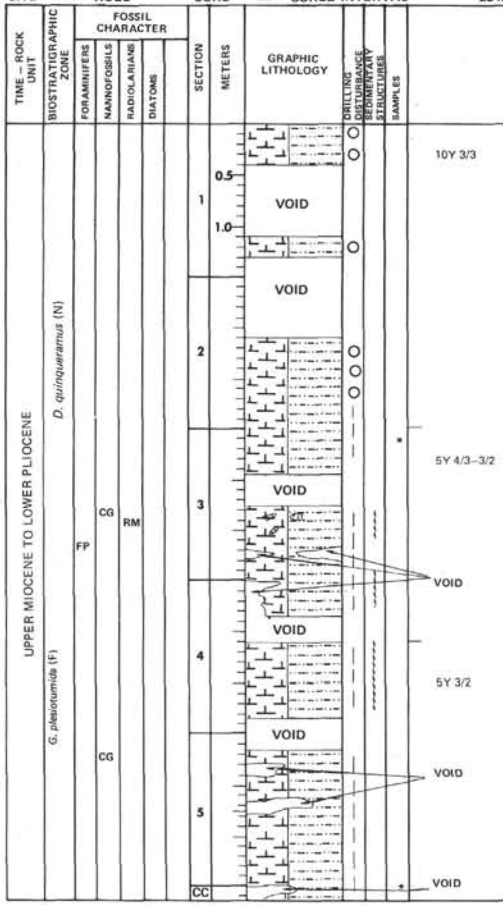
SMEAR SLIDE SUMMARY

	2-80	CC-10
TEXTURE:		
Sand	20	20
Silt	20	25
Clay	60	55
COMPOSITION:		
Quartz	12	5
Feldspar	TR	1
Mica	TR	–
Pyrite	5	3
Other heavy minerals	TR	TR
Clay minerals	25	50
Volcanic glass	35	6
Glauconite	TR	3
Calc.-Dolo.-Arag.	–	TR
Calc. nannofossils	5	15
Diatoms	15	12
Radiolarians	–	TR
Sponge spicules	2	3
Fecal pellets	TR	–
Silicoflagellates	–	1

CARBON-CARBONATE (%)

	4, 66–71
Organic Carbon	0.55
Total Carbonate	10.0

SITE 496 HOLE CORE 28 CORED INTERVAL 254.5–264.0 m



LITHOLOGIC DESCRIPTION

NANNOFOSSIL MUD

Gray-olive green (10Y 3/2). Section 5: sandy tuffaceous mud.

SMEAR SLIDE SUMMARY

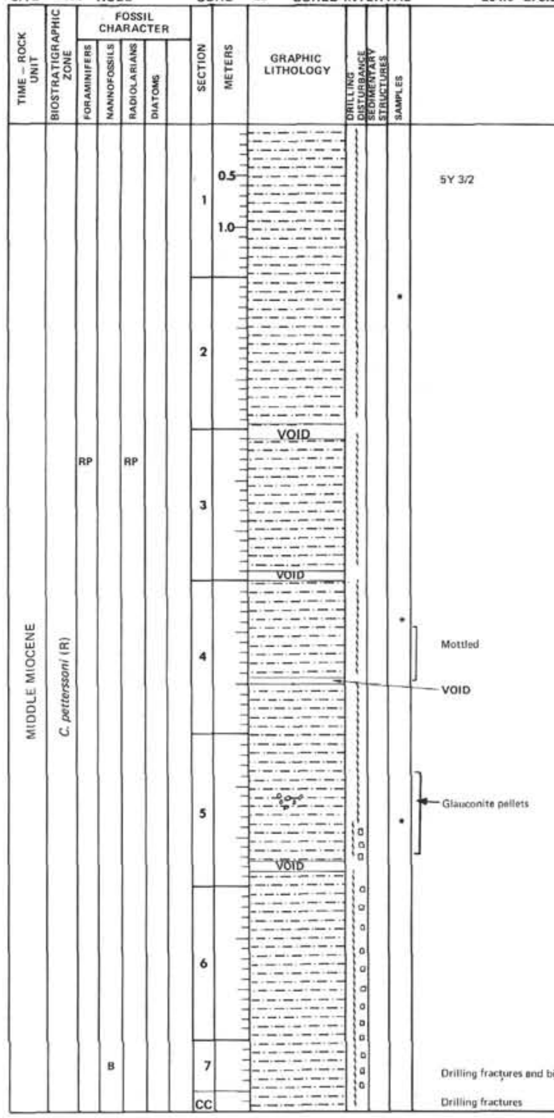
	3-11	CC[†]
TEXTURE:		
Sand	5	3
Silt	5	7
Clay	90	90
COMPOSITION:		
Quartz	1	4
Feldspar	1	TR
Pyrite	1	–
Clay minerals	45	15
Volcanic glass	1	1
Calc.-Dolo.-Arag.	–	80
Foraminifers	2	–
Calc. nannofossils	45	–
Diatoms	2	–
Radiolarians	1	–
Organic matter	1	–

† Taken from pebble (clast), probably not representative of core in general.

CARBON-CARBONATE (%)

	3, 49–53
Organic Carbon	1.03
Total Carbonate	4.0

SITE 496 HOLE CORE 29 CORED INTERVAL 264.0–273.5 m



LITHOLOGIC DESCRIPTION

SANDY MUD

Dark olive gray (5Y 3/2). At 113 cm in Section 1 lots of glauconite pellets. Glauconite grains and pumice grains scattered throughout Section 2. Glauconite pellets and voids between each biscuit in Section 6.

SMEAR SLIDE SUMMARY

	2-19[†]	4-39[†]	5-87[†]
TEXTURE:			
Sand	30	25	20
Silt	25	25	50
Clay	45	50	30
COMPOSITION:			
Quartz	10	2	5
Feldspar	8	5	5
Pyrite	1	1	1
Other heavy minerals	20	2	3
Clay minerals	45	48	30
Volcanic glass	10	15	40
Glauconite	1	1	–
Zeolite	–	5?[††]	4?[††]
Calc. nannofossils	TR	–	–
Radiolarians	–	1	1
Sponge spicules	1	–	–
Fecal pellets	3	20	10

† 2-19: sandy mud; 4-39: tuffaceous mud; and 5-87: tuffaceous mud

†† Refers to I.D., not quantity.

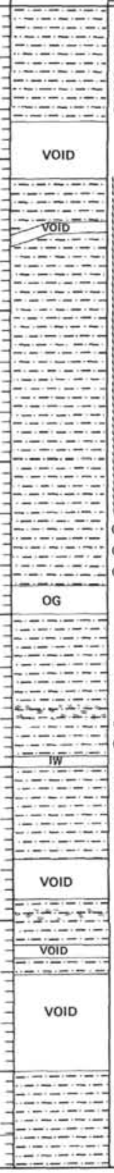
CARBON-CARBONATE (%)

	3, 67–72
Organic Carbon	0.58
Total Carbonate	0

SITE 496 HOLE CORE 30 CORED INTERVAL 273.5–283.0 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FOSSIL CHARACTER: FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS
MIDDLE MIOCENE	D. alata (R); N9 (N)	FM; FG	CG			1, 2, 3, 4, 5, 6, 7, 8, CC	0.5, 1.0

GRAPHIC LITHOLOGY



DRILLING DISTURBANCE / SEDIMENTARY STRUCTURES / SAMPLES

LITHOLOGIC DESCRIPTION

5Y 3/2

5Y 4/2

SANDY MUD

Olive gray (5Y 3/2). Glauconite pellets in Sections 3, 4, and 6 and scattered glauconite grains in Section 5.

SMEAR SLIDE SUMMARY

	5-91†	5-92†
TEXTURE:		
Sand	5	80
Silt	90	15
Clay	5	5
COMPOSITION:		
Quartz	3	5
Feldspar	5	2
Pyrite	1	2
Other heavy minerals	–	1
Volcanic glass	90	15
Glauconite	–	1
Calc.-Dolo.-Arag.	–	2
Foraminifers	–	1
Calc. nannofossils	1	–
Radiolarians	–	TR
Sponge spicules	–	1
Clay aggregates	–	70
Silicoflagellates	–	TR

† Vitric ash

†† Tuffaceous mud

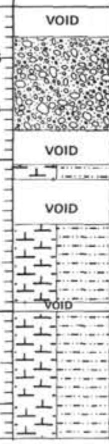
CARBON-CARBONATE (%)

	3, 92–97
Organic Carbon	0.78
Total Carbonate	0.5

SITE 496 HOLE CORE 31 CORED INTERVAL 283.0–292.5 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FOSSIL CHARACTER: FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS
MIDDLE MIOCENE	H. ampliaperta (N); N9 (F)	FM; FG	CM			1, 2, 3, CC	0.5, 1.0

GRAPHIC LITHOLOGY



DRILLING DISTURBANCE / SEDIMENTARY STRUCTURES / SAMPLES

LITHOLOGIC DESCRIPTION

5Y 3/2

10Y 4/2

Intermittent voids

10Y 4/2

NANNOFOSSIL MUDSTONE

Section 1, 30–120 cm: Olive gray (5Y 3/2) intraformation conglomerate (pebbly mudstone) graded?, maximum pebble size approximately 1 cm. Section 3: 10Y 4/2 mudstone; 5Y 6/1 ash; and 5Y 2/1 ash.

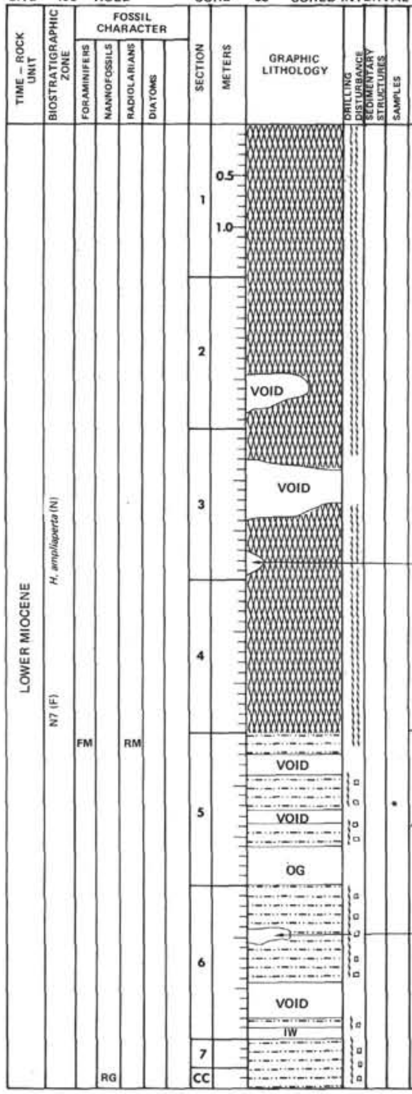
SMEAR SLIDE SUMMARY

	1-89
TEXTURE:	
Sand	5
Silt	25
Clay	70
COMPOSITION:	
Quartz	3
Feldspar	TR
Pyrite	2
Clay minerals	18
Volcanic glass	12
Glauconite	3
Calc.-Dolo.-Arag.	TR
Calc. nannfossils	48
Diatoms	8
Sponge spicules	2
Silicoflagellates	1
Fecal pellets	1

CARBON-CARBONATE (%)

	3, 14–19
Organic Carbon	0.90
Total Carbonate	4.0

SITE 496 HOLE CORE 33 CORED INTERVAL 302.0–311.5 m



LITHOLOGIC DESCRIPTION

SITE 496, CORE 32, 292.5–302.0 m: NO RECOVERY.

NANNOFOSSIL MUDSTONE AND DRILLING BISCUITS AND BRECCIA

Olive green (10Y 4/2). Nannofossil mudstone probably primary state of the area and brecciated is its present form. Section 4: slightly sandy glauconitic grayish-olive mud.

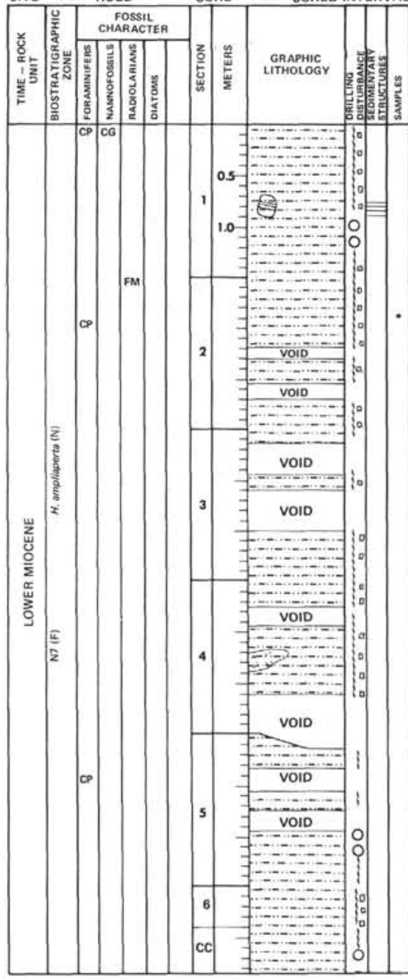
SMEAR SLIDE SUMMARY

	5-68
TEXTURE:	
Sand	20
Silt	20
Clay	60
COMPOSITION:	
Quartz	8
Feldspar	1
Pyrite	2
Other heavy minerals	TR
Clay minerals	45
Volcanic glass	15
Glauconite	3
Calc.-Dolo.-Arag.	1
Foraminifers	1
Calc. nannofossils	20
Diatoms	TR
Sponge spicules	2
Silicoflagellates	1
Fecal pellets	TR

CARBON-CARBONATE (%)

	4, 139–141
Organic Carbon	0.58
Total Carbonate	6.0

SITE 496 HOLE CORE 34 CORED INTERVAL 311.5–321.0 m



5GY 4/2–3/2

Undamaged piece showing initial laminations and little fractures

Abundant glauconite

Abundant glauconite

LITHOLOGIC DESCRIPTION

GLAUCONITIC MUDSTONE/DRILLING BRECCIA

Section 3, 100–150 cm: glauconite abundant in biscuits.

SMEAR SLIDE SUMMARY

	2-32
TEXTURE:	
Sand	30
Silt	45
Clay	25
COMPOSITION:	
Quartz	20
Feldspar	3
Pyrite	2
Other heavy minerals	3
Clay minerals	30
Volcanic glass	5
Glauconite	1
Calc.-Dolo.-Arag.	3
Foraminifers	2
Calc. nannofossils	2
Radiolarians	1
Sponge spicules	1
Fecal pellets	25
Organic matter	2

CARBON-CARBONATE (%)

	3, 127–132
Organic Carbon	0.81
Total Carbonate	6.5

SITE 496 HOLE CORE 35 CORED INTERVAL 321.0–330.5 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES	LITHOLOGIC DESCRIPTION
LOWER MIOCENE	N7 (F) C. costata (R) H. ampliaperta (N)	RP	CG	FM		1, 2, 3, 4, 5, 6, CC	0.5, 1.0	VOID			*	

← Drill fractures

VOID

5Y 4/2

NANNOFOSSIL MUD AND MUDSTONE

Biscuited. Alternation of mud and mudstone and some shells – Section 1. Rarely, benthic foraminifers visible in hand lens (Section 3).

SMEAR SLIDE SUMMARY

	CC-50 (nannofossil mud)
TEXTURE:	
Sand	7
Silt	30
Clay	63
COMPOSITION:	
Quartz	6
Feldspar	1
Pyrite	3
Clay minerals	46
Volcanic glass	14
Glauconite	2
Calc.-Dolo.-Arag.	1
Foraminifers	2
Calc. nannofossils	18
Radiolarians	1
Sponge spicules	3
Silicoflagellates	1
Fecal pellets	1

CARBON-CARBONATE (%)

	4, 88–92
Organic Carbon	1.52
Total Carbonate	2.5

SITE 496 HOLE CORE 36 CORED INTERVAL 330.5–340.0 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES	LITHOLOGIC DESCRIPTION
LOWER MIOCENE	N7 (F) C. costata (R) H. ampliaperta (N)	FM	CG	CG		1, 2, 3, 4, 5, 6, 7, 8, CC	0.5, 1.0	VOID			*	

5Y 4/2

← Veins

Fractures

VOID

MUD AND MUDSTONE

Olive gray (5Y 4/2). Voids from gas escape. Very fractured at 45–80 cm in Section 6.

Section 7: Schistosity at 15–20 cm. None of the structured orientations are parallel to core barrel.

SMEAR SLIDE SUMMARY

	3-2 (ash layer)
TEXTURE:	
Sand	85
Silt	12
Clay	3
COMPOSITION:	
Quartz	8
Feldspar	TR
Pyrite	1
Volcanic glass	90
Glauconite	TR

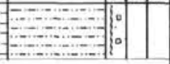
CARBON-CARBONATE (%)

	3, 61–63
Organic Carbon	0.55
Total Carbonate	5.0

SITE 496 HOLE CORE 37 CORED INTERVAL 340.0–349.5 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS
LOWER MIOCENE	N7 (F); C. costata (R); H. ampliaperta (N)	FM		RM		CC	0.5

GRAPHIC LITHOLOGY



LITHOLOGIC DESCRIPTION

5Y 4/2

MUD AND MUDSTONE
Olive gray (5Y 4/2). Biscuits show sigmoidal veins and schistosity in perpendicular plane.

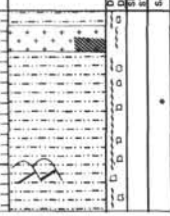
CARBON-CARBONATE (%)

	CC, 62–64
Organic Carbon	1.41
Total Carbonate	6.0

SITE 496 HOLE CORE 38 CORED INTERVAL 349.5–359.0 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS
LOWER MIOCENE	N7 (F); C. costata (R)	AG		RM		1, 2, CC	0.5, 1.0

GRAPHIC LITHOLOGY



LITHOLOGIC DESCRIPTION

5Y 4/2

MUD AND MUDSTONE
Very dark gray (5Y 4/2). Section 1, 15–40 cm: pumice layer, likely degassing and lignite. Small coal pebble (1x0.7x0.7 cm) in Section 1, 26 cm.

← Offset lignite bands

SMEAR SLIDE SUMMARY

	1-84
TEXTURE:	
Sand	15
Silt	45
Clay	40
COMPOSITION:	
Quartz	10
Pyrite	1
Other heavy minerals	4
Clay minerals	18
Volcanic glass	25
Glauconite	5
Zeolite	15
Calc.-Dolo.-Arag.	5
Foraminifers	5
Calc. nannofossils	3
Radiolarians	3
Sponge spicules	2
Fecal pellets	4

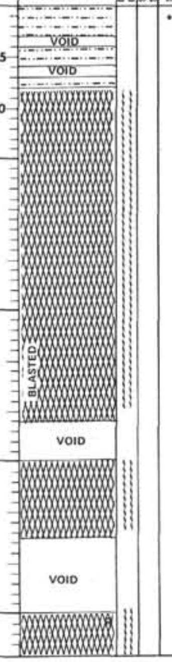
CARBON-CARBONATE (%)

	1, 60–64
Organic Carbon	0.90
Total Carbonate	10.5

SITE 496 HOLE CORE 39 CORED INTERVAL 359.0–368.5 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS
LOWER MIOCENE	N.7 (F); C. costata (R); H. ampliaperta (N)	AG				1, 2, 3, 4, CC	0.5, 1.0

GRAPHIC LITHOLOGY



LITHOLOGIC DESCRIPTION

BIOGENIC,
Very gasy
MUD AND MUDSTONE
Biogenic, very gasy, dark olive gray (5Y 3/2). At Section 3, 65 cm biscuit containing baked wood fiber (not yet coal).

SMEAR SLIDE SUMMARY

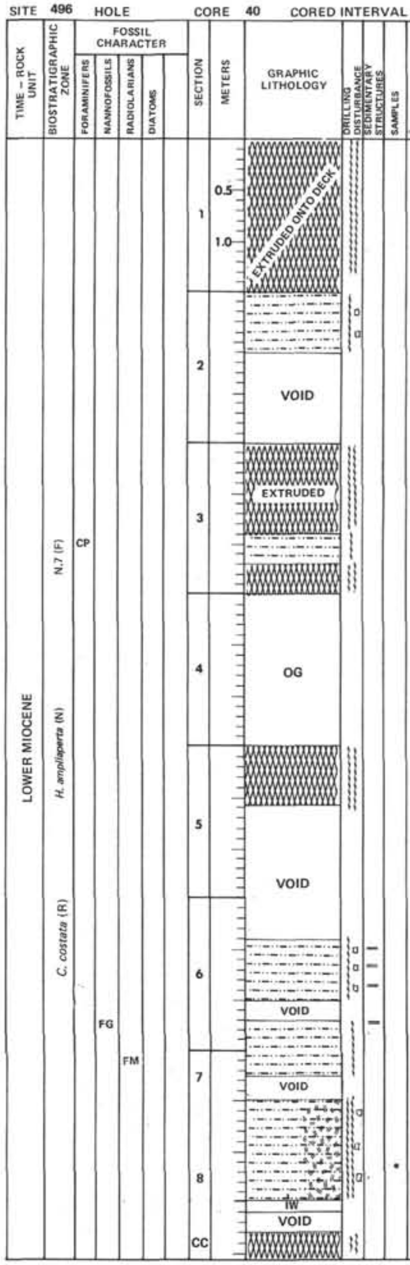
	1-11
TEXTURE:	
Sand	12
Silt	34
Clay	54
COMPOSITION:	
Quartz	5
Feldspar	1
Pyrite	4
Other heavy minerals	1
Clay minerals	52
Volcanic glass	6
Glauconite	5
Zeolite	1
Calc.-Dolo.-Arag.	12
Foraminifers	4
Calc. nannofossils	2
Diatoms	2
Radiolarians	1
Sponge spicules	2
Plant debris	2
Silicoflagellates	TR

CARBON-CARBONATE (%)

	3, 28–30
Organic Carbon	1.20
Total Carbonate	10.0

← Baked wood fiber in a biscuit

SITE 496 HOLE CORE 40 CORED INTERVAL 368.5–378.0 m



LITHOLOGIC DESCRIPTION

MUD AND MUDSTONE
Biogenic, very gasy, dark olive gray (5Y 2/2–3/2).

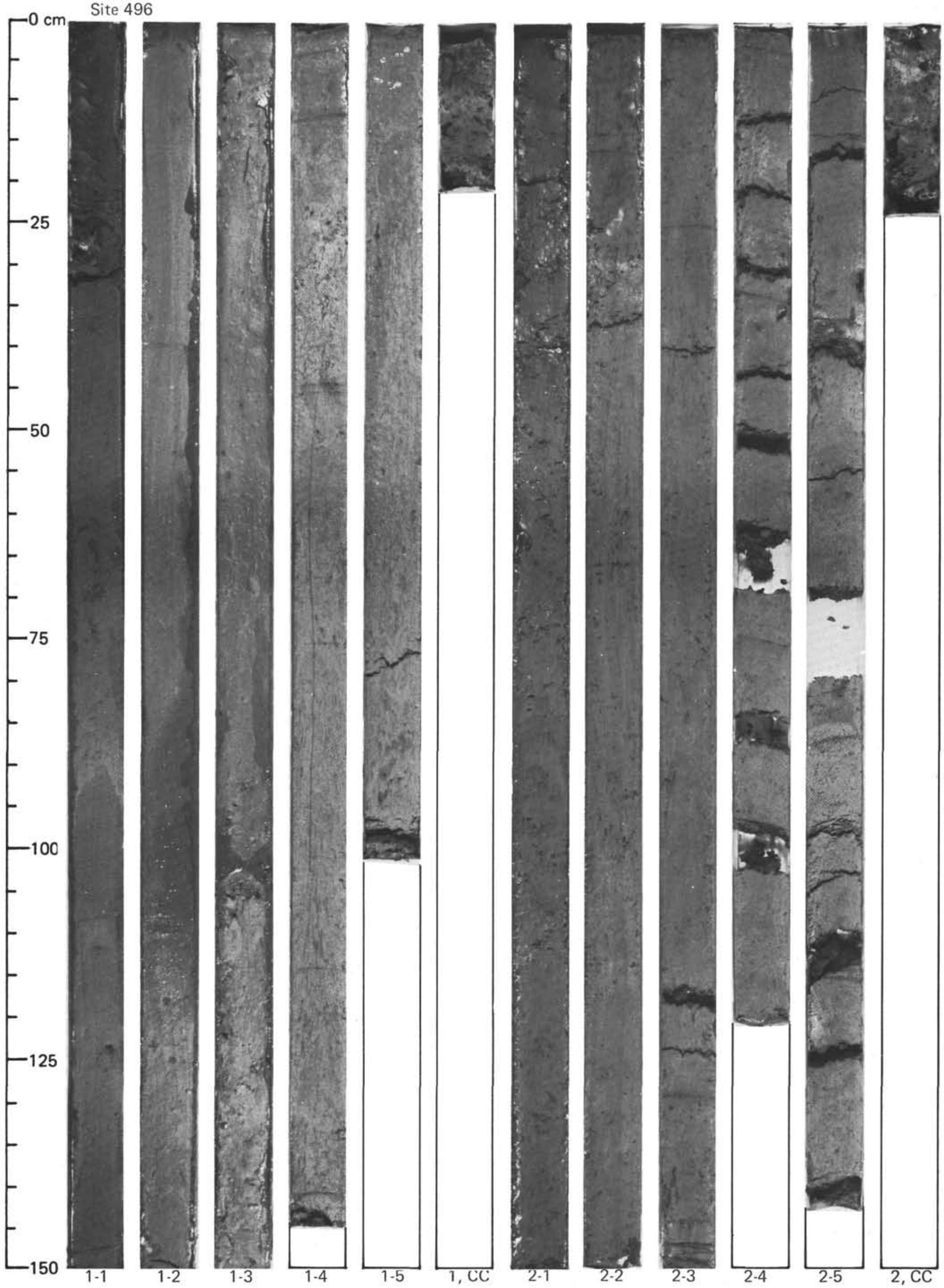
ICE

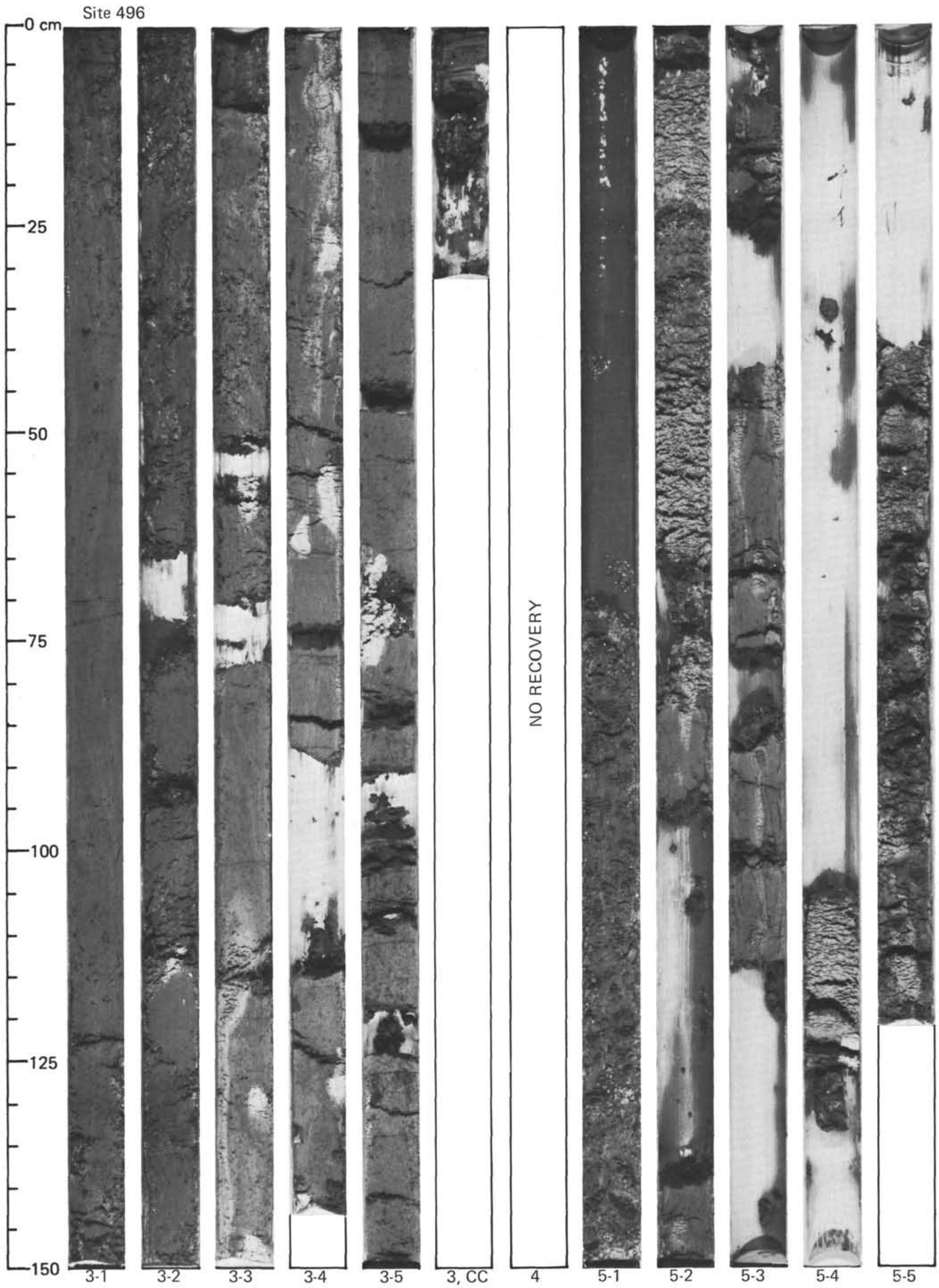
SMEAR SLIDE SUMMARY

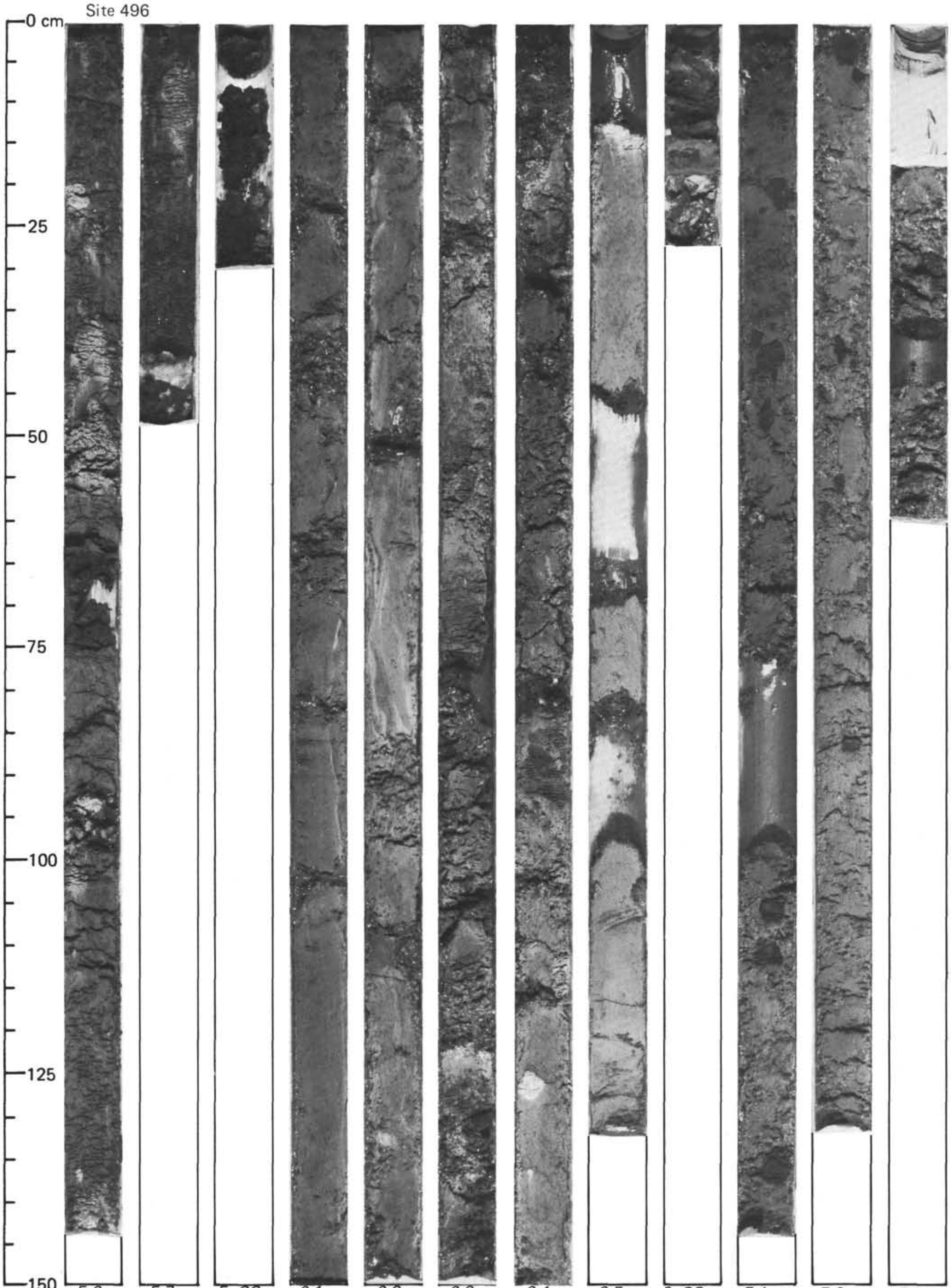
	8-60
TEXTURE:	
Sand	40
Silt	20
Clay	40
COMPOSITION:	
Quartz	3
Feldspar	4
Pyrite	2
Clay minerals	37
Volcanic glass	30
Glauconite	4
Calc.-Dolo.-Arag.	3
Foraminifers	6
Calc. nannofossils	3
Diatoms	2
Radiolarians	2
Sponge spicules	3

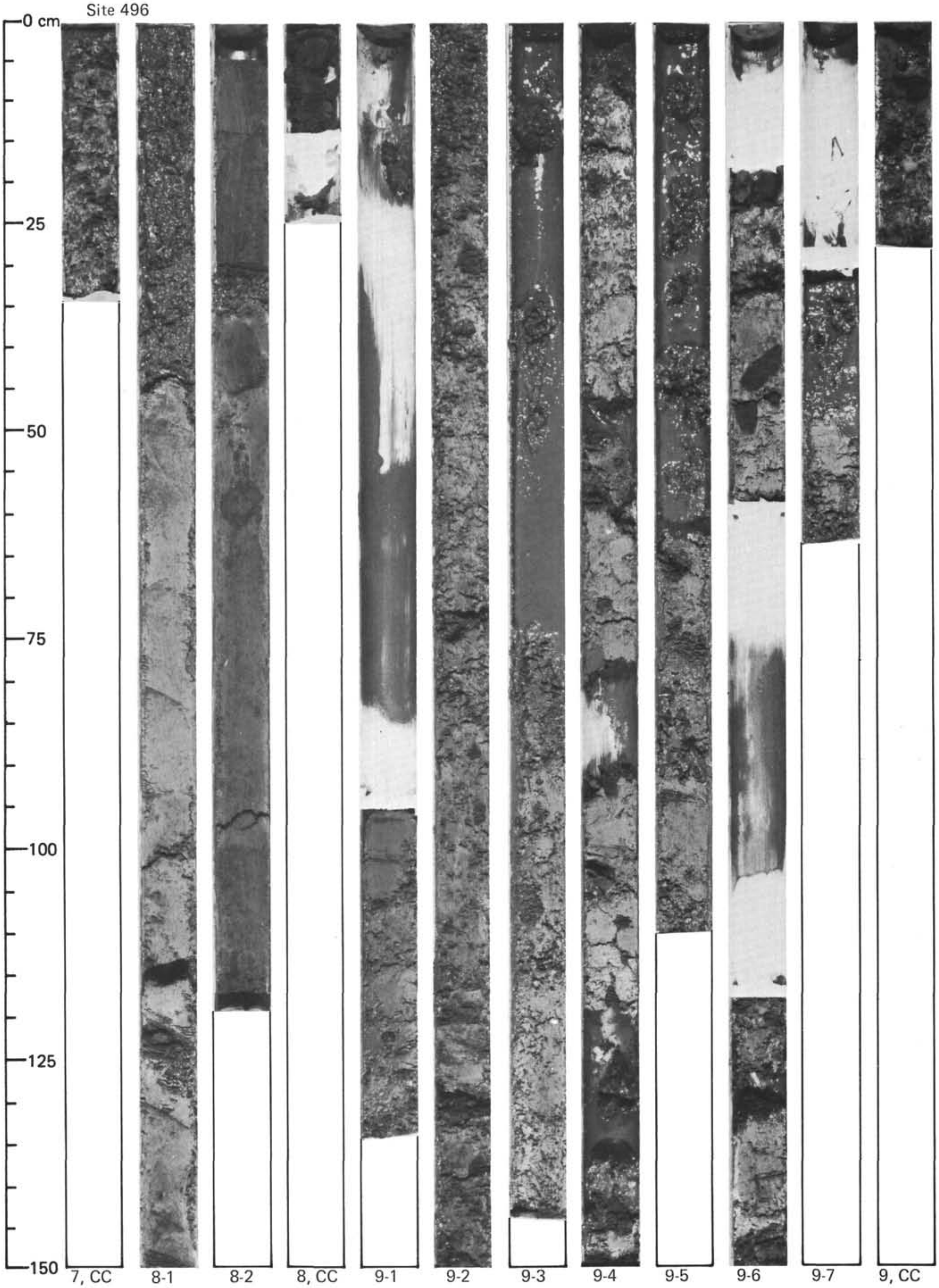
CARBON-CARBONATE (%)

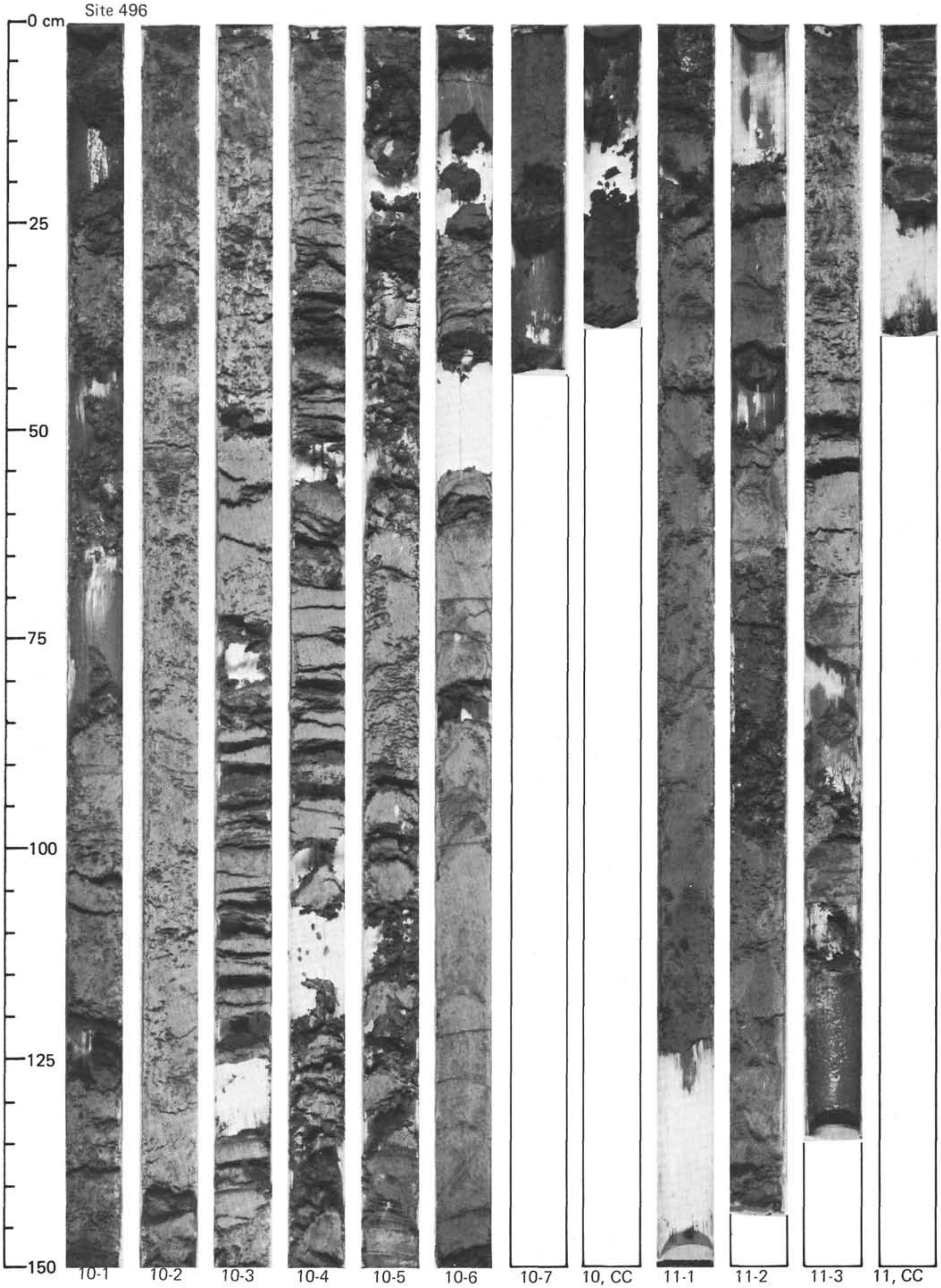
	3, 104–106
Organic Carbon	0.89
Total Carbonate	8.5

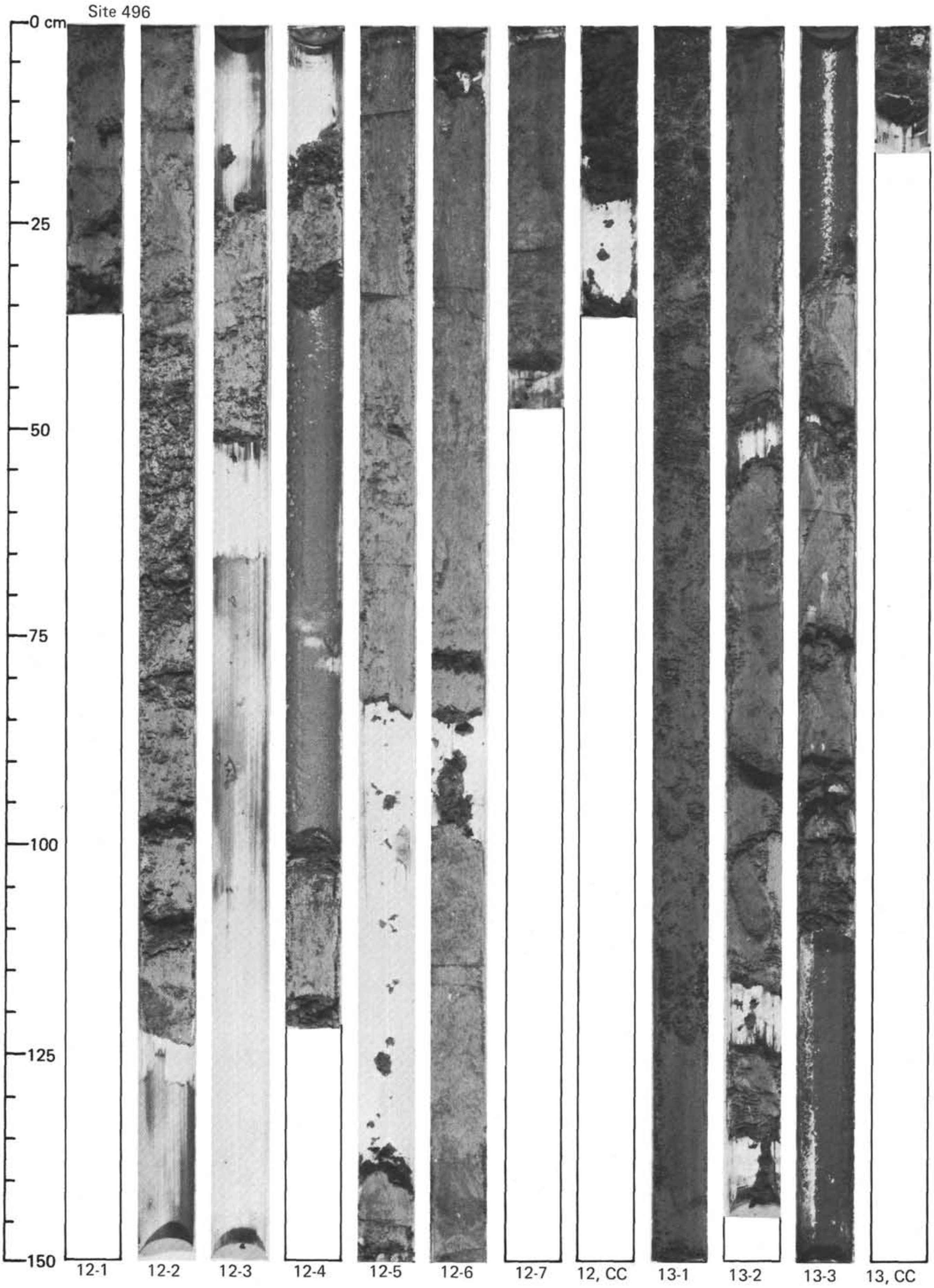

Site 496
0 cm
25
50
75
100
125
150
1-1
1-2
1-3
1-4
1-5
1, CC
2-1
2-2
2-3
2-4
2-5
2, CC

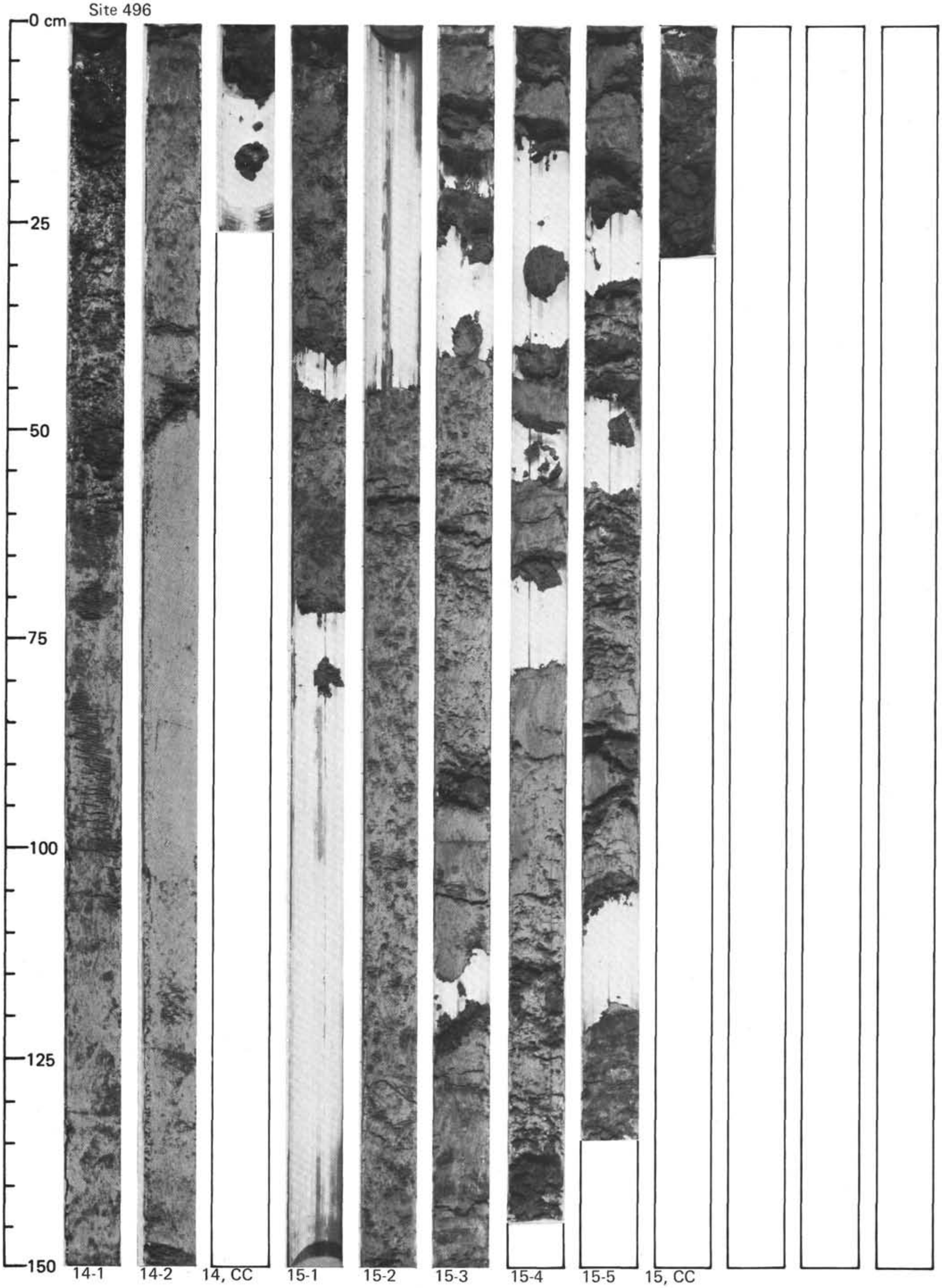

Site 496
0 cm
25
50
75
100
125
150
NO RECOVERY
3-1
3-2
3-3
3-4
3-5
3, CC
4
5-1
5-2
5-3
5-4
5-5

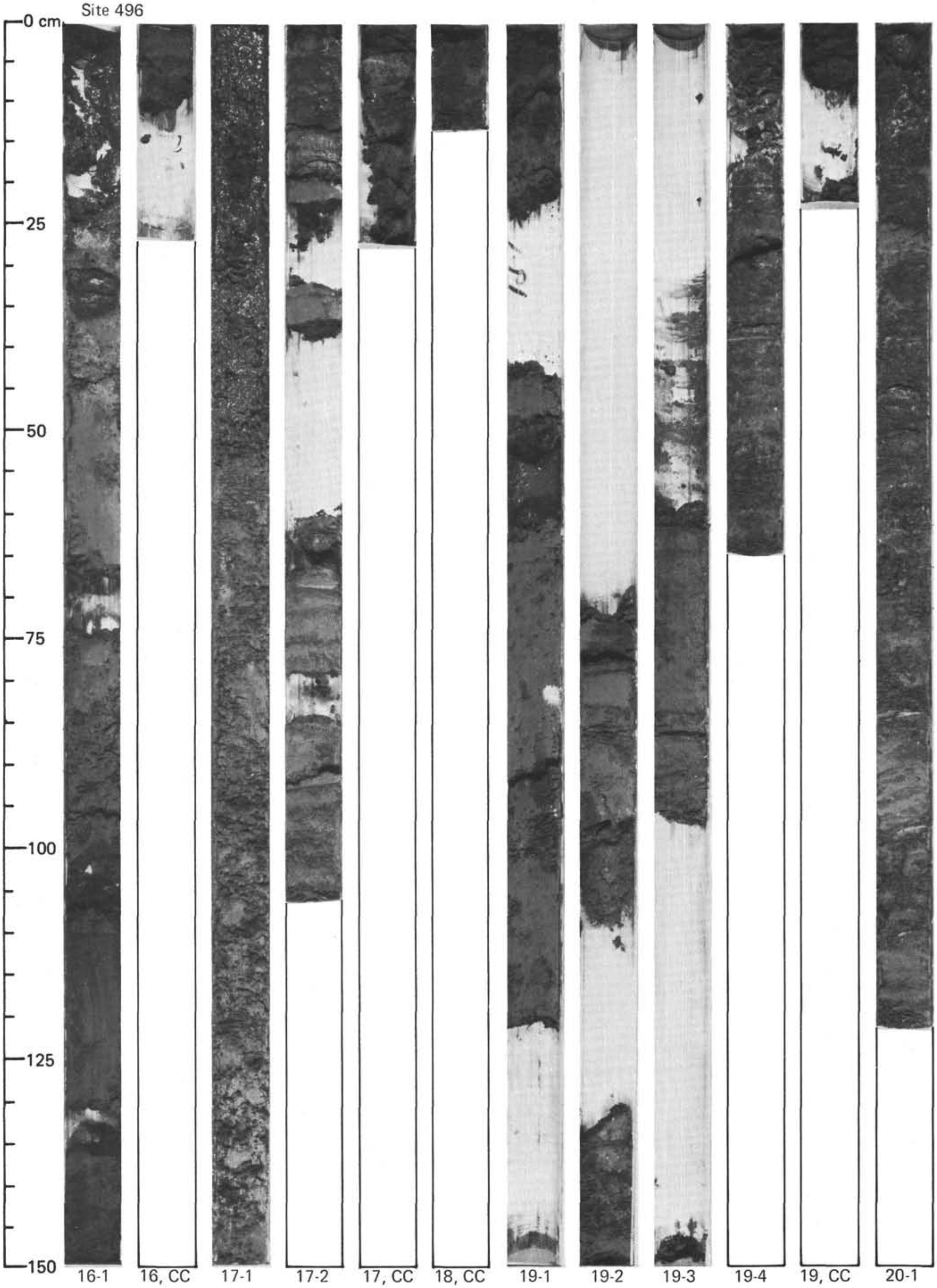

Site 496
0 cm
25
50
75
100
125
150
5-6
5-7
5, CC
6-1
6-2
6-3
6-4
6-5
6, CC
7-1
7-2
7-3


Site 496
0 cm
25
50
75
100
125
150
7, CC
8-1
8-2
8, CC
9-1
9-2
9-3
9-4
9-5
9-6
9-7
9, CC


Site 496
0 cm
25
50
75
100
125
150
10-1
10-2
10-3
10-4
10-5
10-6
10-7
10, CC
11-1
11-2
11-3
11, CC


Site 496
0 cm
25
50
75
100
125
150
12-1
12-2
12-3
12-4
12-5
12-6
12-7
12, CC
13-1
13-2
13-3
13, CC


Site 496
0 cm
25
50
75
100
125
150
14-1
14-2
14, CC
15-1
15-2
15-3
15-4
15-5
15, CC


Site 496
0 cm
25
50
75
100
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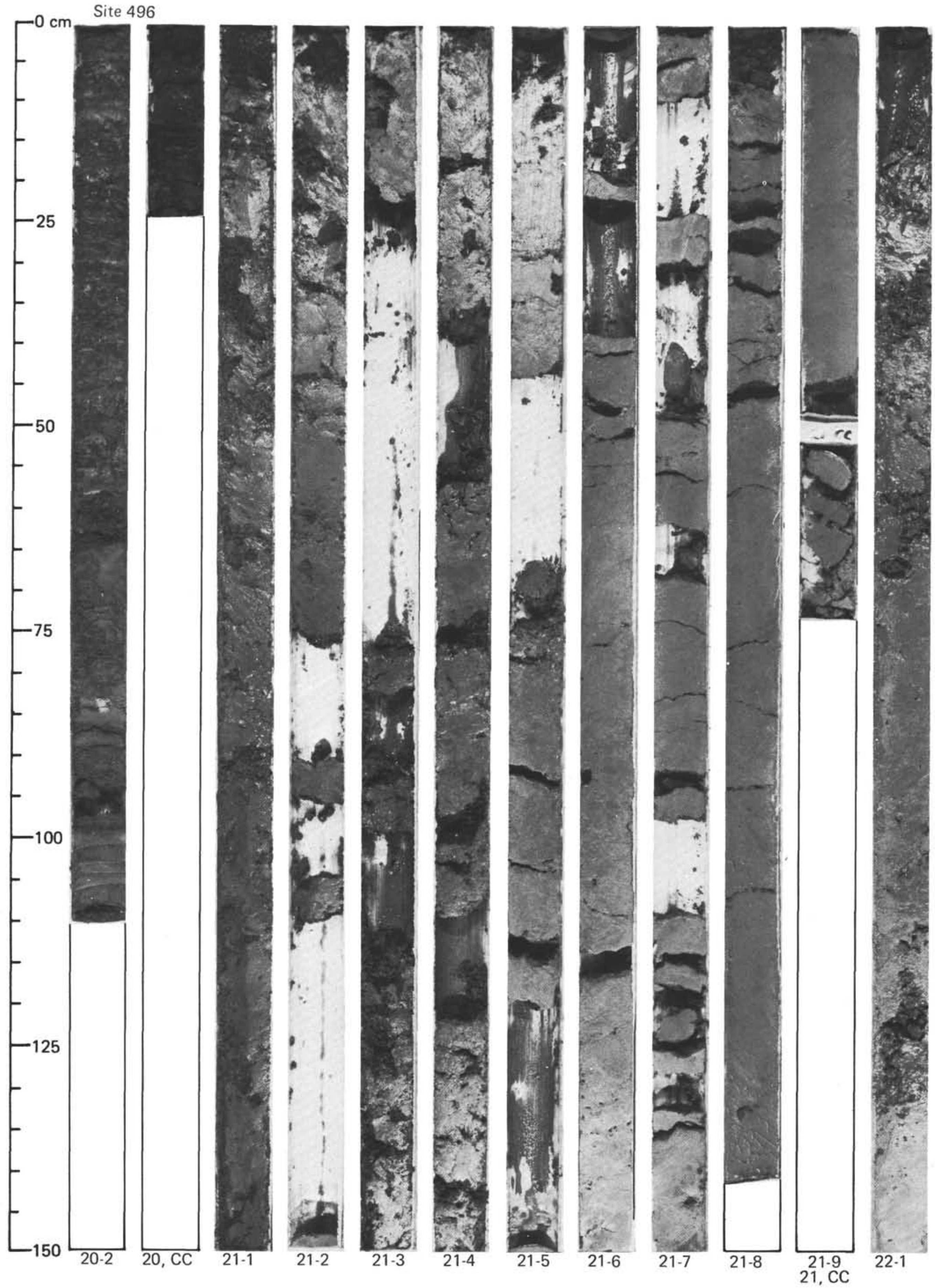
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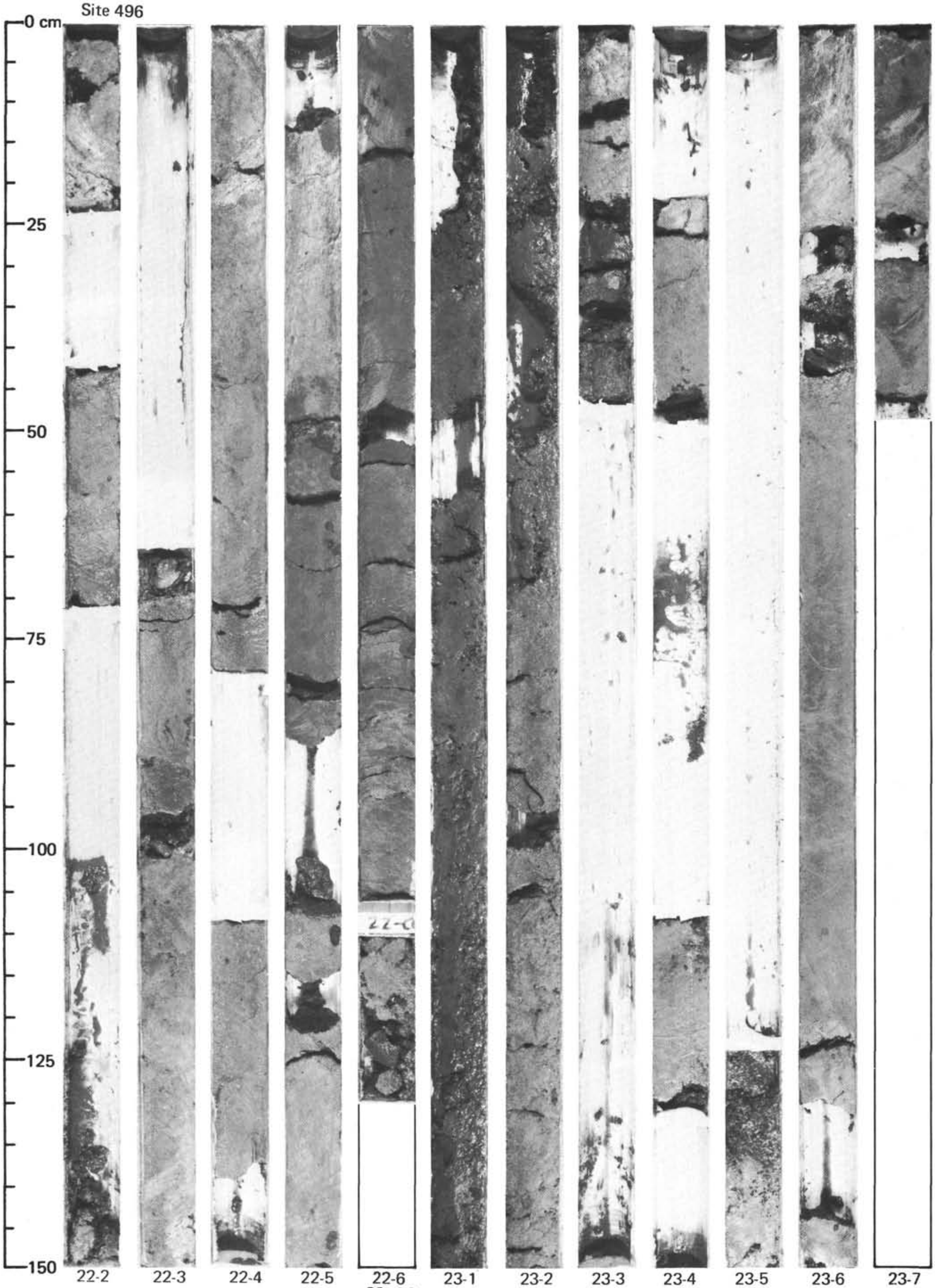
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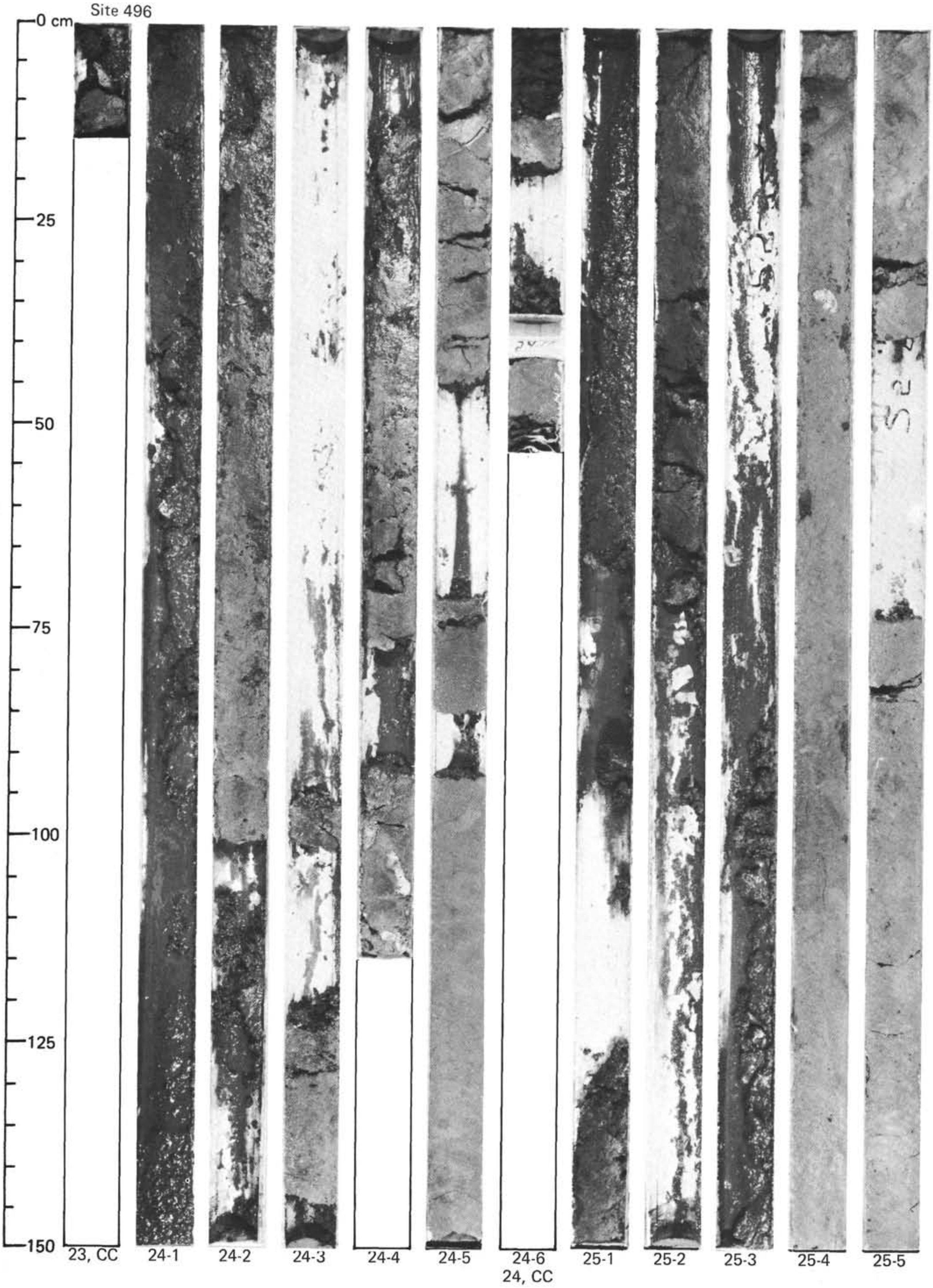
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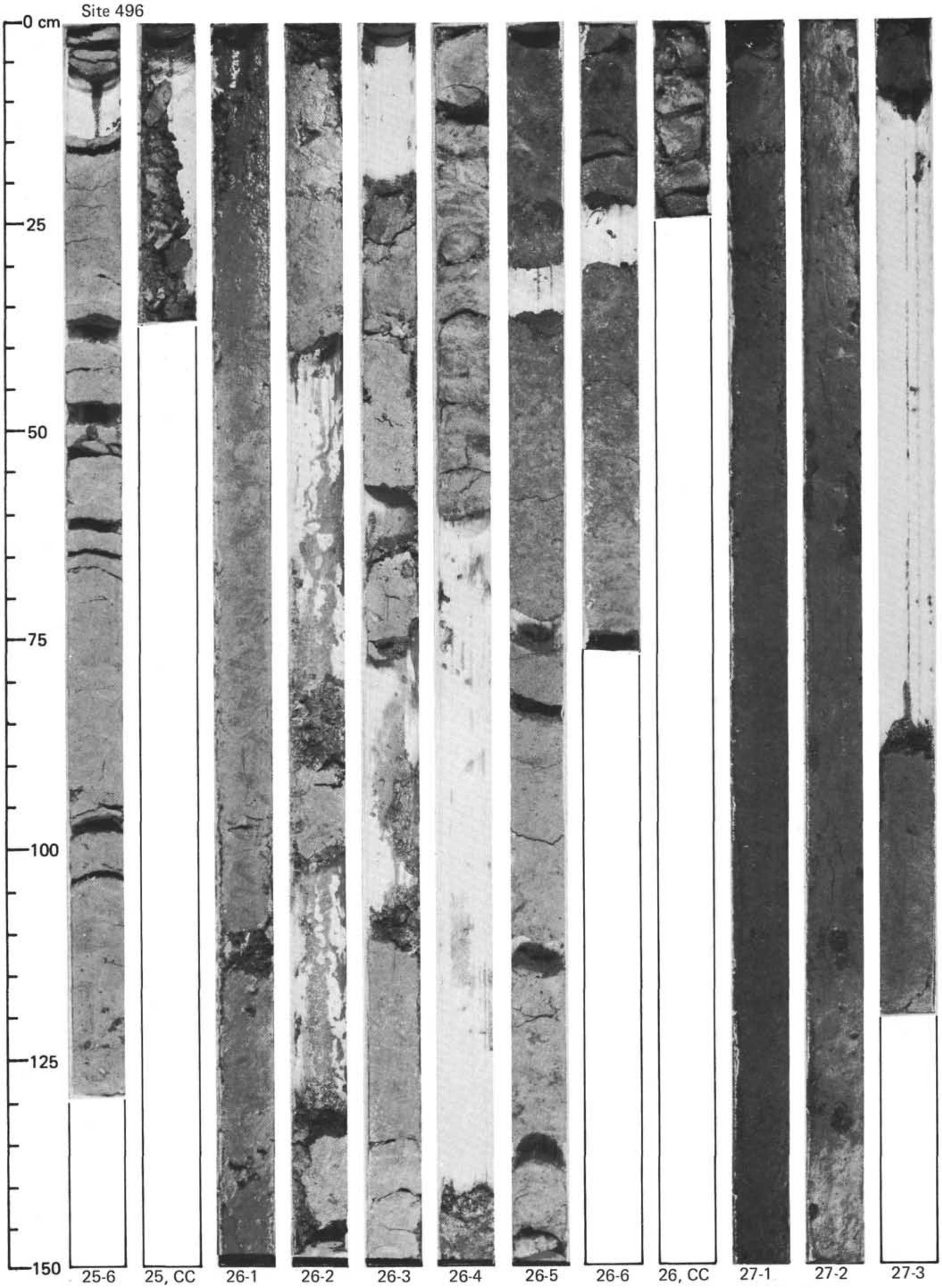
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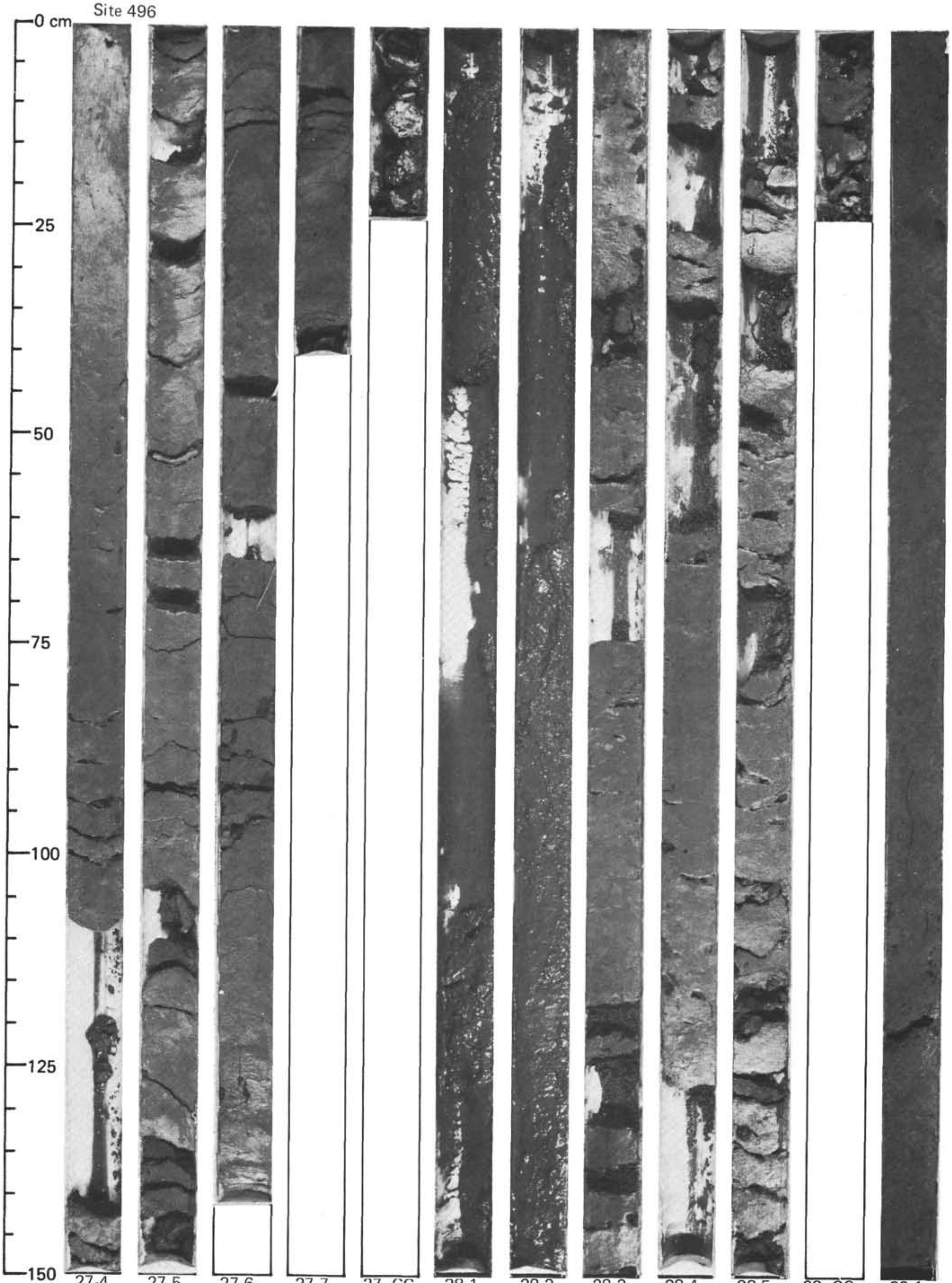
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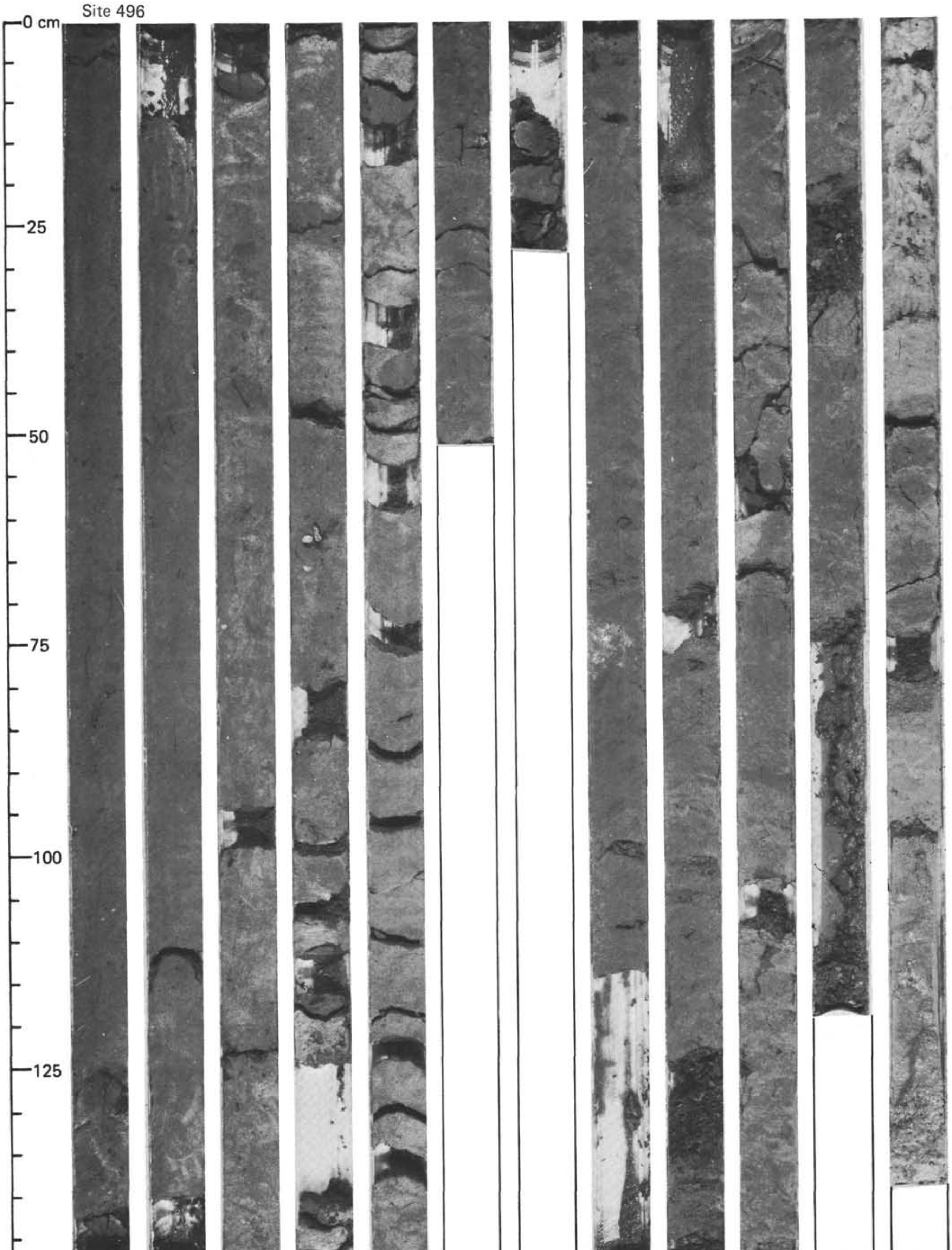
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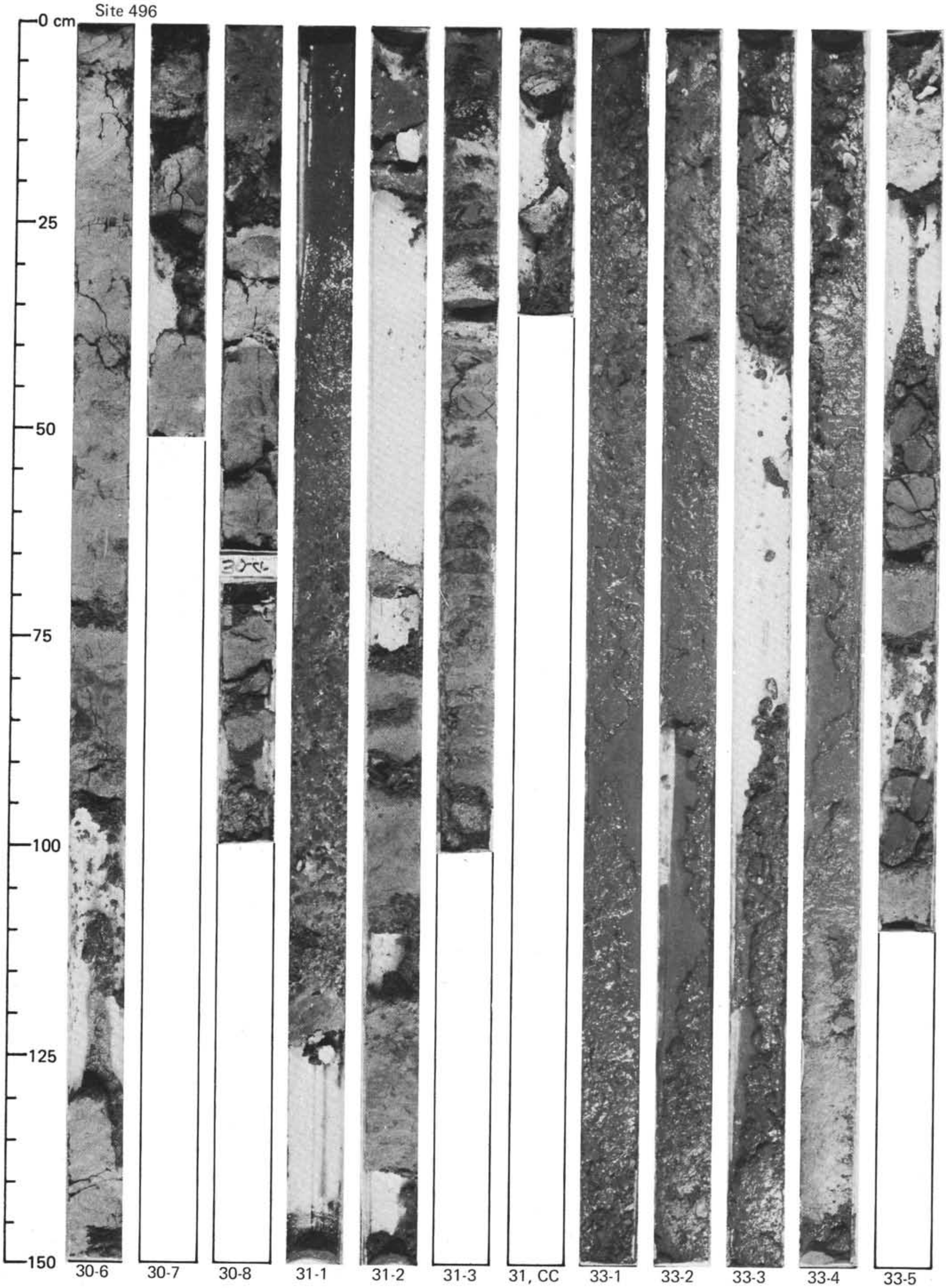
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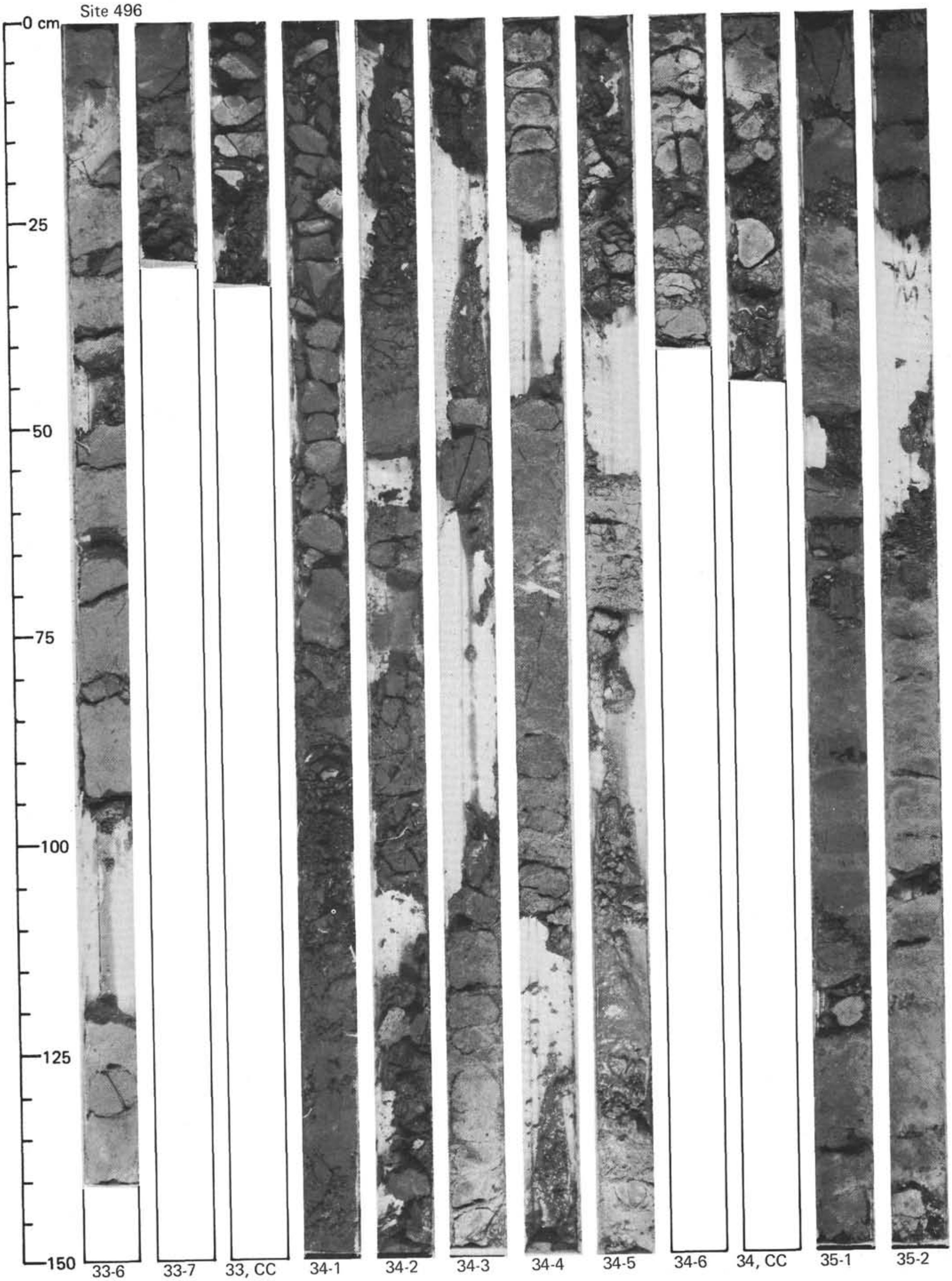
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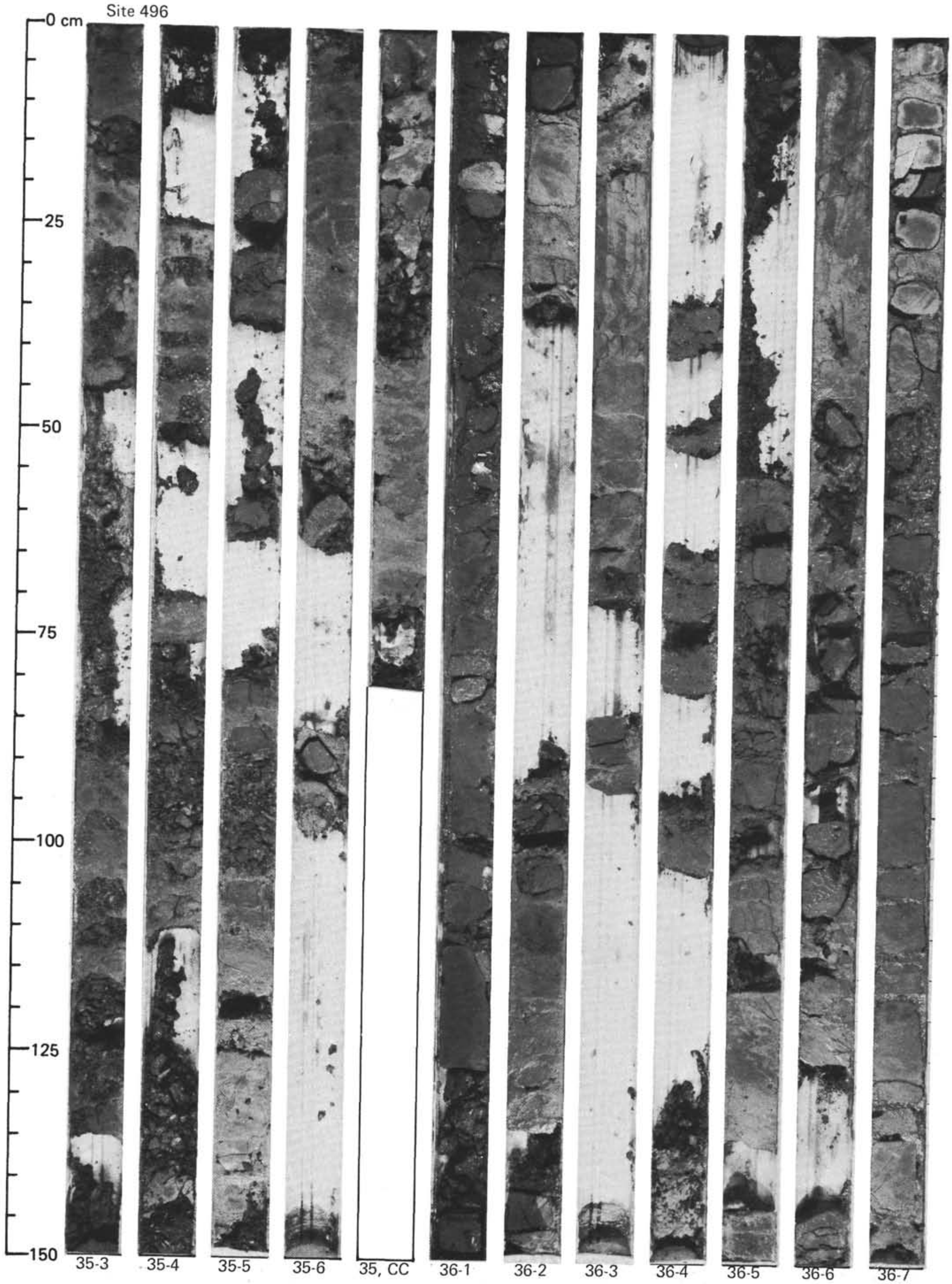
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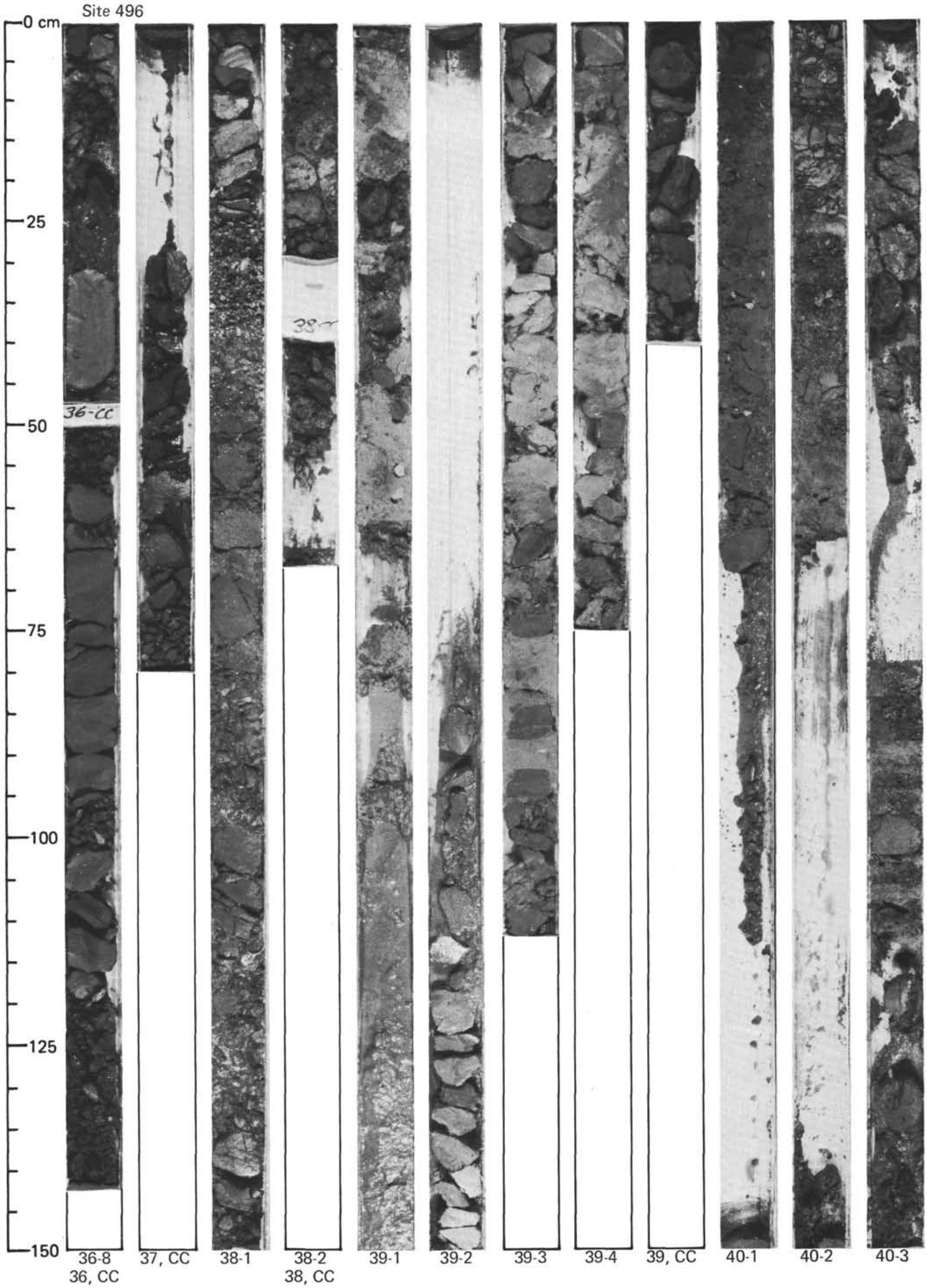
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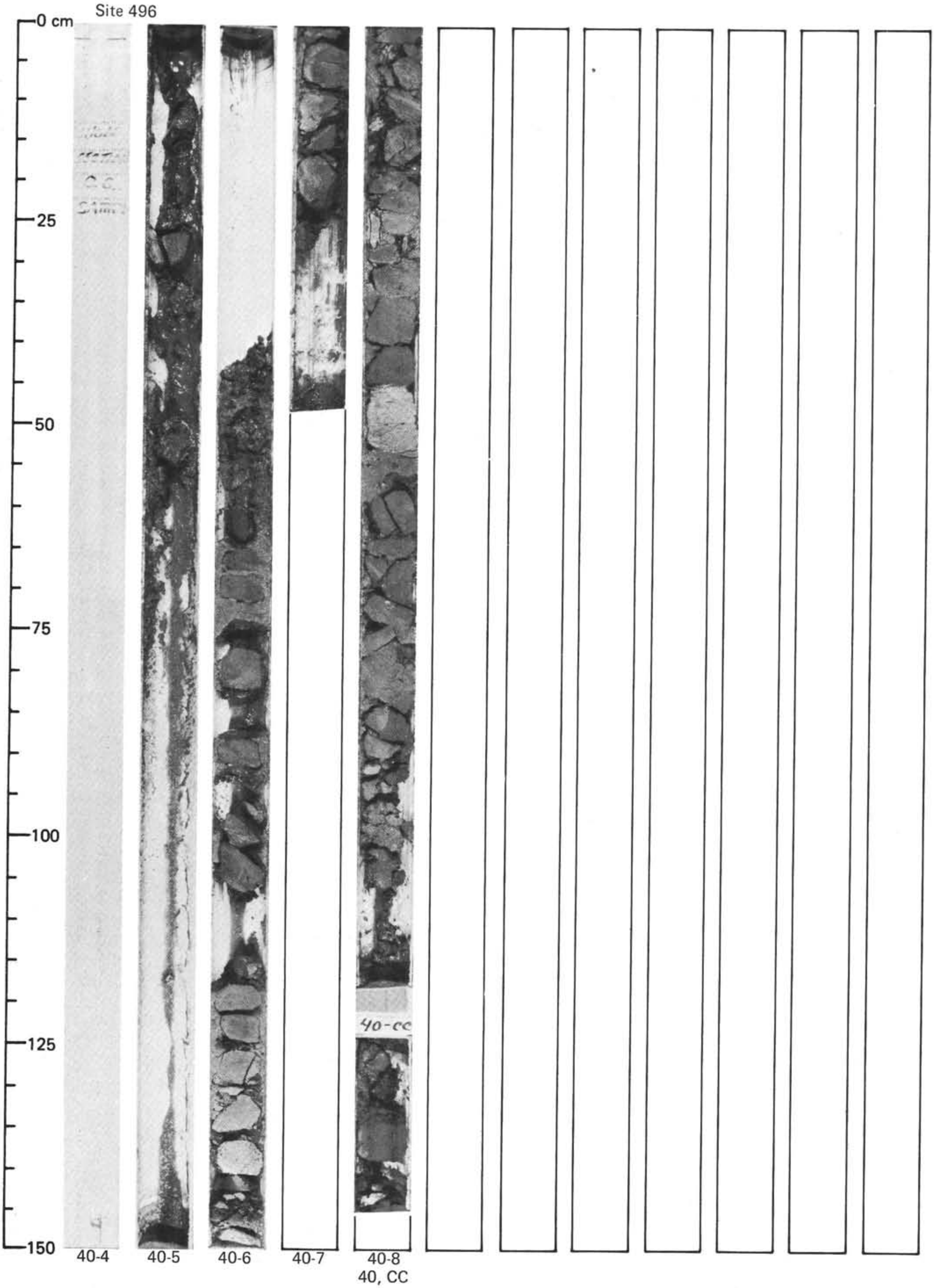
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