Cruise Report

R/V Melville NEMO EXPEDITION, Leg III

Manzanillo Mexico to Puerto Caldera Costa Rica
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Introduction

It has long been recognized that understanding of long-term climate change requires better documentation of the history of intermediate and deep water mass changes, and the relationships of climate changes in the northern and southern hemispheres (*e.g*., MESH Program Plan, 1994, IMAGES Program Plan, 1994, and the ODP Long Range Plan, 1997). Recent data, especially from the northeast Pacific (Behl and Kennett, 1996; Hendy and Kennett, 1999; Canariato and Kennett, 1999; Lund and Mix, 1998; Mix et al, 1999) documents variability of Pacific surface, intermediate, and deep water circulation on millennial time scales, but are not sufficient to assess the mechanisms of change; for example, it is unclear to what extent changes in the subsurface Pacific watermasses originate in the northern or southern hemisphere.

To address these issues on late Neogene time scales, we (Mix, Pisias, Mayer, 1992; Mix et al., 1996) submitted a JOIDES proposal (465 and 465/ADD) to drill a latitudinal array of depth transects along the Pacific margin of South and Central America. The proposed ODP drilling will test a broad set of hypotheses on 1) global thermohaline circulation and the linkage of global oceans through the Antarctic; 2) the interaction of the eastern boundary current with equatorial currents, and their role in the long-term exchanges of CO_2 between the ocean and atmosphere; 3) the role of biological productivity in modifying subsurface watermasses near the eastern boundary; 4) long-term changes in the oxygen minimum zone of the eastern tropical Pacific, and its role in the long-term oceanic nutrient budget, 5) mechanisms of southern-hemisphere wind changes (as reflected in boundary current advection) to changing glacial, orbital, and greenhouse gas forcing, 6) the response of the ocean to the opening and closing of tectonic gateways such as Drake Passage and the Panama Isthmus, and to uplift of the Andes Mountains, and 7) distribution of millennial-scale changes in global climate, to assess sources and mechanisms of

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variability. Proposal 465/ADD is now scheduled for drilling aboard D/V *JOIDES Resolution* as ODP Leg 201 in early 2002. .

In preparation for drilling, we previously summarized available site survey information (Mix et al., 1996), and completed detailed regional site surveys of the Southeast Pacific aboard *R/V Revelle* in February 1997 (Mix et al., 1997; Mix et al., 1998). During that 42-day cruise we surveyed 11 primary ocean drilling targets using SeaBeam and 4-channel seismic systems, and collected 36 multi-cores, 29 piston and trigger cores, and 5 gravity cores at latitudes from 50^{o}S to 15^{o}S. The tropical sites were surveyed Leg III of the .NEMO-(New Millenium of Oceanography) expedition of R/V Melville, supported as part of the National Science Foundation research project ***Ice-Age and Millennial-Scale Changes of Pacific Intermediate Waters: Ventilation from the Southern Ocean?*** (Pisias, Mix, Lyle, Goldfinger, PI's). A primary goal of NEMO-III was to complete the essential surveys needed to properly document sites for ocean drilling as to obtain sediment cores for detailed study of late Quaternary climate variability (deep and surface waters) in the region. Holocene sedimentation rates atop the Carnegie and Cocos Ridges are greater than 10cm/ka (Mix et al., 1991; Pisias and Mix, 1997), and preliminary data (A. Molina-Cruz and M.L. Machain-Castillo, personal communication, 2000) suggest that sedimentation rates in the Gulf of Tehuantepec maybe even higher. These sites may provide an important test of tropical mechanisms for millennial- and orbital-scale climate change before and after the growth of major Pleistocene ice sheets (e.g. Harris and Mix, 1999).

Here we document the shipboard results of NEMO-III.

Oceanographic Setting: Circulation and Watermasses

a) Deep Waters.

Figures 1 and 2 can be used to illustrate how the study locations of NEMO-III, and previous study sites from the GENESIS-3 cruise of R/V Roger Revelle, can be used to address our second goal – providing sediment cores to study changes in vertical ocean circulation and surface ocean processes. Modern subsurface circulation is reflected in watermass properties in a profile of phosphate concentration in a meridional transect of the eastern Pacific (**Fig. 1**). Bottom water presently enters the Pacific from the south, below 3km depth. Models of oceanic radiocarbon distributions (Toggweiler et al., 1989) confirm that this abyssal water does not presently upwell from great depths to the mid-latitude surface of the North Pacific. If it did, the North Pacific would be a huge net source of CO_2 to the atmosphere. Instead, after transiting north, accumulating nutrients and losing oxygen in the North Pacific, much of the Pacific Deep Water exits as a mid-depth southward flow between 1 and 3 km. This mid-depth outflow, and its importance to Pacific (and global) distributions of nutrients has been known for nearly 30 years (Reid, 1973). But how it changes through time remains a mystery. Much of the advective export of phosphate and nitrate from the Pacific occurs in the southward flow between 1 and 3 km in the eastern Pacific, where concentrations of these nutrients are highest (Wunsch et al., 1983). Thus, changes in this flow have the potential to change nutrient budgets in the Pacific and global ocean (Berger, et al., 1997).

b) Intermediate Waters and the Oxygen Minimum Zone.

At intermediate-water depths, water mass properties of the Pacific Ocean are highly asymmetric. Antarctic Intermediate Water is relatively depleted in phosphate (**Fig. 1**) and contains abundant oxygen because it forms in substantial contact with the atmosphere. This combination of processes results in relatively high $\delta^{13}C$ in Antarctic Intermediate Water (Kroopnick, 1985). At present, AAIW is for the most part restricted to the Southern Hemisphere. North Pacific Intermediate Water (NPIW), which forms in the NW Pacific with relatively little interaction with the atmosphere, contains abundant nutrients, but is relatively low in oxygen and has low $\delta^{13}C$. It is primarily detected as a subsurface salinity minimum in the North Pacific (Talley, 1993). An exceptionally steep property gradient between the southern-source and northern-source water masses occurs, at present, south of the equator. These intermediate watermasses are found in the eastern Pacific typically at depths of ~500 – 1000 m.

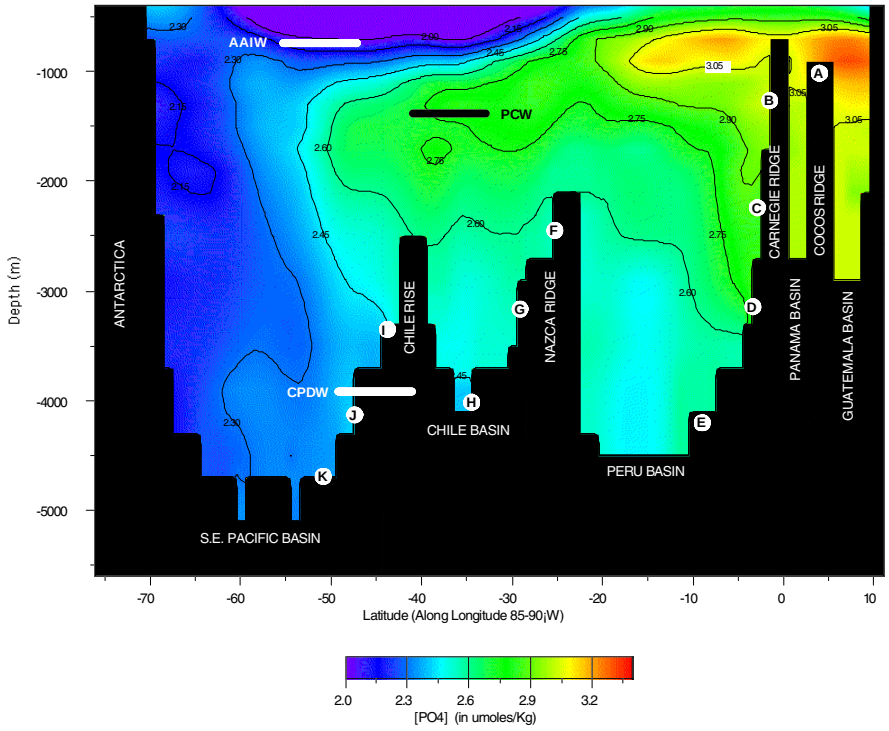

Fig. 1: North-South cross section of water masses, shown by phosphate concentrations, in the S.E. Pacific (Levitus et al., 1993). PO_4-rich mid-depth waters (labeled PCW for Pacific Central Water) spread southward between 1 & 3 km depth (black bar). Northward flowing bottom water, below ~3 km depth (lower white bar), starts as relatively low-nutrient Antarctic Circumpolar Deep Water (CPDW). Northward spreading Antarctic Intermediate Water (AAIW; upper white bar) is present above 1 km. Bathymetry is schematic. Proposed ODP drilling sites (white dots) span the watermasses. Previous study sites V19-27 (dot B), RC13-110 (dot D) (Mix et al, 1991), V19-30 (dot D; Shackleton and Pisias, 1985) and ODP Site 846 (dot D; Mix, Le, et al., 1995; Shackleton et al, 1995) are shown near Carnegie Ridge. Proposed coring sites target shallow regions of the Carnegie Ridge transect from dot C to top, and Cocos Ridge dot A. Sites proposed for Gulf of Tehuantepec off cross section to right in very high PO_4 shallow

At the shallow end of the intermediate water (typically a few hundred meters water depth) is the classical oxygen minimum zone (OMZ), driven by degradation of organic matter sinking out of the euphotic zone, and modified by ocean circulation (Wyrtki, 1962). Dissolved water column oxygen profiles shown in **Fig. 2** place the study sites of the NEMO-3 expedition into the context of the deeper water mass circulation of the Pacific Ocean. In the Gulf of Tehuantepec the OMZ is extremely intense (<0.2 ml/l O_2 between 200 and 900 m, with values <0.1 ml/l between 600

and 800 m depth (for comparison, lowest O_2 concentrations are about 0.5 ml/l in the California Borderlands). This broad depth range of this OMZ reflects the presence of North Pacific Intermediate Water (NPIW). NPIW is depleted of oxygen because it exchanges relatively little with the atmosphere in its northern source areas. Despite the low oxygen in the Gulf of Tehuantepec, mixing is high within the shallower watermasses, suggesting that the low oxygen at shallow depths is maintained by the high levels of primary productivity and organic matter degradation in the region (Tsuchiya and Talley, 1998) and the relatively shallow and abrupt pycnocline below low-salinity surface waters.

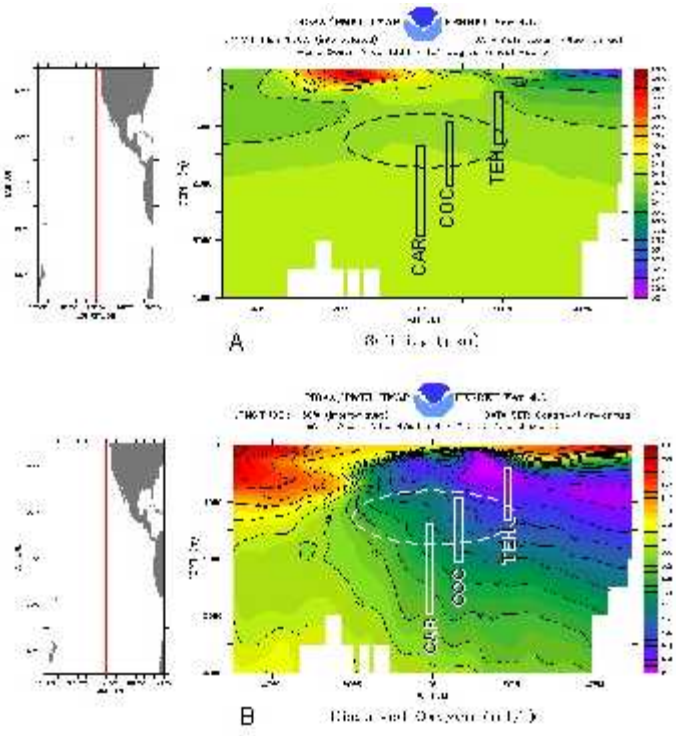

Figure 2 a) Depth versus latitude for salinity along 130W. b) Depth versus latitude for dissolved O along 130W. Depth sections are 0 to 4000 meters from 50S (left) to 50N (right). Hot (red) colors are high salinities and high dissolved oxygen; cold (blue and violets) are low salinity and low oxygen. Dashed oval is area where model results suggest largest change in circulation. Vertical rectangles show sampling transects along Carnegie (CAR) and Cocos (COC) Ridges and Gulf of Tehuanepec (TEH).

Active denitrification occurs in the water column between 300 and 600 m (Tsuchiya and Talley, 1998), and this net loss of nitrate from the ocean system is significant in moderating the total nitrate content of the worlds oceans. Thus, understanding long-term variations in anoxia and denitrification here in the geologic record has implications for changes in the global nutrient budget, and its influence on biological productivity and perhaps the history of atmospheric pCO_2. In addition, denitrification here produces N_2O, a net source to the atmosphere. This opens a unique opportunity in high-resolution paleoclimatology. If variations in the strength of the OMZ and denitrification in the eastern tropical Pacific (detected via nitrogen isotope analyses of organic matter), prove to be responsible for variations in N_2O observed in polar ice cores, the rich archives of paleoclimatic variations recorded in these two areas may be synchronized at high resolution.

Further South, such as over the Carnegie Ridge near the equator, the OMZ is shallower (300-400 m depth), and oxygen values return to typical deep Pacific values of 1 ml/l by ~700m depth, substantial influence of relatively oxygen-rich AAIW (Fig. 2). Further South, off Central Chile, a "double" OMZ reflects southward advection of OMZ waters near Peru at ~200 m depth in the poleward-flowing Gunther Undercurrent, the presence of oxygen-rich AAIW near ~500-1000m,

relatively low-oxygen Pacific Deep Water (of Northern-Hemisphere origin)from ~1500-3500 m depth, and finally the incursion of relatively oxygenated Circumpolar Deep Water (CPDW) below ~3500 m.

c) Near-surface waters.
Near-surface waters of the eastern-tropical Pacific also exhibit exceptional spatial variability (**Fig. 3**). Cool waters of the eastern boundary Humboldt Current are advected northward from Chile to offshore reaches of Peru. Coastal upwelling off central Peru maintains this cool flow, and these waters merge to feed the westward flowing South Equatorial Current, which is in turn maintained by equatorial upwelling as the Equatorial Cold Tongue. A primary question for ocean drilling is the cause of long-term variability of this cold tongue related to changing character of eastern boundary waters (Pisias and Mix, 1997).

Near the equator, east of the Galapagos Islands, the Equatorial Front separates the cold, salty waters of the Peru Current from warmer and fresher tropical waters of the Northern Hemisphere (Wooster, 1969). The Panama Basin region is noted for its exceptionally low salinity (near 32 PSU), extreme warmth (often >30^{o}C) and strong, shallow pycnocline (typically centered near 20-40 m depth). These features north of the equator reflect high rainfall relative to evaporation (Magana et al. 1999), which stabilizes the water column and diminishes vertical mixing of heat

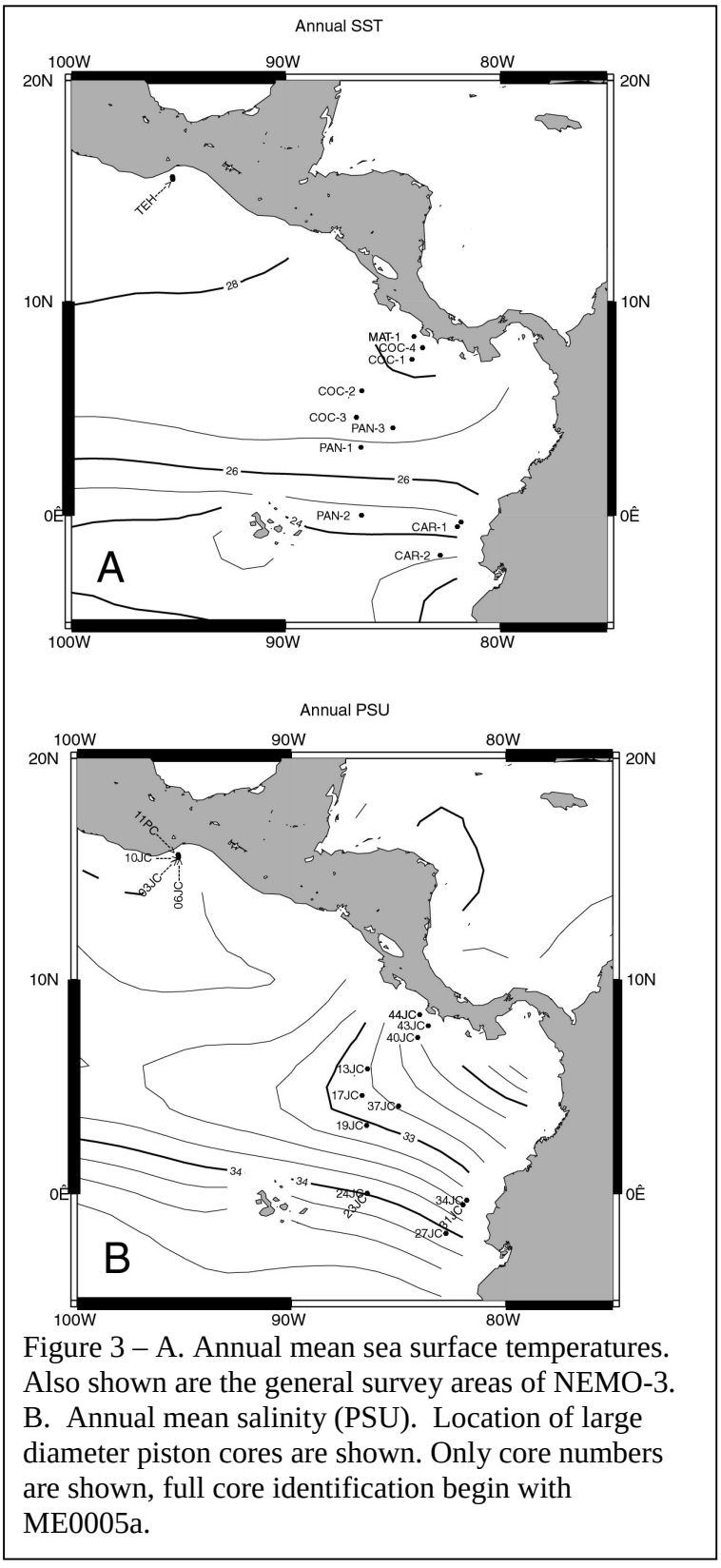

Figure 3 – A. Annual mean sea surface temperatures. Also shown are the general survey areas of NEMO-3. B. Annual mean salinity (PSU). Location of large diameter piston cores are shown. Only core numbers are shown, full core identification begin with ME0005a.

and other properties. A significant fraction of the net fresh water flux to the Panama Basin originates in the Atlantic or Caribbean, so low salinities here reflect the transport of fresh water from the Atlantic to Pacific basins, via the atmosphere.

SURVEY OPERATIONS.

Most of the data presented here reflect survey operations on Leg III of the NEMO Expedition of R/V Melville. This 24-day cruise included the following operations:

1. Survey with SeaBeam swath mapping for bathymetry and sidescan imaging, with three-dimensional "fly-through" imaging that allows us to avoid geologic problems like down-slope transport into channels, and large slumps on the sea floor. Our previous experience with coring and survey work in such topographically complex and tectonically active regions led to this strategy, which yields the best-possible site characterization. The SeaBeam data collected during the NEMO-III Expedition off South and Central America allowed us to identify regions of sediment slumping and to optimize site to avoid sea-floor channels. Without these data cores along these depth transects could have easily been collected in low-angle of repose slumps. With real time data processing, we were able to detect these problems and avoid coring in inappropriate locations.

2. Digital 2 to 7 kHz "chirp" subbottom profiles and digital seismic reflection profiles (GI gun) were processing using commercial (ProMax) seismic processing package. Seismic data is essential for drilling site characterization and helps assess the presence of older sediment disturbance. The high-resolution chirp profiles of the upper ~50 m of the sediment column helped to optimize coring sites that are representative of regional sedimentation patterns.

3. Fifteen long piston cores plus eleven multicores (the best tool to recover the sediment-water interface) were recovered at 11 sites in ten survey areas, using the OSU Coring Facility.
4. Cores were opened and described at sea, and non-intrusive analyses using the OSU core analysis van equipped with a Geotek multisensing core logger (MSCL). This device measures gamma density, narrow-window magnetic susceptibility (5-mm resolution), and p-wave velocity. These data provide important tests of stratigraphic continuity, bulk density for flux calculations, and synthetic seismic for calibration of high-resolution 3.5 kHz profiling data.

In the region-by-region summary that follows, we outline objectives based on understanding these the processes related to changes in deep-water masses, intermediate waters from northern-hemisphere and southern-hemisphere sources, the oxygen minimum zone and its role in denitrification, upper ocean properties such as temperature, salinity, pycnocline, and biological productivity.

SURVEY AREAS:

Sections that follow detail operations on NEMO-3, in the survey areas with the following prefixes:

TEH Gulf of Tehuantepec (TEH-1, TEH-2, TEH-3)
COC Cocos Rise (COC-1, COC-2, COC-3, COC-4).
PAN Panama Basin (PAN-1, PAN-2, PAN-3)
CAR Carnegie Ridge (CAR-1, CAR-2)
MAT Middle Americas Trench (MAT-1)

General locations of these areas are shown in Figure 3. For each of the four primary survey areas (THE, COC, PAN, and CAR) we first describe the general objectives to be addressed in each area. Specific sites selected for possible study by the Ocean Drilling Program within the region are then described. Figures for the ODP proposed sites are given in **Appendix A**. In **Appendix B** we include the SeaBeam bathymetry available for all regions surveyed and in **Appendix C** a summary of sediment core descriptions and **Appendix D** is the Cruise Prospectus that contains descriptions of sampling procedures and laboratory protocols.

1. The Gulf of Tehuantepec Survey Area (TEH-1, -2, and –3)

Science Objectives: The Tehuantepec margin is in the region of the strongest and thickest oxygen minimum zone in the eastern Pacific, and perhaps in the world. The goal in sampling this area is to understand the fate of the oxygen minimum over the late Pleistocene. Thus, sea-floor sampling objectives were to obtain cores in a depth transect through the oxygen minimum zone. The objective of water sampling was to obtain a full depth transect of waters, for calibration of geologic proxies $\delta^{18}O$ (relative to salinity, for paleo-salinity estimation), $\delta^{13}C$ (as a deep-water tracer), and $\delta^{15}N$ (a tracer of denitrification). One potential ODP drill site is proposed in this area (TEH-1).

This region is important because denitrification in this oxygen depleted zone affects global nutrient budgets. Production of nitrous oxide during denitrification may lead to a strategy for synchronizing paleoclimate records here with those of polar ice cores that exhibit rapid oscillations of N_2O. Low-salinity waters here may reflect fresh-water transport from the Atlantic to Pacific basins via the atmosphere. Also, this region is a possible source of low oxygen waters advected to the north in the shallow undercurrent. Definition of variations in source strength here may help to explain observed variations in anoxia in the OMZ of the California margin. It will also be important to study changes in coastal upwelling through time, especially associated with the development of winter high pressure in the Caribbean and strong winds (Tehuantepecanos) blowing through the mountain gap in Mexico.

Geophysical Survey. The Tehuantepec margin was surveyed between May 18 and May 20, 2000, on the R/V Melville NEMO-3 cruise using the Melville Seabeam 2000 swath mapping system for bathymetry, and a digitally-recorded Knudsen 320B echosounder for high-resolution subbottom profiles. We used two 150 c.i. GI guns and the Scripps 4-channel hydrophone streamer to digitally acquire seismic reflection profiles.

The survey discovered a large number of complexities on the upper slope and shelf break of the Tehuantepec margin that made it difficult to find sites of hemipelagic sedimentation. In the northwestern and western part of the survey area we see evidence of a massive slump buried under about 25 m of hemipelagic sediment. Part of the slump can be seen in the northwestern

part of TEH1B-line 1, shown in Figure A-TEH1-3. The central part of the survey area is marked by a large canyon running southwestward between 95° 15'W and 95° 20'W. To the east of the canyon are incised slopes and recent slumps. It appears that the ridge just to the east of the canyon along 95°15'W is one or more detached blocks that have slid some ways downslope. The shelf between 95° 10 and 95°05'W is a hard ground of some sort, reflecting most of the seismic energy back. There is layering within the block suggesting that the hard ground consists of lithified sedimentary material.

Sampling: Three sampling sites in the Gulf of Tehuantepec targeted shallow intermediate waters (<500-1200 m), including the OMZ. At these sites we obtained water samples and sediment cores, as follows:

a) Sediment cores were taken in a depth transect from 577-1082 meters depth. Locations are illustrated in Fig. 3. Here, areas are referred to as TEH-1 (mid depth), TEH-2 (shallow), TEH-3 (deep). One multicore at each site was sliced at 0.5 cm intervals (0-6 cm) or 1.0 cm intervals (6-12 cm), and preserved in buffered formalin and rose bengal stain. This sampling will help to constrain the processes recorded by geologic proxies. The Holocene sediments at all the sites are laminated, with intermittent bioturbated zones. Cores in this area will thus provide an ultra-high resolution record of oceanographic change in the eastern Pacific for comparison with other sections in the Gulf of California and the Santa Barbara Basin. There may also be a record of paleoseismicity along the Polochic fault from nearby slumps, based on slumped material recovered in core ME0005A-10JC.

Area	Cruise	Site	Device	Latitude	Longitude	Depth	Date-Time	Length
				deg-min		(m)	(GMT)	Type deg-min (cm)
TEH-1	ME0005A-	03JC	Jumbo Core	15 39.04	-95 -16.83	740	5/19/00 0109Z	1326
TEH-1	ME0005A-	03TC	Trigger Core	15 39.04	-95 -16.83	740	5/19/00 0109Z	150
TEH-1	ME0005A-	04MC1	Multicore	15 39.27	-95 -16.75	725	5/19/00 0426Z	62
TEH-2	ME0005A-	06JC	Jumbo Core	15 42.61	-95 -17.5	579	5/19/00 1120Z	1445
TEH-2	ME0005A-	06TC	Trigger Core	15 42.61	-95 -17.5	579	5/19/00 1120Z	207
TEH-2	ME0005A-	11PC	Piston Core	15 42.80	-95 -17.51	574	5/21/00 0028Z	1532
TEH-2	ME0005A-	11TC	Trigger Core	15 42.80	-95 -17.51	574	5/21/00 0028Z	197
TEH-2	ME0005A-	07MC1	Multicore	15 42.60	-95 -17.5	577	5/19/00 1607Z	62
TEH-3	ME0005A-	10JC	Jumbo Core	15 34.87	-95 -16.78	1082	5/20/00 0058Z	1297
TEH-3	ME0005A-	10TC	Trigger Core	15 34.87	-95 -16.78	1082	5/20/00 0058Z	87
TEH-3	ME0005A-	08MC1	Multicore	15 34.86	-95 -16.78	1079	5/19/00 2224Z	18

b) Water samples were taken from Niskin bottles deployed on R/V Melville's hydro wire (here denoted "Hydrocast") and on the multicore frame (here denoted "Niskin/MC) in a depth transect for analysis of $\delta^{18}O_{water}$, $\delta^{13}C_{dic}$, Salinity, and $\delta^{15}N_{nitrate}$. This water sampling was designed to constrain the relationship of oxygen isotopes and salinity, the effects of denitrification on $\delta^{15}N$, and the carbon isotopic composition of deep and intermediate waters. Because sites TEH1, TEH2, and TEH3 are quite close to each other, the array of sites constitute a depth transect of the watercolumn from the surface to 1019m, spanning the OMZ.

Area	Cruise	Site	Device	Latitude	Longitude	Bott.	Date-Time	Depth
				deg-min	deg-min	Type (m)	(GMT)	deg-min (m)
TEH-1	ME0005A-	01NB1	Hydrocast	15 39.37	-95 -16.85	730	5/18/00 2315Z	2
TEH-1	ME0005A-	01NB2	Hydrocast	15 39.37	-95 -16.85	730	5/18/00 2315Z	100
TEH-1	ME0005A-	02NB1	Hydrocast	15 39.36	-95 -16.86	725	5/18/00 2330Z	50
TEH-1	ME0005A-	02NB2	Hydrocast	15 39.36	-95 -16.86	725	5/18/00 2330Z	150
TEH-1	ME0005A-	04NB1	Niskin/MC	15 39.27	-95 -16.75	725	5/19/00 0426Z	725
TEH-2	ME0005A-	05NB1	Hydrocast	15 42.62	-95 -17.49	577	5/19/00 0915Z	200
TEH-2	ME0005A-	05NB2	Hydrocast	15 42.62	-95 -17.49	577	5/19/00 0915Z	250
TEH-2	ME0005A-	07NB1	Niskin/MC	15 42.60	-95 -17.5	577	5/19/00 1607Z	576
TEH-3	ME0005A-	08NB1	Niskin/MC	15 34.86	-95 -16.78	1079	5/19/00 2224Z	1079
TEH-3	ME0005A-	09NB1	Hydrocast	15 34.87	-95 -16.78	1085	5/19/00 2345Z	300
TEH-3	ME0005A-	09NB2	Hydrocast	15 34.87	-95 -16.78	1085	5/19/00 2345Z	400

Proposed ODP Drill Site: Based on the survey data we obtained in NEMO-III, we constrain the following potential drill site.

TEH-1 Gulf of Tehuantepec
(15° 36.08'N 95° 21.40' W, water depth–802 uncorr. m)

TEH-1 is situated on the Tehuantepec continental slope in the only place we are confident that has a continuous sediment section in the upper 300-400 m of the sediment column. It is located on the TEH-1B survey line 1 on a hill on the southern flank of a possible transform fault cutting the margin from northeast to southwest (Figure A-TEH-2). Nearest sediment core: ME0005A-003PC, taken on NEMO-3; 15° 39.04' N, 95° 16.83'W, 740 m water depth, 13.42 m sediment recovered. The piston core is laminated through much of its length, although significant intervals are homogeneous or have distinct burrows through laminations. The basal sediments of the core are homogeneous. The core had a strong H_2S odor over its entire length, indicating strongly reducing conditions from the surface of the sediments. Occasional ~0.5 cm light-colored layers of ash and/ or overbank turbidite deposits can be found through the core. Thick laminations can be found in some intervals.

Seismic Interpretation:
Primary Site (TEH-1): TEH1B survey line 1, 04:17:08 Z(SP 114)
Location: 15° 36.08' N 95° 21.40' W
Site water depth: 802 m (uncorr. m)
Sediment thickness: >0.93 sec (> 800 m)
Proposed Drilling Depth: 250 m
TEH-1 is sited on a sedimentary ridge between two canyons, one to the west mostly filled with a slump deposit. It is the only location we surveyed that appears to have a continuous sediment section without missing units slumped away or major slump deposits in the section.

Figures found in Appendix A:

Fig TEH1-1: Location map for TEH-1. Proposed drill site is marked.

Fig TEH1-2: Swathmap bathymetry for the TEH-1 region, from the NEMO-3 site survey. Proposed drill site and sediment cores obtained on NEMO-3 are marked.

Fig TEH1-3: Bandpass-filtered seismic reflection profile TEH1B-seisline 1 across TEH-1, from Nemo-3. Proposed drill site is marked.

Fig TEH1-4: 2-7 kHz Chirp subbottom profile TEH1-35line 1 across TEH-1, from EW9709. Proposed drill site is marked

2. Cocos Rise Survey Areas (COC-1,COC-2, COC–3, COC-4, COC-5):

Science Objectives: The Cocos Ridge transect is intended to sample surface waters associated with the eastern Pacific Intertropical Convergence Zone (ITCZ), as well as a water column profile from about 500-2000 m to monitor deep and intermediate waters near the lower boundary of the oxygen minimum zone (OMZ). An additional objective of this transect is to assess variations in the strength of the eastern tropical Pacific OMZ with respect to changing biological productivity. The deeper Guatemala Basin below about 2700 m is essentially homogeneous in conservative properties because it is filled by water flowing over the East Pacific Rise and not from the other eastern Pacific Basins (Tsuchiya and Talley, 1998). Differences in $\delta^{13}C$ or nutrients within the basin with respect to the properties measured on the ridges (e.g. those measured in core RC13-110) represent the integrated degradation of particulate organic matter that reaches the deep water column within the Guatemala Basin and provide a measure of oxygen utilization independent from flux measurements on cores.

Geophysical Survey. The central Cocos Rise (COC-2 and 3) was surveyed between May 23 and May 25, 2000, and the eastern Cocos Rise (COC-1, COC-4, COC-5) was surveyed between June 5 and 7, 2000, on the R/V Melville NEMO-3 cruise using the Melville Seabeam 2000 swathmapping system for bathymetry, and a digitally-recorded Knudsen 320B echosounder for high-resolution subbottom profiles. We used two 150 c.i. GI guns and the Scripps 4-channel hydrophone streamer to digitally acquire seismic reflection profiles.

The survey discovered excellent sites of pelagic sedimentation on the Central Cocos Rise near Cocos Island. Site COC-2 is near 2000 m water depth, provided a excellent monitor of deep water, and a good record of surface water properties under the low-salinity, warm waters of the Panama Basin. Site COC-3 is near 900 m waterdepth, provided an excellent depth transect of the mixing zone between AAIW and NPIW.

On the eastern Cocos Rise, COC-1 and COC-4 provide additional sites at mid-water depths of 1003 and 1370m respectively.

Sampling: Four sampling sites on the Cocos Rise targeted intermediate and deep waters (~900-2000 m depth), and are expected to monitor warm surface waters of the Panama Basin region,

and the zone of high biological production along the Costa Rica margin. At these sites we obtained water samples and sediment cores, as follows:

a) Central Cocos Rise: Sediment cores were taken in a depth transect from ~900-2000 meters depth. Here, areas are referred to as COC-1C (eastern Cocos Rise, 1004 m depth atop seamount), COC-2 (central Cocos Rise, north flank, 2045 m depth), COC-3 (central Cocos Rise, 905 m depth, atop seamount), COC-4 (easternmost Cocos Rise, ~1370 m depth, near its intersection with the Middle Americas Trench. One multicore at each site was sliced at 0.5 cm intervals (0-6 cm) or 1.0 cm intervals (6-12 cm), and preserved in buffered formalin and rose bengal stain. This sampling will help to constrain the processes recorded by geologic proxies. Sediment cores at COC-2 revealed pelagic sedimentation with abundant calcareous and siliceous microfossils.

Area	**Cruise**	**Site**	**Device**	**Latitude**		**Longitude**		**Depth**	**Date-Time**	**Length**
									Type	deg-min (cm)
COC-1C	ME0005A-	38MC1	Multicore	7	19.00	-84	-6.80	1003	6/05/00 1554Z	30
COC-1C	ME0005A-	40TC	Trigger Core	7	19.00	-84	-6.80	1004	6/05/00 xxxxZ	132
COC-1C	ME0005A-	40JC	Jumbo Core	7	19.00	-84	-6.80	1004	6/05/00 xxxxZ	1241
COC-2	ME0005A-	13TC	Trigger Core	5	50.79	-86	-26.92	2045	5/24/00 1137Z	190
COC-2	ME0005A-	13JC	Jumbo Core	5	50.79	-86	-26.92	2045	5/24/00 1137Z	1211
COC-2	ME0005A-	14MC1	Multicore	5	50.79	-86	-26.92	2045	5/24/00 1612Z	35
COC-3	ME0005A-	15MC1	Multicore	4	36.82	-86	-42.23	904	5/25/00 1027Z	16
COC-3	ME0005A-	17TC	Trigger Core	4	36.82	-86	-42.23	905	5/25/00 1335Z	34
COC-3	ME0005A-	17JC	Jumbo Core	4	36.82	-86	-42.23	905	5/25/00 1335Z	1379
COC-4	ME0005A-	41MC1	Multicore	7	51.34	-83	-36.49	1370	6/06/00 1345Z	49
COC-4	ME0005A-	43TC	Trigger Core	7	51.35	-83	-36.50	1368	6/05/00 1717Z	195
COC-4	ME0005A-	43JC	Jumbo Core	7	51.35	-83	-36.50	1368	6/05/00 1717Z	1508

Water samples were taken from Niskin bottles deployed on R/V Melville's hydro wire (here denoted "Hydrocast") and on the multicore frame (here denoted "Niskin/MC") in a depth transect for analysis of $\delta^{18}O_{water}$, $\delta^{13}C_{dic}$, Salinity, and $\delta^{15}N_{nitrate}$. This water sampling was designed to constrain the relationship of oxygen isotopes and salinity in low-salinity surface waters, the effects of denitrification on $\delta^{15}N$ of nitrate at the base of the euphotic zone, and the carbon isotopic composition of deep and intermediate waters.

Area	**Cruise**	**Site**	**Device**	**Latitude**		**Longitude**		**Bott.**	**Date-Time**	**Depth**
									Type	deg-min (m)
COC-1C	ME0005A-	38NB1	Niskin/MC	7	19.00	-84	-6.80	1003	6/05/00 1554Z	1003
COC-1C	ME0005A-	39NB1	Hydrocast	7	19.00	-84	-6.80	1003	6/05/00 1554Z	2
COC-1C	ME0005A-	39NB2	Hydrocast	7	19.00	-84	-6.80	1003	6/05/00 1554Z	100
COC-2	ME0005A-	12NB1	Hydrocast	5	50.79	-86	-26.91	2047	5/24/00 1013Z	2
COC-2	ME0005A-	12NB2	Hydrocast	5	50.79	-86	-26.91	2047	5/24/00 1013Z	100
COC-2	ME0005A-	14NB1	Niskin/MC	5	50.79	-86	-26.92	2045	5/24/00 1612Z	2045

COC-3	ME0005A-	15NB1	Niskin/MC	4	36.82	-86	-42.23	904	5/25/00	1027Z	904
COC-3	ME0005A-	16NB1	Hydrocast	4	36.87	-86	-42.32	907	5/25/00	1140Z	2
COC-3	ME0005A-	16NB2	Hydrocast	4	36.87	-86	-42.32	907	5/25/00	1140Z	100
COC-4	ME0005A-	41NB1	Niskin/MC	7	51.34	-83	-36.49	1370	6/06/00	1345Z	1370
COC-4	ME0005A-	42NB1	Hydrocast	7	51.41	-83	-36.52	7.8568	6/06/00	1601Z	2
COC-4	ME0005A-	42NB2	Hydrocast	7	51.41	-83	-36.52	7.8568	6/06/00	1601Z	100

Proposed ODP Drill Sites
Based on the survey data we obtained in NEMO-3, we can constrain the following two drill sites.

SITE COC-2 (SW Cocos Ridge)
(5° 50.566'N 86° 26.674' W, water depth–2042 m)

Site Objectives
COC-2 is located roughly under the modern northern summer position of the Intertropical Convergence Zone. In the late Pleistocene, this region has a time series of $CaCO_3$ mass accumulation rate distinctive from the Pacific equatorial region (Lyle et al., in press). Lyle et al. (in press) observed a strong coherence with obliquity in a nearby core and speculated that the region experiences a relatively strong north Pacific influence.

Because of its relatively shallow depth, the sediments have experienced little carbonate dissolution. The relatively large size of the basin also makes it an effective sediment trap--the sediments appear to retain the fine sediment fraction. While we have no information yet on surface sedimentation rates, assuming a crustal age of 10-15 Myr and a sediment thickness (from the seismic survey) of 400 m yields an average Neogene sedimentation rate of 25-40 m/Myr.

General Description
The COC-2 area is situated on the northern flank of the Cocos Ridge in a basin ringed by small volcanoes (Figures A-COC2-1 and A-COC2-2) . The basement topography is relatively flat and the sediments have filled an area greater than 20 km by 10 km to a depth of about 400 m. This site has always been near or above the 2 km water depth, and the sediment record should provide a means to sample intermediate waters 1 km or less in the early part of the late Miocene epoch.

Lithologic Description
Sediment lithology can be defined from sediment core: ME0005-0013PC, taken at 5° 50.79' N, 86° 26.92'W, 2045 m water depth, 12.11 m sediment recovered

Sediment core ME0005A-13PC (5^{o}50.79'N, 86^{o}26.92W, 2045m, 12.00 m) was obtained on leg III of the NEMO expedition. It is comprised of olive to gray foram nanno ooze, highly mottled. The core alternates between light gray (5Y-7/1) zones relatively rich in calcareous fossils (characterized by low magnetic susceptibility), and gray (5Y-5/1) zones relatively enriched in siliceous microfossils (and with higher magnetic susceptibility), with a typical wavelength of about 150-200 cm.. If average sedimentation rates are near 25 m/Ma, this alternation may reflect the well-known 100,000 year climate cycle of the late Pleistocene. Alternatively, if the sedimentation rates are near 40-50 m/Ma, the observed alternation of lithologies could reflect the

41,000 year climate cycle. One layer of sandy black ash, of unknown age and provenance, was observed at 1047-1058cm depth. In a nearby core (Y71-3-2, 7.17N, 85.15W, 2164 m) late Pleistocene mass accumulation rates of $CaCO_3$ in mimic variations in orbital obliquity, suggesting an influence of subsurface watermasses of high-latitude origin in controlling carbonate preservation (Lyle et al., submitted, 2000).

Figures Found in Appendix A

Figure COC2-2: Swathmap bathymetry for the COC-2 survey on the NEMO-3 cruise. COC-2 is located on the northern flank of the aseismic Cocos Ridge..

FigureCOC2-3 Bandpass-filtered seismic reflection profile COC-2a Line 1 from the NEMO-3 survey. Site COC-2 is at the cross of line 1 and line 3

Figure COC2-4: Seismic crossline COC-2a Line 3 across proposed drillsite COC-2

Figure COC2-5 Chirp Seismic taken during Seismic Line 1 across COC-2

SITE COC-1 (top of Cocos Ridge)
(7° 18.646'N 84° 07.309' W, water depth–1007 m)

Site Objectives

COC-1 is a priority site for Leg 201 (SE Pacific Neogene) to monitor the composition of basal intermediate waters at the northern edge of the Panama Basin, and will be used to monitor the North Equatorial Countercurrent.

COC-1A has been sited in a small basin on the top of Cocos Ridge near the position where the Cocos Ridge collides with Costa Rica (Figure 3). It is near the shallowest point on the Cocos Ridge in this vicinity. We chose the position of COC-1A in a small but somewhat deformed basin.

Because of the shallow depth of COC-1, the sediments should be above the lysocline and carbonate dissolution should be controlled by the relative rates of carbonate rain from the surface waters and organic carbon degradation within the surface sediments. The presence of discoasters in the multicore surface samples suggests that there is a moderate amount of sediment reworking in the vicinity.

General Description

COC-1 is situated in a shallow (~1000 m deep) sedimentary basin at the crest of the Cocos ridge immediately before the ridge collides with the Mesoamerican Trench. The basin has experienced some deformation as indicated by some unconformable reflectors in the sediment sequence. The basement age is probably early Miocene, and the sediment began filling the basin at a somewhat later date. The deformation of the sediments within the basin would suggest that the basin was formed as part of the subduction process of the Cocos Ridge, or perhaps in the late Miocene.

The COC-1 basin contains 250-400 m of sediment and is surrounded by volcanic terrain. On all sides except to the northwest (which we didn't survey), volcanic basement outcrops within 3-4 km of the basin center. The basin deepens to the south, suggesting a downdropped graben.

Lithologic Description
Nearest sediment core: ME0005-0040JC, taken on NEMO-3; 7° 19.00' N, 84° 06.80'W, 1004 m water depth, 12.41 m sediment recovered

The piston core is dark olive to dark olive gray foram-nanno ooze with some biosiliceous debris. Colors alternate downcore suggesting carbonate cycles. The sediments are mottled throughout. Some reworking is indicated by the presence of discoasters in the core, including at 11 cm in the adjoining multicore samples.

Seismic Interpretation
Primary Site (COC-1A): COC-1 survey line 4, JD157 10:51:08Z (SP3908; CDP 3908)
Crossline: CAR-1 survey line 7,
Location: 7° 18.646'N, 84° 07.309' W
Site water depth: 1007 m (center beam depth; 1.342 sec TWTT)
Sediment thickness: 0.441 sec (353 m)
Proposed Drilling Depth: 358 m

COC-1A is located on the crest of the Cocos Ridge, near where it is being subducted into the Mesoamerican trench. Because the highest priority objective is to sample lower intermediate waters, it is located in the shallowest basin we could find, at about 1000 m water depth. We chose the position because it has both an expanded upper (Pleistocene?) sediment sequence and one of the thickest sequences of earlier sediments. The upper sediment sequence is 80 m thick, and if Pleistocene in age, implies a sedimentation rate of 40 m/Myr in the basin.

Figures Found in Appendix A
Fig COC1-2: Swathmap bathymetry for the CAR-1 region, from the Nemo-3 site survey. Proposed drill site is marked.
Fig COC1-3: Bandpass-filtered seismic reflection profile CAR1 Line 6 across CAR-1A, from NEMO-3. Proposed drill site is marked, and our correlation to the Bloomer et al. (1995) seismic stratigraphy is labeled.
Fig COC1-4: Crossline profile CAR1 Line 12 just to the northeast of CAR-1A, from NEMO-3. Line crossing with Line 6 is marked.
Figure COC2-5: 2-7 kHz Chirp Seismic taken along Seismic Line 6 across the proposed drillsite.

SITE COC-4 (Intersection of Crest of Cocos Ridge with Costa Rica Margin)
(7° 51.352'N 83° 36.402' W, water depth 1370 m)

Site Objectives
COC-4 will monitor the composition of basal intermediate waters and upper deep waters at the northern edge of the Panama Basin, and will be used to monitor the Costa Rica Current and the movement of the intertropical convergence zone. It will also be used to monitor upwelling along

the Costa Rica Margin. Because of the shallow depth of COC-4, the sediments should be above the lysocline and carbonate dissolution should be controlled by the relative rates of carbonate rain from the surface waters and organic carbon degradation within the surface sediments. The unconformity at the base of the sediment section provides an opportunity examine a middle Miocene shallow pelagic section from the Galapagos region and will provide an opportunity to date the onset of hemipelagic sedimentation.

General Description

COC-4 is situated in a shallow (~1400 m deep) basin within the structurally complex intersection between the Cocos Ridge and the Mesoamerican Trench (Figure A-COC4-1 and A-COC4- 2; von Huene et al, 2000). The site lies in a graben on the crest of the Cocos Rift, which is in turn crosscut by younger normal faulting striking roughly ENE (Figure A-COC4-3). Tectonic activity has had a striking effect on sedimentation. The COC-4 drillsite not only occupies a shallow bathymetric basin, but seismic reflection data shows the basin to be a shallow listric fault which is apparently still active. The crossline, COC4 Line 7 (Figure A-COC4-3) shows the 3-D nature of the deformation approximately along strike to the surface expression of the basin. The more recent sediments lie unconformably on top of the older sediment pile (presumably middle to early Miocene carbonates) which seems to be folded perhaps by the subduction process. Some older sediments outcrop along major anticlines, as can be observed at the southern end of COC4 Line 5 (Figures A-COC4-2) forming 'badlands'. Because the primary objectives of Leg 202 involve high resolution studies of the late Pliocene to Recent section, we chose a thick section within the most recent grabens as the COC-4 drillsite.

Lithologic Description

Nearest sediment core: ME0005-43JC, taken on NEMO-3; 7° 51.35' N, 83° 36.50'W, 1368 m water depth, 15.08 m sediment recovered This core was not opened on the cruise, but from section breaks we noted dark olive gray clay with forams.

Seismic Interpretation

Primary Site (COC-4): COC4 line 5, JD158 09:09:05Z (SP3295)
Crossline: COC4 line 7,
Location: 7° 51.349'N, 83° 36.488' W
Site water depth: 1368 m (center beam depth; 1.735 sec TWTT)
Sediment thickness: 0.559 sec (461 m at 1650 m/sec velocity)
Proposed Drilling Depth: 465 m.

COC-4 is located in a graben on the crest of the Cocos Ridge, within the region of strong hemipelagic sedimentation from Costa Rica. Because the highest priority objectives involve sampling a high-resolution Pleistocene section we picked a graben with thick hemipelagic infill. It is uncertain how fast these sediments have filled the graben, although the basement age should be middle to late early Miocene based upon other DSDP and ODP drillsites. The hemipelagic sediment-filled modern graben is of uncertain age, but if it is Pleistocene in origin, the sedimentation rate is on the order of
150 m/million years (the graben sediments are about 300 m thick).

Figures Found in Appendix A

Fig COC4-1: Swathmap bathymetry for the COC-4 region, from the Nemo-3 site survey. Proposed drill site is marked. The "badlands" region are the southern small basins in the center of the map.

Fig COC4-2: Bandpass-filtered seismic reflection profile COC4 Line 5 across COC-4, from NEMO-3. Proposed drill site is marked.

Fig COC4-3: Crossline profile COC4 line 7, from NEMO-3. Crossing with Line 5 is marked.

3. The Panama Basin Survey Areas (PAN-1, -2, -3).

Science Objectives: Sites within the deep Panama Basin offer relatively high sedimentation rates in a latitudinal transect of sites across warm surface waters of the eastern Pacific region, an opportunity to monitor low-salinity surface waters caused by high rainfall, a possible tracer of Atlantic-Pacific transport of fresh water via the atmosphere, and a record of high biogenic accumulation along the equator, under the Equatorial Front (Wooster, 1969). In addition, deep waters of the relatively isolated Panama Basin are modified by the rain of organic matter from productive waters above. Comparison of deep water properties with those of shallower source waters to the North and South thus provide an opportunity to assess changing rates of biogenic productivity, and its role on the oxygen minimum zone.

Geophysical Survey. The Panama Basin areas PAN-1 and PAN-2 were surveyed between May 26 and May 28, 2000, and PAN-3 was surveyed on 4 June, on the R/V Melville NEMO-3 cruise using the Melville Seabeam 2000 swathmapping system for bathymetry, and a digitally-recorded Knudsen 320B echosounder for high-resolution subbottom profiles. We used two 150 c.i. GI guns and the Scripps 4-channel hydrophone streamer to digitally acquire seismic reflection profiles.

Sampling:

a) Sediment cores

Area	Cruise	Site	Device	Latitude	Longitude	Depth	Date-Time	Length
						deg-min		Type deg-min
						(m)	(GMT)	(cm)
PAN-1	ME0005A-	19JC	Jumbo Core	3 12.74	-86 -29.16	2674	5/26/00 1258Z	1561
PAN-1	ME0005A-	19TC	Trigger Core	3 12.74	-86 -29.16	2674	5/26/00 1258Z	205
PAN-1	ME0005A-	20MC1	Multicore	3 12.74	-86 -29.16	2675	5/26/00 1737Z	29
PAN-2	ME0005A-	21MC1	Multicore	0 1.29	-86 -27.79	2942	5/28/00 0015Z	44
PAN-2	ME0005A-	23JC	Jumbo Core	0 1.30	-86 -27.79	2945	5/28/00 0429Z	1903
PAN-2	ME0005A-	23TC	Trigger Core	0 1.30	-86 -27.79	2945	5/28/00 0429Z	150
PAN-2	ME0005A-	24JC	Jumbo Core	0 1.30	-86 -27.79	2941	5/28/00 1719Z	1927
PAN-2	ME0005A-	24TC	Trigger Core	0 1.30	-86 -27.79	2941	5/28/00 1719Z	0

PAN-3	ME0005A-	35MC1	Multicore	4	7.19	-85	-0.30	3404	6/04/00 0438Z	28
PAN-3	ME0005A-	37TC	Trigger Core	4	7.19	-85	-0.30	3409	6/04/00 0920Z	50
PAN-3	ME0005A-	37JC	Jumbo Core	4	7.19	-85	-0.30	3409	6/04/00 0920Z	2006

b) Water samples were taken from Niskin bottles deployed on R/V Melville's hydro wire (here denoted "Hydrocast") and on the multicore frame (here denoted "Niskin/MC) in a depth transect for analysis of $\delta^{18}O_{water}$, $\delta^{13}C_{dic}$, Salinity, and $\delta^{15}N_{nitrate}$. This water sampling was designed to constrain the relationship of oxygen isotopes and salinity in these low-salinity surface waters, the effects of denitrification on $\delta^{15}N$, and the carbon isotopic composition of deep and intermediate waters.

Area	**Cruise**	**Site**	**Device**	**Latitude**		**Longitude**		**Bott.**	**Date-Time** Type	**Depth** deg-min
				deg-min		deg-min			(m)(GMT)	(m)
PAN-1	ME0005A-	18NB1	Hydrocast	3	12.74	-86	-29.16	2674	5/26/00 xxxxZ	2
PAN-1	ME0005A-	18NB2	Hydrocast	3	12.74	-86	-29.16	2674	5/26/00 xxxxZ	100
PAN-1	ME0005A-	20NB1	Niskin/MC	3	12.74	-86	-29.16	2675	5/26/00 1737Z	2675
PAN-2	ME0005A-	21NB1	Niskin/MC	0	1.29	-86	-27.79	2942	5/28/00 0015Z	2942
PAN-2	ME0005A-	22NB1	Hydrocast	0	1.22	-86	-27.79	2937	5/28/00 0215Z	2
PAN-2	ME0005A-	22NB2	Hydrocast	0	1.22	-86	-27.79	2937	5/28/00 0215Z	100
PAN-3	ME0005A-	35NB1	Niskin/MC	4	7.19	-85	-0.30	3404	6/04/00 0438Z	3404
PAN-3	ME0005A-	36NB1	Hydrocast	4	7.19	-85	-0.30	3404	6/04/00 0701Z	2
PAN-3	ME0005A-	36NB2	Hydrocast	4	7.19	-85	-0.30	3404	6/04/00 0701Z	100

Proposed ODP Drill Site

SITE PAN-2 (Panama Basin Equatorial site)
(00° 01.312'N 86° 42.334' W, water depth 2941 m)

Site Objectives
PAN-2 was survey and sampled to study variability in equatorial upwelling on time scales ranging from the millennial to megayear, from the Late Pliocene to the Holocene. It has an average sedimentation rate over the last 3 million years of 90 m/Myr, easily allowing the resolution of millennial- scale climate processes. Because it lies on the Nazca Plate, which has a zonal backtrack path with respect the spin axis, it has been within 10' of the equator for its entire history.

General Description
PAN-2 survey area is located on 3 Ma crust formed at the Galapagos Spreading Center (Hey, 1977) within the Panama Basin (Figure A-PAN2-1). On NEMO-3 we crossed the GSC rise crest at 00°51'N on the transit to PAN-2, a little less than 100 km north of the survey region. PAN-2 is typical of classic abyssal hill topography (Figure A-PAN2-2), with typical relief of 200-300 m between ridges and basins. The basins are all filled with sediment, ranging from 250 to >350 msec TWTT in thick-ness (~200-300 m), while the ridges have 0 to >100 m of sediment (Figure A-PAN2-4). Based upon its location in magnetic anomaly C2An.2n (Hey, 1977), the basement

age should be 3.15 Ma (Cande and Kent, 1995). With a sediment thickness estimated at 282 m, the average sedimentation rate at PAN-2 should be 90 m/Myr.

Lithologic Description
Nearest sediment core: ME0005A-24JC (Jumbo Core, taken on NEMO-3 expedition), location 0°01.30'N, 86°27.79'W, water depth 2941m, core length 19.27m. Description: Olive Gray to dark olive colored, diatom-nannofossil ooze. Foraminifera and sponge spicules are common to abundant, and radiolarians are rare to common. Core is heavily burrow mottled throughout, and contains some open burrows, suggesting significant bioturbation. Ash layer at 988 cm, if assumed to be ash layer 'L' (230 ka, Ninkovich and Shackleton, 1975) suggests a sedimentation rate of 43 m/ma. Nearby piston core Y69-71 has a prominent ash layer at 660 cm in MIS-5a, equivalent to the Los Chocoyos (D) ash (84 ka; Drexler et al., 1980). If this is the 988 cm ash in 24JC, the sedimentation rate is 118 m/Myr.

Figures Found in Appendix A
Fig PAN2-1: Swathmap bathymetry for the PAN-2 region, from the Nemo-3 site survey. Proposed drill site is marked.
Fig PAN2-2: Crossline PAN2 Line 1 through the proposed PAN-2 drillsite
Fig PAN2-3: Bandpass-filtered seismic reflection profile PAN2 line 5 across PAN-2, from Nemo-3. Proposed drill site is marked.

4. The Carnegie Ridge Transect (CAR-1 and CAR-2):

Science Objectives: On the Carnegie Ridge transect we will survey and core the upper part of the Carnegie Ridge with the primary objective to sample a depth transect from lower intermediate waters to the mid-depth range (~1000-3000 m). Sites selected on the Carnegie Ridge are part of the highly ranked Ocean Drilling Proposal now being considered by the JOIDES advisory structure (sites CAR-1, CAR-2, CAR-3). The primary objective will be to study the evolution of southern source intermediate waters and millennial variations in water properties, productivity, and carbonate burial. We will locate high-resolution core sites near the important V19-27/28/29/30 core set (for which geophysical data is of poor quality making them un-drillable at present), and should fill in an important gap in core coverage between 2800 and 1300 m.

Geophysical Survey. The eastern Carnegie Ridge was surveyed between May 30 and June 2, 2000, on the R/V Melville NEMO-3 cruise using the Melville Seabeam 2000 swathmapping system for bathymetry, and a digitally-recorded Knudsen 320B echosounder for high-resolution subbottom profiles. We used two 150 c.i. GI guns and the Scripps 4-channel hydrophone streamer to digitally acquire seismic reflection profiles.

Sampling:

a) Sediment cores

Area	Cruise	Site	Device	Latitude	Longitude	Depth	Date-Time	Length

											Type	deg-min	(m)	(GMT)
										(cm)				
CAR-1	ME0005A-	29MC1	Multicore	0	-30.80	-81	-59.70	1343	6/01/00	1930Z		46		
CAR-1	ME0005A-	31TC	Trigger Core	0	-30.80	-81	-59.70	1343	6/01/00	2221Z		188		
CAR-1	ME0005A-	31JC	Jumbo Core	0	-30.80	-81	-59.70	1343	6/01/00	2221Z		1226		
CAR-1	ME0005A-	34TC	Trigger Core	0	-18.28	-81	-48.94	746	6/02/00	1202Z		31		
CAR-1	ME0005A-	34JC	Jumbo Core	0	-18.28	-81	-48.94	746	6/02/00	1202Z		1277		
CAR-2	ME0005A-	25MC1	Multicore	-1	-51.20	-82	-47.20	2203	5/30/00	1345Z		-30		
CAR-2	ME0005A-	27TC	Trigger Core	-1	-51.20	-82	-47.20	2203	5/30/00	1731Z		203		
CAR-2	ME0005A-	27JC	Jumbo Core	-1	-51.20	-82	-47.20	2203	5/30/00	1731Z		918		
CAR-2	ME0005A-	28GC	Gravity Core	-1	-51.20	-82	-47.20	2203	5/31/00	0159Z		270		

b) Water samples were taken from Niskin bottles deployed on R/V Melville's hydro wire (here denoted "Hydrocast") and on the multicore frame (here denoted "Niskin/MC) in a depth transect for analysis of $\delta^{18}O_{water}$, $\delta^{13}C_{dic}$, Salinity, and $\delta^{15}N_{nitrate}$. This water sampling was designed to constrain the relationship of oxygen isotopes and salinity in these low-salinity surface waters, the effects of denitrification on $\delta^{15}N$, and the carbon isotopic composition of deep and intermediate waters.

Area	**Cruise**	**Site**	**Device**	**Latitude**		**Longitude**		**Bott.**	**Date-Time**		**Depth**
									Type		deg-min
				deg-min					(m)	(GMT)	(m)
CAR-1	ME0005A-	29NB1	Niskin/MC	0	-30.80	-81	-59.70	1343	6/01/00	1930Z	1343
CAR-1	ME0005A-	30NB1	Hydrocast	0	-30.85	-81	-59.73	1343	6/01/00	2145Z	2
CAR-1	ME0005A-	30NB1	Hydrocast	0	-30.85	-81	-59.73	1343	6/01/00	2145Z	100
CAR-2	ME0005A-	25NB1	Niskin/MC	-1	-51.20	-82	-47.20	2203	5/30/00	1345Z	2203
CAR-2	ME0005A-	26NB1	Hydrocast	-1	-51.20	-82	-47.20	2203	5/30/00	1530Z	2
CAR-2	ME0005A-	26NB2	Hydrocast	-1	-51.20	-82	-47.20	2203	5/30/00	1530Z	100

Proposed ODP Drill Sites:

SITE CAR-2 (SE flank of Carnegie Ridge)
(1° 52.406'S 82° 46.914' W, water depth–2223 m)

Site Objectives
CAR-2 is a high priority site for Leg 202 (SE Pacific Neogene) to study the Pleistocene history of upwelling and paleoproductivity off Ecuador and the movement of the equatorial front. It will be used to monitor the South Equatorial Current and to monitor the composition of waters that flow into the Panama Basin.

It is located within a sediment section slowly creeping downhill ("mud glacier") on the southeastern margin of the Carnegie Ridge. Seismic reflection profiling has imaged a deformed layer about 250 m deep within the section. A secondary objective at this site will be to drill this

layer and determine its physical properties. The sediments above this layer are basically undeformed, as in an ice glacier.

Because of the relatively shallow depth of CAR-2, the sediments should be above the lysocline and carbonate dissolution should be controlled by the relative rates of carbonate rain from the surface waters and organic carbon degradation within the surface sediments. The presence of what is probably ash layer L at 10.42 m in the piston core suggests an average late Pleistocene sedimentation rate of 40-50 m/Myr.

General Description

CAR-2 is situated in a basement scallop along the southeastern flank of the Carnegie Ridge near where the Carnegie Ridge collides with the Peru-Chile Trench (Figure A-CAR2-1). To the south the sea floor topography steps up from typical depths >4 km south of Sarmiento Ridge (~7°S) to 3 km at the base of the slope on this flank at about 2°S.

The CAR-2 survey was carried out at the upper part of this slope, mainly between about 1500 m and 2500 m (Figure A-CAR2-2). There is a major channel in the southern end of the survey area, passing just north of a prominent seamount. Sediments above the channel are relatively uniform in thickness, 400-500 m thick (500-600 msec TWTT). There is strong evidence that the sediments are creeping down into the channel. The edge of the channel is marked by "seracs" of the sediment section detaching and falling into it (Figure A-CAR2-2 and A-CAR2-3). A disturbed zone, possible representing a detachment, can be imaged at about 250 m below the sea floor (305 msec TWTT) in the vicinity of the proposed CAR-2A drillsite. The "serac" line marks where the sediment passes over drops in basement level, and there is a separation at the top of the sediment section and the basement outcrop behind (Figure A-CAR2-4).

Lithologic Description

Sediment lithology is exemplified by sediment core: ME0005-0027C, taken on NEMO-3; 1° 51.21' S, 82° 47.20'W, 2203 m water depth, 19.18 m sediment recovered

The piston core is olive to olive gray siliceous nannofossil ooze, highly mottled. There is a subtle alteration of colors downcore which probably represents orbital cyclicity. An 18 cm thick ash layer (perhaps Ash layer L, 230 ka) was found between 10.42 and 10.60 mbsf. Below 15 m the lighter layers in the light-dark banding became lighter, and were observed to have higher nannofossil content than in the shallow section.

Proposed ODP drill site CAR-2A is located on a gentle slope on the southeast flank of the Carnegie Ridge where it meets the Peru-Chile Trench. The slope appears to have been steepened during this collision and the sediment section is creeping downhill. The shear zone appears to be within the sediments, at a depth of 0.305 sec TWTT (about 245 mbsf, Figure A-CAR2-5), and we believe from a preliminary seismic interpretation that the failure interval is a biogenic-silica rich late Miocene to early Pliocene high productivity unit. Basement is located 0.277 sec below the top of the disturbed interval, or at a depth of about 480 m. The region around the proposed drillsite has the same basic stratigraphy, although the upper sediment column at Site CAR-2A is slightly thicker than most of the area.

Figures found in Appendix A

Fig CAR2-2: Swathmap bathymetry for the CAR-2 region, from the Nemo-3 site survey. Proposed drill site is marked.

Fig CAR2-3: Migrated Seismic image across the "serac" zone on seismic line 5 showing the deformation of the sediment column.

Figure CAR2-4: Seismic line 4 showing the sediments downslope from the basement outcrop of Carnegie Ridge. Sediment is being deformed over the 2 basement steps. The deformation appears to be occurring about halfway through the sediment column

Fig CAR2-5: Bandpass-filtered seismic reflection profile CAR2-seisline 3 across CAR-2A, from NEMO-3. Proposed drill site is marked.

Fig CAR2-6: Crossline profile CAR2-seisline 6 across CAR-2A, from NEMO-3. Proposed drill site is marked.

Figure CAR2-7 2-7 kHz Chirp Seismic taken during Seismic Line 3 across the proposed drillsite.

SITE CAR-1 (top of Carnegie Ridge)
(00° 40.319'S 82° 04.853' W, water depth–1423 m)

Site Objectives

CAR-1 is a high priority site for ODP Leg 202 (SE Pacific Neogene) to study the Pleistocene history of upwelling and paleoproductivity off Ecuador and the movement of the equatorial front. It will be used to monitor the composition of basal intermediate waters, and will be used to monitor the South Equatorial Current.

CAR-1A has been sited in a large flat sediment-covered region on the top of Carnegie Ridge to the southwest of the highest topography we surveyed. While the surface sediment cover is flat, subsurface topography has significant relief, and each local basin has a somewhat different sediment history. We chose the position of CAR-1A in a basin with the highest late Neogene sedimentation.

Because of the shallow depth of CAR-1, the sediments should be above the lysocline and carbonate dissolution should be controlled by the relative rates of carbonate rain from the surface waters and organic carbon degradation within the surface sediments. The presence of what is probably ash layer L at 11.11 m in the piston core suggests an average late Pleistocene sedimentation rate of about 50 m/Myr.

General Description

CAR-1 is situated on the broad flat top of the Carnegie Ridge just to the west of the Peru-Chile trench and Ecuador (Figure A-CAR1-1). The site is just south of the equator and should have been underneath the equatorial divergence region for essentially the entire time since the basalt crust was formed, probably in the middle to early Miocene. Carnegie Ridge is on the Nazca Plate and should follow a Nazca plate backtrack trajectory.

In the region of CAR-1A the entire top of the ridge is sediment-covered and shallow, typically 1400 m deep and covered to a depth of 400-600 msec TWTT (300-500 m). To the northeast, the ridge shallows and basement outcrops (Figure A-CAR1-2). CAR-1A is in a very large region of sediment cover, extending more than 50 km to the southwest and 20 km to the northeast. This large sediment-covered region is broken up into subbasins by E-W trending basement ridges. One major basement ridge occurs about 9 km north of the proposed drillsite. It has been imaged on CAR1 line 6 (Figure A-CAR1-3) at 07:53Z on JD 153.

Lithologic Description

ME0005-0031JC, taken at 00° 30.80' S, 81° 59.70'W, 1323 m water depth, 12.26 m sediment recovered

The piston core is dark olive to dark olive gray foram ooze with nannofossils, highly mottled. There is a subtle alteration of colors downcore which probably represents orbital cyclicity. Two ash layers were found in the core at 5.4 m (?Ash D, 84 ka) and at 11.11 m (?Ash L, 230 ka). Some pyritization occurs lower in the core.

ODP drill site CAR-1A is located on an almost flat section of the top of the Carnegie Ridge. We have chosen to site the proposed drillsite to the south of the prominent subsurface ridge because we observe an expanded upper sediment section here. North of the ridge the lower sediment section is better developed. By comparison of the seismic section to that developed for the cores of Leg 138 to the west (Bloomer et al., 1995), we have been able to make a hypothesis about the rates of sediment deposition within the basin. If our identification is correct, the basal sediments at CAR-1A began accumulating near the middle-late Miocene boundary and the average sedimentation rate has been relatively constant at about 30 m/Myr since then, with the exception of the late Miocene-early Pliocene interval between reflectors R3 and R6. This interval has a sedimentation rate roughly twice as high. The late Miocene-early Pliocene is the interval of enhanced equatorial productivity in the eastern Pacific.

Figures found in Appendix A

Fig CAR1-2: Swathmap bathymetry for the CAR-1 region, from the Nemo-3 site survey. Proposed drill site is marked.

Fig CAR1-3: Bandpass-filtered seismic reflection profile CAR1 Line 6 across CAR-1A, from NEMO-3. Proposed drill site is marked, and our correlation to the Bloomer et al. (1995) seismic stratigraphy is labeled.

Fig CAR2-6: Crossline profile CAR1 Line 12 just to the northeast of CAR-1A, from NEMO-3. Line crossing with Line 6 is marked.

Figure CAR2-7 2-7 kHz Chirp Seismic taken along Seismic Line 6 across the proposed drillsite.

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Appendix A

Figures for Sites Proposed to the Ocean Drilling Program

Cruise Report

R/V Melville NEMO EXPEDITION, Leg III

Manzanillo Mexico to Puerto Caldera Costa Rica
15 May 2000 to 8 June 2000

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Oregon State University

Mitch Lyle
Boise State University

TEH-1: Gulf of Tehuantepec

Fig TEH1-1: Location map for TEH-1. Proposed drill site is marked.

Fig TEH1-2: Swathmap bathymetry for the TEH-1 region, from the NEMO-3 site survey. Proposed drill site and sediment cores obtained on NEMO-3 are marked.

Fig TEH1-3: Bandpass-filtered seismic reflection profile TEH1B-seisline 1 across TEH-1, from Nemo-3. Proposed drill site is marked.

Fig TEH1-4: 2-7 kHz Chirp subbottom profile TEH1-35line 1 across TEH-1, from EW9709. Proposed drill site is marked

Figure TEH-1: Site map showing the position of TEH-1 in the Gulf of Tehuantepec. Basemap is Carta Batimetrica CB-008 (Golfo de Tehuantepec), Direccion General de Geografia de los Estados Unidos de Mexico.

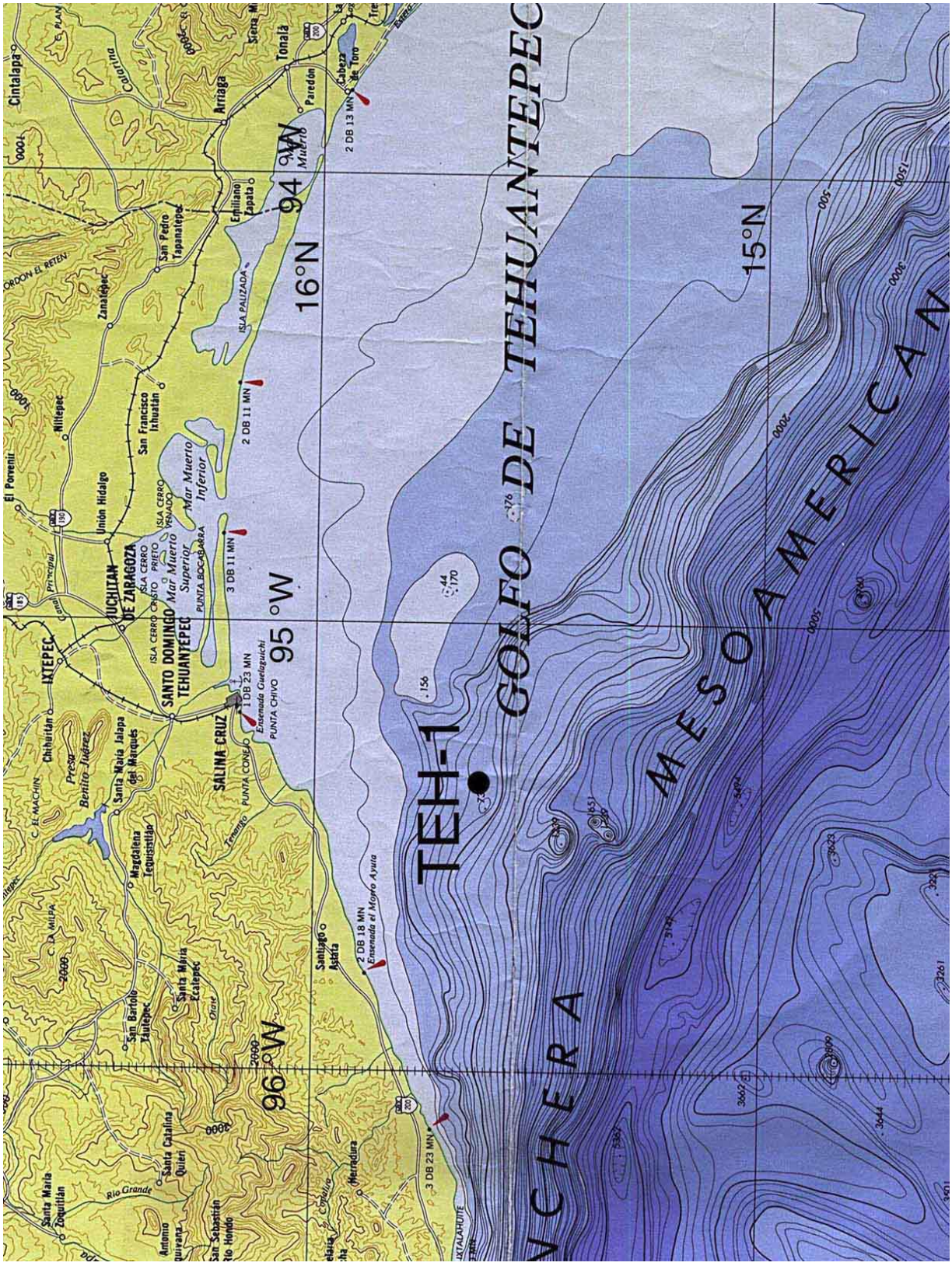
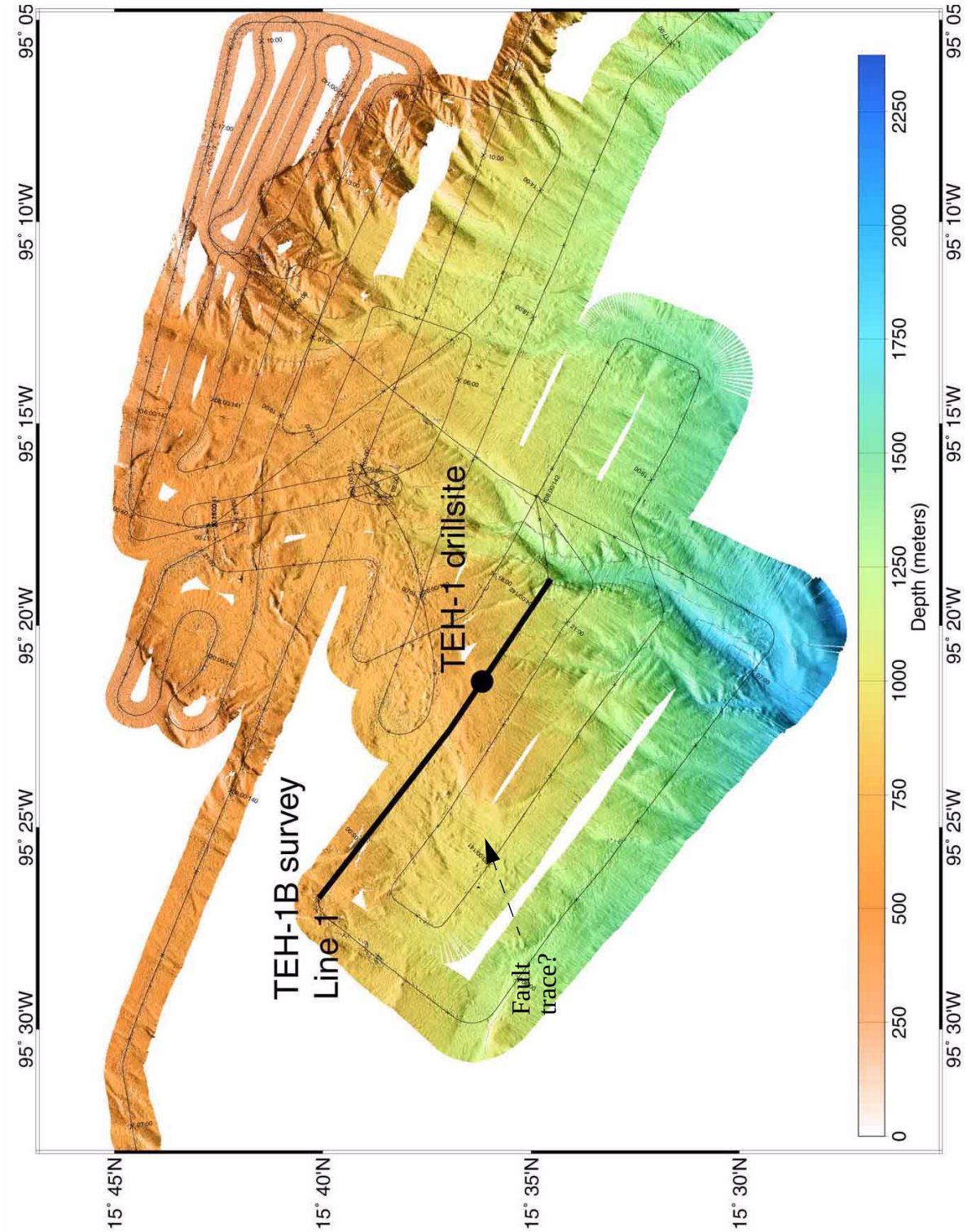
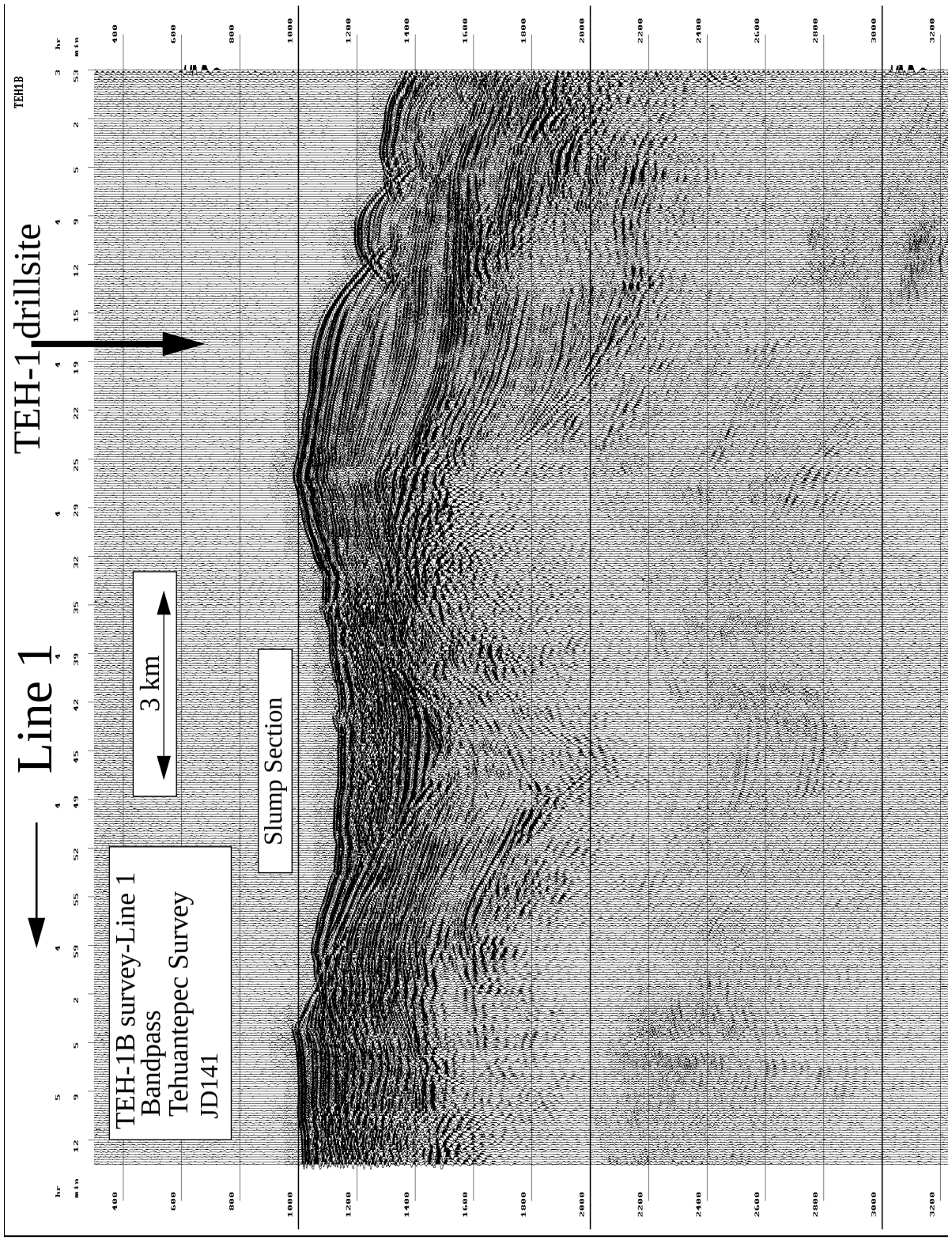


Figure PAT17-2: Swathmap bathymetry for the TEH-1 survey on the NEMO-3 cruise. TEH-1 is located on the southern flank of a possible transform fault cutting from NE to SW.



FigureTEH1-3: Bandpass-filtered seismic reflection profile TEH1B-seisline 1 across TEH-1, from the NEMO-3 survey



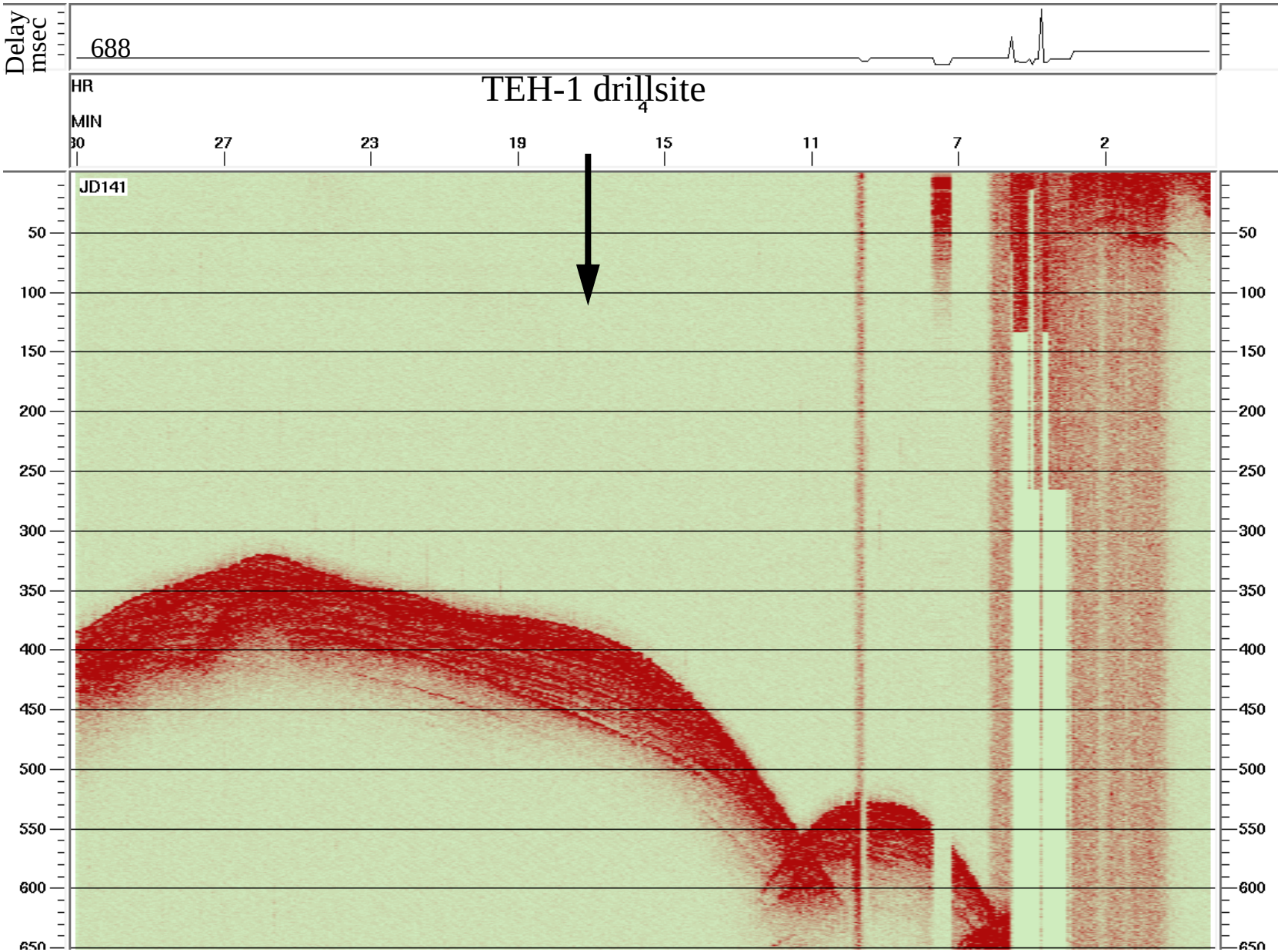


Figure TEH1-4: 3.5 kHz profile TEH1B-35line1 across TEH-1, from the NEMO-3 survey

SITE COC-2 (SW Cocos Ridge)
(5° 50.566'N 86° 26.674' W, water depth–2042 m)

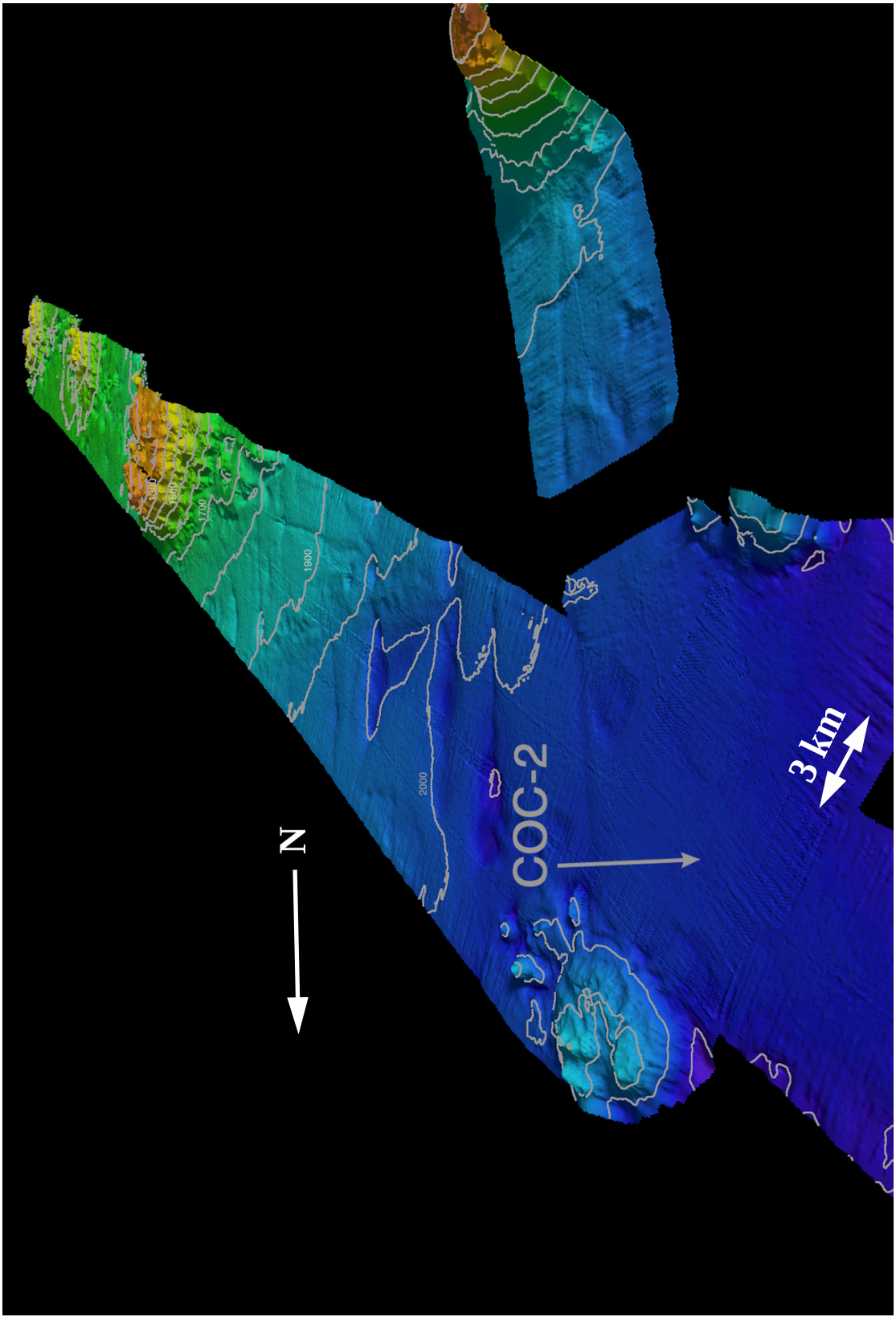
Figure COC2-2: Swathmap bathymetry for the COC-2 survey on the NEMO-3 cruise. COC-2 is located on the northern flank of the aseismic Cocos Ridge..

FigureCOC2-3 Bandpass-filtered seismic reflection profile COC-2a Line 1 from the NEMO-3 survey. Site COC-2 is at the cross of line 1 and line 3

Figure COC2-4: Seismic crossline COC-2a Line 3 across proposed drillsite COC-2

Figure COC2-5 Chirp Seismic taken during Seismic Line 1 across COC-2

Figure COC2-2: Swathmap bathymetry for the COC-2 survey on the NEMO-3 cruise. COC-2 is located on the northern flank of the aseismic Cocos Ridge..



FigureCOC2-3 Bandpass-filtered seismic reflection profile COC-2a Line 1 from the NEMO-3 survey. Site COC-2 is at the cross of line 1 and line 3

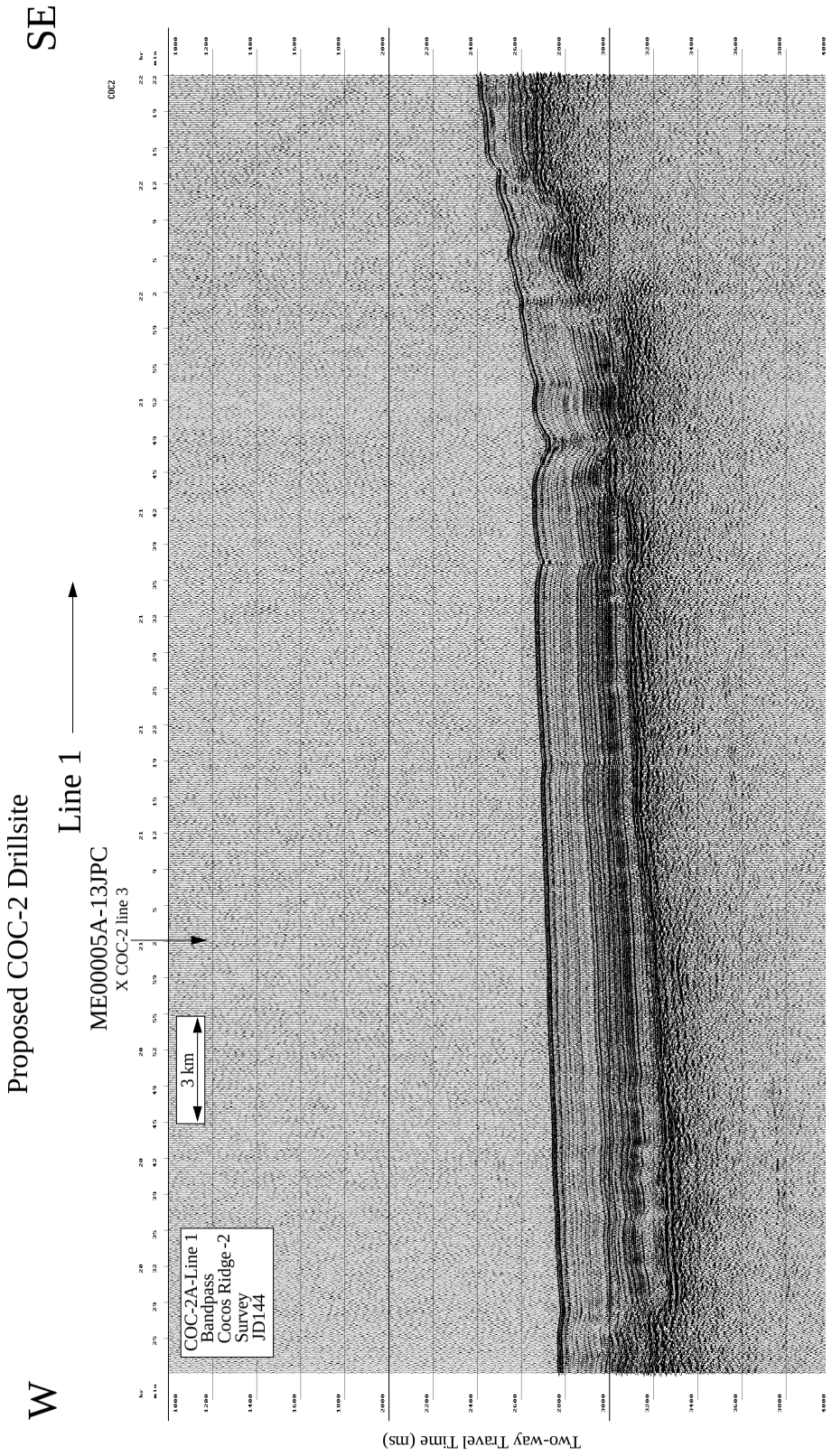
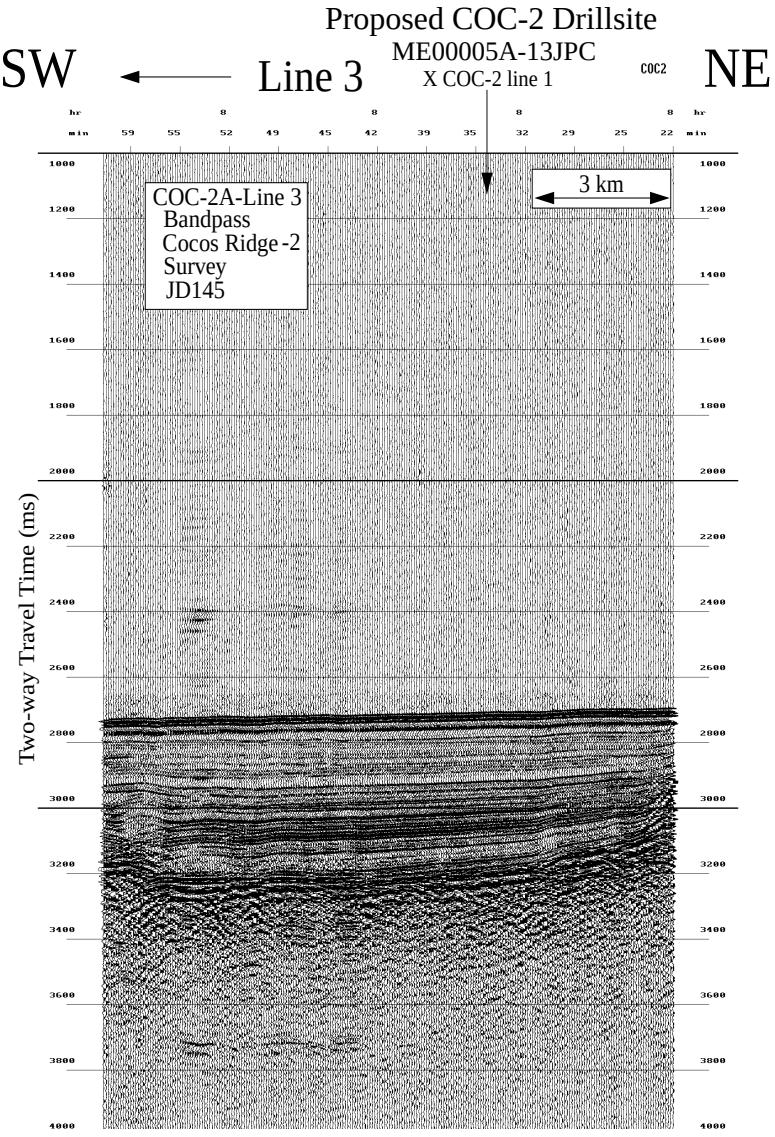


Figure COC2-4: Seismic crossline COC-2a Line 3 across proposed drillsite COC-2



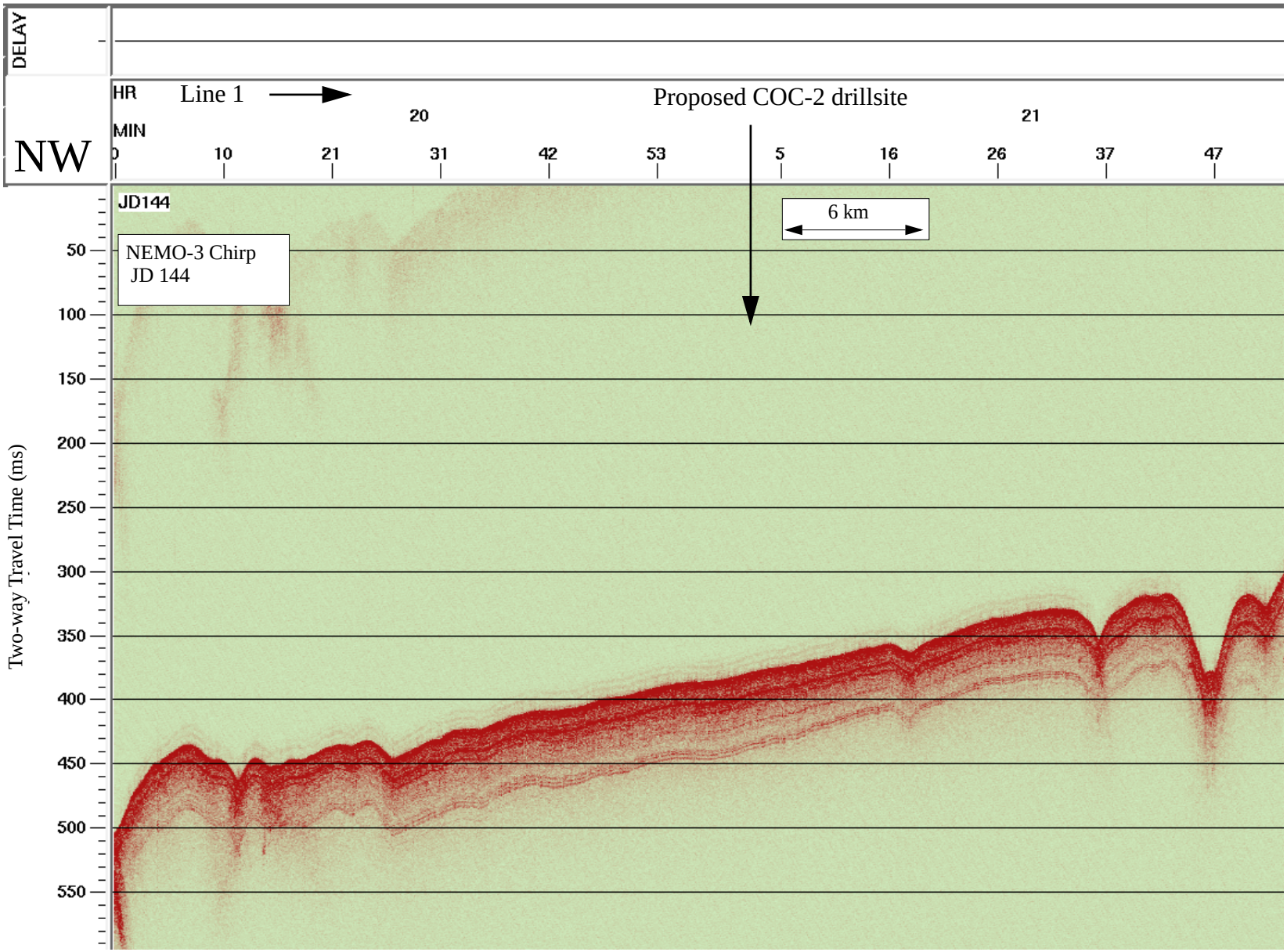


Figure COC2-5 Chirp Seismic taken during Seismic Line 1 across COC-2

SITE COC-1 (top of Cocos Ridge)
(7° 18.646'N 84° 07.309' W, water depth–1007 m)

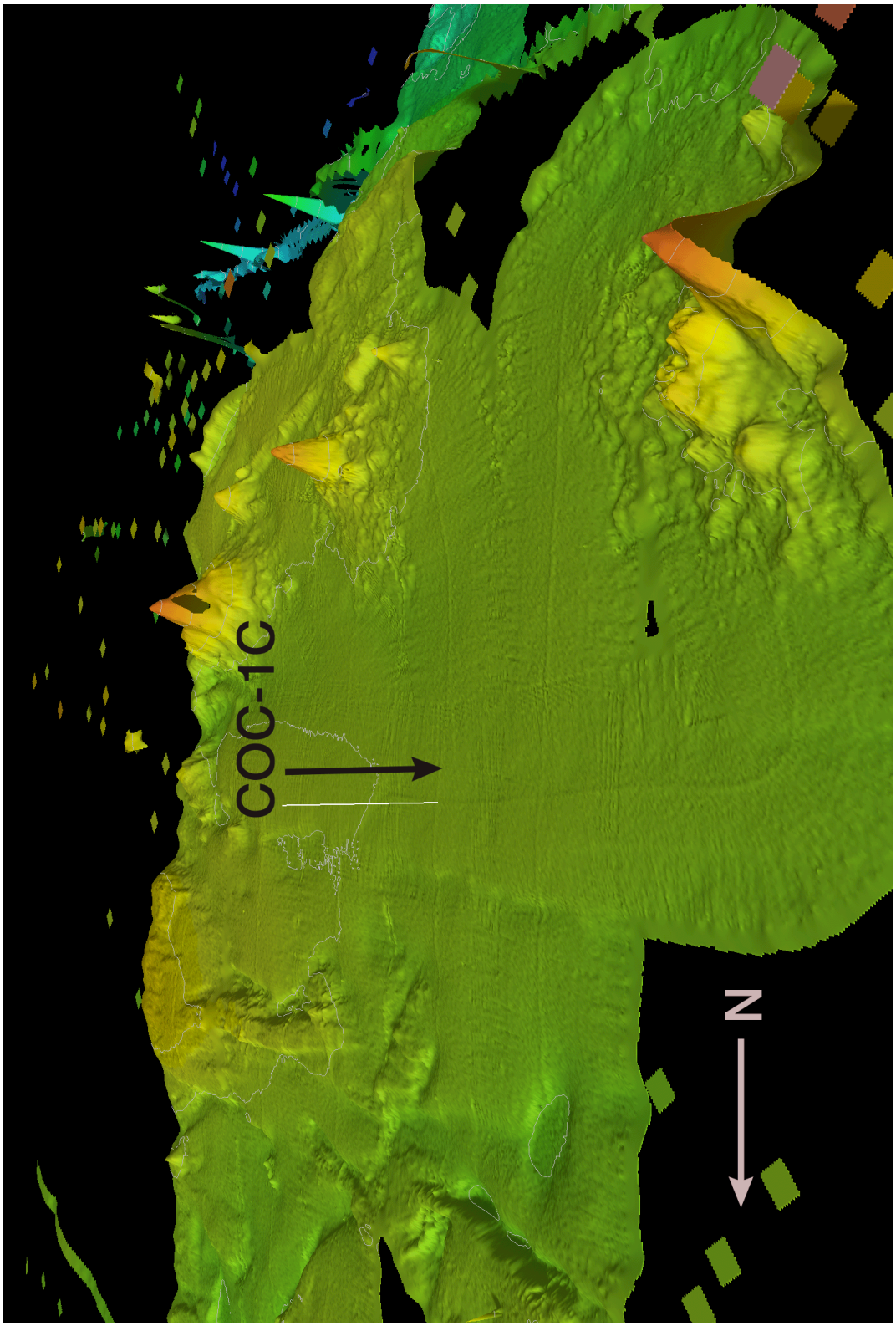
Fig COC1-2: Swathmap bathymetry for the CAR-1 region, from the Nemo-3 site survey. Proposed drill site is marked.

Fig COC1-3: Bandpass-filtered seismic reflection profile CAR1 Line 6 across CAR-1A, from NEMO-3. Proposed drill site is marked, and our correlation to the Bloomer et al. (1995) seismic stratigraphy is labeled.

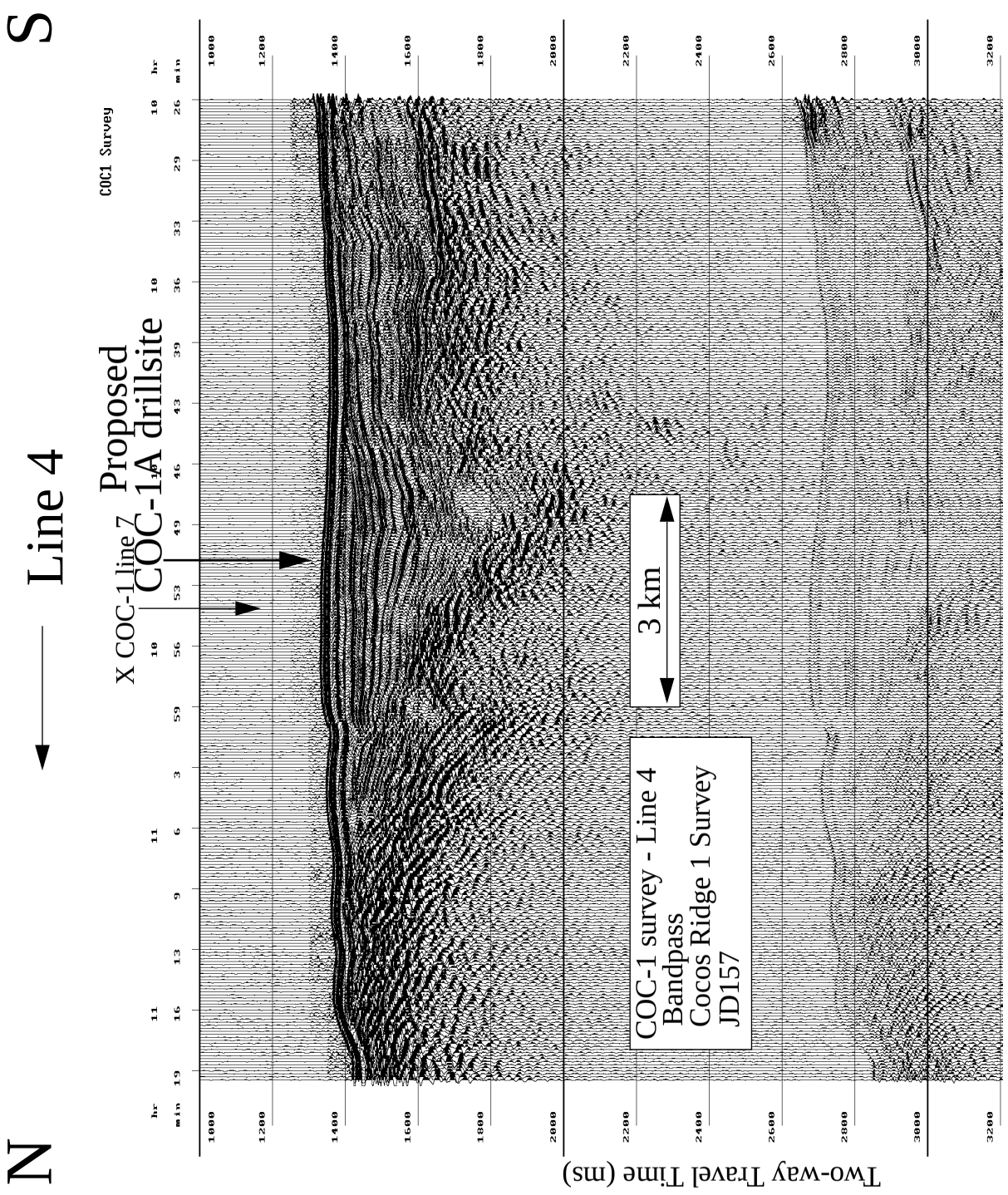
Fig COC1-4: Crossline profile CAR1 Line 12 just to the northeast of CAR-1A, from NEMO-3. Line crossing with Line 6 is marked.

Figure COC2-5: 2-7 kHz Chirp Seismic taken along Seismic Line 6 across the proposed drillsite.

Figure COC1-2: Swathmap bathymetry for the COC-1 survey on the NEMO-3 cruise. COC-1A is marked.



FigureCOC1-3 Bandpass-filtered seismic reflection profile showing a segment of COC1 Seismic line 4, through the proposed COC-1A drillsite. Proposed drillsite location is just south of the cross between Line 4 and Line 7..



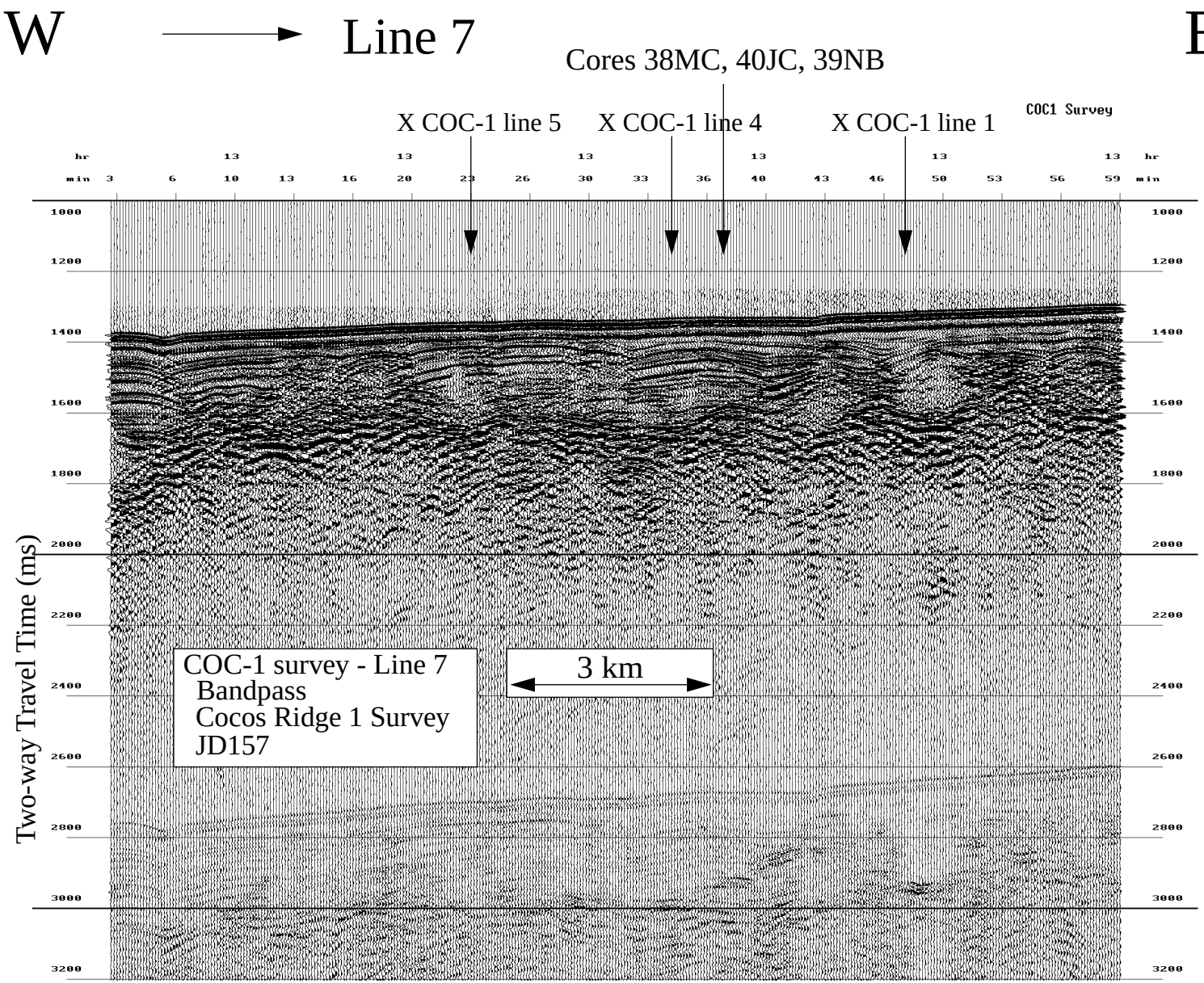


Figure COC1-6: Seismic crossline COC1 Line 4 across proposed drillsite.

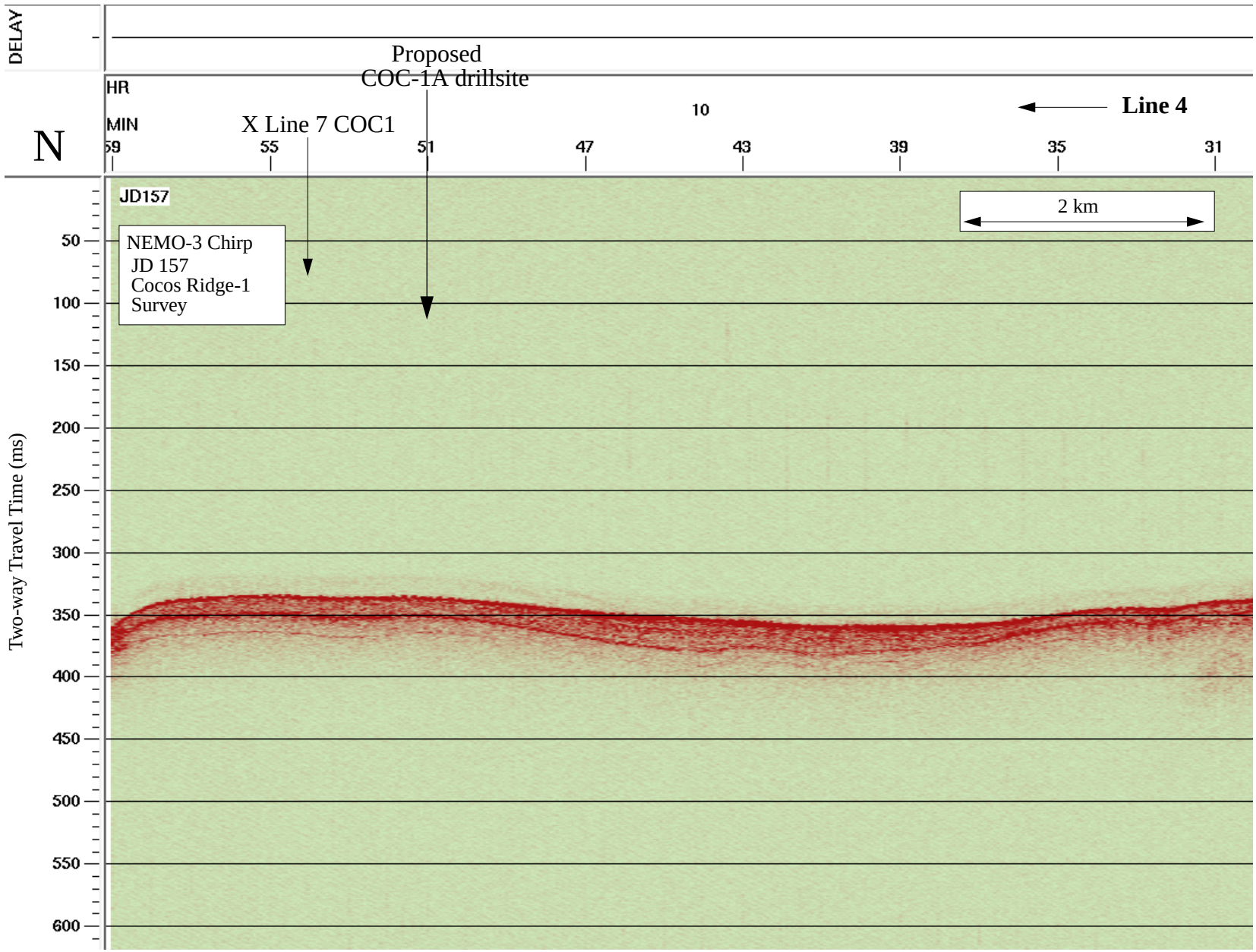


Figure COC1-7 Chirp Seismic taken during Seismic Line 4 across the proposed drillsite.

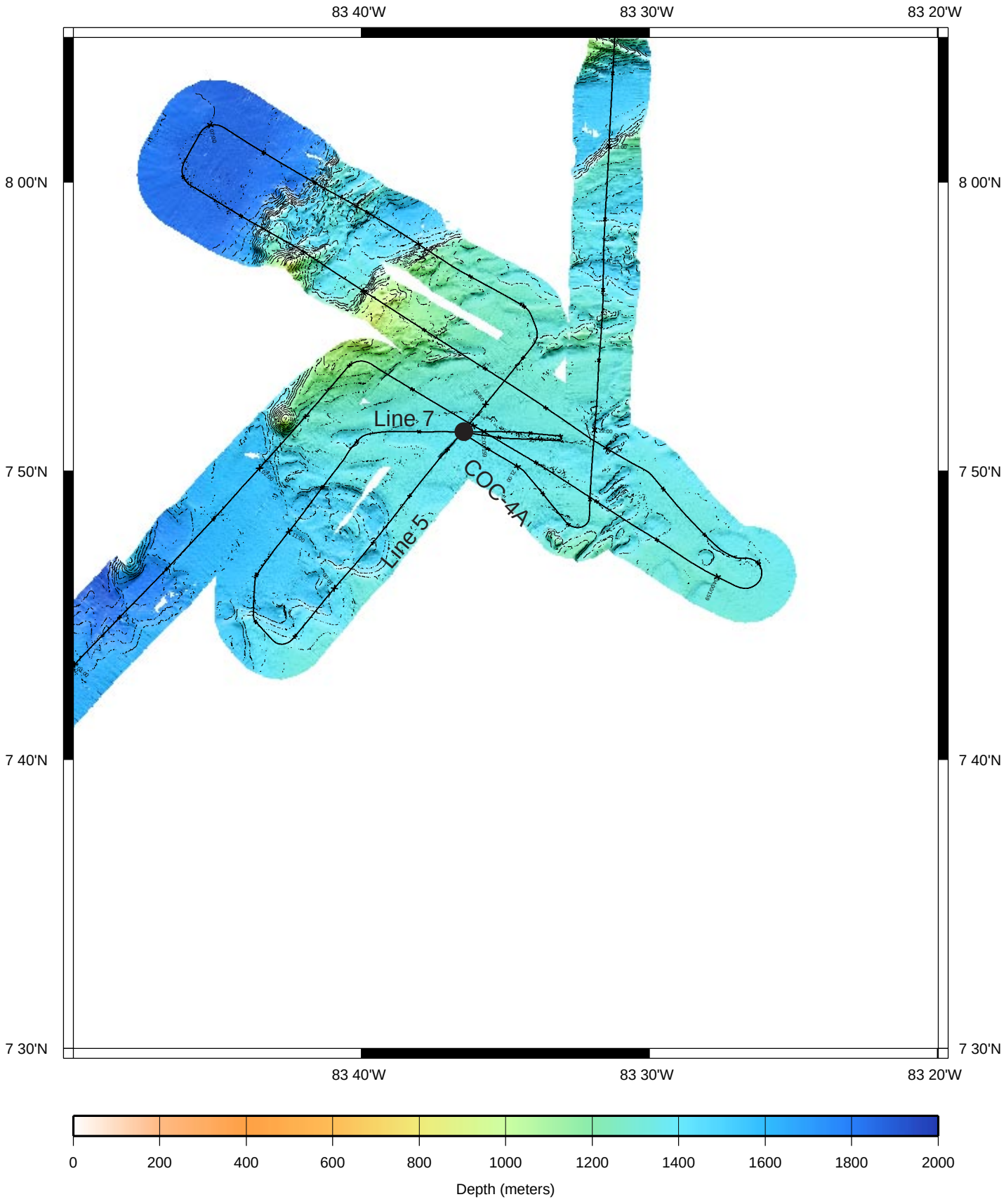
SITE COC-4 (Intersection of Crest of Cocos Ridge with Costa Rica Margin)
(7° 51.352'N 83° 36.402' W, water depth 1370 m)

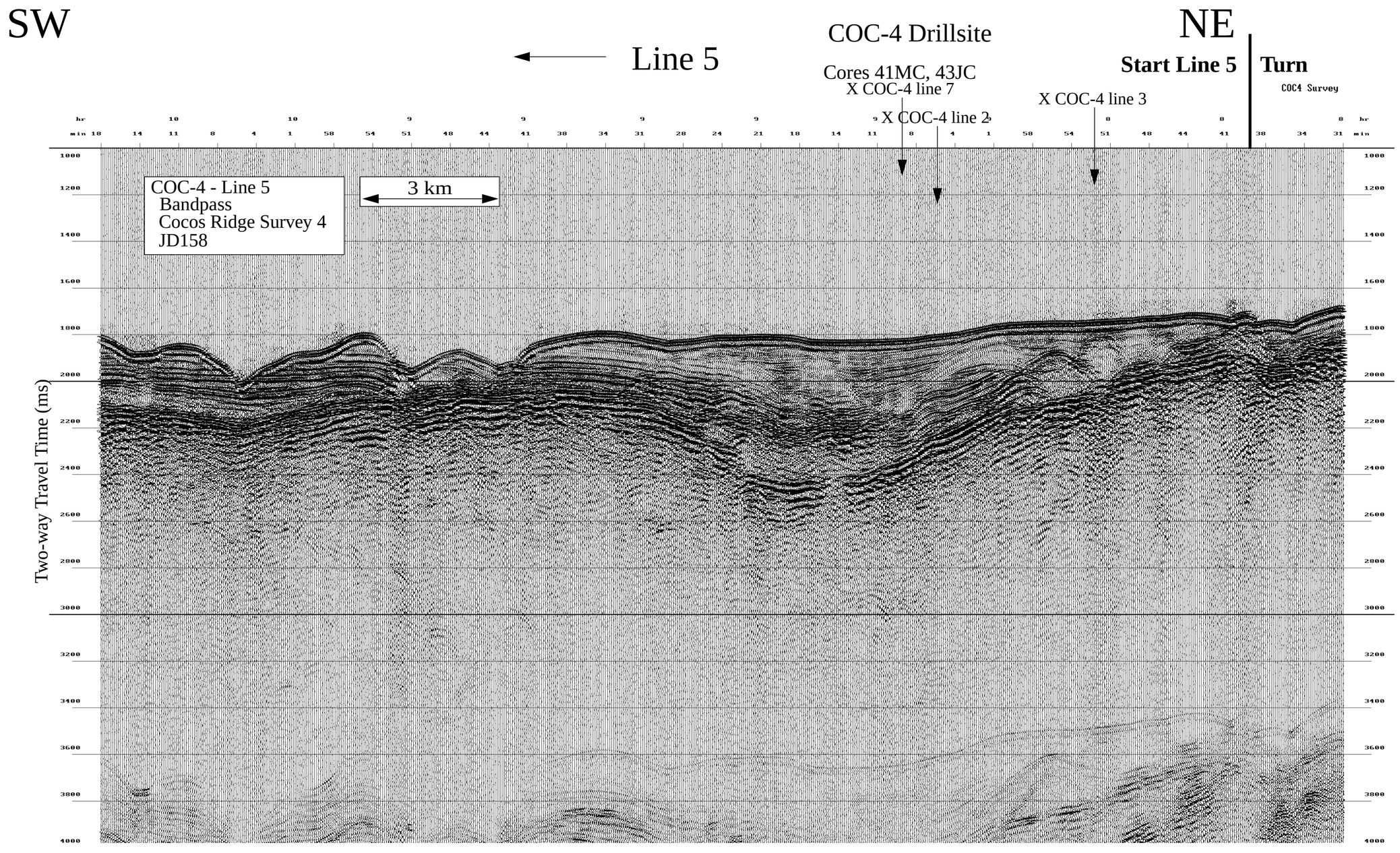
Fig COC4-1: Swathmap bathymetry for the COC-4 region, from the Nemo-3 site survey. Proposed drill site is marked. The "badlands" region are the southern small basins in the center of the map.

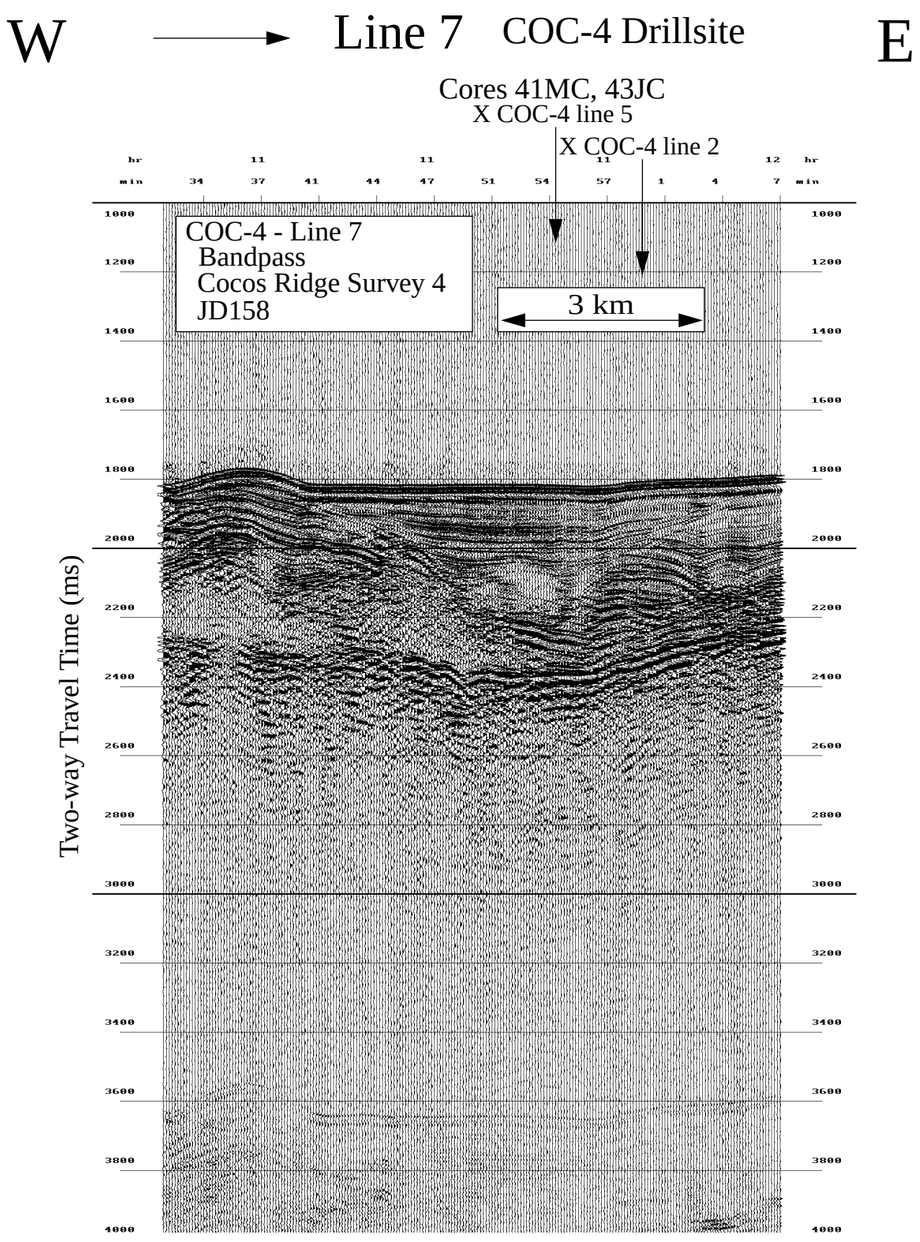
Fig COC4-2: Bandpass-filtered seismic reflection profile COC4 Line 5 across COC-4, from NEMO-3. Proposed drill site is marked.

Fig COC4-3: Crossline profile COC4 line 7, from NEMO-3. Crossing with Line 5 is marked.

COC-4 Bathymetry/Navigation




SW
Line 5
COC-4 Drillsite
Cores 41MC, 43JC
X COC-4 line 7
X COC-4 line 2
X COC-4 line 3
NE
Start Line 5
Turn
COC4 Survey
COC-4 - Line 5
Bandpass
Cocos Ridge Survey 4
JD158
3 km
Two-way Travel Time (ms)

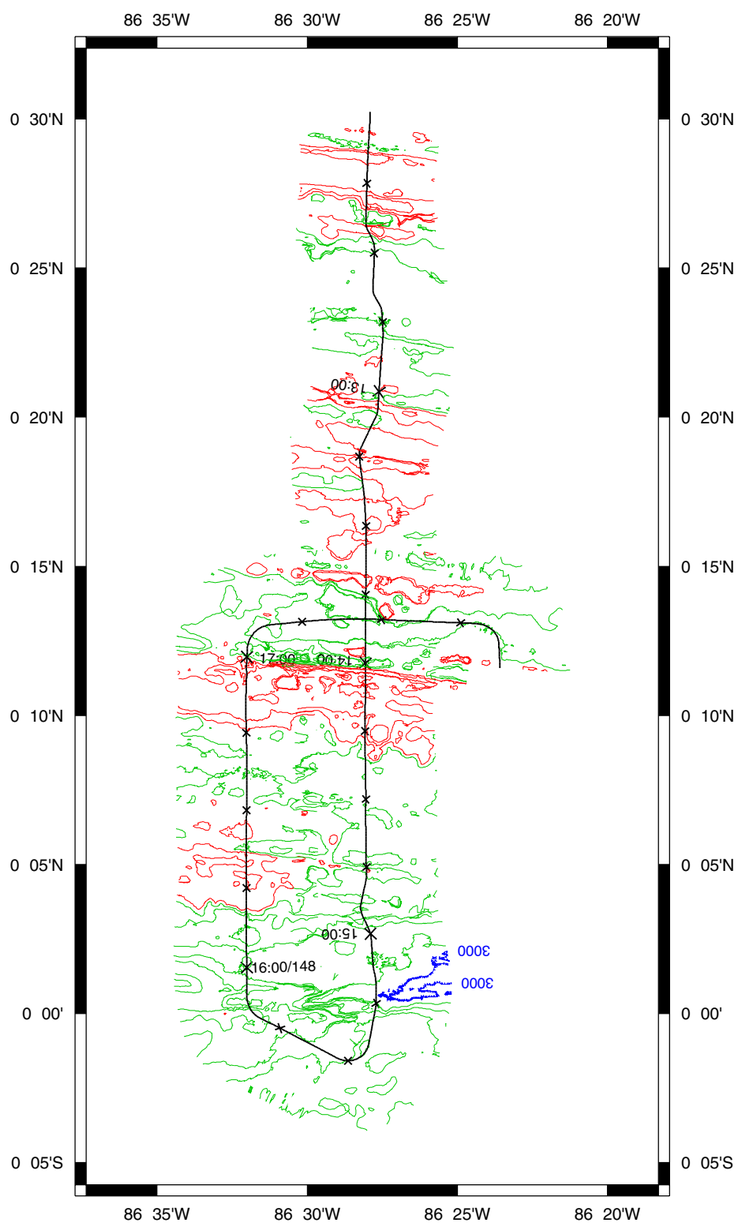

W
Line 7
COC-4 Drillsite
E
Cores 41MC, 43JC
X COC-4 line 5
X COC-4 line 2
COC-4 - Line 7
Bandpass
Cocos Ridge Survey 4
JD158
3 km
Two-way Travel Time (ms)
hr
min
11
34
37
41
44
47
51
54
57
1
4
7
12
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000

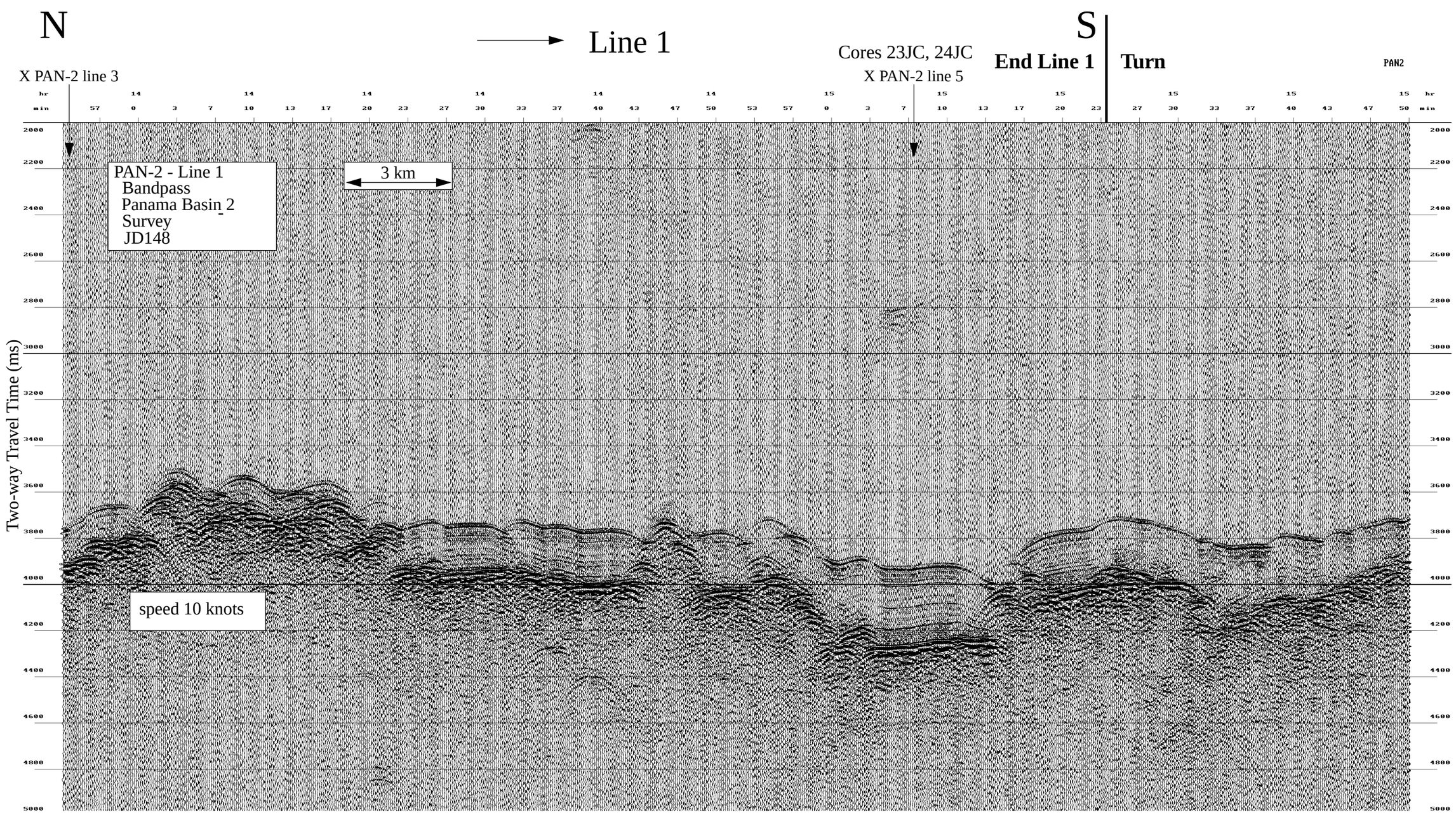
SITE PAN-2 (Panama Basin Equatorial site)
(00° 01.312'N 86° 42.334' W, water depth 2941 m)

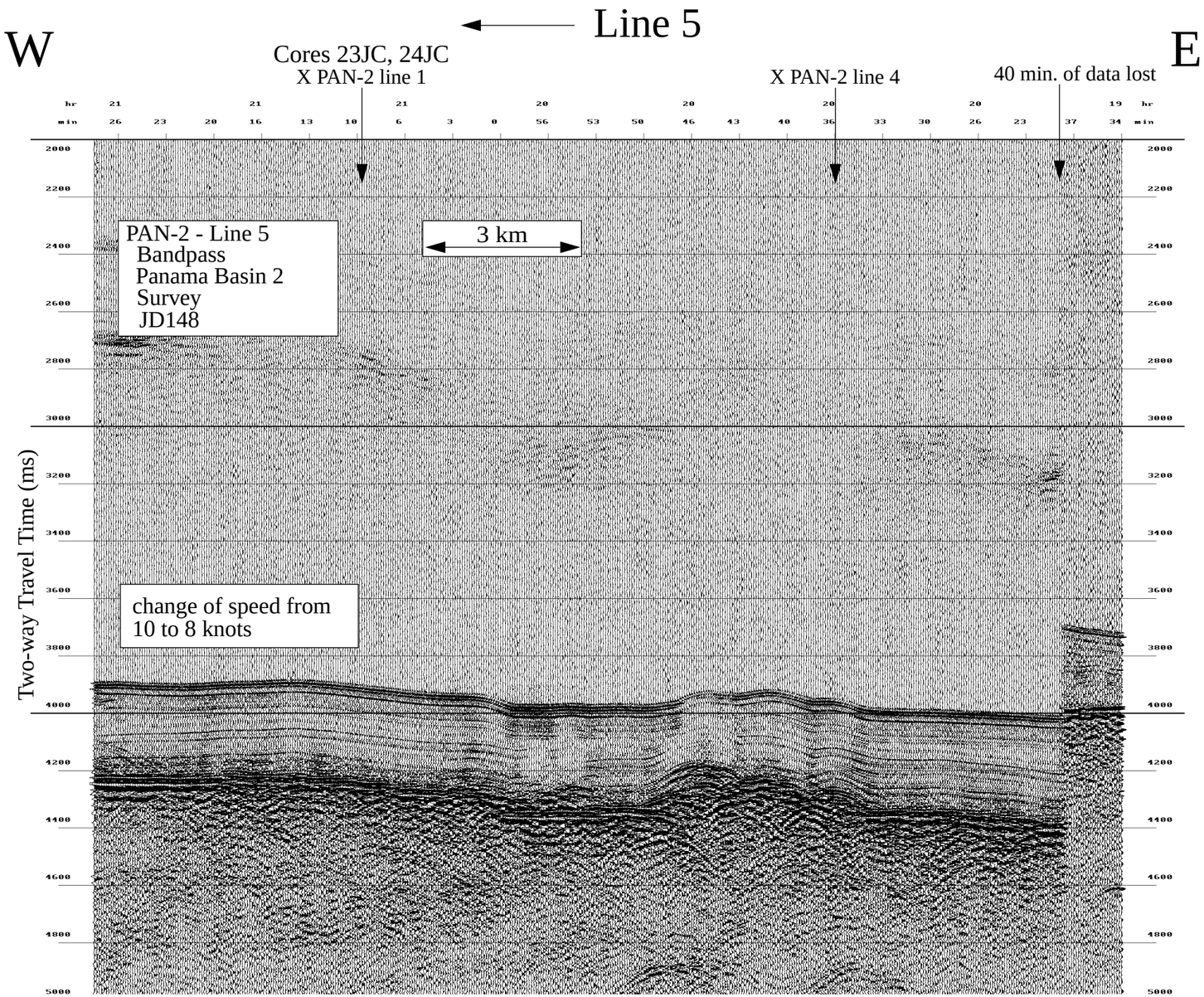
Fig PAN2-1: Swathmap bathymetry for the PAN-2 region, from the Nemo-3 site survey. Proposed drill site is marked.

Fig PAN2-2: Crossline PAN2 Line 1 through the proposed PAN-2 drillsite

Fig PAN2-3: Bandpass-filtered seismic reflection profile PAN2 line 5 across PAN-2, from Nemo-3. Proposed drill site is marked.


Data File SBfixavg.2000may27.1200-1800
86 35'W
86 30'W
86 25'W
86 20'W
0 30'N
0 25'N
0 20'N
0 15'N
0 10'N
0 05'N
0 00'
0 05'S
18:00
17:00
15:00
16:00/148
3000
3000


N
Line 1
S
Cores 23JC, 24JC
X PAN-2 line 3
X PAN-2 line 5
End Line 1
Turn
PAN2
hr
min
PAN-2 - Line 1
Bandpass
Panama Basin 2
Survey
JD148
3 km
speed 10 knots
Two-way Travel Time (ms)
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
4200
4400
4600
4800
5000


Line 5
W
E
Cores 23JC, 24JC
X PAN-2 line 1
X PAN-2 line 4
40 min. of data lost
PAN-2 - Line 5
Bandpass
Panama Basin 2
Survey
JD148
3 km
change of speed from
10 to 8 knots
Two-way Travel Time (ms)

SITE CAR-2 (SE flank of Carnegie Ridge)
(1° 52.406'S 82° 46.914' W, water depth–2223 m)

Fig CAR2-2: Swathmap bathymetry for the CAR-2 region, from the Nemo-3 site survey. Proposed drill site is marked.

Fig CAR2-3: Migrated Seismic image across the "serac" zone on seismic line 5 showing the deformation of the sediment column.

Figure CAR2-4: Seismic line 4 showing the sediments downslope from the basement outcrop of Carnegie Ridge. Sediment is being deformed over the 2 basement steps. The deformation appears to be occurring about halfway through the sediment column

Fig CAR2-5: Bandpass-filtered seismic reflection profile CAR2-seisline 3 across CAR-2A, from NEMO-3. Proposed drill site is marked.

Fig CAR2-6: Crossline profile CAR2-seisline 6 across CAR-2A, from NEMO-3. Proposed drill site is marked.

Figure CAR2-7 2-7 kHz Chirp Seismic taken during Seismic Line 3 across the proposed drillsite.

Figure CAR2-2: Swathmap bathymetry for the CAR-2 survey on the NEMO-3 cruise. CAR-2A is located on the southeastern flank of the aseismic Carnegie Ridge.Note the similarities to glacial morphology.

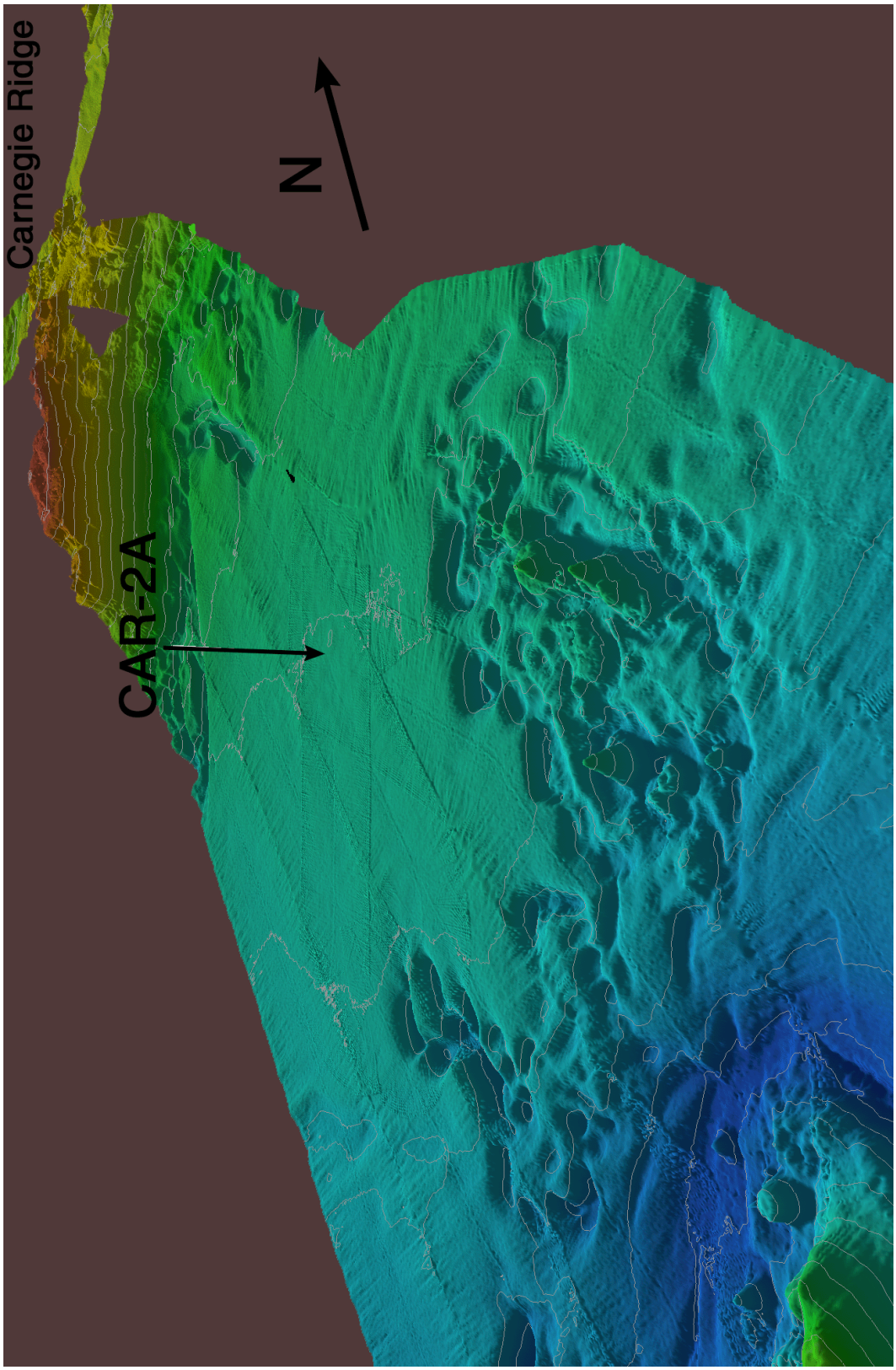


Figure CAR2-3: Migrated Seismic image across the “serac” zone on seismic line 5 showing the deformation of the sediment column.

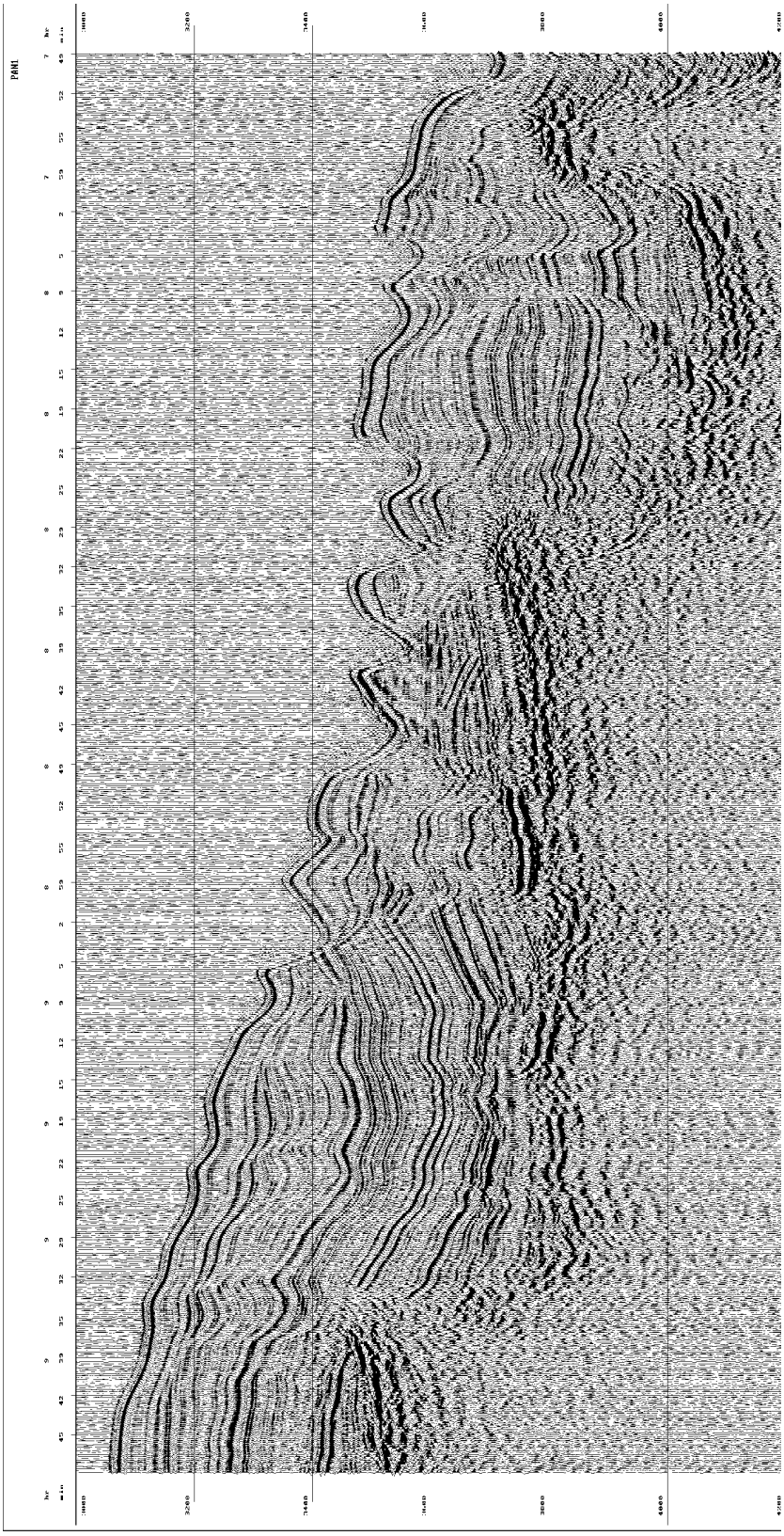
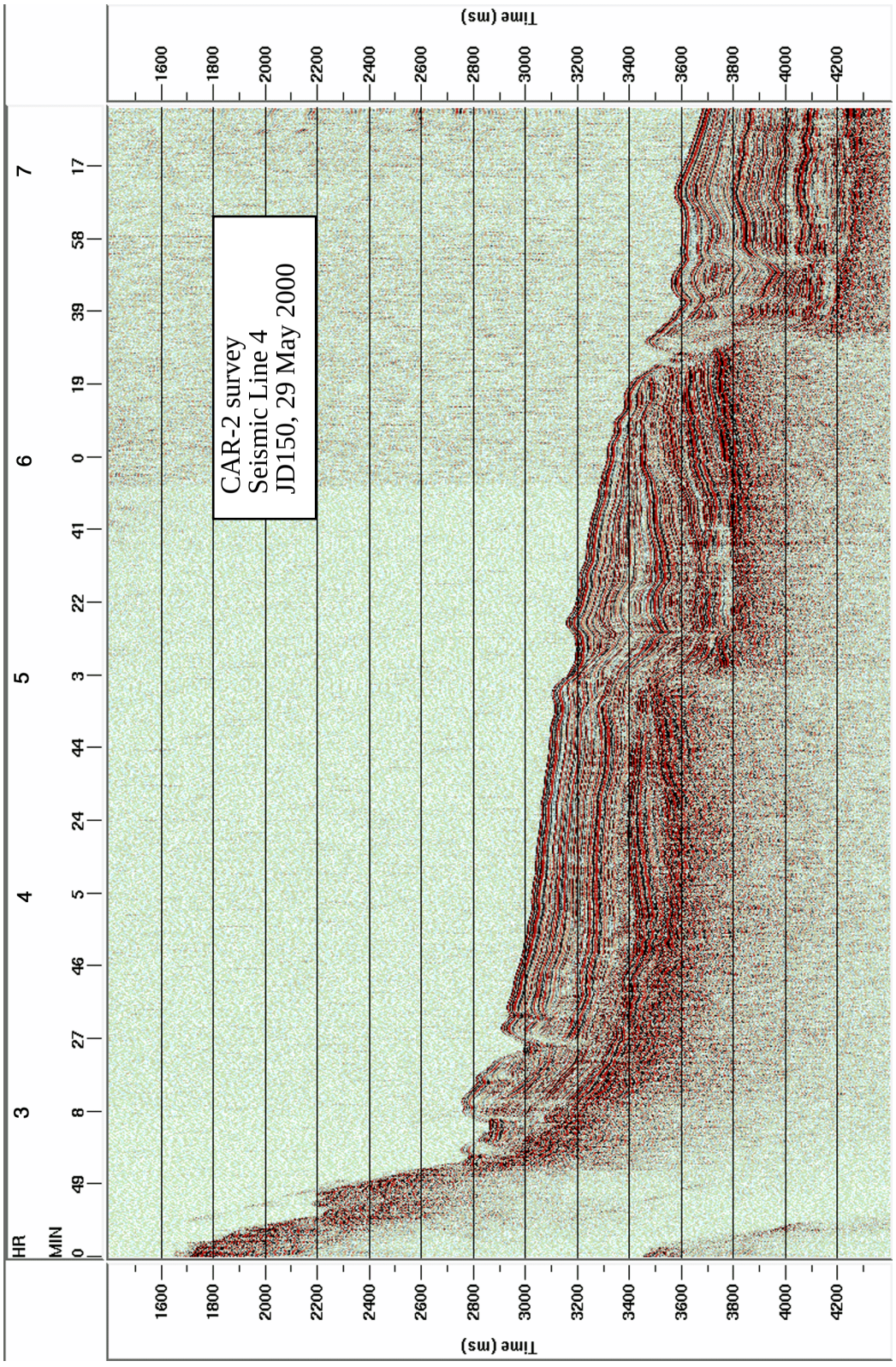
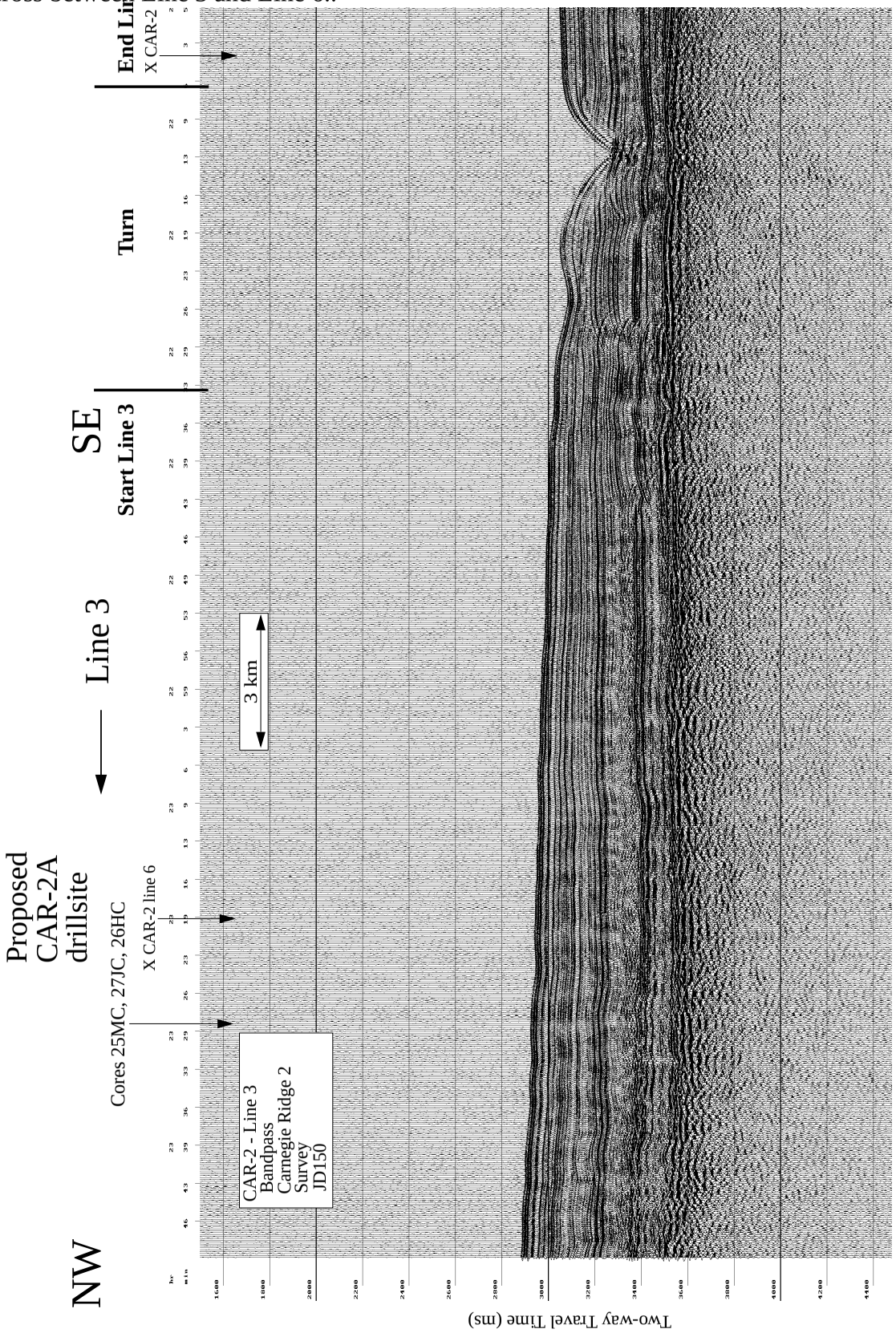


Figure CAR2-4: Seismic line 4 from the basement outcrop of Carnegie Ridge on the upper slope showing sediment being deformed over the 2 basement steps.



FigureCAR2-5 Bandpass-filtered seismic reflection profile showing a segment of CAR2 Seismic line 3, showing the dip line through the proposed CAR-2 drillsite. Proposed drillsite location is at the cross between Line 3 and Line 6..



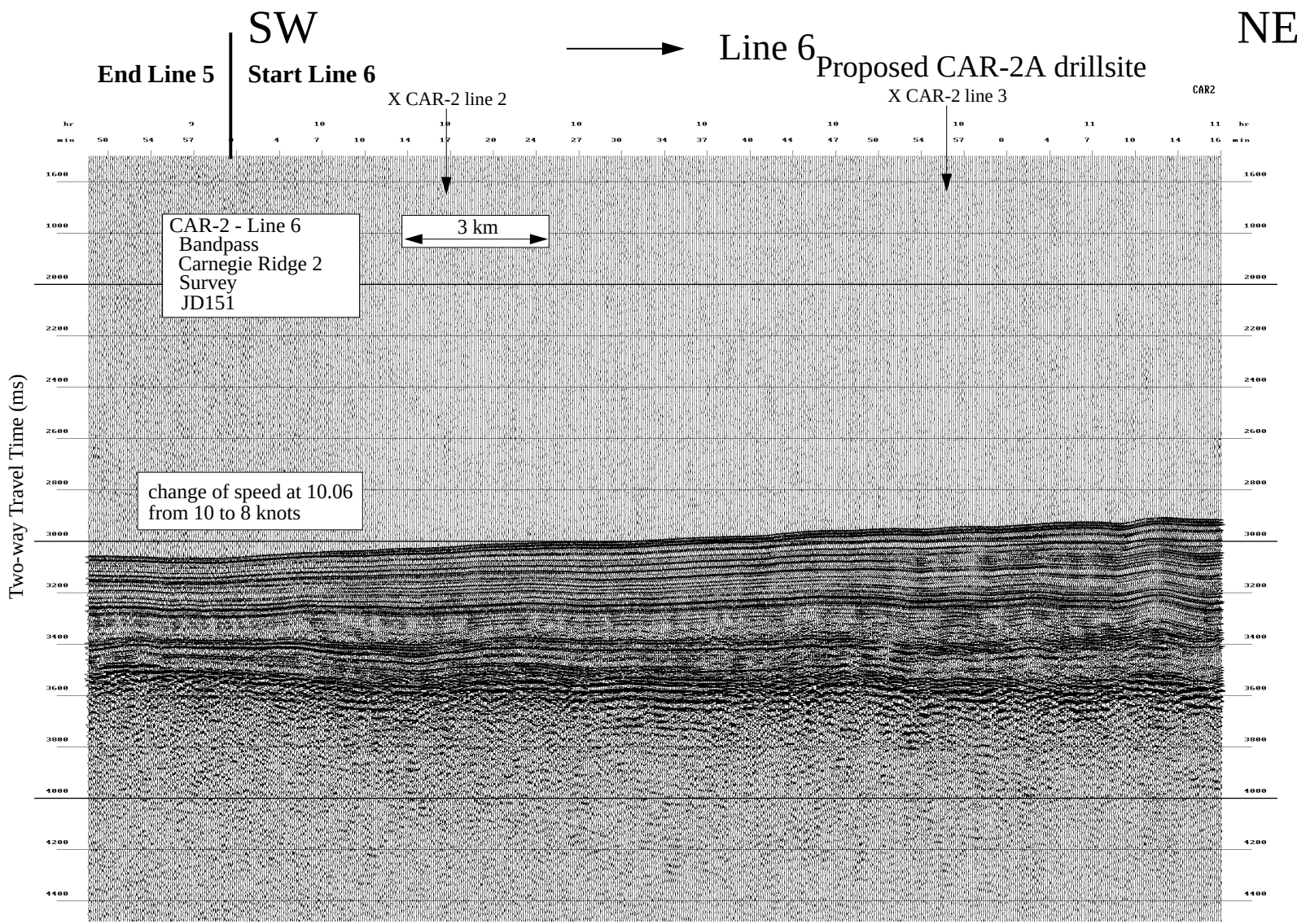


Figure CAR2-6: Seismic crossline CAR2 Line 6 across proposed drillsite.

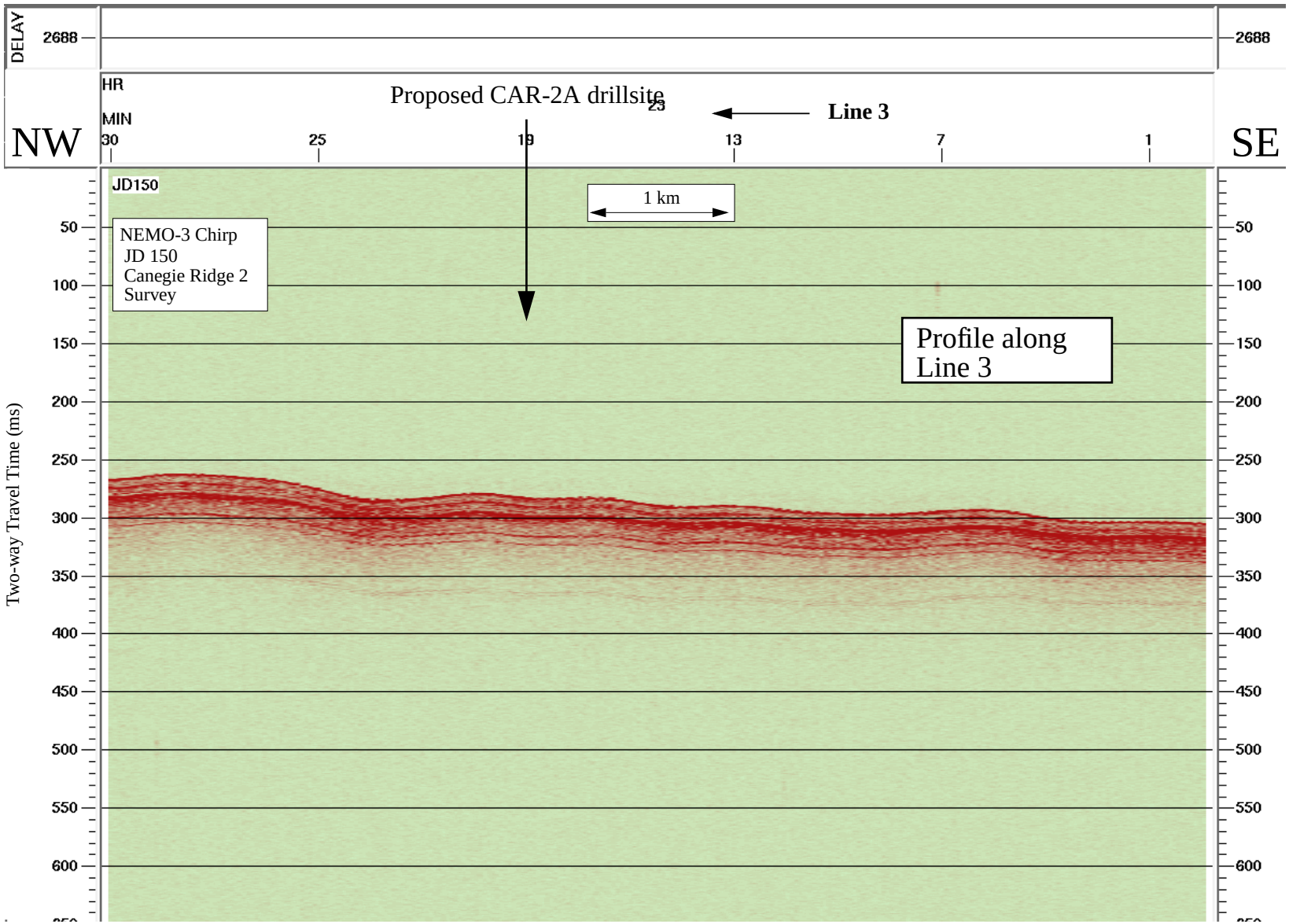


Figure CAR2-7 Chirp Seismic taken during Seismic Line 3 across the proposed drillsite.

SITE CAR-1 (top of Carnegie Ridge)
(00° 40.319'S 82° 04.853' W, water depth–1423 m)

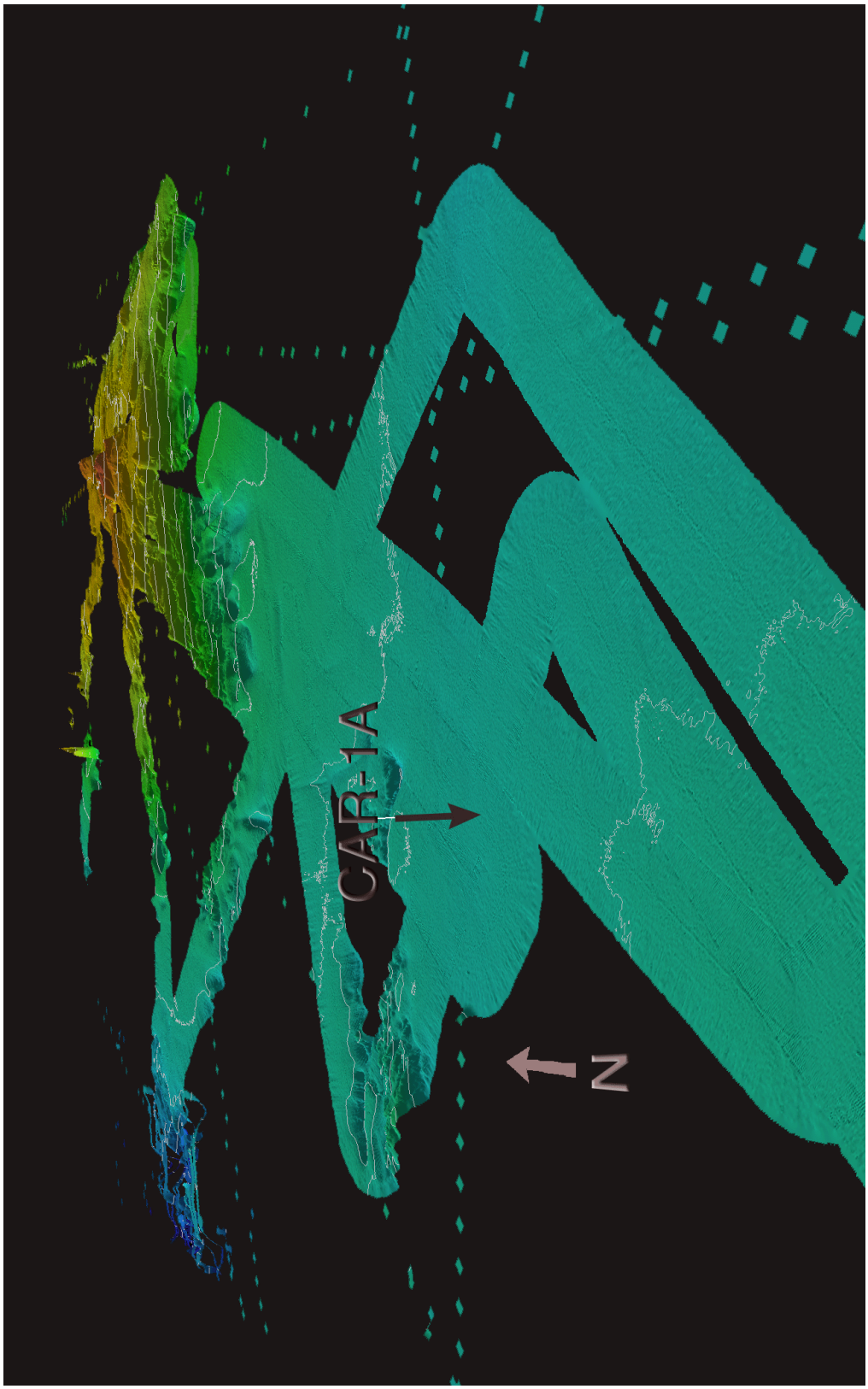
Fig CAR1-2: Swathmap bathymetry for the CAR-1 region, from the Nemo-3 site survey. Proposed drill site is marked.

Fig CAR1-3: Bandpass-filtered seismic reflection profile CAR1 Line 6 across CAR-1A, from NEMO-3. Proposed drill site is marked, and our correlation to the Bloomer et al. (1995) seismic stratigraphy is labeled.

Fig CAR2-6: Crossline profile CAR1 Line 12 just to the northeast of CAR-1A, from NEMO-3. Line crossing with Line 6 is marked.

Figure CAR2-7 2-7 kHz Chirp Seismic taken along Seismic Line 6 across the proposed drillsite.

Figure CAR1-2: Swathmap bathymetry for the CAR-1 survey on the NEMO-3 cruise. CAR-1A is located on the flat topography about 1400 meters below sea level to the southwest of the highest point on the Carnegie Ridge.



FigureCAR1-3 Bandpass-filtered seismic reflection profile showing a segment of CAR1 Seismic line 6, through the proposed CAR-1A drillsite. Proposed drillsite location is just southwest of the cross between Line 6 and Line 12..

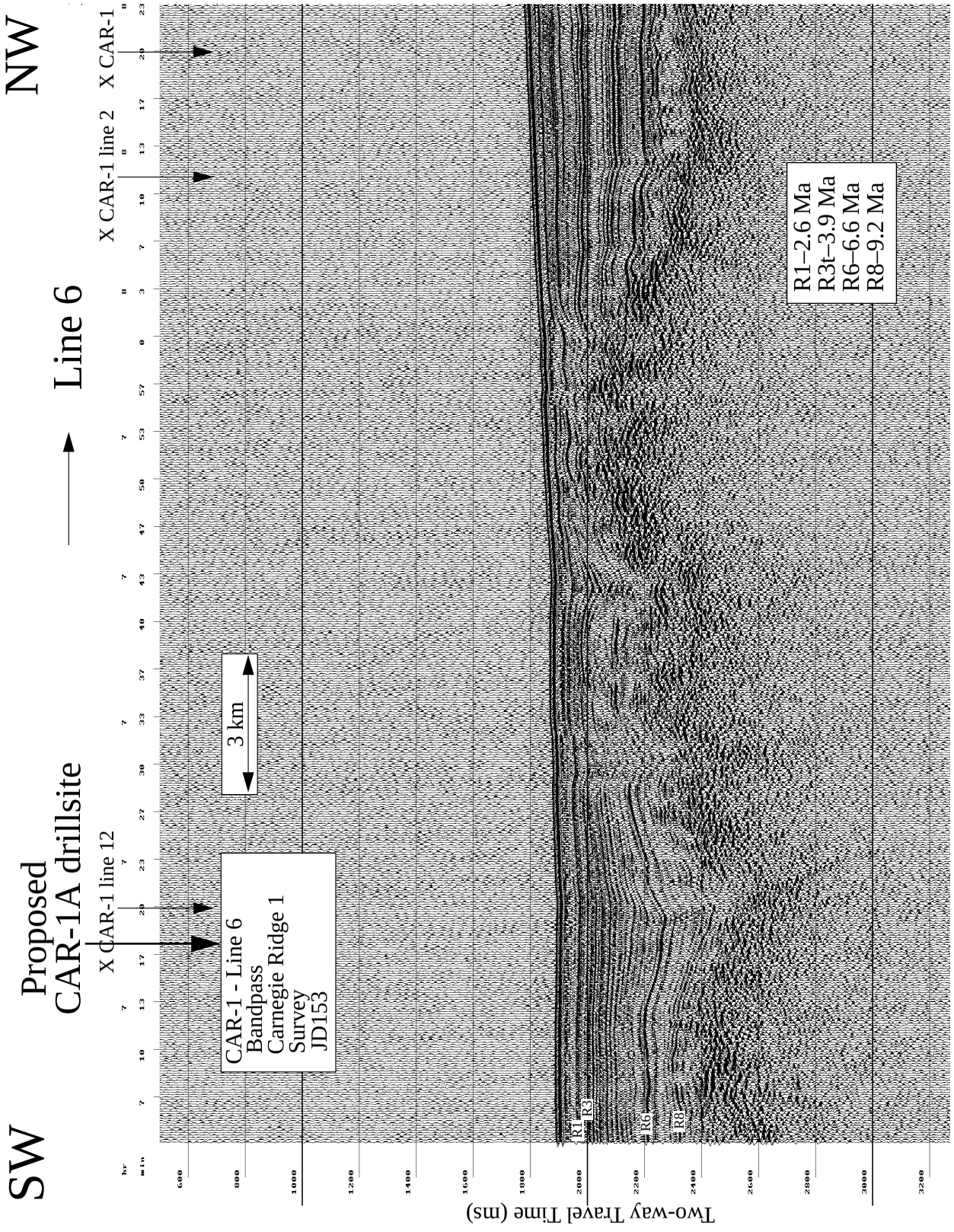
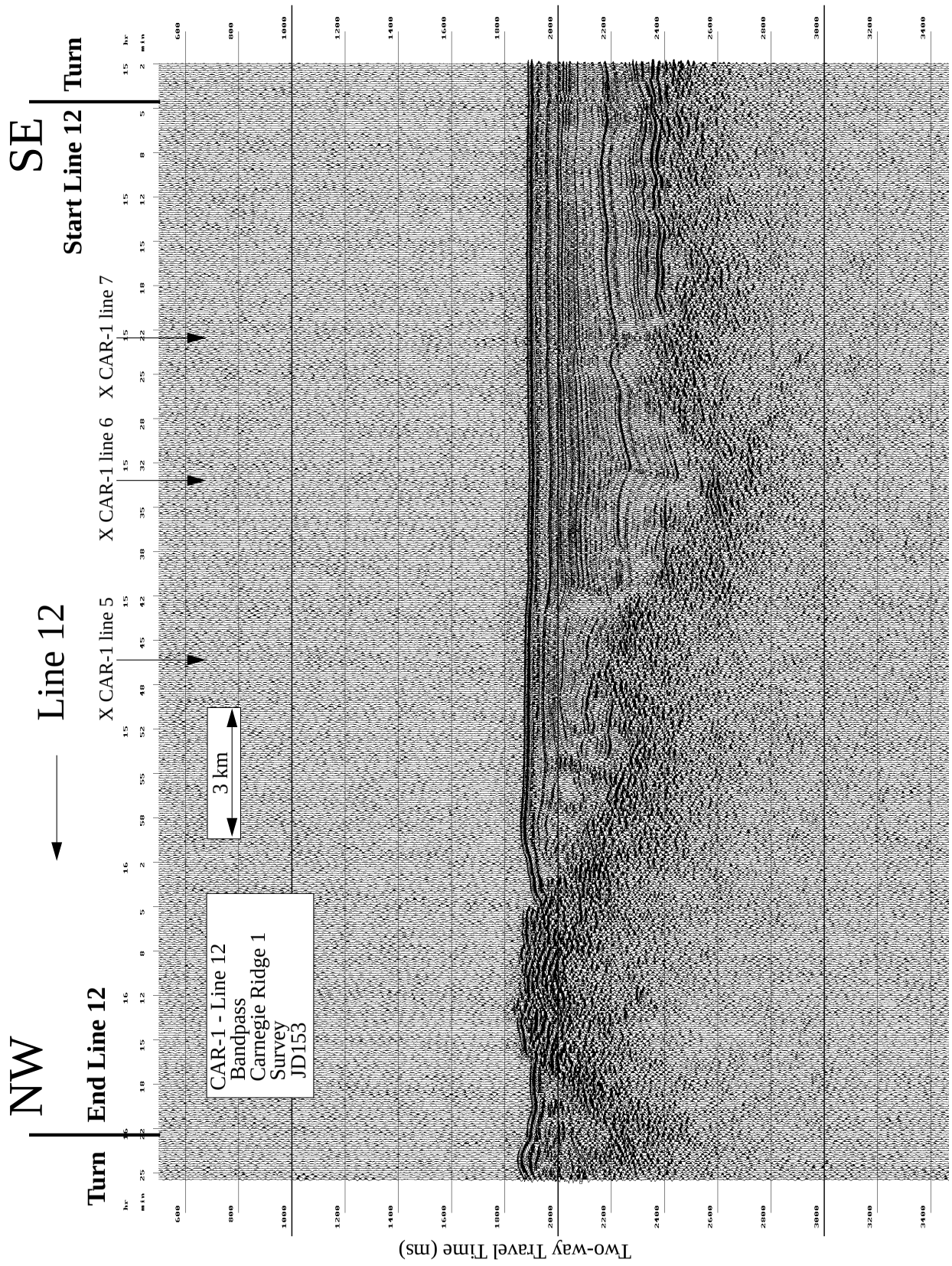


Figure CAR2-6: Seismic crossline CAR2 Line 6 across proposed drillsite.



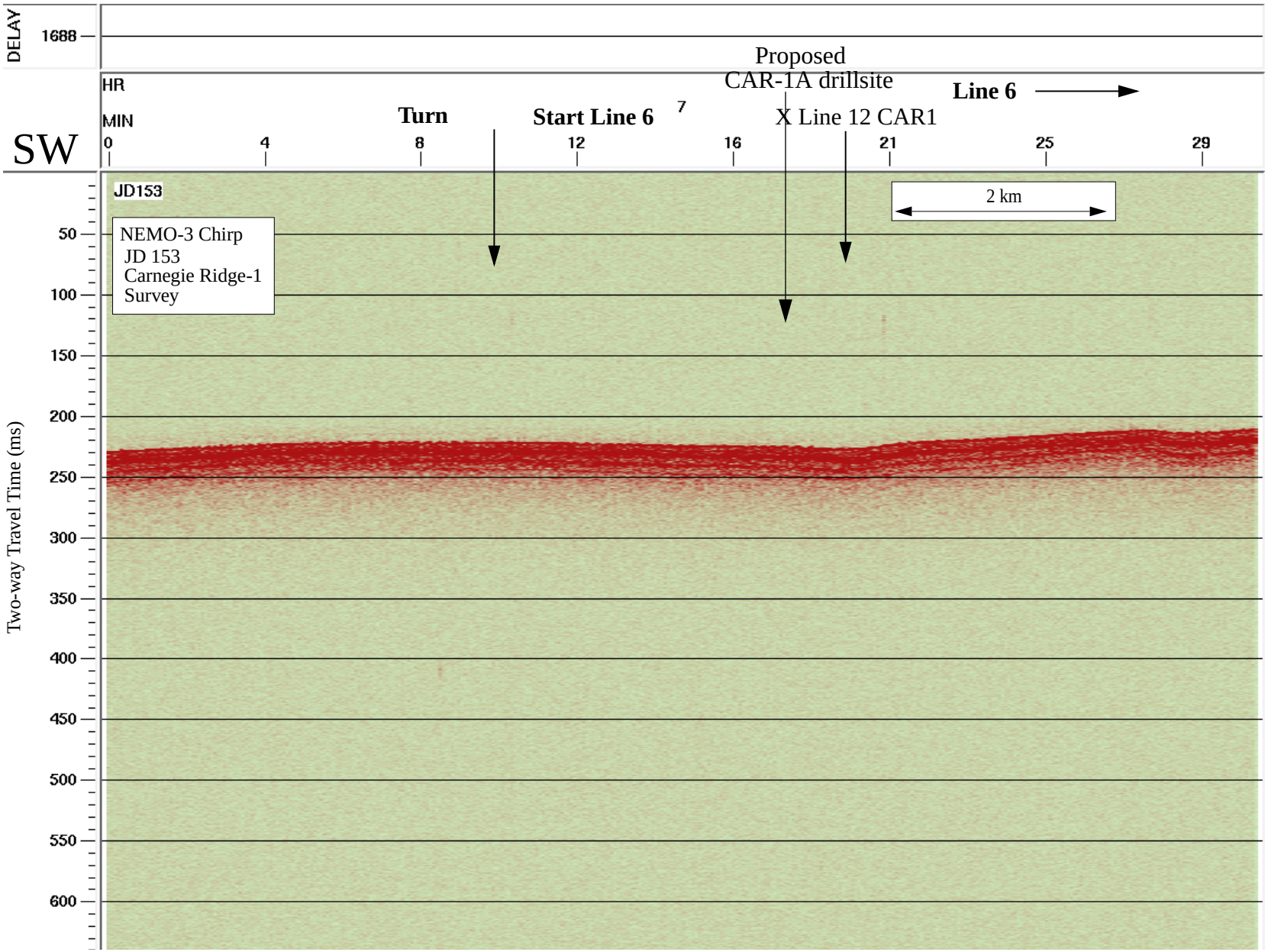


Figure CAR2-7 Chirp Seismic taken during Seismic Line 3 across the proposed drillsite.

Appendix B

NEMO-III
Seabeam Maps for Survey Regions

Cruise Report

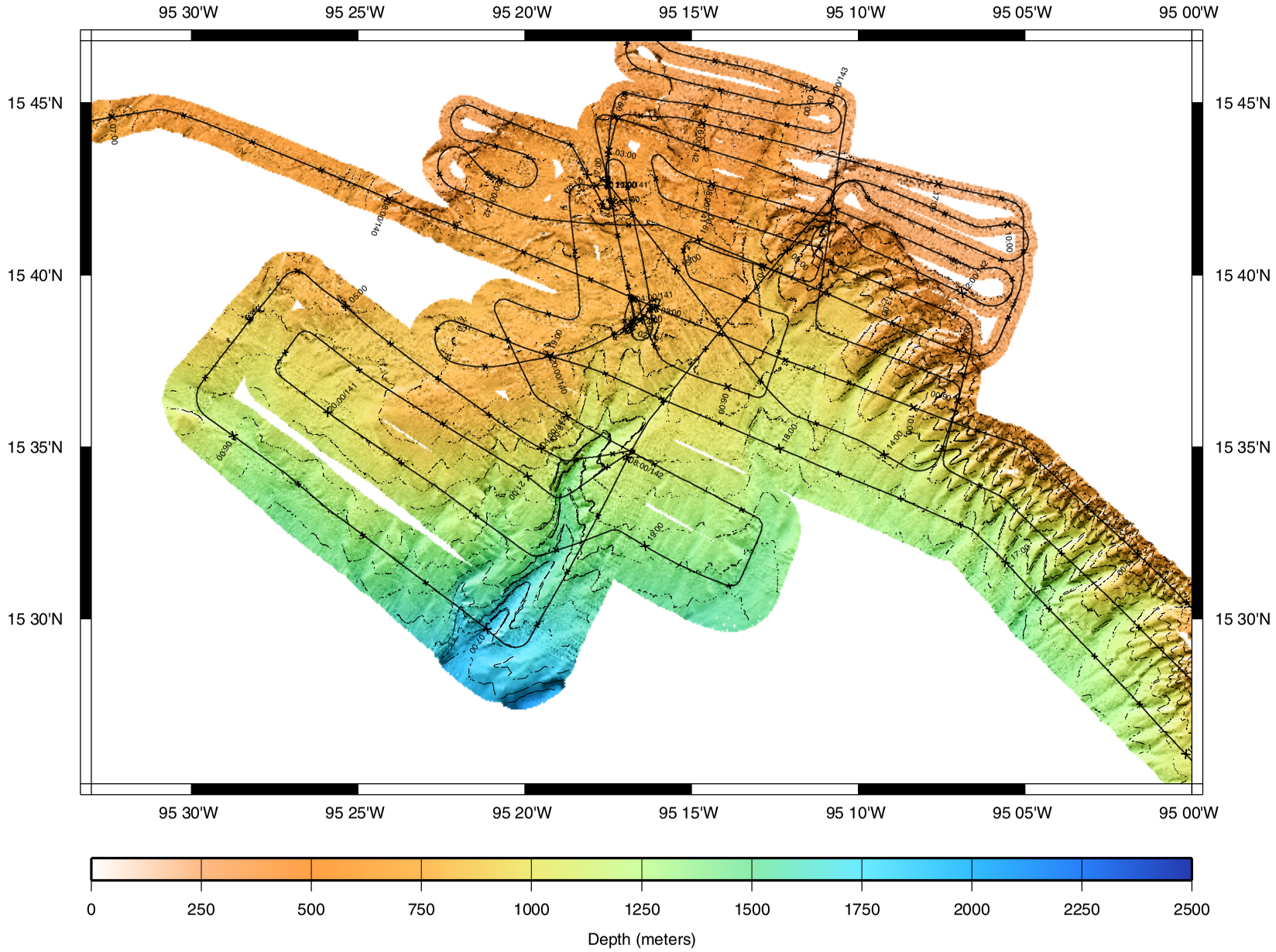
R/V Melville NEMO EXPEDITION, Leg III

Manzanillo Mexico to Puerto Caldera Costa Rica
15 May 2000 to 8 June 2000

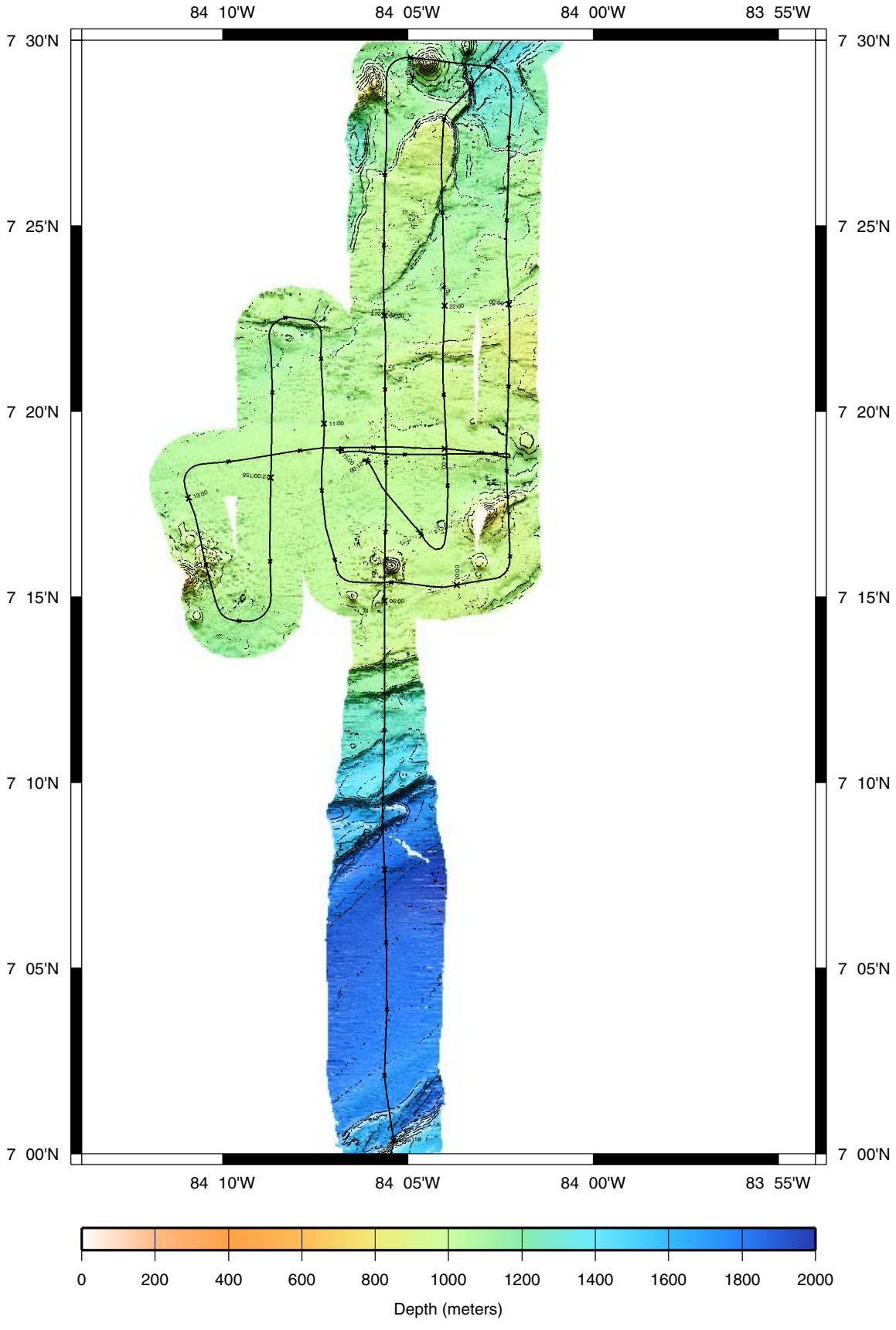
Nicklas G. Pisias, Alan C. Mix, Chris Goldfinger
Oregon State University

Mitch Lyle
Boise State University

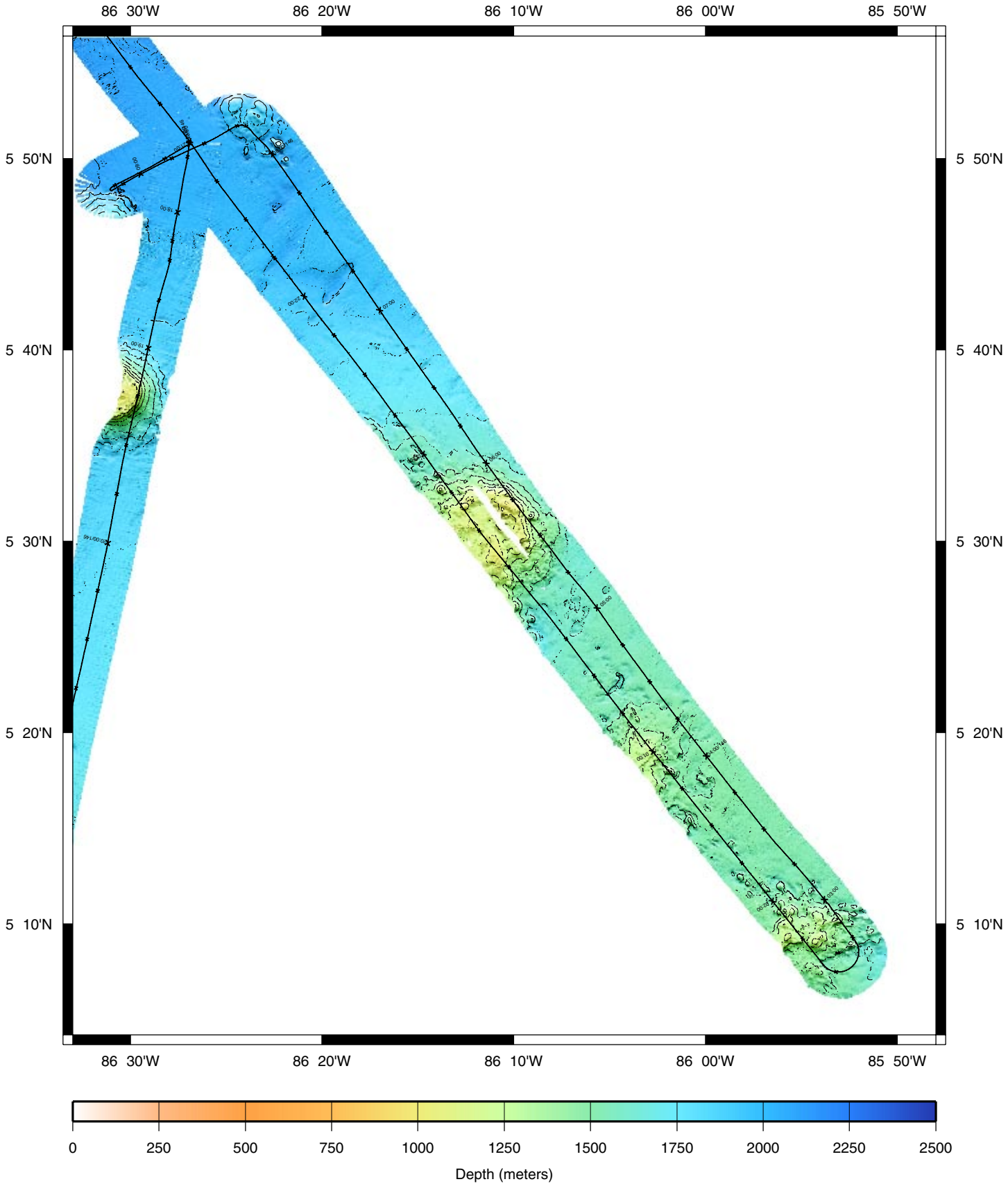
TEH-1 Bathymetry/Navigation



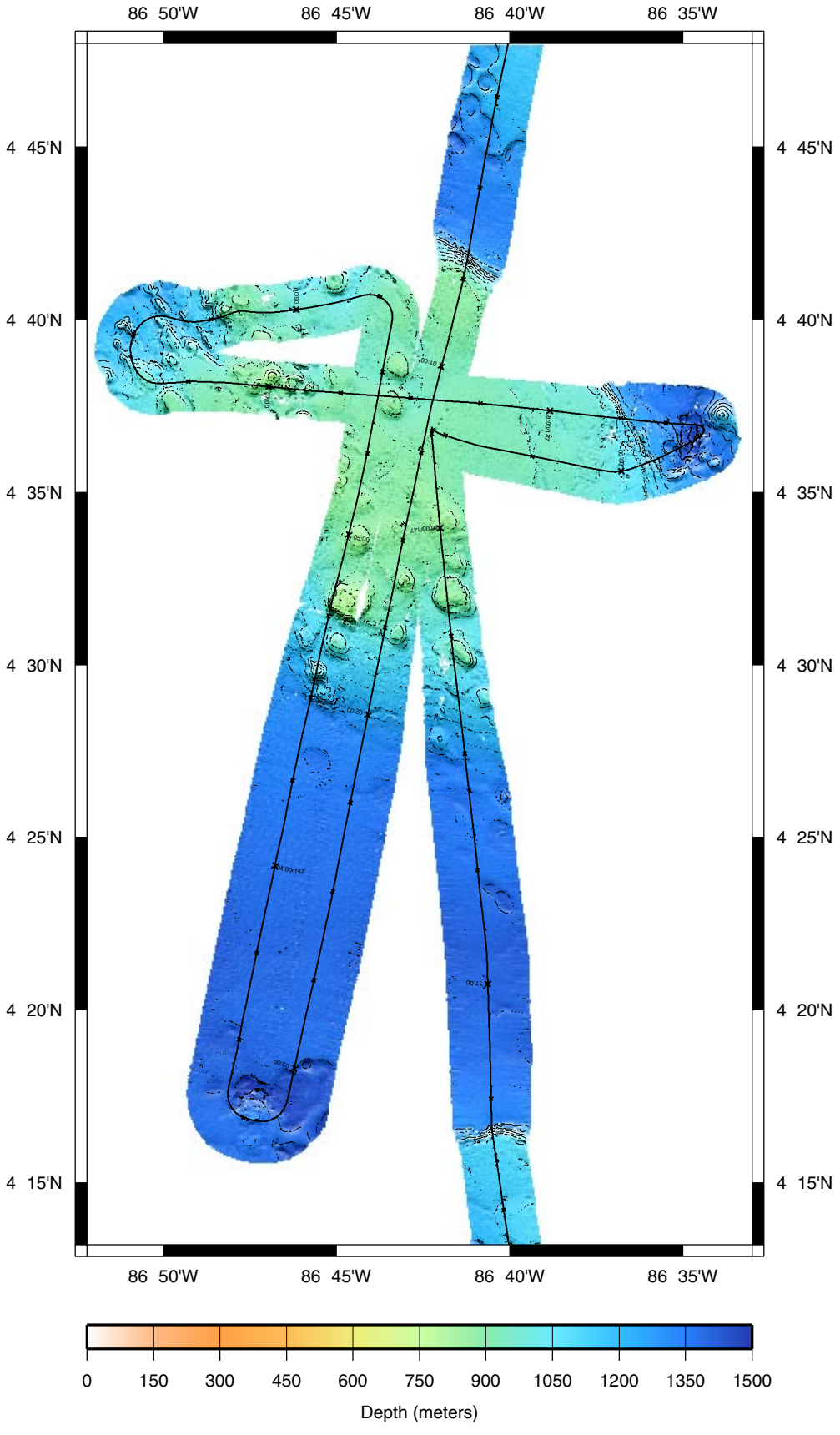
COC-1 Bathymetry/Navigation



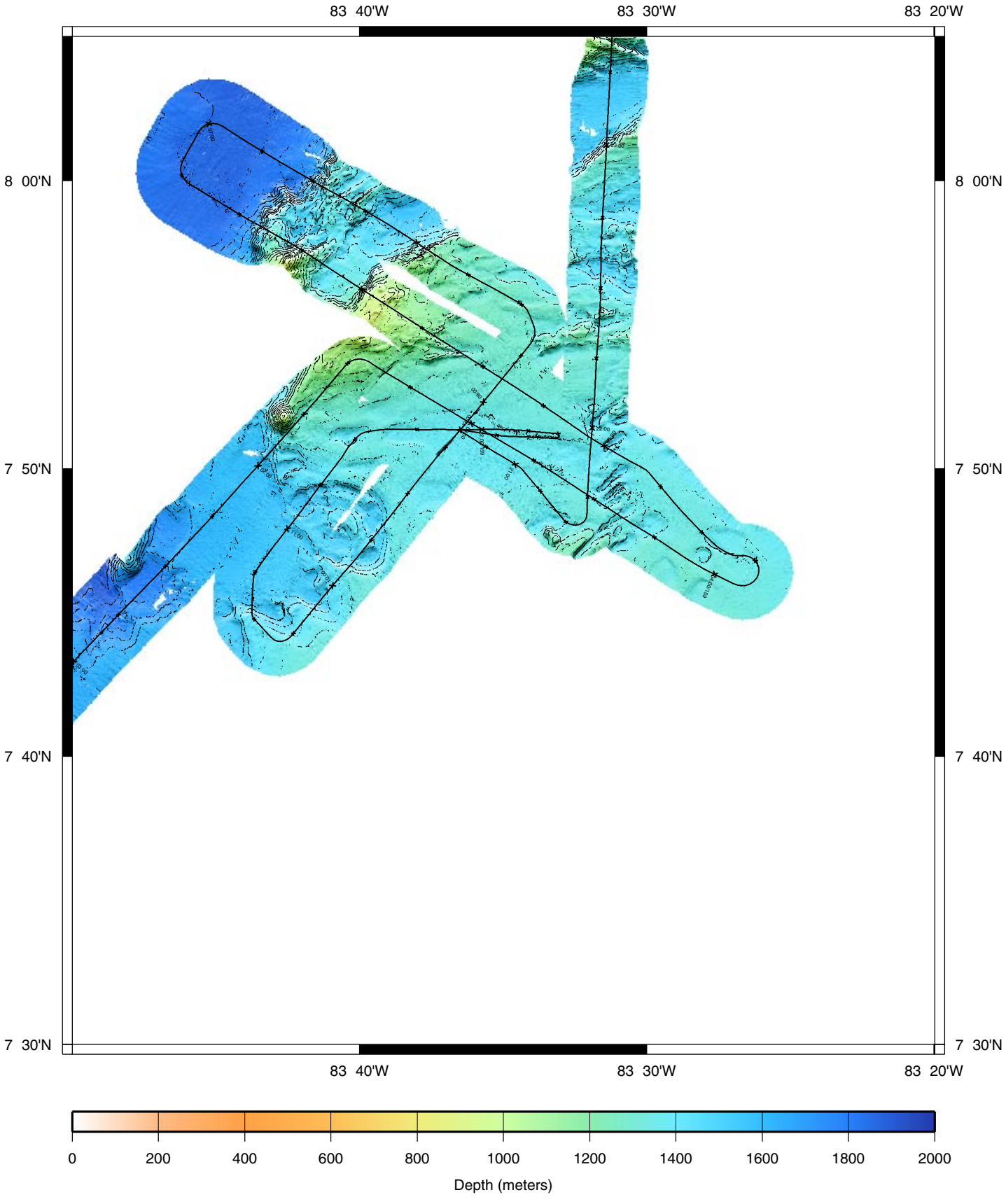
COC-2 Bathymetry/Navigation



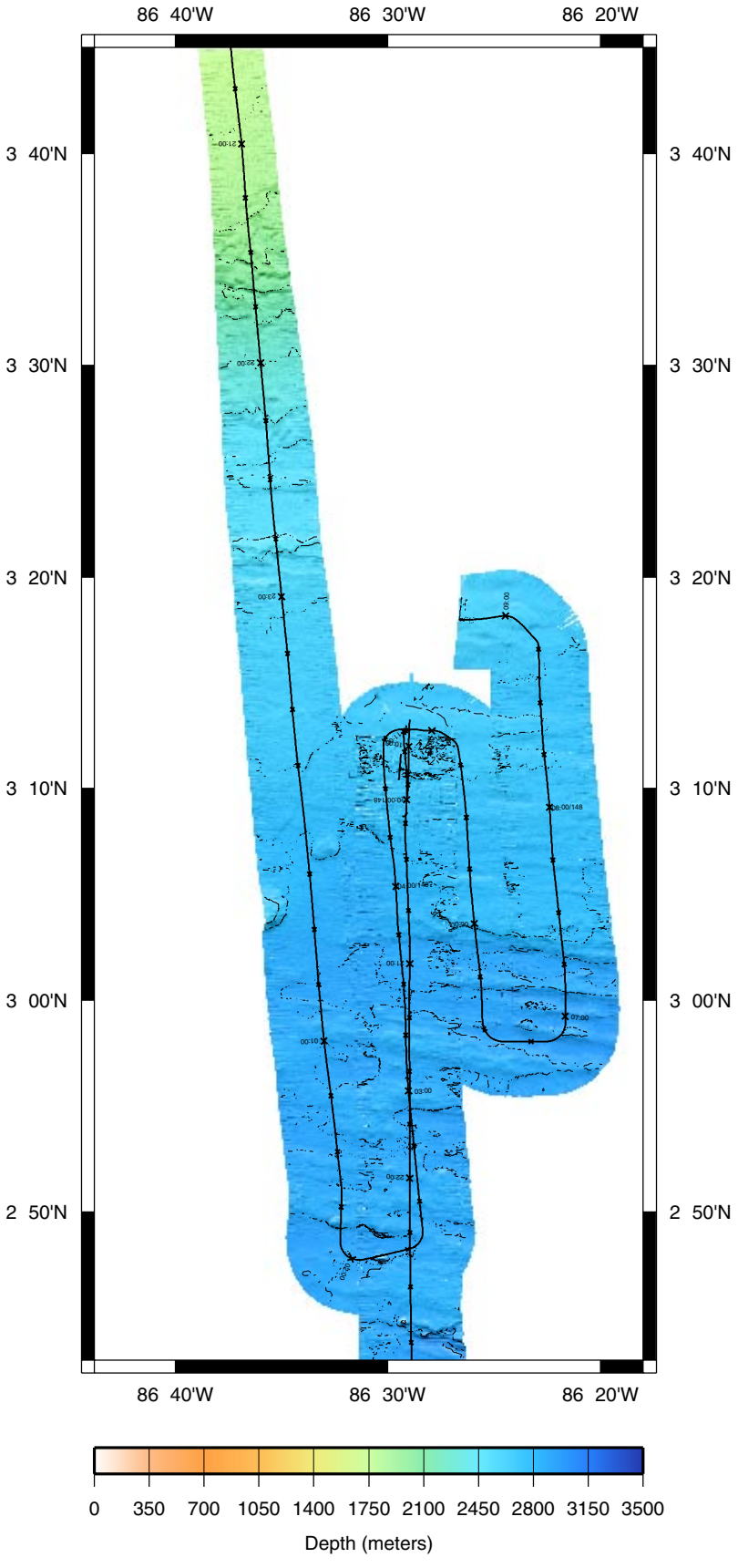
COC-3 Bathymetry/Navigation



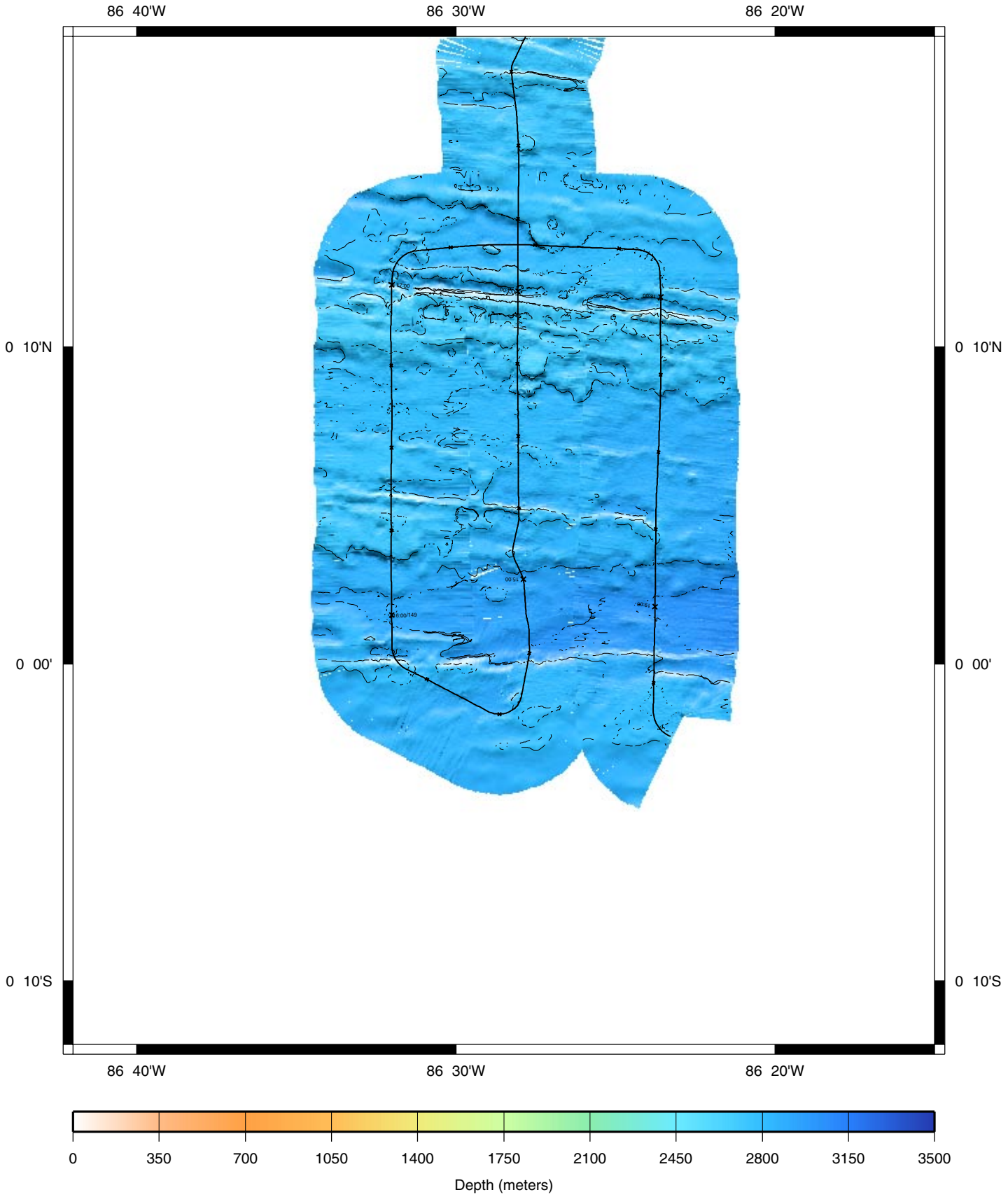
COC-4 Bathymetry/Navigation



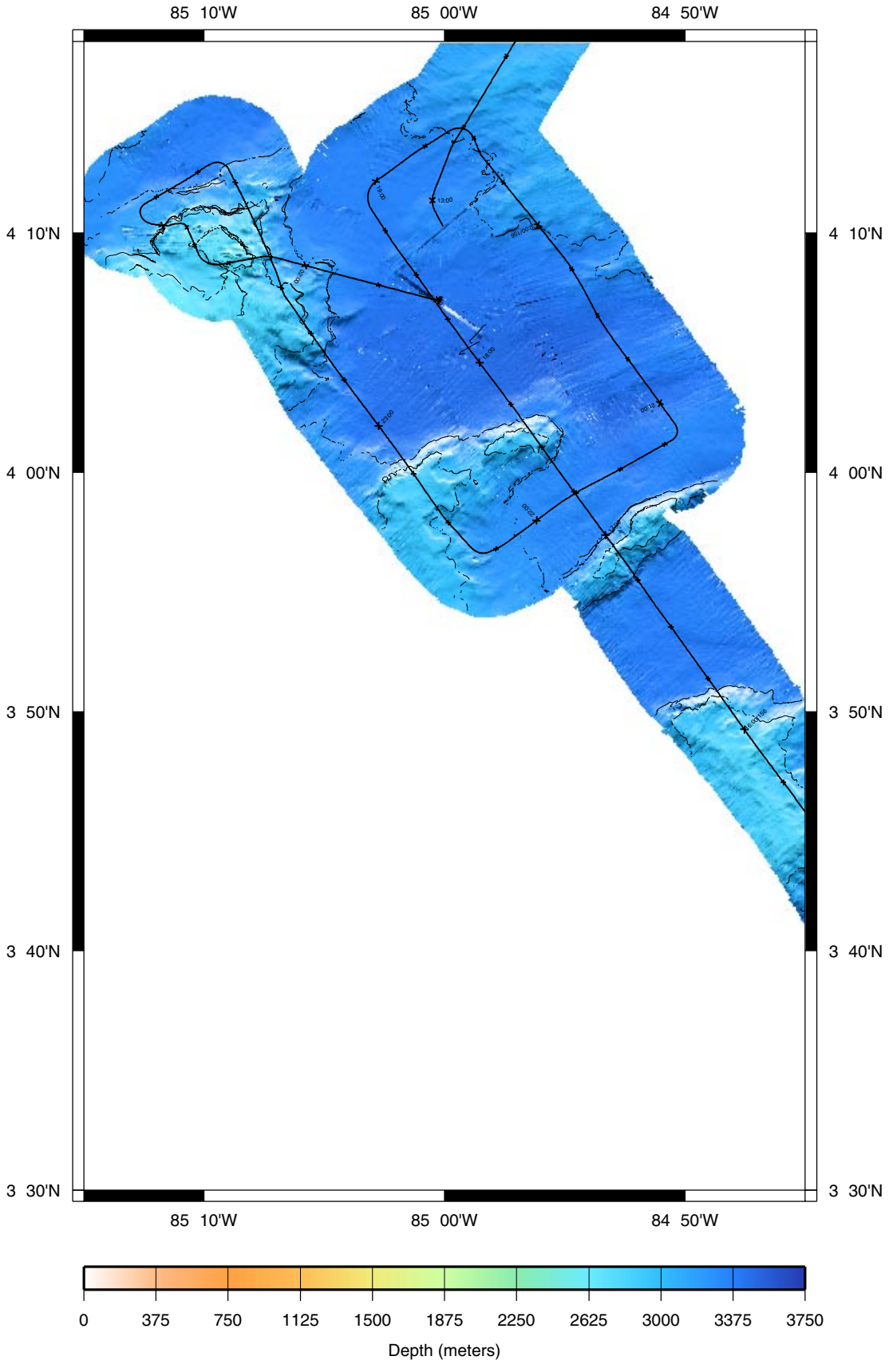
PAN-1 Bathymetry/Navigation



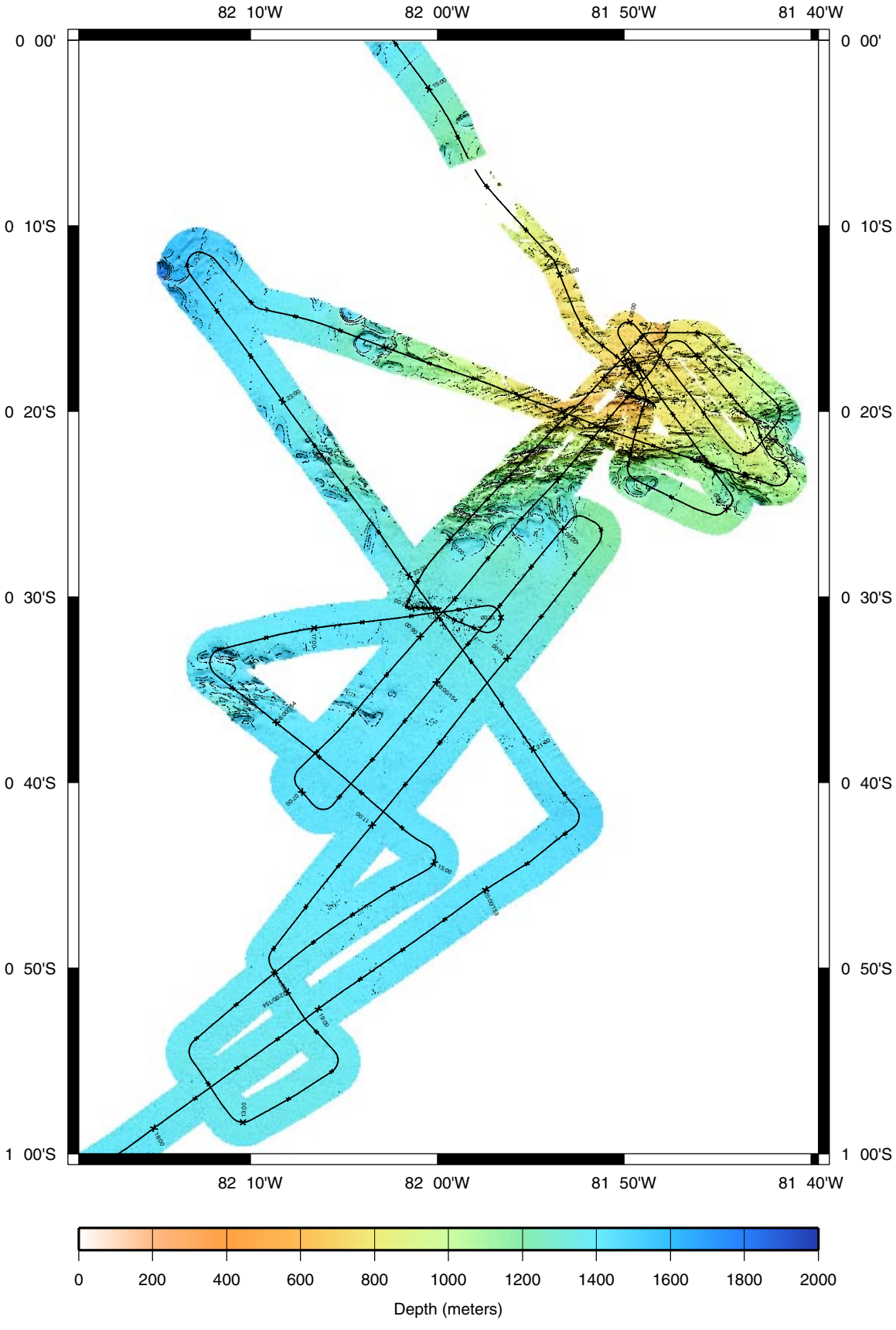
PAN-2 Bathymetry/Navigation



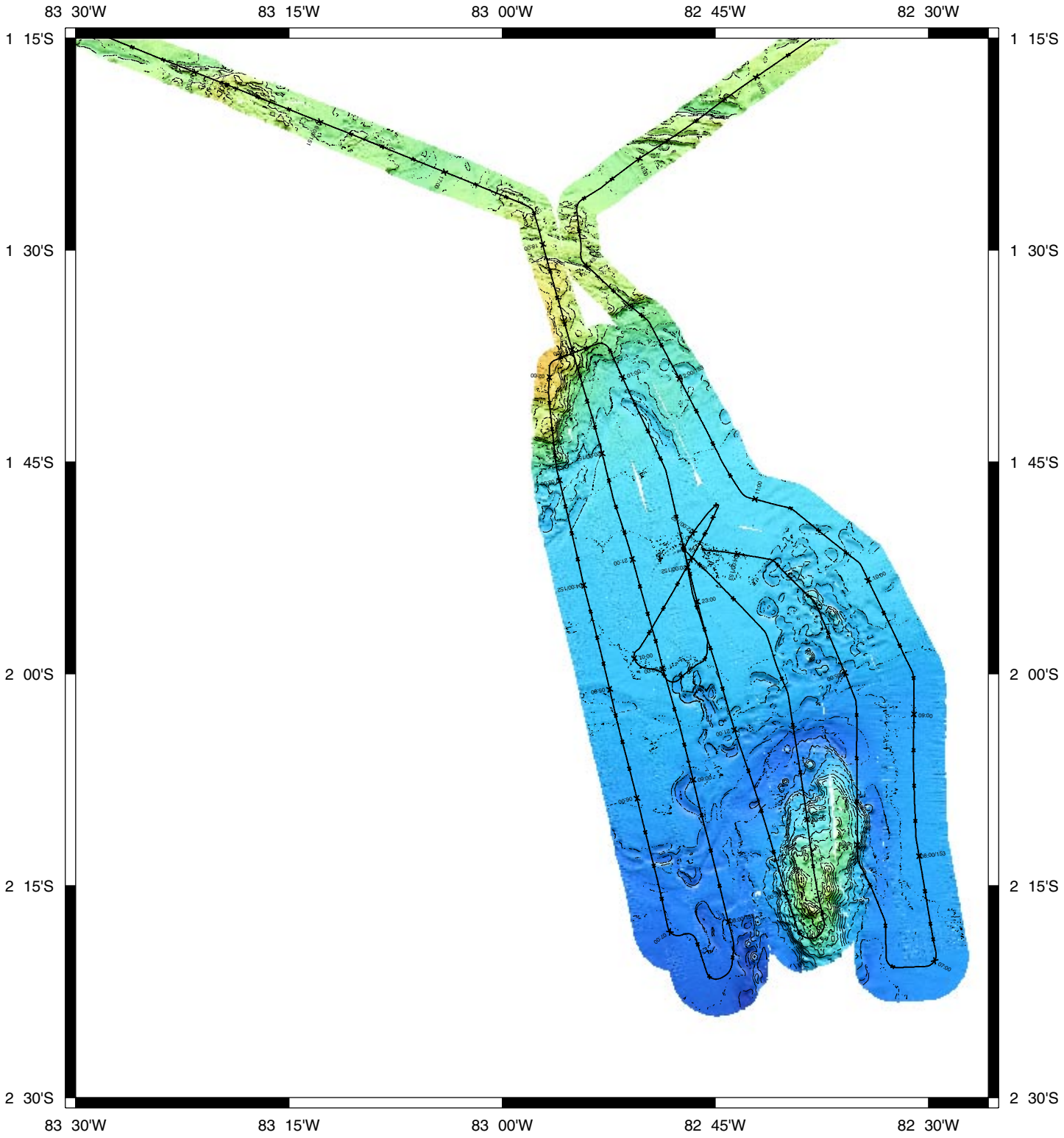
PAN-3 Bathymetry/Navigation

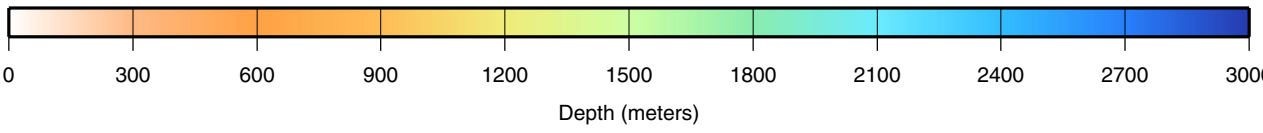


CAR-1 Bathymetry/Navigation

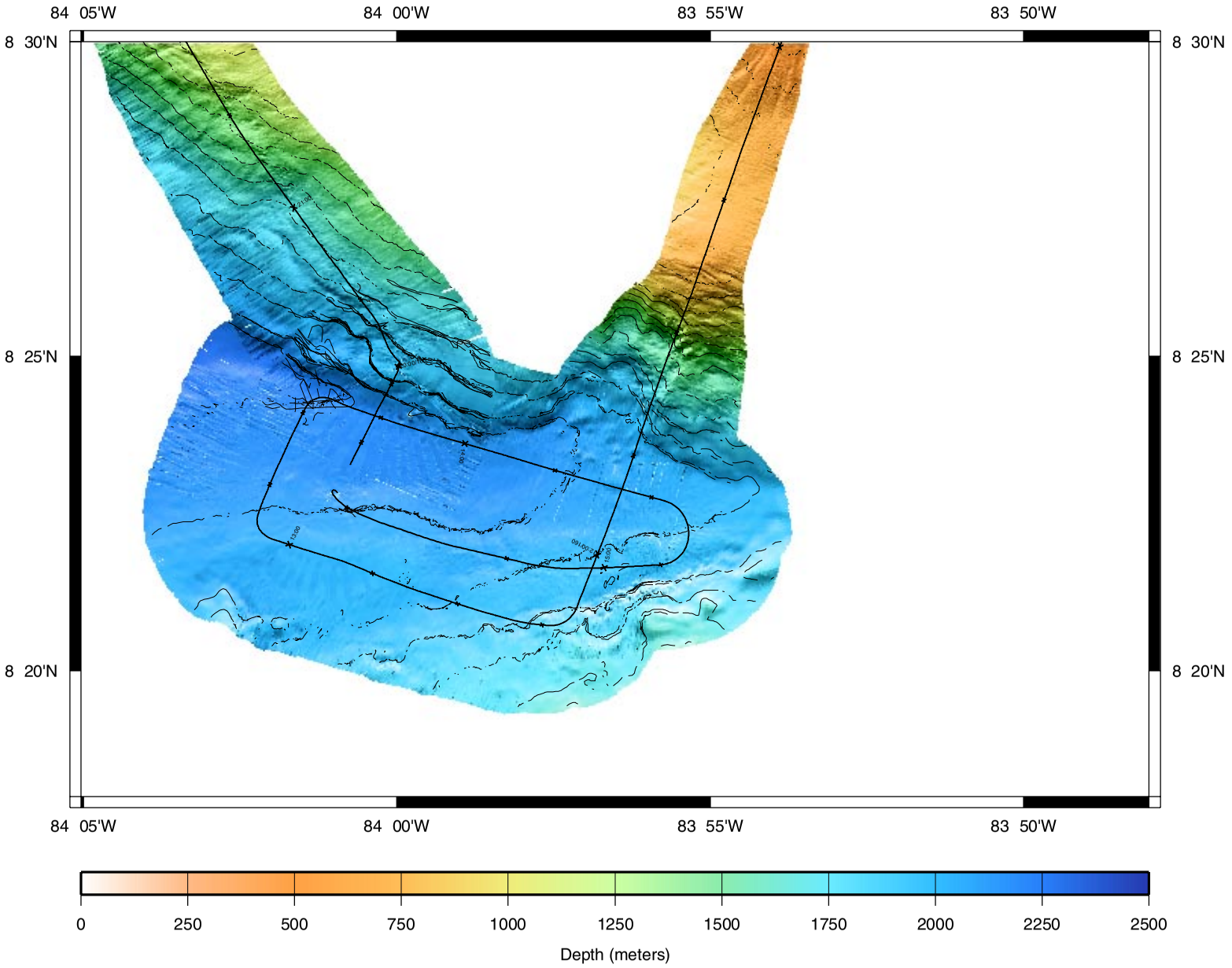


CAR-2 Bathymetry/Navigation





MAT-1 Bathymetry/Navigation



Appendix C

NEMO-III
Preliminary Sediment Core Descriptions

R/V Melville NEMO EXPEDITION, Leg III

Manzanillo Mexico to Puerto Caldera Costa Rica
15 May 2000 to 8 June 2000

Nicklas G. Pisias, Alan C. Mix, Chris Goldfinger
Oregon State University

Mitch Lyle
Boise State University

CORE LOG

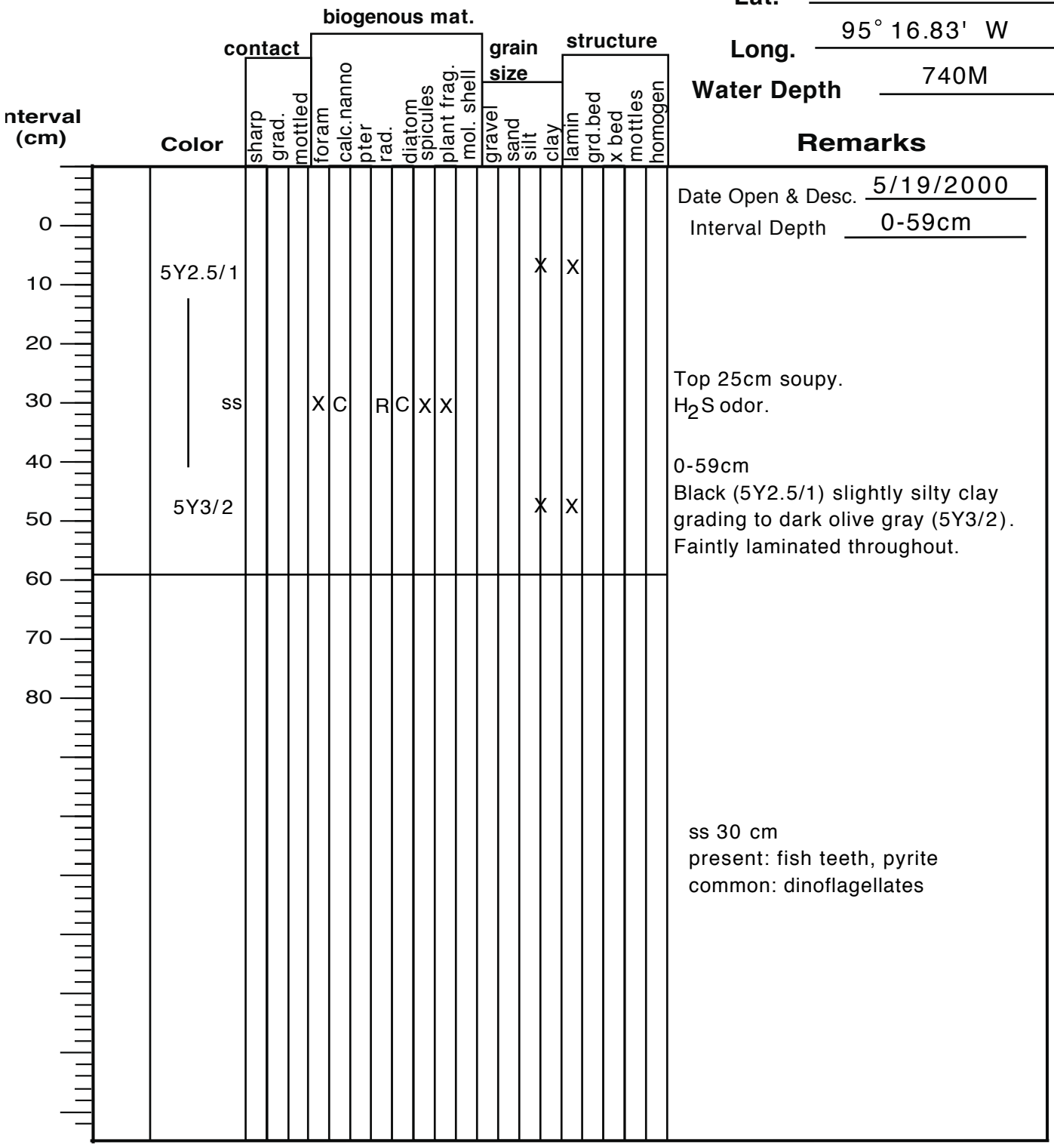
CORE ID ME0005A-03JC

SECTION 1 **of** 14

Lat. 15° 39.04' N

Long. 95° 16.83' W

Water Depth 740M



Date Open & Desc. 5/19/2000

Interval Depth 0-59cm

Top 25cm soupy.
H_2S odor.

0-59cm
Black (5Y2.5/1) slightly silty clay grading to dark olive gray (5Y3/2). Faintly laminated throughout.

ss 30 cm
present: fish teeth, pyrite
common: dinoflagellates

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

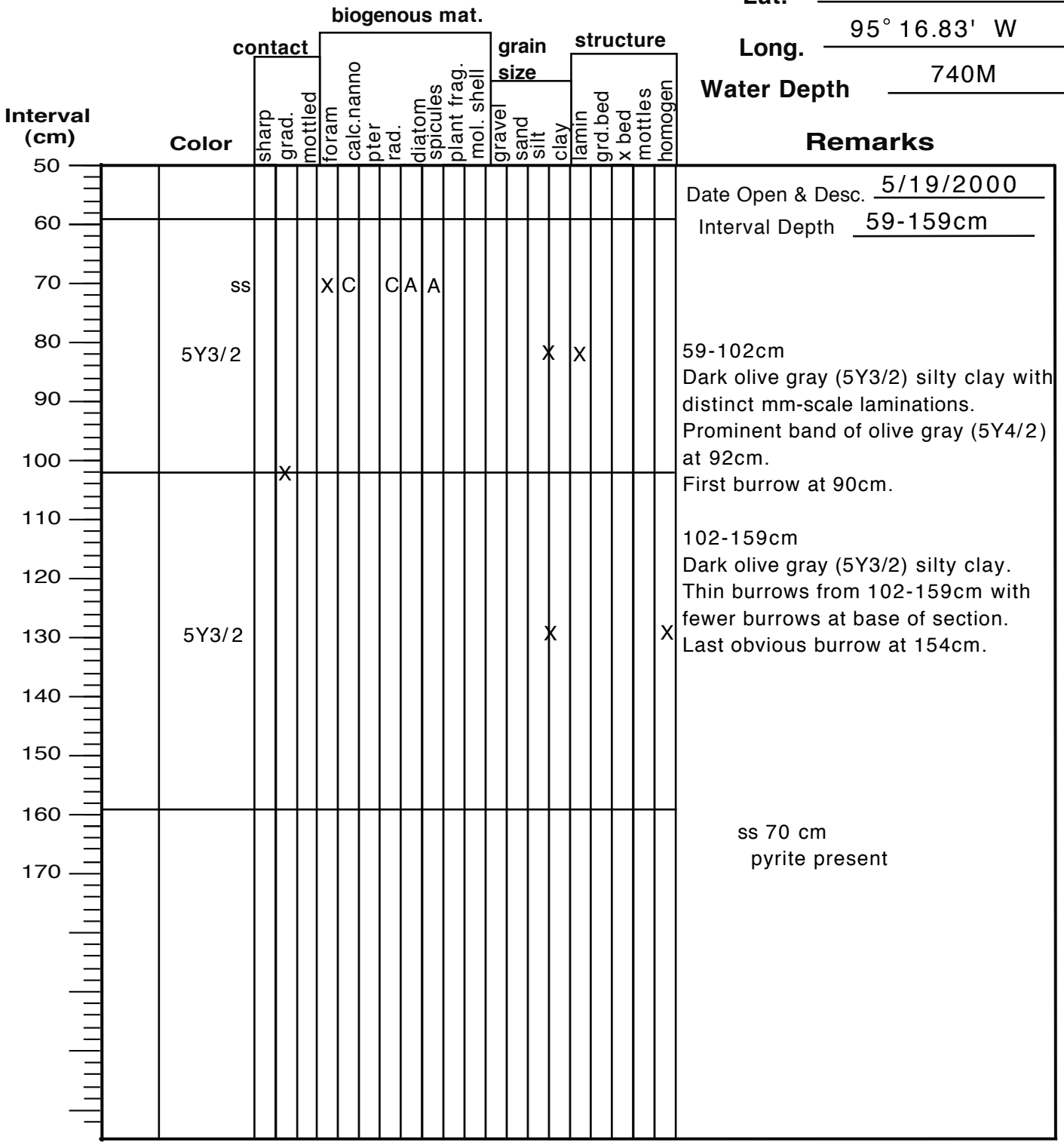
CORE ID ME0005A-03JC

SECTION 2 **of** 14

Lat. 15° 39.04' N

Long. 95° 16.83' W

Water Depth 740M



Date Open & Desc. 5/19/2000

Interval Depth 59-159cm

59-102cm
Dark olive gray (5Y3/2) silty clay with distinct mm-scale laminations.
Prominent band of olive gray (5Y4/2) at 92cm.
First burrow at 90cm.

102-159cm
Dark olive gray (5Y3/2) silty clay.
Thin burrows from 102-159cm with fewer burrows at base of section.
Last obvious burrow at 154cm.

ss 70 cm
pyrite present

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

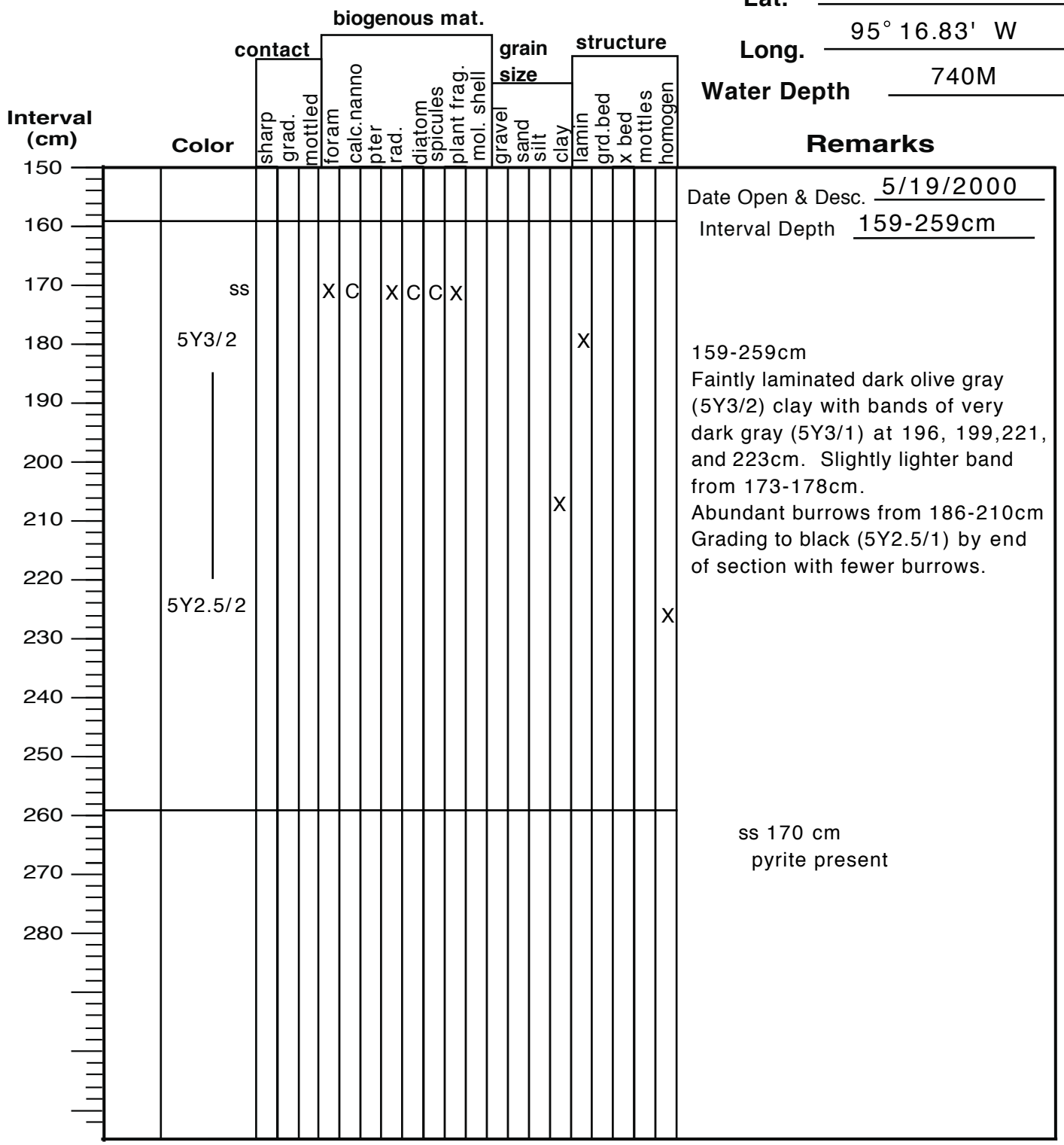
CORE ID ME0005A-03JC

SECTION 3 **of** 14

Lat. 15° 39.04' N

Long. 95° 16.83' W

Water Depth 740M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

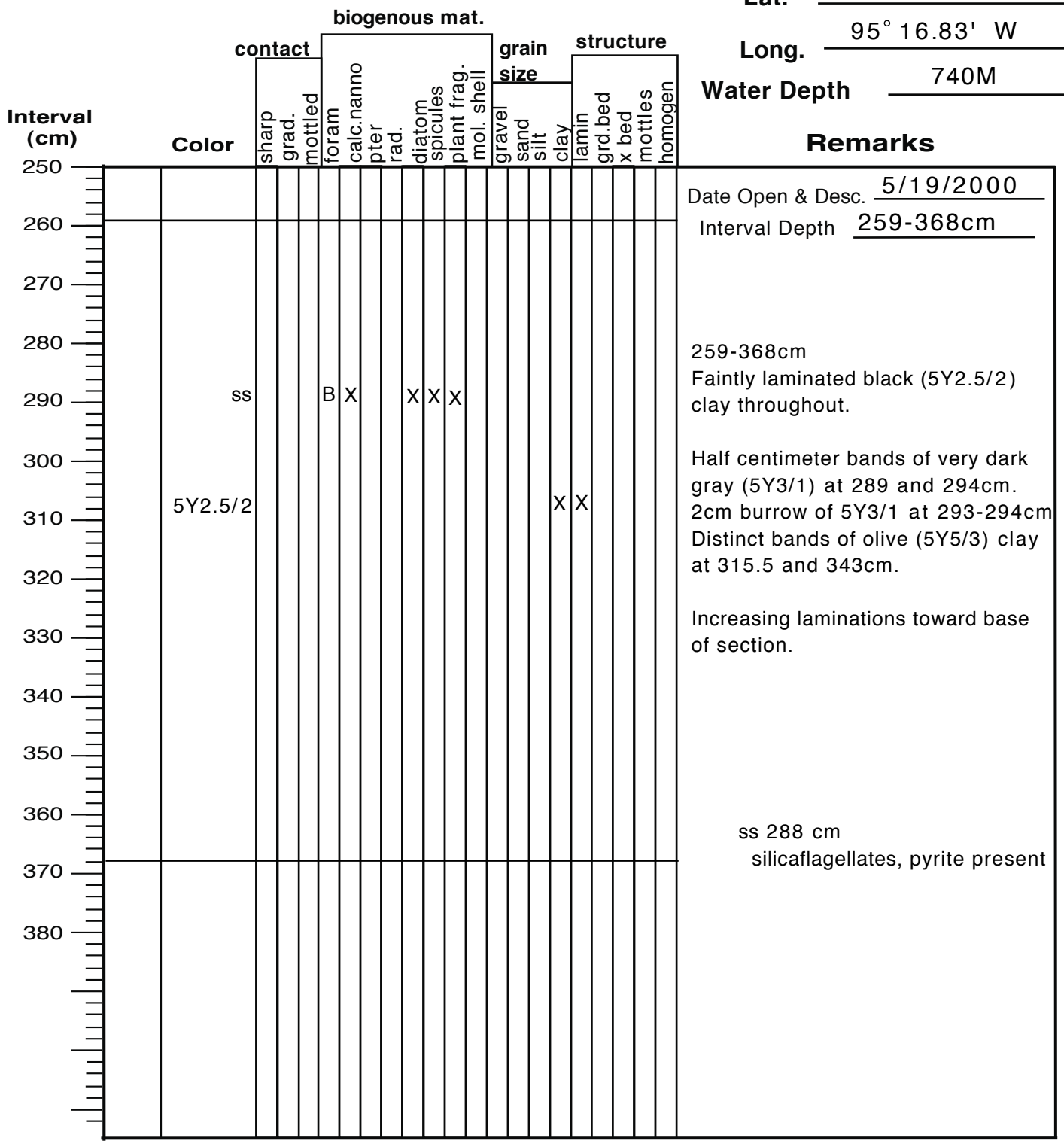
CORE ID ME0005A-03JC

SECTION 4 **of** 14

Lat. 15° 39.04' N

Long. 95° 16.83' W

Water Depth 740M



Date Open & Desc. 5/19/2000

Interval Depth 259-368cm

259-368cm
Faintly laminated black (5Y2.5/2) clay throughout.

Half centimeter bands of very dark gray (5Y3/1) at 289 and 294cm.
2cm burrow of 5Y3/1 at 293-294cm
Distinct bands of olive (5Y5/3) clay at 315.5 and 343cm.

Increasing laminations toward base of section.

ss 288 cm
silicaflagellates, pyrite present

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

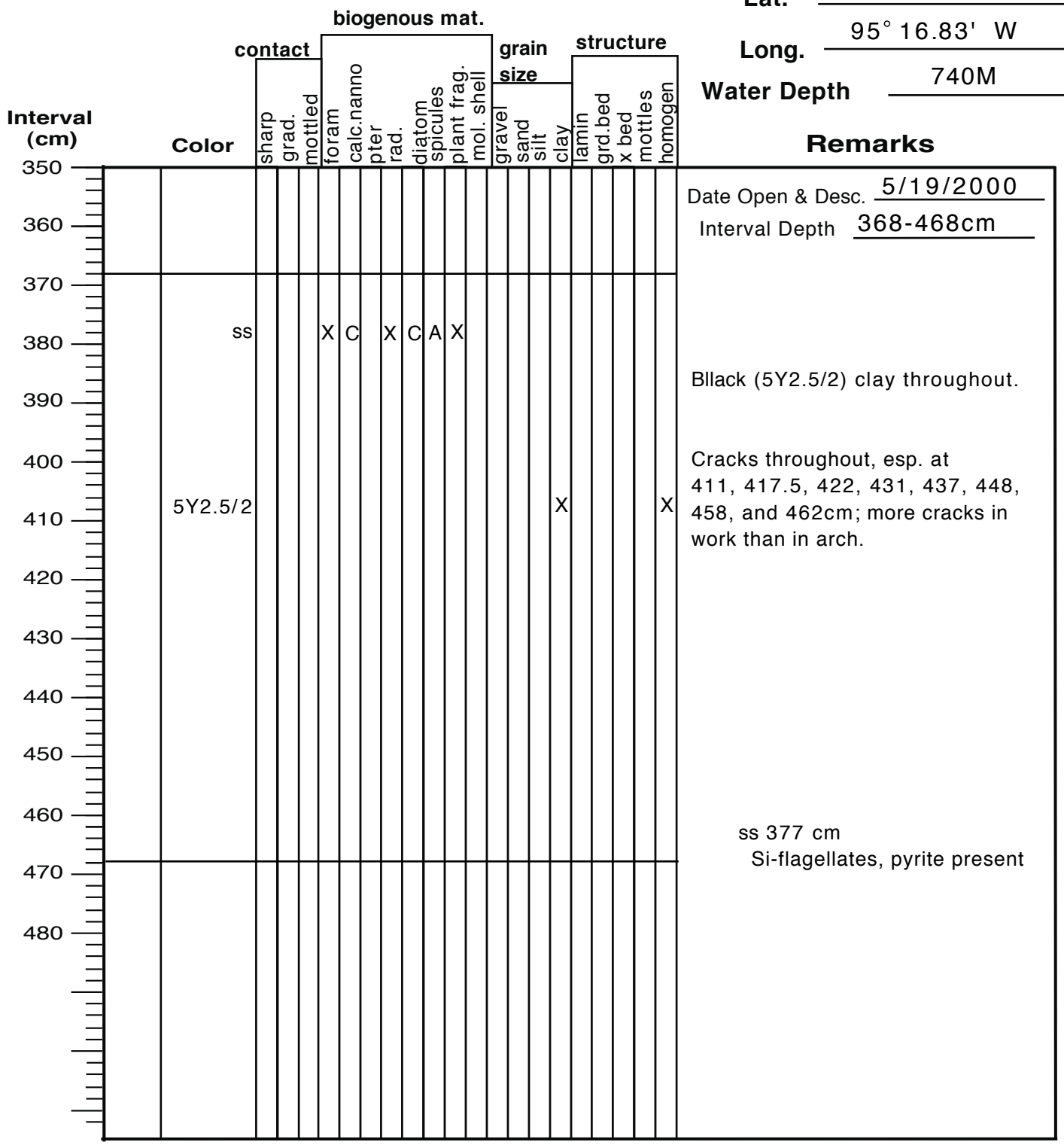
CORE ID ME0005A-03JC

SECTION 5 **of** 14

Lat. 15° 39.04' N

Long. 95° 16.83' W

Water Depth 740M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

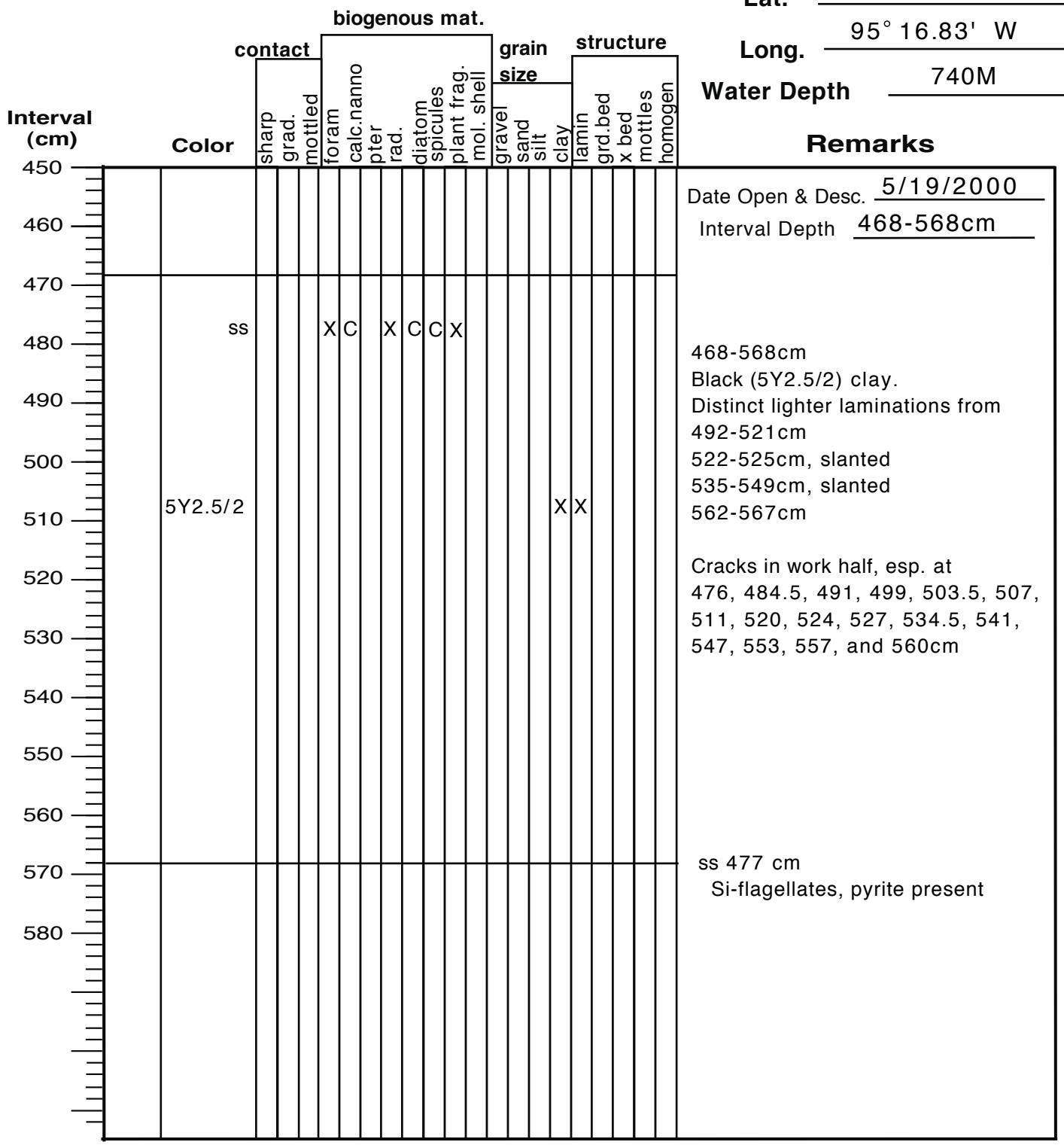
CORE ID ME0005A-03JC

SECTION 6 **of** 14

Lat. 15° 39.04' N

Long. 95° 16.83' W

Water Depth 740M



Date Open & Desc. 5/19/2000

Interval Depth 468-568cm

468-568cm
Black (5Y2.5/2) clay.
Distinct lighter laminations from
492-521cm
522-525cm, slanted
535-549cm, slanted
562-567cm

Cracks in work half, esp. at
476, 484.5, 491, 499, 503.5, 507,
511, 520, 524, 527, 534.5, 541,
547, 553, 557, and 560cm

ss 477 cm
Si-flagellates, pyrite present

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

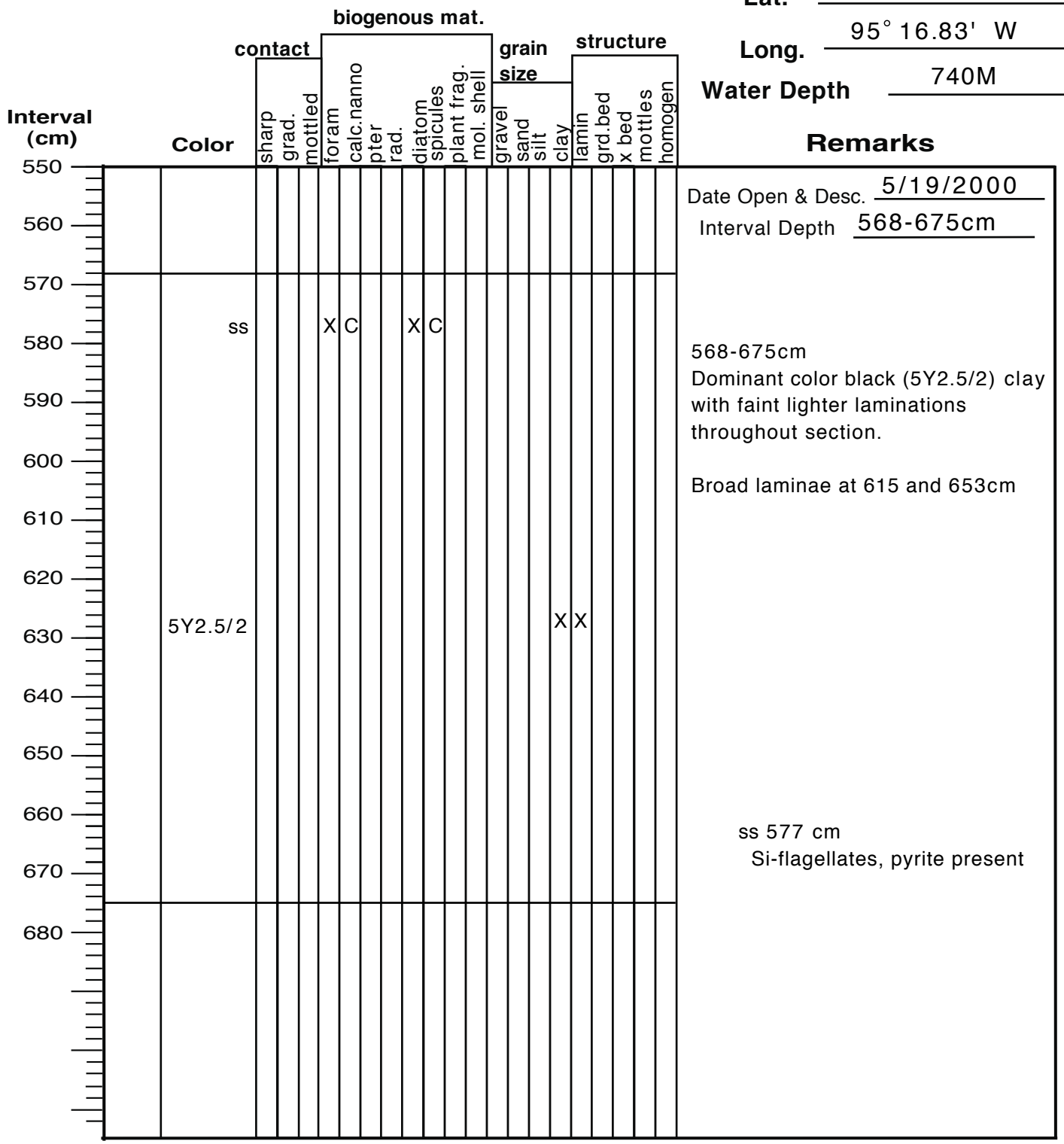
CORE ID ME0005A-03JC

SECTION 7 **of** 14

Lat. 15° 39.04' N

Long. 95° 16.83' W

Water Depth 740M



Date Open & Desc. 5/19/2000

Interval Depth 568-675cm

568-675cm
Dominant color black (5Y2.5/2) clay with faint lighter laminations throughout section.

Broad laminae at 615 and 653cm

ss 577 cm
Si-flagellates, pyrite present

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

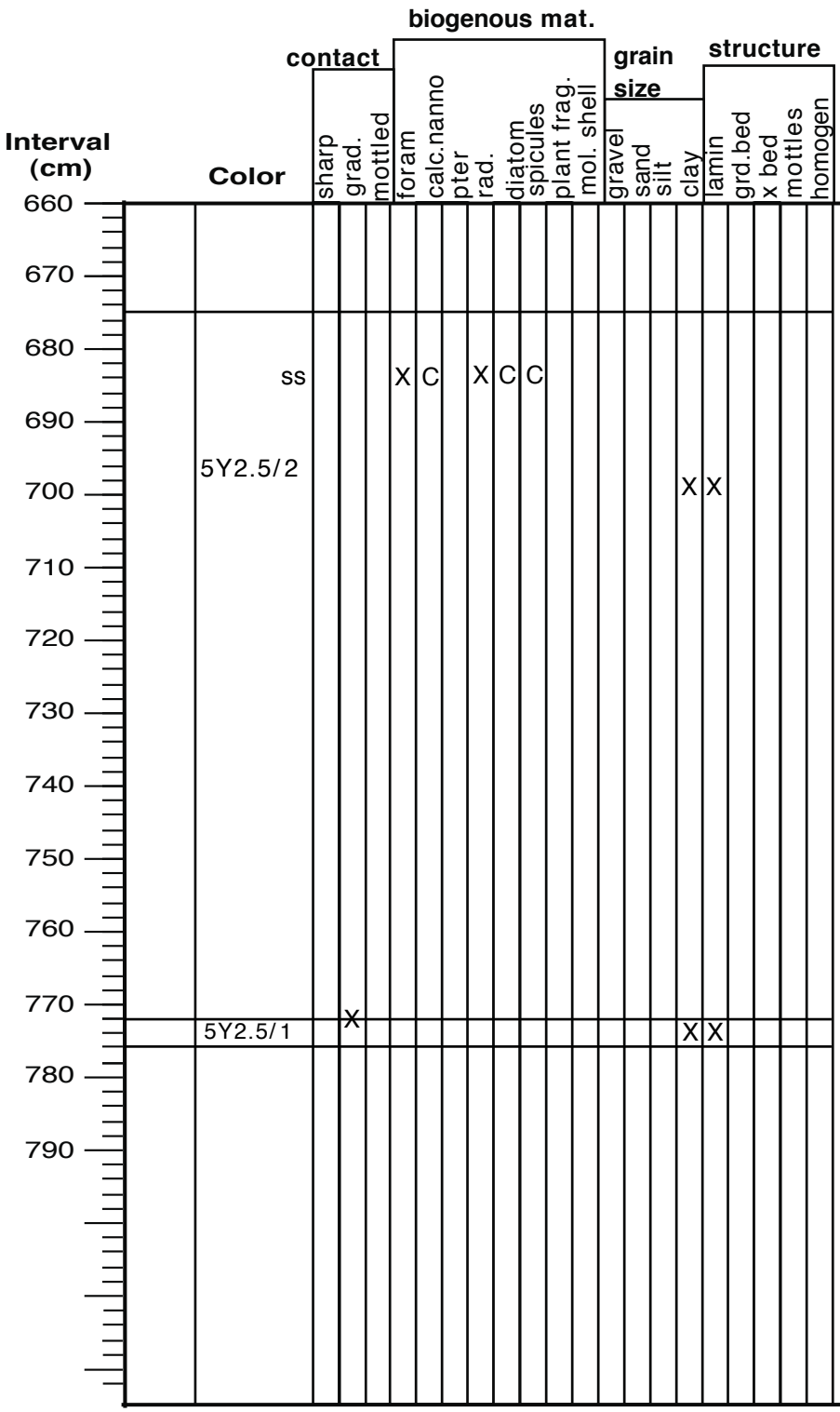
CORE ID ME0005A-03JC

SECTION 8 **of** 14

Lat. 15° 39.04' N

Long. 95° 16.83' W

Water Depth 740M



Remarks

Date Open & Desc. 5/19/2000

Interval Depth 675-776cm

Laminations throughout section

675-772cm
Dominant color black (5Y2.5/2) clay.
Dark 2mm band at 756cm.
Light ash layer at 758cm.

Shell at 750cm in work half

Grading to

772-776cm
Dominant color black (5Y2.5/1) clay.

ss 684.5 cm
Si-flagellates, pyrite present

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

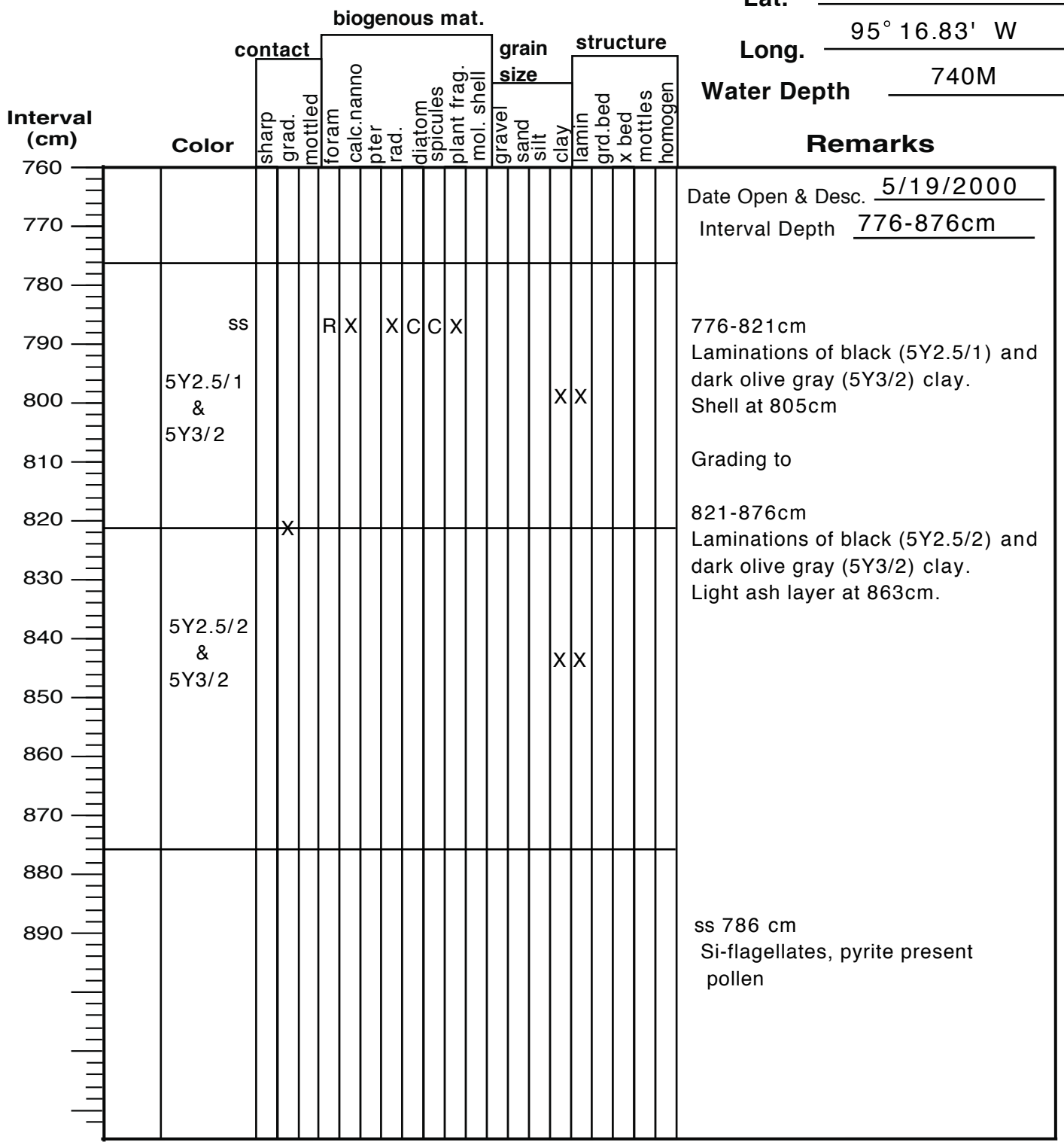
CORE ID ME0005A-03JC

SECTION 9 **of** 14

Lat. 15° 39.04' N

Long. 95° 16.83' W

Water Depth 740M



Remarks

Date Open & Desc. 5/19/2000

Interval Depth 776-876cm

776-821cm
Laminations of black (5Y2.5/1) and dark olive gray (5Y3/2) clay.
Shell at 805cm

Grading to

821-876cm
Laminations of black (5Y2.5/2) and dark olive gray (5Y3/2) clay.
Light ash layer at 863cm.

ss 786 cm
Si-flagellates, pyrite present
pollen

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

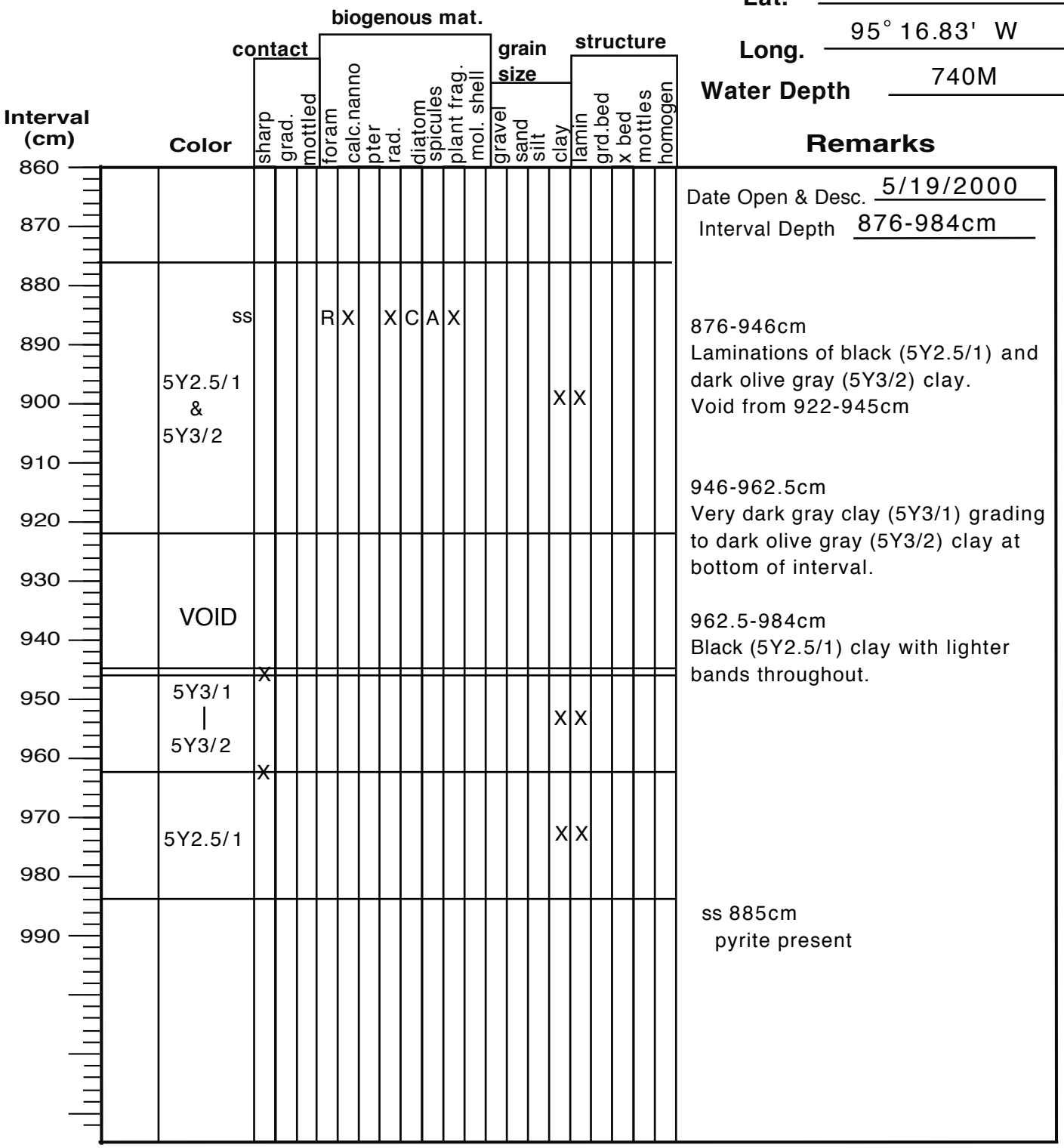
CORE ID ME0005A-03JC

SECTION 10 **of** 14

Lat. 15° 39.04' N

Long. 95° 16.83' W

Water Depth 740M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

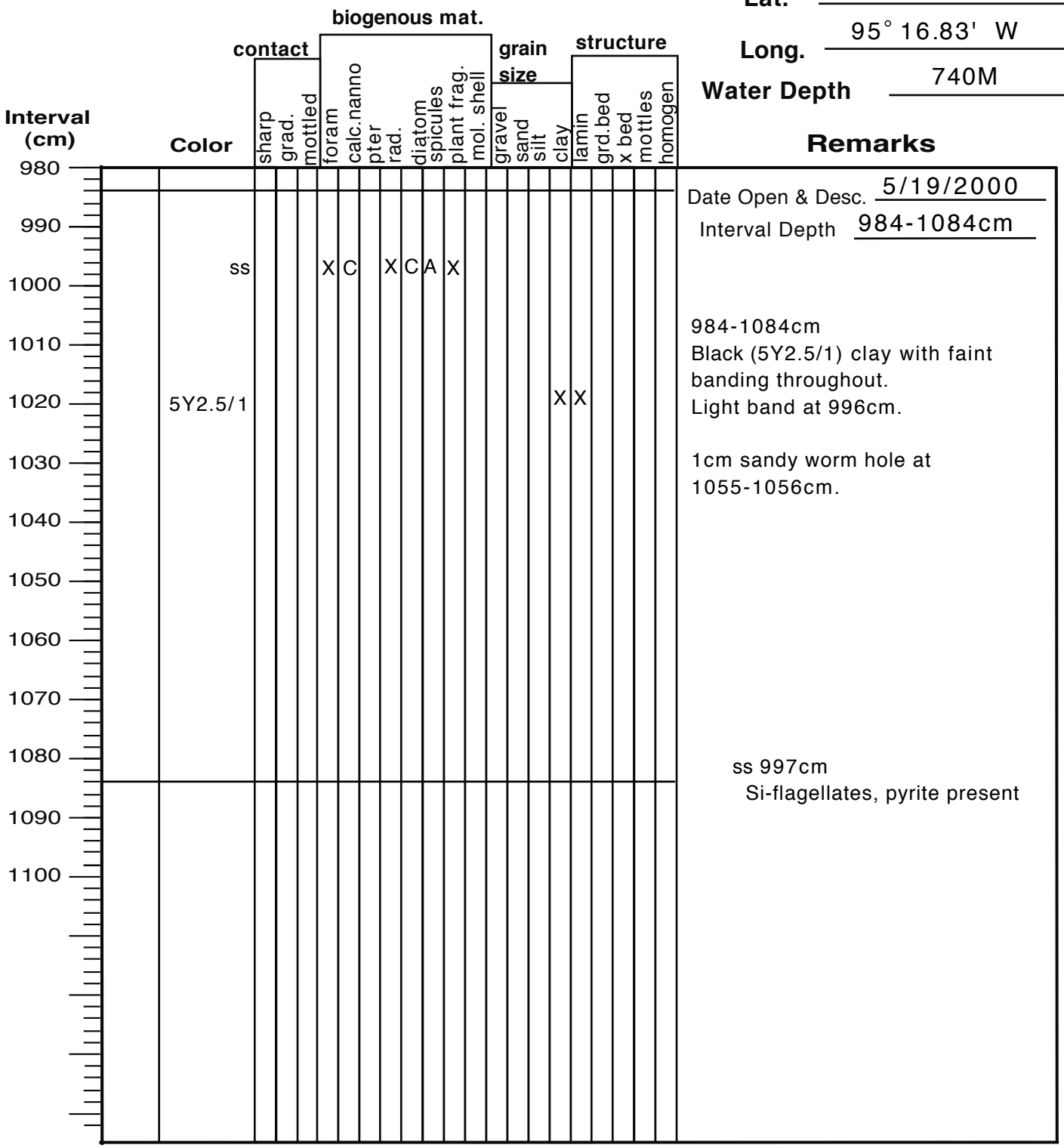
CORE ID ME0005A-03JC

SECTION 11 **of** 14

Lat. 15° 39.04' N

Long. 95° 16.83' W

Water Depth 740M



Remarks

Date Open & Desc. 5/19/2000

Interval Depth 984-1084cm

984-1084cm
Black (5Y2.5/1) clay with faint banding throughout.
Light band at 996cm.

1cm sandy worm hole at 1055-1056cm.

ss 997cm
Si-flagellates, pyrite present

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

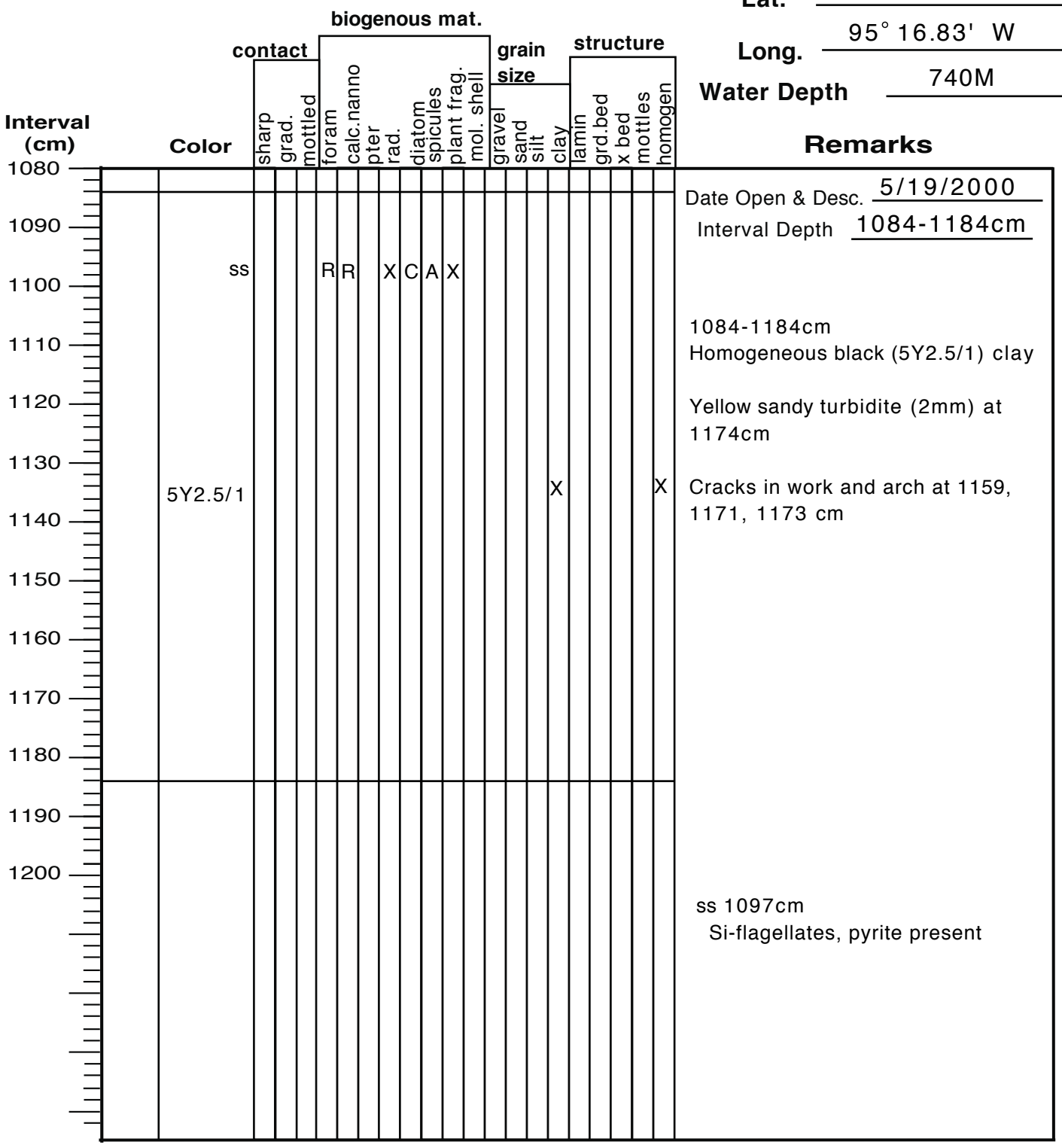
CORE ID ME0005A-03JC

SECTION 12 **of** 14

Lat. 15° 39.04' N

Long. 95° 16.83' W

Water Depth 740M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

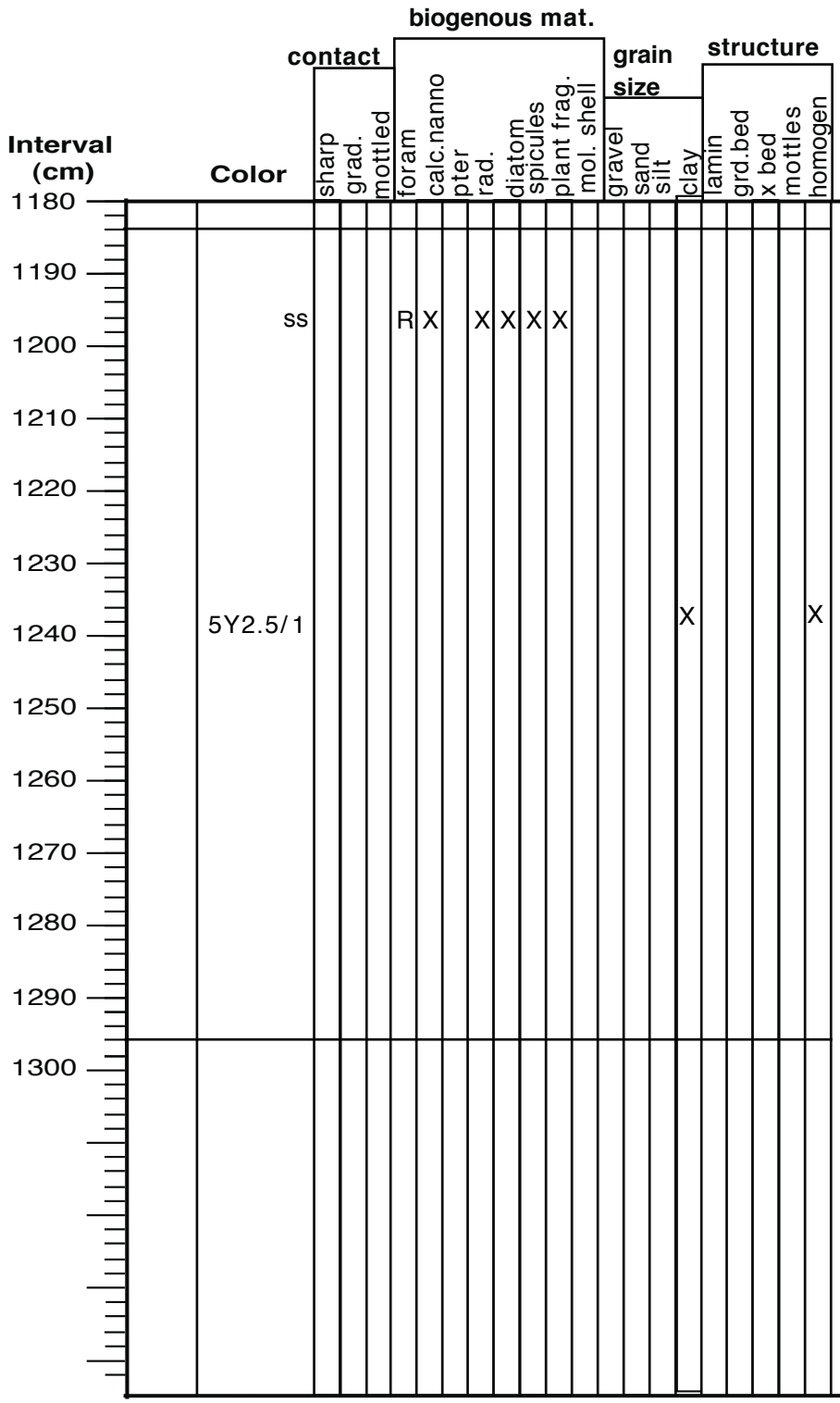
CORE ID ME0005A-03JC

SECTION 13 **of** 14

Lat. 15° 39.04' N

Long. 95° 16.83' W

Water Depth 740M



Remarks

Date Open & Desc. 5/19/2000

Interval Depth 1184-1296cm

1184-1296cm
Homogeneous black (5Y2.5/1) clay

Light yellow curved bands at 1218 and 1222cm.

In work and archive, extensive deep cracks 1267-1274cm

ss 1197cm
Si-flagellates, pyrite present

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

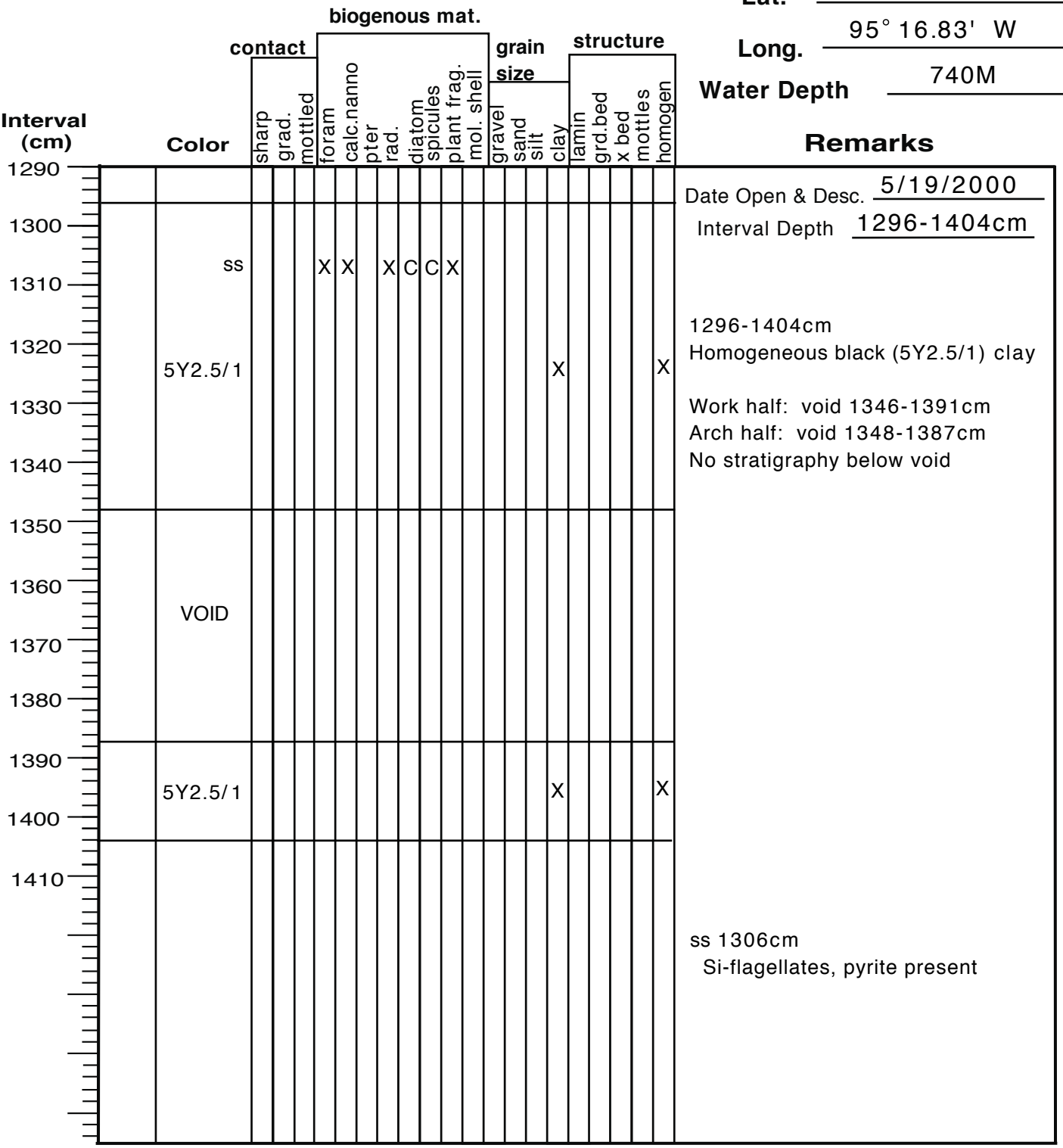
CORE ID ME0005A-03JC

SECTION 14 **of** 14

Lat. 15° 39.04' N

Long. 95° 16.83' W

Water Depth 740M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

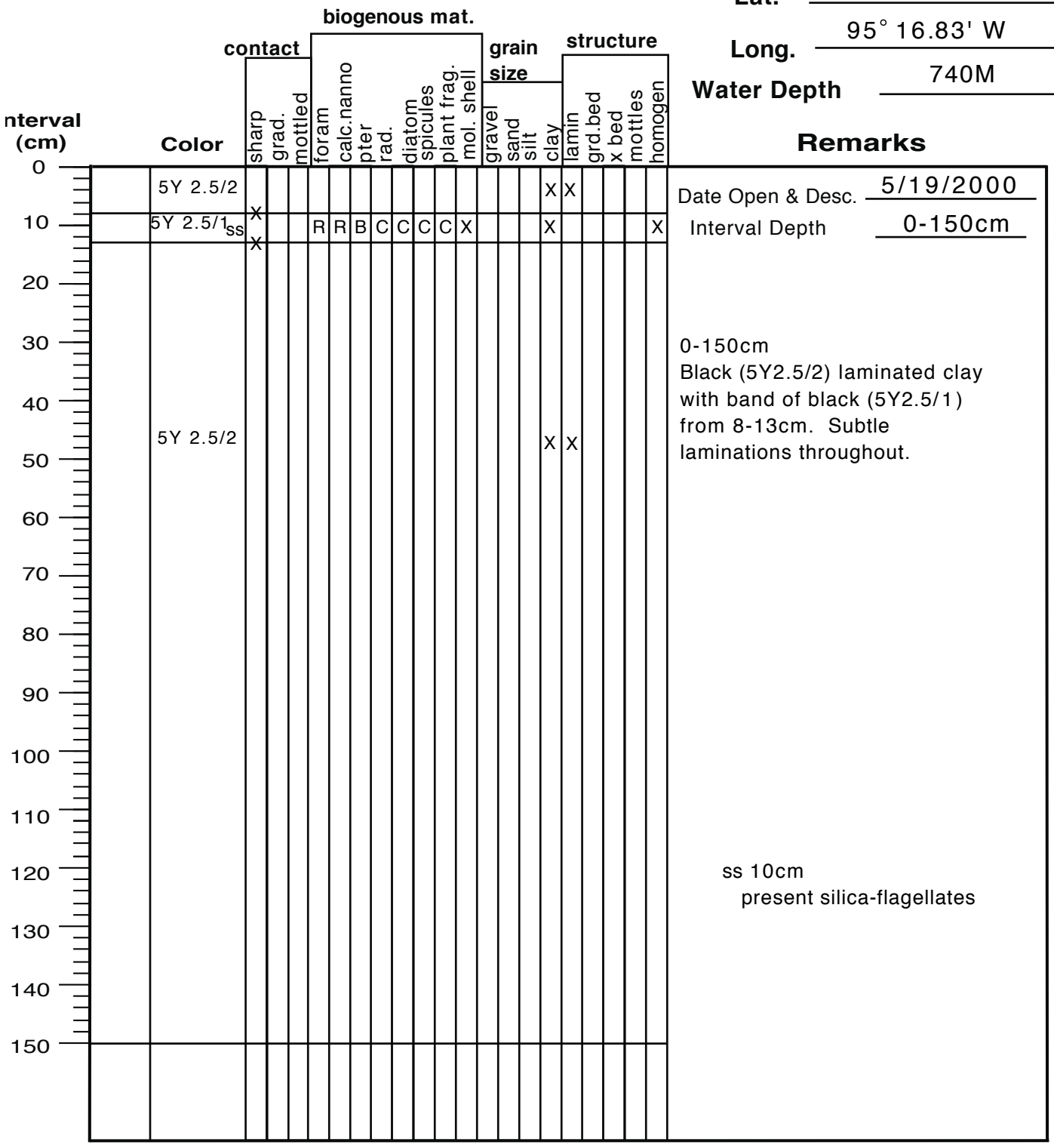
CORE ID ME0005A-03GC

SECTION 1 of 1

Lat. 15° 39.04' N

Long. 95° 16.83' W

Water Depth 740M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

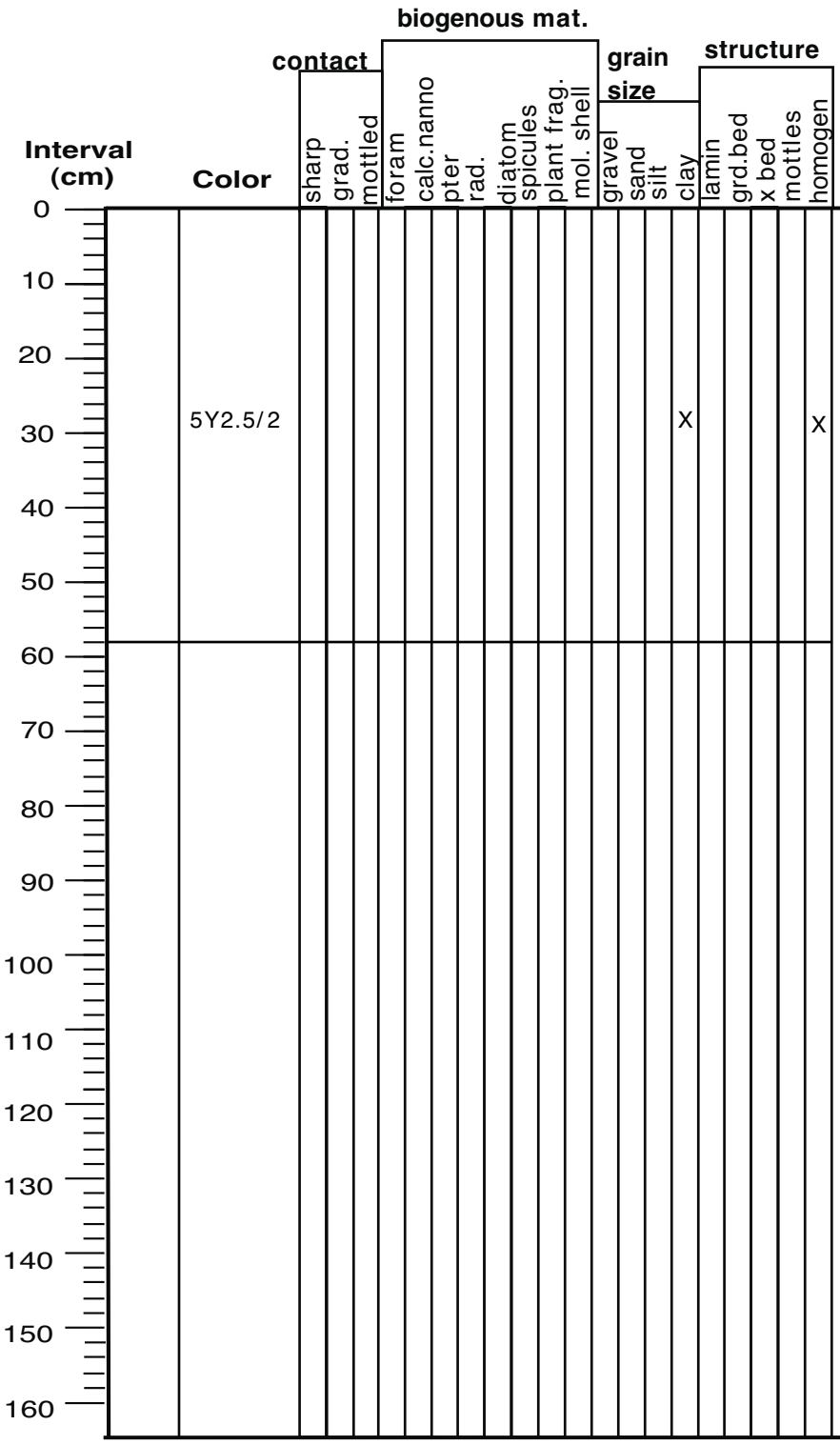
CORE ID ME0005A-04MC2

SECTION 1 **of** 1

Lat. 15° 39.27' N

Long. 95° 16.75' W

Water Depth 725M



Remarks

Date Open & Desc. 5/19/2000

Interval Depth 0-58cm

described 8/17/00

not split evenly,
WORK, 2/3; ARCH 1/3

very soft core

0-58cm
Black (5Y2.5/2) clay

no ss

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

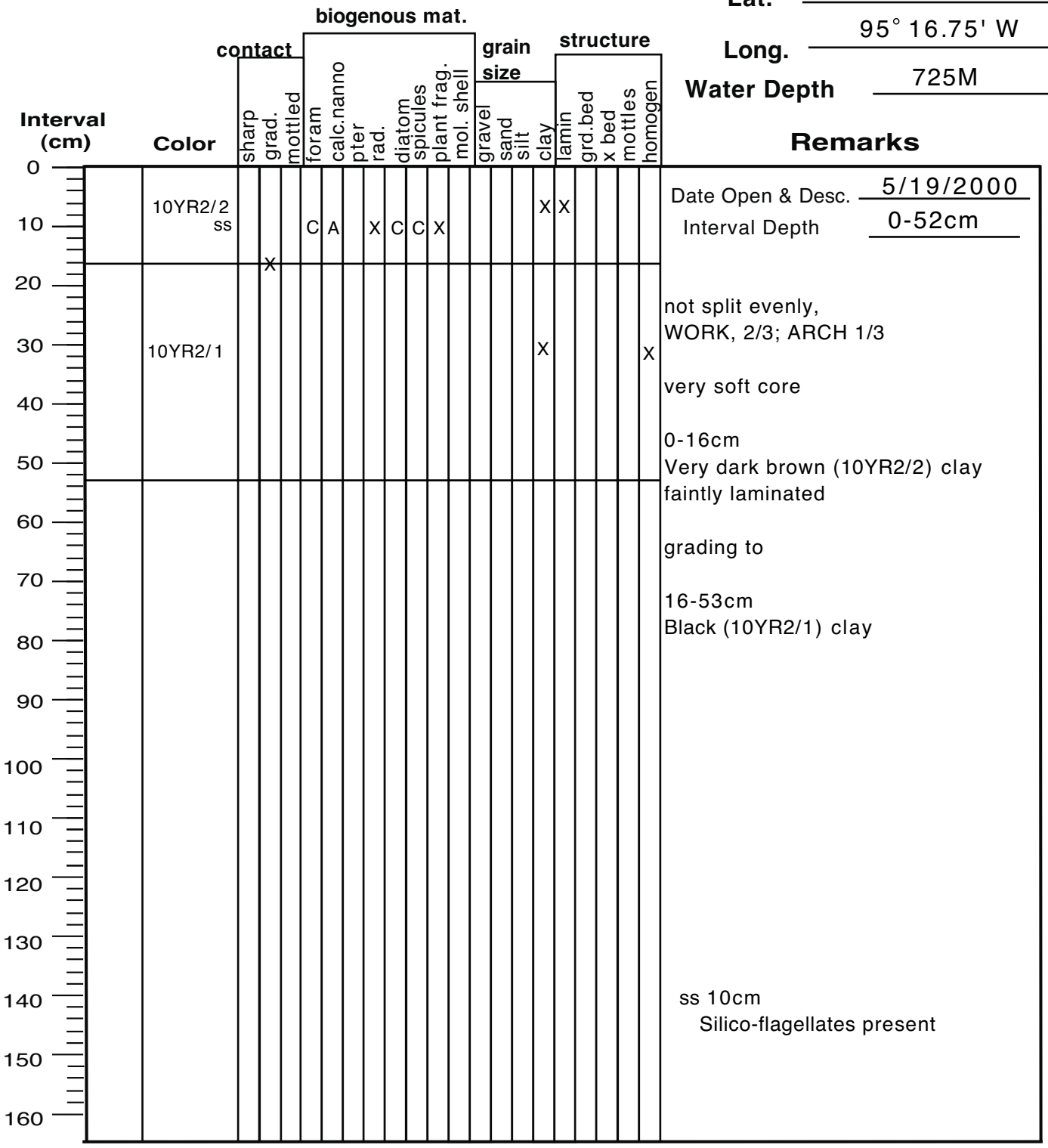
CORE ID ME0005A-04MC4

SECTION 1 **of** 1

Lat. 15° 39.27' N

Long. 95° 16.75' W

Water Depth 725M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

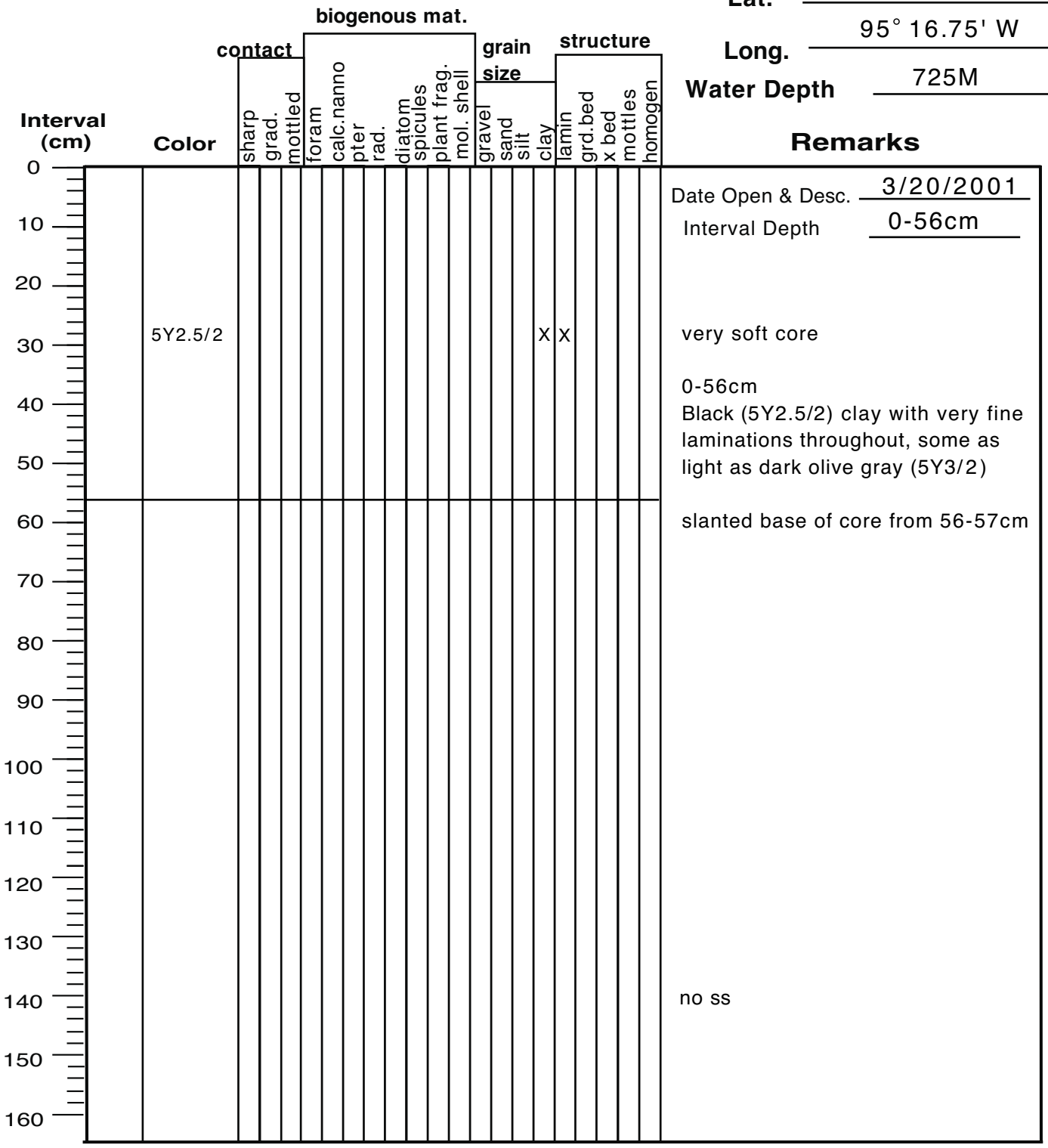
CORE ID ME0005A-04MC6

SECTION 1 **of** 1

Lat. 15° 39.27' N

Long. 95° 16.75' W

Water Depth 725M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

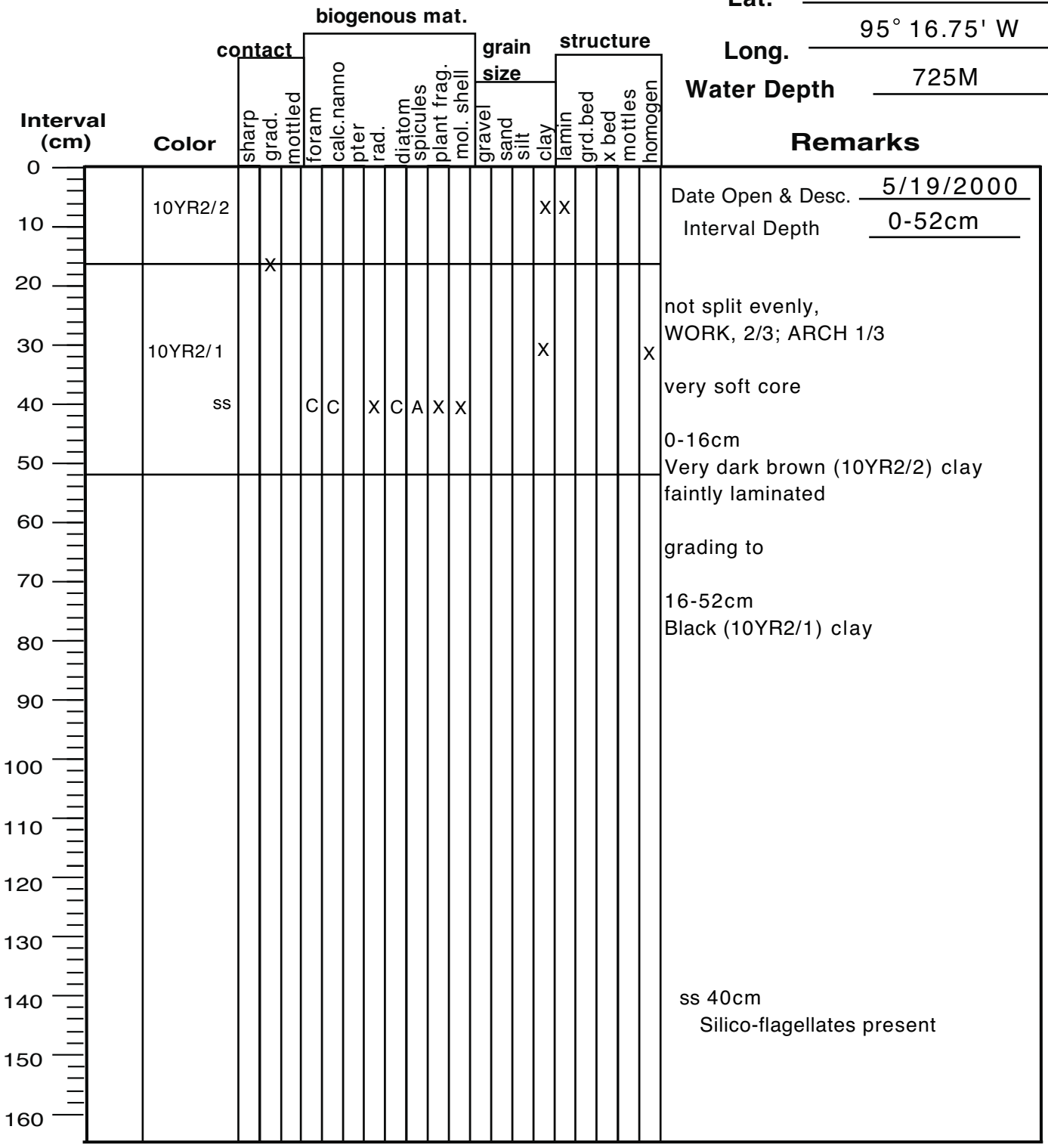
CORE ID ME0005A-04MC7

SECTION 1 **of** 1

Lat. 15° 39.27' N

Long. 95° 16.75' W

Water Depth 725M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

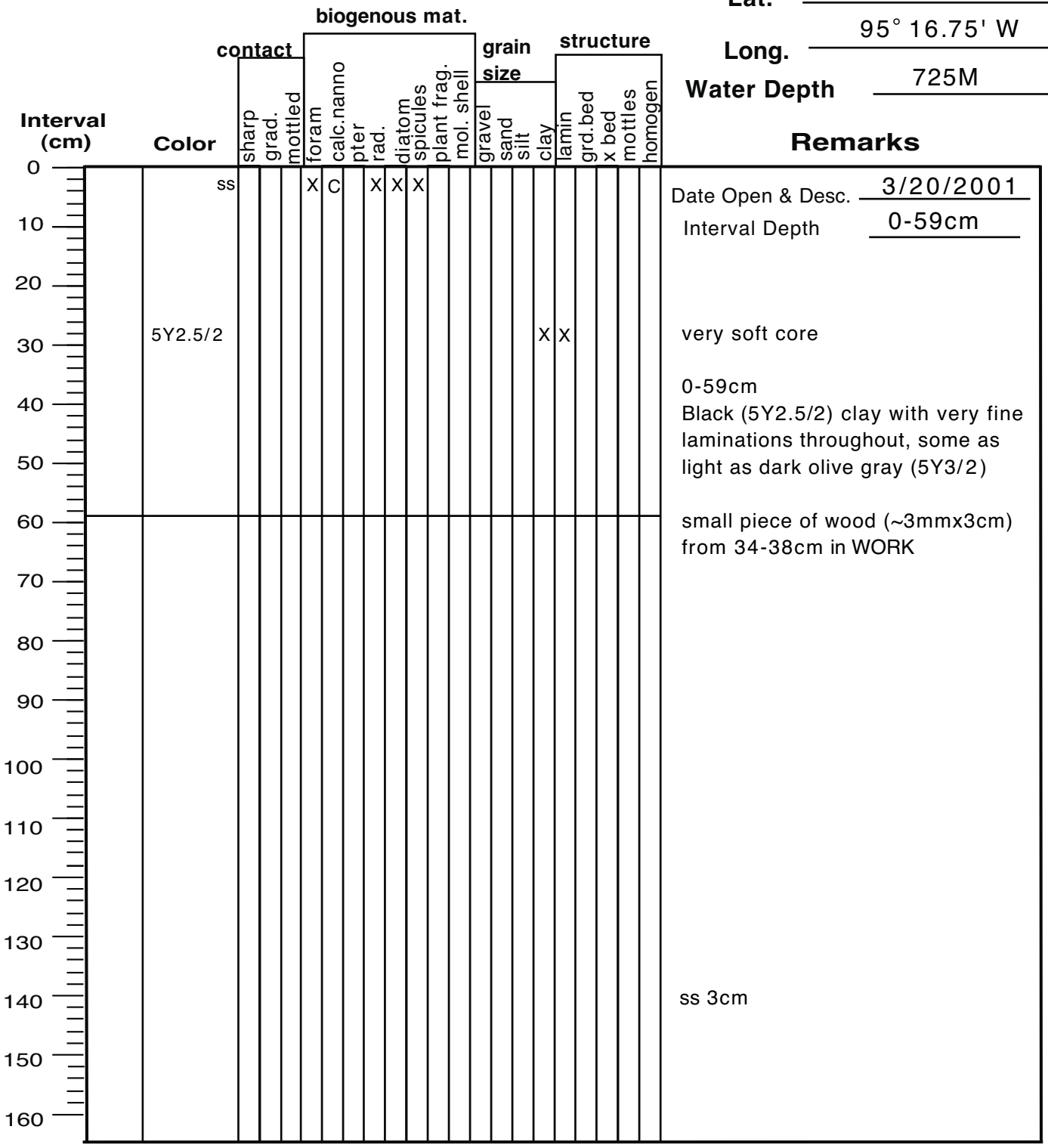
CORE ID ME0005A-04MC8

SECTION 1 **of** 1

Lat. 15° 39.27' N

Long. 95° 16.75' W

Water Depth 725M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

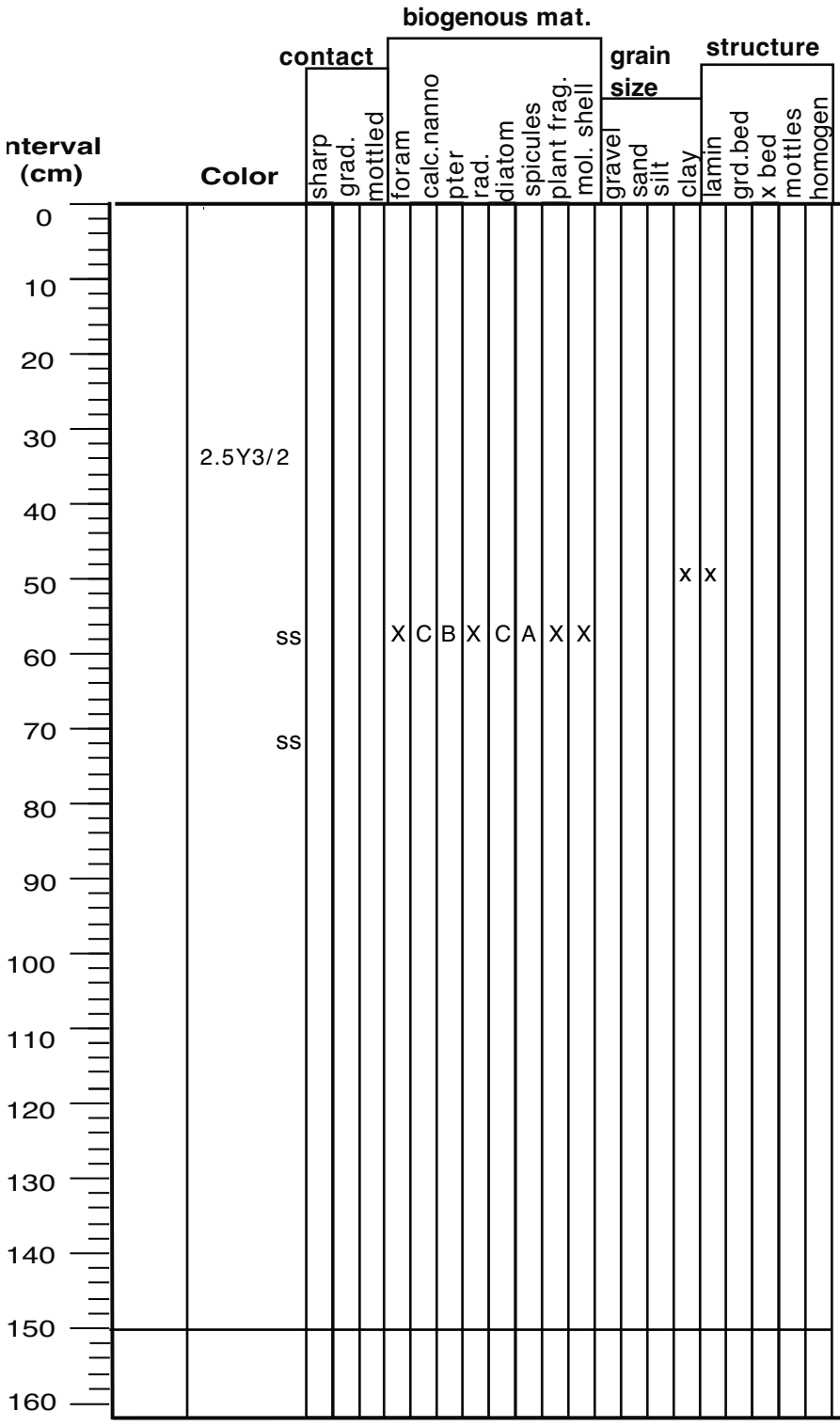
CORE ID ME0005A-06JC

SECTION 01 **of** 13

Lat. 15.710° N

Long. 95.292° W

Water Depth 579m



Remarks

Date Open & Desc. 5/19/00

Interval Depth 0-150cm

redescribed 8/17/00

0-150cm
tube not completely filled with sediment, approximately first 15cm

Dominant color very dark grayish brown (2.5Y3/2) clay, with fine laminations of grayish brown (2.5Y5/2) throughout. Broader and more obvious laminae from 72-82cm.

2-3mm hard layer of olive gray (5Y4/2) at 72cm; possibly ash. Corresponds to layer at 151cm inTC

Shell fragment in ARCH at 95cm

SS 58, 72cm
at 58cm, present silica flagellates; no ash/glass

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

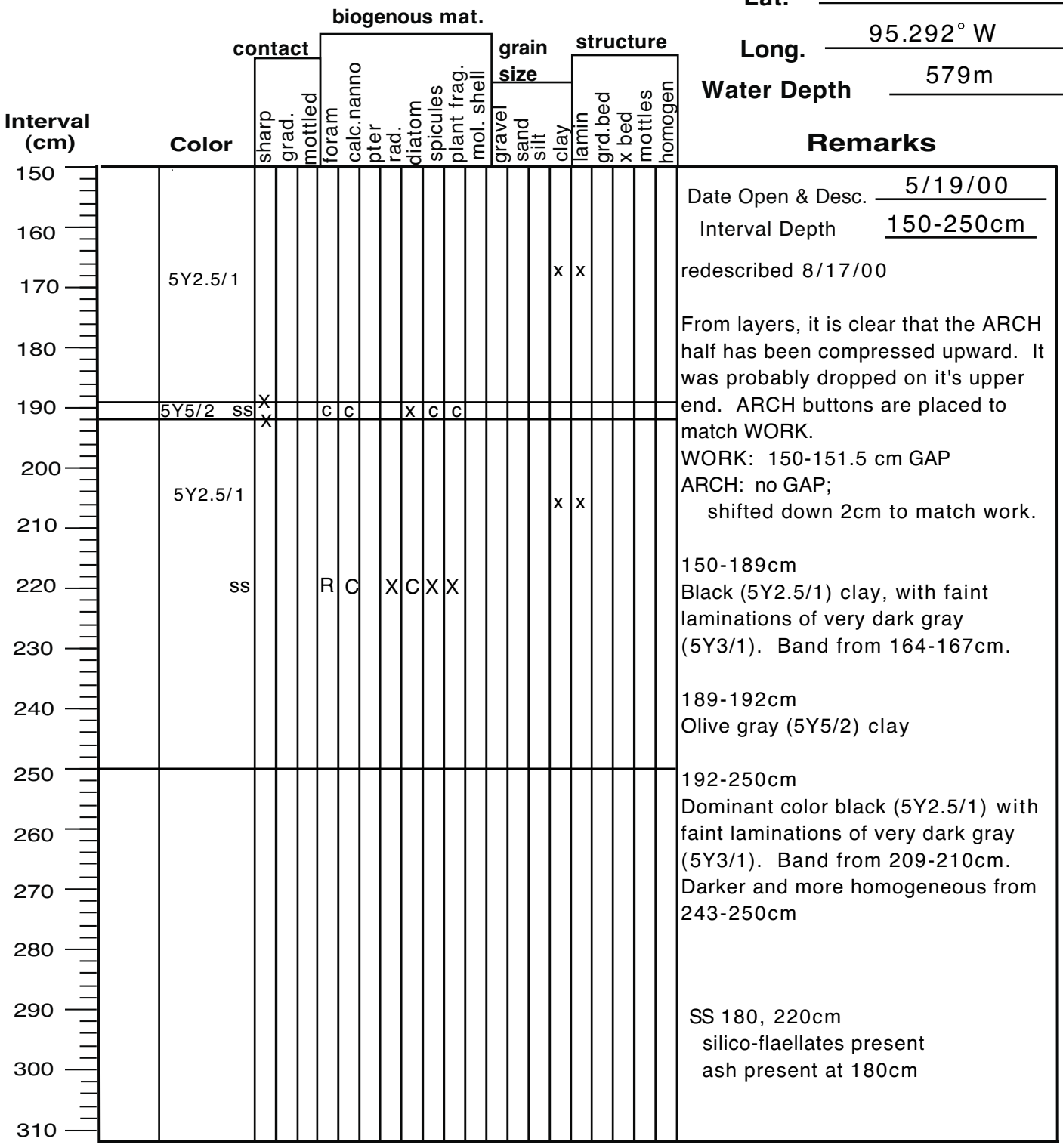
CORE ID ME0005A-06JC

SECTION 02 **of** 13

Lat. 15.710° N

Long. 95.292° W

Water Depth 579m



Remarks

Date Open & Desc. 5/19/00

Interval Depth 150-250cm

redescribed 8/17/00

From layers, it is clear that the ARCH half has been compressed upward. It was probably dropped on it's upper end. ARCH buttons are placed to match WORK.
WORK: 150-151.5 cm GAP
ARCH: no GAP;
shifted down 2cm to match work.

150-189cm
Black (5Y2.5/1) clay, with faint laminations of very dark gray (5Y3/1). Band from 164-167cm.

189-192cm
Olive gray (5Y5/2) clay

192-250cm
Dominant color black (5Y2.5/1) with faint laminations of very dark gray (5Y3/1). Band from 209-210cm. Darker and more homogeneous from 243-250cm

SS 180, 220cm
silico-flaellates present
ash present at 180cm

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

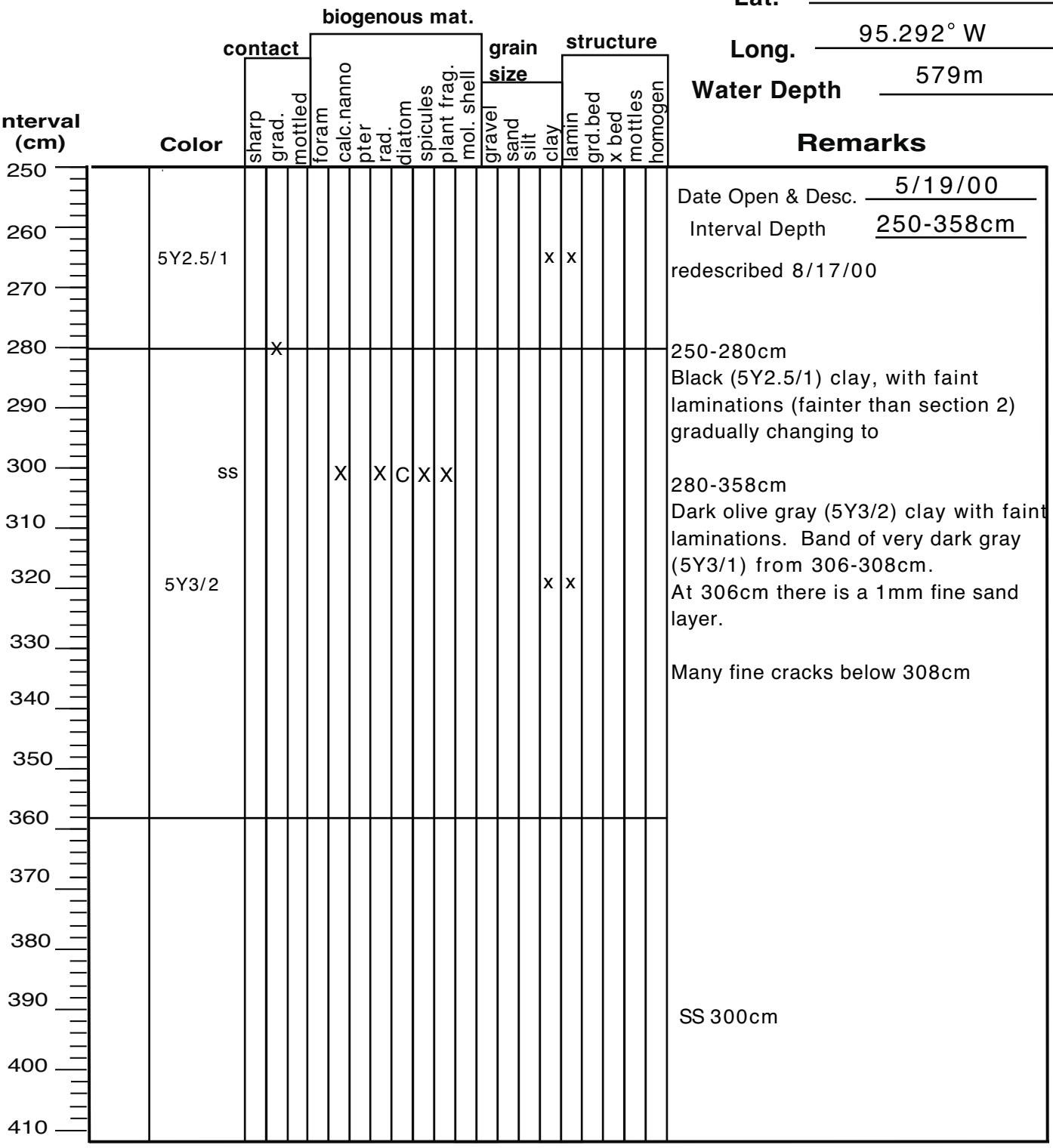
CORE ID ME0005A-06JC

SECTION 03 **of** 13

Lat. 15.710° N

Long. 95.292° W

Water Depth 579m



Remarks

Date Open & Desc. 5/19/00

Interval Depth 250-358cm

redescribed 8/17/00

250-280cm
Black (5Y2.5/1) clay, with faint laminations (fainter than section 2) gradually changing to

280-358cm
Dark olive gray (5Y3/2) clay with faint laminations. Band of very dark gray (5Y3/1) from 306-308cm.
At 306cm there is a 1mm fine sand layer.

Many fine cracks below 308cm

SS 300cm

Fossils: X-Present A-Abundant C-Common R-rare B-Barren

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

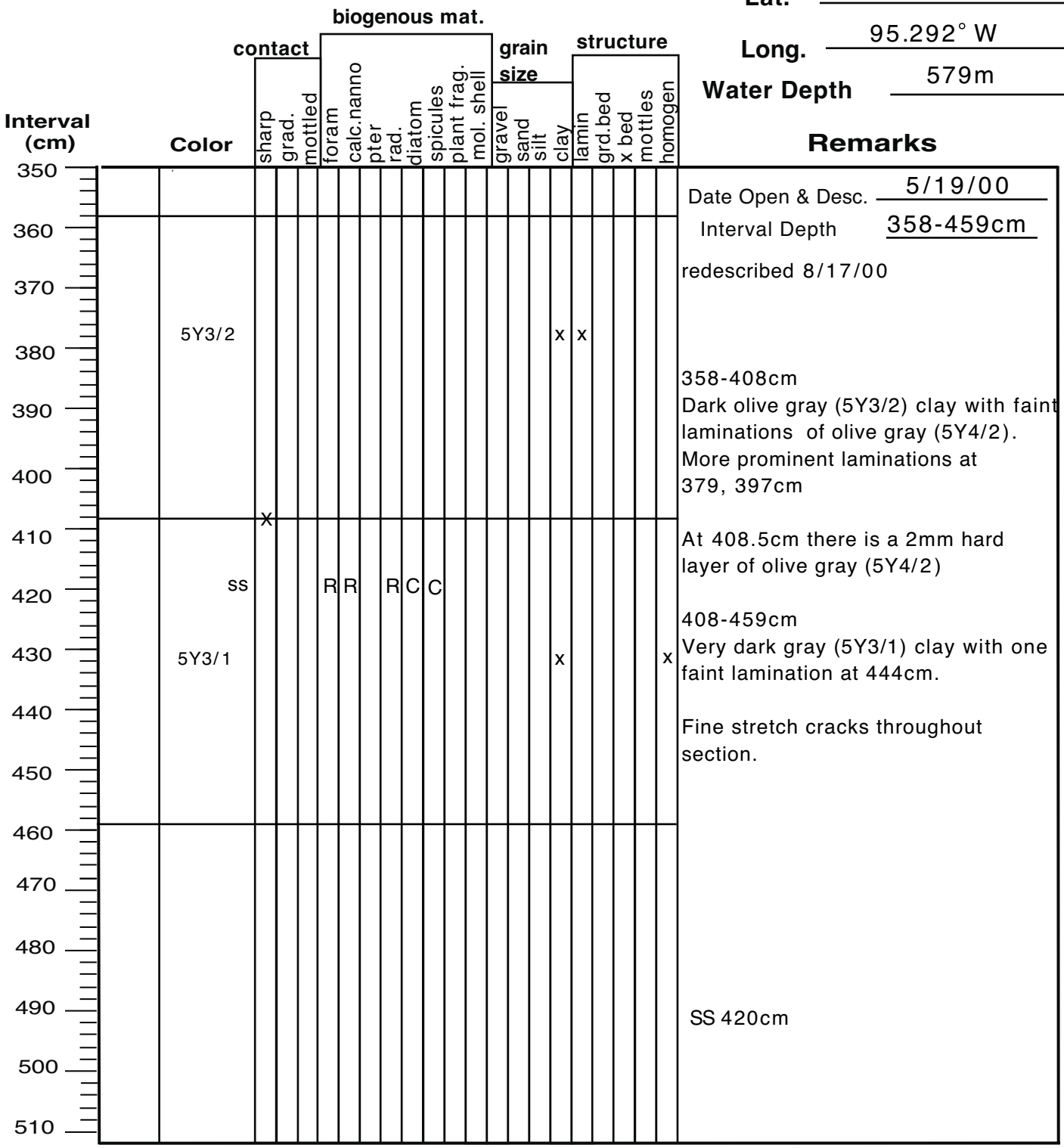
CORE ID ME0005A-06JC

SECTION 04 **of** 13

Lat. 15.710° N

Long. 95.292° W

Water Depth 579m



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

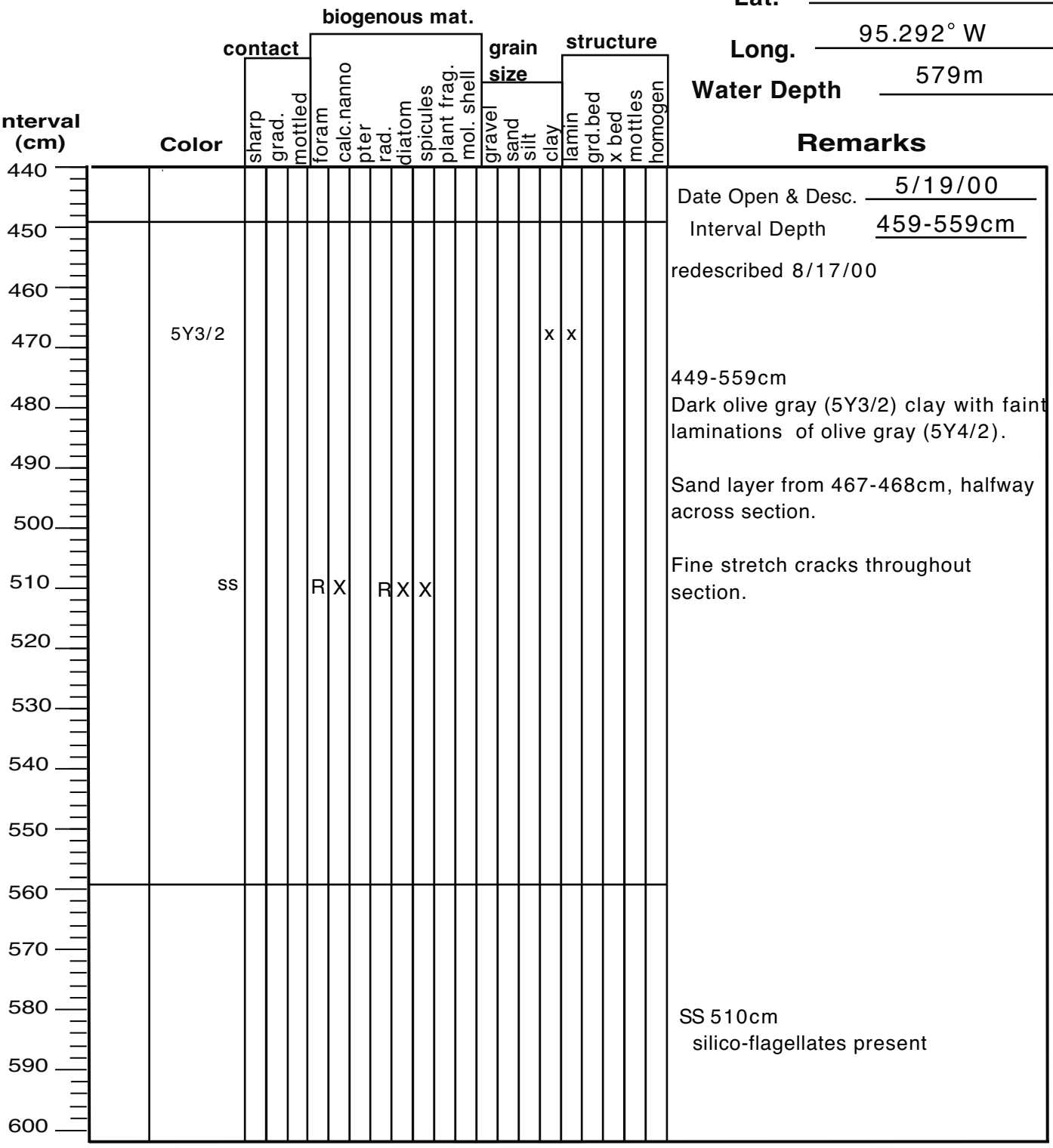
CORE ID ME0005A-06JC

SECTION 05 **of** 13

Lat. 15.710° N

Long. 95.292° W

Water Depth 579m



Date Open & Desc. 5/19/00

Interval Depth 459-559cm

redescribed 8/17/00

449-559cm
Dark olive gray (5Y3/2) clay with faint laminations of olive gray (5Y4/2).

Sand layer from 467-468cm, halfway across section.

Fine stretch cracks throughout section.

SS 510cm
silico-flagellates present

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

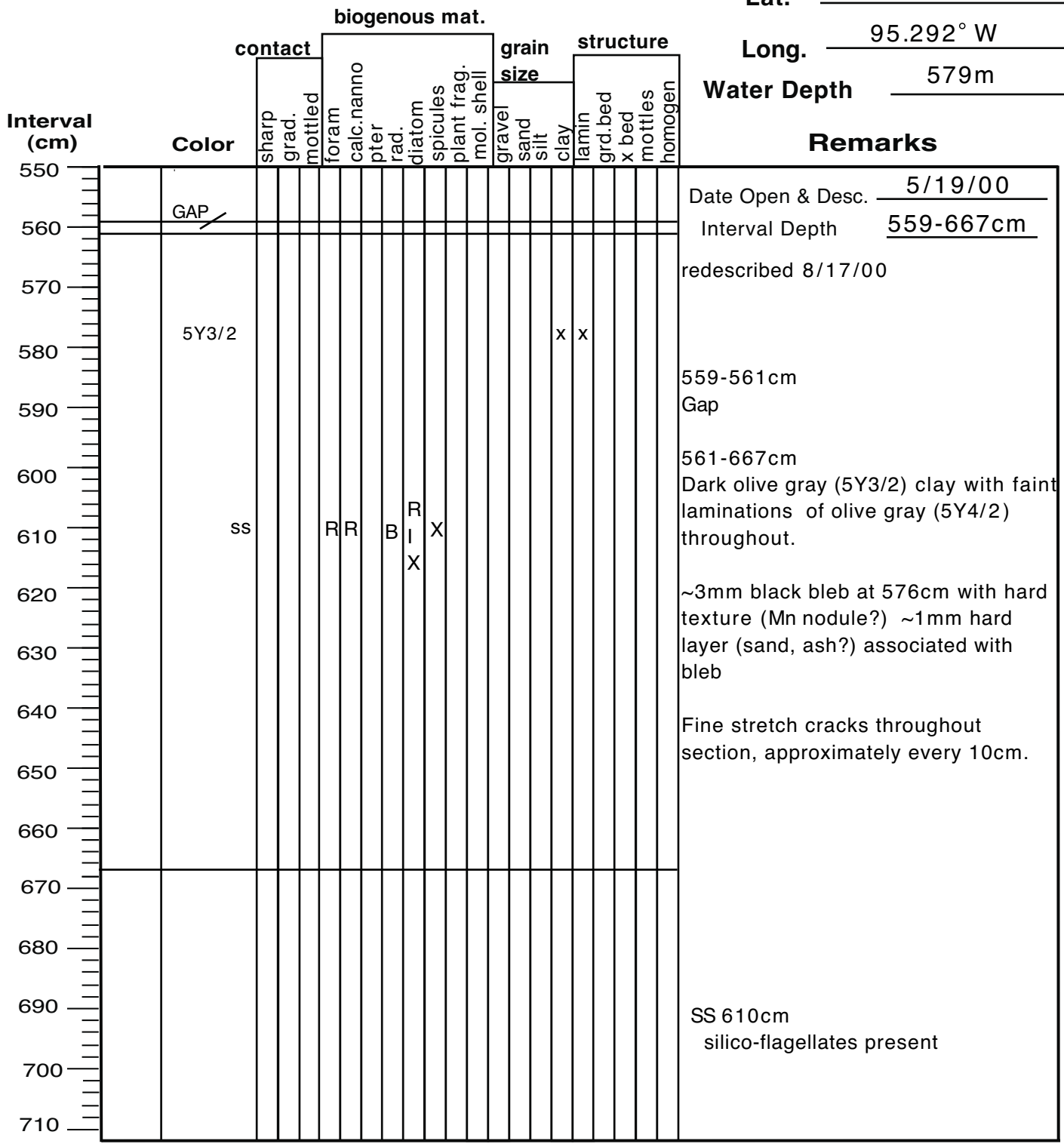
CORE ID ME0005A-06JC

SECTION 06 **of** 13

Lat. 15.710° N

Long. 95.292° W

Water Depth 579m



Remarks

Date Open & Desc. 5/19/00

Interval Depth 559-667cm

redescribed 8/17/00

559-561cm
Gap

561-667cm
Dark olive gray (5Y3/2) clay with faint laminations of olive gray (5Y4/2) throughout.

~3mm black bleb at 576cm with hard texture (Mn nodule?) ~1mm hard layer (sand, ash?) associated with bleb

Fine stretch cracks throughout section, approximately every 10cm.

SS 610cm
silico-flagellates present

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

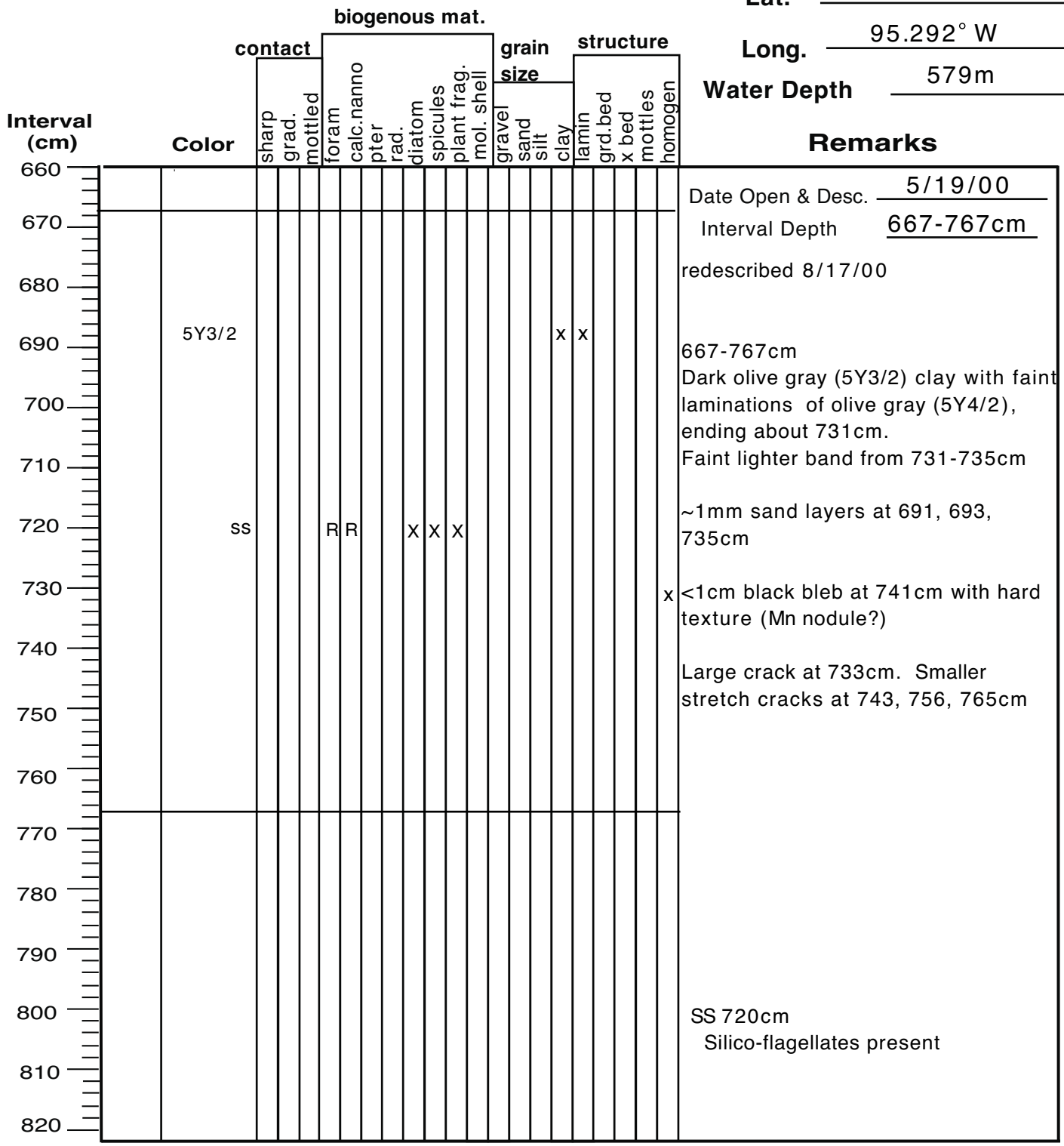
CORE ID ME0005A-06JC

SECTION 07 **of** 13

Lat. 15.710° N

Long. 95.292° W

Water Depth 579m



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

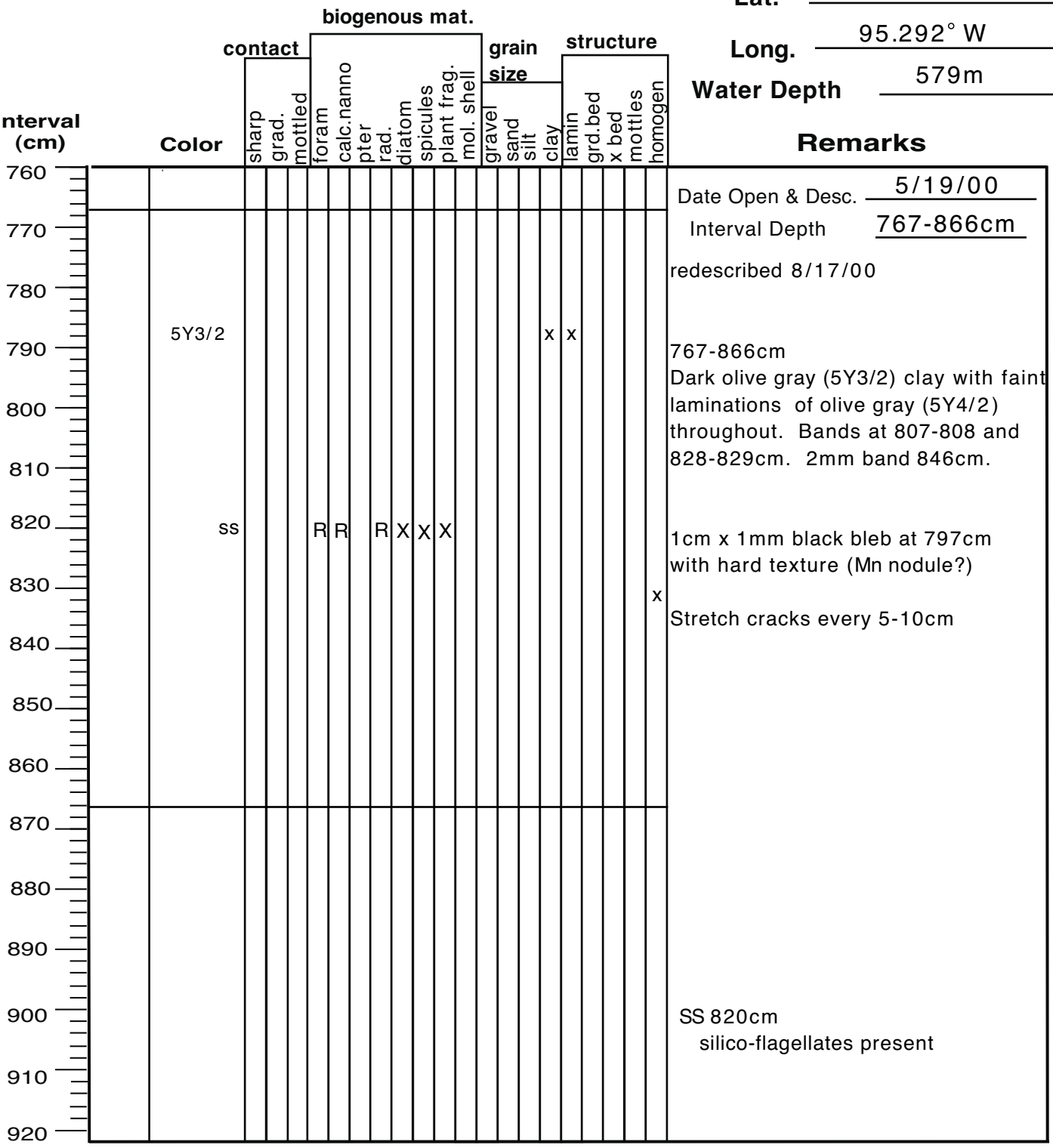
CORE ID ME0005A-06JC

SECTION 08 **of** 13

Lat. 15.710° N

Long. 95.292° W

Water Depth 579m



Date Open & Desc. 5/19/00

Interval Depth 767-866cm

redescribed 8/17/00

767-866cm
Dark olive gray (5Y3/2) clay with faint laminations of olive gray (5Y4/2) throughout. Bands at 807-808 and 828-829cm. 2mm band 846cm.

1cm x 1mm black bleb at 797cm with hard texture (Mn nodule?)

Stretch cracks every 5-10cm

SS 820cm
silico-flagellates present

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

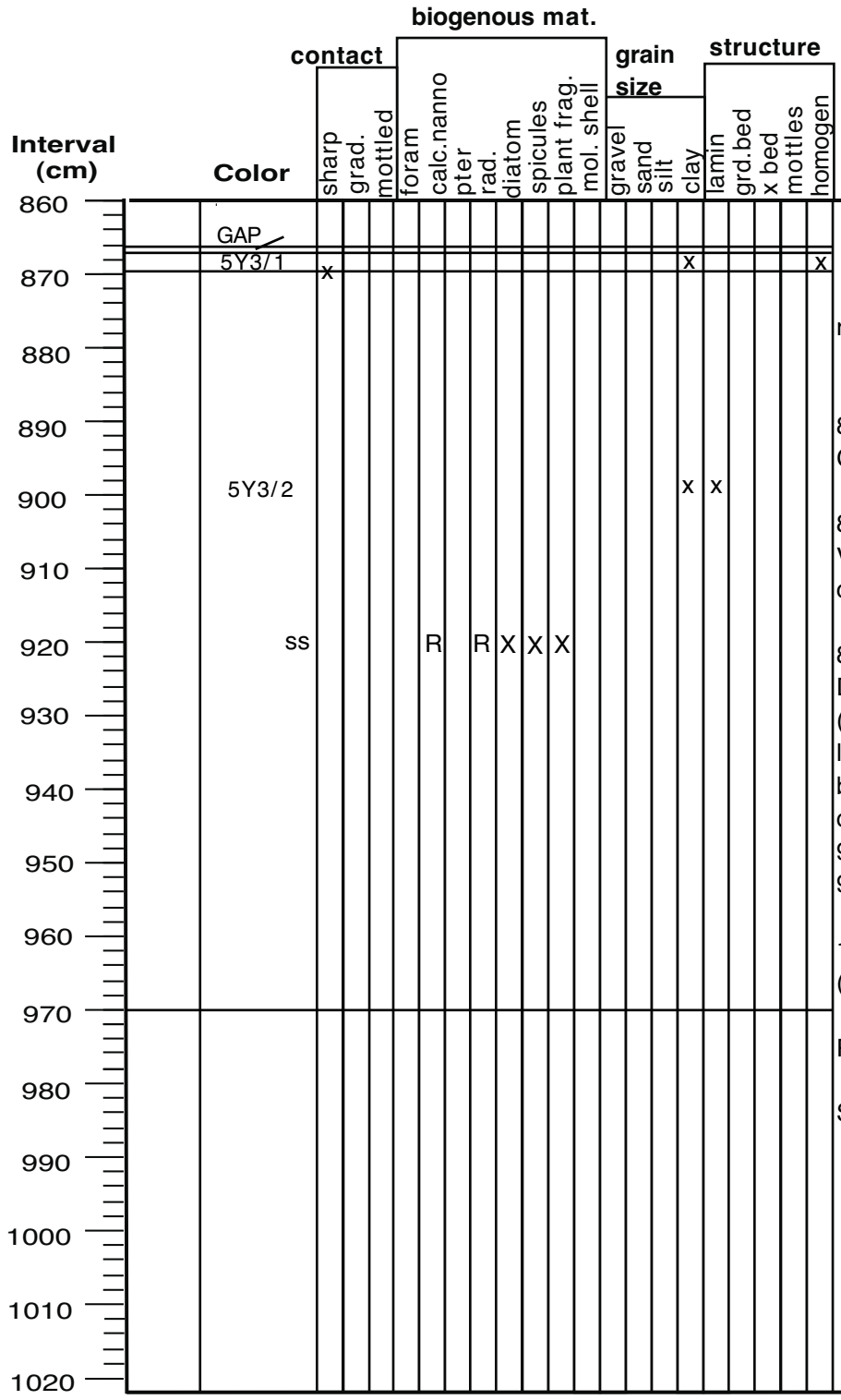
CORE ID ME0005A-06JC

SECTION 09 **of** 13

Lat. 15.710° N

Long. 95.292° W

Water Depth 579m



Remarks

Date Open & Desc. 5/19/00

Interval Depth 866-970cm

redescribed 8/17/00

866-867cm
GAP

867-869.5cm
Very dark gray (5Y3/1) clay. Color change possibly due to oxidation.

869.5-970cm
Dominant color dark olive gray (5Y3/2) clay with fine faint laminations throughout. Distinct banding from 883-890cm. Bands of olive gray (5Y4/2) at 914-915, 917cm. Faint lighter bands at 946-947, 959-961cm.

1cm x 2mm black bleb at 940cm (Sand or Mn nodule?)

Possible ash layer (~3mm) at 955cm

Stretch cracks at 883, 898cm

SS 920cm
Silico-flagellates present

Fossils: X-Present A-Abundant C-Common R-rare B-Barren

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

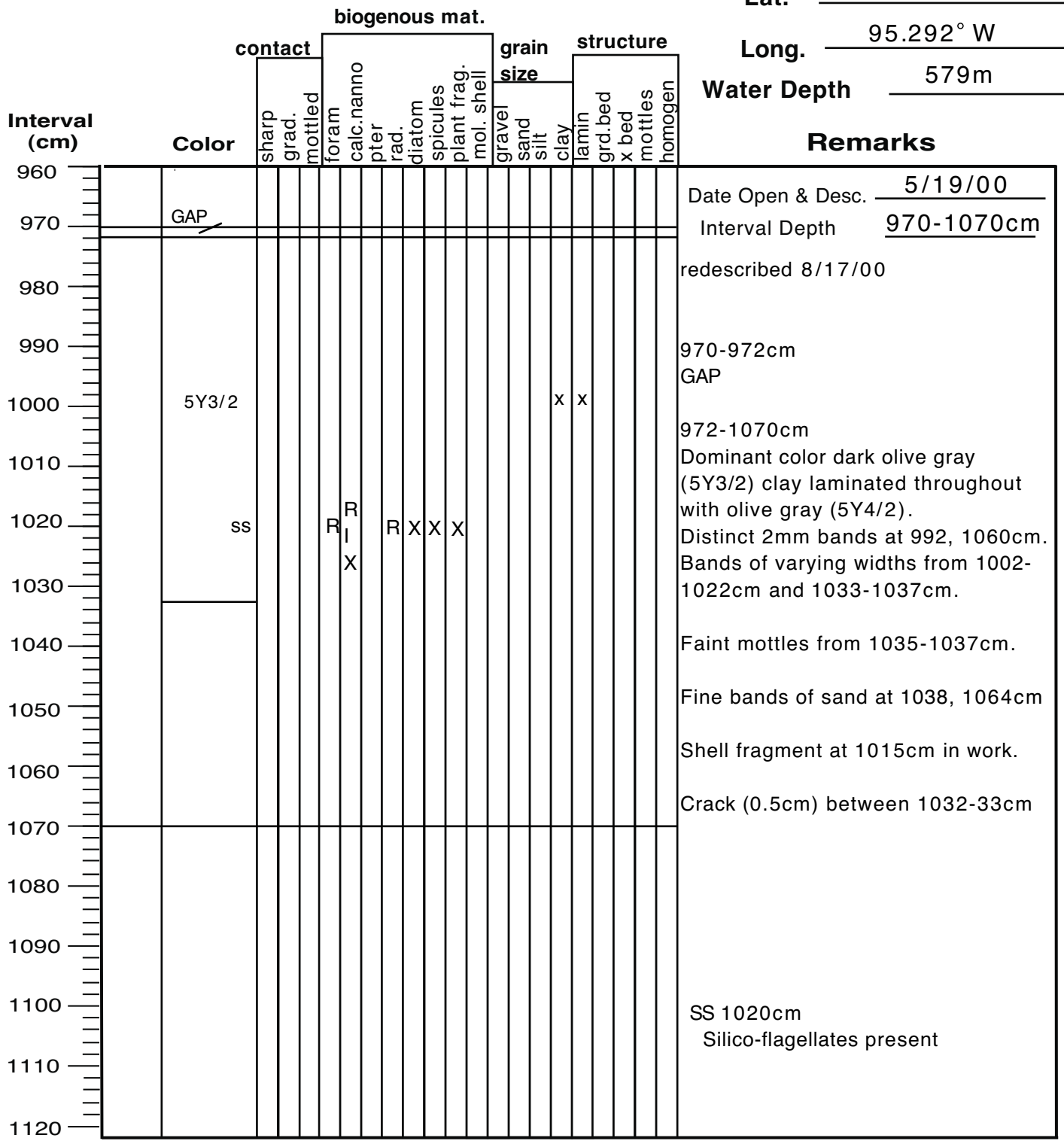
CORE ID ME0005A-06JC

SECTION 10 **of** 13

Lat. 15.710° N

Long. 95.292° W

Water Depth 579m



Remarks

Date Open & Desc. 5/19/00

Interval Depth 970-1070cm

redescribed 8/17/00

970-972cm
GAP

972-1070cm
Dominant color dark olive gray (5Y3/2) clay laminated throughout with olive gray (5Y4/2).
Distinct 2mm bands at 992, 1060cm.
Bands of varying widths from 1002-1022cm and 1033-1037cm.

Faint mottles from 1035-1037cm.

Fine bands of sand at 1038, 1064cm

Shell fragment at 1015cm in work.

Crack (0.5cm) between 1032-33cm

SS 1020cm
Silico-flagellates present

Fossils: X-Present A-Abundant C-Common R-rare B-Barren

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

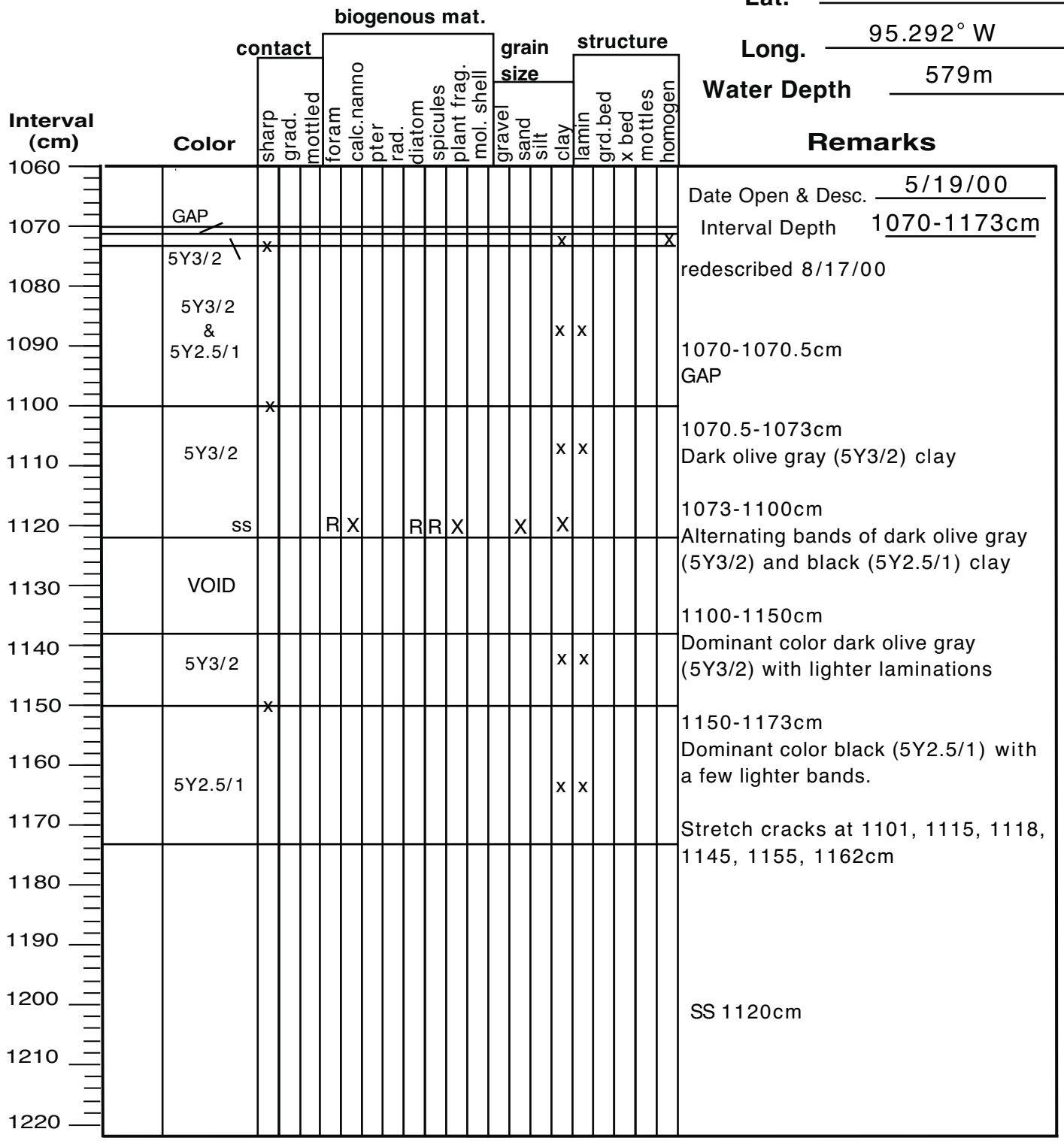
CORE ID ME0005A-06JC

SECTION 11 **of** 13

Lat. 15.710° N

Long. 95.292° W

Water Depth 579m



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

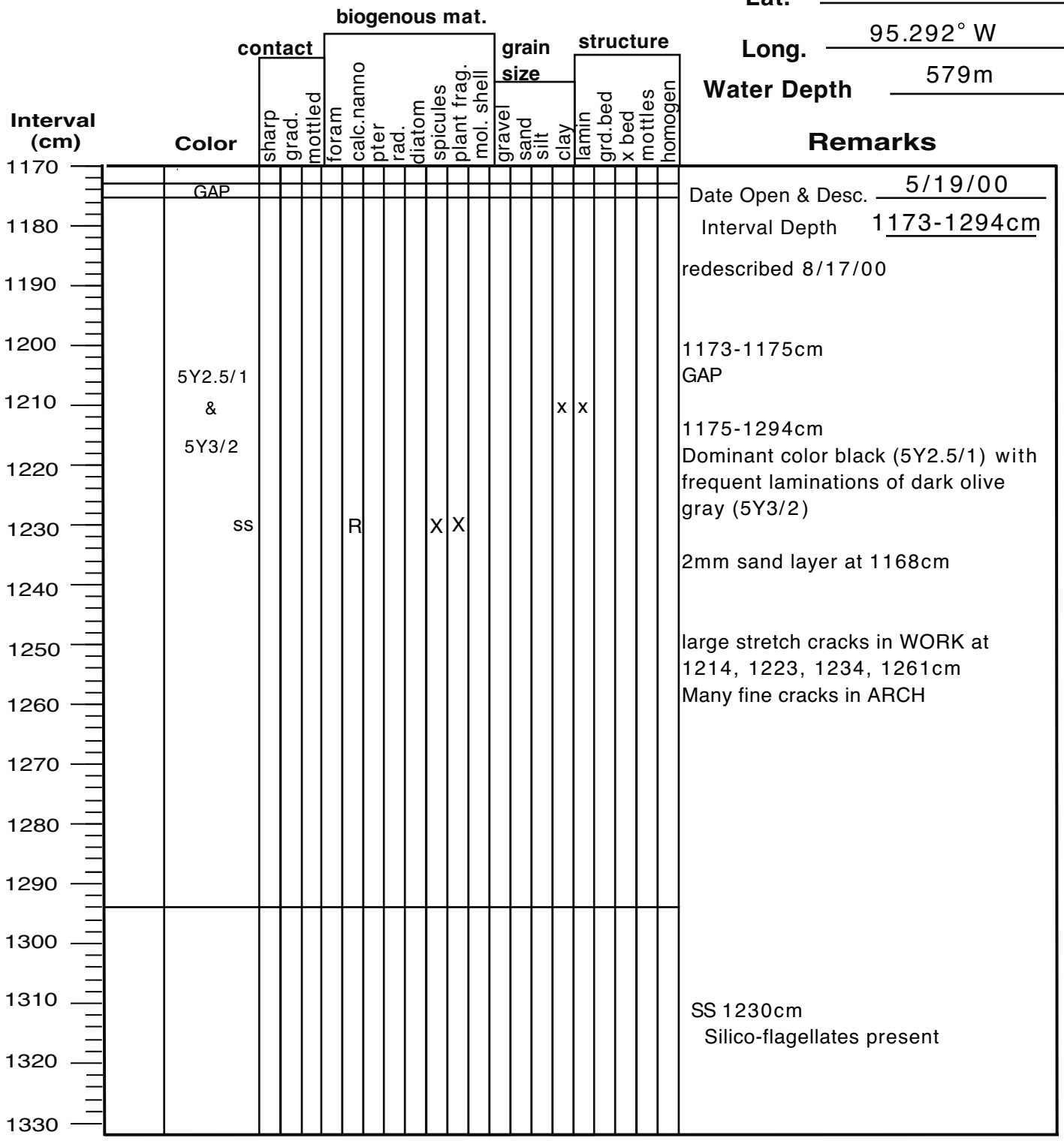
CORE ID ME0005A-06JC

SECTION 12 **of** 13

Lat. 15.710° N

Long. 95.292° W

Water Depth 579m



Date Open & Desc. 5/19/00

Interval Depth 1173-1294cm

redescribed 8/17/00

1173-1175cm
GAP

1175-1294cm
Dominant color black (5Y2.5/1) with frequent laminations of dark olive gray (5Y3/2)

2mm sand layer at 1168cm

large stretch cracks in WORK at 1214, 1223, 1234, 1261cm
Many fine cracks in ARCH

SS 1230cm
Silico-flagellates present

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

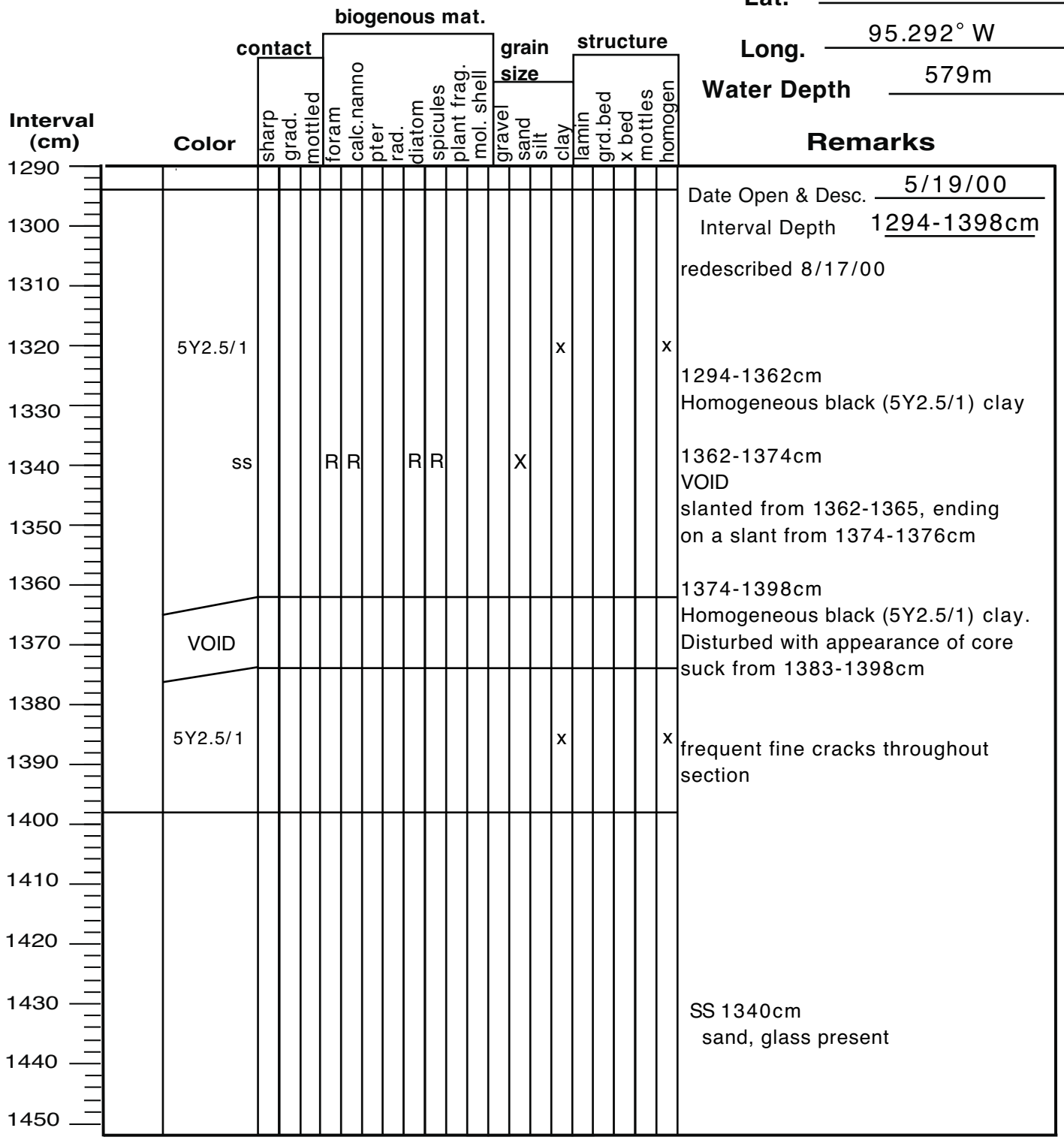
CORE ID ME0005A-06JC

SECTION 13 **of** 13

Lat. 15.710° N

Long. 95.292° W

Water Depth 579m



Fossils: X-Present A-Abundant C-Common R-rare B-Barren

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

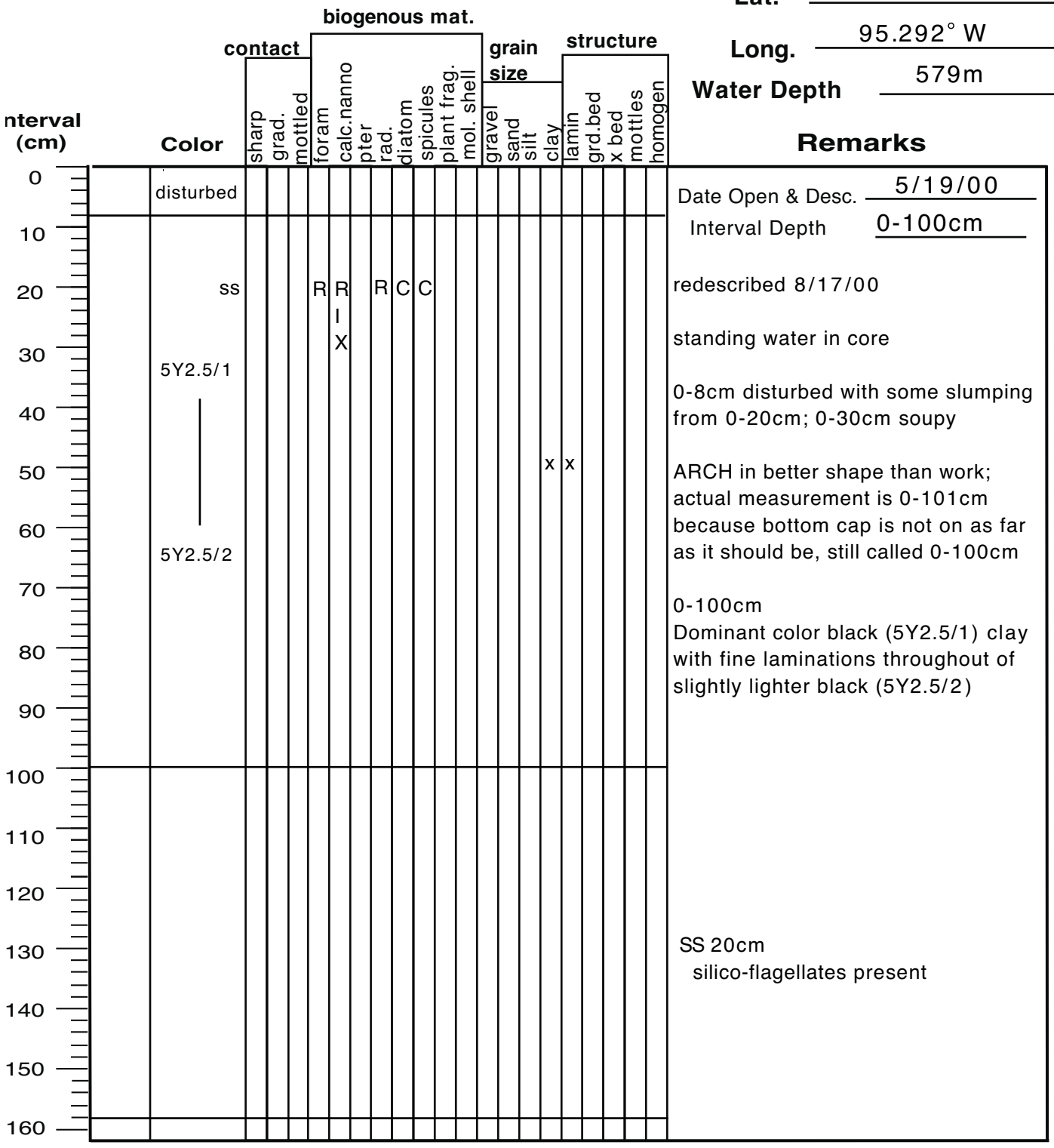
CORE ID ME0005A-06TC

SECTION 01 **of** 02

Lat. 15.710° N

Long. 95.292° W

Water Depth 579m



Date Open & Desc. 5/19/00

Interval Depth 0-100cm

redescribed 8/17/00

standing water in core

0-8cm disturbed with some slumping from 0-20cm; 0-30cm soupy

ARCH in better shape than work; actual measurement is 0-101cm because bottom cap is not on as far as it should be, still called 0-100cm

0-100cm
Dominant color black (5Y2.5/1) clay with fine laminations throughout of slightly lighter black (5Y2.5/2)

SS 20cm
silico-flagellates present

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

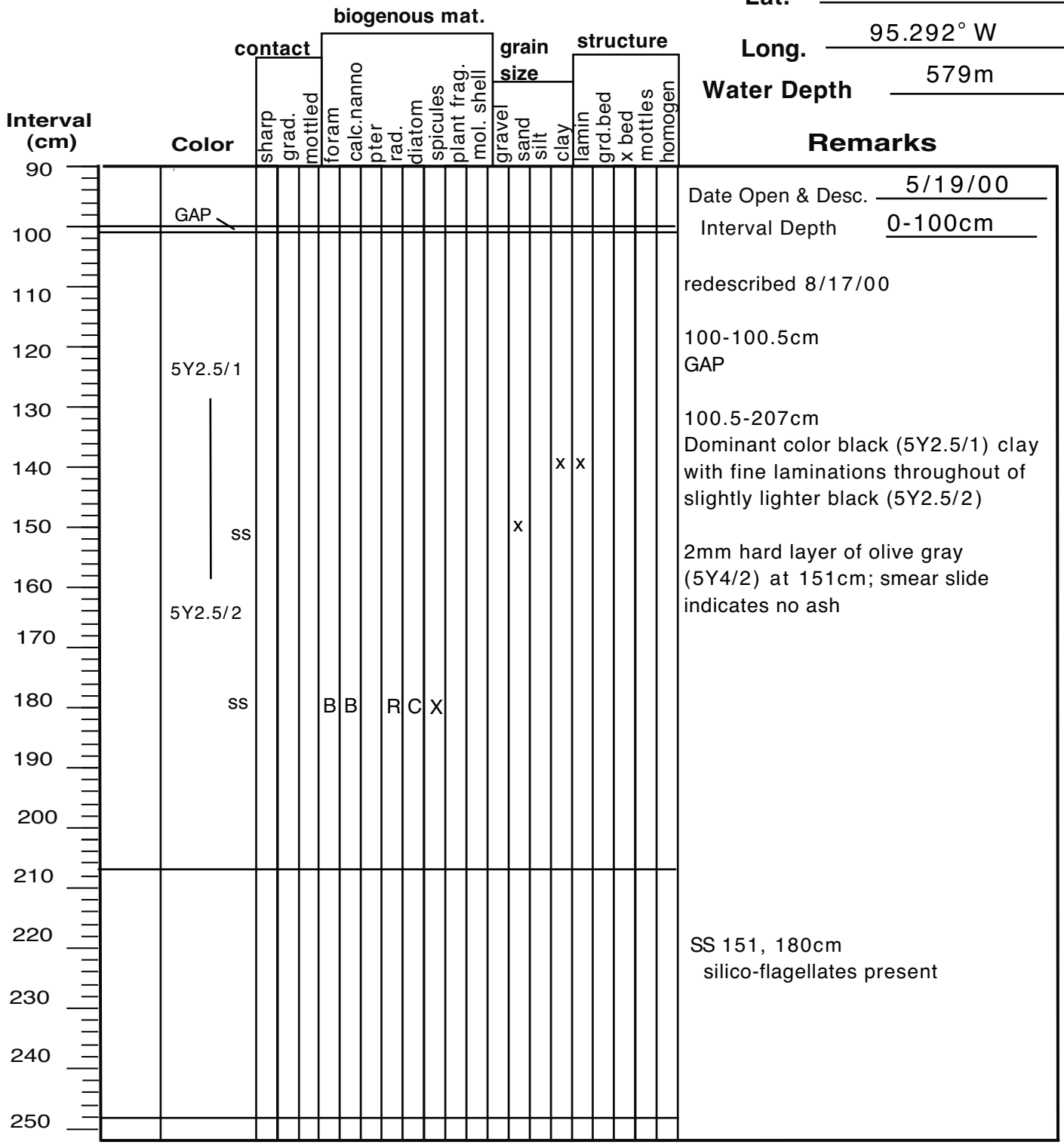
CORE ID ME0005A-06TC

SECTION 02 **of** 02

Lat. 15.710° N

Long. 95.292° W

Water Depth 579m



Date Open & Desc. 5/19/00

Interval Depth 0-100cm

redescribed 8/17/00

100-100.5cm
GAP

100.5-207cm
Dominant color black (5Y2.5/1) clay with fine laminations throughout of slightly lighter black (5Y2.5/2)

2mm hard layer of olive gray (5Y4/2) at 151cm; smear slide indicates no ash

SS 151, 180cm
silico-flagellates present

Fossils: X-Present A-Abundant C-Common R-rare B-Barren

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

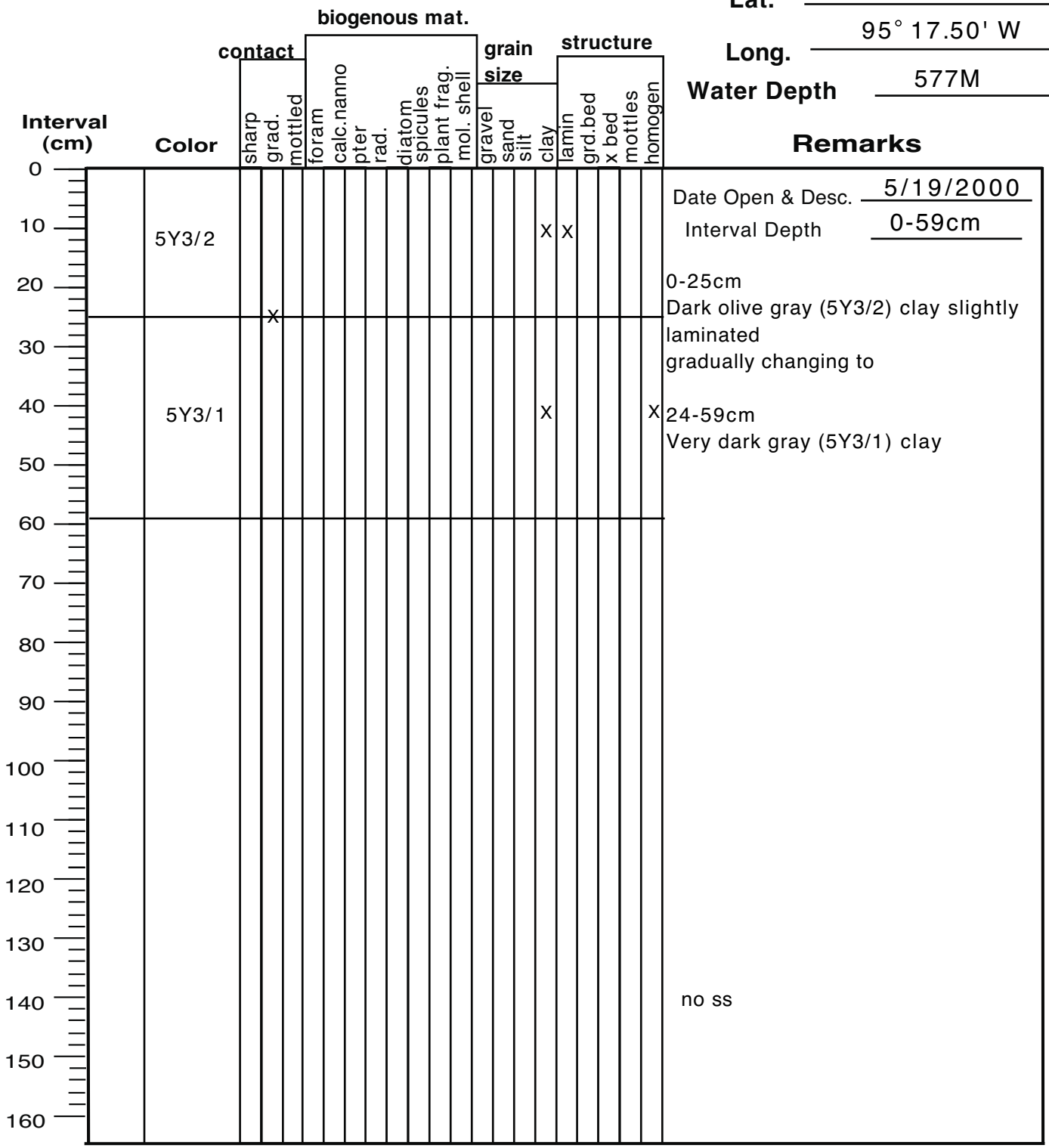
CORE ID ME0005A-07MC2

SECTION 1 **of** 1

Lat. 15° 42.6' N

Long. 95° 17.50' W

Water Depth 577M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

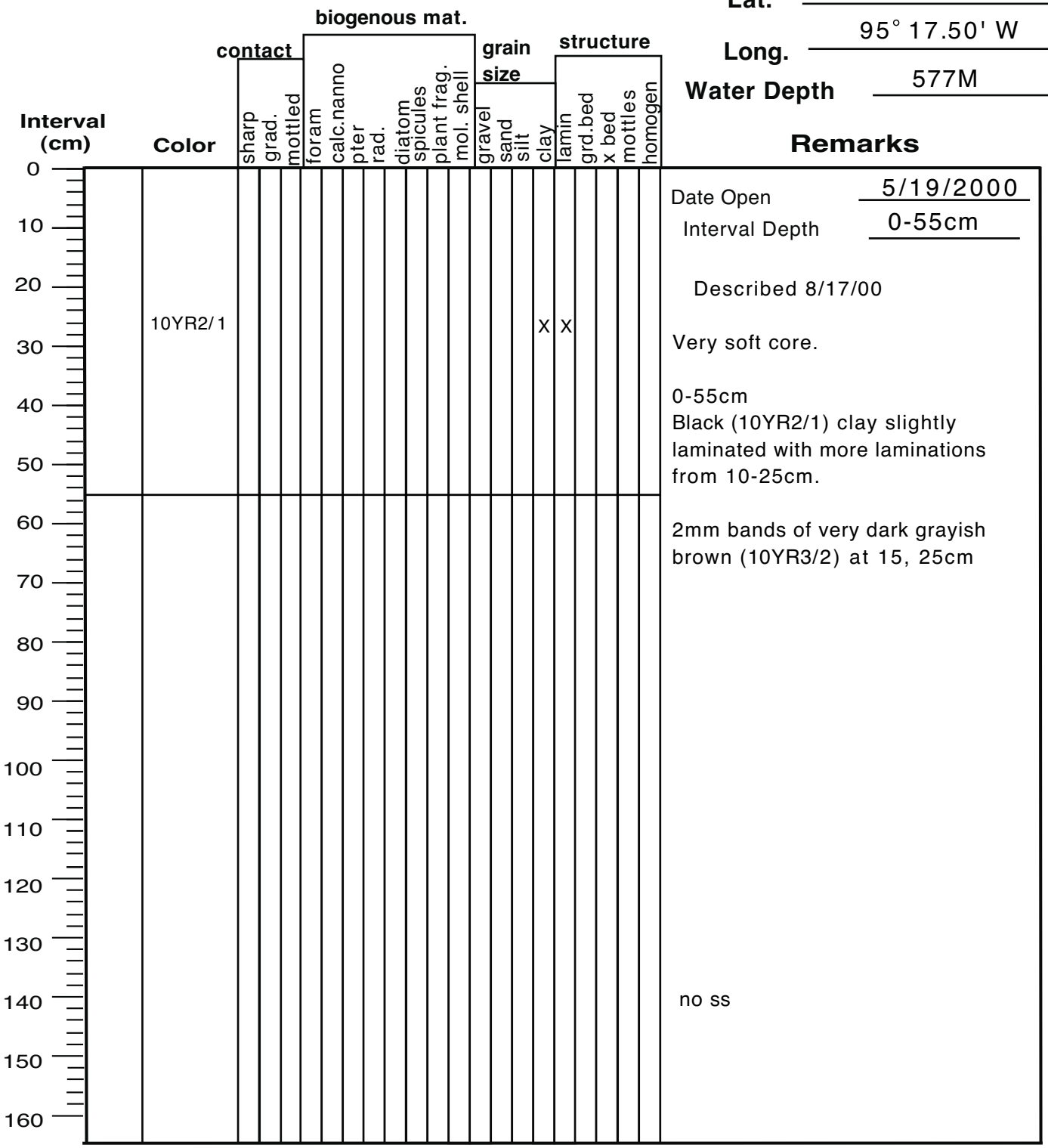
CORE ID ME0005A-07MC3

SECTION 1 **of** 1

Lat. 15° 42.6' N

Long. 95° 17.50' W

Water Depth 577M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

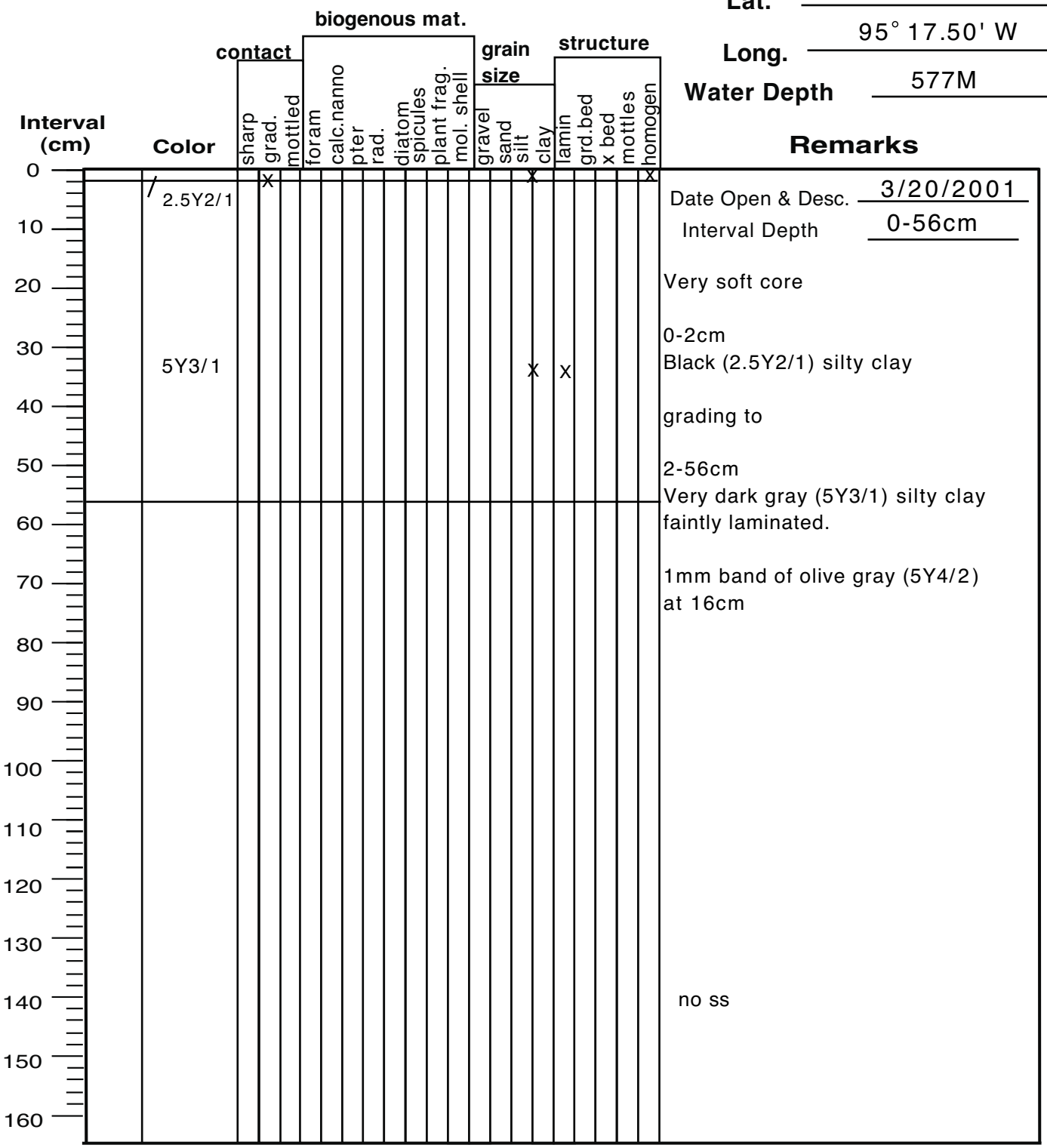
CORE ID ME0005A-07MC4

SECTION 1 **of** 1

Lat. 15° 42.6' N

Long. 95° 17.50' W

Water Depth 577M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

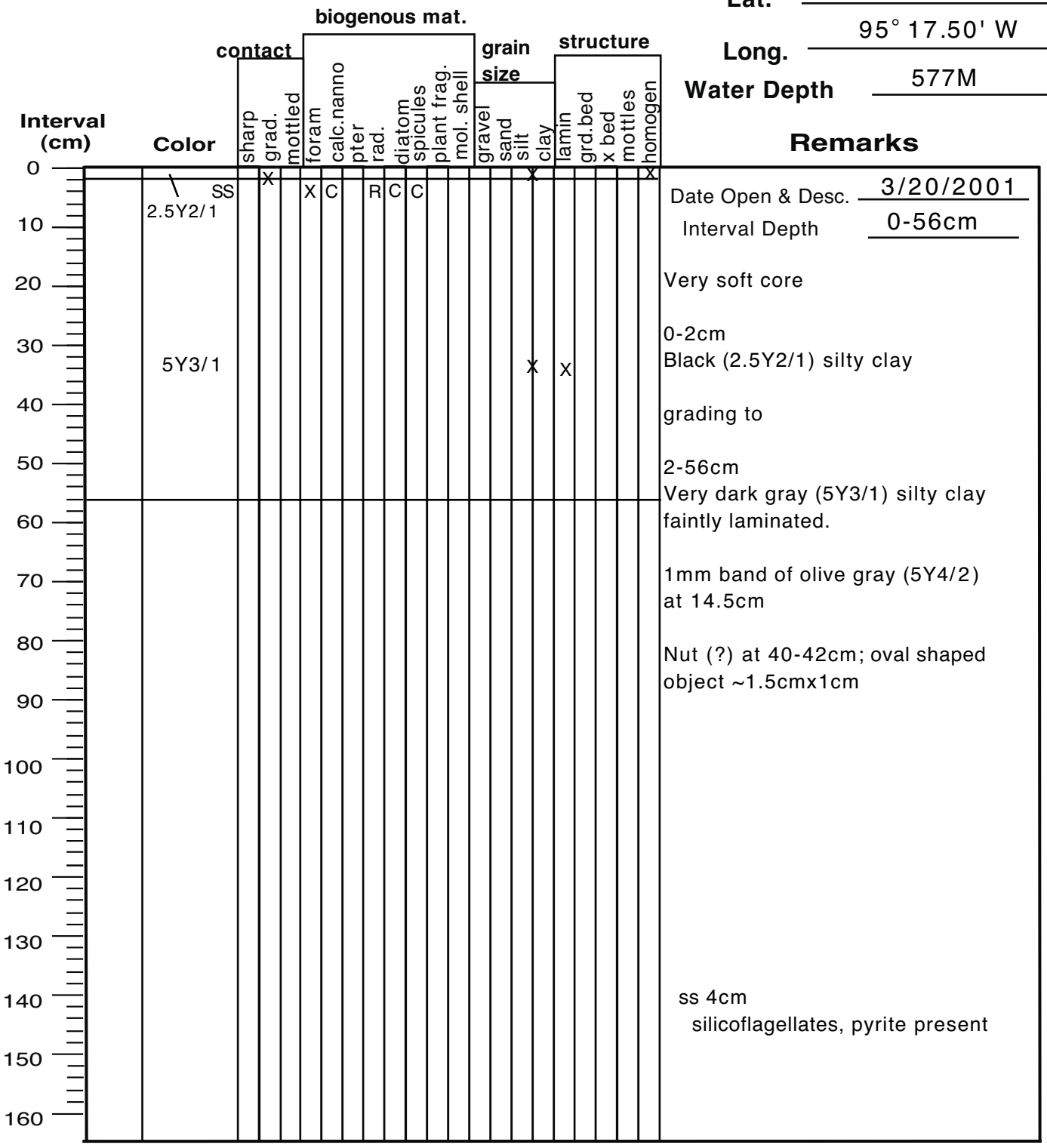
CORE ID ME0005A-07MC6

SECTION 1 **of** 1

Lat. 15° 42.6' N

Long. 95° 17.50' W

Water Depth 577M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

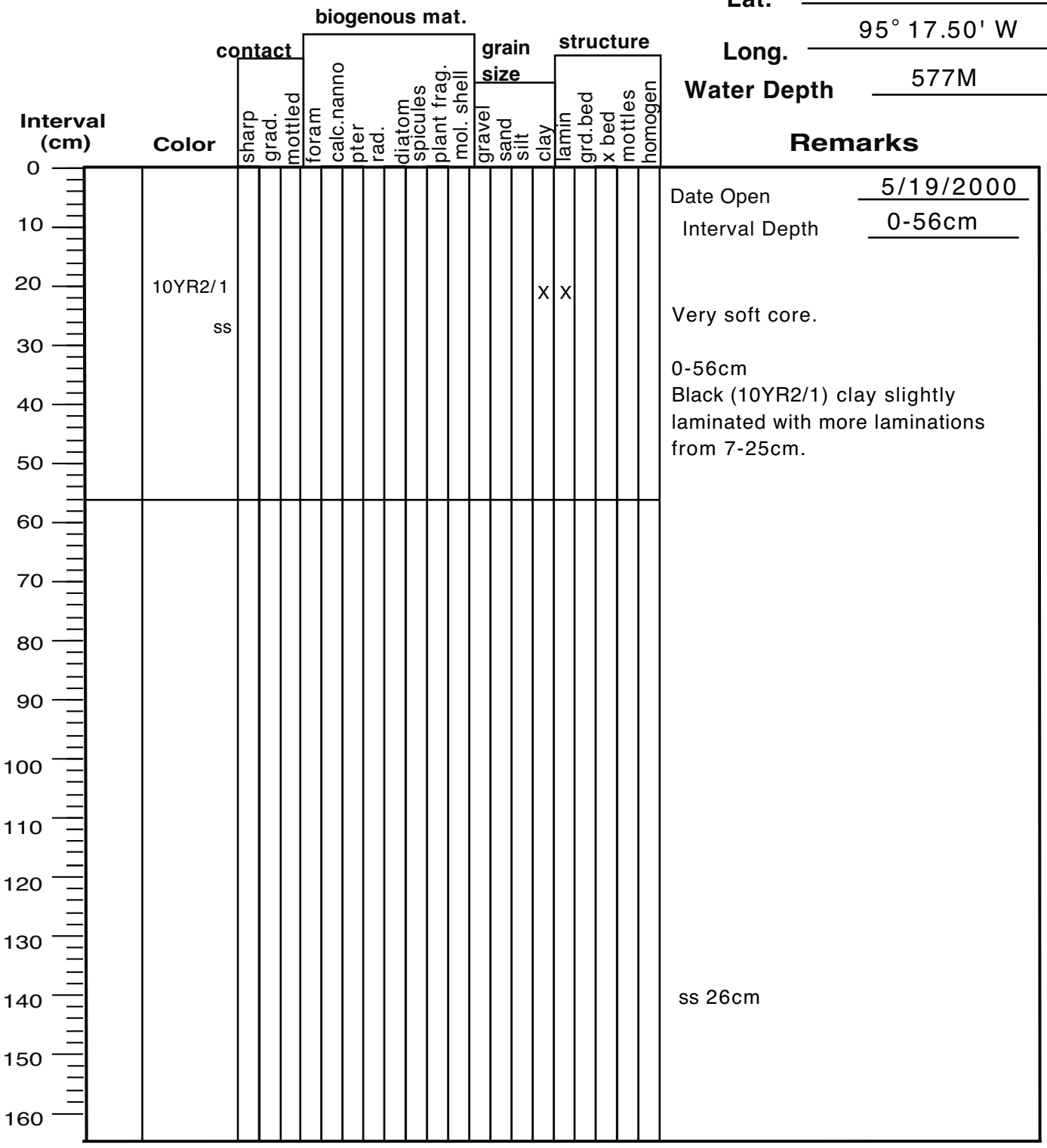
CORE ID ME0005A-07MC7

SECTION 1 **of** 1

Lat. 15° 42.6' N

Long. 95° 17.50' W

Water Depth 577M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

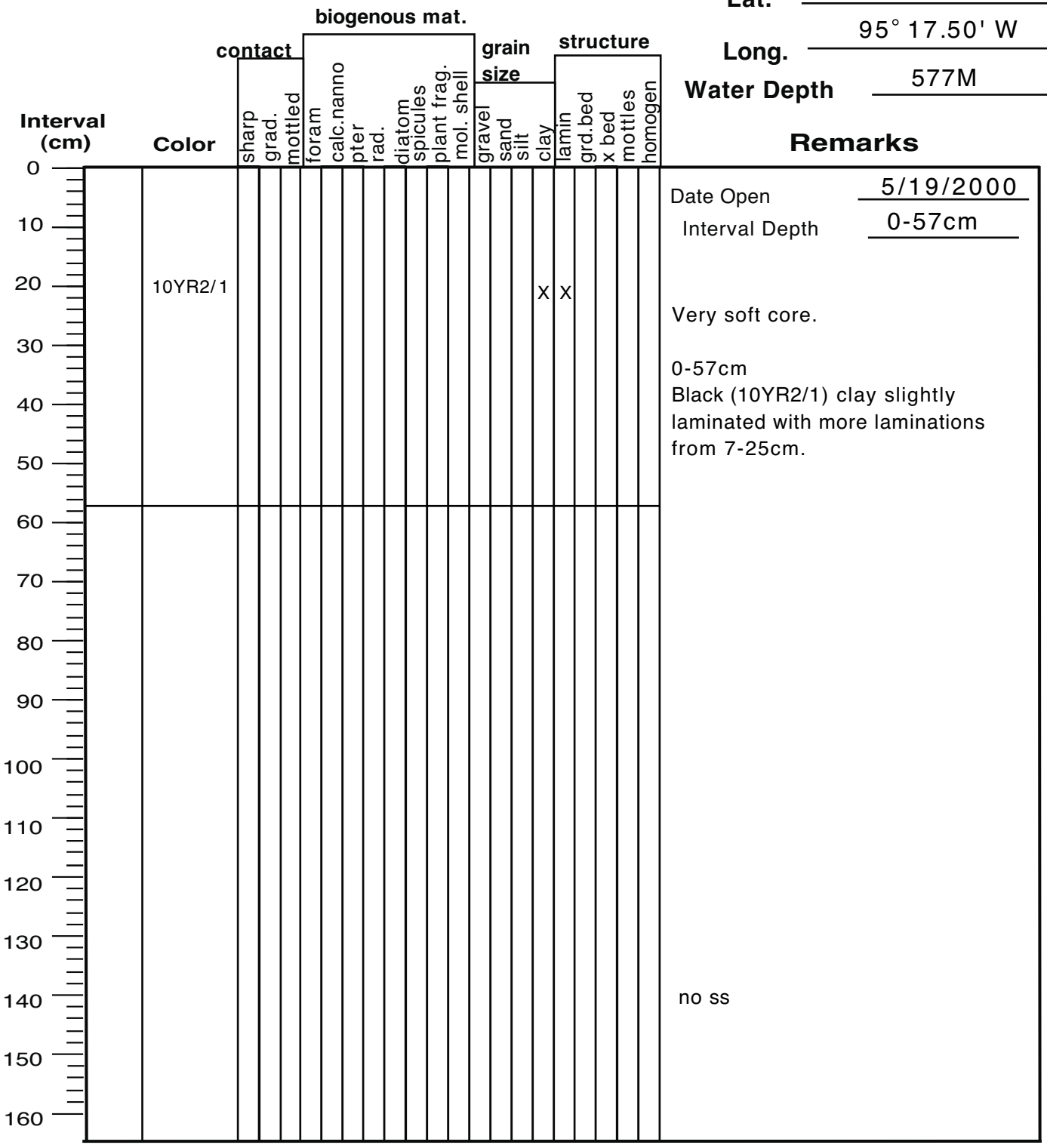
CORE ID ME0005A-07MC8

SECTION 1 **of** 1

Lat. 15° 42.6' N

Long. 95° 17.50' W

Water Depth 577M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

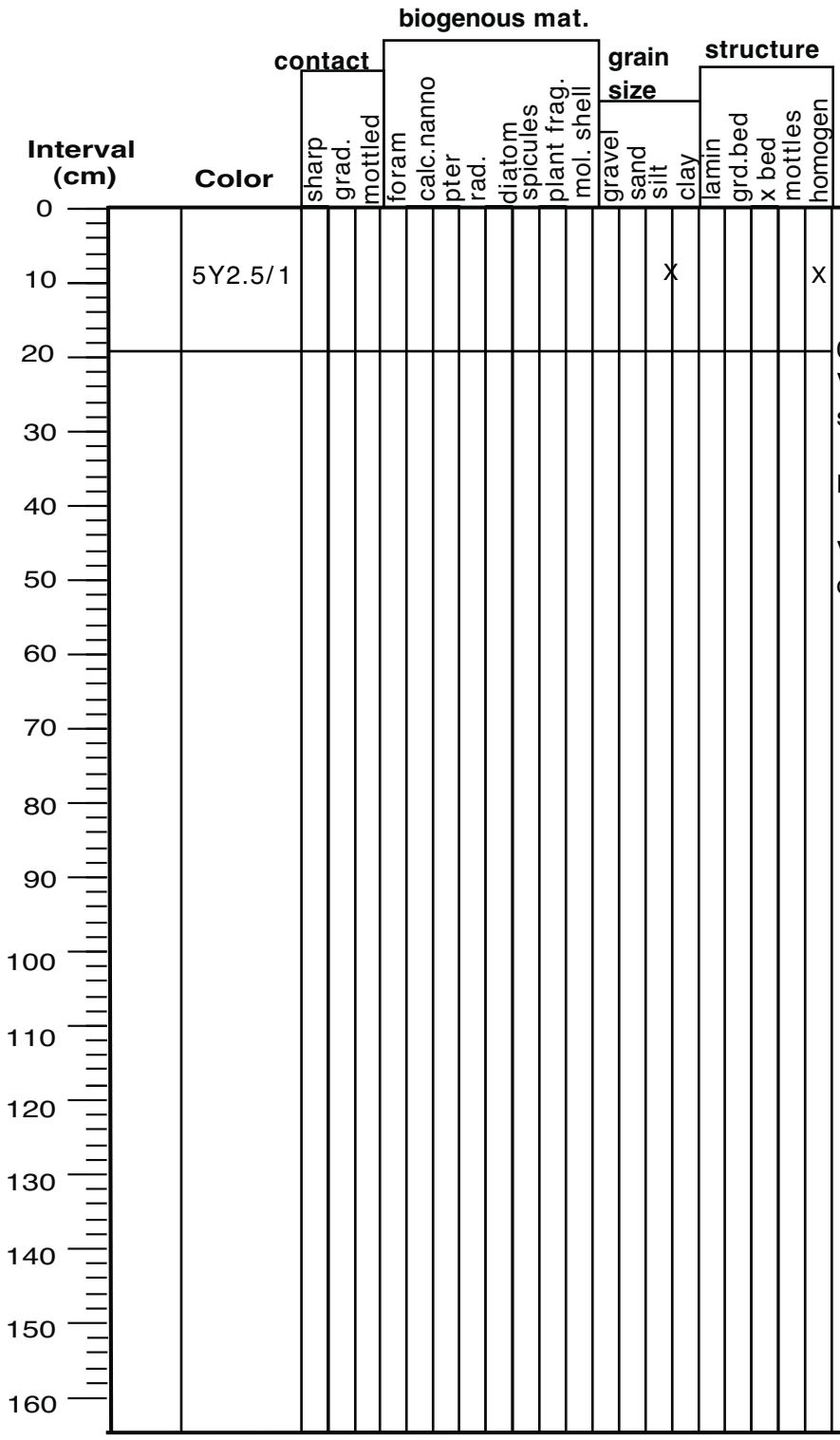
CORE ID ME0005A-08MC3

SECTION 1 **of** 1

Lat. 15° 34.86' N

Long. 95° 16.78' W

Water Depth 1079M



Remarks

Date Open & Desc. 3/15/2001

Interval Depth 0-19cm

0-19cm
Very soft core from 0-7cm; more solid from 7-19cm

Black (5Y2.5/1) silty clay

Vertical crack from 9-16cm in center of core

no ss

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

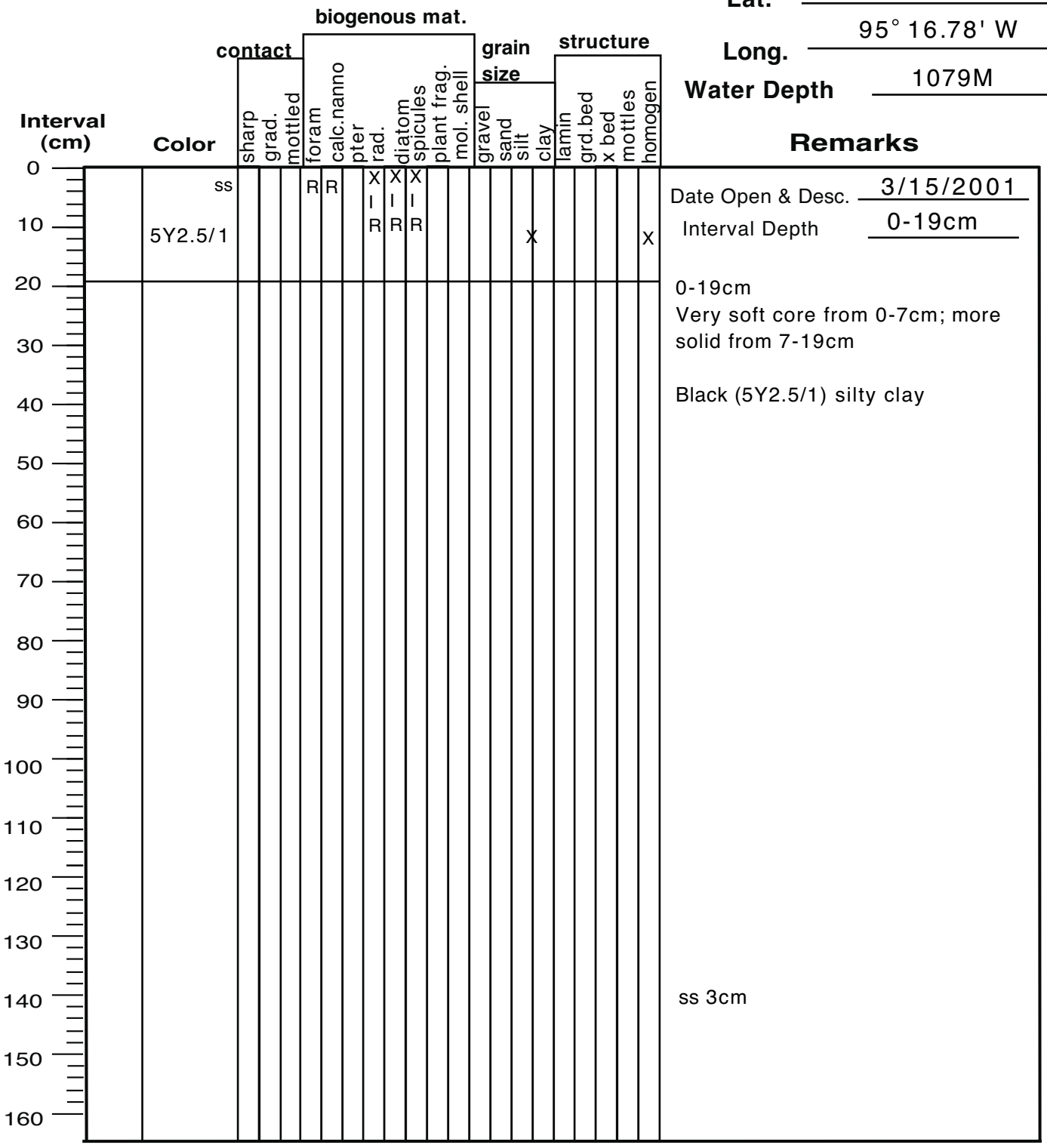
CORE ID ME0005A-08MC4

SECTION 1 **of** 1

Lat. 15° 34.86' N

Long. 95° 16.78' W

Water Depth 1079M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

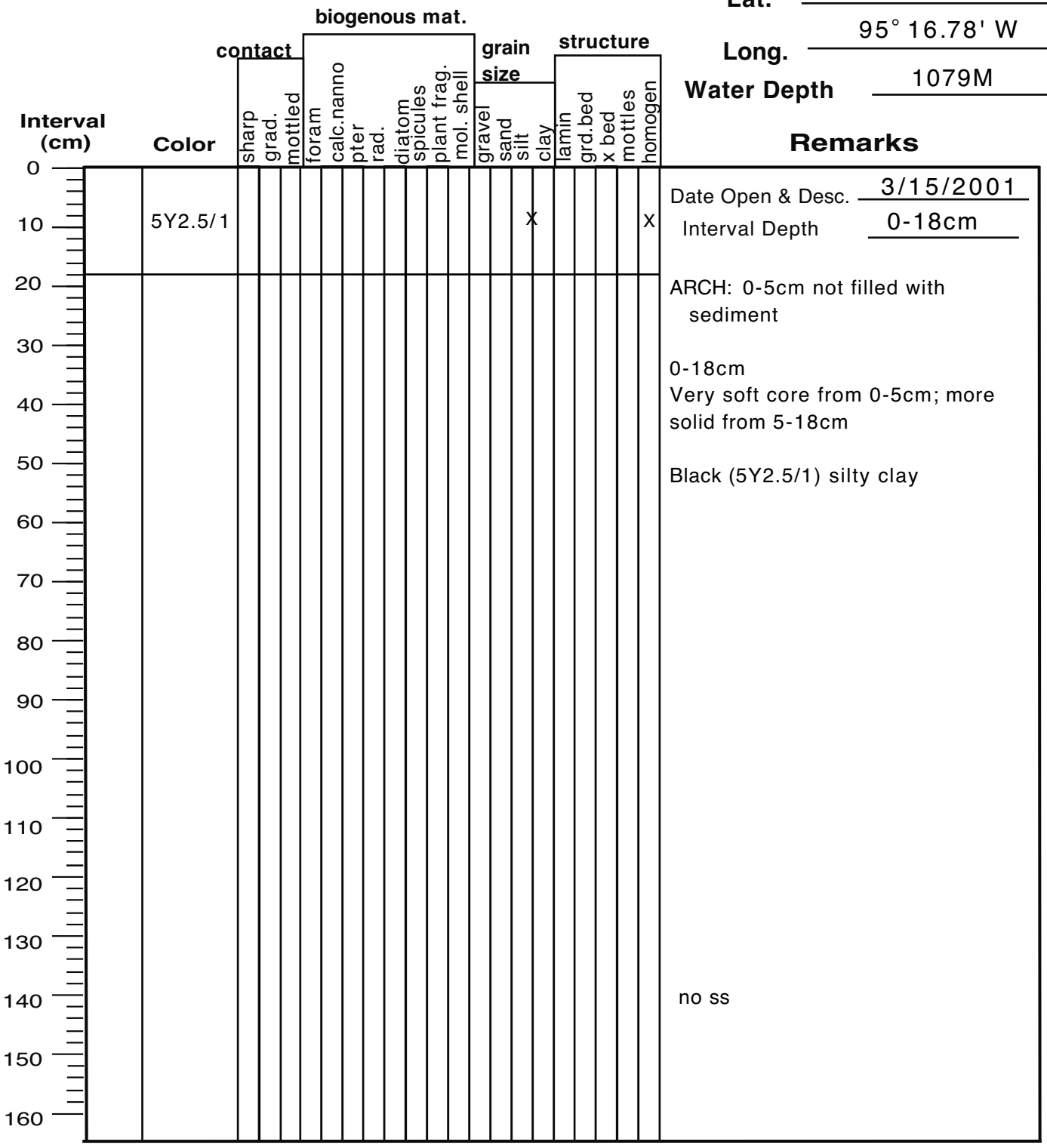
CORE ID ME0005A-08MC7

SECTION 1 **of** 1

Lat. 15° 34.86' N

Long. 95° 16.78' W

Water Depth 1079M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

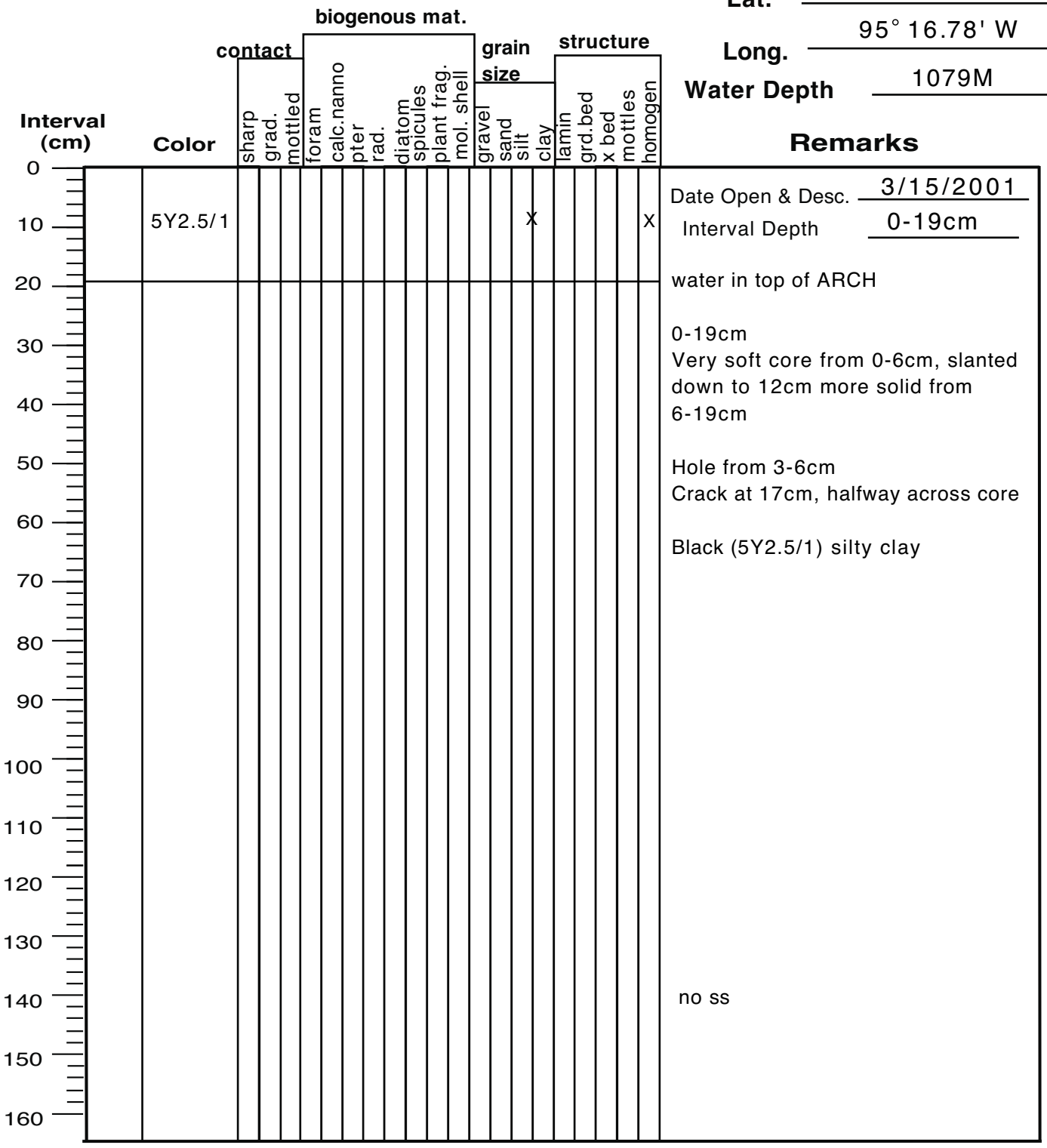
CORE ID ME0005A-08MC8

SECTION 1 **of** 1

Lat. 15° 34.86' N

Long. 95° 16.78' W

Water Depth 1079M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

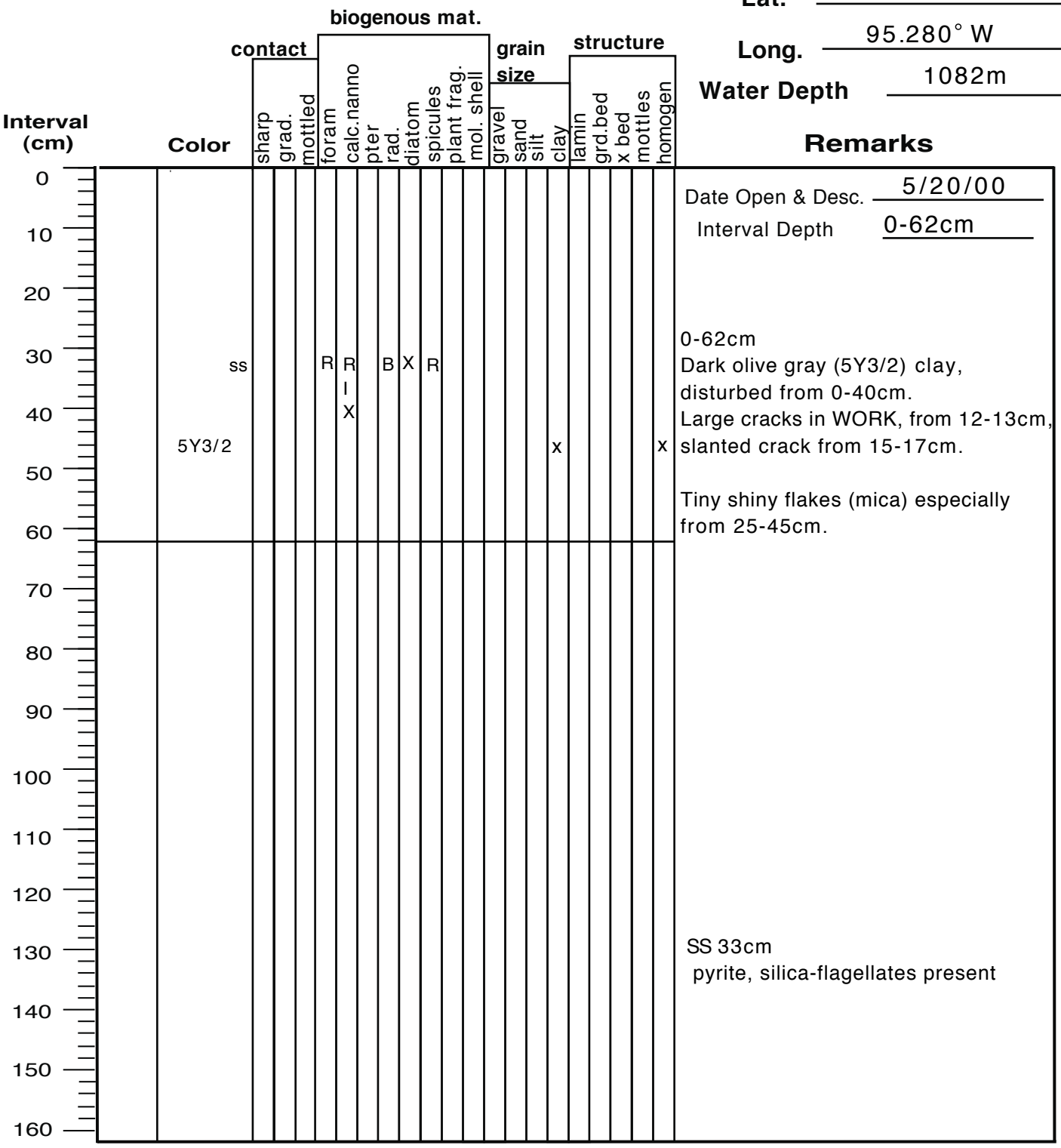
CORE ID ME0005A-10JC

SECTION 01 **of** 13

Lat. 15.581° N

Long. 95.280° W

Water Depth 1082m



Date Open & Desc. 5/20/00

Interval Depth 0-62cm

0-62cm
Dark olive gray (5Y3/2) clay, disturbed from 0-40cm.
Large cracks in WORK, from 12-13cm, slanted crack from 15-17cm.

Tiny shiny flakes (mica) especially from 25-45cm.

SS 33cm
pyrite, silica-flagellates present

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

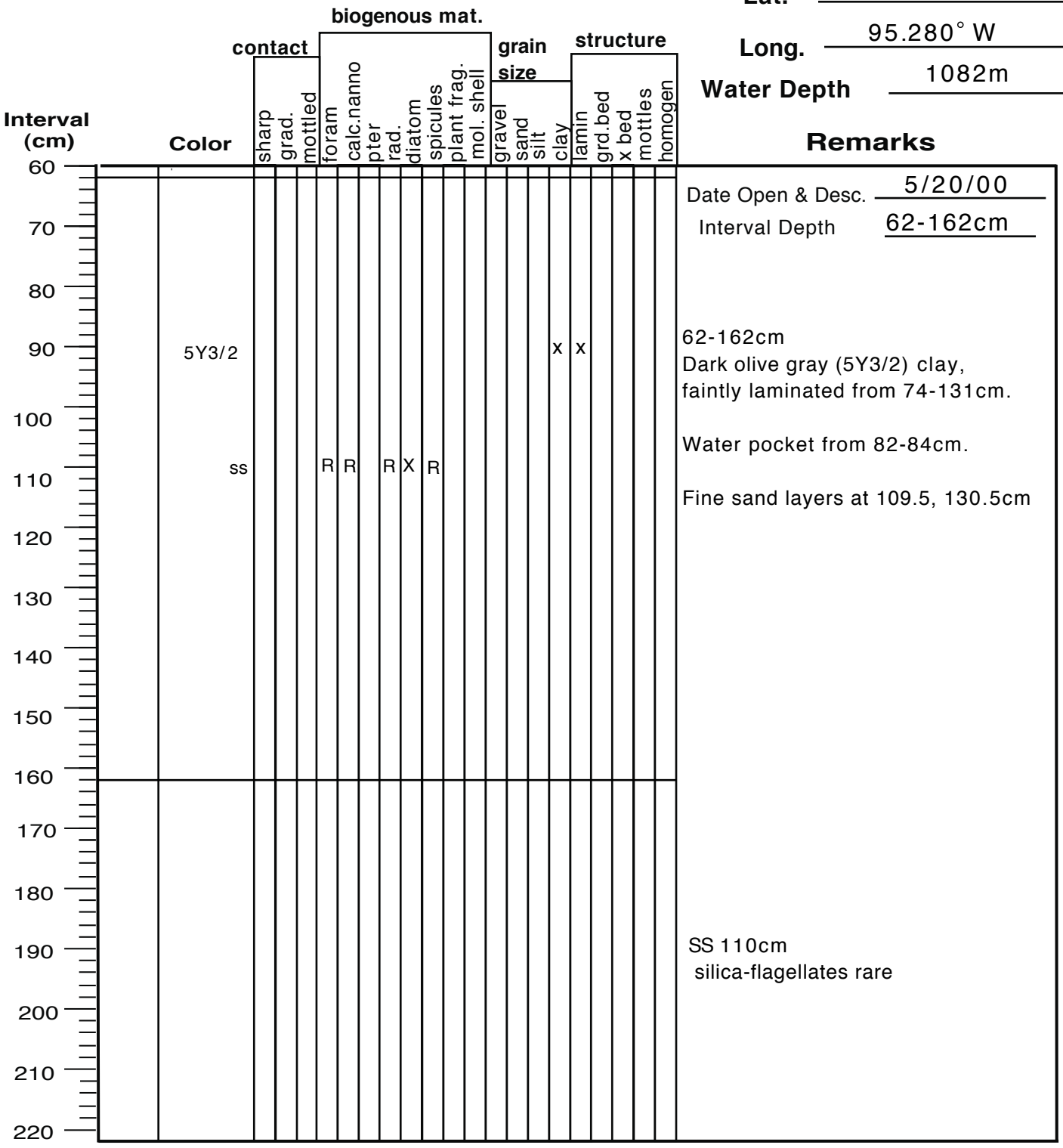
CORE ID ME0005A-10JC

SECTION 02 **of** 13

Lat. 15.581° N

Long. 95.280° W

Water Depth 1082m



Date Open & Desc. 5/20/00

Interval Depth 62-162cm

62-162cm
Dark olive gray (5Y3/2) clay,
faintly laminated from 74-131cm.

Water pocket from 82-84cm.

Fine sand layers at 109.5, 130.5cm

SS 110cm
silica-flagellates rare

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

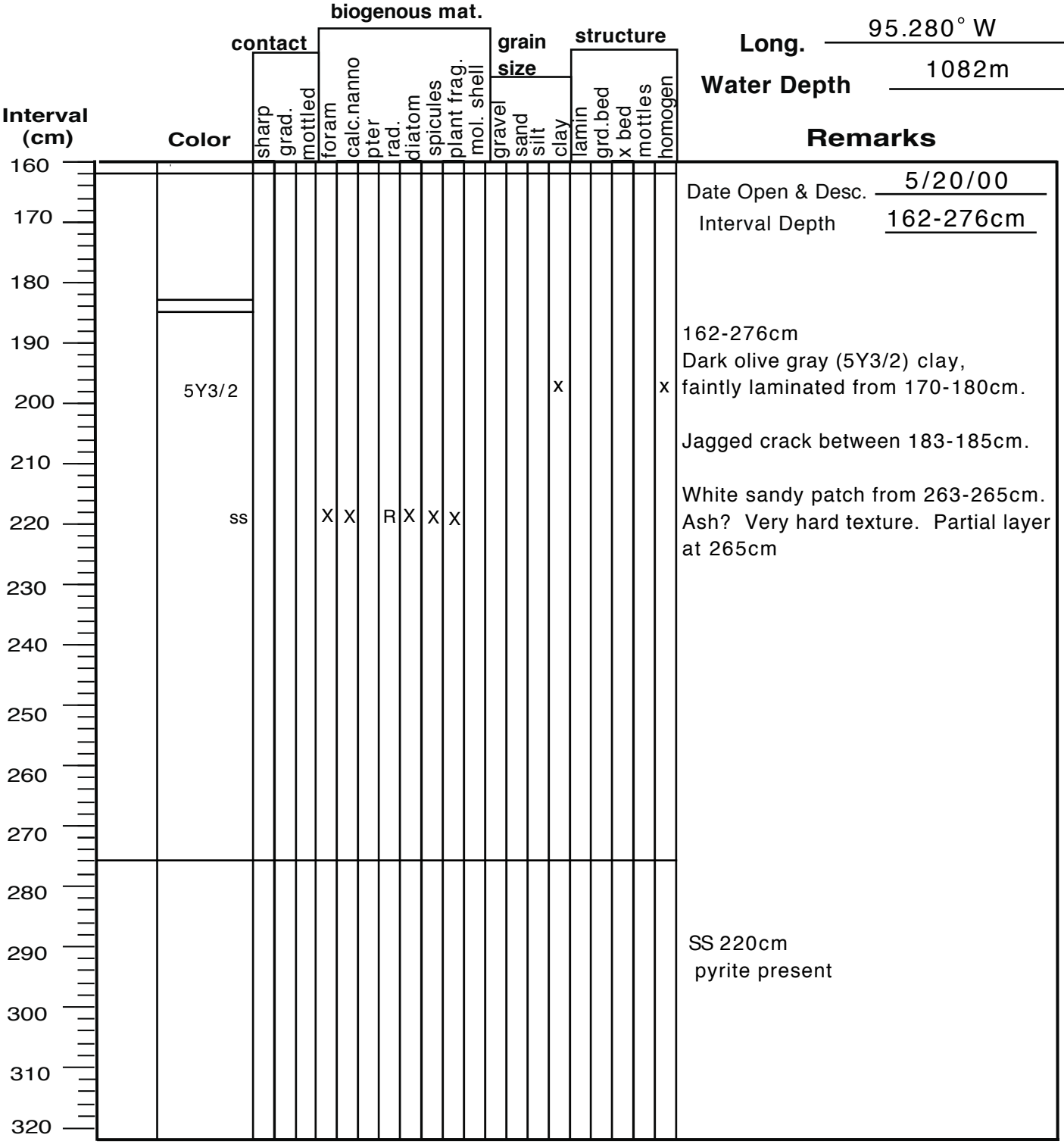
CORE ID ME0005A-10JC

SECTION 03 **of** 13

Lat. 15.581° N

Long. 95.280° W

Water Depth 1082m



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

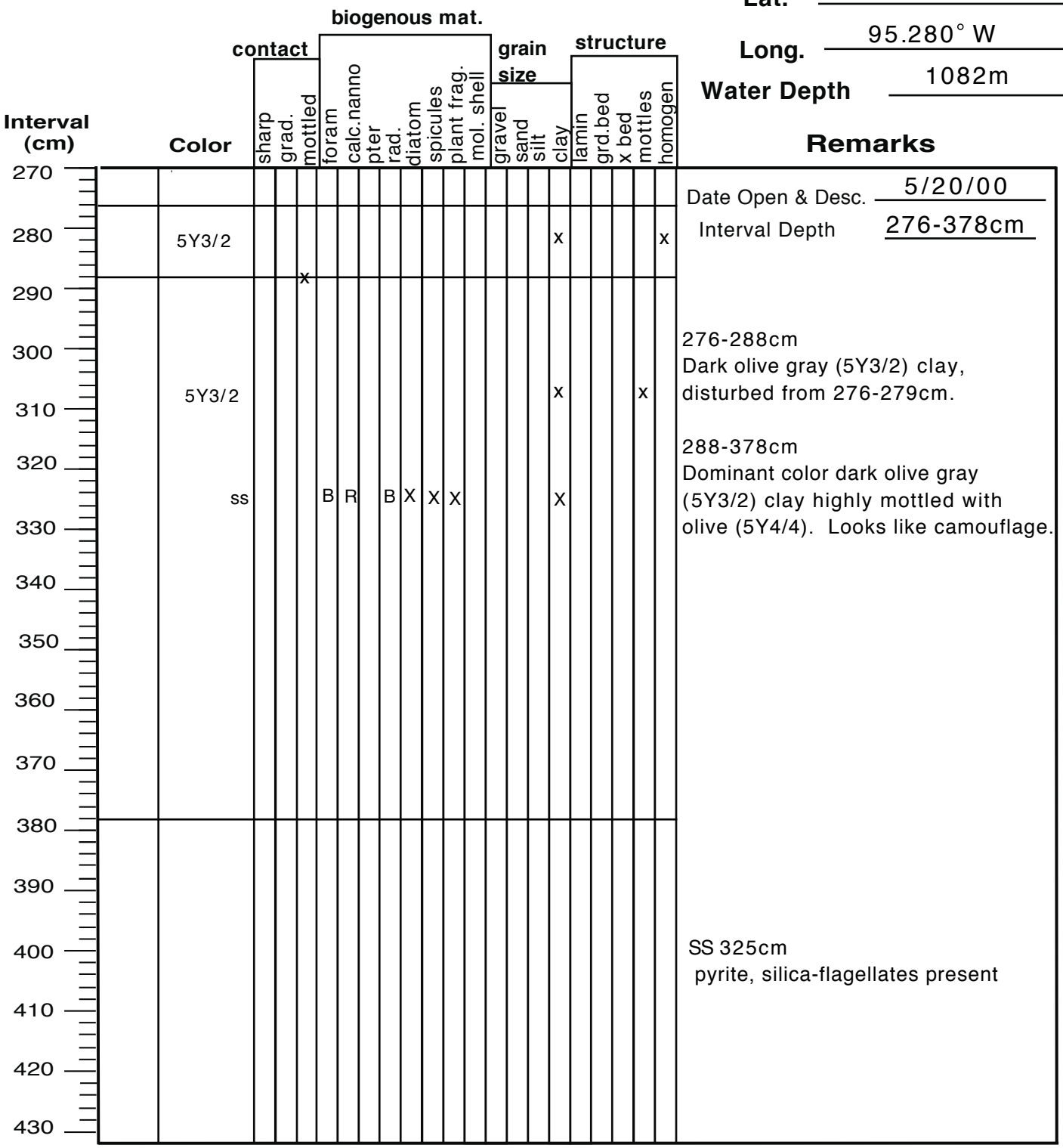
CORE ID ME0005A-10JC

SECTION 04 **of** 13

Lat. 15.581° N

Long. 95.280° W

Water Depth 1082m



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

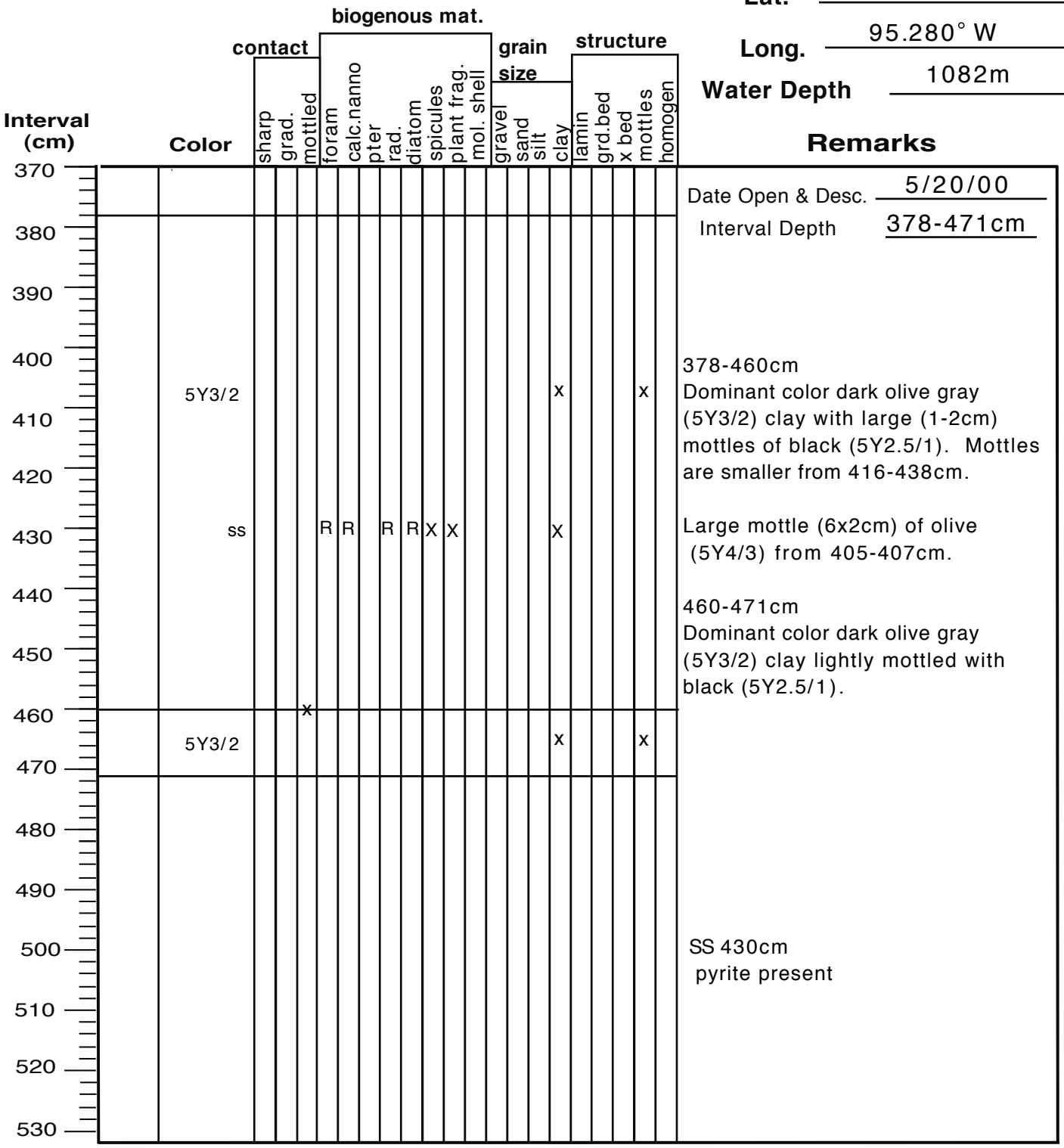
CORE ID ME0005A-10JC

SECTION 05 **of** 13

Lat. 15.581° N

Long. 95.280° W

Water Depth 1082m



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

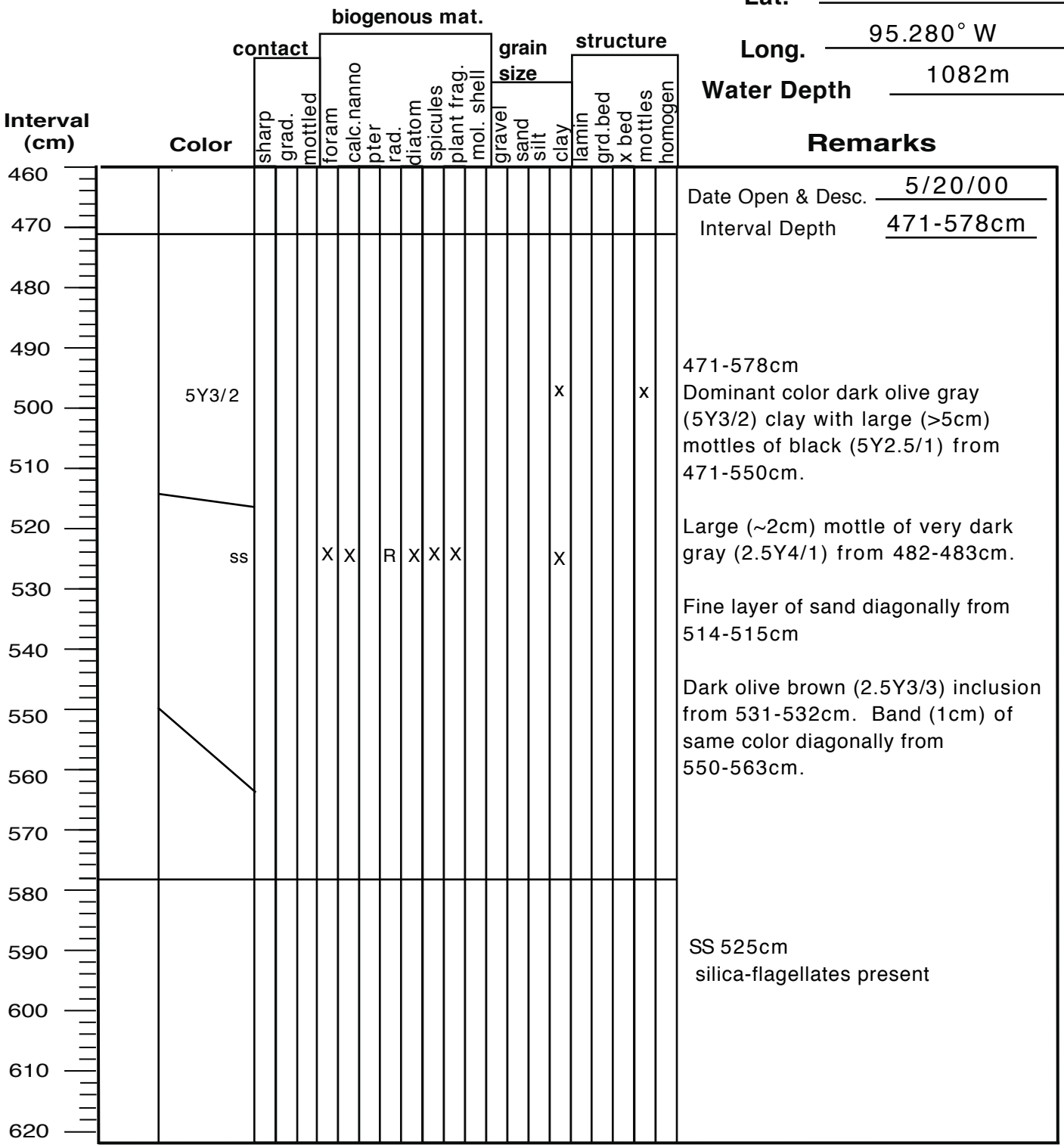
CORE ID ME0005A-10JC

SECTION 06 **of** 13

Lat. 15.581° N

Long. 95.280° W

Water Depth 1082m



Date Open & Desc. 5/20/00

Interval Depth 471-578cm

471-578cm
Dominant color dark olive gray (5Y3/2) clay with large (>5cm) mottles of black (5Y2.5/1) from 471-550cm.

Large (~2cm) mottle of very dark gray (2.5Y4/1) from 482-483cm.

Fine layer of sand diagonally from 514-515cm

Dark olive brown (2.5Y3/3) inclusion from 531-532cm. Band (1cm) of same color diagonally from 550-563cm.

SS 525cm
silica-flagellates present

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

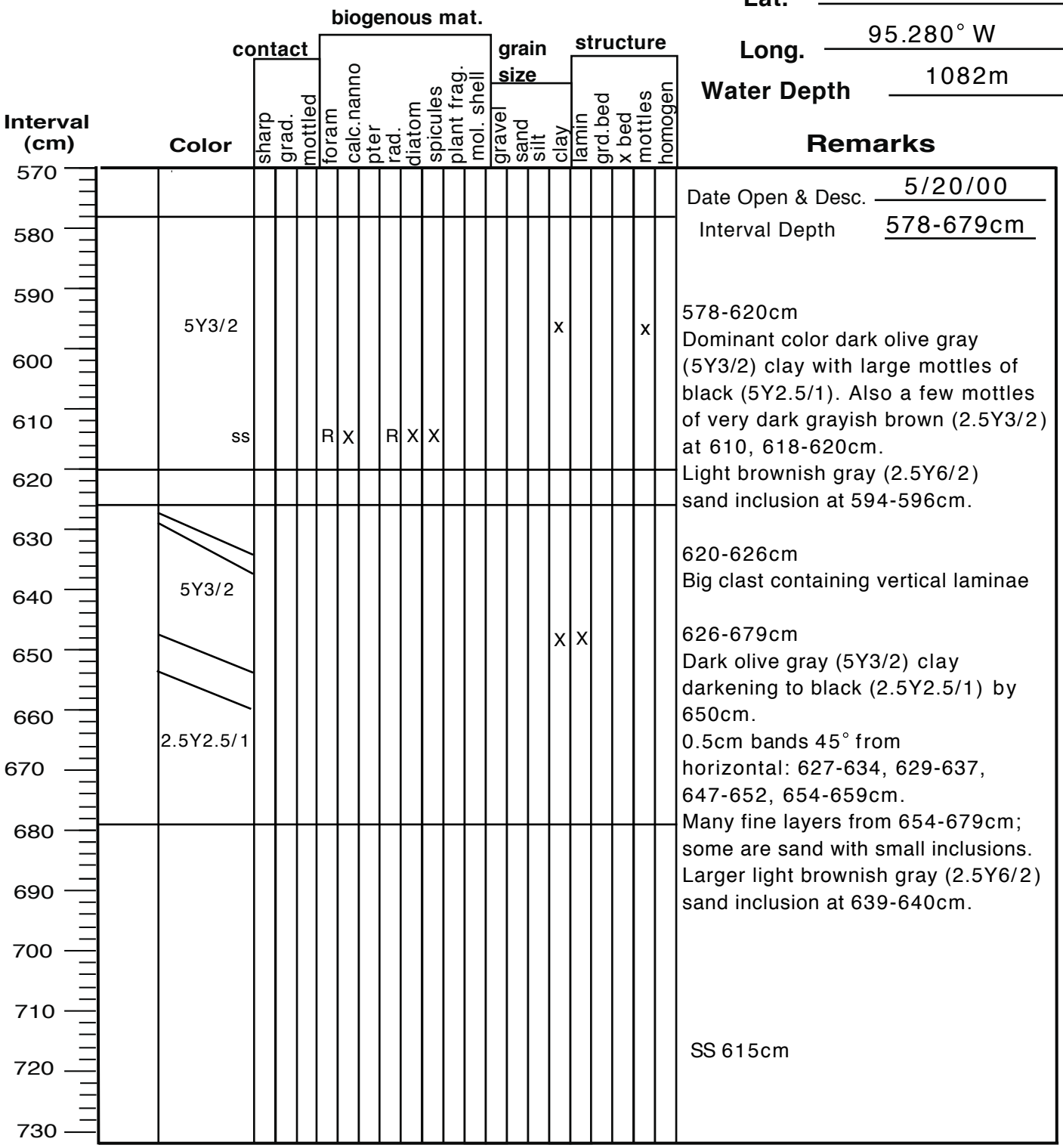
CORE ID ME0005A-10JC

SECTION 07 **of** 13

Lat. 15.581° N

Long. 95.280° W

Water Depth 1082m



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

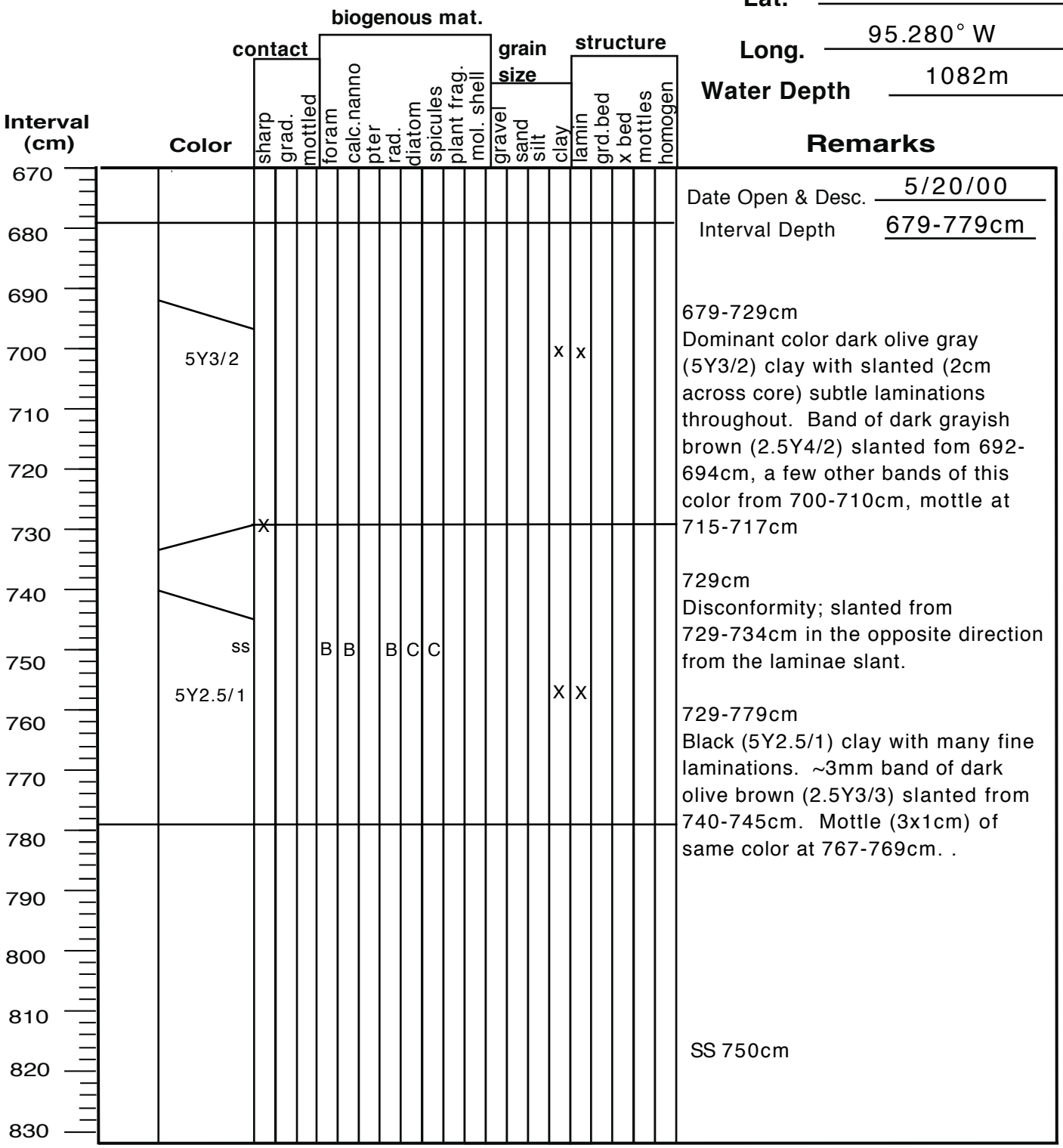
CORE ID ME0005A-10JC

SECTION 08 **of** 13

Lat. 15.581° N

Long. 95.280° W

Water Depth 1082m



Date Open & Desc. 5/20/00

Interval Depth 679-779cm

679-729cm
Dominant color dark olive gray (5Y3/2) clay with slanted (2cm across core) subtle laminations throughout. Band of dark grayish brown (2.5Y4/2) slanted fom 692-694cm, a few other bands of this color from 700-710cm, mottle at 715-717cm

729cm
Disconformity; slanted from 729-734cm in the opposite direction from the laminae slant.

729-779cm
Black (5Y2.5/1) clay with many fine laminations. ~3mm band of dark olive brown (2.5Y3/3) slanted from 740-745cm. Mottle (3x1cm) of same color at 767-769cm. .

SS 750cm

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

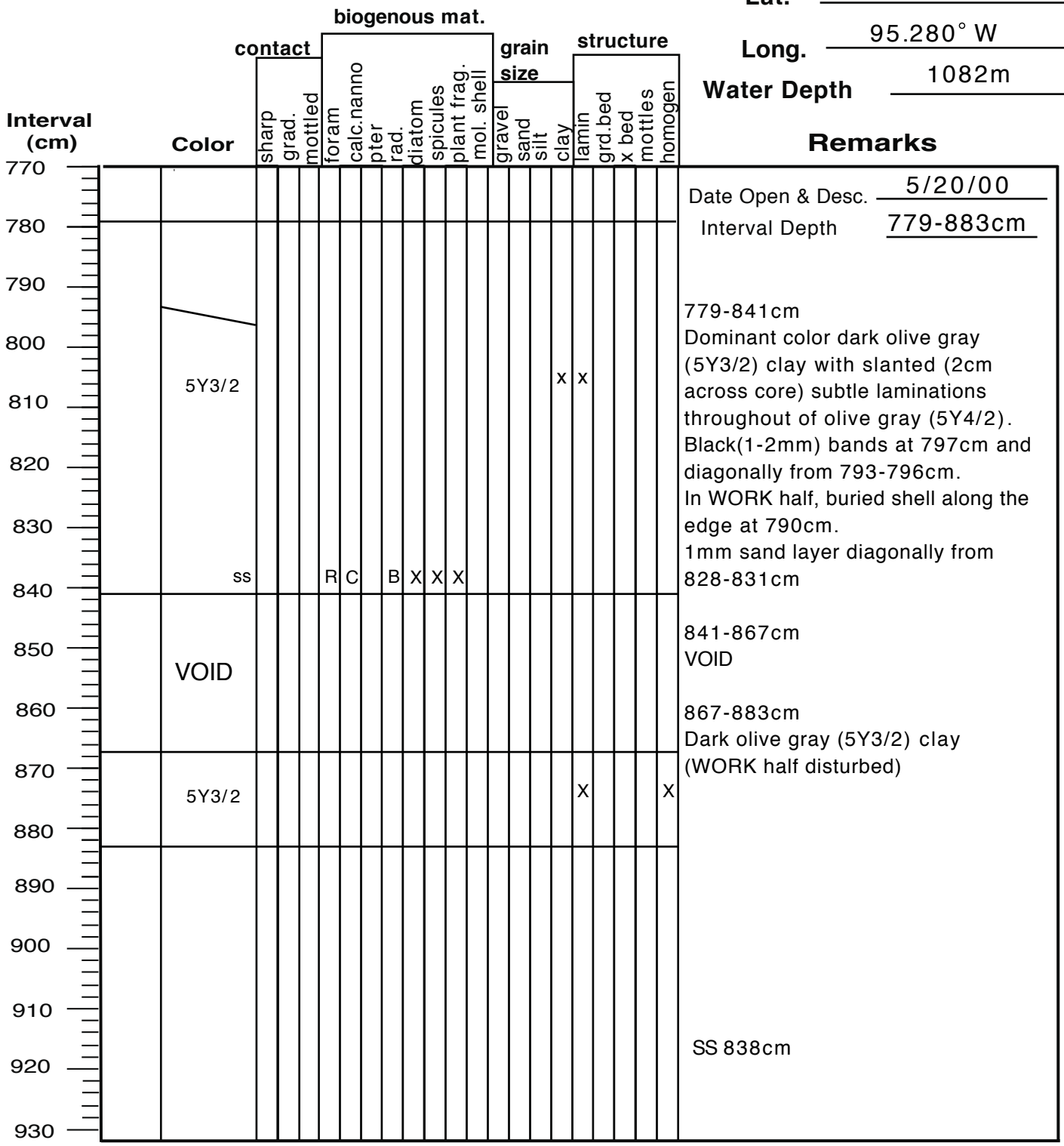
CORE ID ME0005A-10JC

SECTION 09 **of** 13

Lat. 15.581° N

Long. 95.280° W

Water Depth 1082m



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

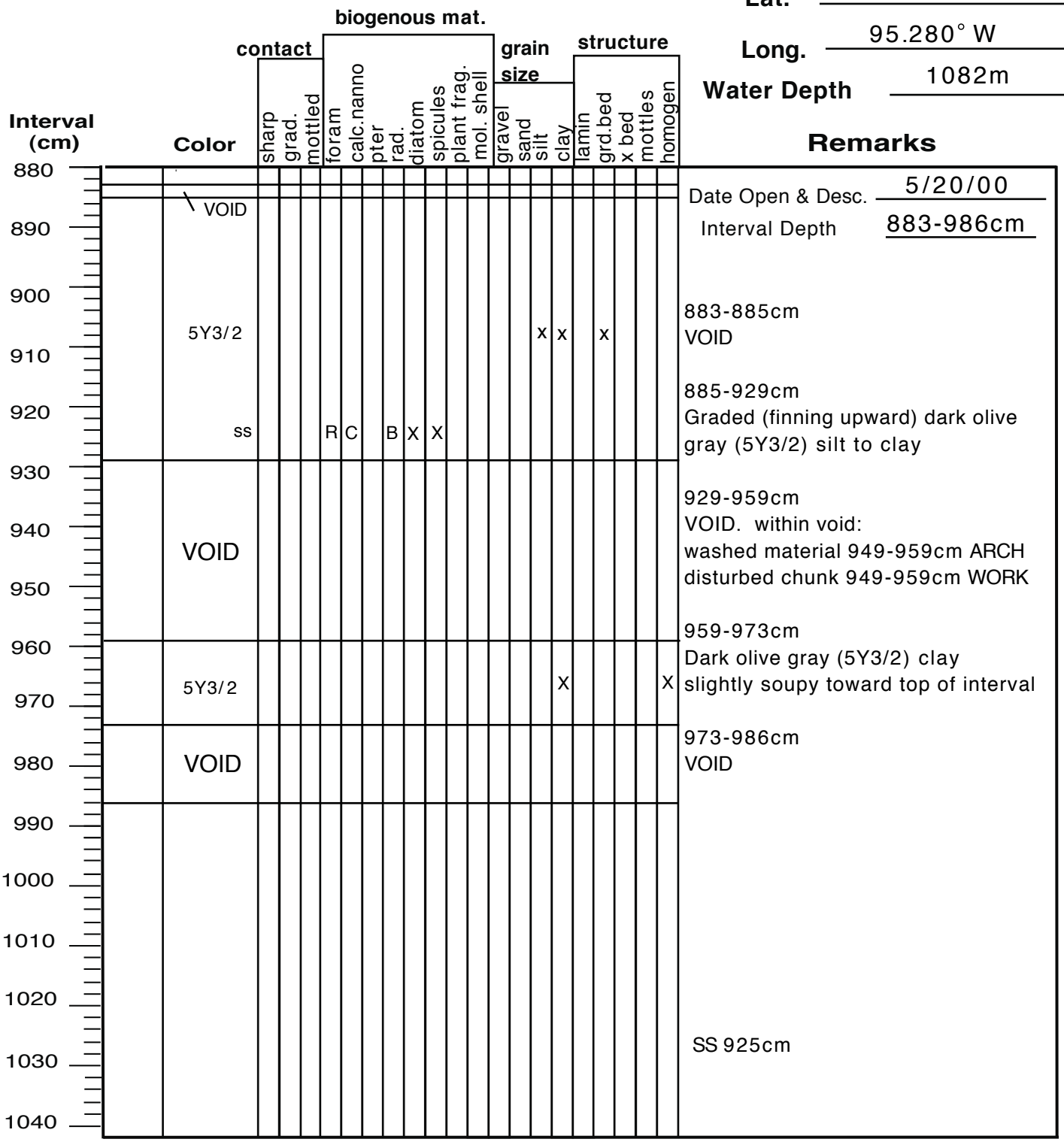
CORE ID ME0005A-10JC

SECTION 10 **of** 13

Lat. 15.581° N

Long. 95.280° W

Water Depth 1082m



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

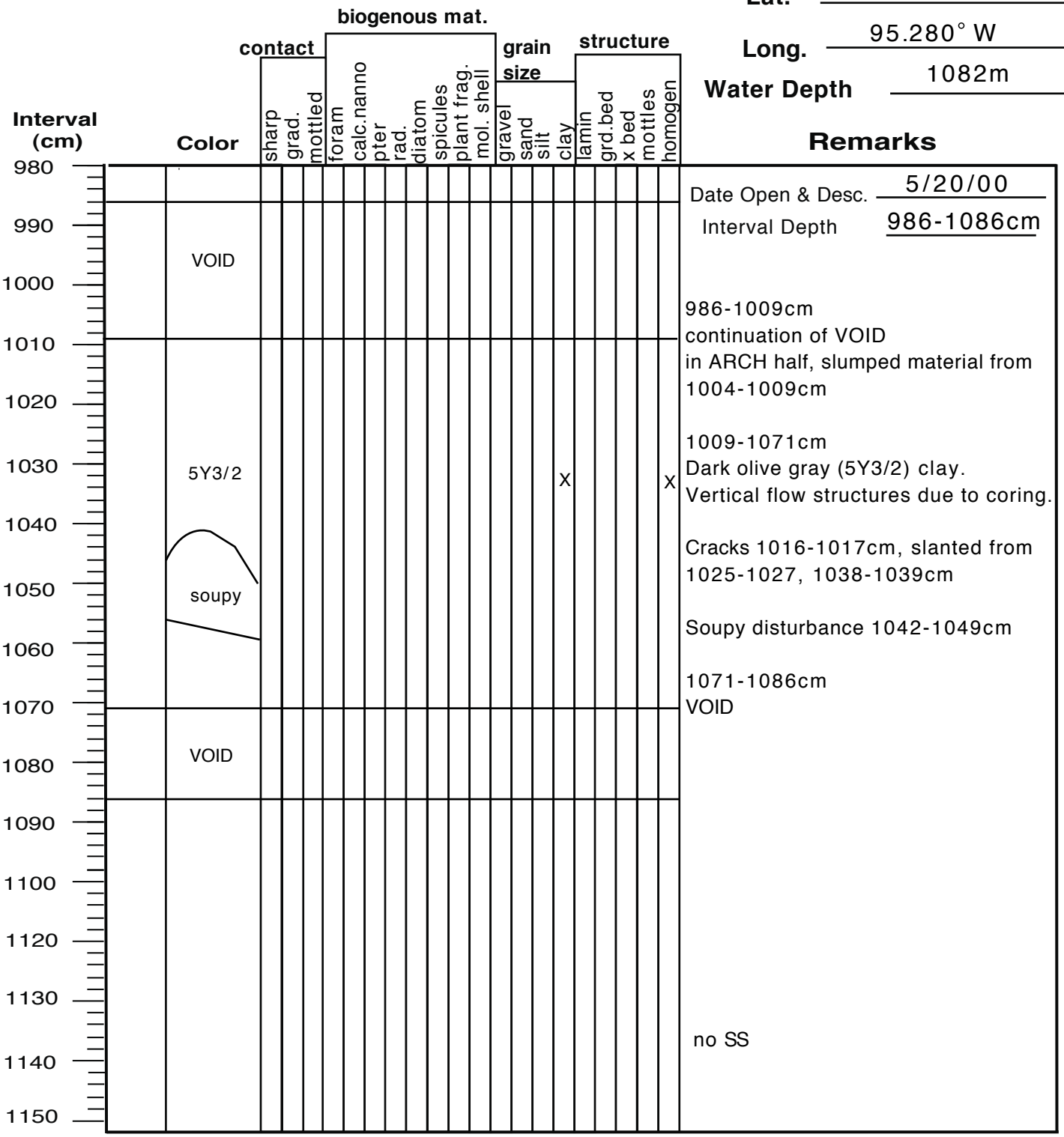
CORE ID ME0005A-10JC

SECTION 11 **of** 13

Lat. 15.581° N

Long. 95.280° W

Water Depth 1082m



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

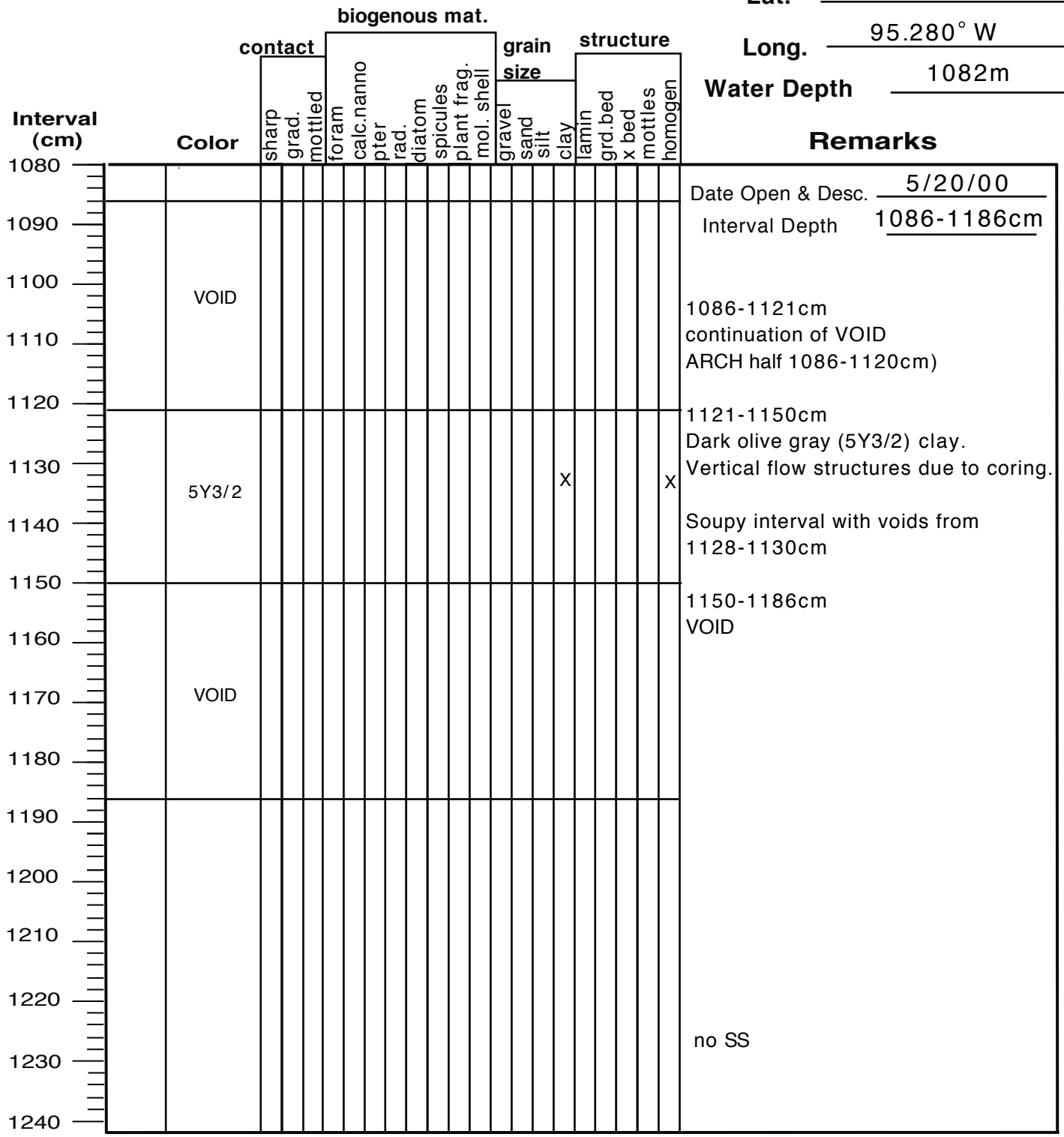
CORE ID ME0005A-10JC

SECTION 12 **of** 13

Lat. 15.581° N

Long. 95.280° W

Water Depth 1082m



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

CORE ID ME0005A-10JC

SECTION 13 **of** 13

Lat. 15.581° N

Long. 95.280° W

Water Depth 1082m

Interval (cm)	Color	contact: sharp	contact: grad.	contact: mottled	biogenous mat.: foram	biogenous mat.: calc.nanno	biogenous mat.: pter	biogenous mat.: rad.	biogenous mat.: diatom	biogenous mat.: spicules	biogenous mat.: plant frag.	biogenous mat.: mol. shell	grain size: gravel	grain size: sand	grain size: silt	grain size: clay	structure: lamin	structure: grd.bed	structure: x bed	structure: mottles	structure: homogen	Remarks
1180																						Date Open & Desc. 5/20/00
1190	Soupy in work															X					X	Interval Depth 1186-1314cm
1200	5Y3/2																					
1210	VOID inARCH																					1186-1217cm Soupy in work; VOID in ARCH Dark olive gray (5Y3/2) clay.
1220																						1217-1238 cm
1230	5Y3/2															X					X	Dark olive gray (5Y3/2) clay. Vertical flow structures due to coring. In ARCH, 1/4core VOID 1225-1228cm
1240	Soupy in work VOID inARCH															X					X	1238-1254cm Soupy in work; VOID in ARCH Dark olive gray (5Y3/2) clay.
1250																						
1260																						1254-1314cm
1270	5Y3/2																					Dark olive gray (5Y3/2) clay. Vertical flow structures due to coring. Broken bivalve shells at 1259-1262,
1280																X					X	1265-1267cm Sediment disturbed 1300-1310cm
1290																						
1300																						
1310																						
1320																						no SS
1330																						
1340																						

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

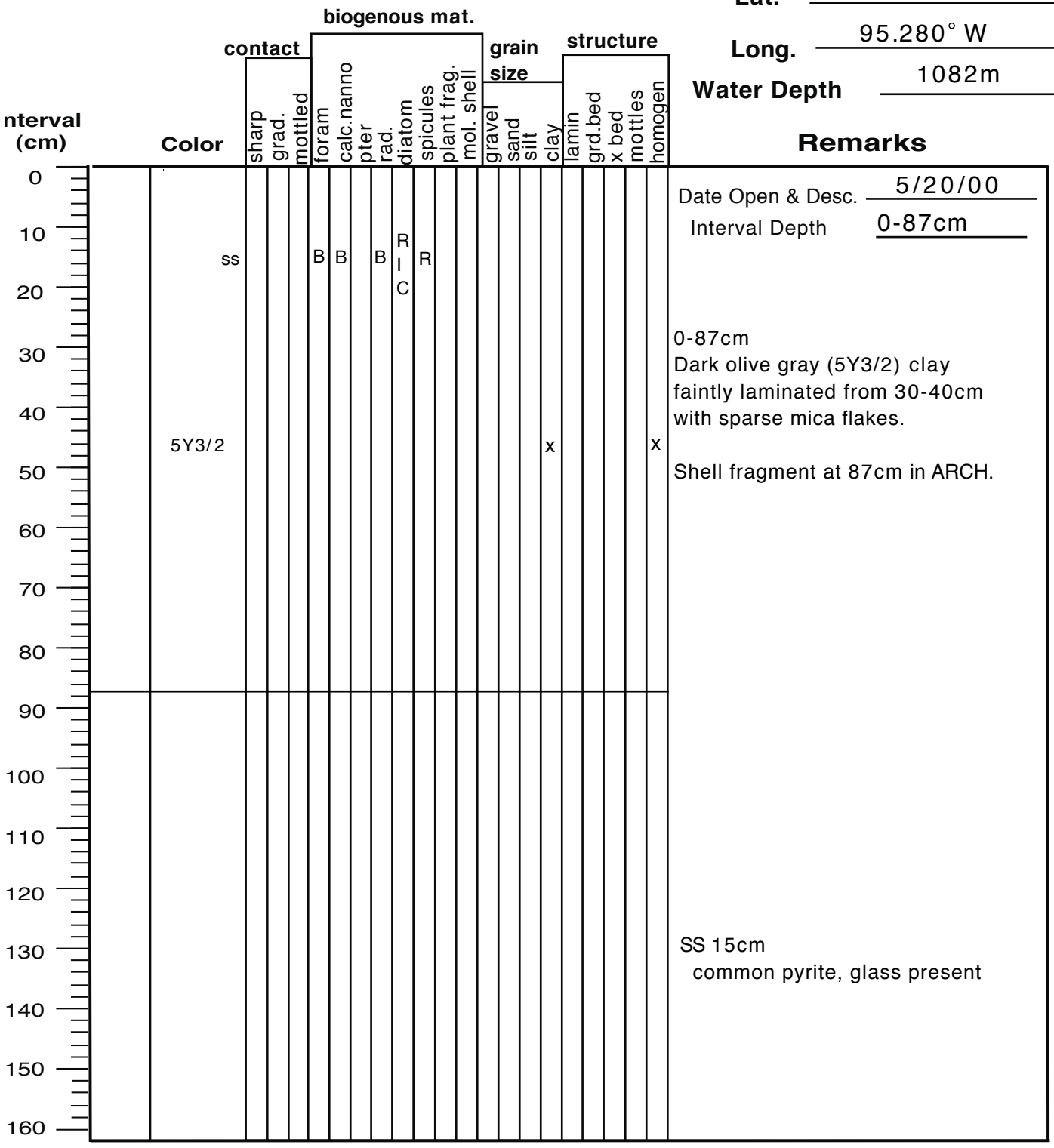
CORE ID ME0005A-10TC

SECTION 01 **of** 01

Lat. 15.581° N

Long. 95.280° W

Water Depth 1082m



Date Open & Desc. 5/20/00

Interval Depth 0-87cm

0-87cm
Dark olive gray (5Y3/2) clay faintly laminated from 30-40cm with sparse mica flakes.

Shell fragment at 87cm in ARCH.

SS 15cm
common pyrite, glass present

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

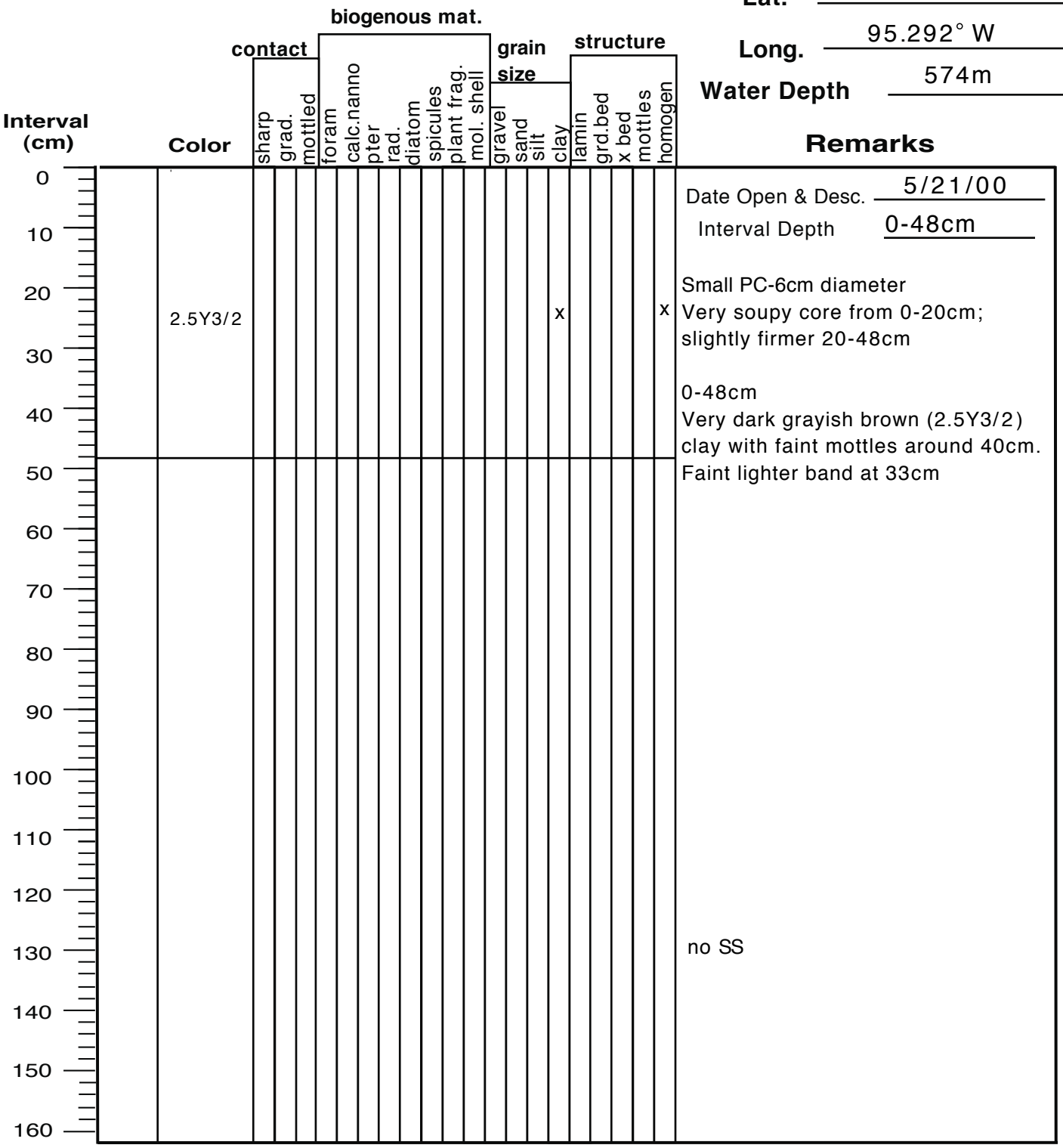
CORE ID ME0005A-11PC

SECTION 01 **of** 15

Lat. 15.713° N

Long. 95.292° W

Water Depth 574m



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

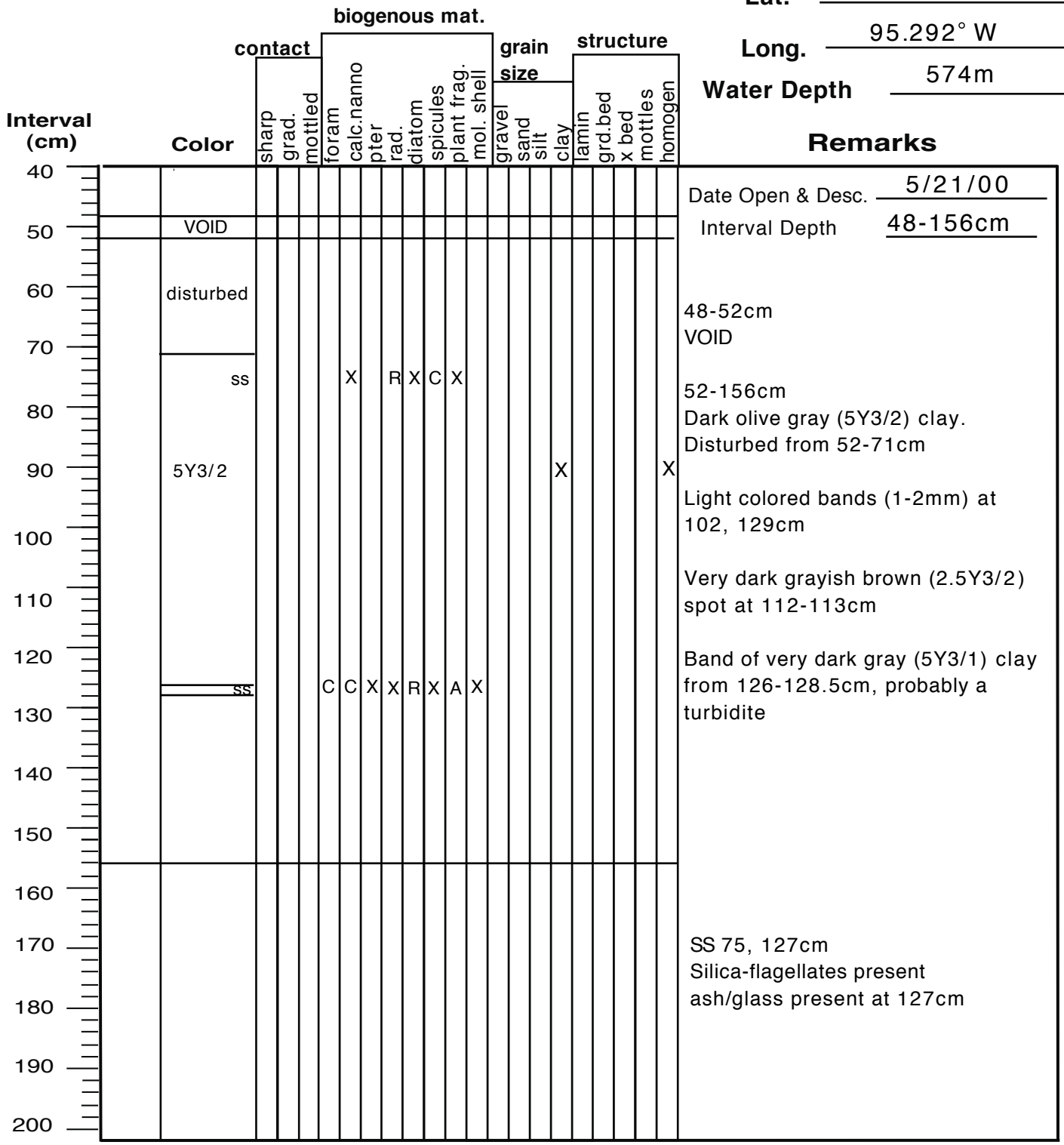
CORE ID ME0005A-11PC

SECTION 02 **of** 15

Lat. 15.713° N

Long. 95.292° W

Water Depth 574m



Date Open & Desc. 5/21/00

Interval Depth 48-156cm

48-52cm
VOID

52-156cm
Dark olive gray (5Y3/2) clay.
Disturbed from 52-71cm

Light colored bands (1-2mm) at 102, 129cm

Very dark grayish brown (2.5Y3/2) spot at 112-113cm

Band of very dark gray (5Y3/1) clay from 126-128.5cm, probably a turbidite

SS 75, 127cm
Silica-flagellates present
ash/glass present at 127cm

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

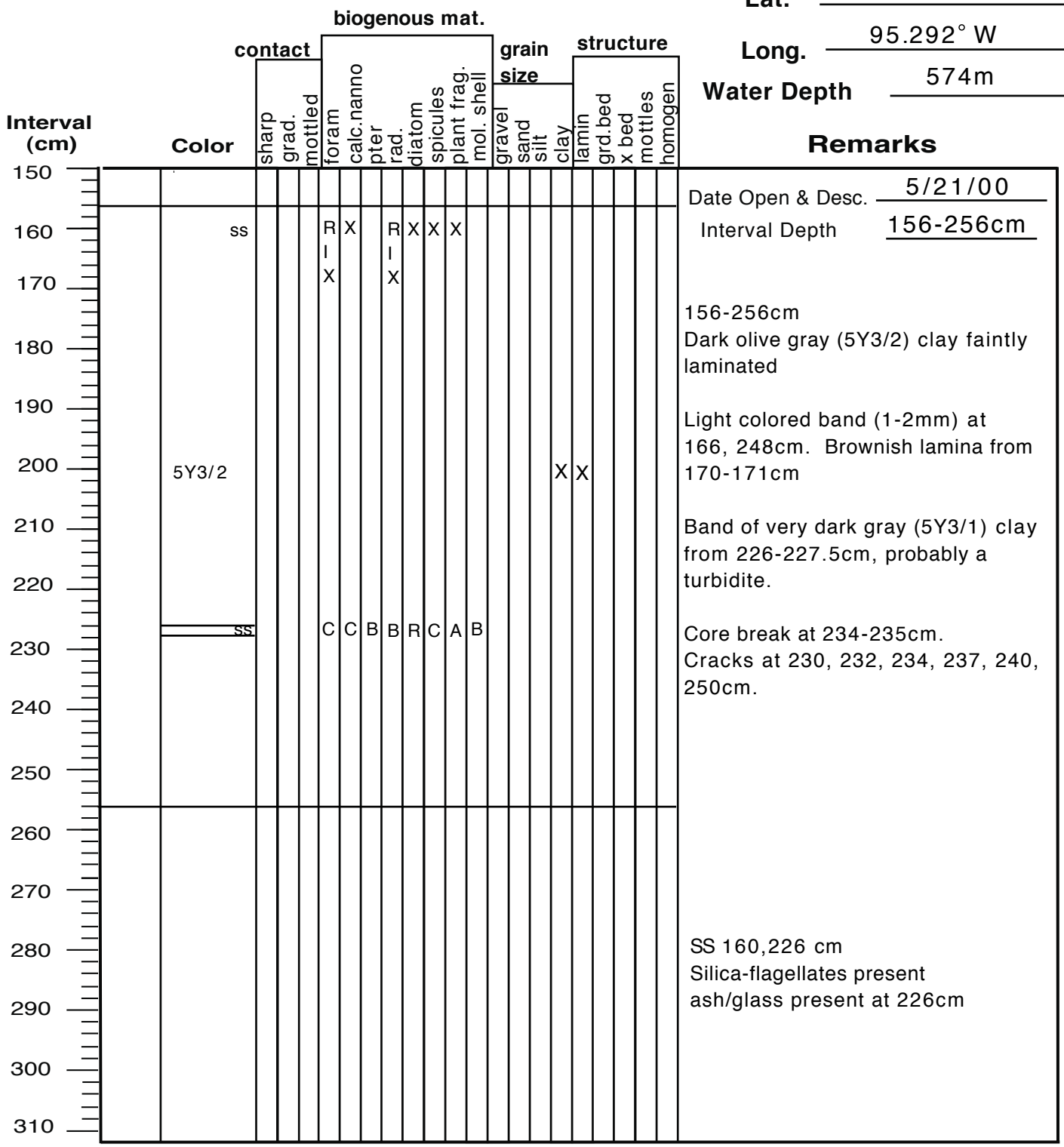
CORE ID ME0005A-11PC

SECTION 03 **of** 15

Lat. 15.713° N

Long. 95.292° W

Water Depth 574m



Date Open & Desc. 5/21/00

Interval Depth 156-256cm

156-256cm
Dark olive gray (5Y3/2) clay faintly laminated

Light colored band (1-2mm) at 166, 248cm. Brownish lamina from 170-171cm

Band of very dark gray (5Y3/1) clay from 226-227.5cm, probably a turbidite.

Core break at 234-235cm.
Cracks at 230, 232, 234, 237, 240, 250cm.

SS 160,226 cm
Silica-flagellates present
ash/glass present at 226cm

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

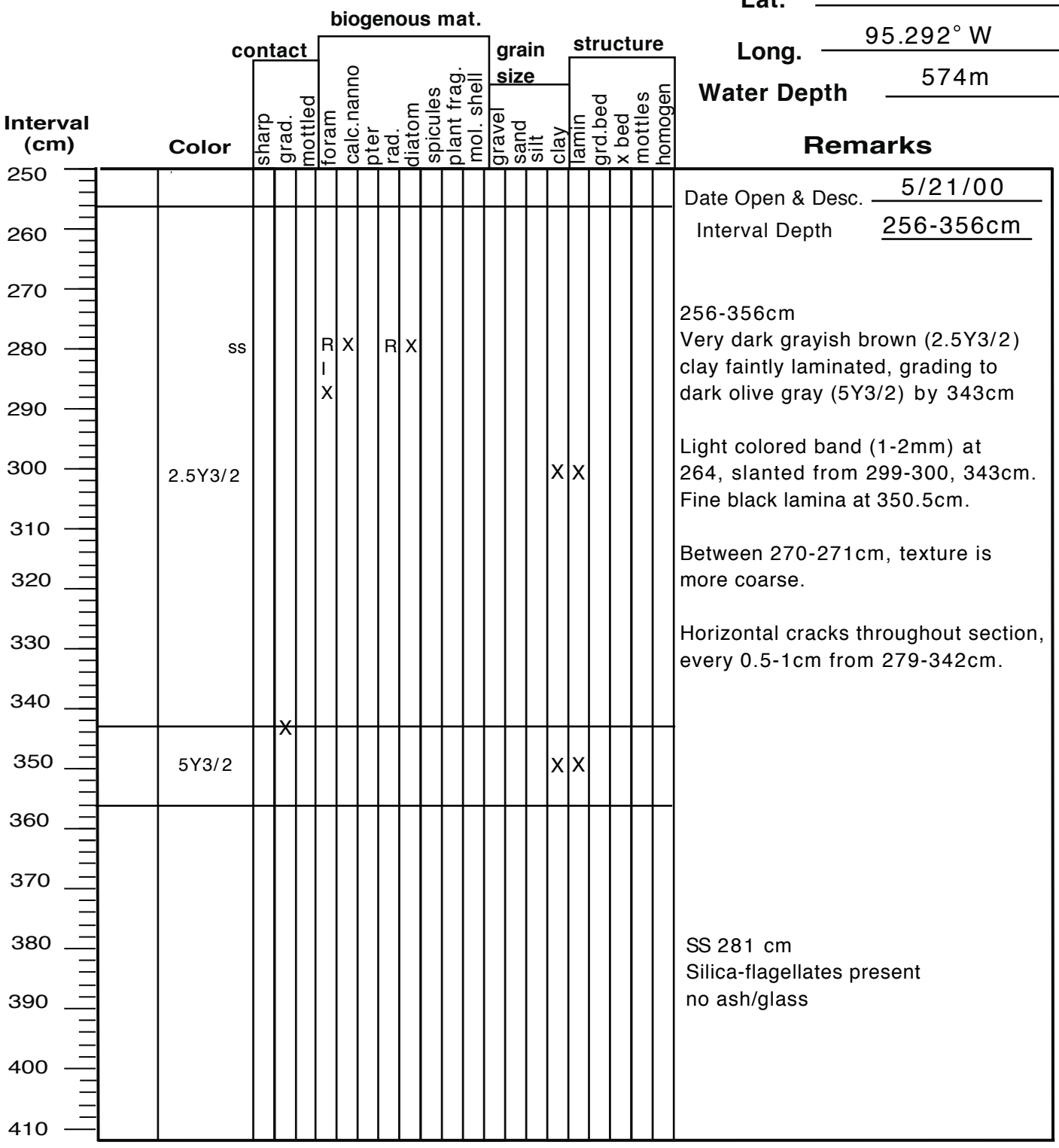
CORE ID ME0005A-11PC

SECTION 04 **of** 15

Lat. 15.713° N

Long. 95.292° W

Water Depth 574m



Remarks

Date Open & Desc. 5/21/00

Interval Depth 256-356cm

256-356cm
Very dark grayish brown (2.5Y3/2) clay faintly laminated, grading to dark olive gray (5Y3/2) by 343cm

Light colored band (1-2mm) at 264, slanted from 299-300, 343cm. Fine black lamina at 350.5cm.

Between 270-271cm, texture is more coarse.

Horizontal cracks throughout section, every 0.5-1cm from 279-342cm.

SS 281 cm
Silica-flagellates present
no ash/glass

Fossils: X-Present A-Abundant C-Common R-rare B-Barren

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

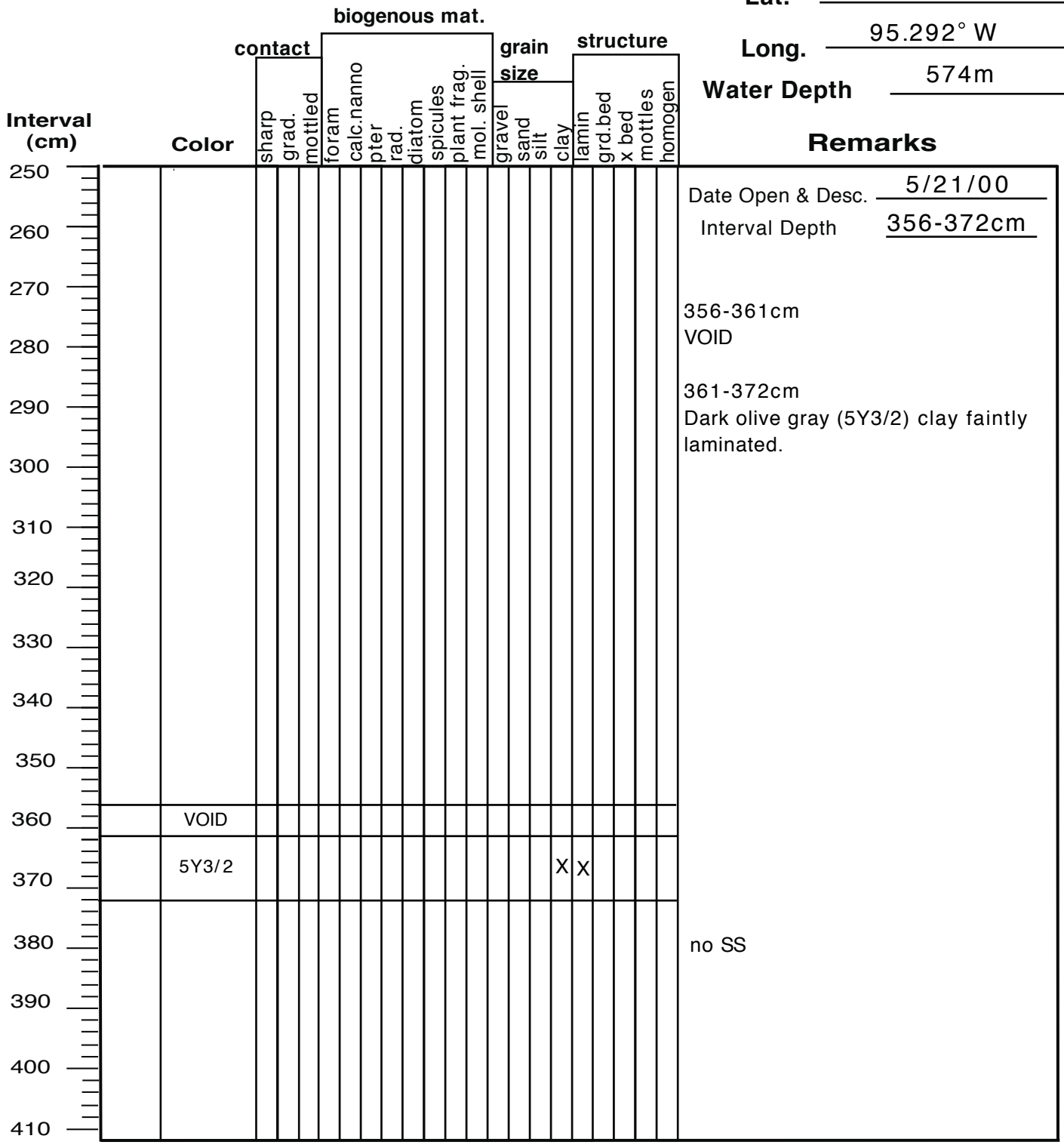
CORE ID ME0005A-11PC

SECTION 05 **of** 15

Lat. 15.713° N

Long. 95.292° W

Water Depth 574m



Fossils: X-Present A-Abundant C-Common R-rare B-Barren

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

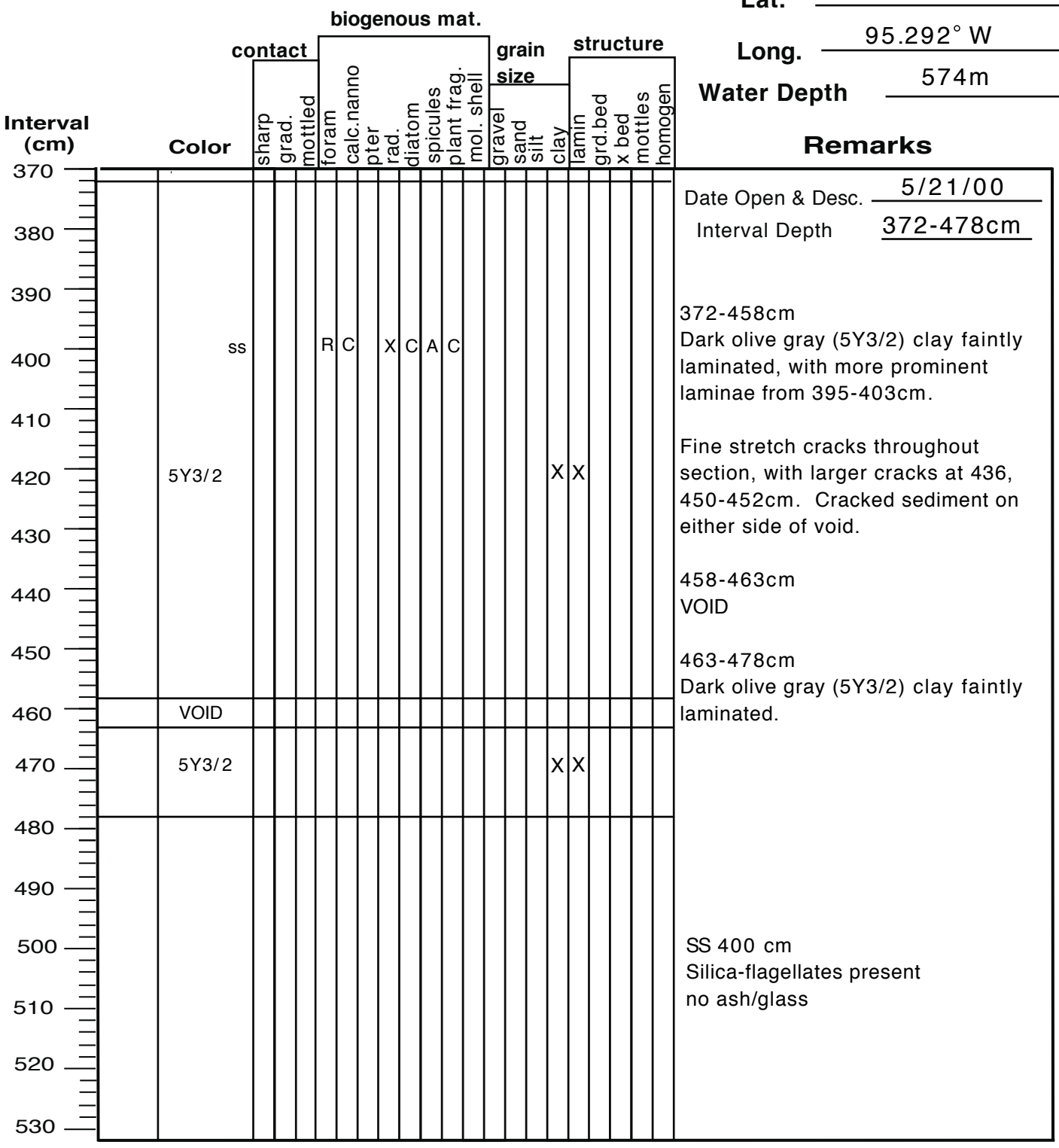
CORE ID ME0005A-11PC

SECTION 06 **of** 15

Lat. 15.713° N

Long. 95.292° W

Water Depth 574m



Remarks

Date Open & Desc. 5/21/00

Interval Depth 372-478cm

372-458cm
Dark olive gray (5Y3/2) clay faintly laminated, with more prominent laminae from 395-403cm.

Fine stretch cracks throughout section, with larger cracks at 436, 450-452cm. Cracked sediment on either side of void.

458-463cm
VOID

463-478cm
Dark olive gray (5Y3/2) clay faintly laminated.

SS 400 cm
Silica-flagellates present
no ash/glass

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

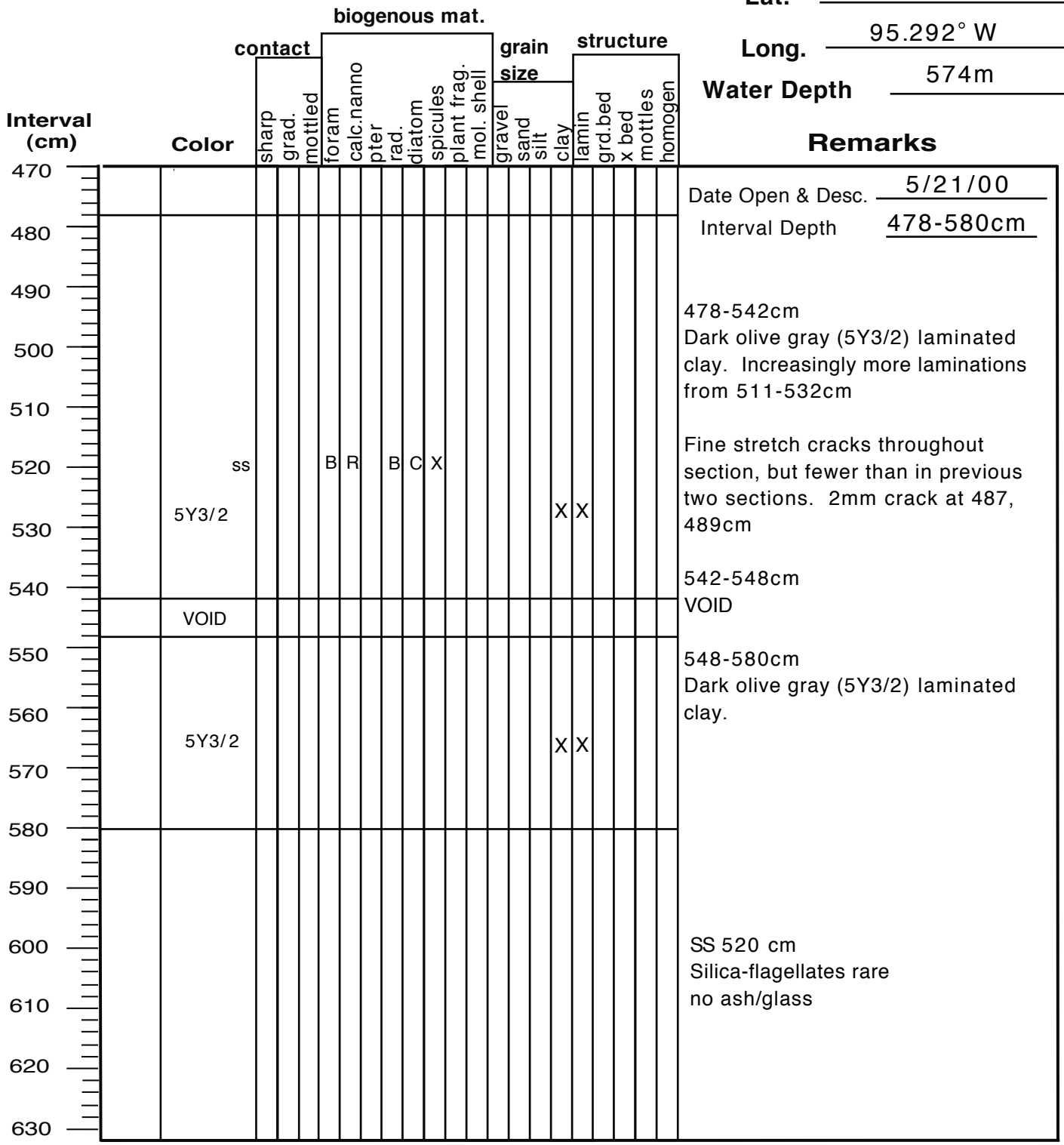
CORE ID ME0005A-11PC

SECTION 07 **of** 15

Lat. 15.713° N

Long. 95.292° W

Water Depth 574m



Date Open & Desc. 5/21/00

Interval Depth 478-580cm

478-542cm
Dark olive gray (5Y3/2) laminated clay. Increasingly more laminations from 511-532cm

Fine stretch cracks throughout section, but fewer than in previous two sections. 2mm crack at 487, 489cm

542-548cm
VOID

548-580cm
Dark olive gray (5Y3/2) laminated clay.

SS 520 cm
Silica-flagellates rare
no ash/glass

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

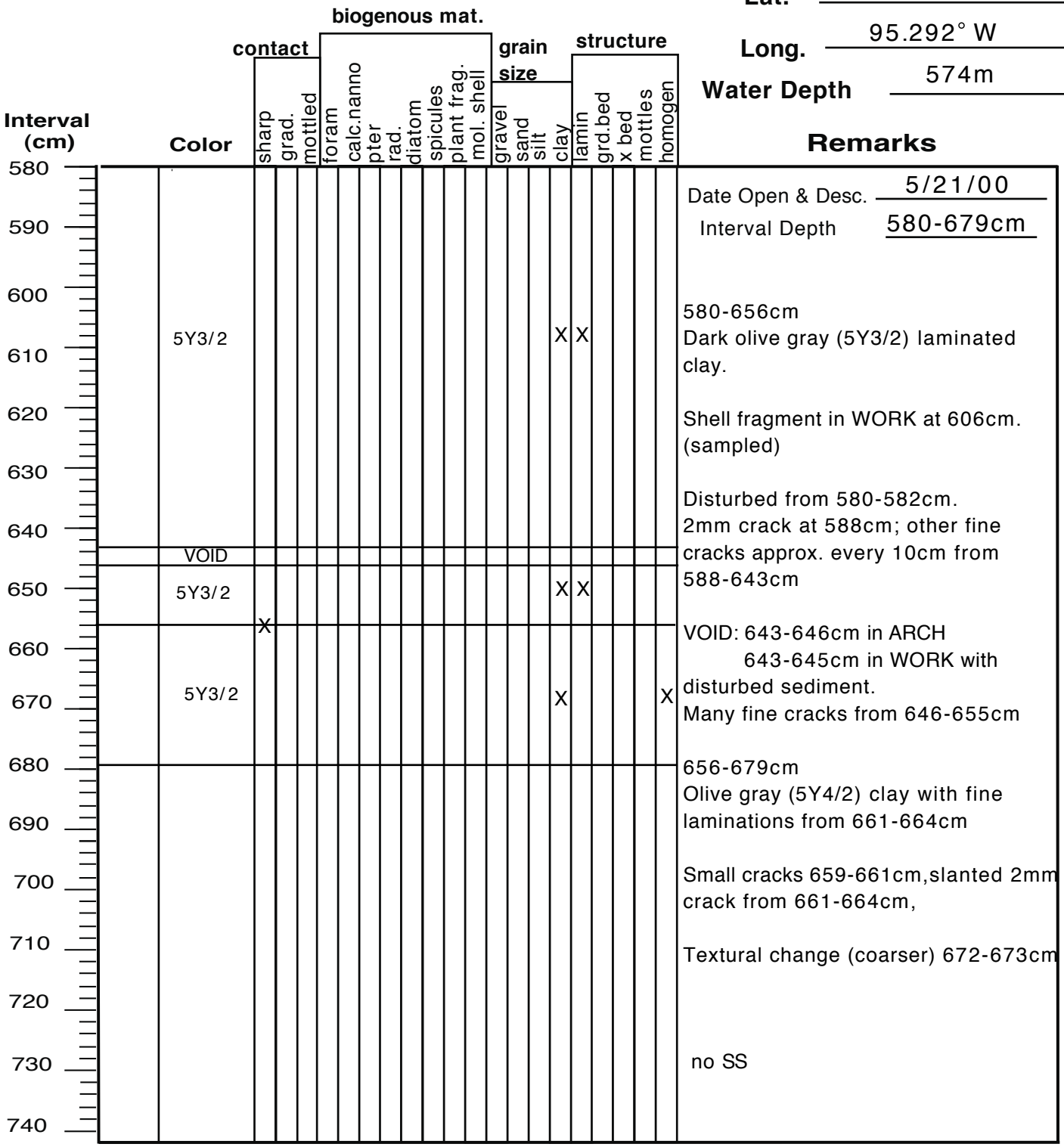
CORE ID ME0005A-11PC

SECTION 08 **of** 15

Lat. 15.713° N

Long. 95.292° W

Water Depth 574m



Remarks

Date Open & Desc. 5/21/00

Interval Depth 580-679cm

580-656cm
Dark olive gray (5Y3/2) laminated clay.

Shell fragment in WORK at 606cm. (sampled)

Disturbed from 580-582cm.
2mm crack at 588cm; other fine cracks approx. every 10cm from 588-643cm

VOID: 643-646cm in ARCH
643-645cm in WORK with disturbed sediment.
Many fine cracks from 646-655cm

656-679cm
Olive gray (5Y4/2) clay with fine laminations from 661-664cm

Small cracks 659-661cm,slanted 2mm crack from 661-664cm,

Textural change (coarser) 672-673cm

no SS

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

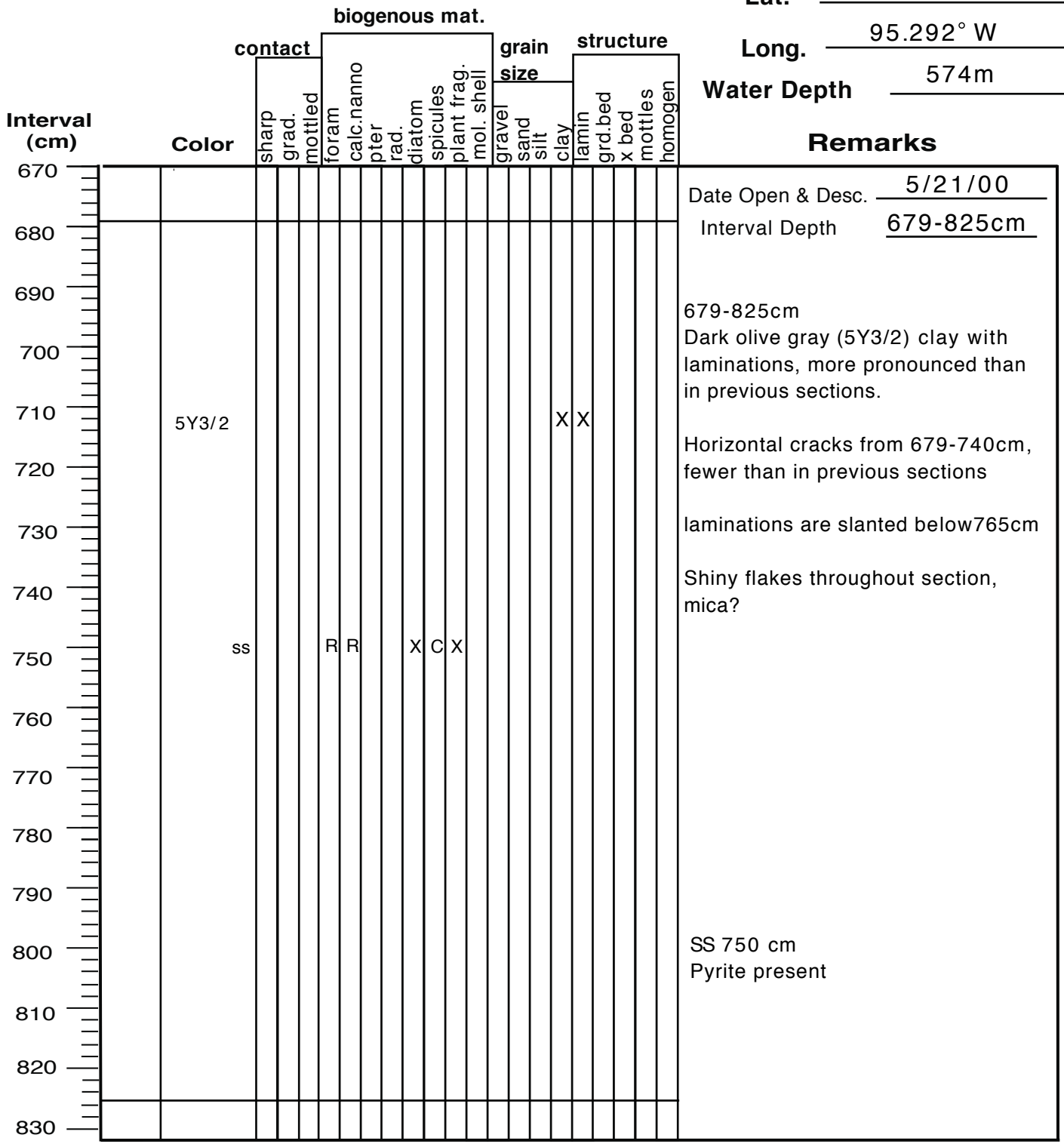
CORE ID ME0005A-11PC

SECTION 09 **of** 15

Lat. 15.713° N

Long. 95.292° W

Water Depth 574m



Remarks

Date Open & Desc. 5/21/00

Interval Depth 679-825cm

679-825cm
Dark olive gray (5Y3/2) clay with laminations, more pronounced than in previous sections.

Horizontal cracks from 679-740cm, fewer than in previous sections

laminations are slanted below765cm

Shiny flakes throughout section, mica?

SS 750 cm
Pyrite present

Fossils: X-Present A-Abundant C-Common R-rare B-Barren

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

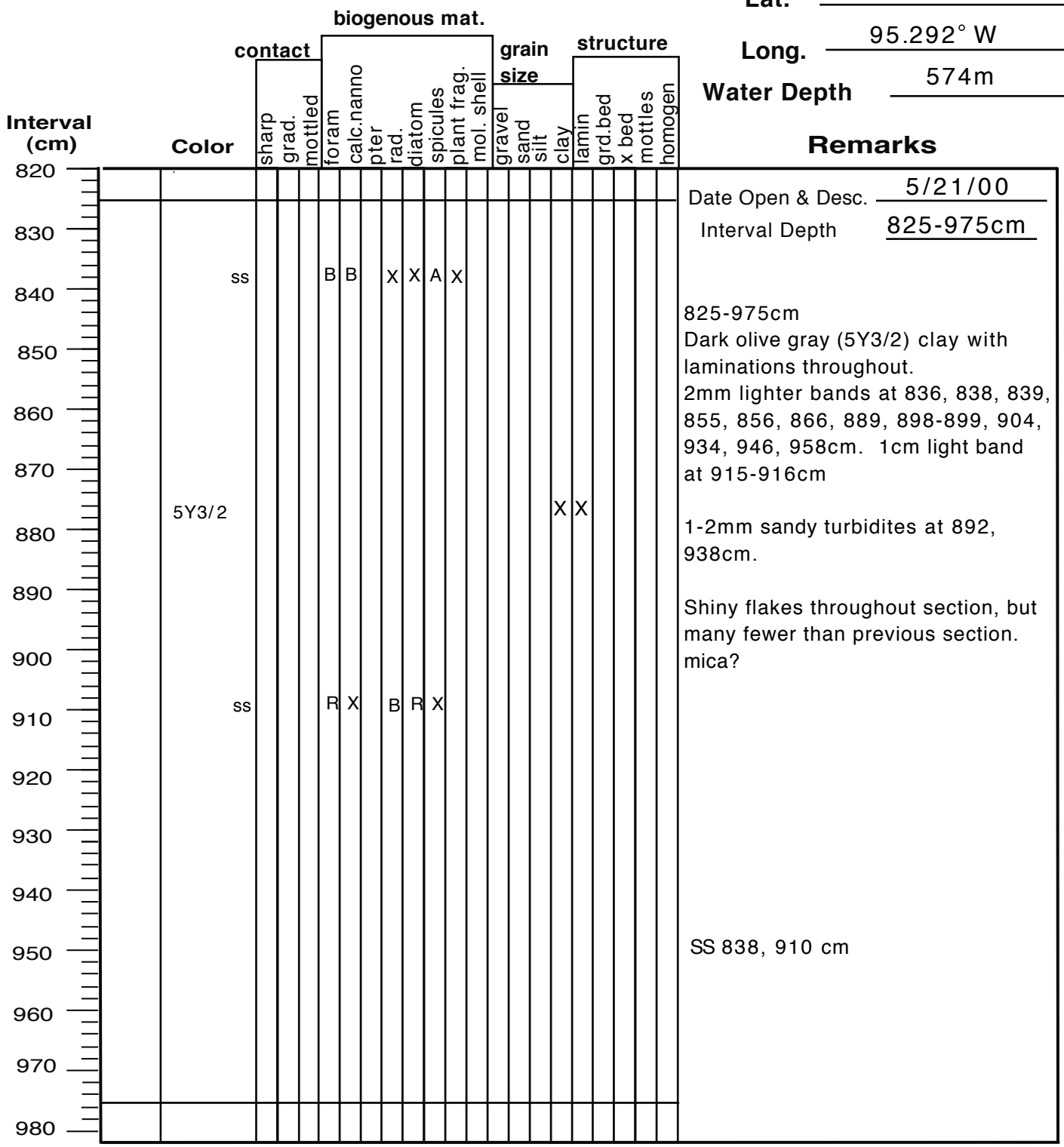
CORE ID ME0005A-11PC

SECTION 10 **of** 15

Lat. 15.713° N

Long. 95.292° W

Water Depth 574m



Remarks

Date Open & Desc. 5/21/00

Interval Depth 825-975cm

825-975cm
Dark olive gray (5Y3/2) clay with laminations throughout.
2mm lighter bands at 836, 838, 839, 855, 856, 866, 889, 898-899, 904, 934, 946, 958cm. 1cm light band at 915-916cm

1-2mm sandy turbidites at 892, 938cm.

Shiny flakes throughout section, but many fewer than previous section. mica?

SS 838, 910 cm

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

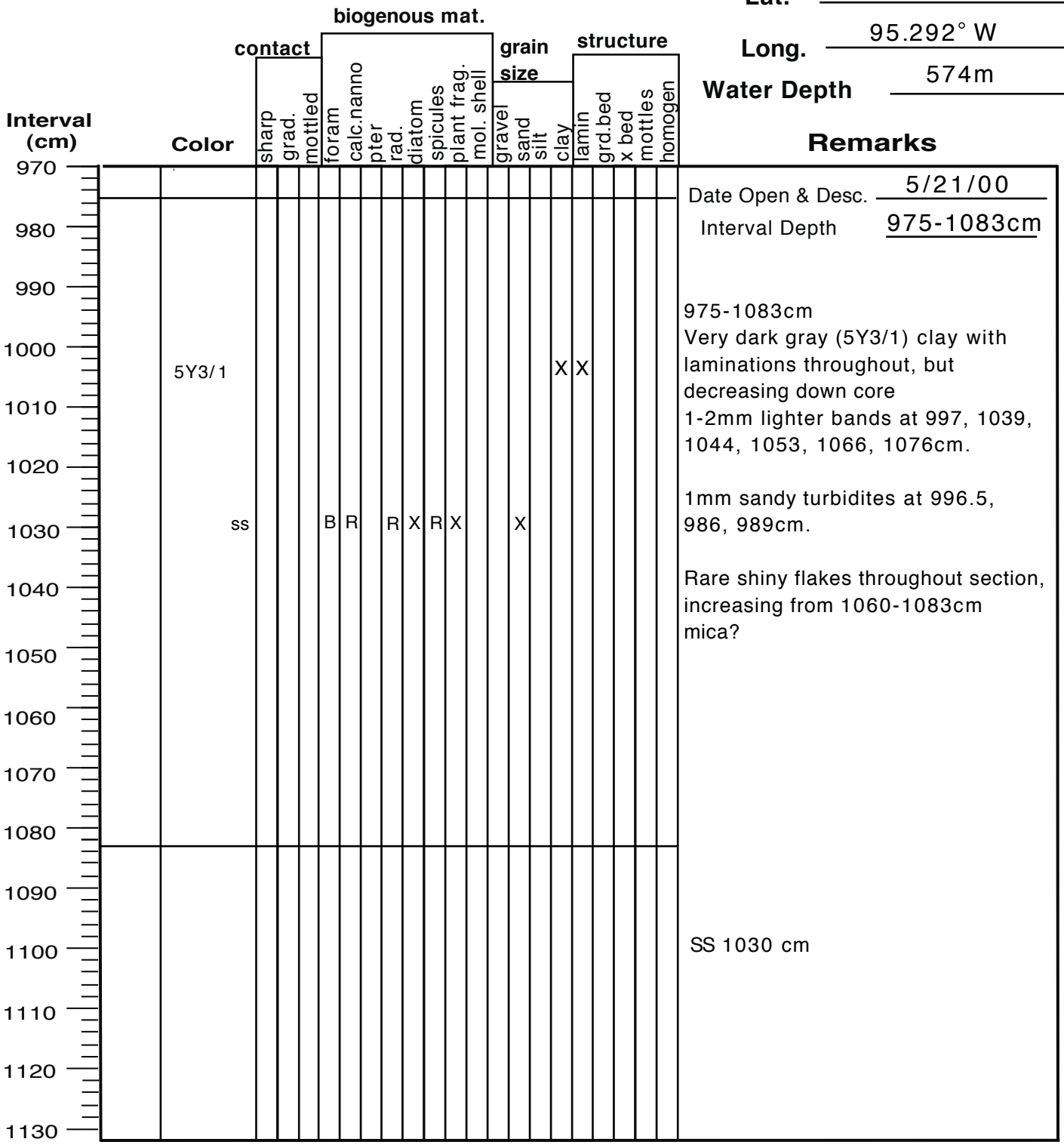
CORE ID ME0005A-11PC

SECTION 11 **of** 15

Lat. 15.713° N

Long. 95.292° W

Water Depth 574m



Remarks

Date Open & Desc. 5/21/00

Interval Depth 975-1083cm

975-1083cm
Very dark gray (5Y3/1) clay with laminations throughout, but decreasing down core
1-2mm lighter bands at 997, 1039, 1044, 1053, 1066, 1076cm.

1mm sandy turbidites at 996.5, 986, 989cm.

Rare shiny flakes throughout section, increasing from 1060-1083cm
mica?

SS 1030 cm

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

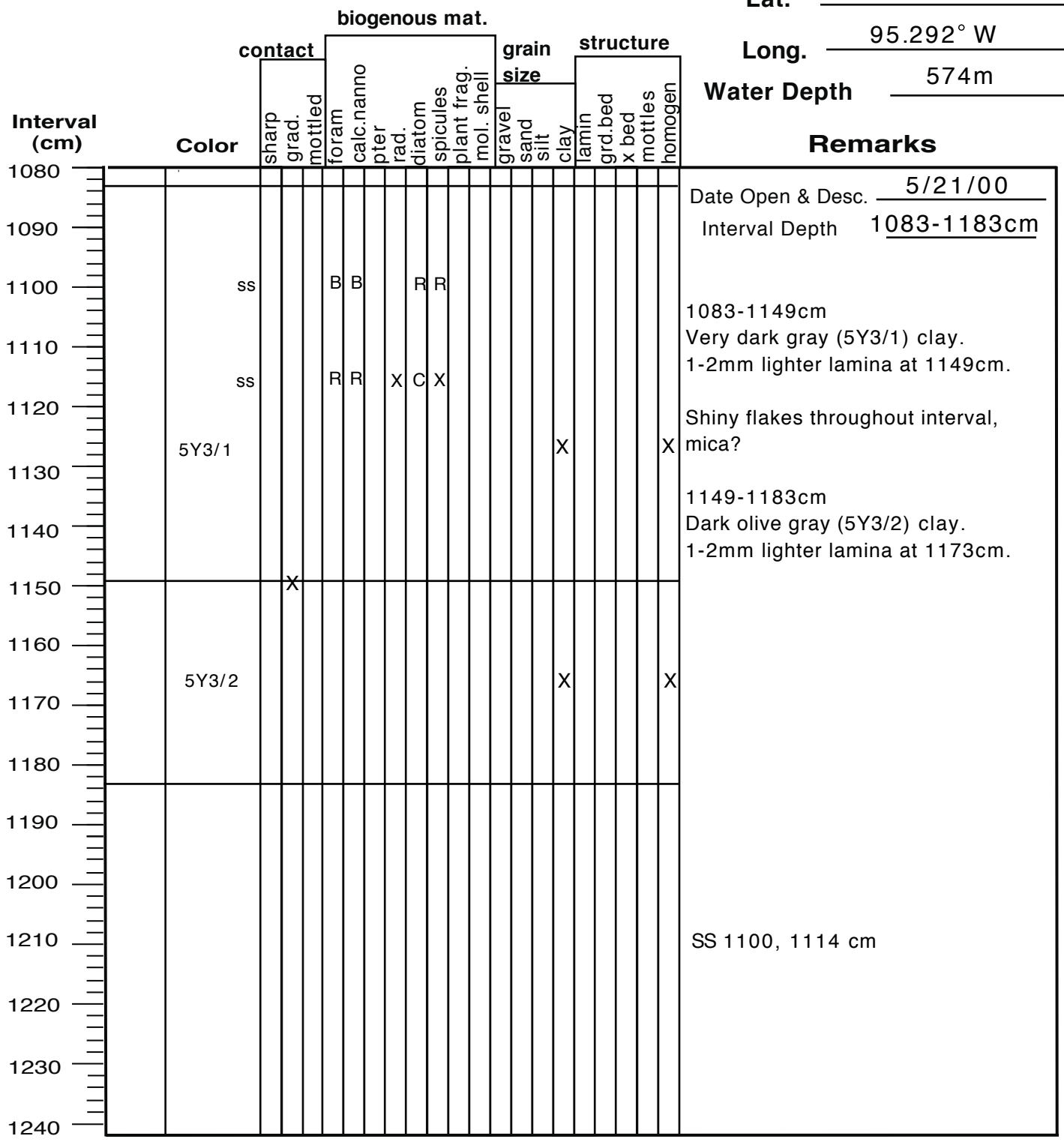
CORE ID ME0005A-11PC

SECTION 12 **of** 15

Lat. 15.713° N

Long. 95.292° W

Water Depth 574m



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

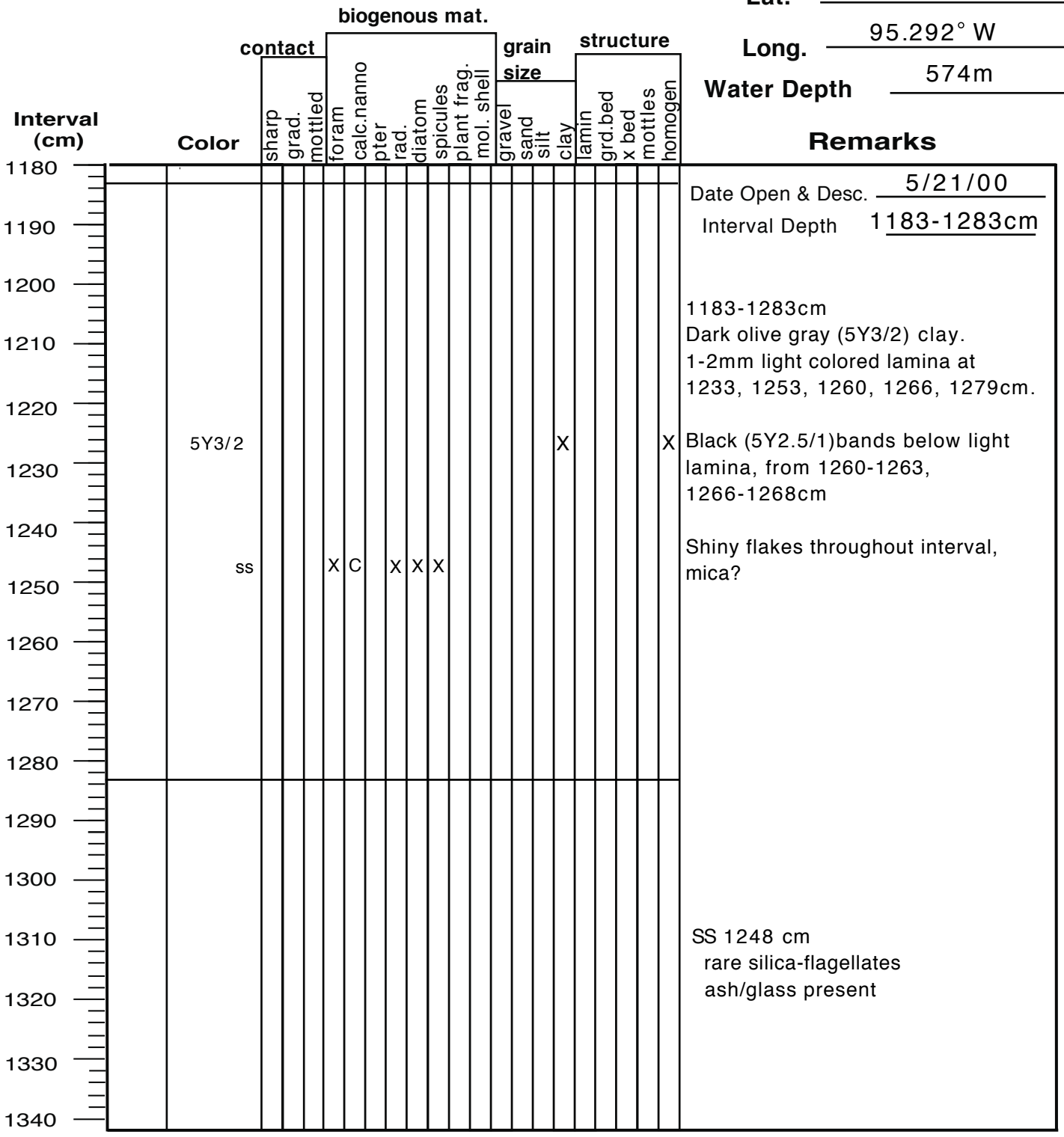
CORE ID ME0005A-11PC

SECTION 13 **of** 15

Lat. 15.713° N

Long. 95.292° W

Water Depth 574m



Remarks

Date Open & Desc. 5/21/00

Interval Depth 1183-1283cm

1183-1283cm
Dark olive gray (5Y3/2) clay.
1-2mm light colored lamina at
1233, 1253, 1260, 1266, 1279cm.

Black (5Y2.5/1)bands below light lamina, from 1260-1263, 1266-1268cm

Shiny flakes throughout interval, mica?

SS 1248 cm
rare silica-flagellates
ash/glass present

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

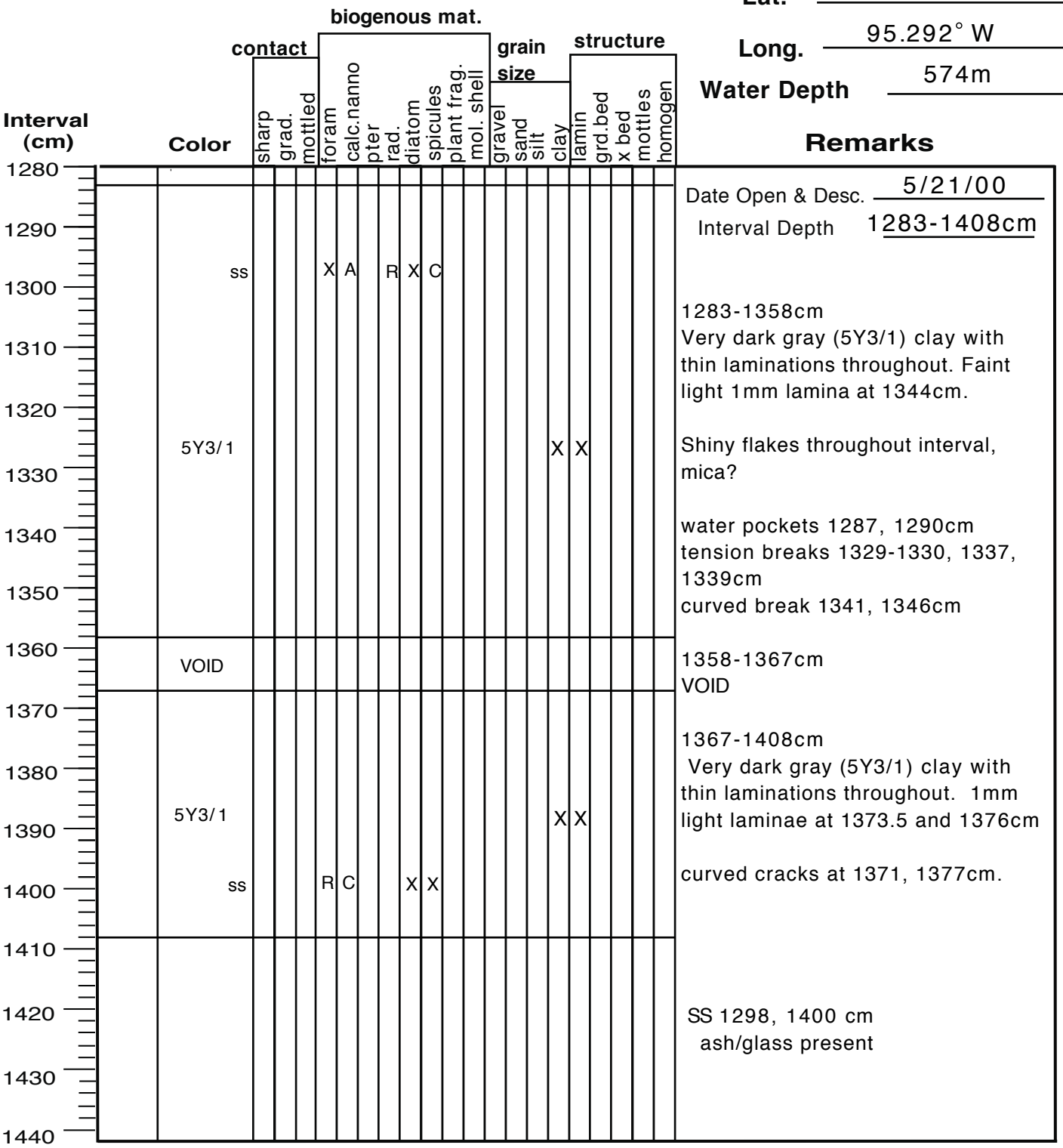
CORE ID ME0005A-11PC

SECTION 14 **of** 15

Lat. 15.713° N

Long. 95.292° W

Water Depth 574m



Date Open & Desc. 5/21/00

Interval Depth 1283-1408cm

1283-1358cm
Very dark gray (5Y3/1) clay with thin laminations throughout. Faint light 1mm lamina at 1344cm.

Shiny flakes throughout interval, mica?

water pockets 1287, 1290cm
tension breaks 1329-1330, 1337, 1339cm
curved break 1341, 1346cm

1358-1367cm
VOID

1367-1408cm
Very dark gray (5Y3/1) clay with thin laminations throughout. 1mm light laminae at 1373.5 and 1376cm

curved cracks at 1371, 1377cm.

SS 1298, 1400 cm
ash/glass present

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

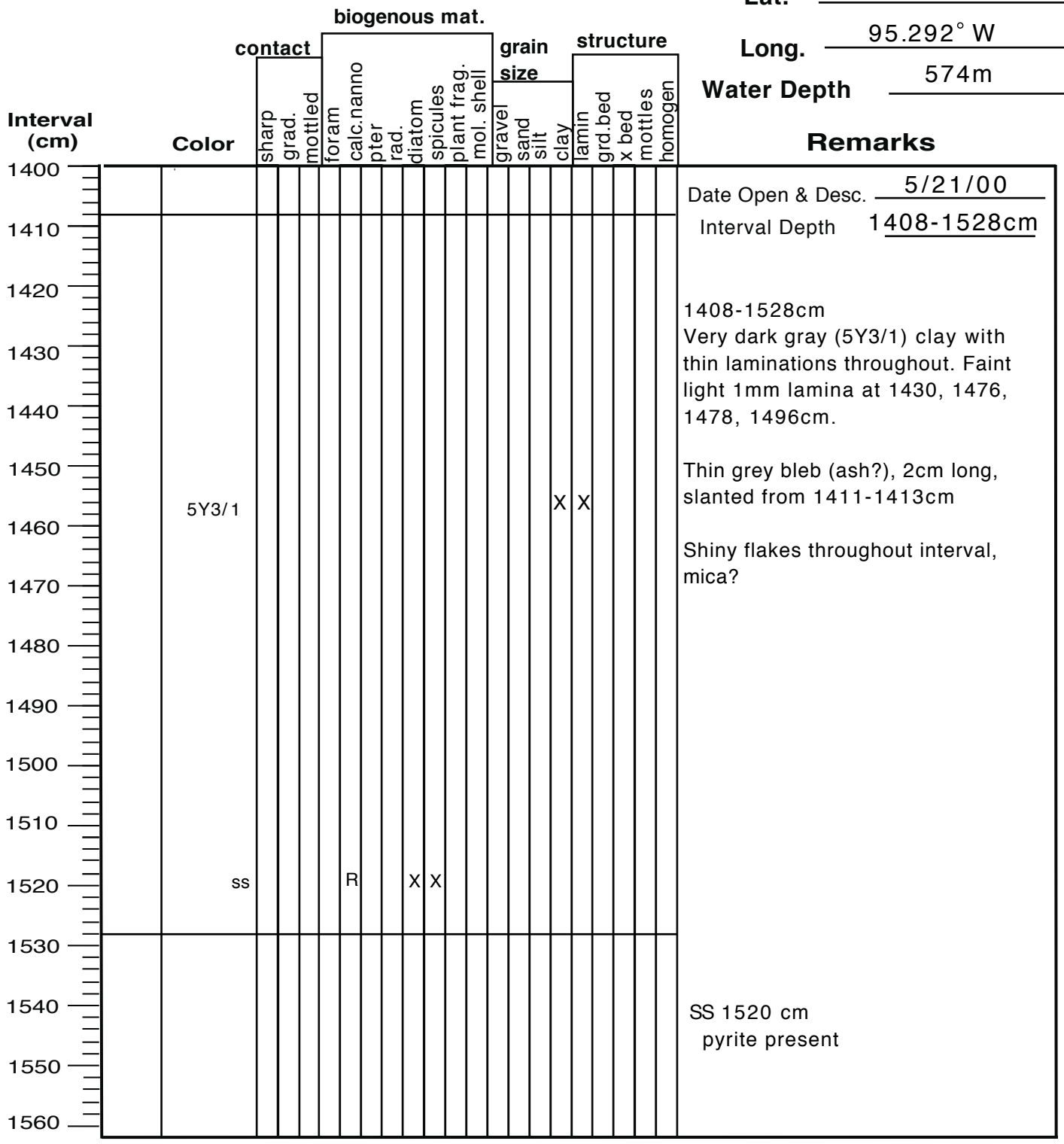
CORE ID ME0005A-11PC

SECTION 15 **of** 15

Lat. 15.713° N

Long. 95.292° W

Water Depth 574m



Remarks

Date Open & Desc. 5/21/00

Interval Depth 1408-1528cm

1408-1528cm
Very dark gray (5Y3/1) clay with thin laminations throughout. Faint light 1mm lamina at 1430, 1476, 1478, 1496cm.

Thin grey bleb (ash?), 2cm long, slanted from 1411-1413cm

Shiny flakes throughout interval, mica?

SS 1520 cm
pyrite present

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

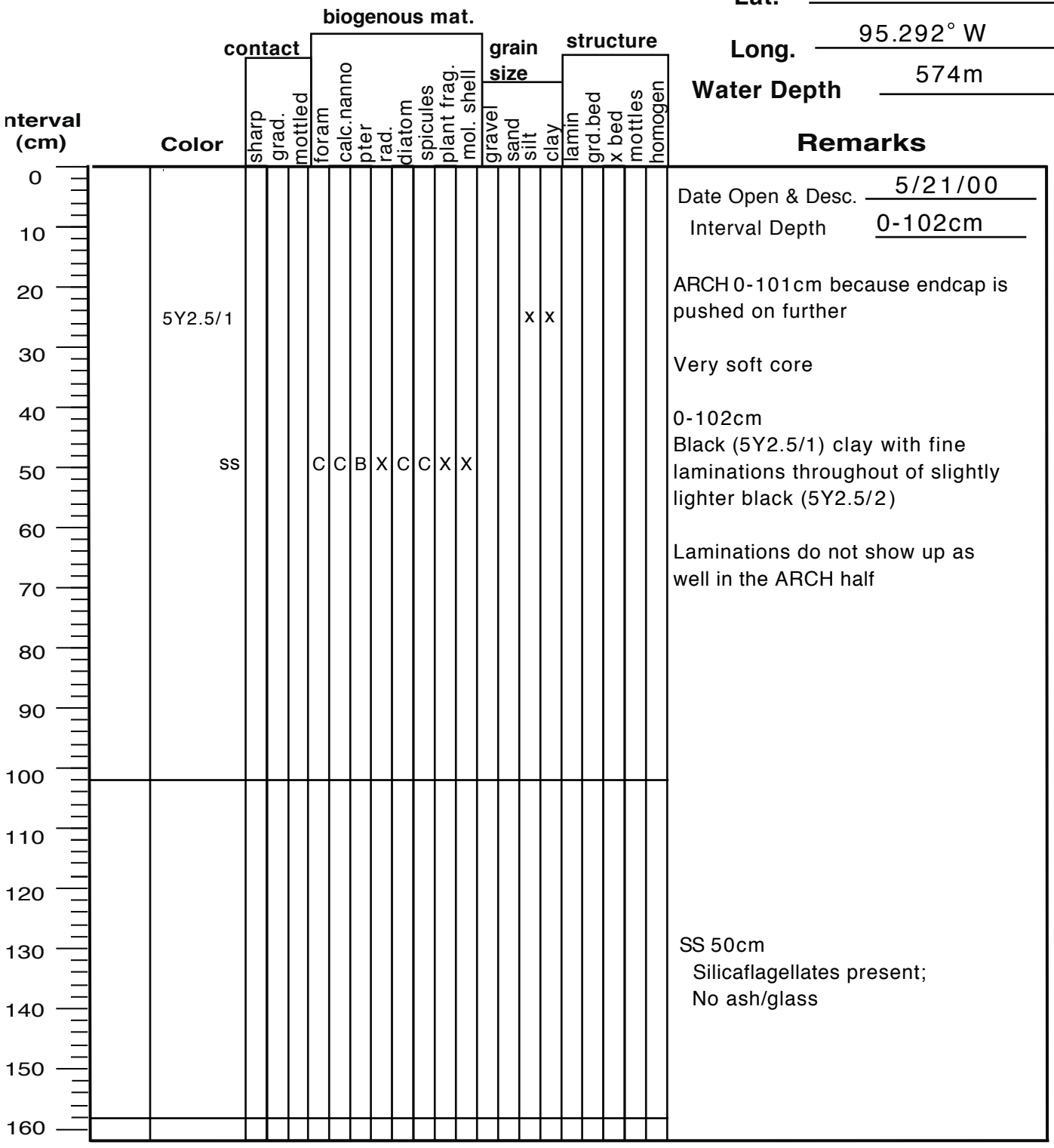
CORE ID ME0005A-11TC

SECTION 01 **of** 02

Lat. 15.713° N

Long. 95.292° W

Water Depth 574m



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

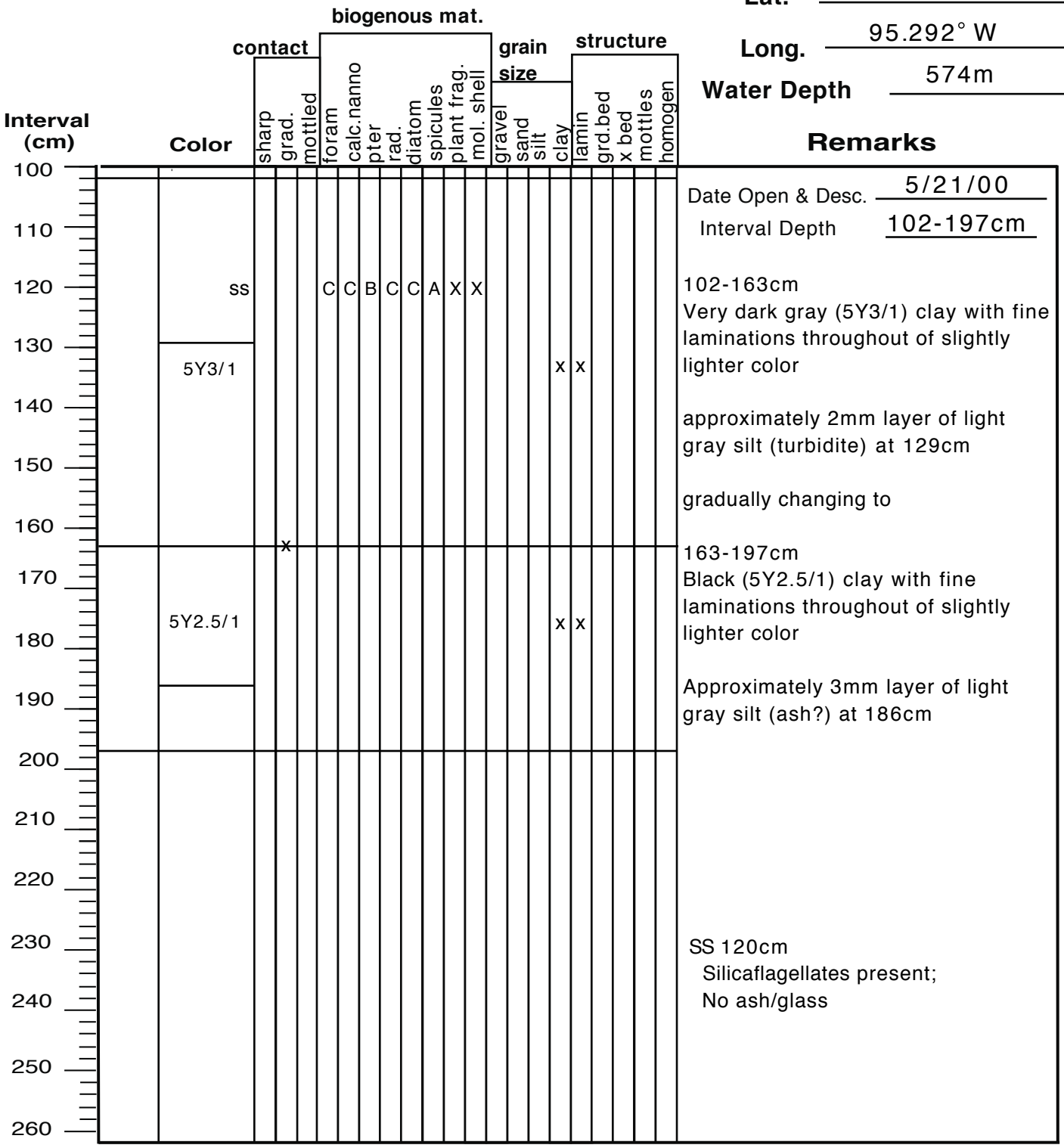
CORE ID ME0005A-11TC

SECTION 02 **of** 02

Lat. 15.713° N

Long. 95.292° W

Water Depth 574m



Remarks

Date Open & Desc. 5/21/00

Interval Depth 102-197cm

102-163cm
Very dark gray (5Y3/1) clay with fine laminations throughout of slightly lighter color

approximately 2mm layer of light gray silt (turbidite) at 129cm

gradually changing to

163-197cm
Black (5Y2.5/1) clay with fine laminations throughout of slightly lighter color

Approximately 3mm layer of light gray silt (ash?) at 186cm

SS 120cm
Silicaflagellates present;
No ash/glass

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

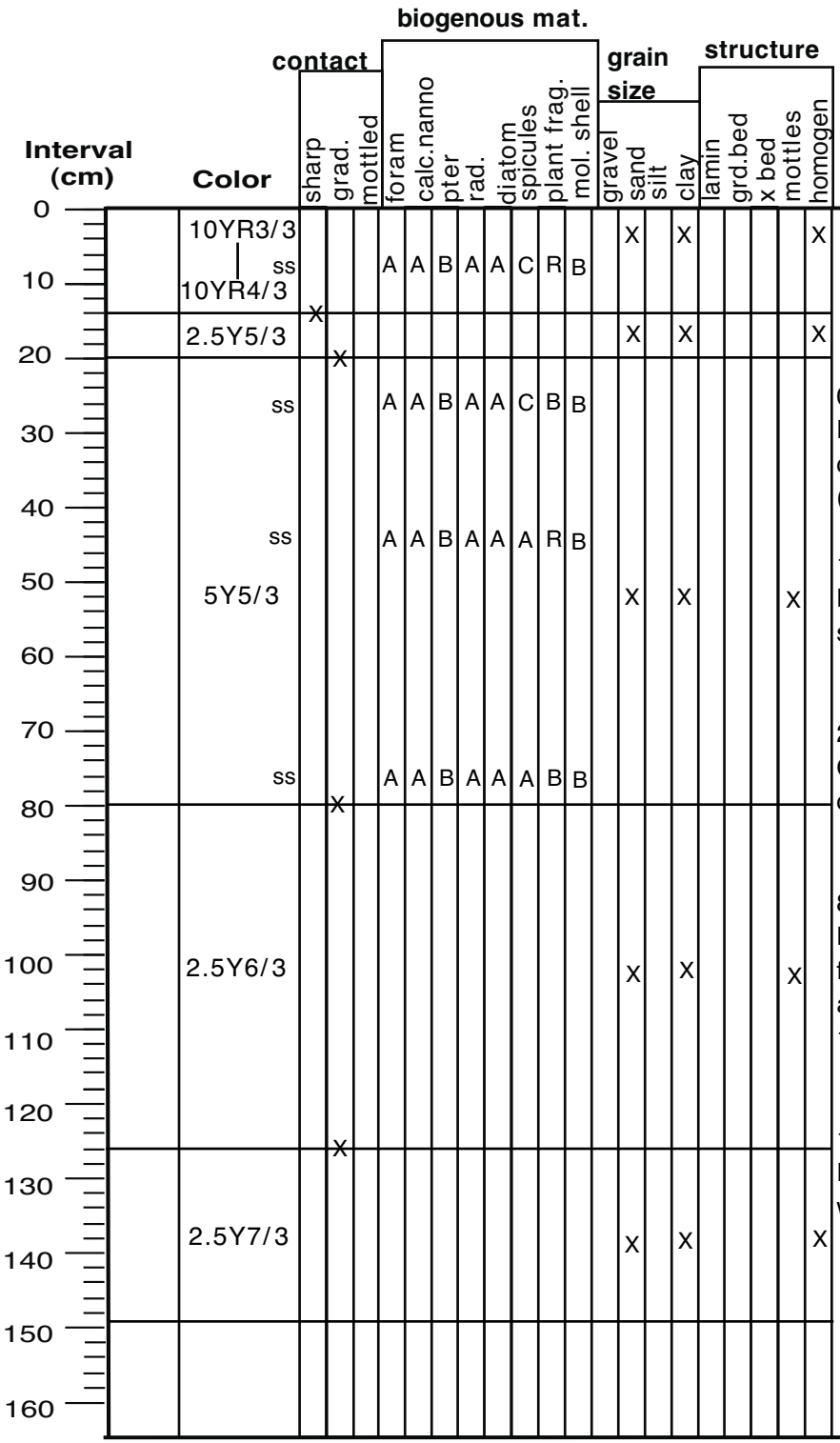
CORE ID ME0005A-19TC

SECTION 1 **of** 2

Lat. 3° 12.75' N

Long. 86° 29.16' W

Water Depth 2675M



Remarks

Date Open & Desc. 5/26/2000

Interval Depth 0-149cm

Redescribed 1/17/2002

0-14cm
Dark brown (10YR3/3) calcareous ooze grading to brown (10YR4/3) (Brown-green transition)

14-20cm
Light olive brown (2.5Y5/3) foram sand
grading to

20-80cm
Olive (5Y5/3) foram sand with a few darker mottles
grading to

80-126cm
Light yellowish brown (2.5Y6/3) foram sand with a few darker streaks and mottles. Open burrows at 93, 105cm
grading to

126-149cm
Pale yellow (2.5Y7/3) foram sand with one darker mottle at 133-134cm

ss 8,26,44,77cm
silica flagellates present in all;
echinoid spines observed at 44cm

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

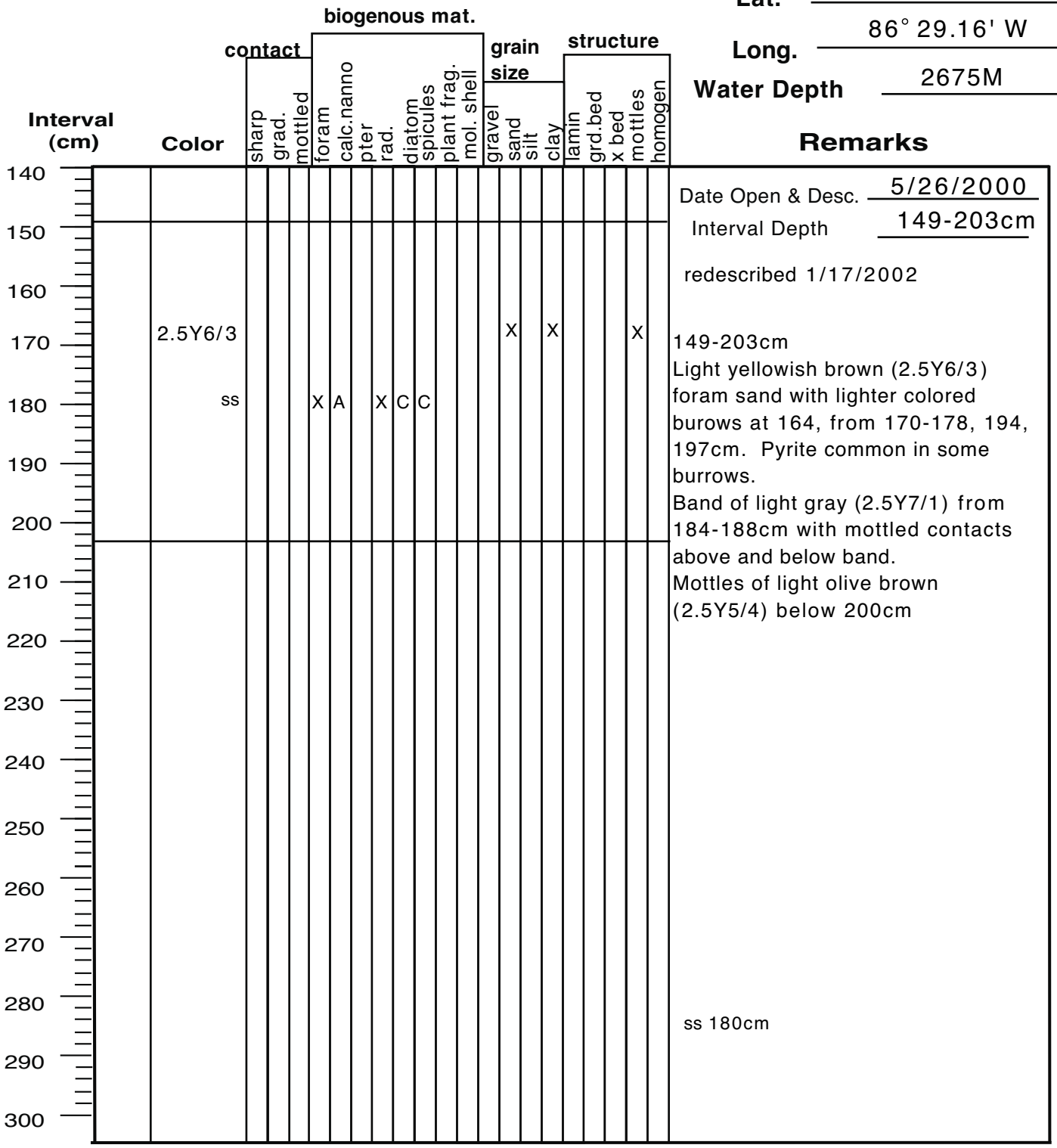
CORE ID ME0005A-19TC

SECTION 2 **of** 2

Lat. 3° 12.75' N

Long. 86° 29.16' W

Water Depth 2675M



Date Open & Desc. 5/26/2000

Interval Depth 149-203cm

redescribed 1/17/2002

149-203cm
Light yellowish brown (2.5Y6/3) foram sand with lighter colored burows at 164, from 170-178, 194, 197cm. Pyrite common in some burrows.
Band of light gray (2.5Y7/1) from 184-188cm with mottled contacts above and below band.
Mottles of light olive brown (2.5Y5/4) below 200cm

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

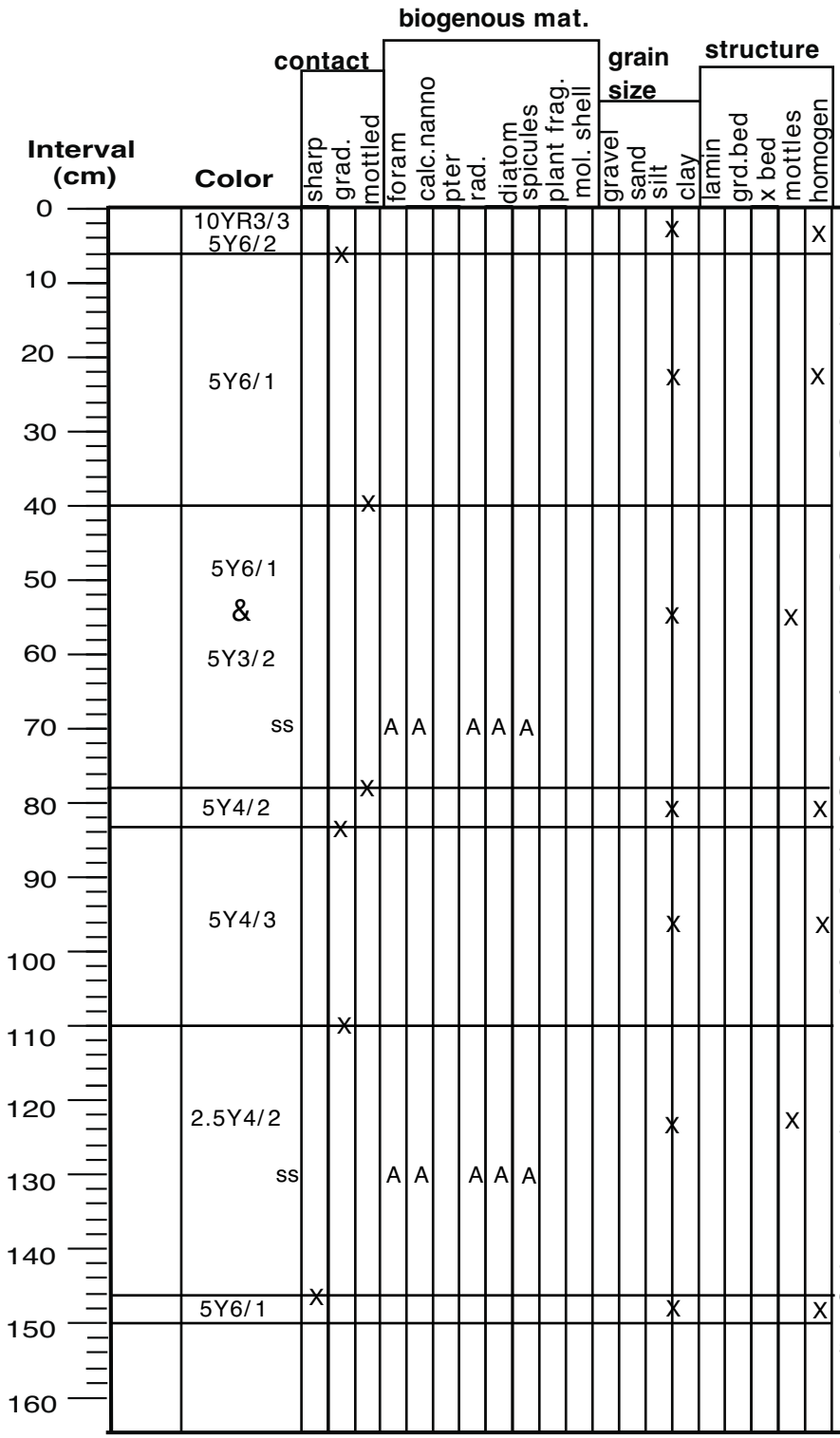
CORE ID ME0005A-23TC

SECTION 1 **of** 1

Lat. 0° 1.30' N

Long. 86° 27.79' W

Water Depth 2945M



Remarks

Date Open & Desc. 5/28/2000

Interval Depth 0-150cm

soft core with water pocket at 38cm

Dark brown (10YR3/3) surface layer entrained down side of core
0-6cm
Light olive gray (5Y6/2) siliceous nannofossil ooze
grading to
6-40cm
Gray (5Y6/1) ooze

40-78cm
Highly mottled mix of gray (5Y6/1) diatomaceous ooze with dark olive gray (5Y3/2) carbonate ooze

78-83cm
Olive gray (5Y4/2) ooze

83-110cm
Olive (5Y4/3) nannofossil ooze

110-146cm
Dark grayish brown (2.5Y4/2) ooze subtly mottled

146-150cm
Dark brown (10YR3/3) 1-2mm band at transition, curved across the core. Gray (5Y6/1) nannofossil ooze.

ss 70, 130cm
silica flagellates abundant at 70cm
present at 130cm

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

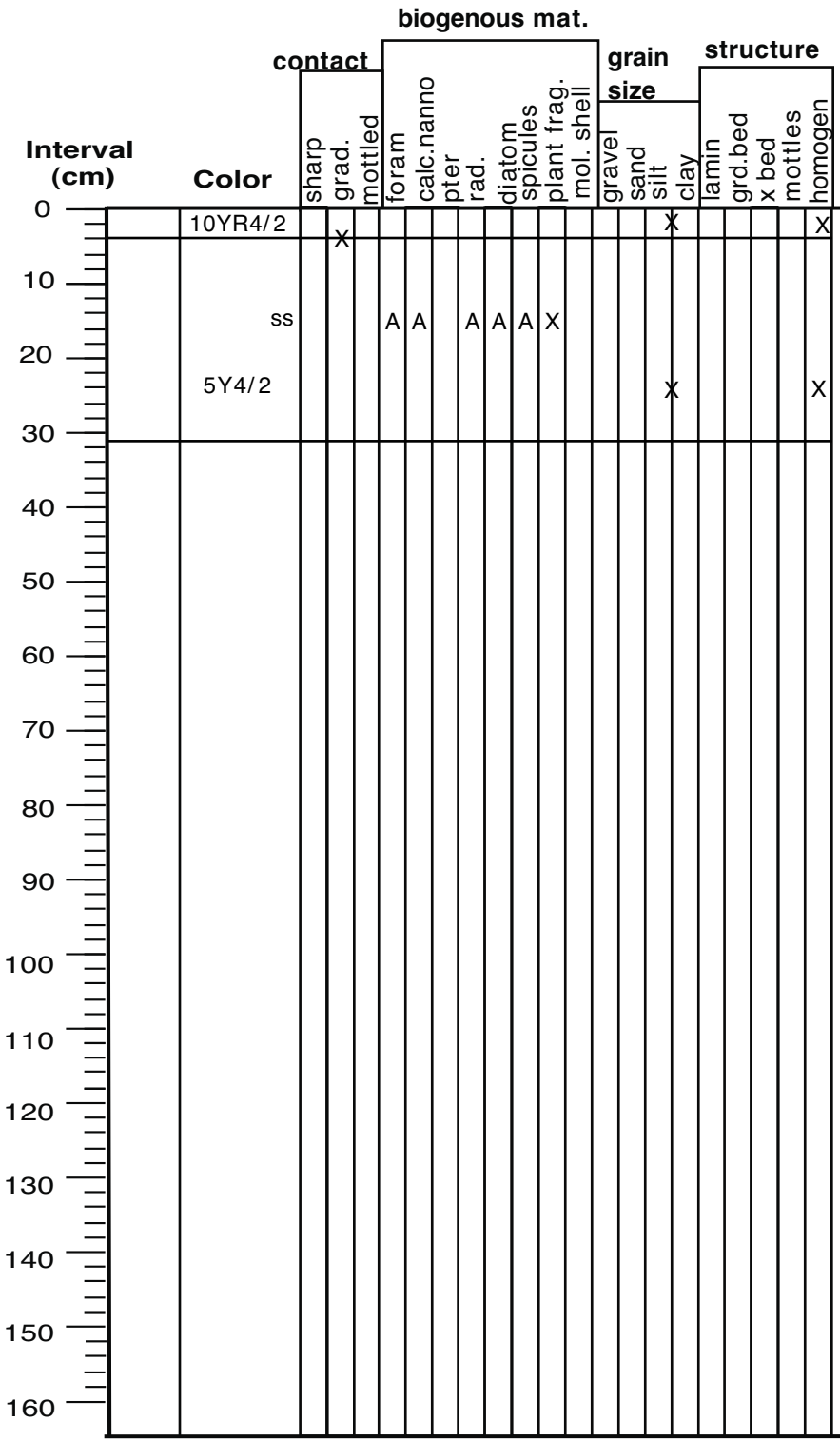
CORE ID ME0005A-25MC2

SECTION 1 **of** 1

Lat. 1° 51.202' S

Long. 82° 47.201' W

Water Depth 2204M



Date Open & Desc. 5/30/2000

Interval Depth 0-31cm

poorly split,
1/3 ARCH; 2/3 WORK

0-4cm
Dark grayish brown (10YR4/2) foram ooze

grading to

Olive gray (5Y4/2) foram ooze.

Open burrows at 22 and 25cm

ss 15cm
silico-flagellates present

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

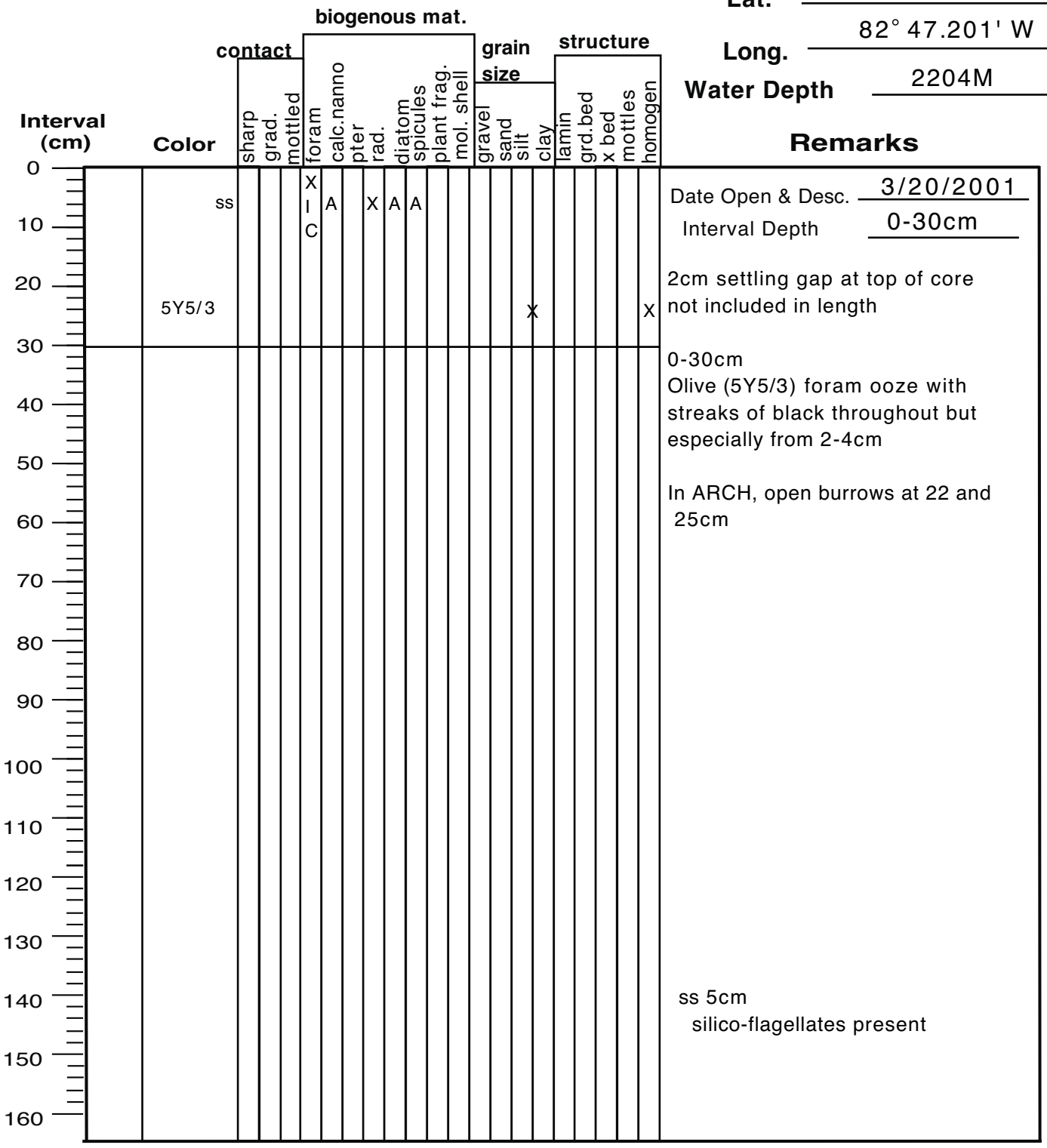
CORE ID ME0005A-25MC3

SECTION 1 **of** 1

Lat. 1° 51.202' S

Long. 82° 47.201' W

Water Depth 2204M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

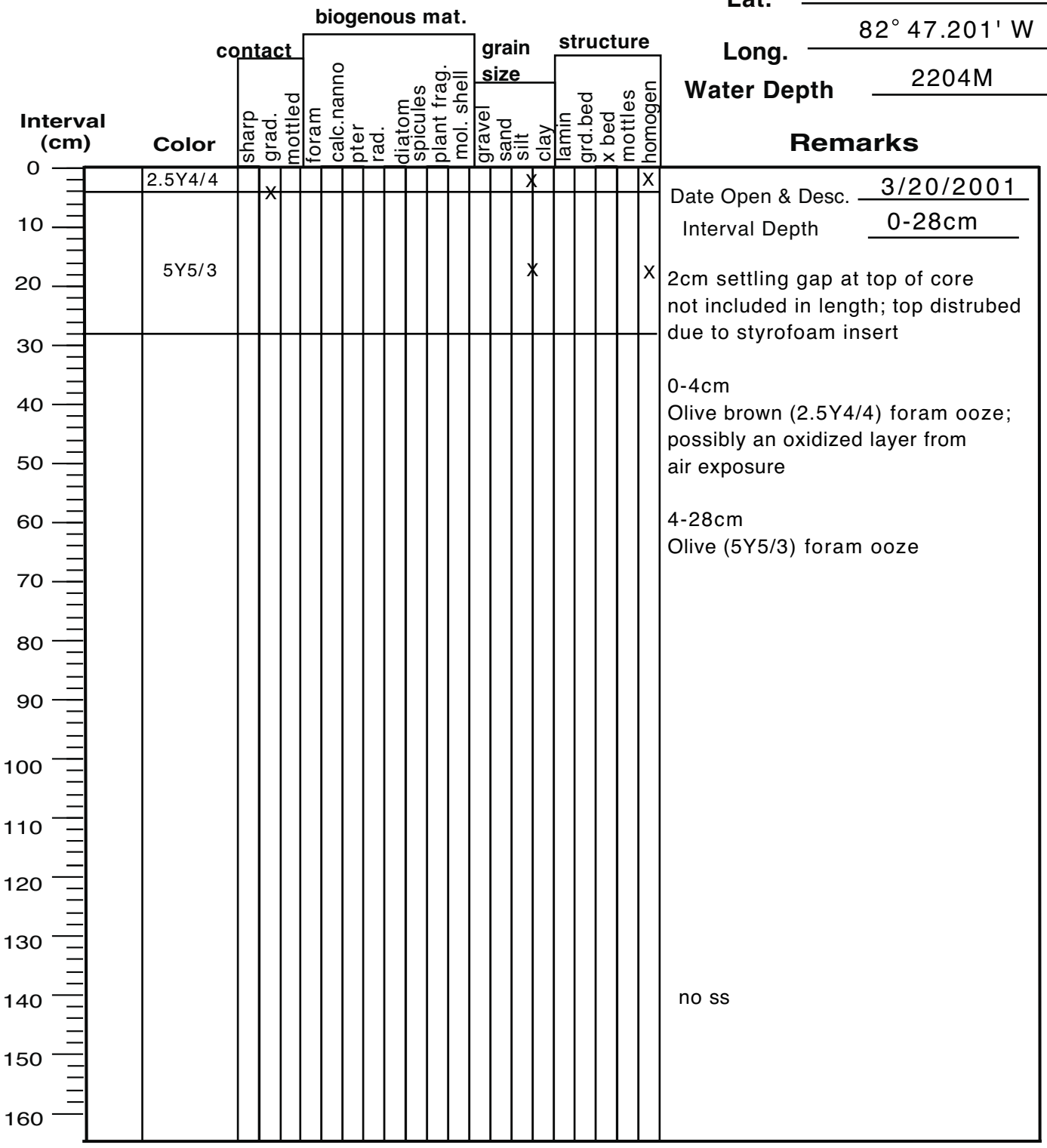
CORE ID ME0005A-25MC4

SECTION 1 **of** 1

Lat. 1° 51.202' S

Long. 82° 47.201' W

Water Depth 2204M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

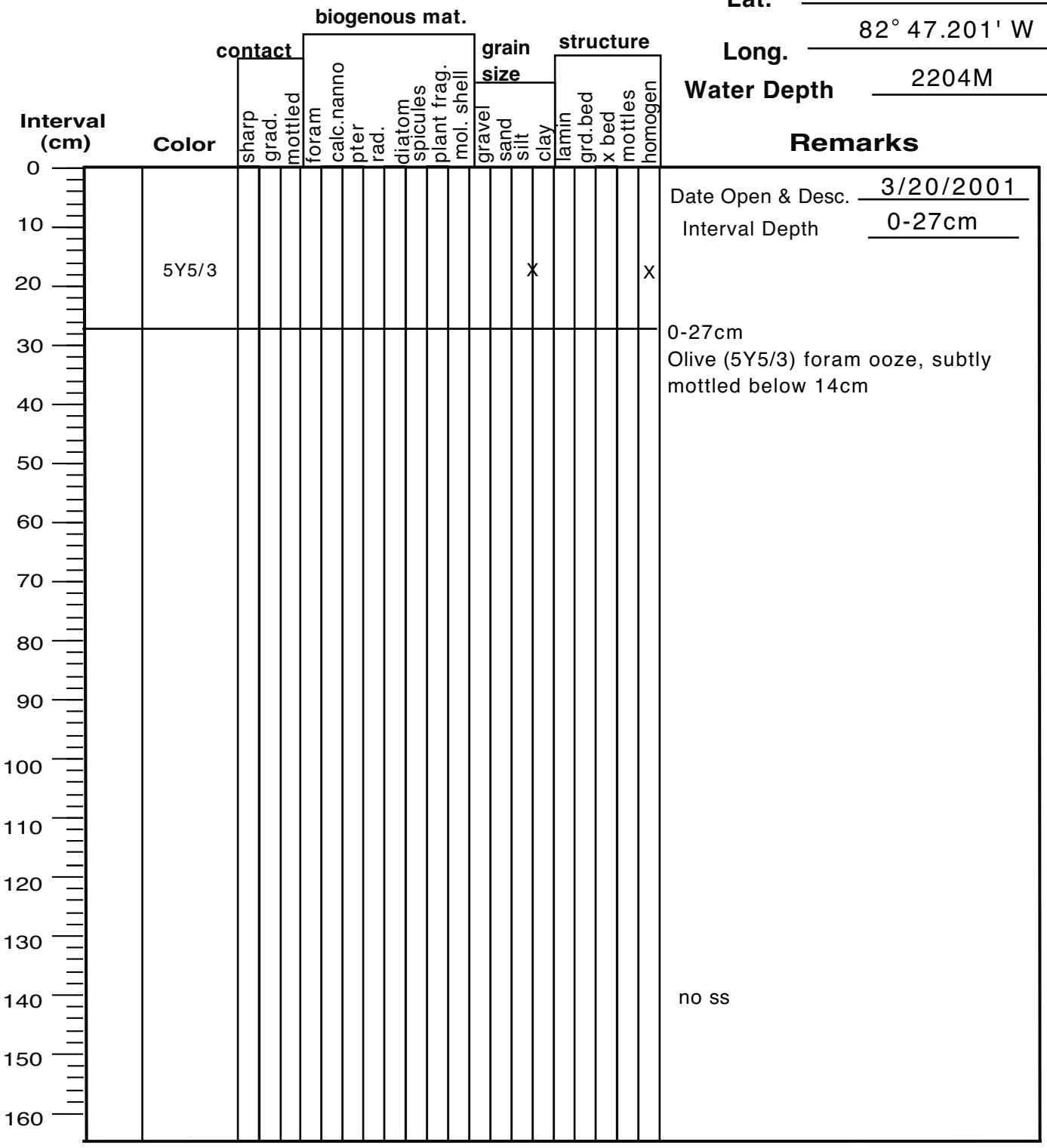
CORE ID ME0005A-25MC5

SECTION 1 **of** 1

Lat. 1° 51.202' S

Long. 82° 47.201' W

Water Depth 2204M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

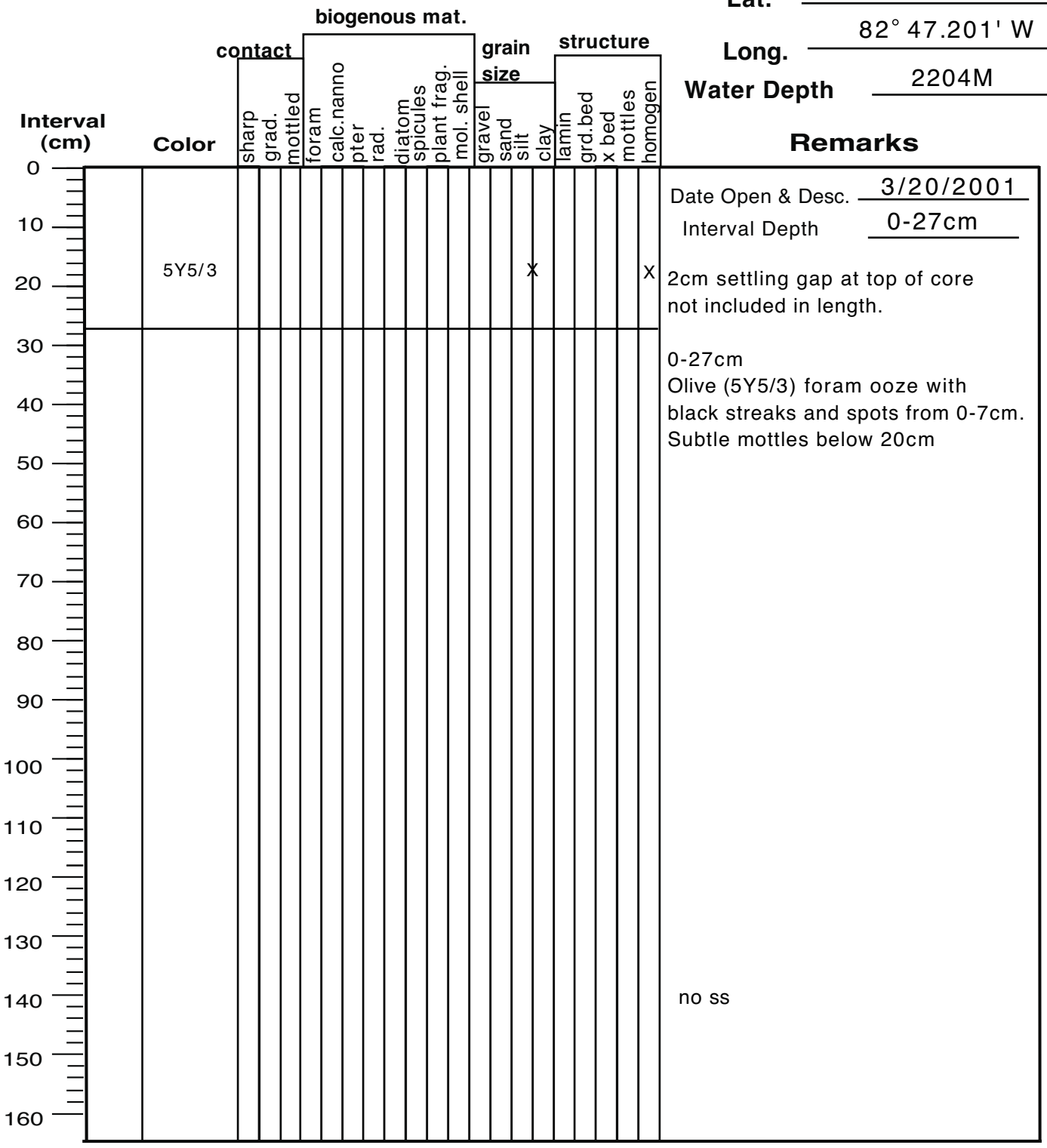
CORE ID ME0005A-25MC6

SECTION 1 **of** 1

Lat. 1° 51.202' S

Long. 82° 47.201' W

Water Depth 2204M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

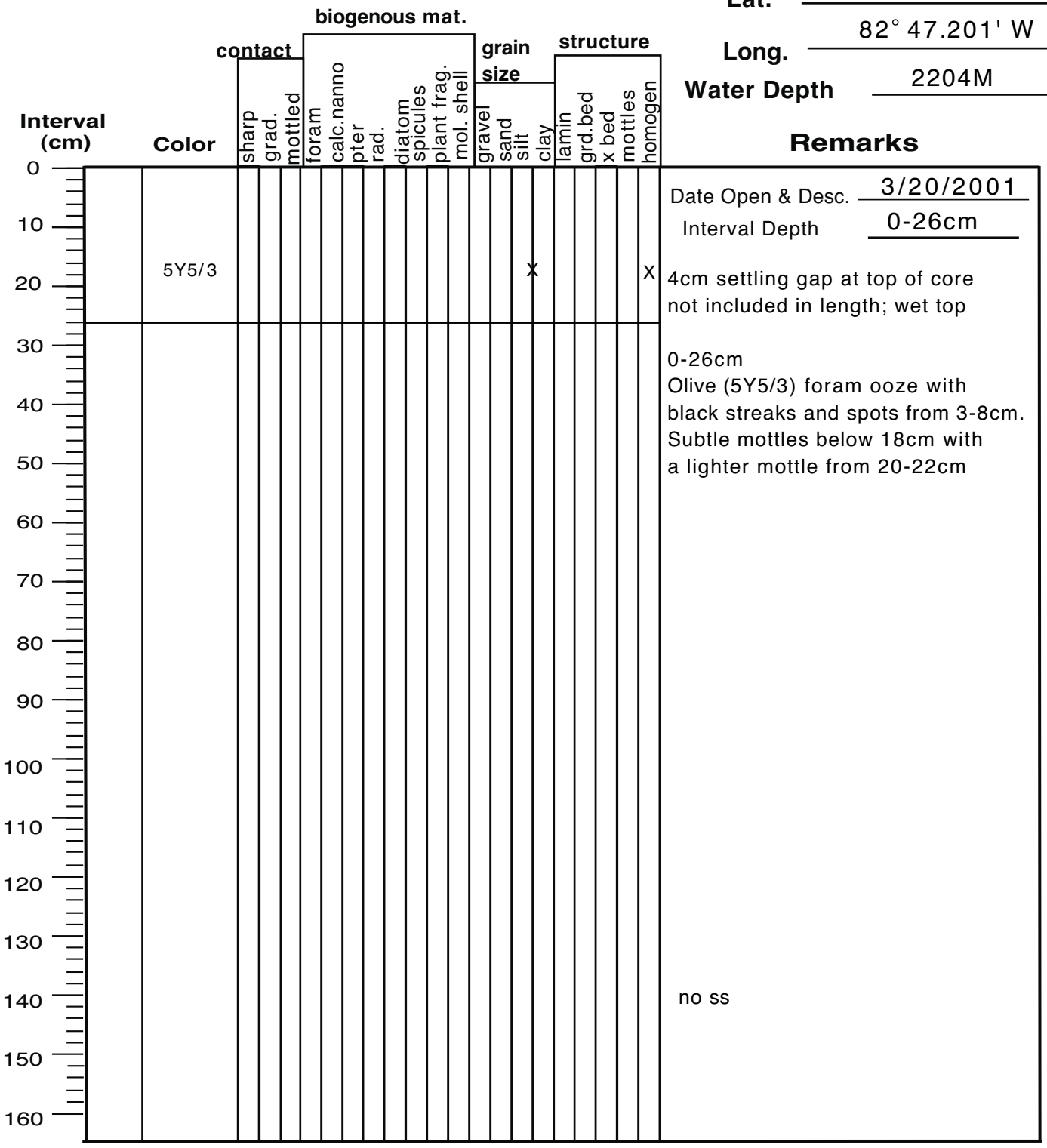
CORE ID ME0005A-25MC7

SECTION 1 **of** 1

Lat. 1° 51.202' S

Long. 82° 47.201' W

Water Depth 2204M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

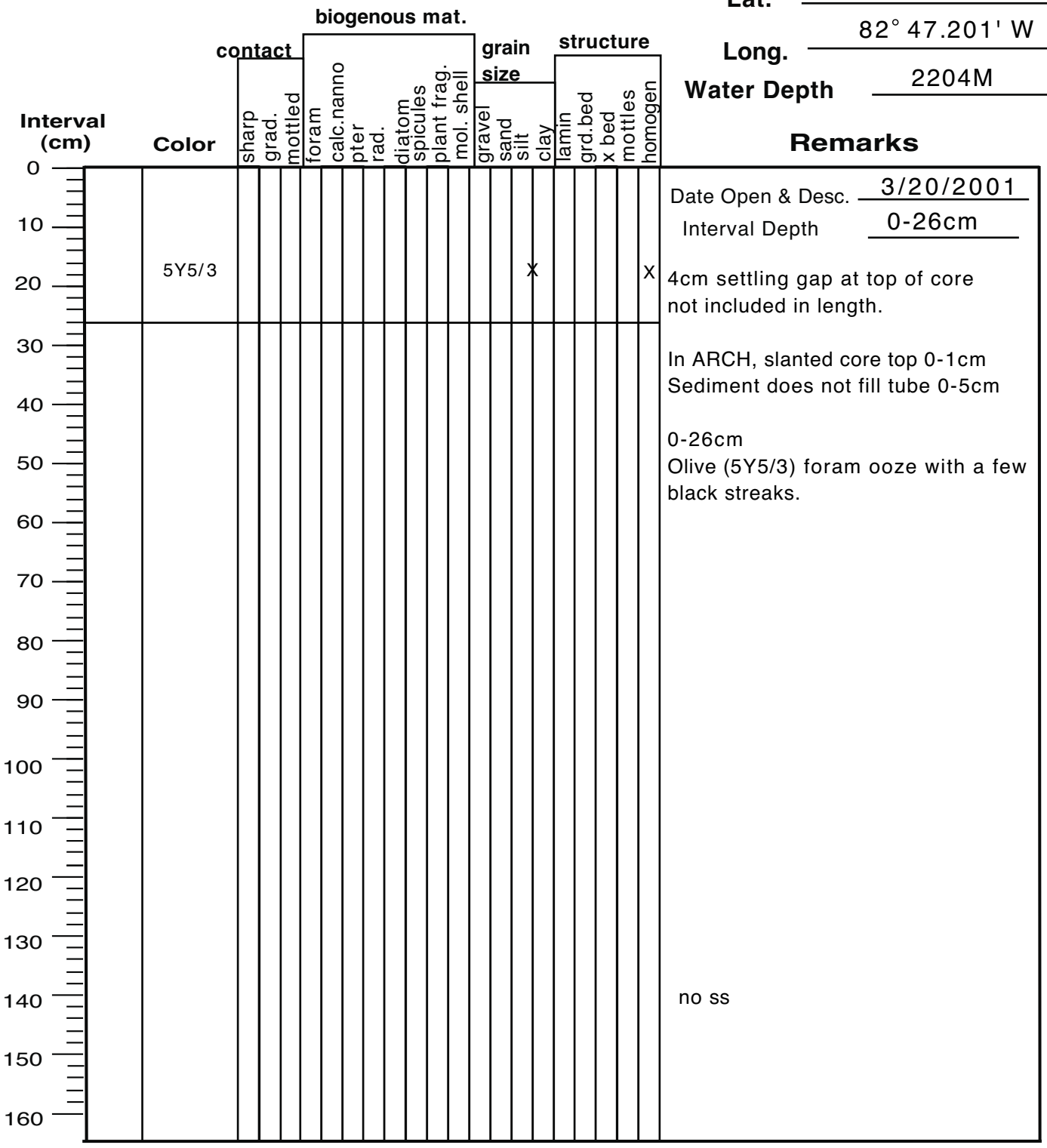
CORE ID ME0005A-25MC8

SECTION 1 **of** 1

Lat. 1° 51.202' S

Long. 82° 47.201' W

Water Depth 2204M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

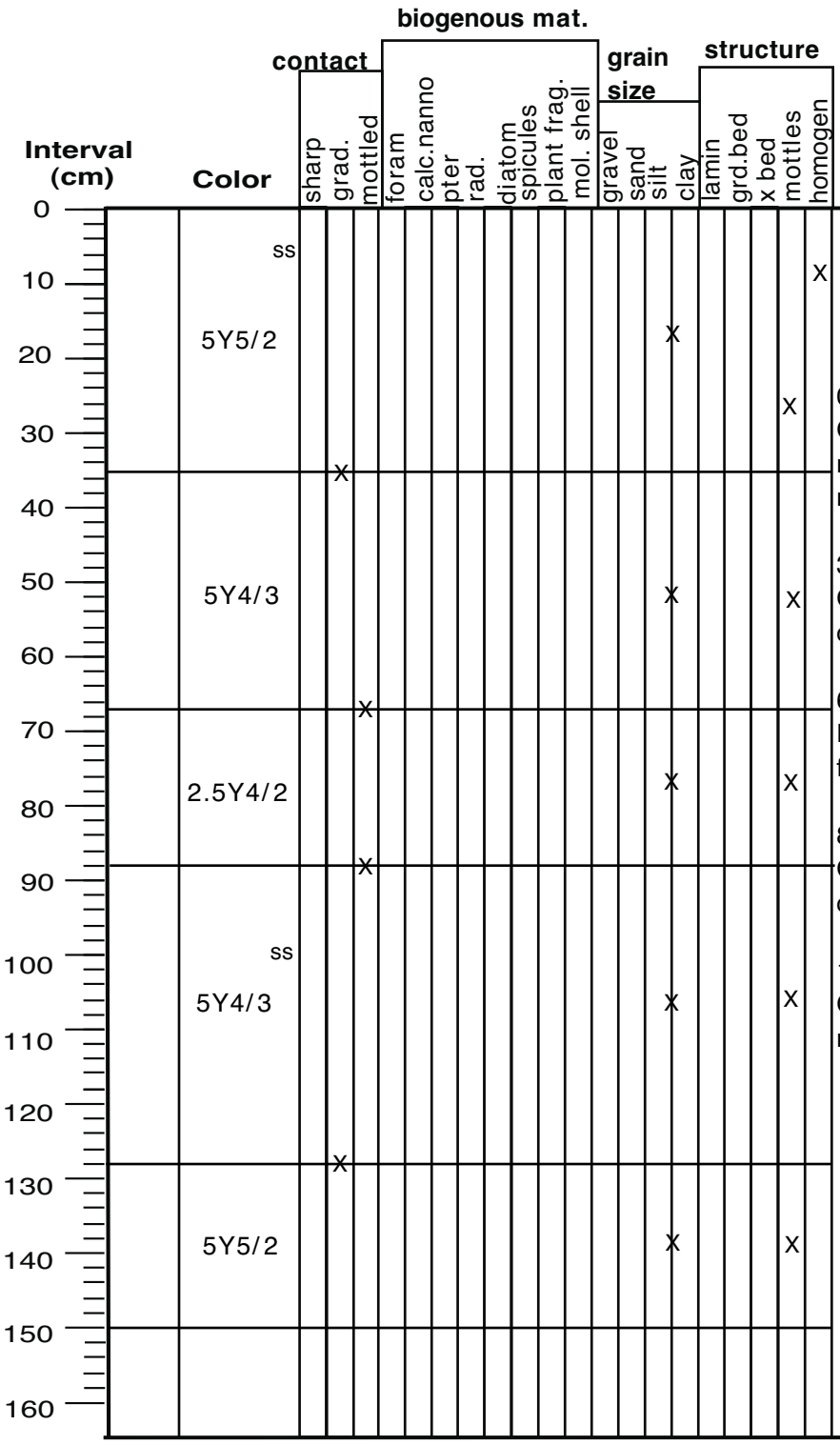
CORE ID ME0005A-27TC

SECTION 1 **of** 2

Lat. 1° 51.201' S

Long. 82° 47.200' W

Water Depth 2203M



Remarks

Date Open & Desc. 5/30/2000

Interval Depth 0-150cm

0-35cm
Olive gray (5Y5/2) siliceous nannofossil ooze with some mottling near base of interval

35-67cm
Olive (5Y4/3) siliceous nannofossil ooze lightly mottled

67-88cm
Dark grayish brown (2.5Y4/2) with a few lighter mottles

88-128cm
Olive (5Y4/3) siliceous nannofossil ooze lightly mottled.

128-150cm
Olive gray (5Y5/2) siliceous nannofossil ooze lightly mottled

ss 5, 100cm

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

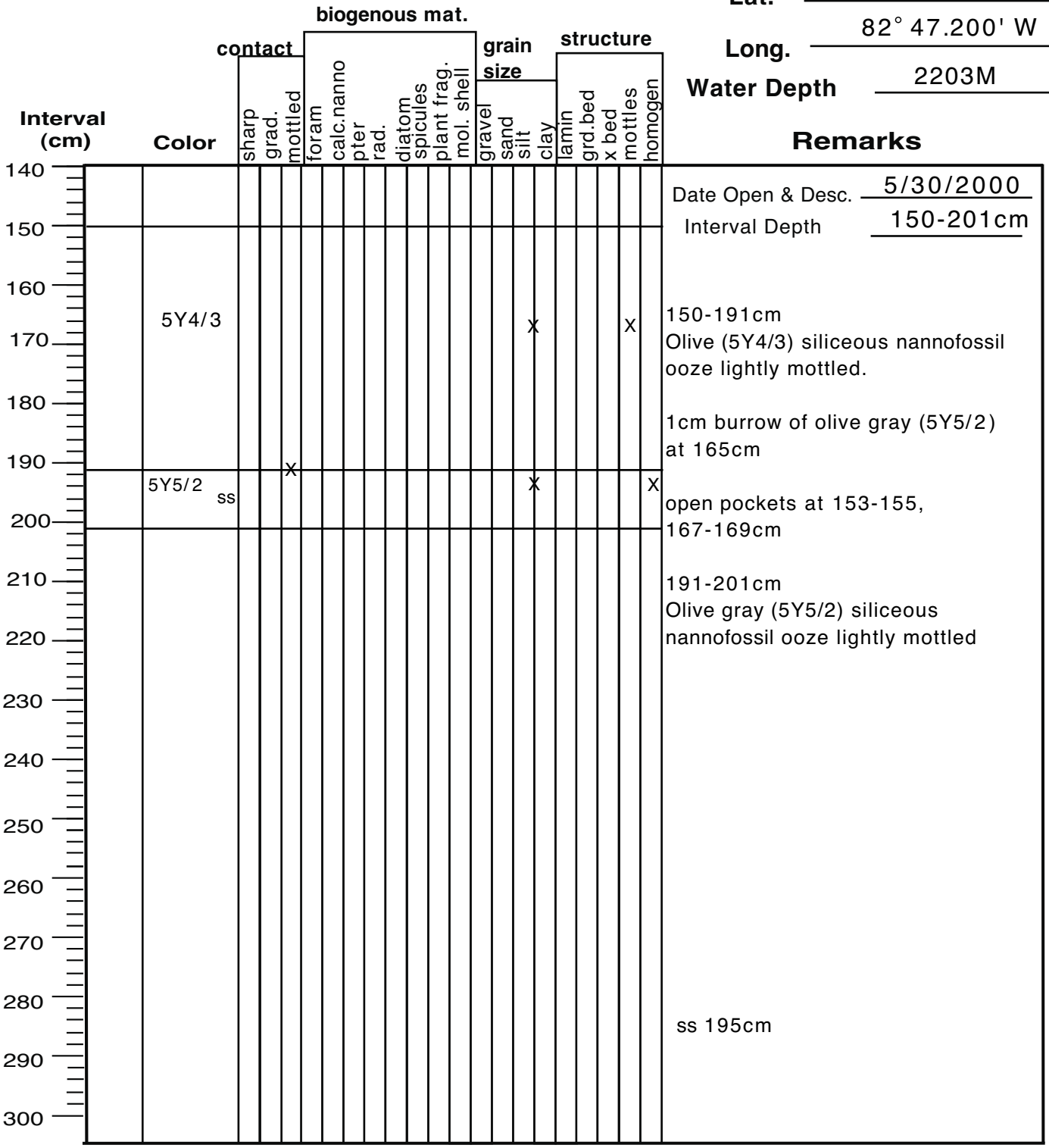
CORE ID ME0005A-27TC

SECTION 2 **of** 2

Lat. 1° 51.201' S

Long. 82° 47.200' W

Water Depth 2203M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

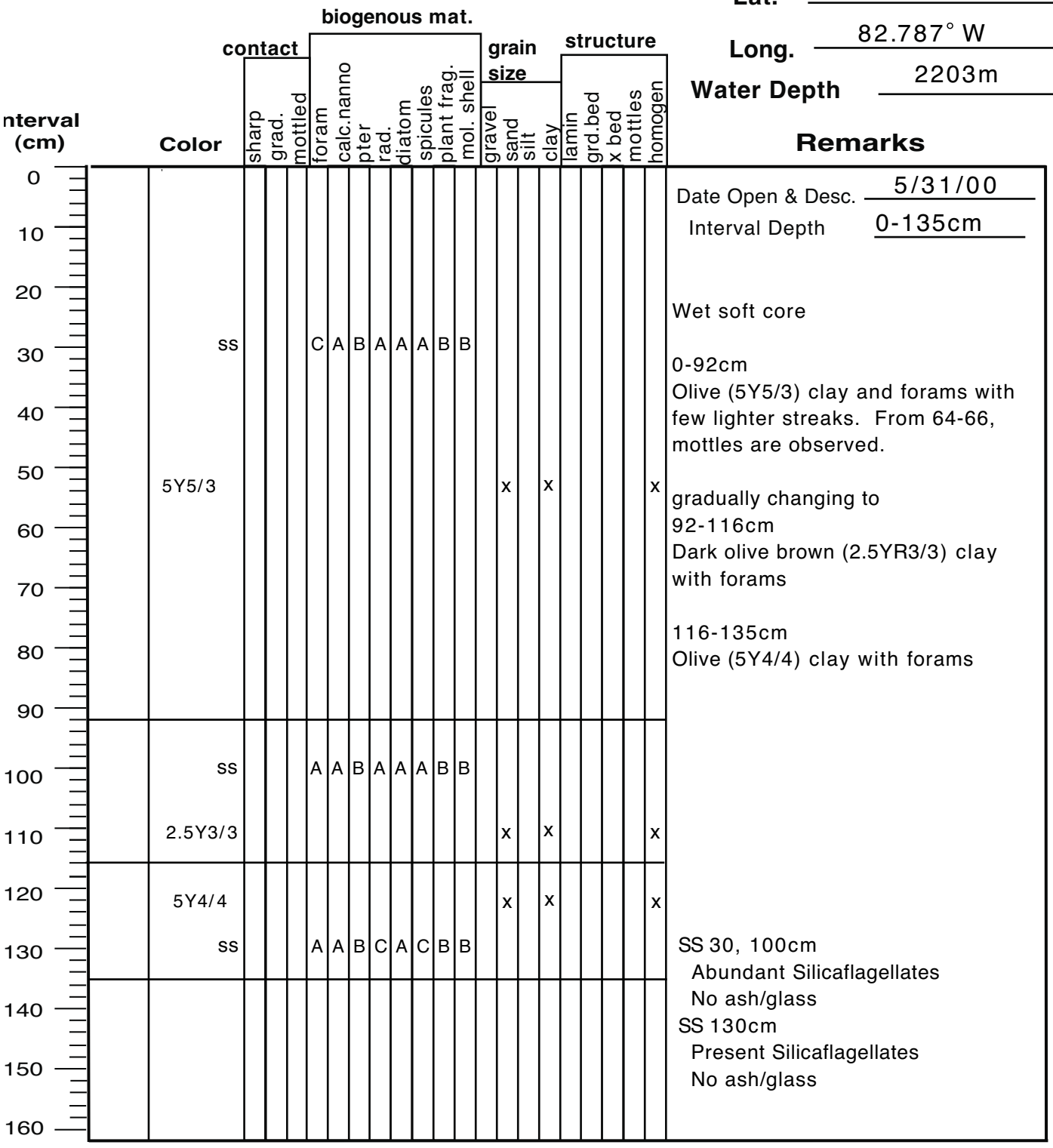
CORE ID ME0005A-28GC

SECTION 01 **of** 02

Lat. 1.853° S

Long. 82.787° W

Water Depth 2203m



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

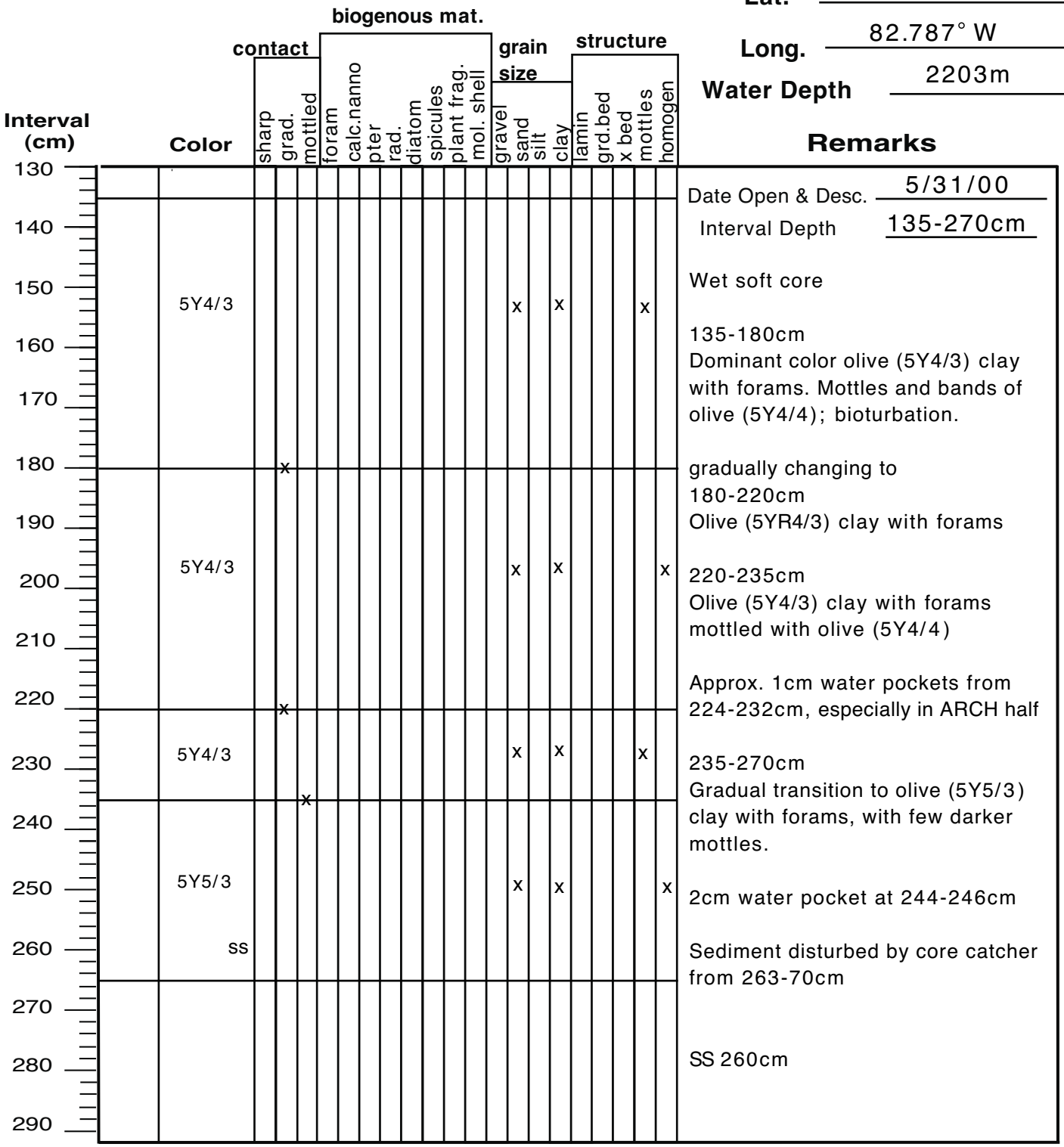
CORE ID ME0005A-28GC

SECTION 02 **of** 02

Lat. 1.853° S

Long. 82.787° W

Water Depth 2203m



Remarks

Date Open & Desc. 5/31/00

Interval Depth 135-270cm

Wet soft core

135-180cm
Dominant color olive (5Y4/3) clay with forams. Mottles and bands of olive (5Y4/4); bioturbation.

gradually changing to
180-220cm
Olive (5YR4/3) clay with forams

220-235cm
Olive (5Y4/3) clay with forams mottled with olive (5Y4/4)

Approx. 1cm water pockets from 224-232cm, especially in ARCH half

235-270cm
Gradual transition to olive (5Y5/3) clay with forams, with few darker mottles.

2cm water pocket at 244-246cm

Sediment disturbed by core catcher from 263-70cm

SS 260cm

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

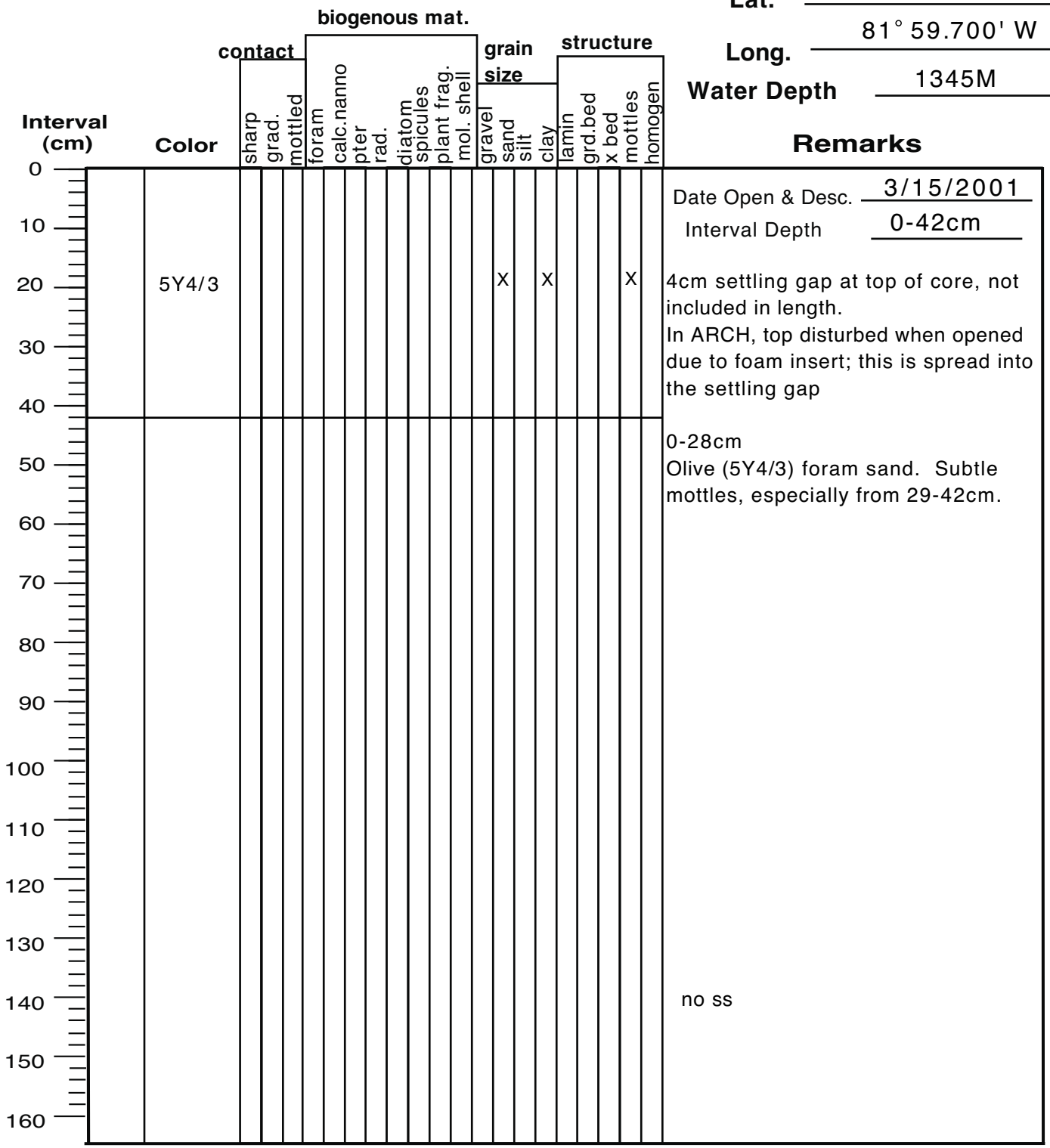
CORE ID ME0005A-29MC1

SECTION 1 **of** 1

Lat. 0° 30.801' S

Long. 81° 59.700' W

Water Depth 1345M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

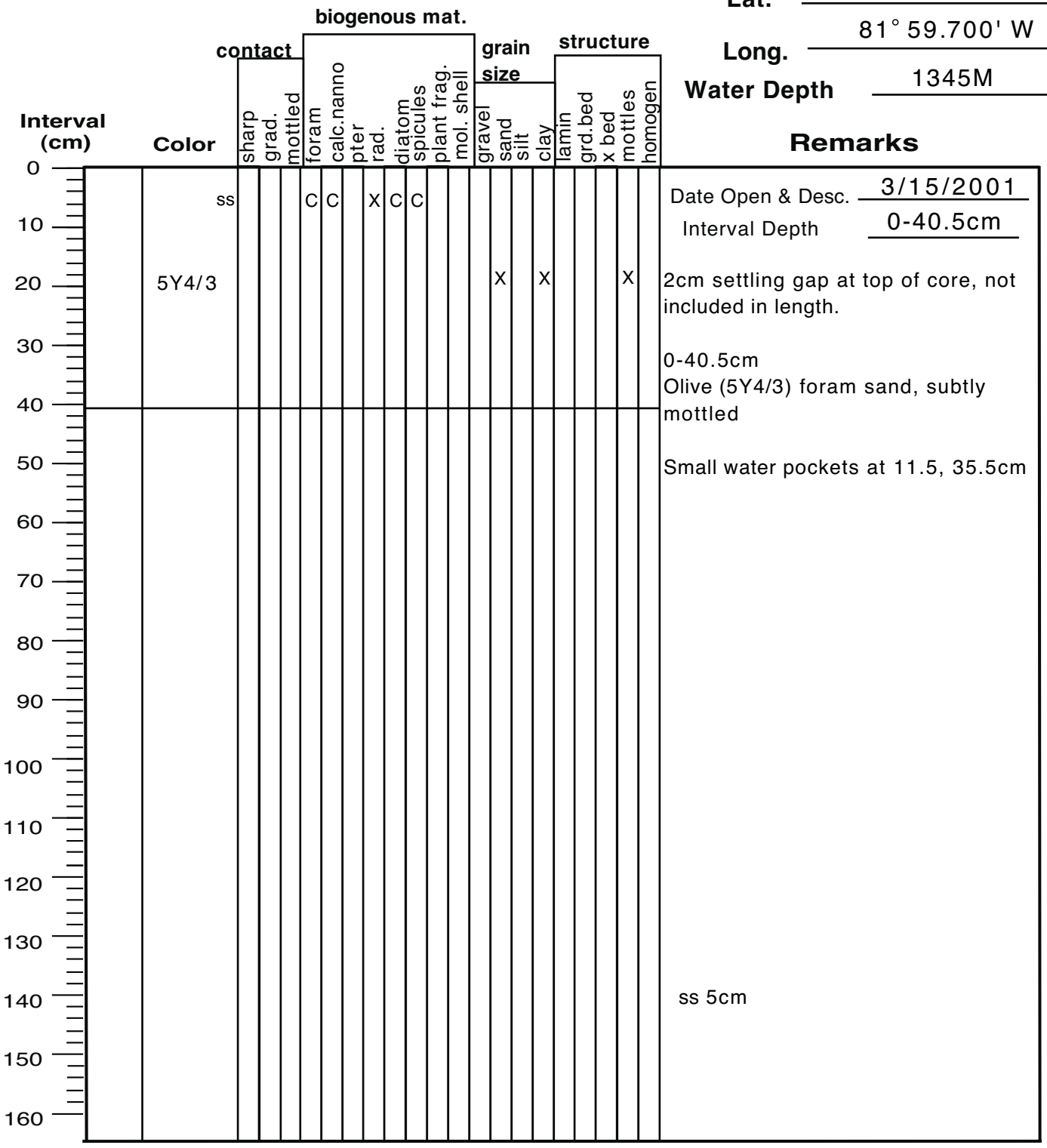
CORE ID ME0005A-29MC2

SECTION 1 **of** 1

Lat. 0° 30.801' S

Long. 81° 59.700' W

Water Depth 1345M



Date Open & Desc. 3/15/2001

Interval Depth 0-40.5cm

2cm settling gap at top of core, not included in length.

0-40.5cm
Olive (5Y4/3) foram sand, subtly mottled

Small water pockets at 11.5, 35.5cm

ss 5cm

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

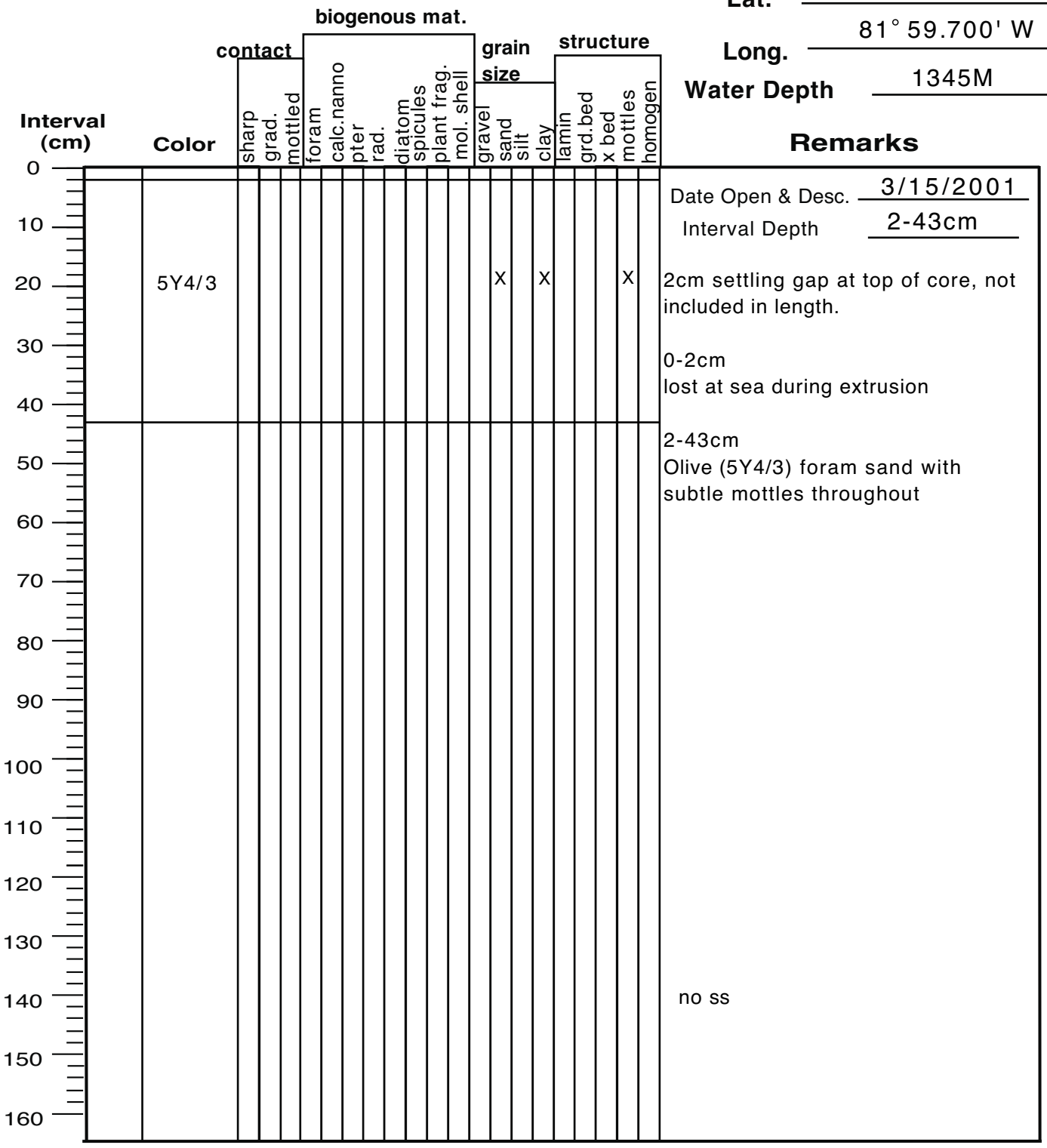
CORE ID ME0005A-29MC3

SECTION 1 **of** 1

Lat. 0° 30.801' S

Long. 81° 59.700' W

Water Depth 1345M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

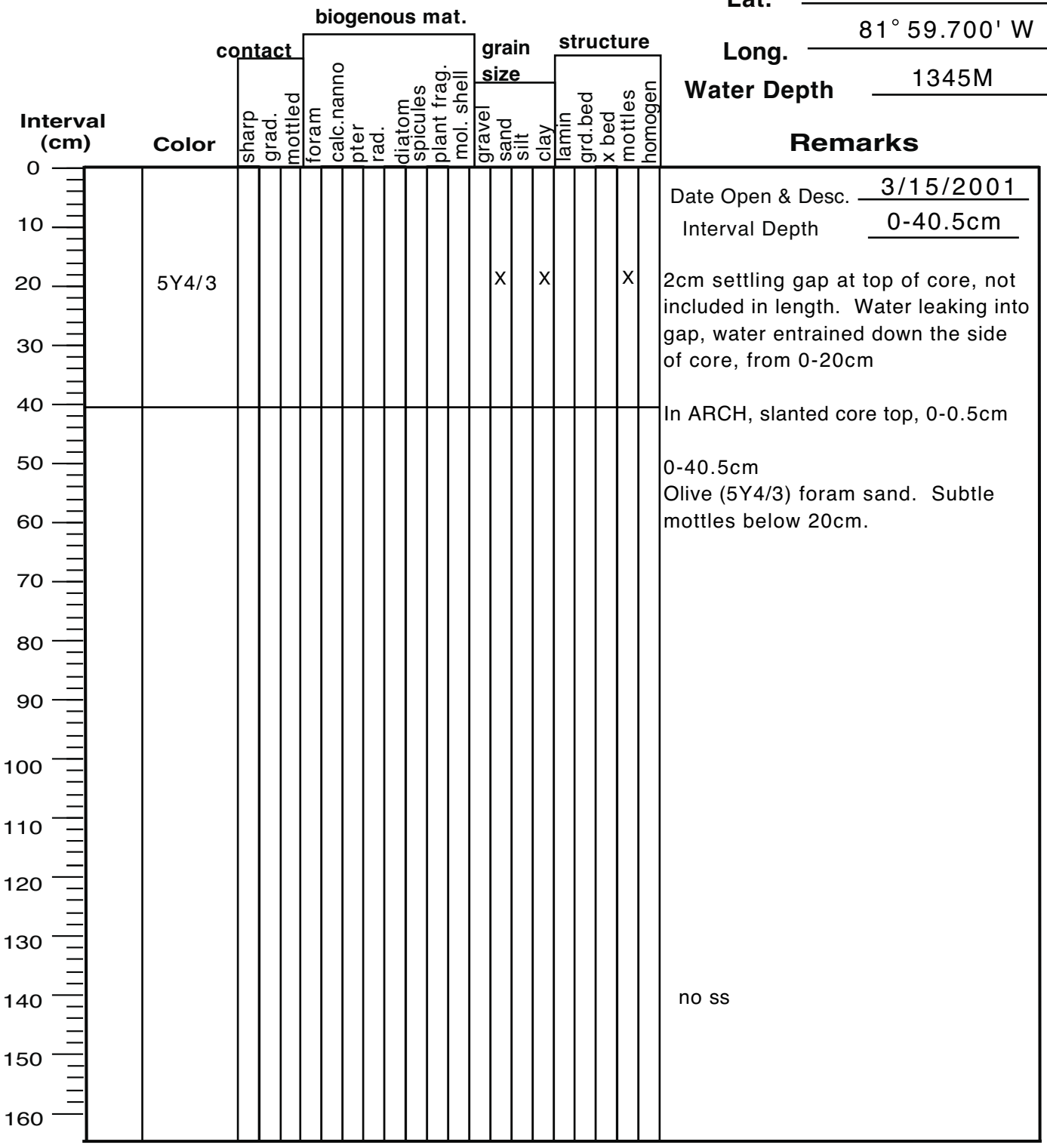
CORE ID ME0005A-29MC6

SECTION 1 **of** 1

Lat. 0° 30.801' S

Long. 81° 59.700' W

Water Depth 1345M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

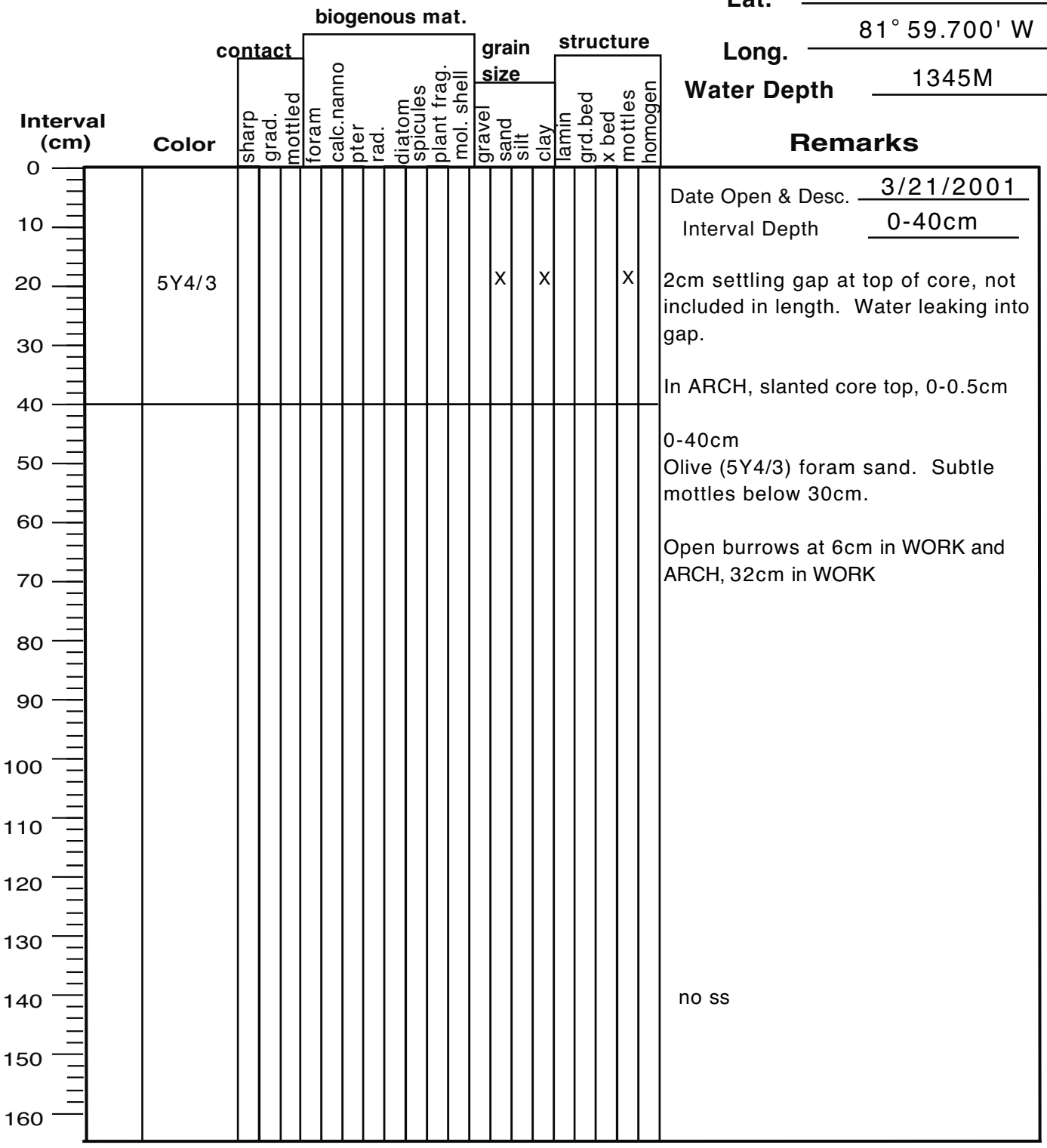
CORE ID ME0005A-29MC7

SECTION 1 **of** 1

Lat. 0° 30.801' S

Long. 81° 59.700' W

Water Depth 1345M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

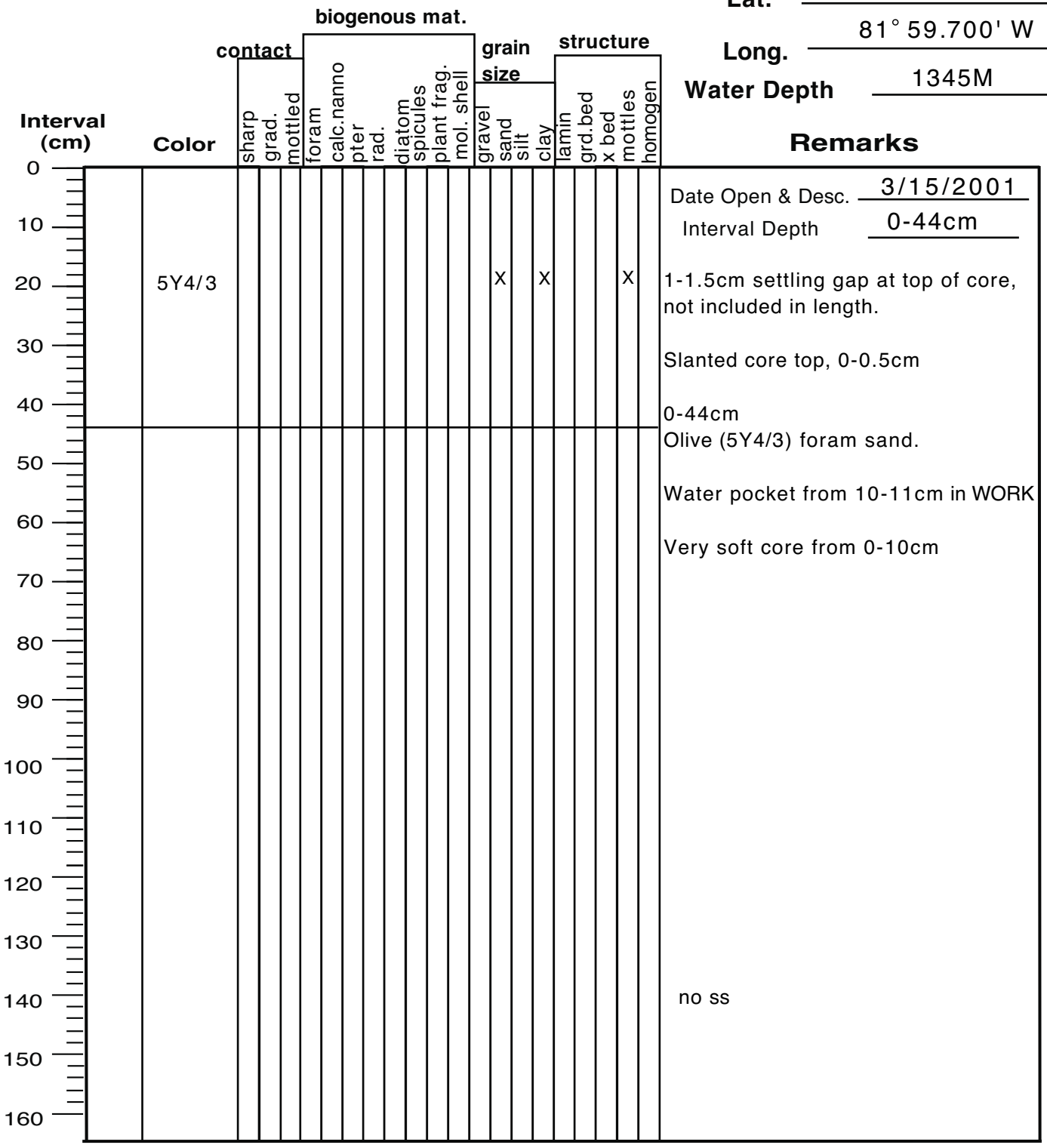
CORE ID ME0005A-29MC8

SECTION 1 **of** 1

Lat. 0° 30.801' S

Long. 81° 59.700' W

Water Depth 1345M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

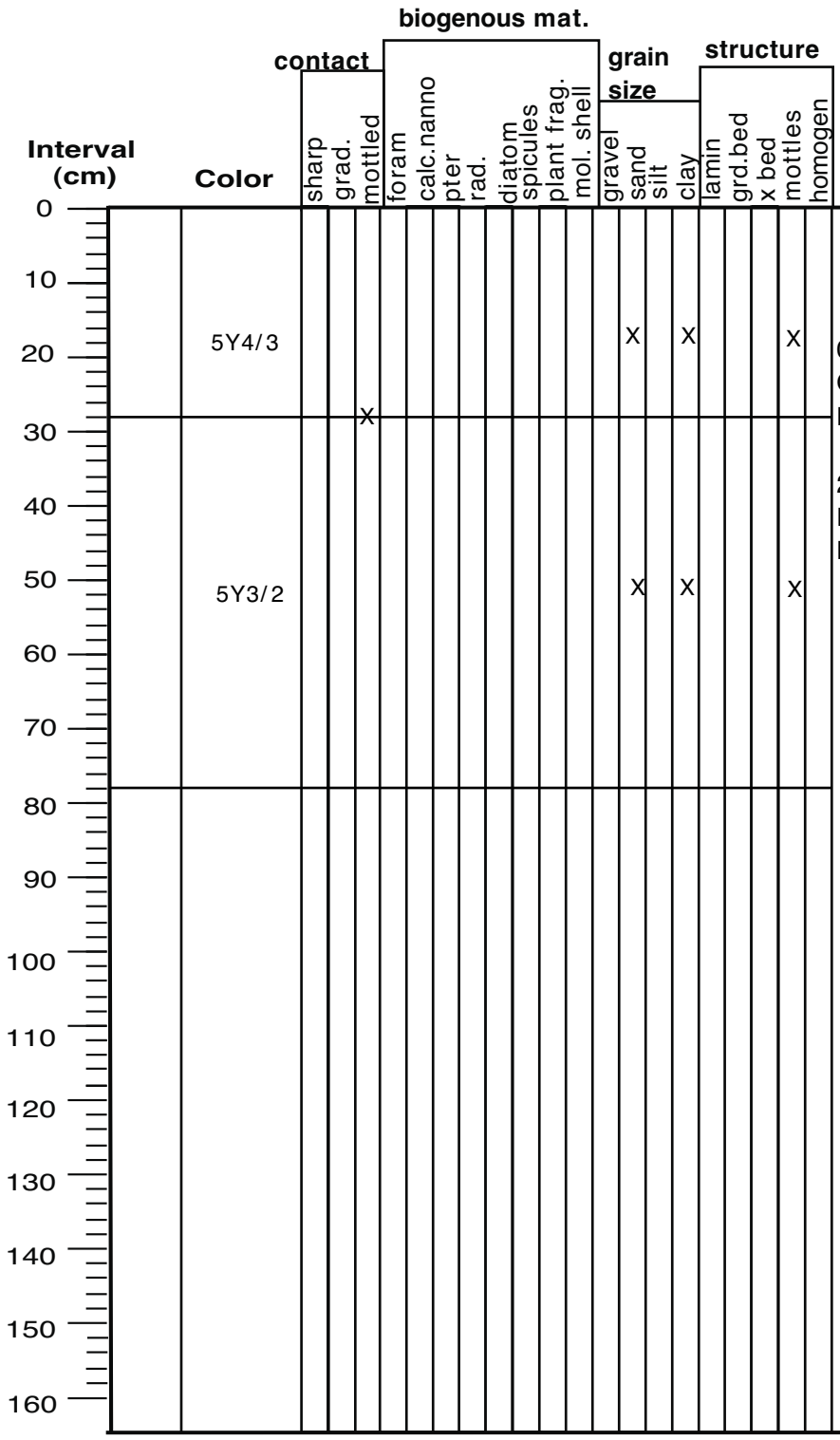
CORE ID ME0005A-31JC

SECTION 1 **of** 9

Lat. 0° 30.802' S

Long. 81° 59.700' W

Water Depth 1346M



Remarks

Date Open & Desc. 6/1/2000

Interval Depth 0-73cm

0-28cm
Olive (5Y4/3) foram sand.
Lightly mottled (bioturbation).

28-73cm
Dark olive gray (5Y3/2) foram sand.
Lightly mottled (bioturbation).

no ss

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

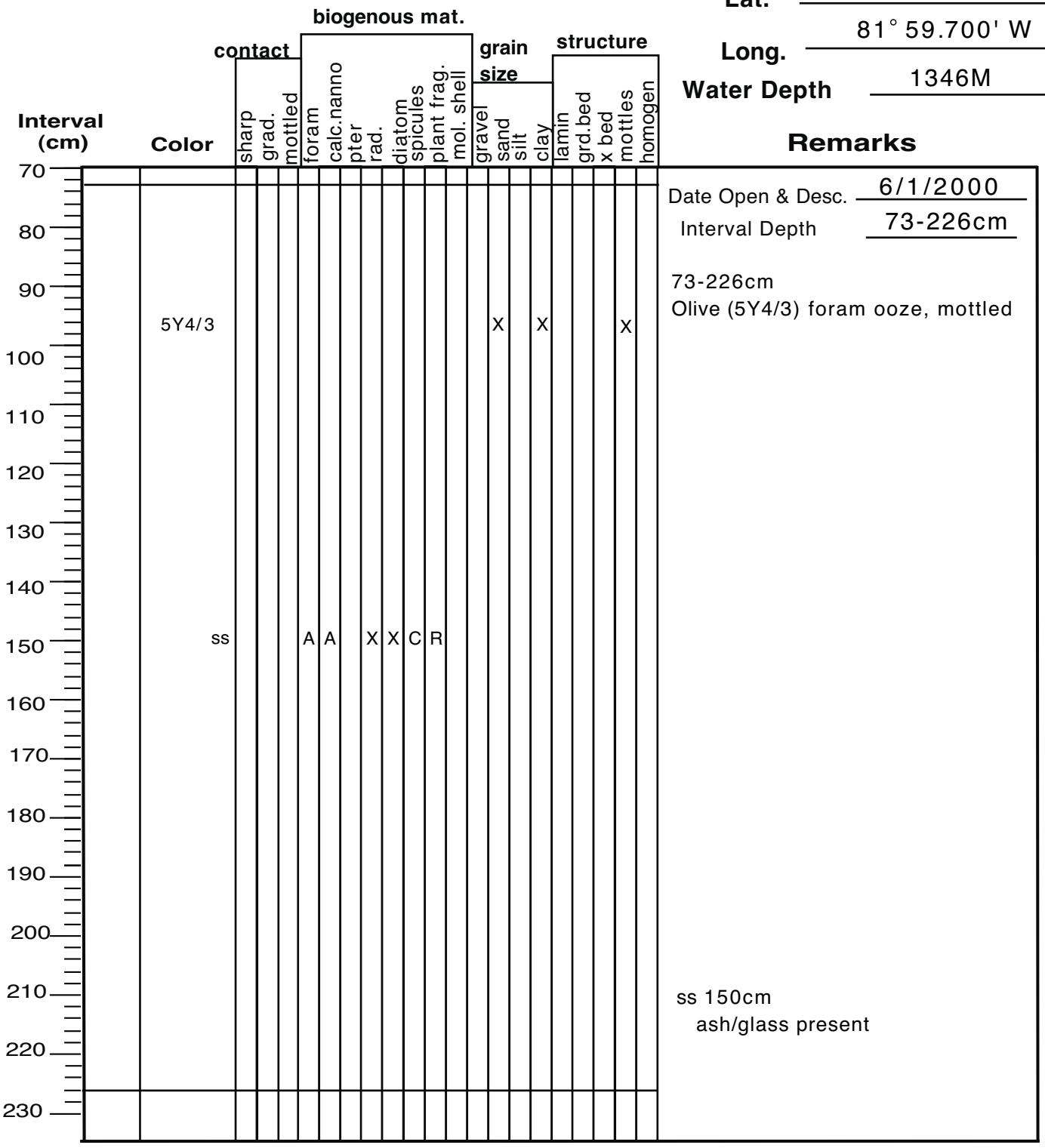
CORE ID ME0005A-31JC

SECTION 2 **of** 9

Lat. 0° 30.802' S

Long. 81° 59.700' W

Water Depth 1346M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

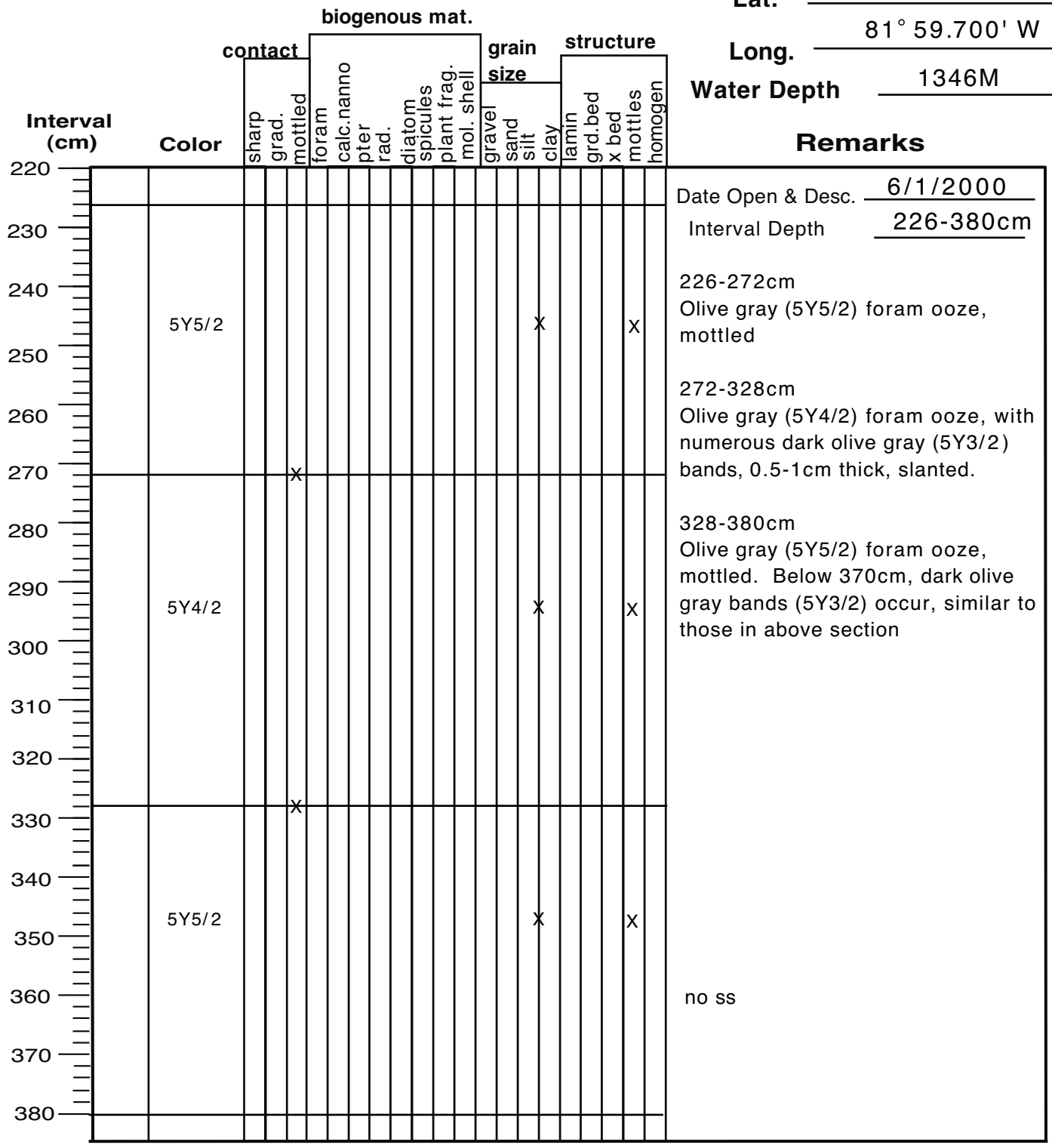
CORE ID ME0005A-31JC

SECTION 3 **of** 9

Lat. 0° 30.802' S

Long. 81° 59.700' W

Water Depth 1346M



Remarks

Date Open & Desc. 6/1/2000

Interval Depth 226-380cm

226-272cm
Olive gray (5Y5/2) foram ooze, mottled

272-328cm
Olive gray (5Y4/2) foram ooze, with numerous dark olive gray (5Y3/2) bands, 0.5-1cm thick, slanted.

328-380cm
Olive gray (5Y5/2) foram ooze, mottled. Below 370cm, dark olive gray bands (5Y3/2) occur, similar to those in above section

no ss

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

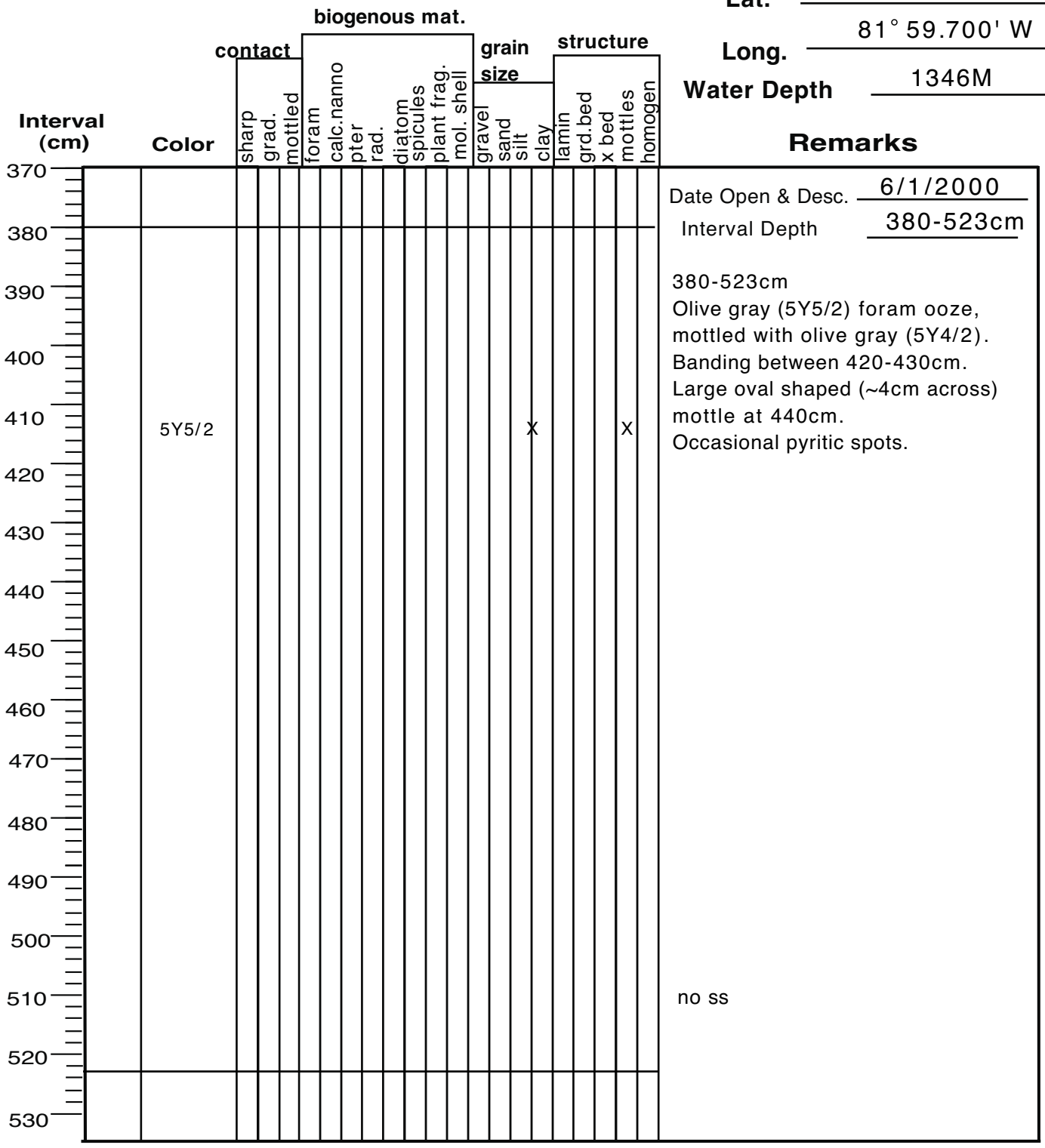
CORE ID ME0005A-31JC

SECTION 4 **of** 9

Lat. 0° 30.802' S

Long. 81° 59.700' W

Water Depth 1346M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

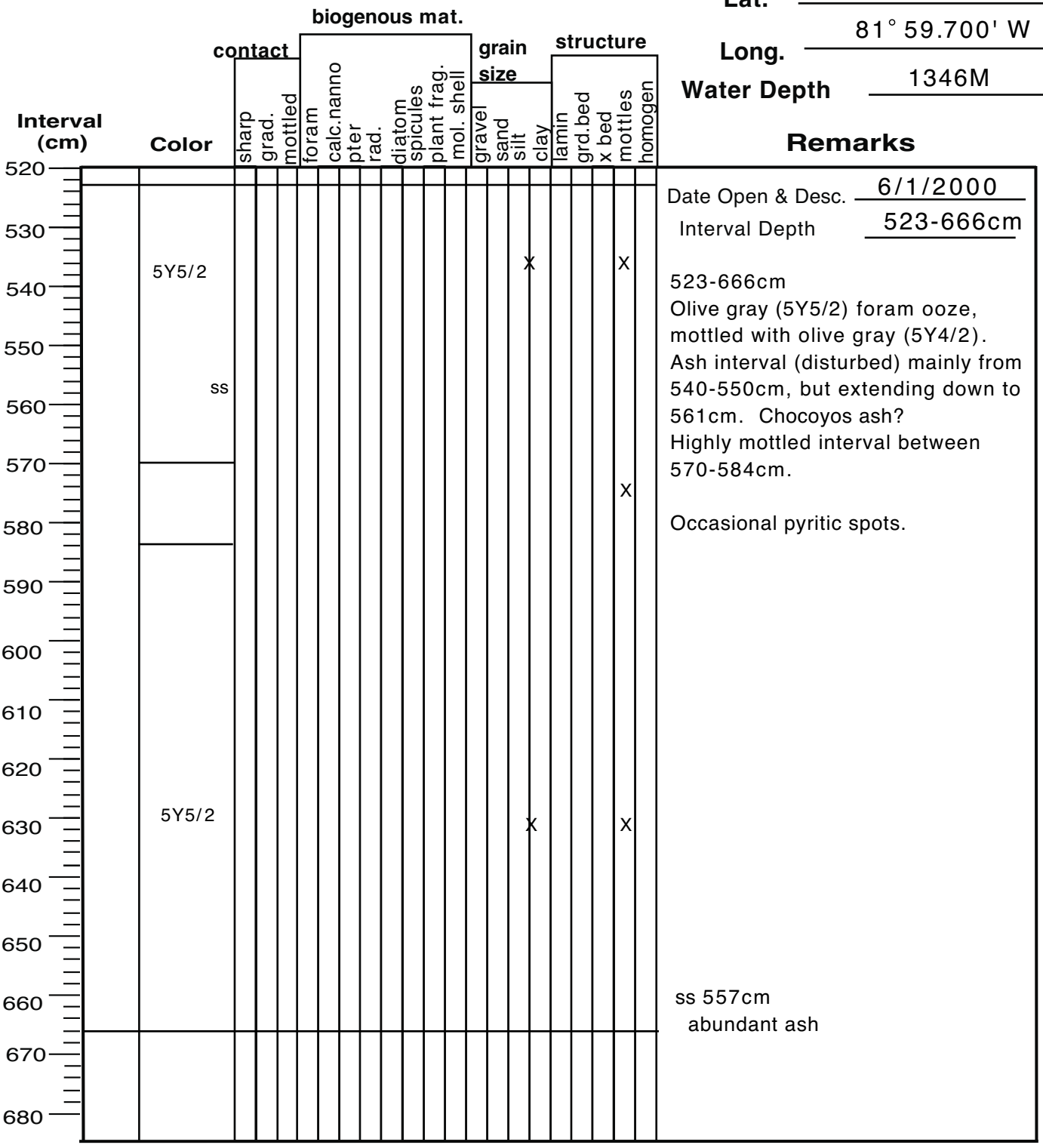
CORE ID ME0005A-31JC

SECTION 5 **of** 9

Lat. 0° 30.802' S

Long. 81° 59.700' W

Water Depth 1346M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

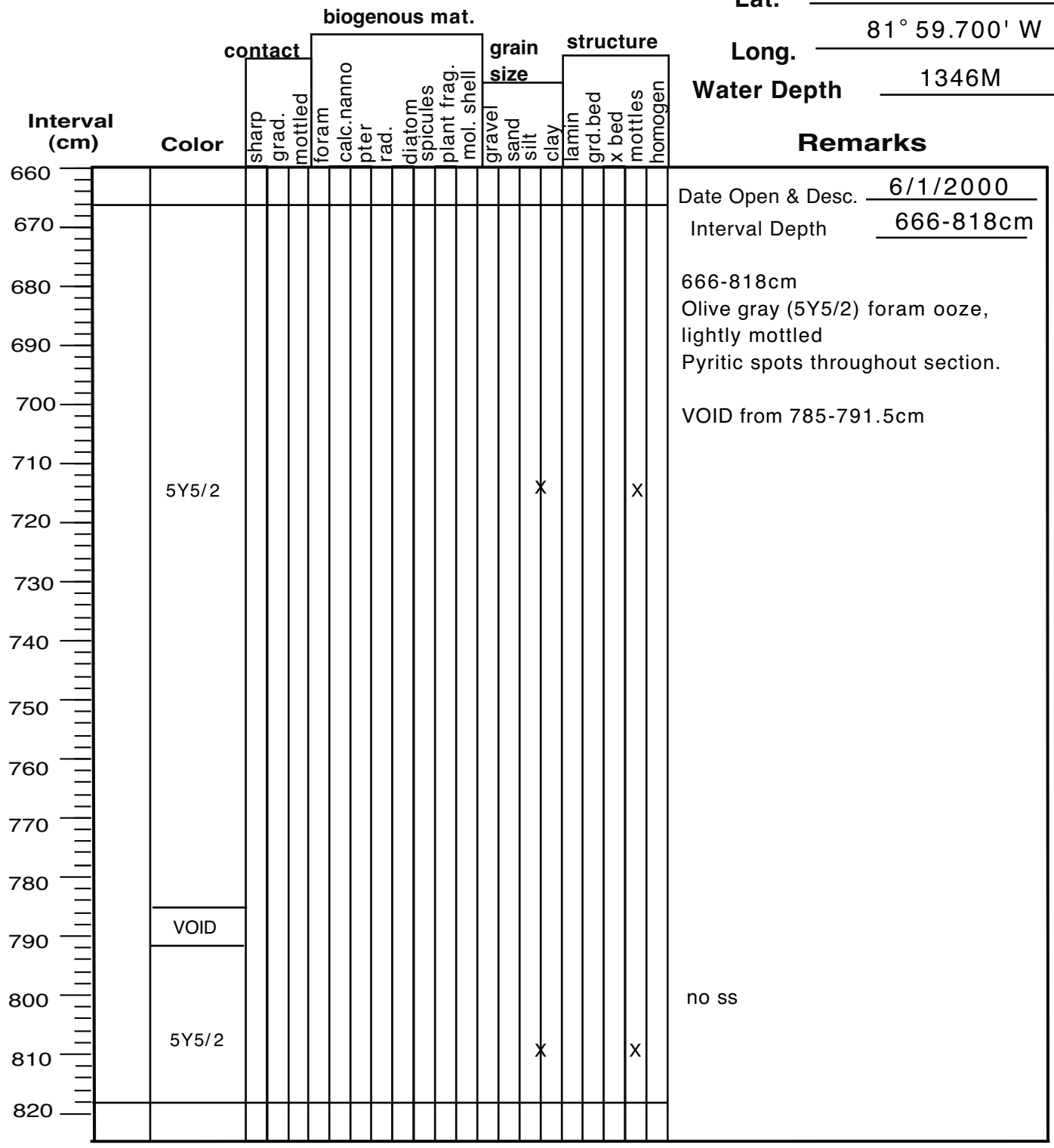
CORE ID ME0005A-31JC

SECTION 6 **of** 9

Lat. 0° 30.802' S

Long. 81° 59.700' W

Water Depth 1346M



Remarks

Date Open & Desc. 6/1/2000

Interval Depth 666-818cm

666-818cm
Olive gray (5Y5/2) foram ooze, lightly mottled
Pyritic spots throughout section.

VOID from 785-791.5cm

no ss

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

CORE ID ME0005A-31JC

SECTION 7 **of** 9

Lat. 0° 30.802' S

Long. 81° 59.700' W

Water Depth 1346M

Interval (cm)	Color	contact: sharp	contact: grad.	contact: mottled	biogenous mat.: foram	calc.nanno	pter	rad.	diatom	spicules	plant frag.	mol. shell	grain size: gravel	sand	silt	clay	structure: lamin	grd.bed	x bed	mottles	homogen
818–859	5Y4/2															X				X	
859/860 (contact)				X																	
859–885	5Y3/2															X				X	
ss (~878)					A	A		X	R	C											
885 (contact)		X																			
885–929	5Y4/2															X				X	
929–940	5Y4/4																				
940–971	5Y4/2															X				X	

Remarks

Date Open & Desc. 6/1/2000

Interval Depth 818-971cm

818-859cm
Olive gray (5Y5/2) foram ooze, lightly mottled with olive gray (5Y4/2).

859-885cm
Dark olive gray (5Y3/2) foram ooze. Highly mottled, decreasing in lower third of interval.

885-971cm
Olive gray (5Y5/2) foram ooze, lightly mottled with olive gray (5Y4/2).

Band of olive (5Y4/4) from 929-940cm

ss 878cm
ash present

Fossils: X-Present C-Common B-Barren A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

/\ graded bed (turbidite)

ss-smear slide

CORE LOG

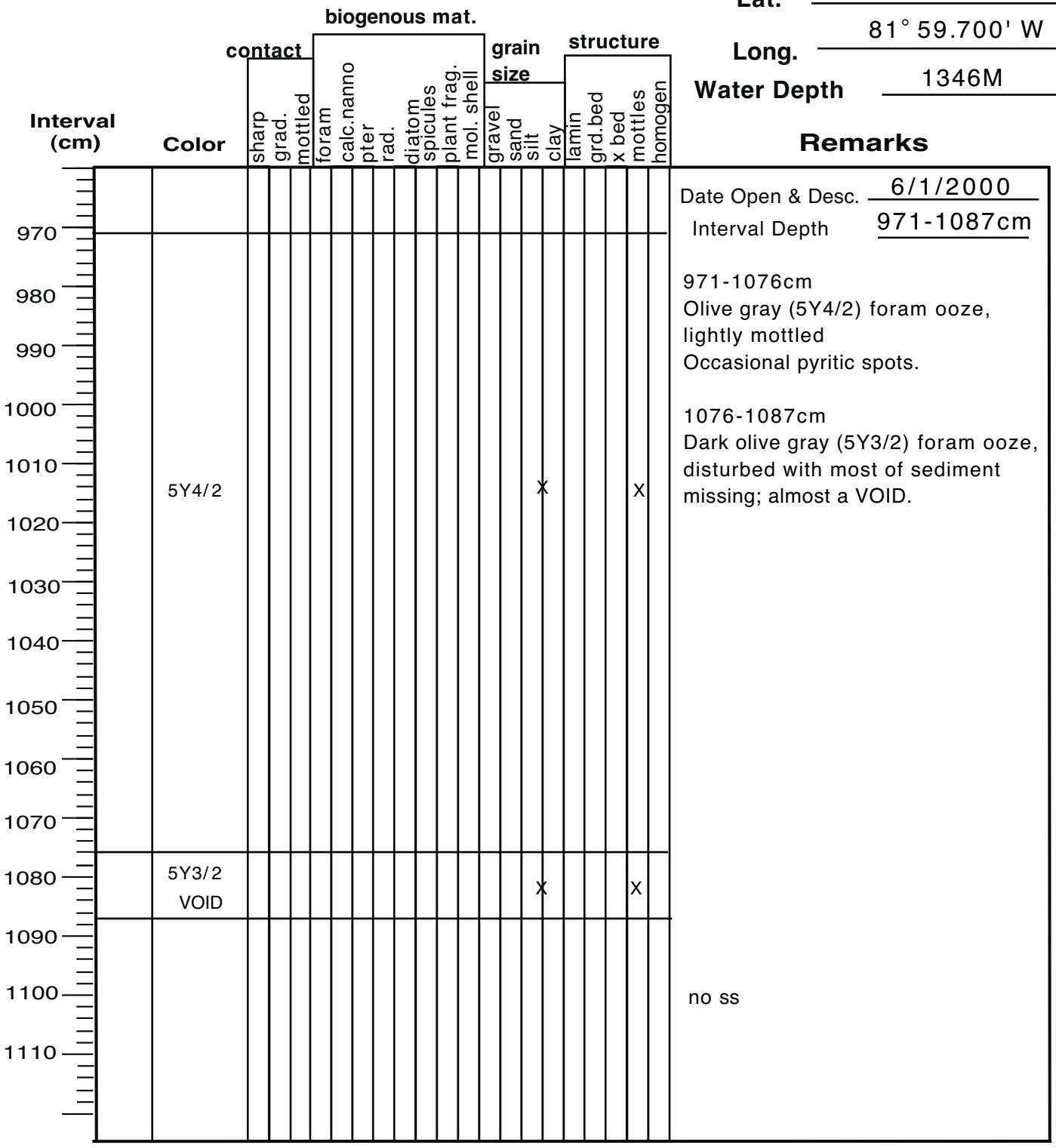
CORE ID ME0005A-31JC

SECTION 8 **of** 9

Lat. 0° 30.802' S

Long. 81° 59.700' W

Water Depth 1346M



Remarks

Date Open & Desc. 6/1/2000

Interval Depth 971-1087cm

971-1076cm
Olive gray (5Y4/2) foram ooze, lightly mottled
Occasional pyritic spots.

1076-1087cm
Dark olive gray (5Y3/2) foram ooze, disturbed with most of sediment missing; almost a VOID.

no ss

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

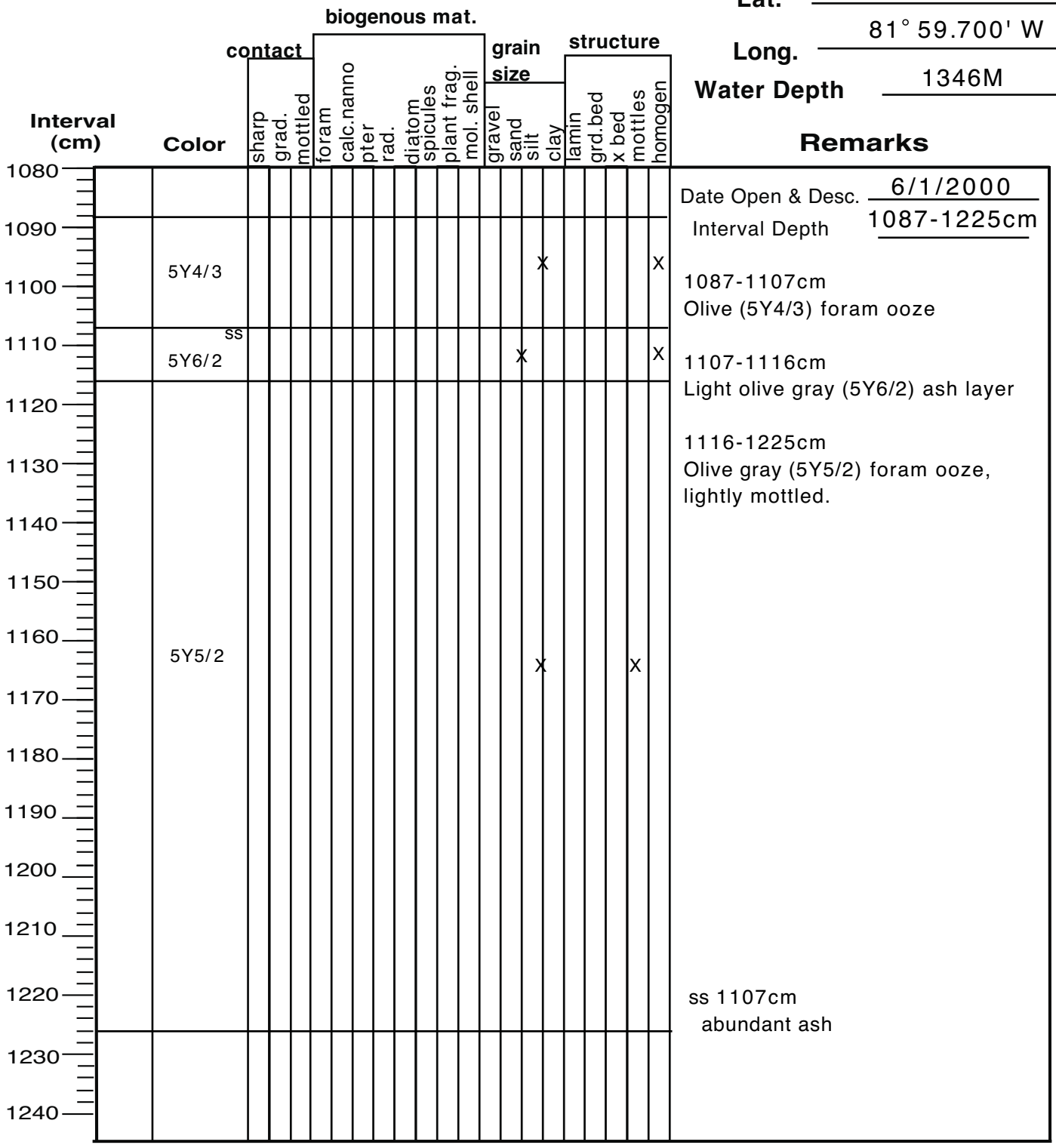
CORE ID ME0005A-31JC

SECTION 9 **of** 9

Lat. 0° 30.802' S

Long. 81° 59.700' W

Water Depth 1346M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

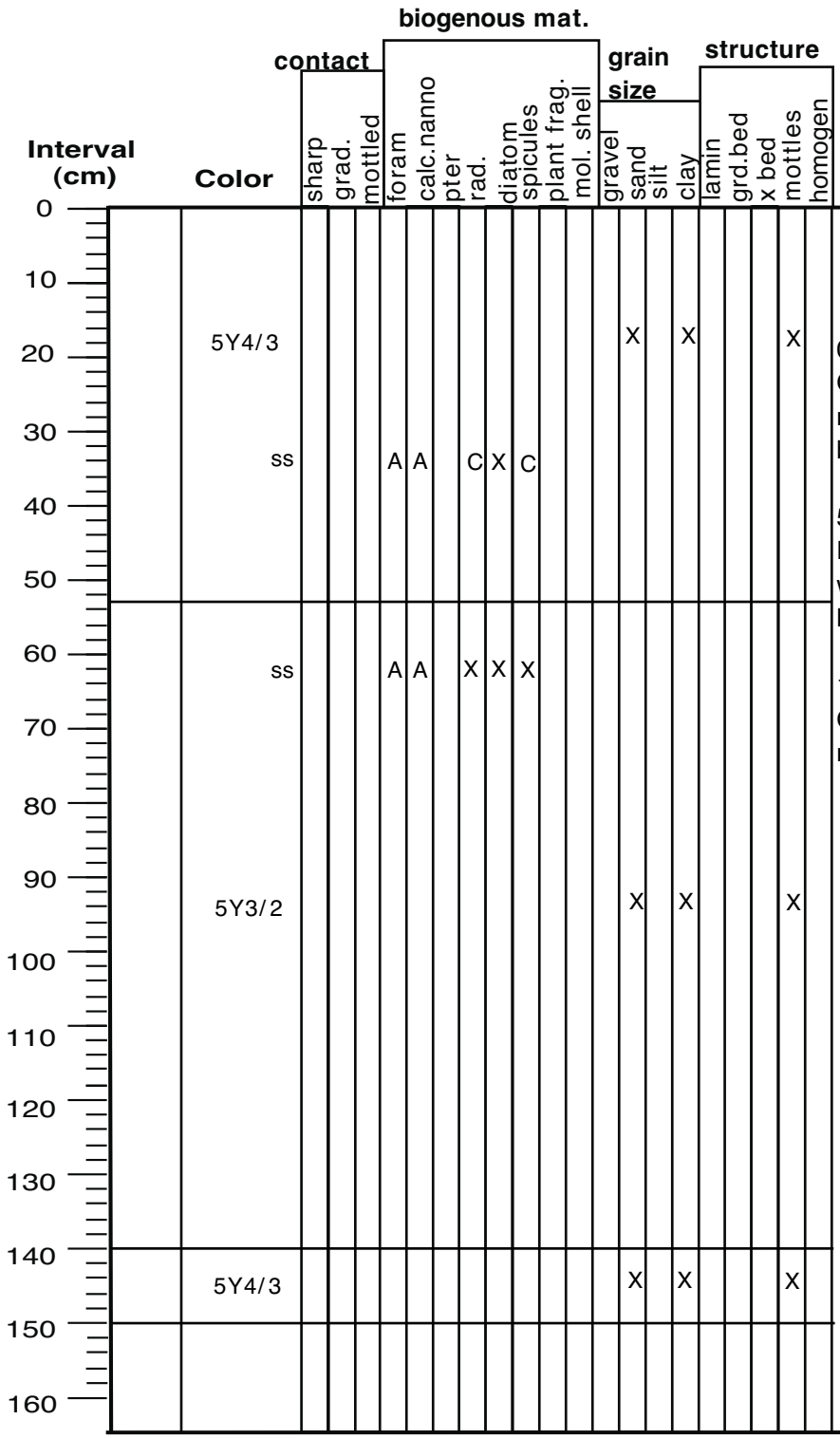
CORE ID ME0005A-31TC

SECTION 1 **of** 2

Lat. 0° 30.802' S

Long. 81° 59.700' W

Water Depth 1346M



Remarks

Date Open & Desc. 6/1/2000

Interval Depth 0-150cm

0-53cm
Olive (5Y4/3) foram sand with nannofossils. Lightly mottled below 35cm

53-140cm
Dark olive gray (5Y3/2) foram sand with nannofossils. Many burrows and highly mottled.

140-150cm
Olive (5Y4/3) foram sand with nannofossils. Lightly mottled

ss 43, 63cm
43cm: silicoflagellates, ash/glass, pyrite noted
63cm: pyrite noted

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

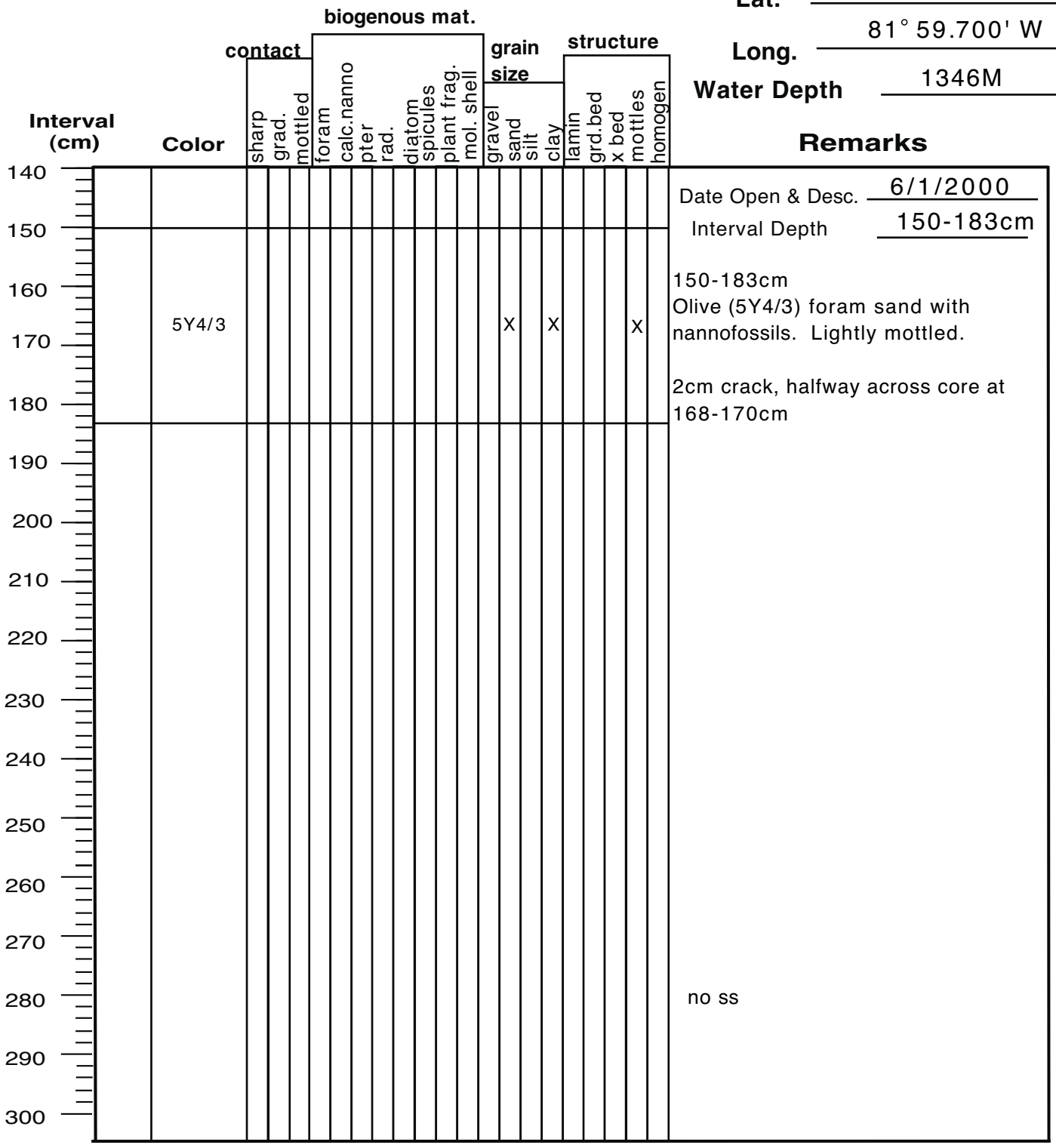
CORE ID ME0005A-31TC

SECTION 2 **of** 2

Lat. 0° 30.802' S

Long. 81° 59.700' W

Water Depth 1346M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

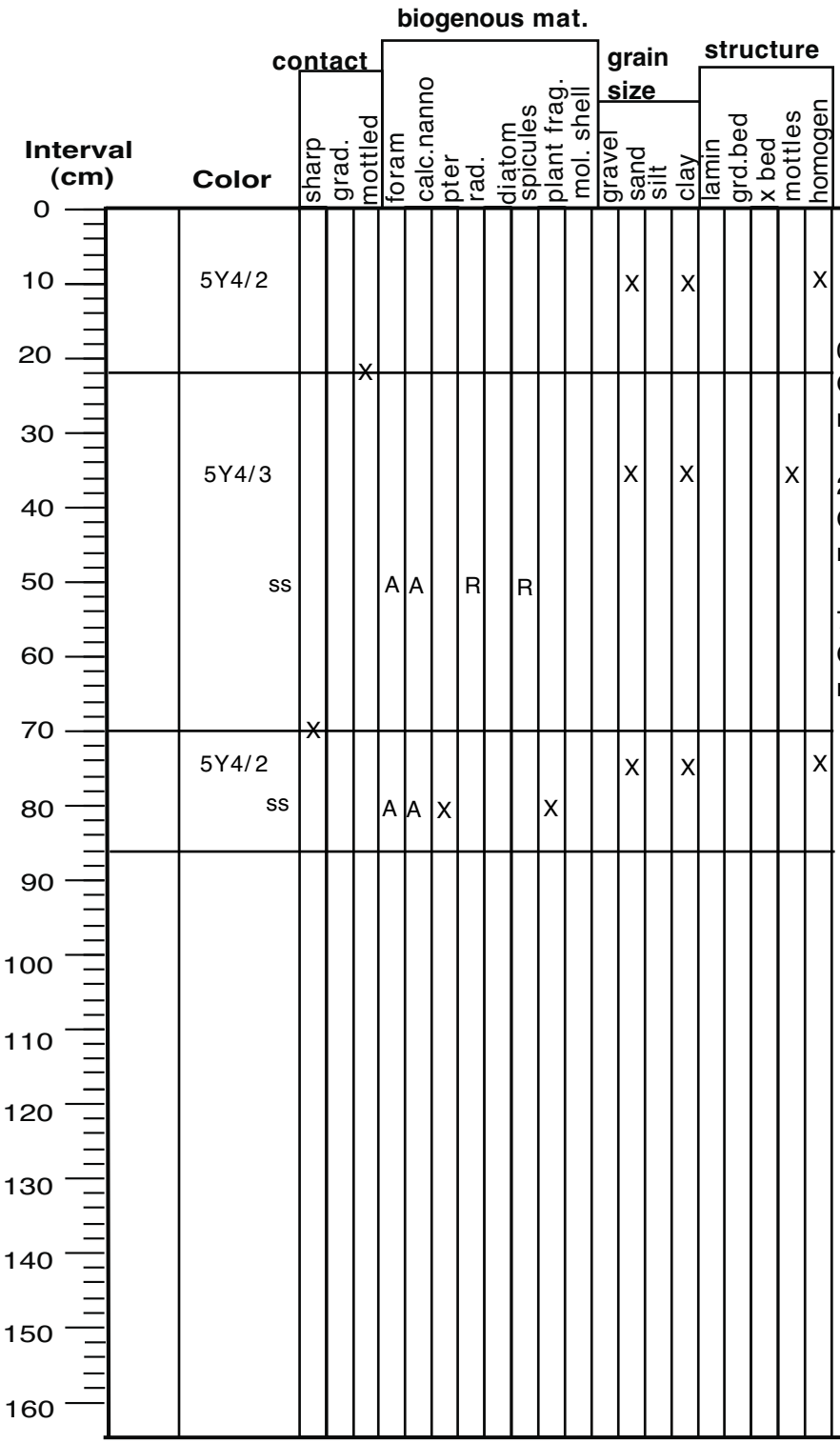
CORE ID ME0005A-34JC

SECTION 1 **of** 10

Lat. 0° 18.279' S

Long. 81° 48.940' W

Water Depth 746M



Remarks

Date Open & Desc. 6/4/2000

Interval Depth 0-86cm

0-22cm
Olive gray (5Y4/2) foram sand with nannofossils

22-70
Olive (5Y4/3) foram sand with nannofossils, subtly mottled

70-86cm
Olive gray (5Y4/2) foram sand with nannofossils

ss 50, 80cm
at 50cm glass, pyrite, echinoid spines are present

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

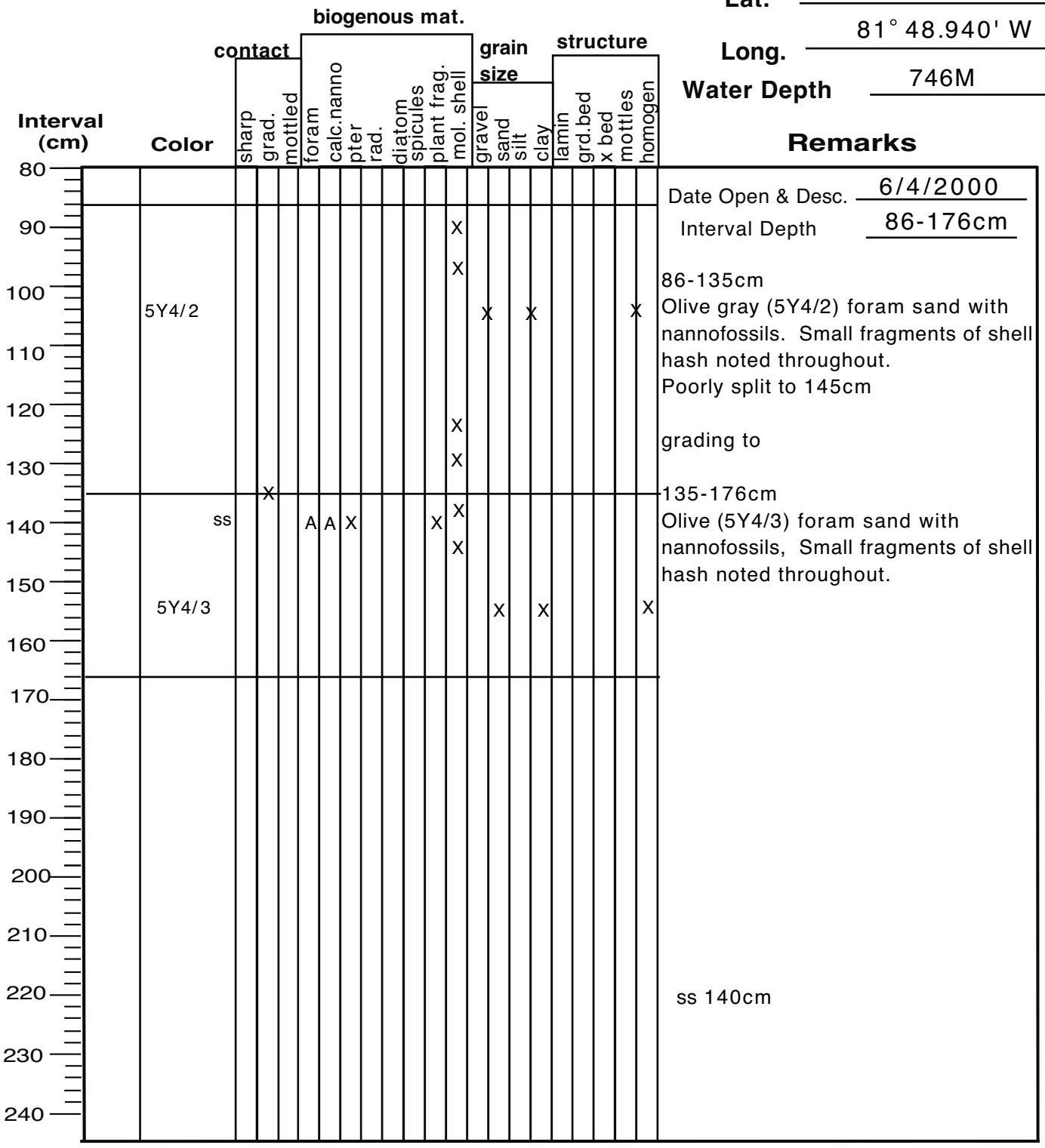
CORE ID ME0005A-34JC

SECTION 2 **of** 10

Lat. 0° 18.279' S

Long. 81° 48.940' W

Water Depth 746M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

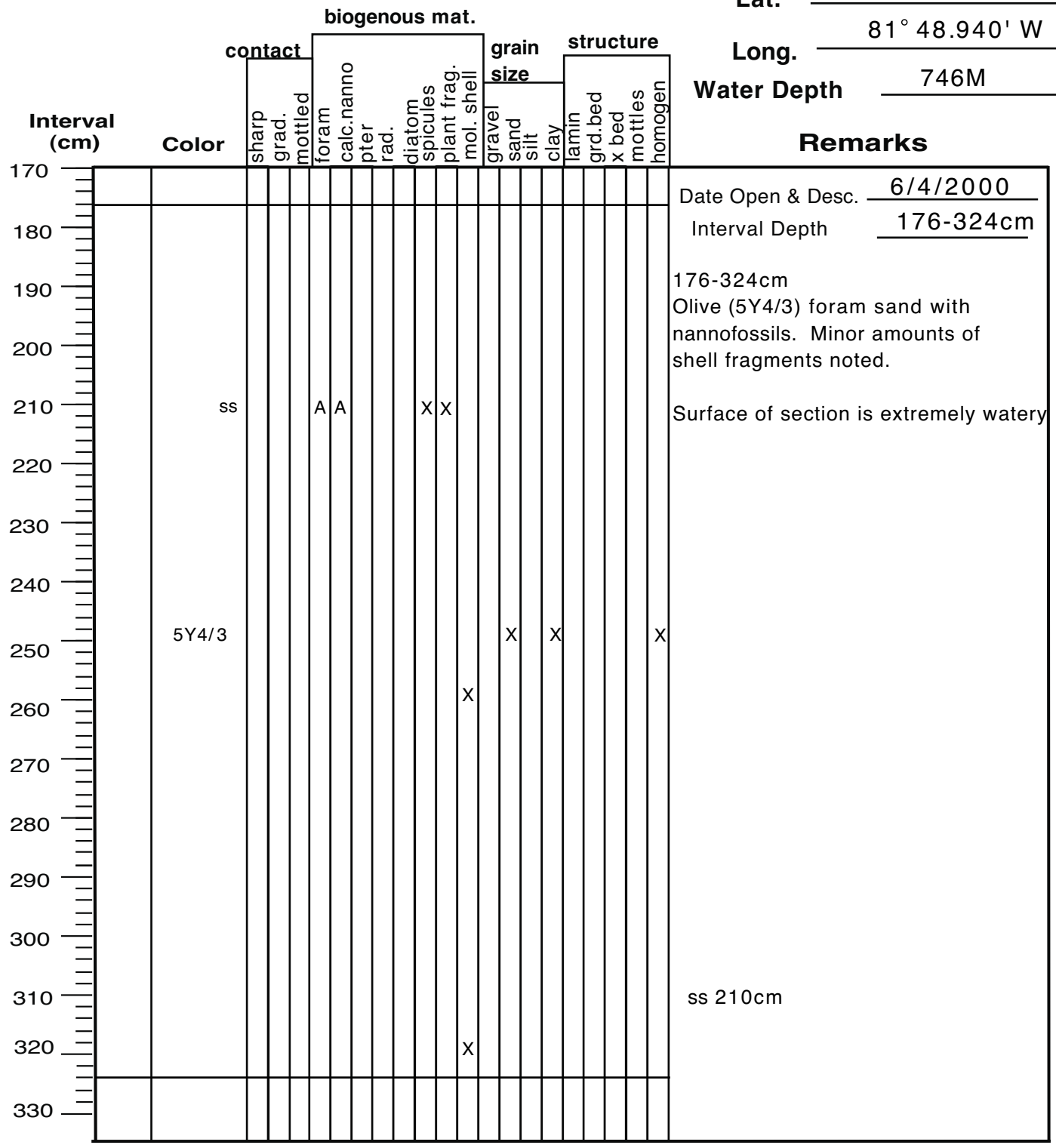
CORE ID ME0005A-34JC

SECTION 3 **of** 10

Lat. 0° 18.279' S

Long. 81° 48.940' W

Water Depth 746M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

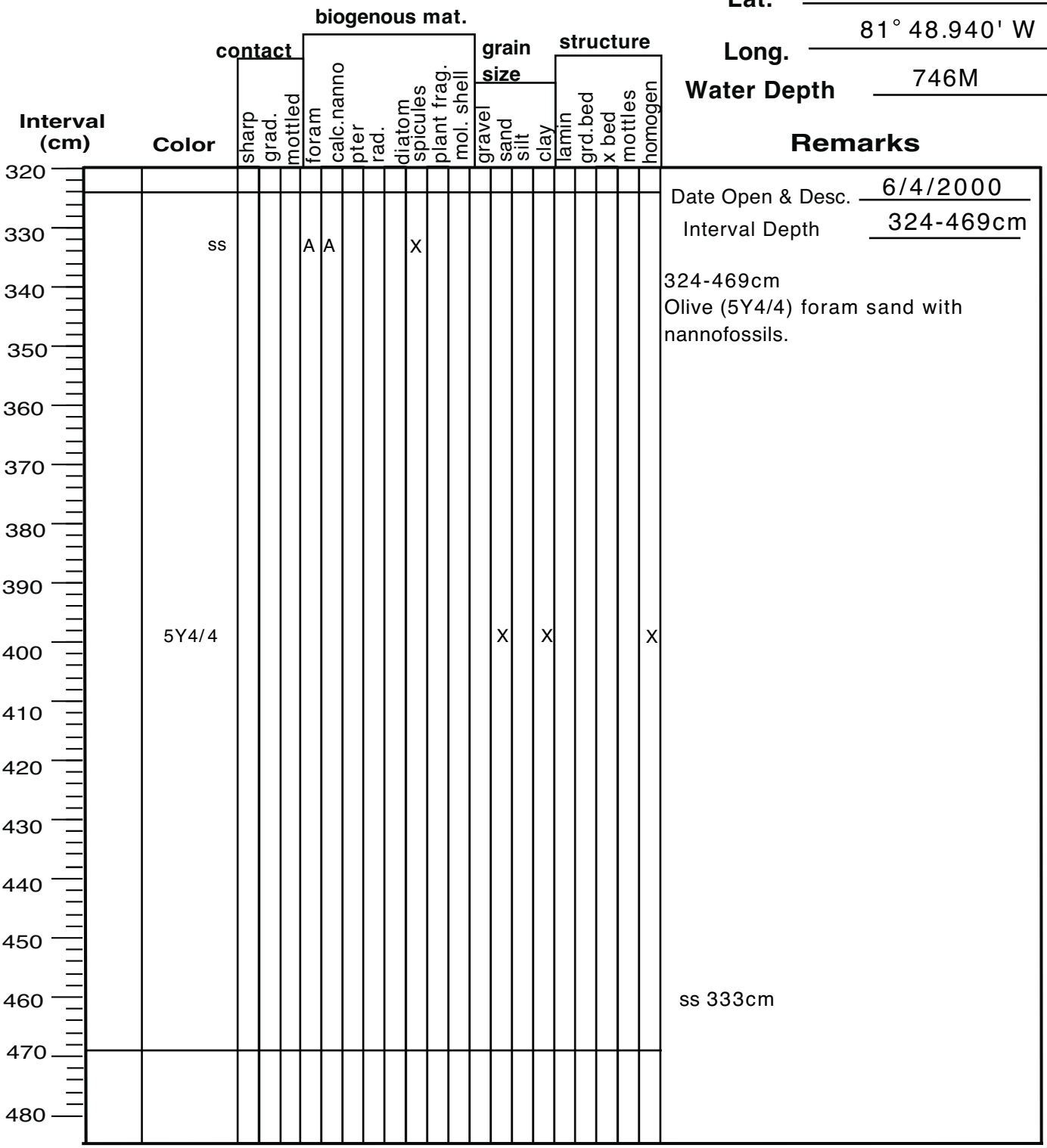
CORE ID ME0005A-34JC

SECTION 4 **of** 10

Lat. 0° 18.279' S

Long. 81° 48.940' W

Water Depth 746M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

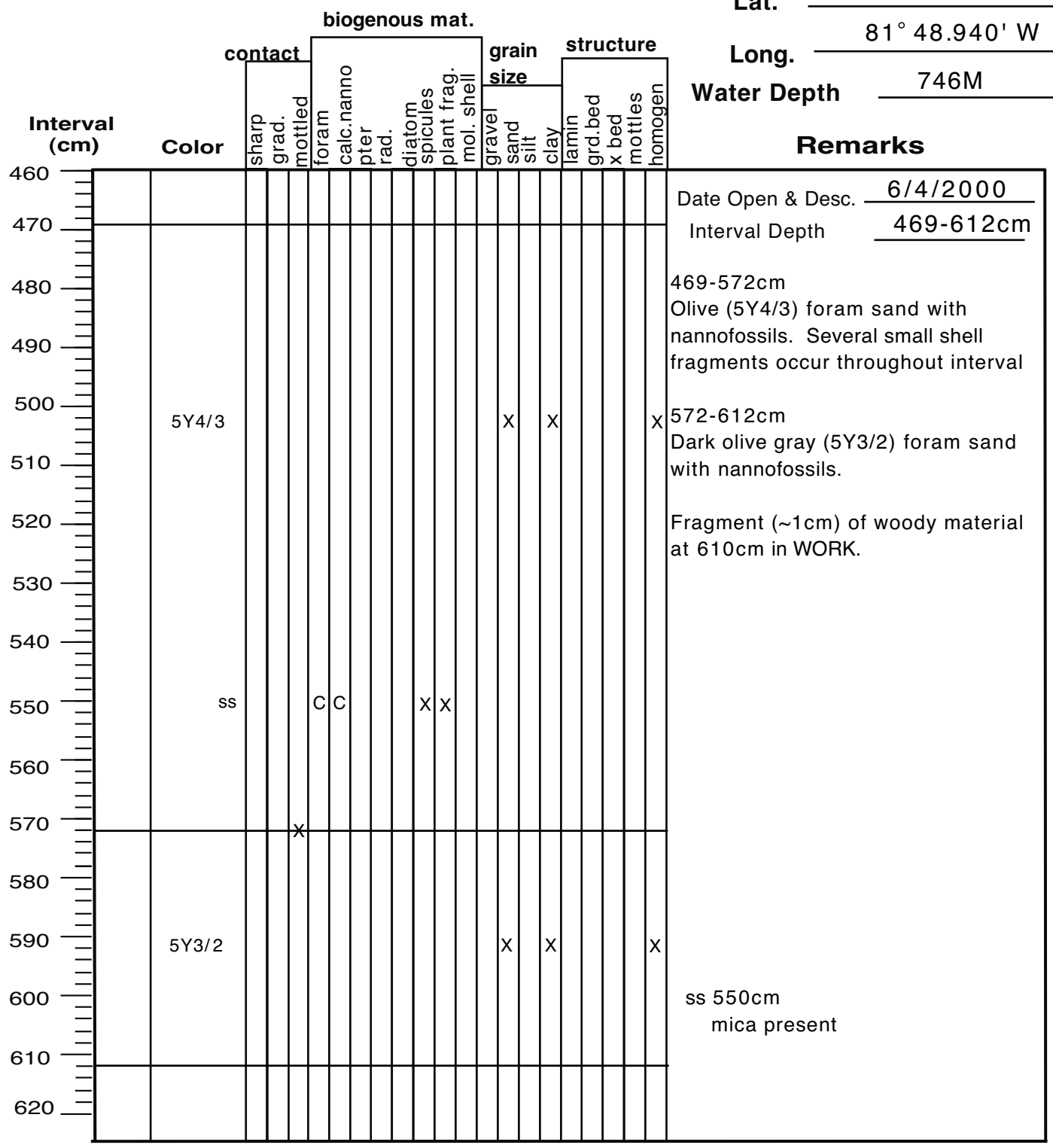
CORE ID ME0005A-34JC

SECTION 5 **of** 10

Lat. 0° 18.279' S

Long. 81° 48.940' W

Water Depth 746M



Date Open & Desc. 6/4/2000

Interval Depth 469-612cm

469-572cm
Olive (5Y4/3) foram sand with nannofossils. Several small shell fragments occur throughout interval

572-612cm
Dark olive gray (5Y3/2) foram sand with nannofossils.

Fragment (~1cm) of woody material at 610cm in WORK.

ss 550cm
mica present

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

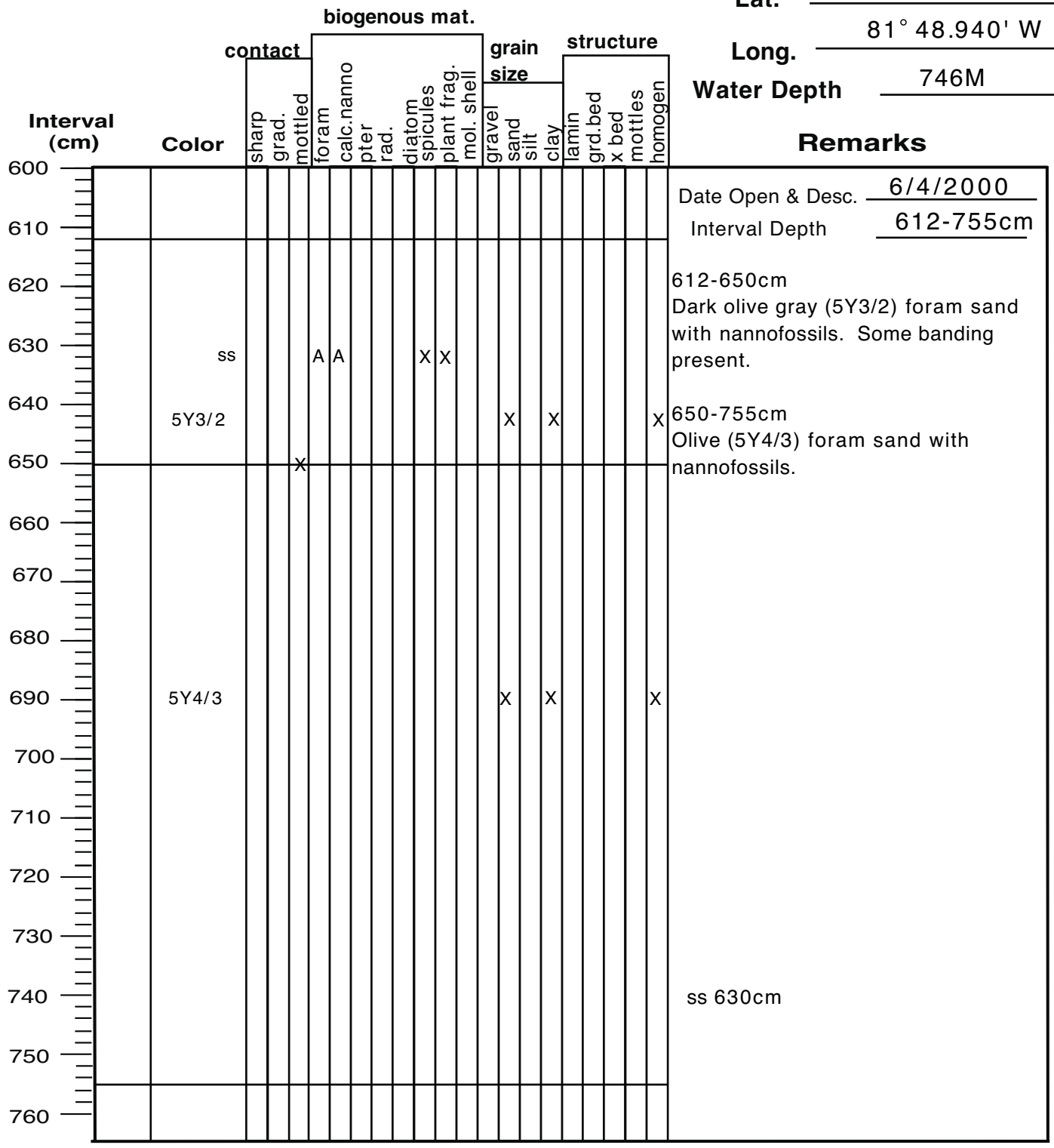
CORE ID ME0005A-34JC

SECTION 6 **of** 10

Lat. 0° 18.279' S

Long. 81° 48.940' W

Water Depth 746M



Date Open & Desc. 6/4/2000

Interval Depth 612-755cm

612-650cm
Dark olive gray (5Y3/2) foram sand with nannofossils. Some banding present.

650-755cm
Olive (5Y4/3) foram sand with nannofossils.

ss 630cm

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

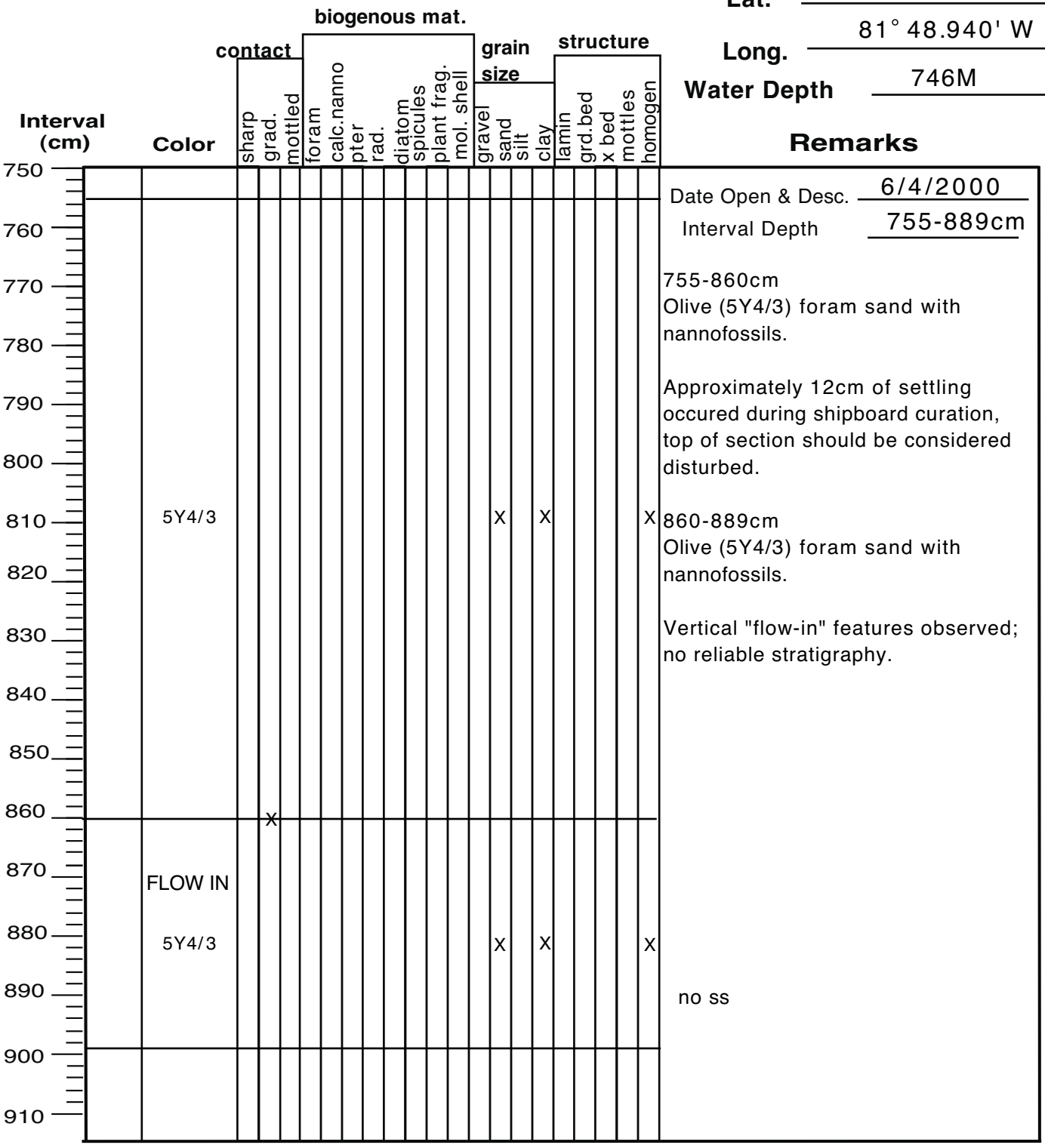
CORE ID ME0005A-34JC

SECTION 7 **of** 10

Lat. 0° 18.279' S

Long. 81° 48.940' W

Water Depth 746M



Remarks

Date Open & Desc. 6/4/2000

Interval Depth 755-889cm

755-860cm
Olive (5Y4/3) foram sand with nannofossils.

Approximately 12cm of settling occured during shipboard curation, top of section should be considered disturbed.

860-889cm
Olive (5Y4/3) foram sand with nannofossils.

Vertical "flow-in" features observed; no reliable stratigraphy.

no ss

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

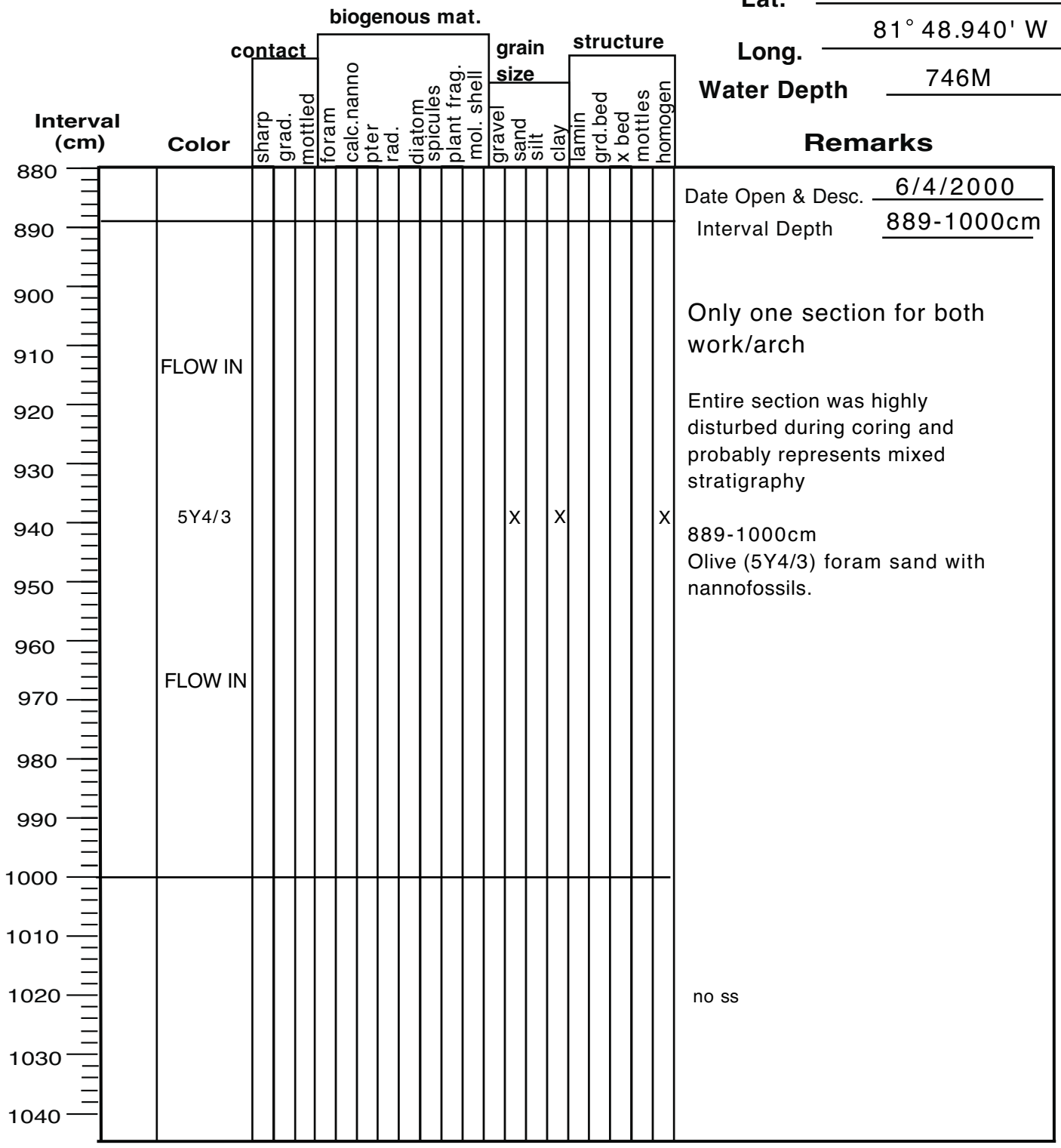
CORE ID ME0005A-34JC

SECTION 8 **of** 10

Lat. 0° 18.279' S

Long. 81° 48.940' W

Water Depth 746M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

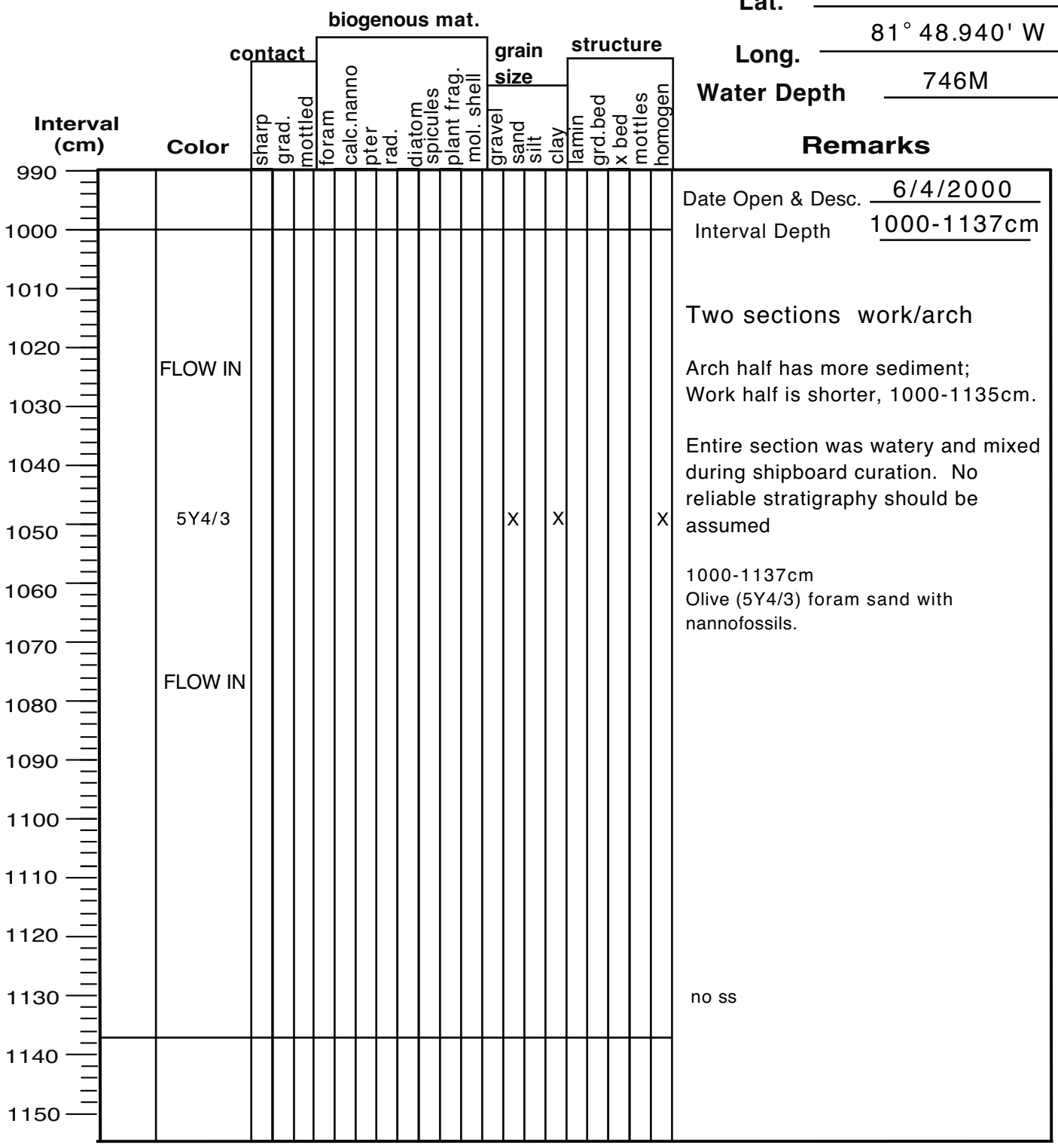
CORE ID ME0005A-34JC

SECTION 9 **of** 10

Lat. 0° 18.279' S

Long. 81° 48.940' W

Water Depth 746M



Remarks

Date Open & Desc. 6/4/2000

Interval Depth 1000-1137cm

Two sections work/arch

Arch half has more sediment;
Work half is shorter, 1000-1135cm.

Entire section was watery and mixed during shipboard curation. No reliable stratigraphy should be assumed

1000-1137cm
Olive (5Y4/3) foram sand with nannofossils.

no ss

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

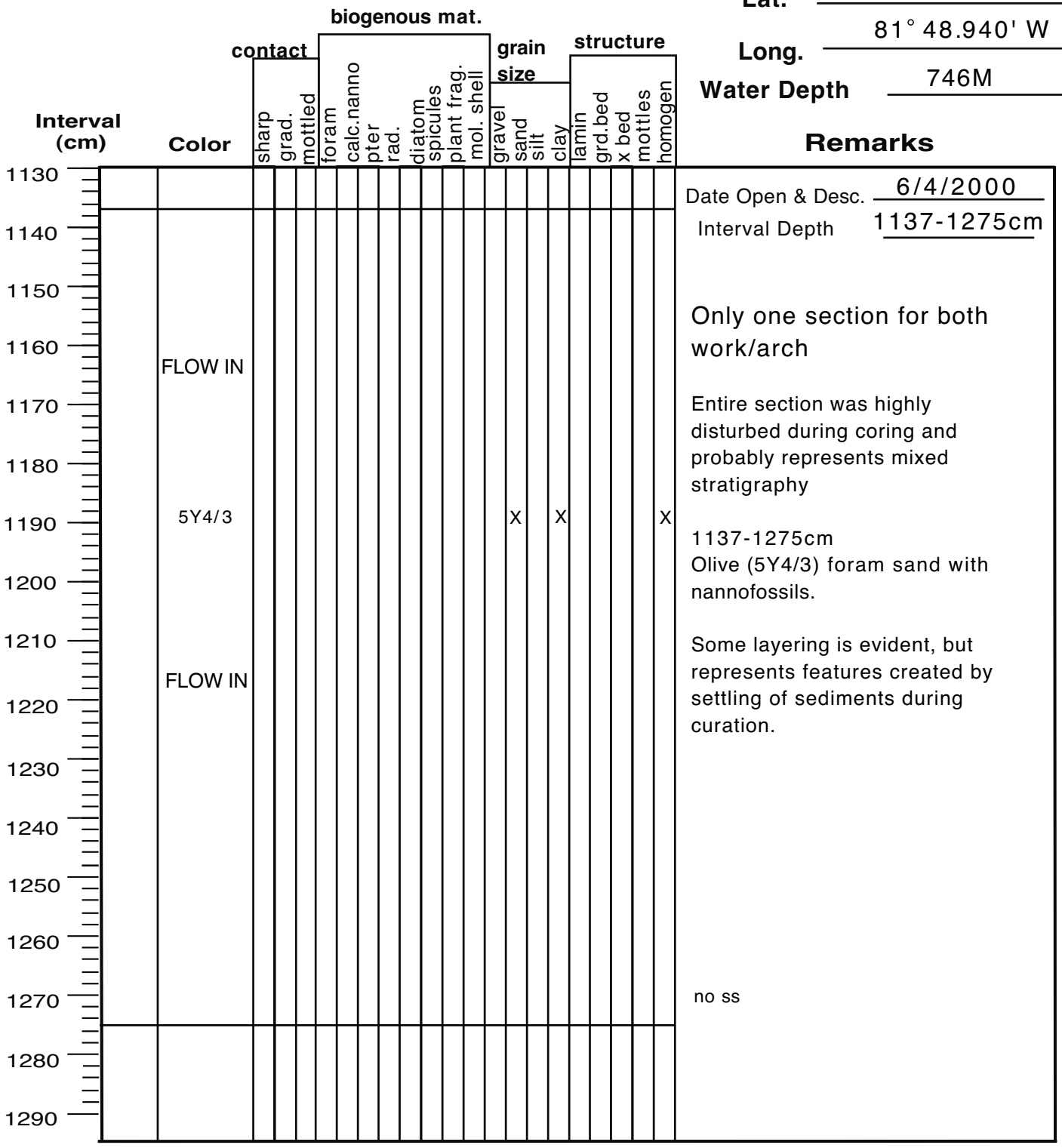
CORE ID ME0005A-34JC

SECTION 10 **of** 10

Lat. 0° 18.279' S

Long. 81° 48.940' W

Water Depth 746M



Remarks

Date Open & Desc. 6/4/2000

Interval Depth 1137-1275cm

Only one section for both work/arch

Entire section was highly disturbed during coring and probably represents mixed stratigraphy

1137-1275cm
Olive (5Y4/3) foram sand with nannofossils.

Some layering is evident, but represents features created by settling of sediments during curation.

no ss

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

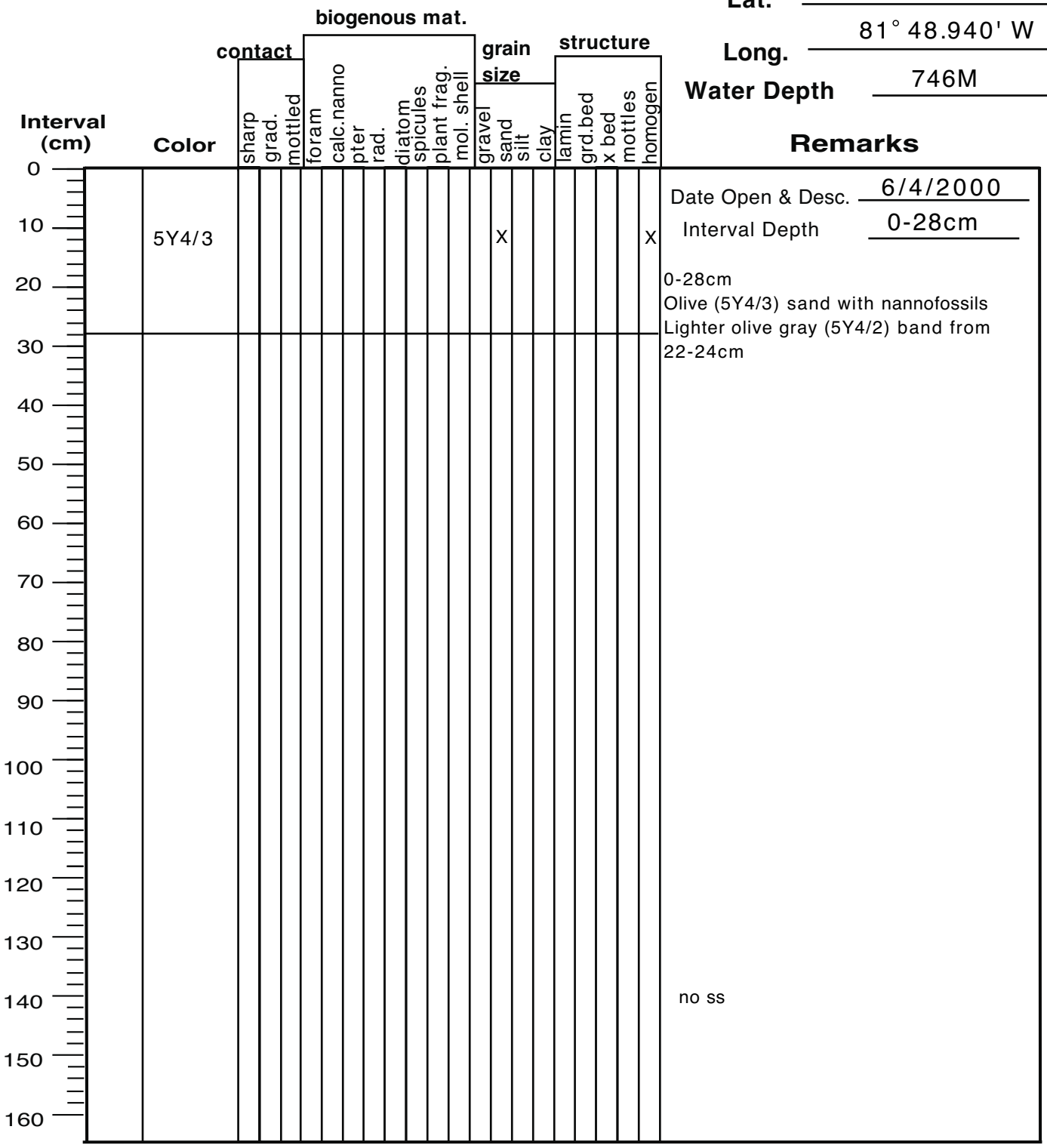
CORE ID ME0005A-34TC

SECTION 1 **of** 1

Lat. 0° 18.279' S

Long. 81° 48.940' W

Water Depth 746M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

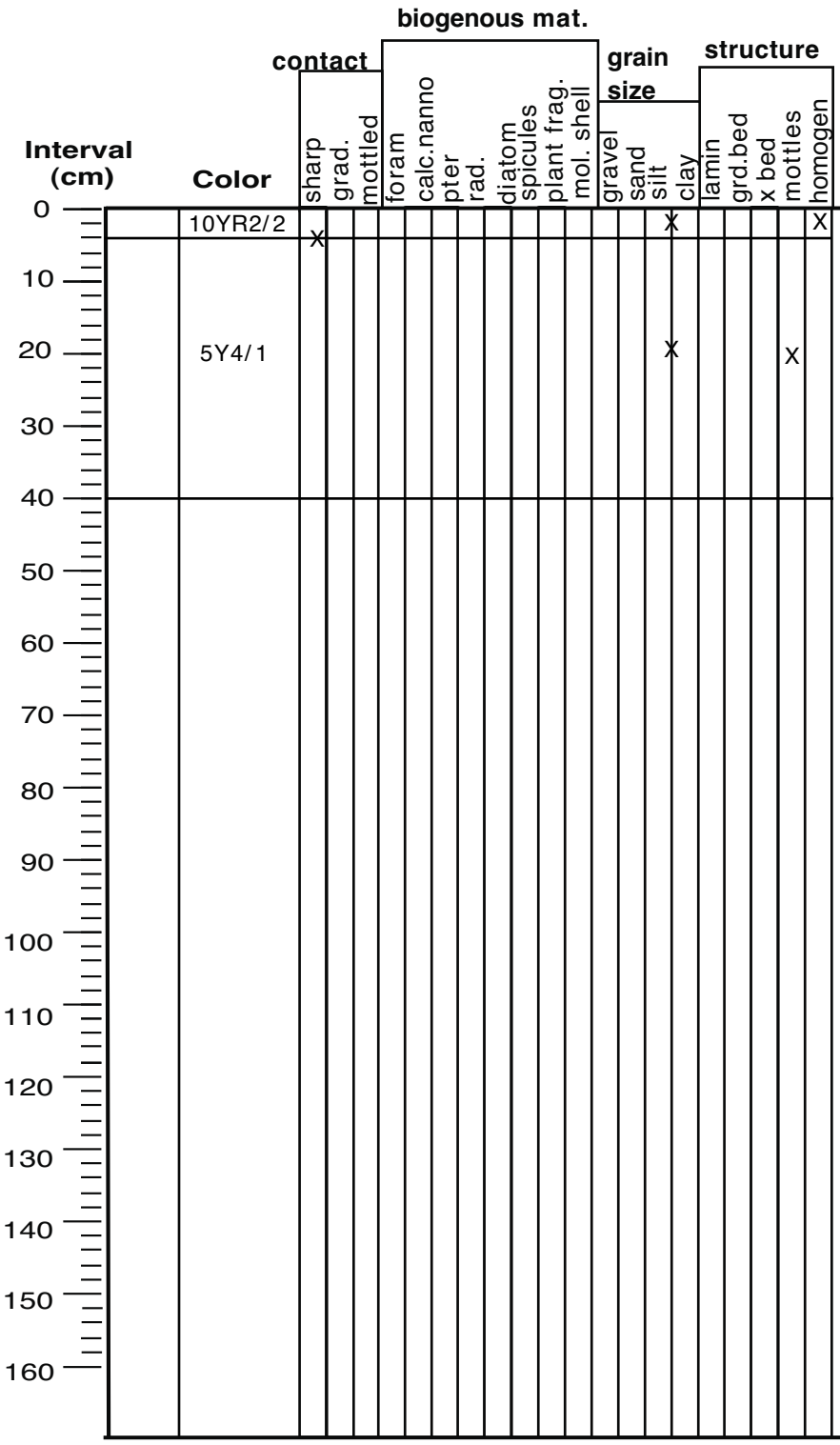
CORE ID ME0005A-37TC

SECTION 1 **of** 1

Lat. 4° 07.19' N

Long. 85° 0.299' W

Water Depth 3409M



Remarks

Date Open & Desc. 6/04/2000

Interval Depth 0-40cm

0-4cm
Very dark brown (10YR2/2) silty clay

Small open burrow at 4cm

4-40cm
Dominant color dark gray (5Y4/1) silty clay with darker and lighter mottles.

no ss

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

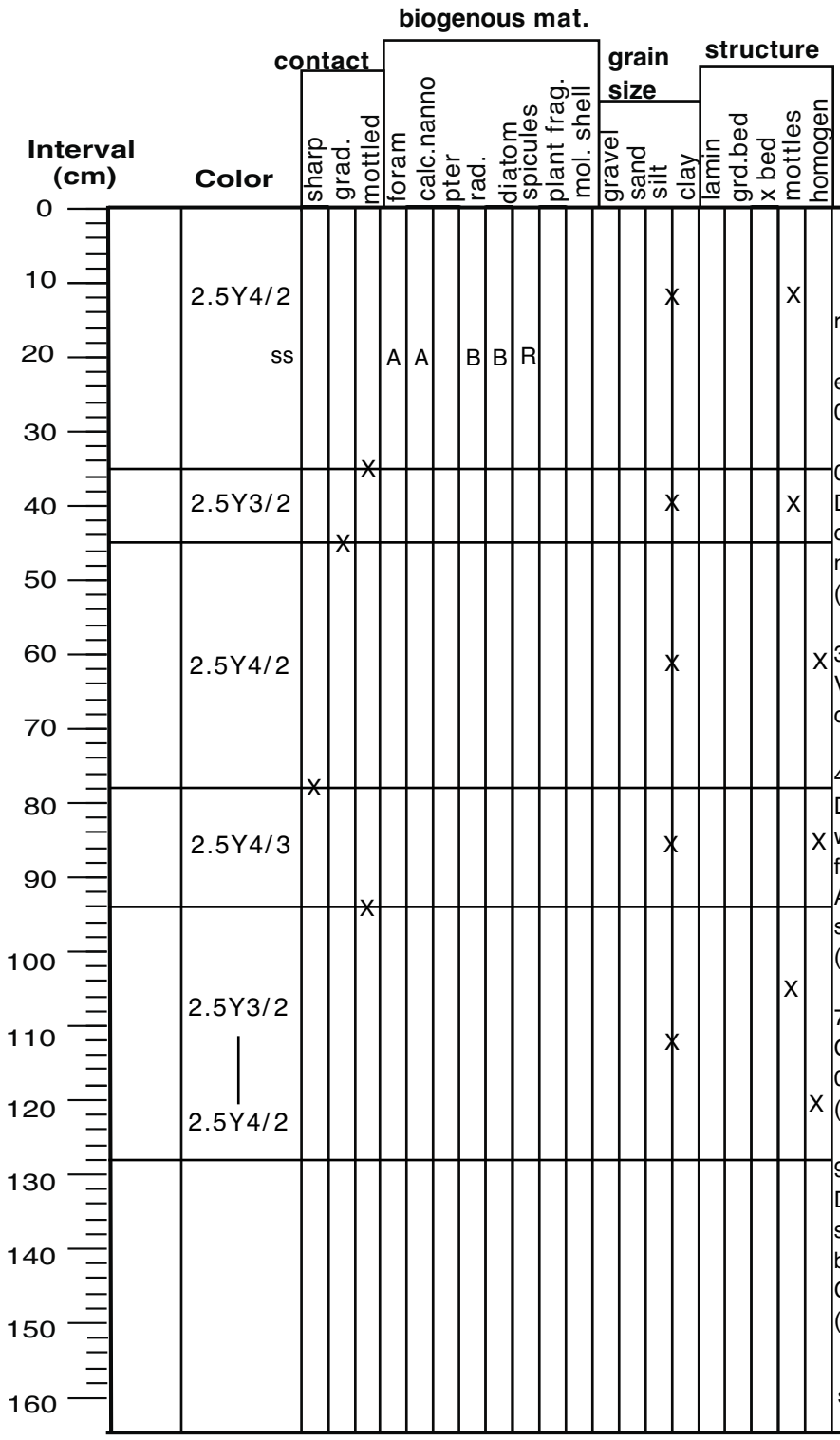
CORE ID ME0005A-40TC

SECTION 1 **of** 1

Lat. 7° 19.0' N

Long. 84° 06.8' W

Water Depth 1004M



Remarks

Date Open & Desc. 6/5/2000

Interval Depth 0-128cm

redescribed 11/29/01

entire section is foram nannofossil ooze
0-7cm ARCH; little sediment; disturbed

0-35cm
Dominant color dark grayish brown silty clay (2.5Y4/2) with increasing bands and mottles of very dark grayish brown (2.5Y3/2) from 23-35cm

35-45cm
Very dark grayish brown (2.5Y3/2) silty clay with faint mottles, gradually changing

45-78cm
Dark grayish brown (2.5Y4/2) silty clay with a band of olive brown (2.5Y4/3) from 70-72cm
At 70cm, a 0.5cm fragment of siliceous skeletal material or fish scale. (not present, 11/29/01)

78-94cm
Olive brown (2.5Y4/3) silty clay with 0.5cm bands of dark grayish brown (2.5Y4/2) at 82, 83, 87, 88, and 90cm

94-128cm
Dominant color very dark brown (2.5Y3/2) silty clay with mottles and bands of olive brown (2.5Y4/3) from 94-105cm. Gradually changing to dark grayish brown (2.5Y4/2) by end of section

ss 20cm

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

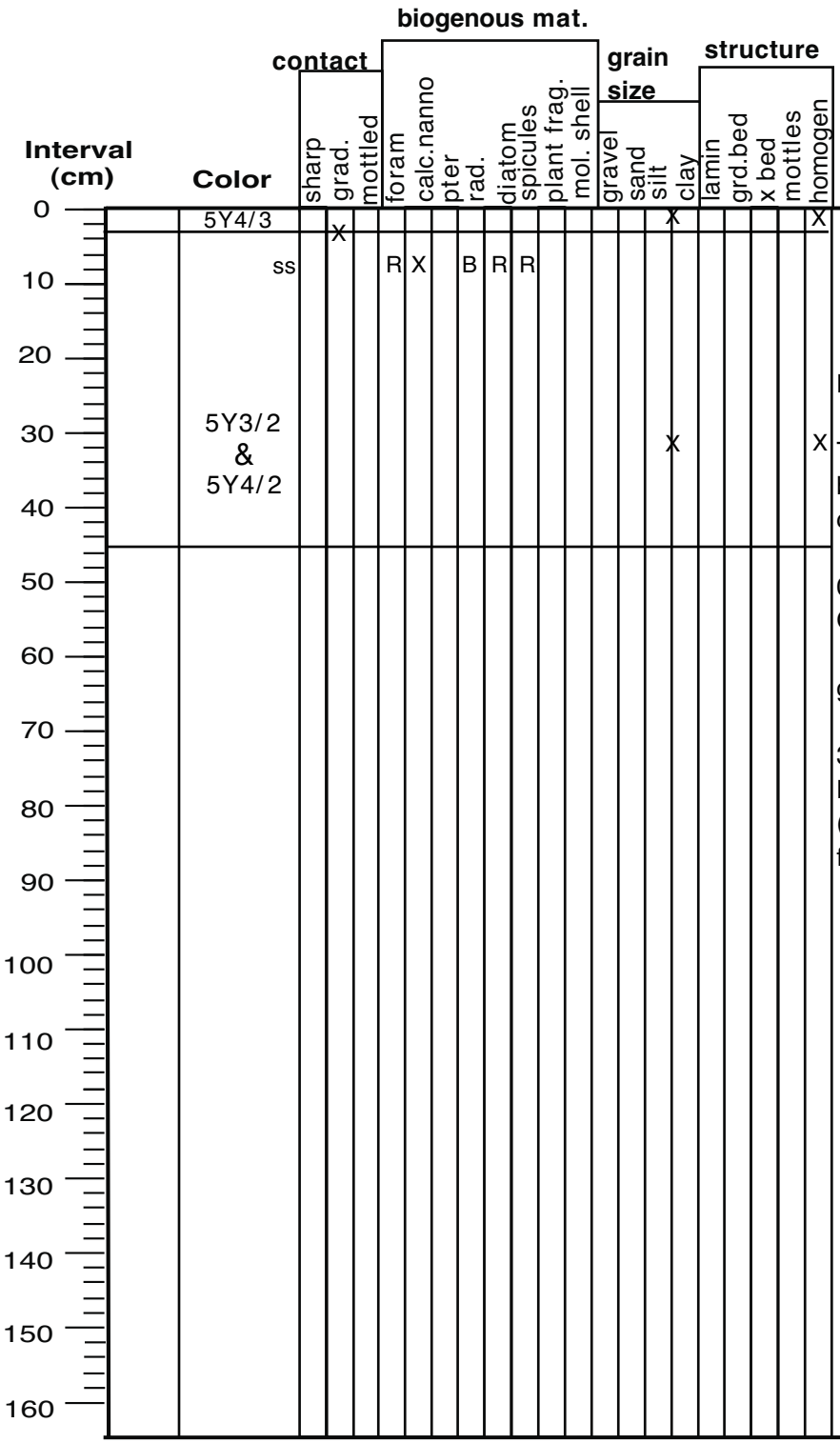
CORE ID ME0005A-41MC1

SECTION 1 **of** 1

Lat. 7° 51.35' N

Long. 83° 36.49' W

Water Depth 1367M



Date Open & Desc. 3/15/2001

Interval Depth 0-45cm

Black mold between core and liner.

Top soft, soupy, gradually becoming more consolidated downcore.

0-3cm
Olive (5Y4/3) silty clay.

grading to

3-45cm
Mix of olive/dark olive gray (5Y4/2 5Y3/2) silty clay. Small white flecks last third of core.

ss 8cm

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

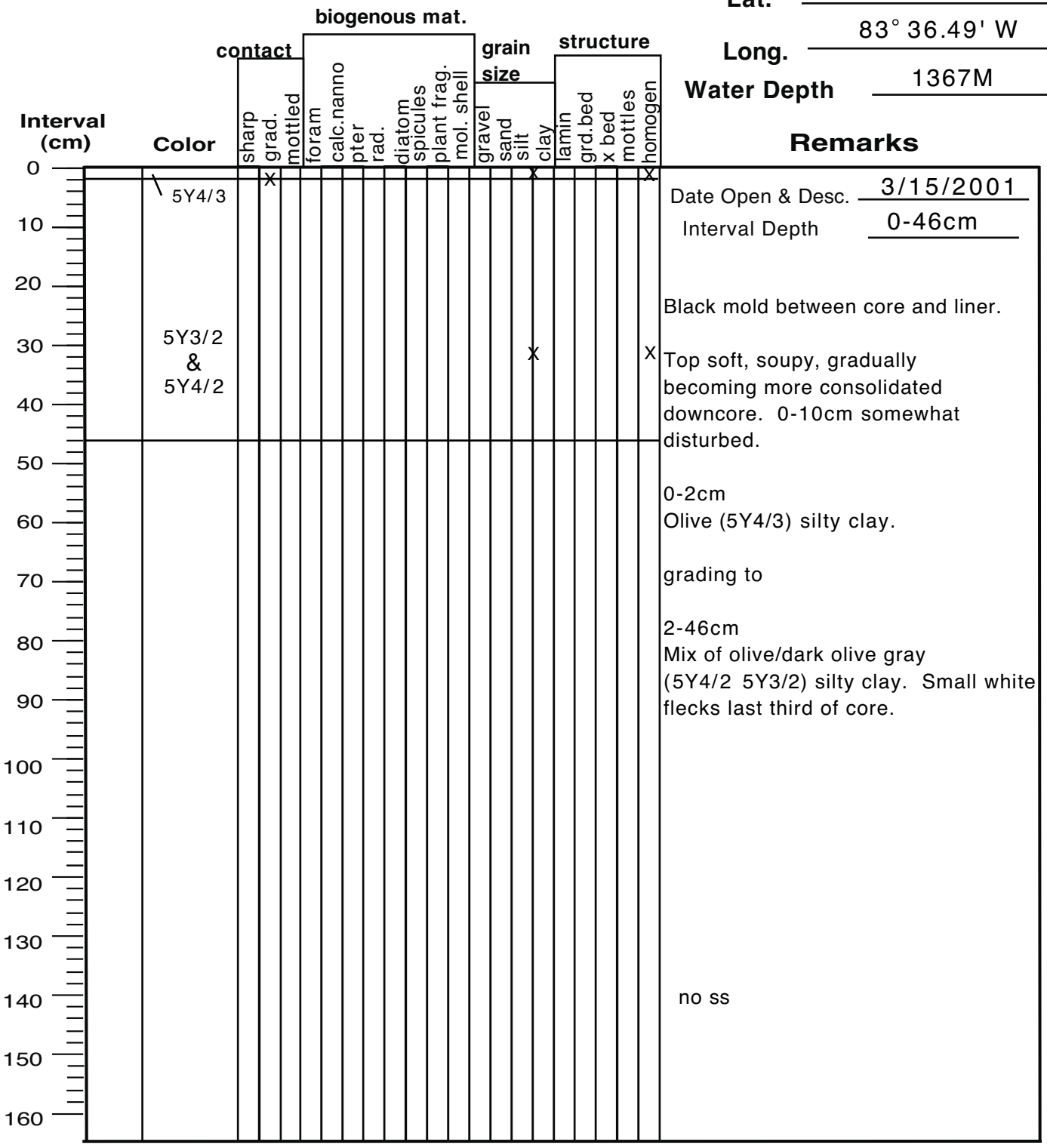
CORE ID ME0005A-41MC2

SECTION 1 **of** 1

Lat. 7° 51.35' N

Long. 83° 36.49' W

Water Depth 1367M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

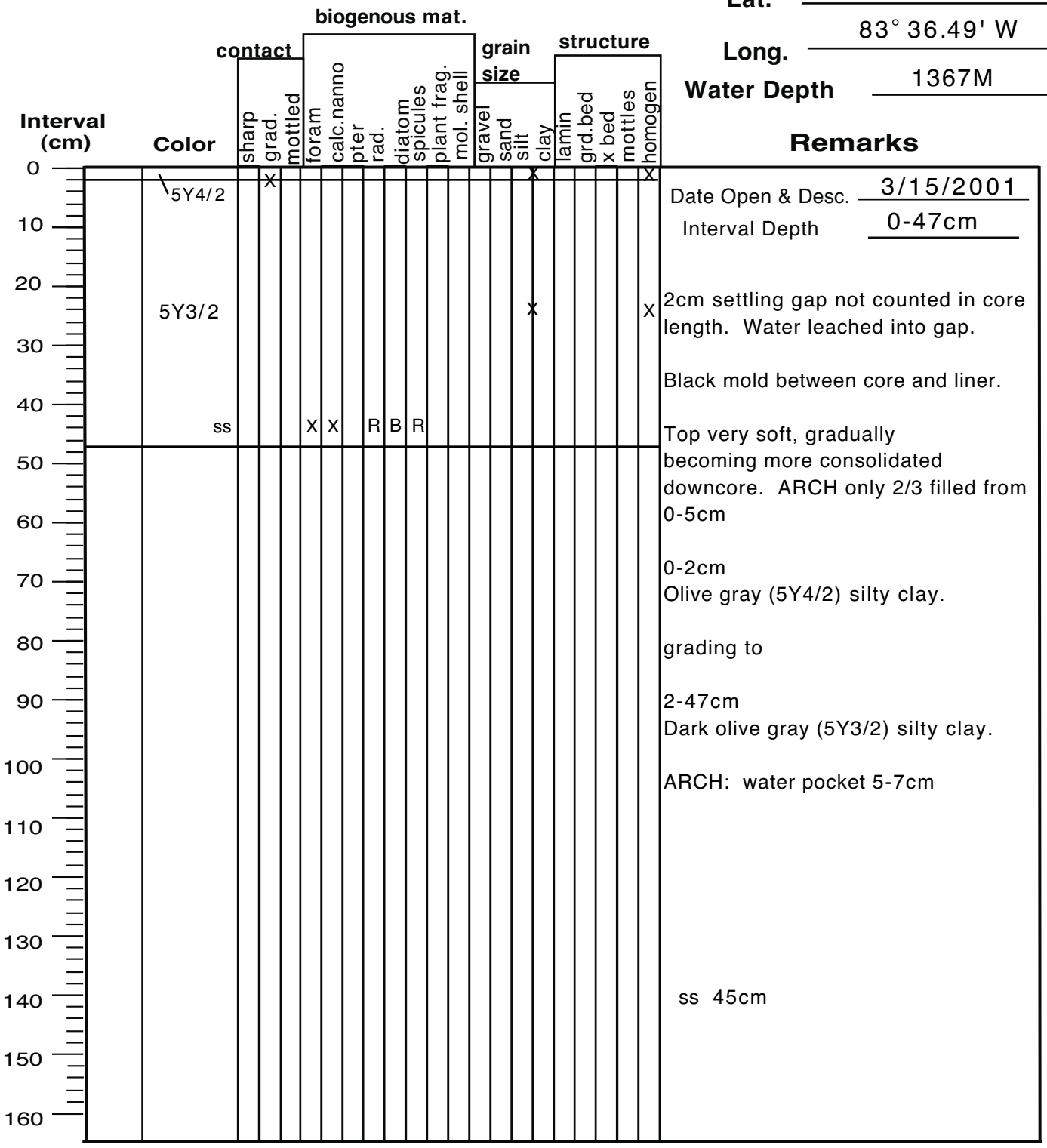
CORE ID ME0005A-41MC3

SECTION 1 **of** 1

Lat. 7° 51.35' N

Long. 83° 36.49' W

Water Depth 1367M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

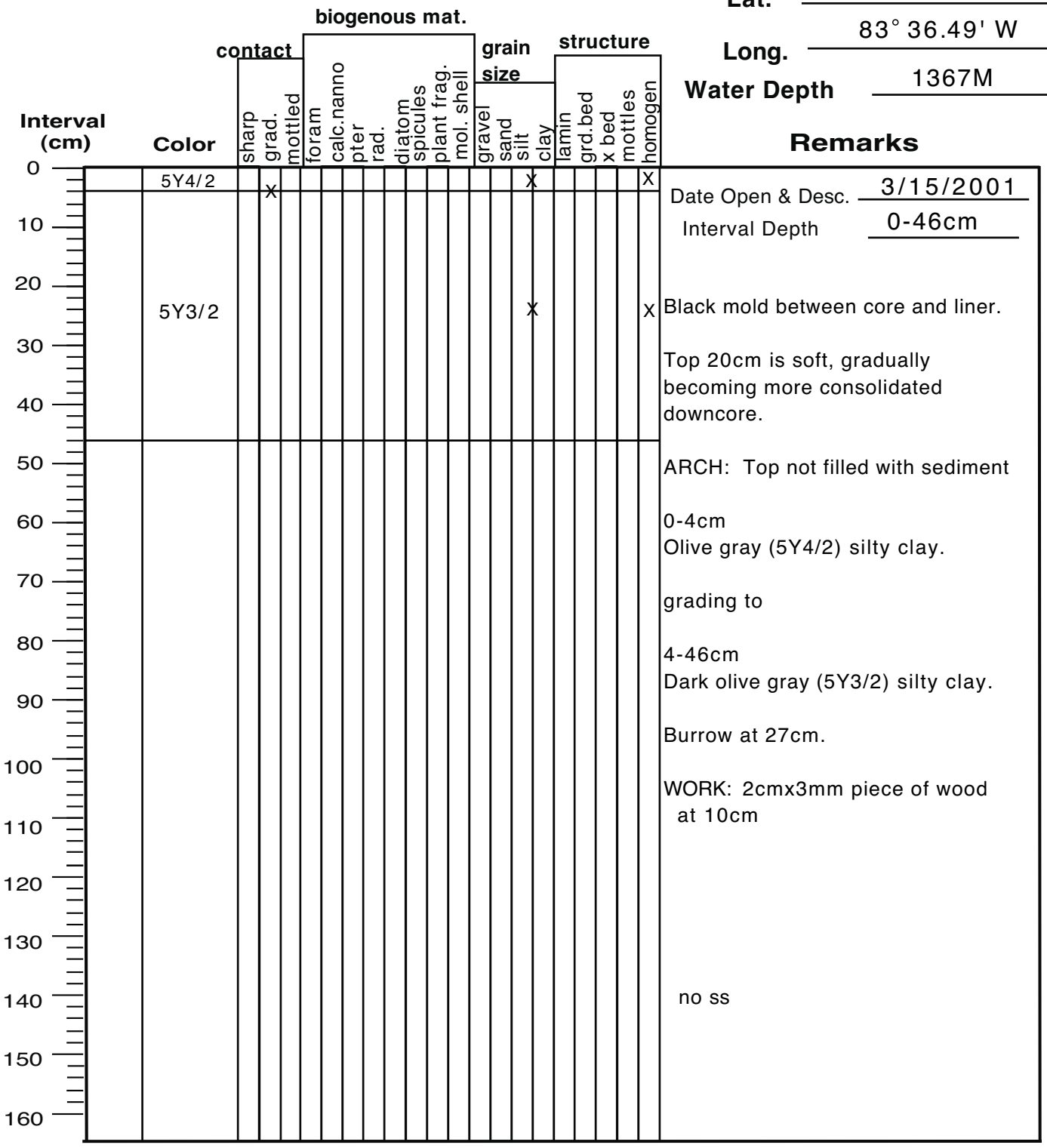
CORE ID ME0005A-41MC4

SECTION 1 **of** 1

Lat. 7° 51.35' N

Long. 83° 36.49' W

Water Depth 1367M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

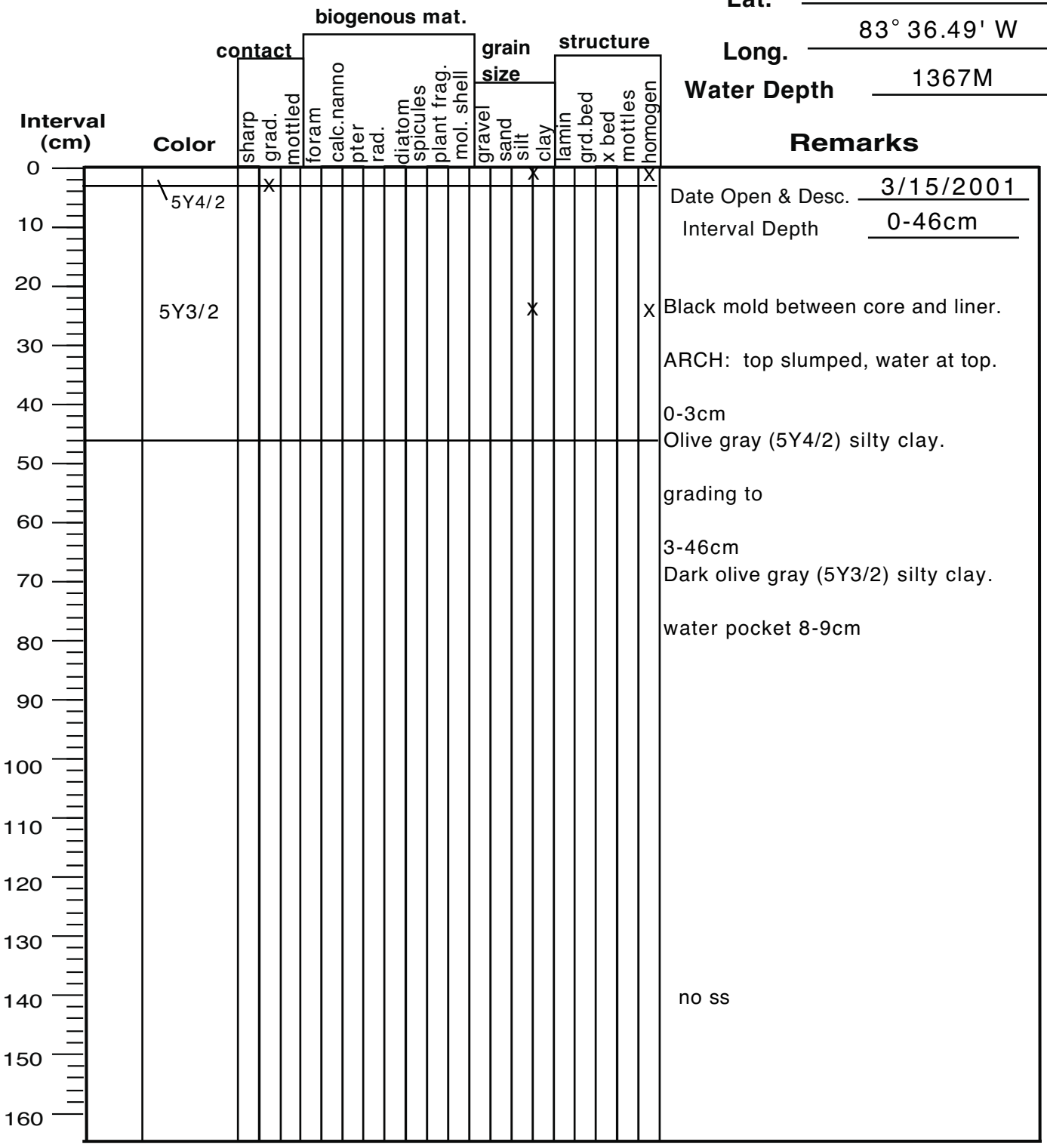
CORE ID ME0005A-41MC5

SECTION 1 **of** 1

Lat. 7° 51.35' N

Long. 83° 36.49' W

Water Depth 1367M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

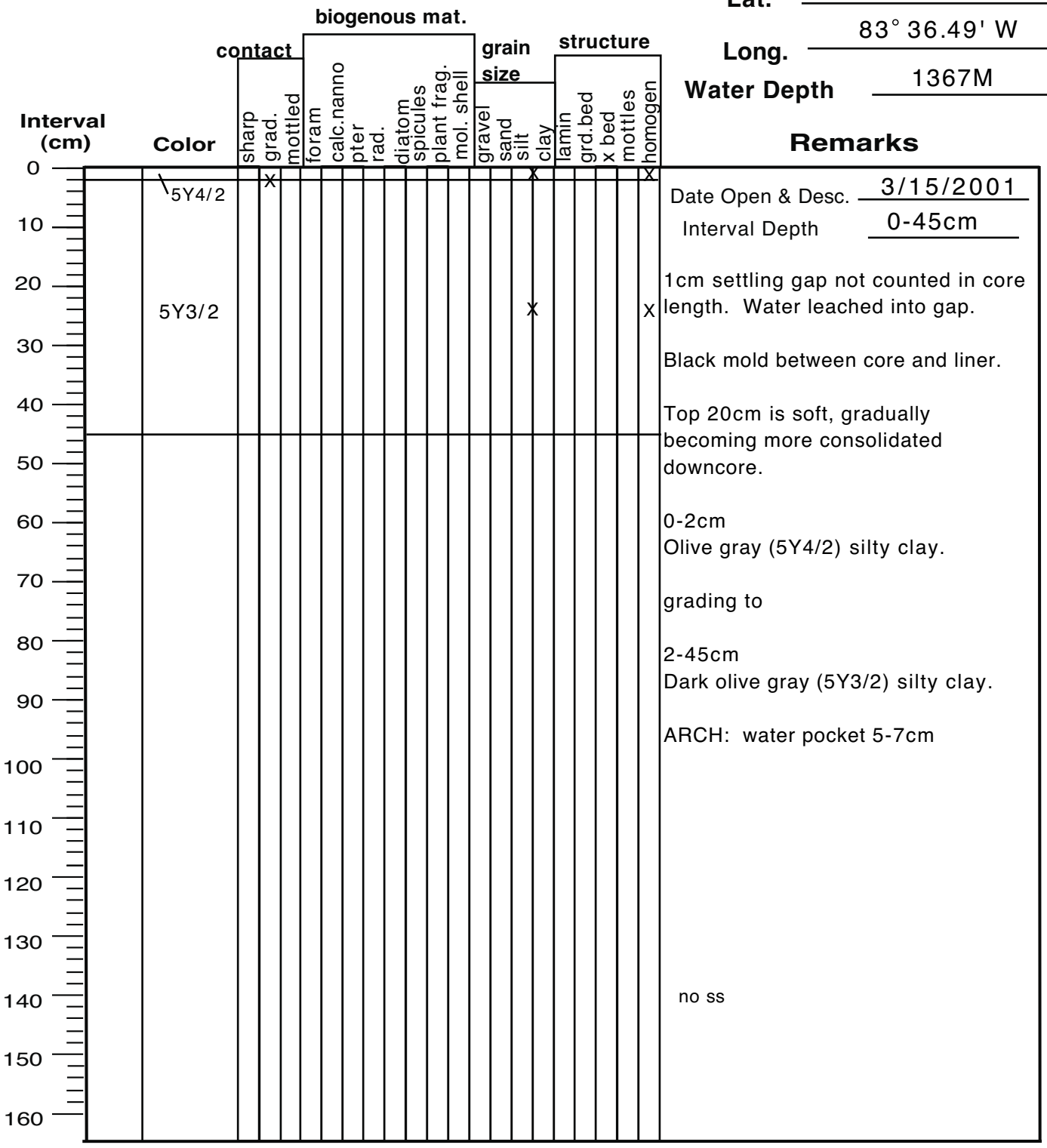
CORE ID ME0005A-41MC6

SECTION 1 **of** 1

Lat. 7° 51.35' N

Long. 83° 36.49' W

Water Depth 1367M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

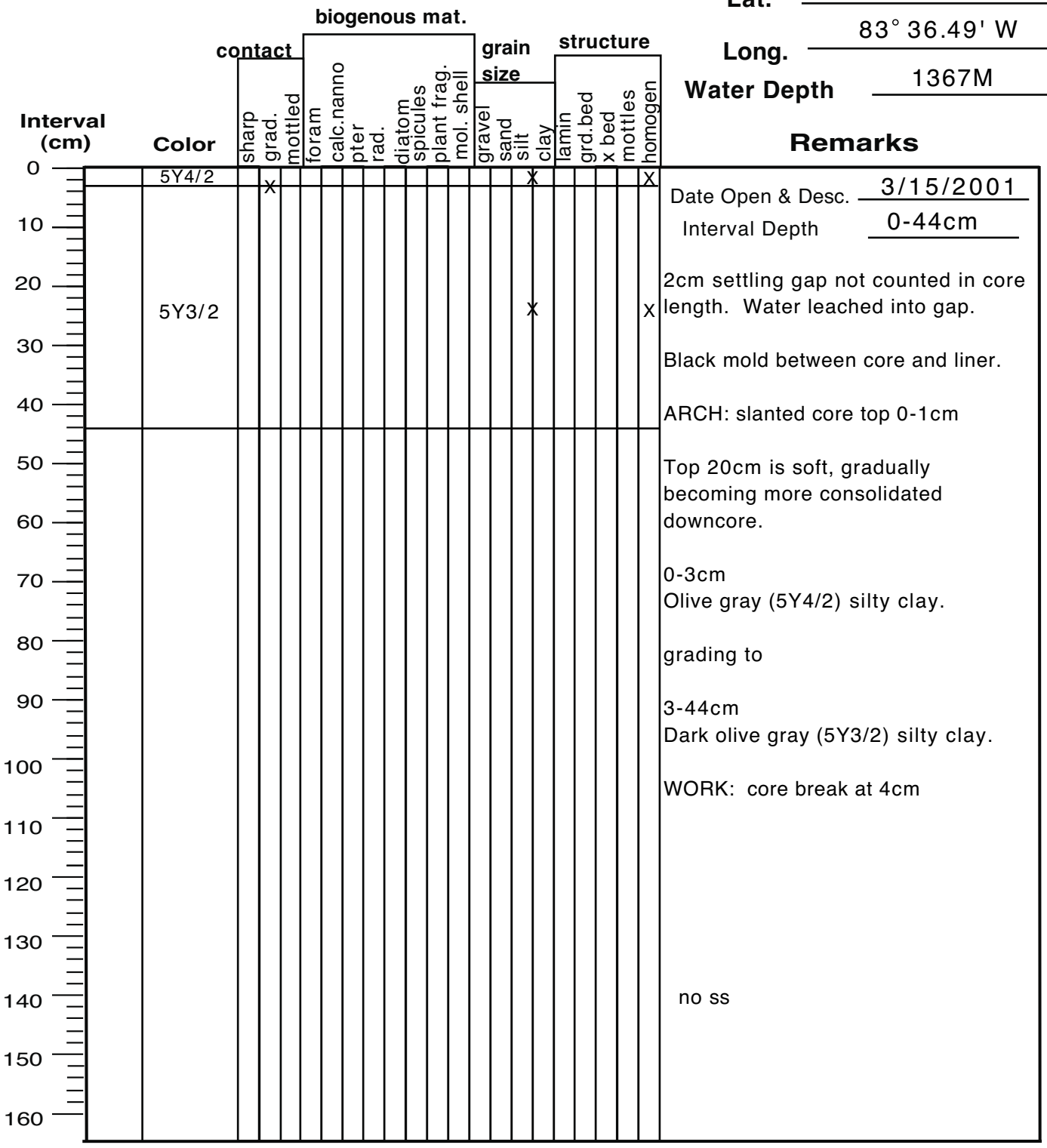
CORE ID ME0005A-41MC7

SECTION 1 **of** 1

Lat. 7° 51.35' N

Long. 83° 36.49' W

Water Depth 1367M



Date Open & Desc. 3/15/2001

Interval Depth 0-44cm

2cm settling gap not counted in core length. Water leached into gap.

Black mold between core and liner.

ARCH: slanted core top 0-1cm

Top 20cm is soft, gradually becoming more consolidated downcore.

0-3cm
Olive gray (5Y4/2) silty clay.

grading to

3-44cm
Dark olive gray (5Y3/2) silty clay.

WORK: core break at 4cm

no ss

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

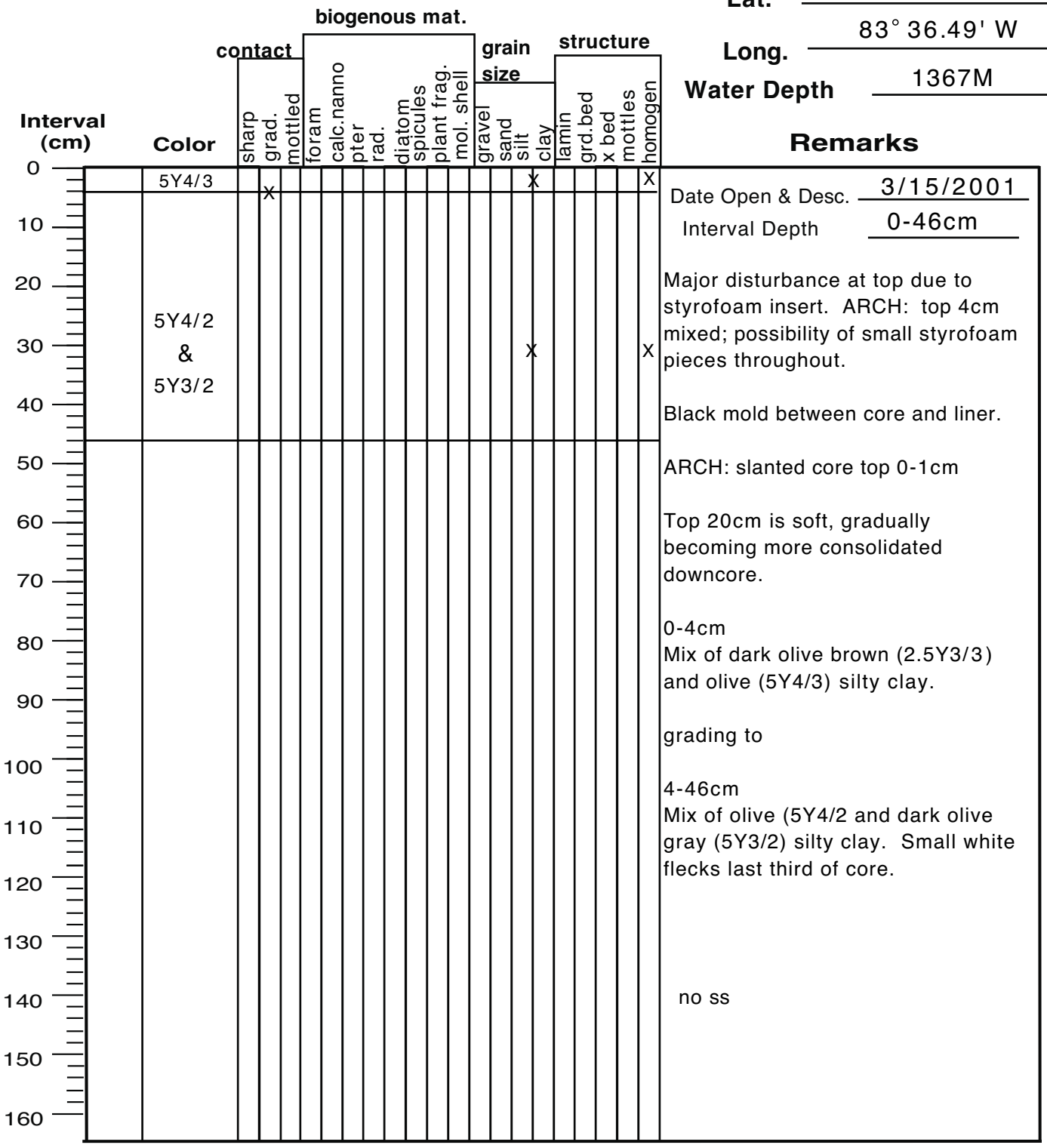
CORE ID ME0005A-41MC8

SECTION 1 **of** 1

Lat. 7° 51.35' N

Long. 83° 36.49' W

Water Depth 1367M



Remarks

Date Open & Desc. 3/15/2001

Interval Depth 0-46cm

Major disturbance at top due to styrofoam insert. ARCH: top 4cm mixed; possibility of small styrofoam pieces throughout.

Black mold between core and liner.

ARCH: slanted core top 0-1cm

Top 20cm is soft, gradually becoming more consolidated downcore.

0-4cm
Mix of dark olive brown (2.5Y3/3) and olive (5Y4/3) silty clay.

grading to

4-46cm
Mix of olive (5Y4/2 and dark olive gray (5Y3/2) silty clay. Small white flecks last third of core.

no ss

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

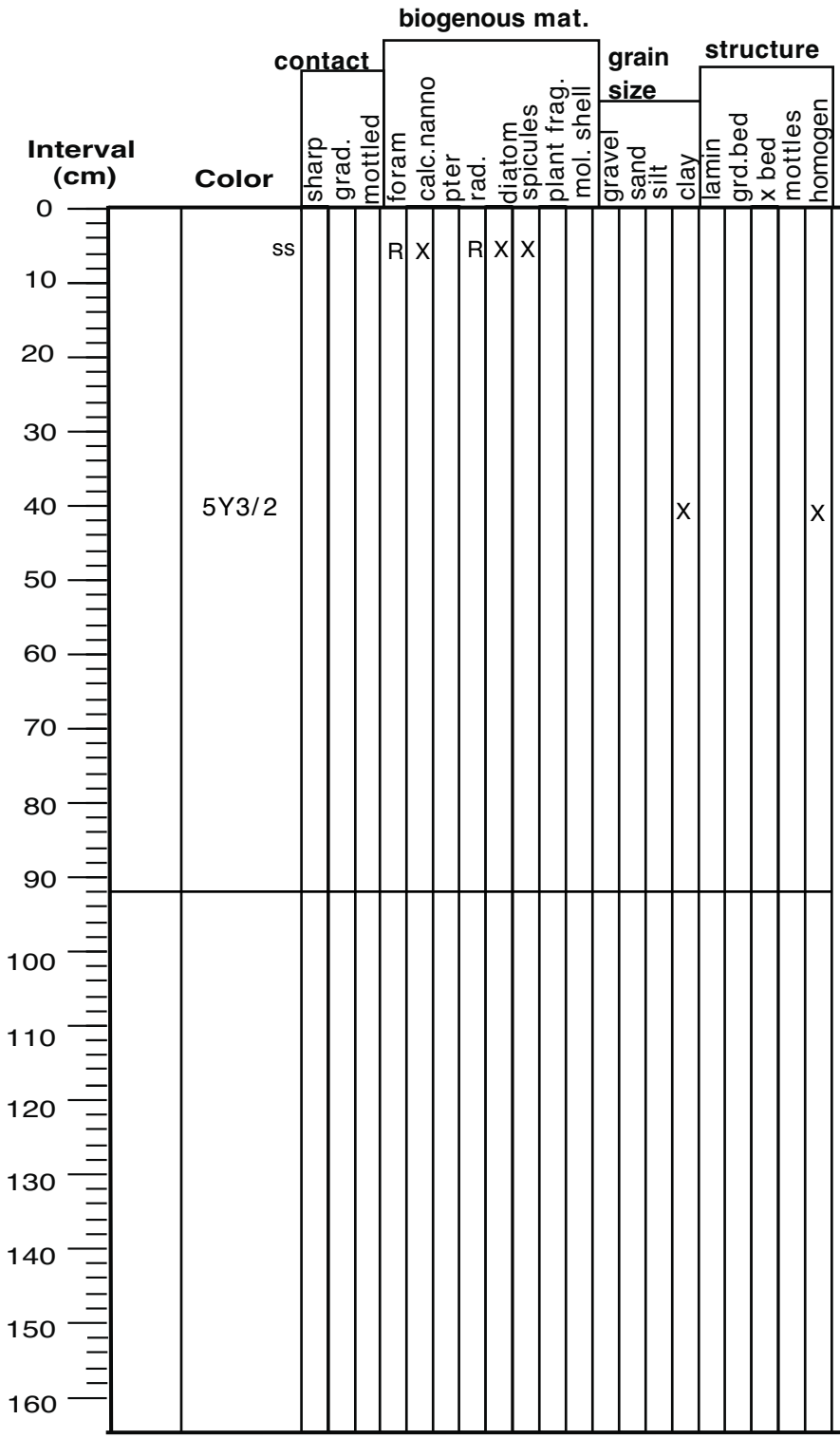
CORE ID ME0005A-43JC

SECTION 1 **of** 12

Lat. 7° 51.35' N

Long. 83° 36.50' W

Water Depth 1368M



Remarks

Date Open & Desc. 2/6/2001

Interval Depth 0-92cm

very soft core.

0-92cm
Dark olive gray (5Y3/2) clay

Faint burrows (0.5cm) below 50cm, more prominant from 75-85cm.

ss 5cm

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

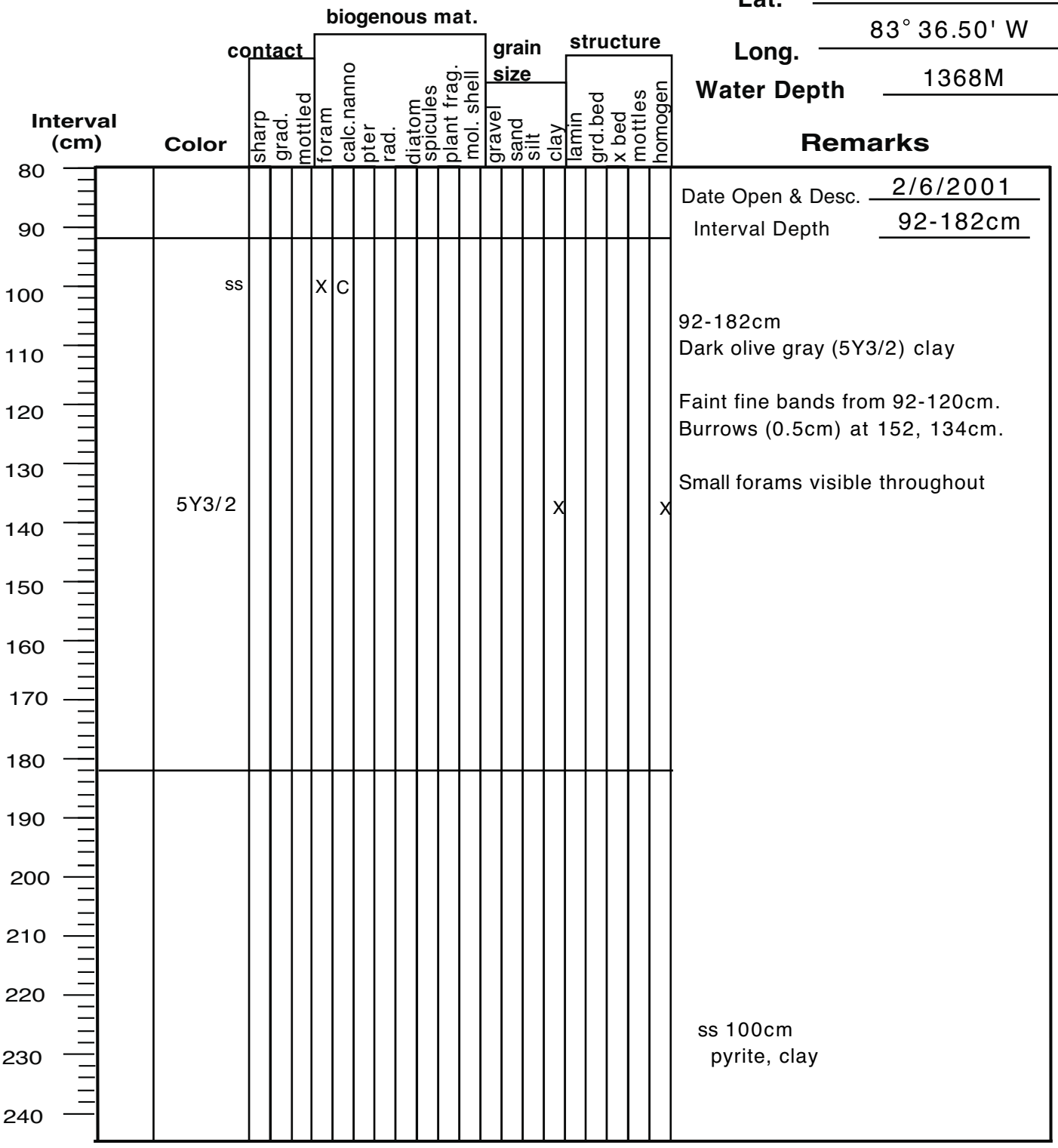
CORE ID ME0005A-43JC

SECTION 2 **of** 12

Lat. 7° 51.35' N

Long. 83° 36.50' W

Water Depth 1368M



Date Open & Desc. 2/6/2001

Interval Depth 92-182cm

92-182cm
Dark olive gray (5Y3/2) clay

Faint fine bands from 92-120cm.
Burrows (0.5cm) at 152, 134cm.

Small forams visible throughout

ss 100cm
pyrite, clay

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

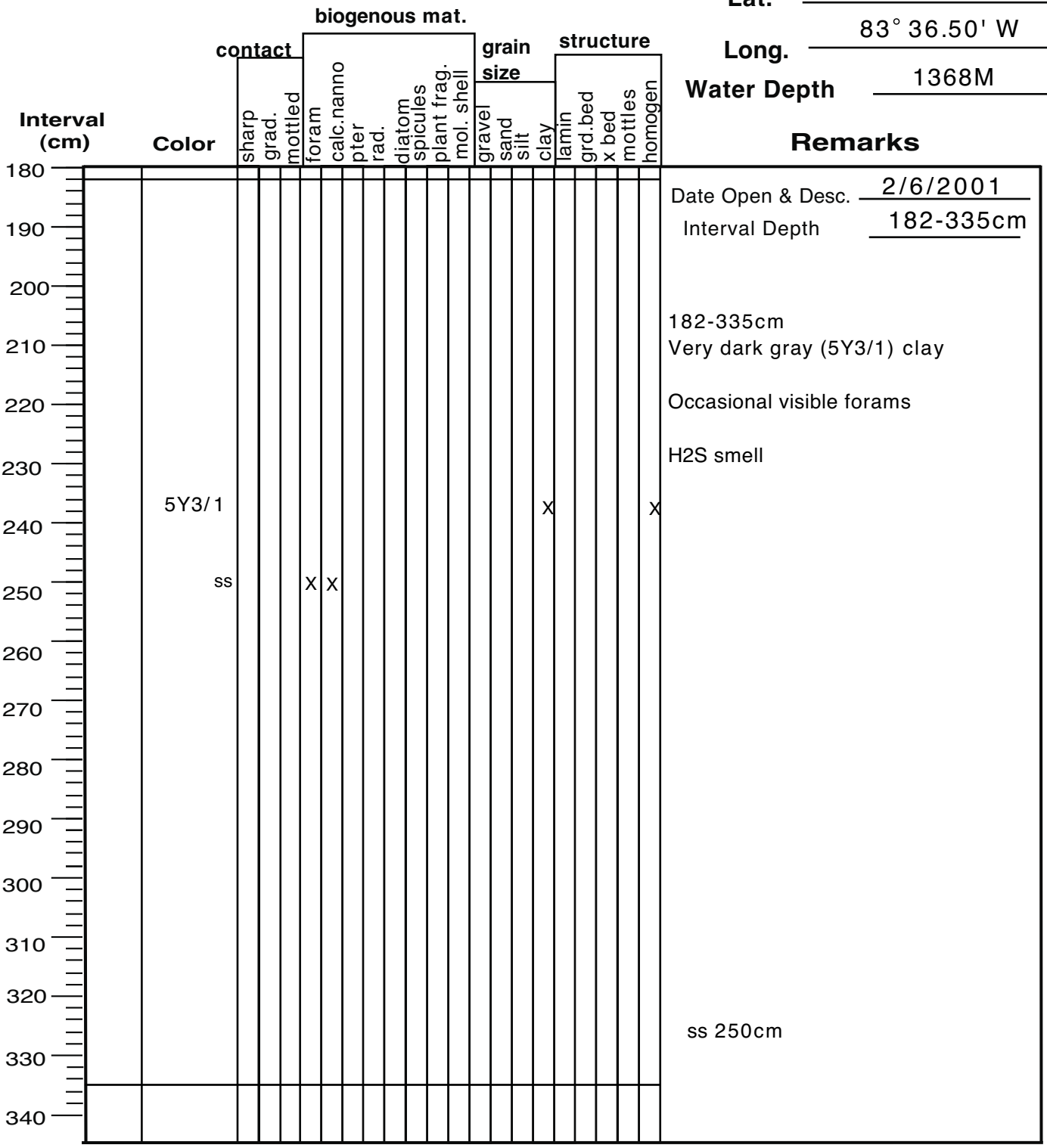
CORE ID ME0005A-43JC

SECTION 3 **of** 12

Lat. 7° 51.35' N

Long. 83° 36.50' W

Water Depth 1368M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

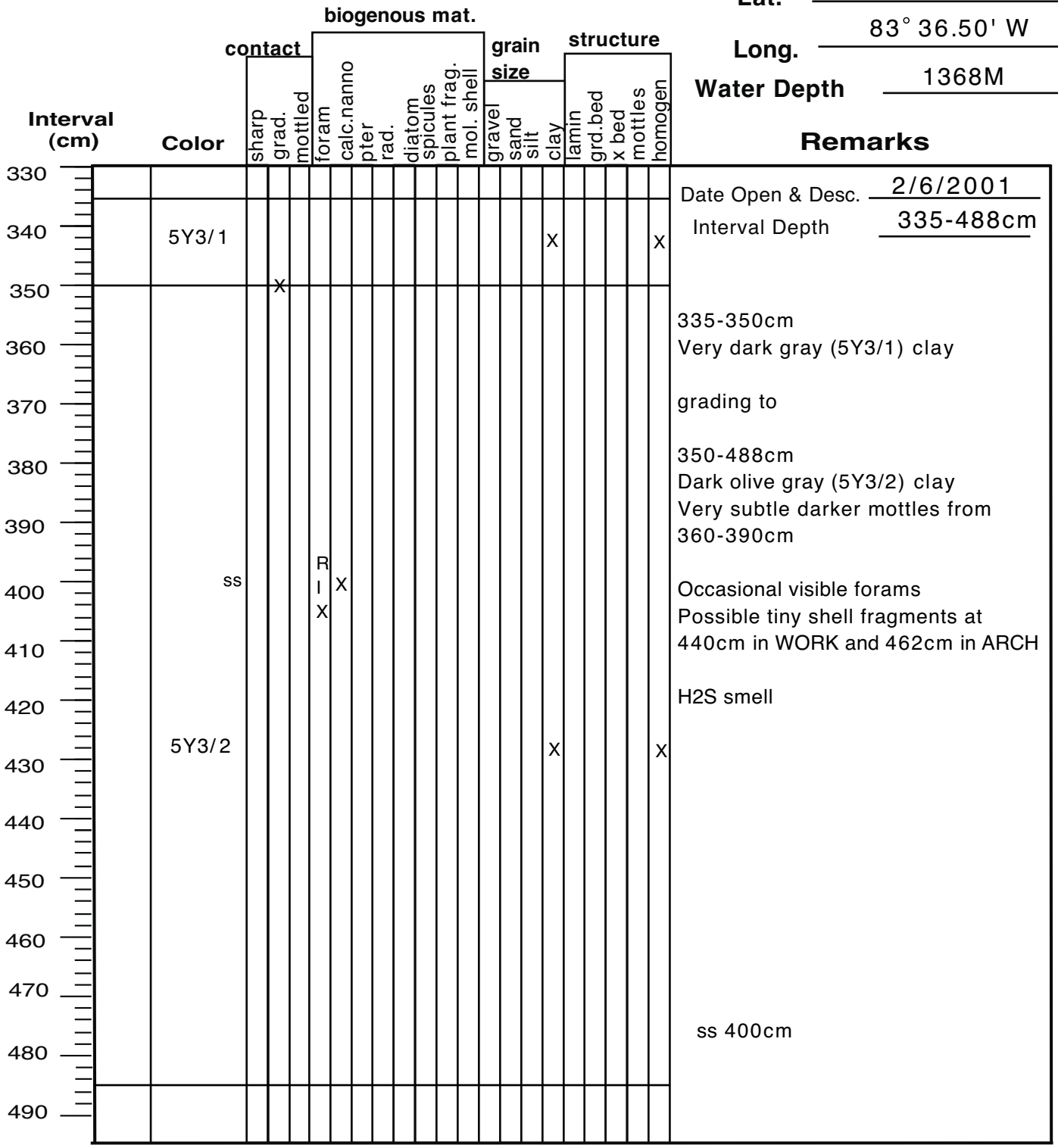
CORE ID ME0005A-43JC

SECTION 4 **of** 12

Lat. 7° 51.35' N

Long. 83° 36.50' W

Water Depth 1368M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

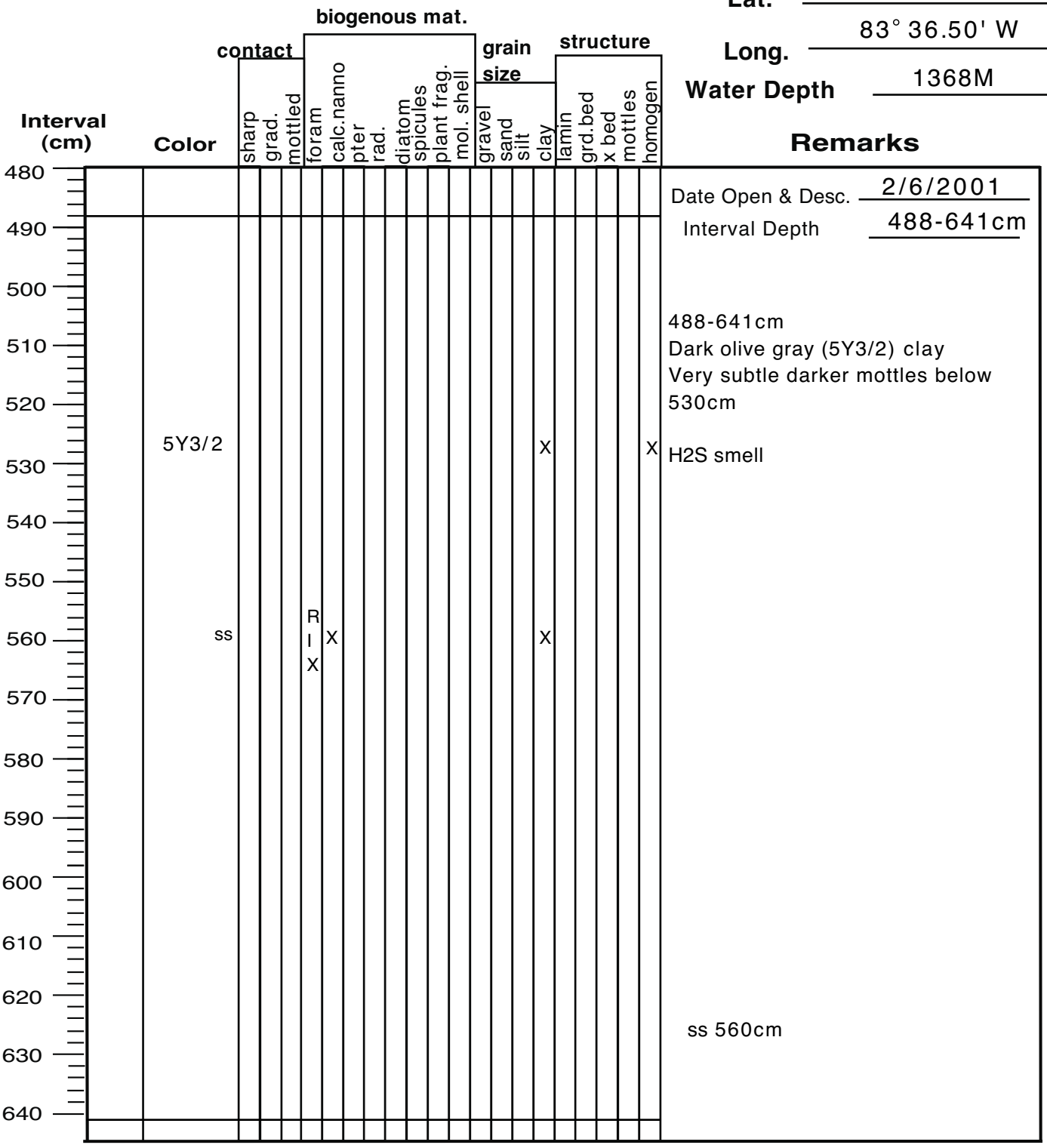
CORE ID ME0005A-43JC

SECTION 5 **of** 12

Lat. 7° 51.35' N

Long. 83° 36.50' W

Water Depth 1368M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

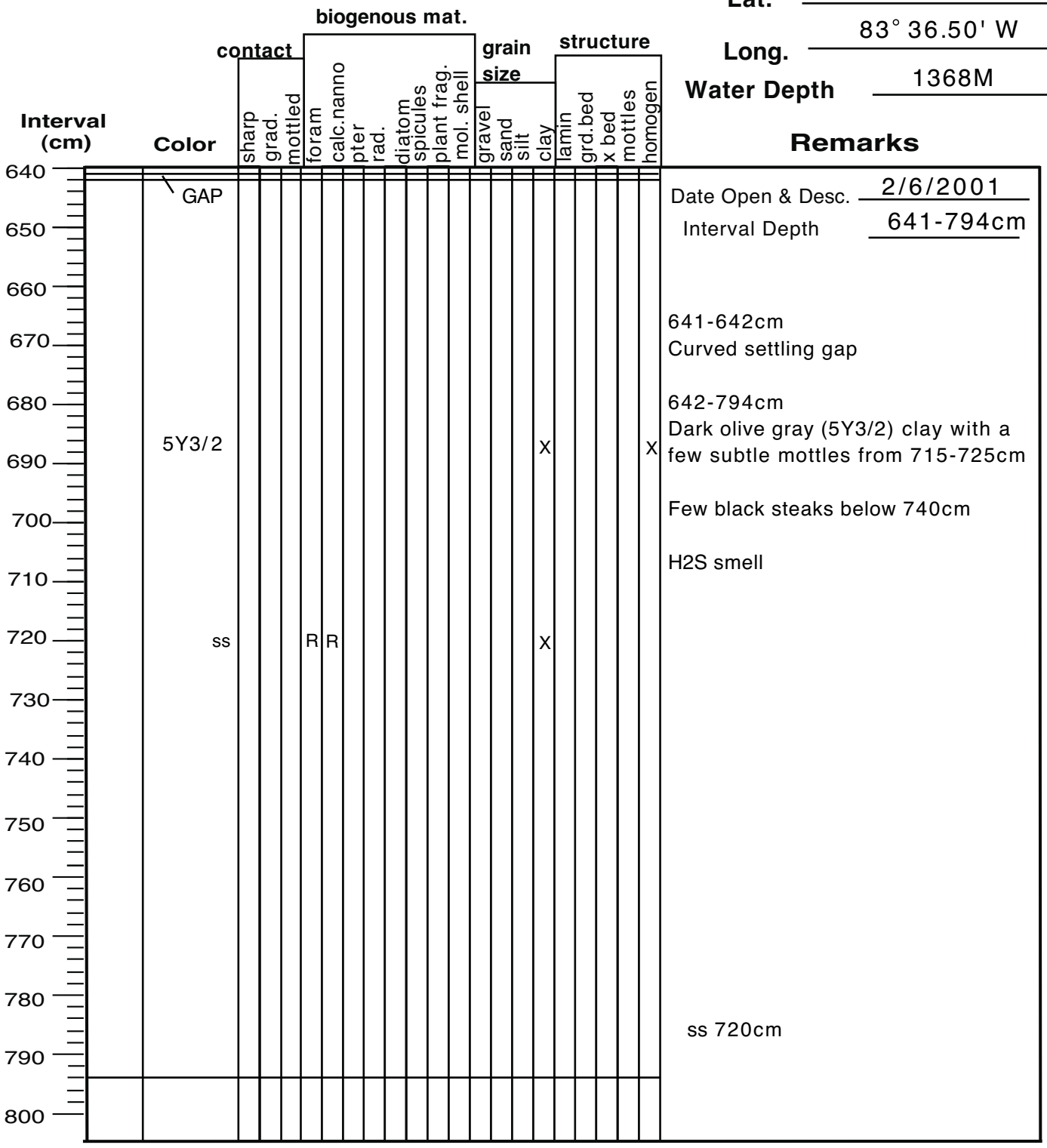
CORE ID ME0005A-43JC

SECTION 6 **of** 12

Lat. 7° 51.35' N

Long. 83° 36.50' W

Water Depth 1368M



Date Open & Desc. 2/6/2001

Interval Depth 641-794cm

641-642cm
Curved settling gap

642-794cm
Dark olive gray (5Y3/2) clay with a few subtle mottles from 715-725cm

Few black steaks below 740cm

H2S smell

ss 720cm

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

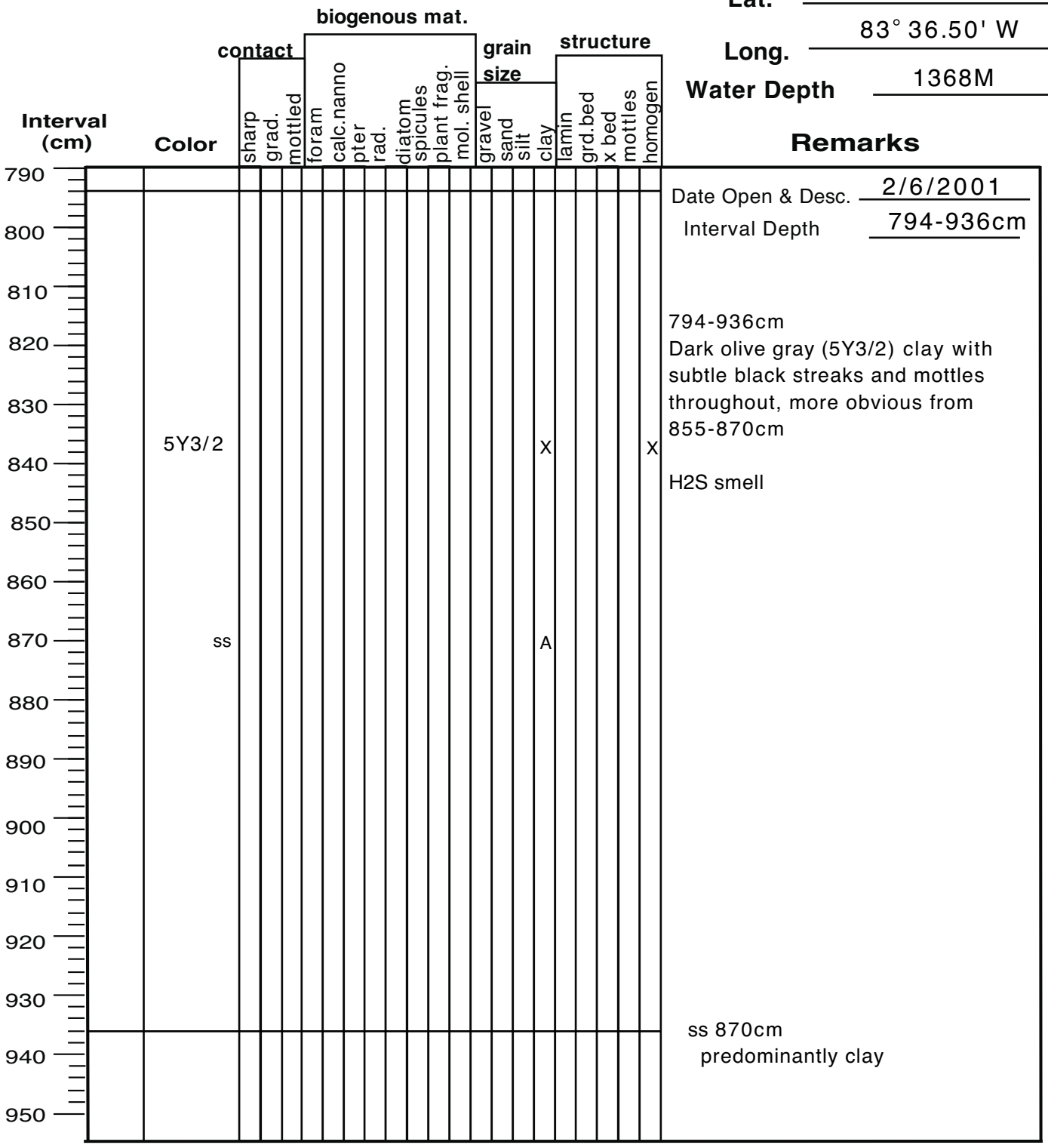
CORE ID ME0005A-43JC

SECTION 7 **of** 12

Lat. 7° 51.35' N

Long. 83° 36.50' W

Water Depth 1368M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

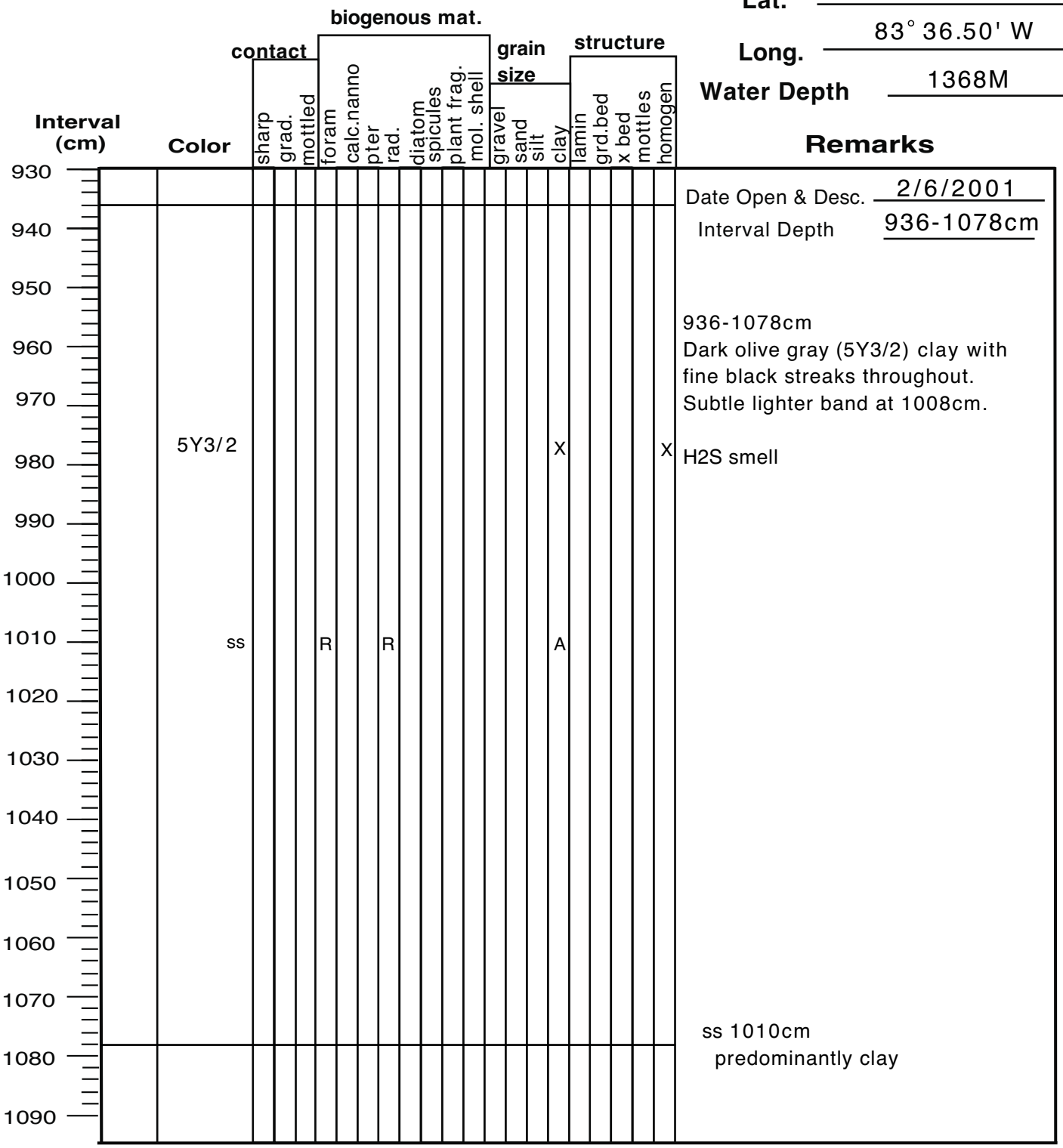
CORE ID ME0005A-43JC

SECTION 8 **of** 12

Lat. 7° 51.35' N

Long. 83° 36.50' W

Water Depth 1368M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

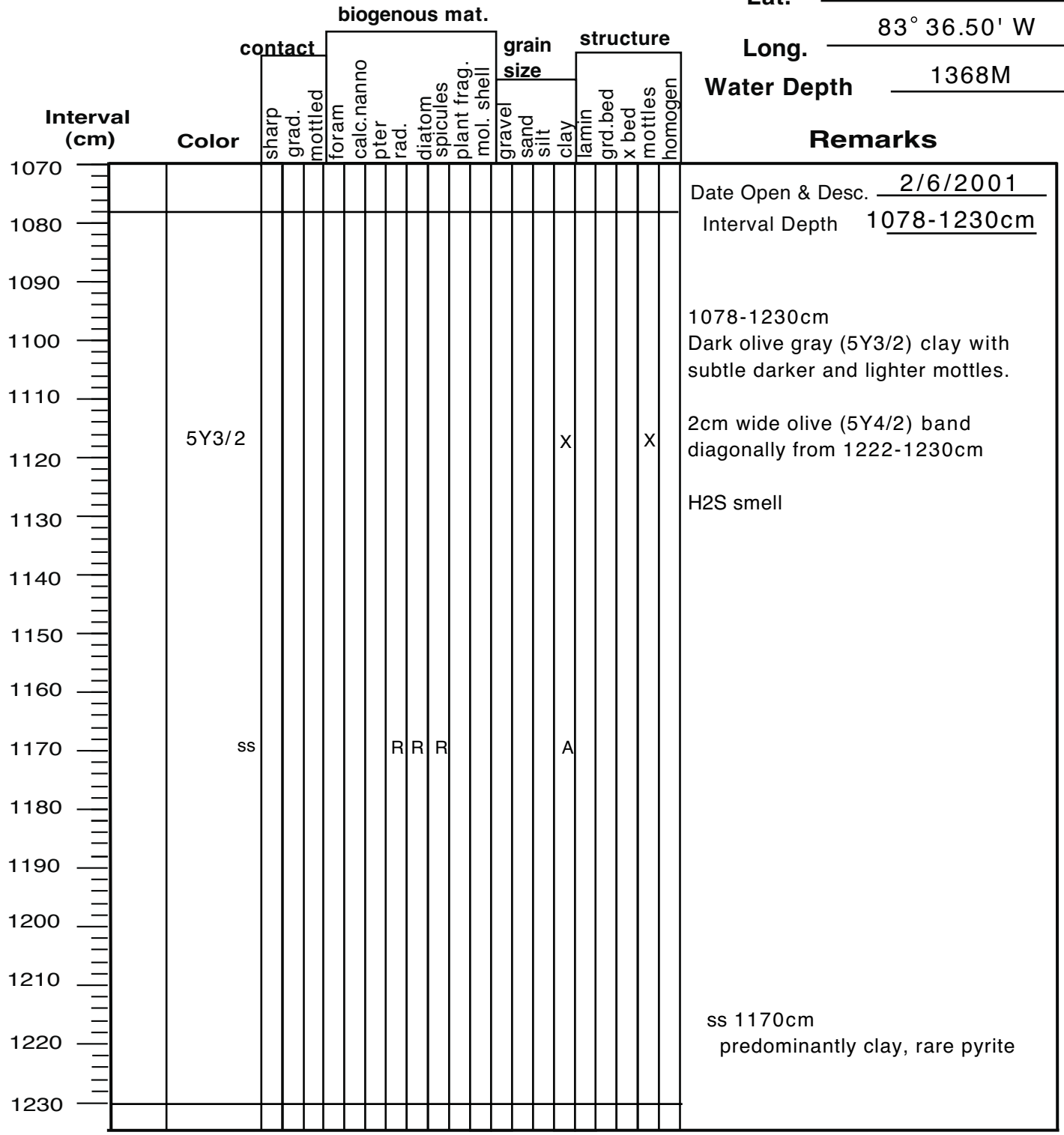
CORE ID ME0005A-43JC

SECTION 9 **of** 12

Lat. 7° 51.35' N

Long. 83° 36.50' W

Water Depth 1368M



Date Open & Desc. 2/6/2001

Interval Depth 1078-1230cm

1078-1230cm
Dark olive gray (5Y3/2) clay with subtle darker and lighter mottles.

2cm wide olive (5Y4/2) band diagonally from 1222-1230cm

H2S smell

ss 1170cm
predominantly clay, rare pyrite

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

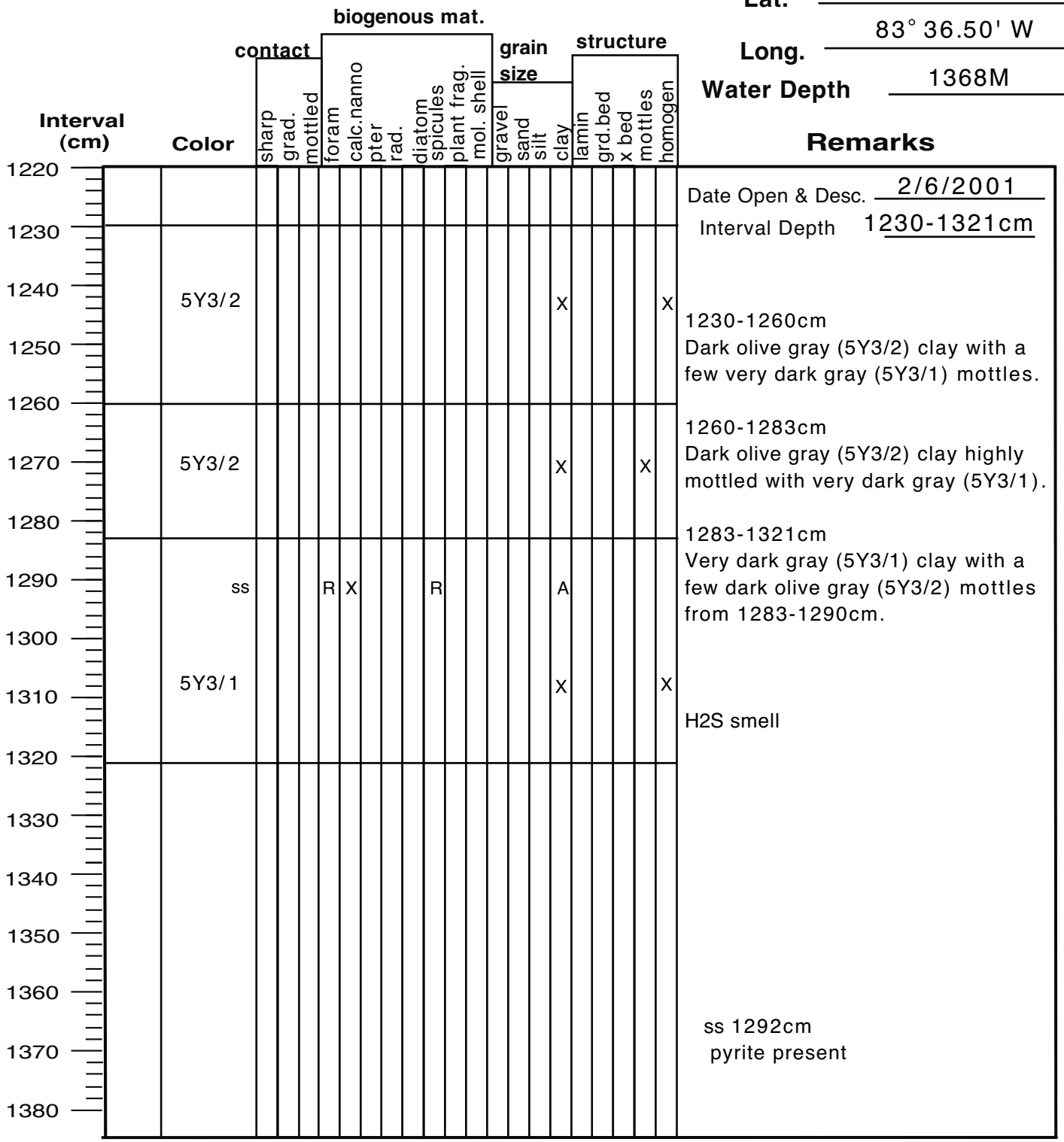
CORE ID ME0005A-43JC

SECTION 10 **of** 12

Lat. 7° 51.35' N

Long. 83° 36.50' W

Water Depth 1368M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

graded bed (turbidite)

Contacts: s-sharp; g-gradational; m-mottled

ss-smear slide

CORE LOG

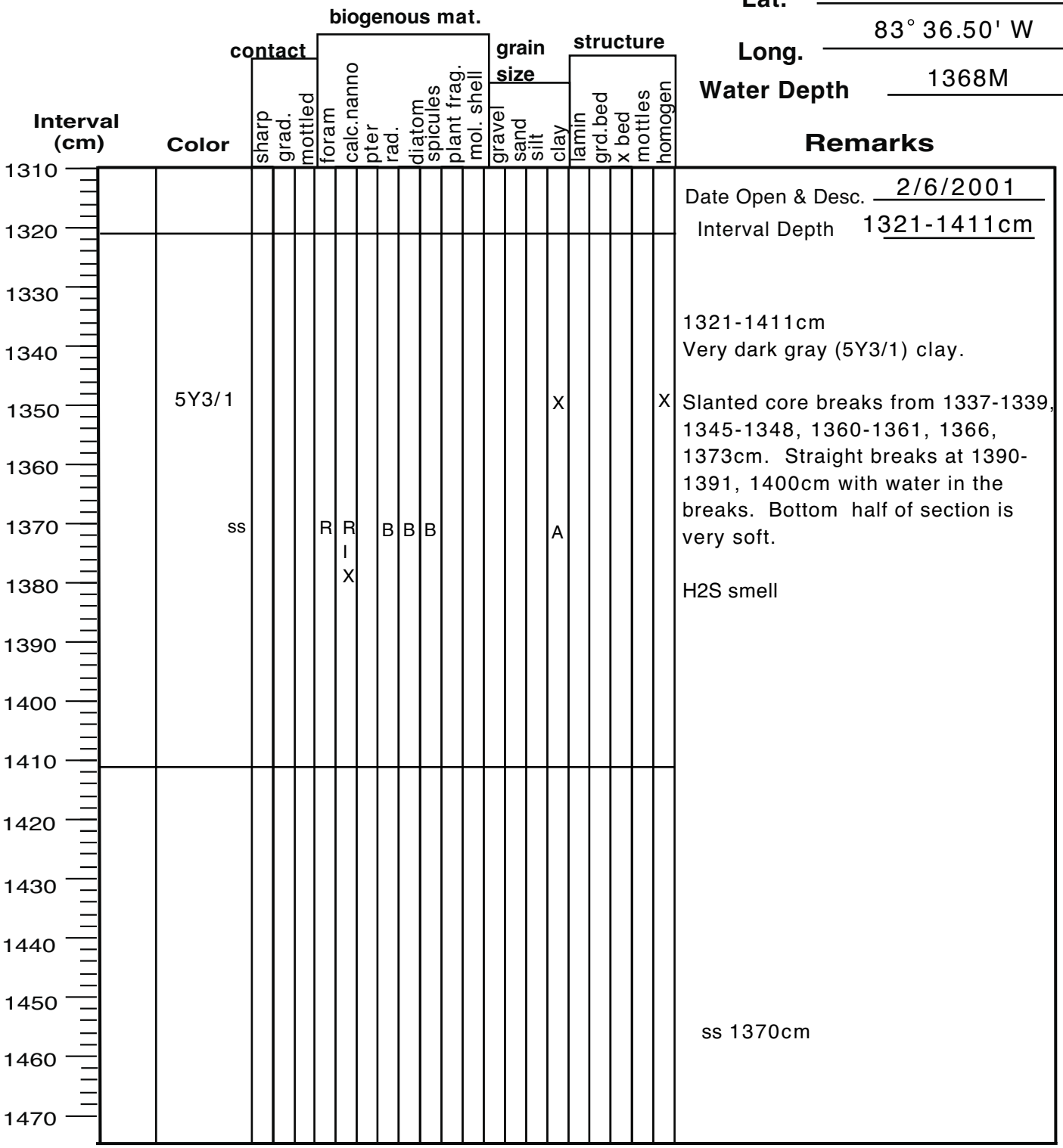
CORE ID ME0005A-43JC

SECTION 11 **of** 12

Lat. 7° 51.35' N

Long. 83° 36.50' W

Water Depth 1368M



Date Open & Desc. 2/6/2001

Interval Depth 1321-1411cm

1321-1411cm
Very dark gray (5Y3/1) clay.

Slanted core breaks from 1337-1339, 1345-1348, 1360-1361, 1366, 1373cm. Straight breaks at 1390-1391, 1400cm with water in the breaks. Bottom half of section is very soft.

H2S smell

ss 1370cm

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

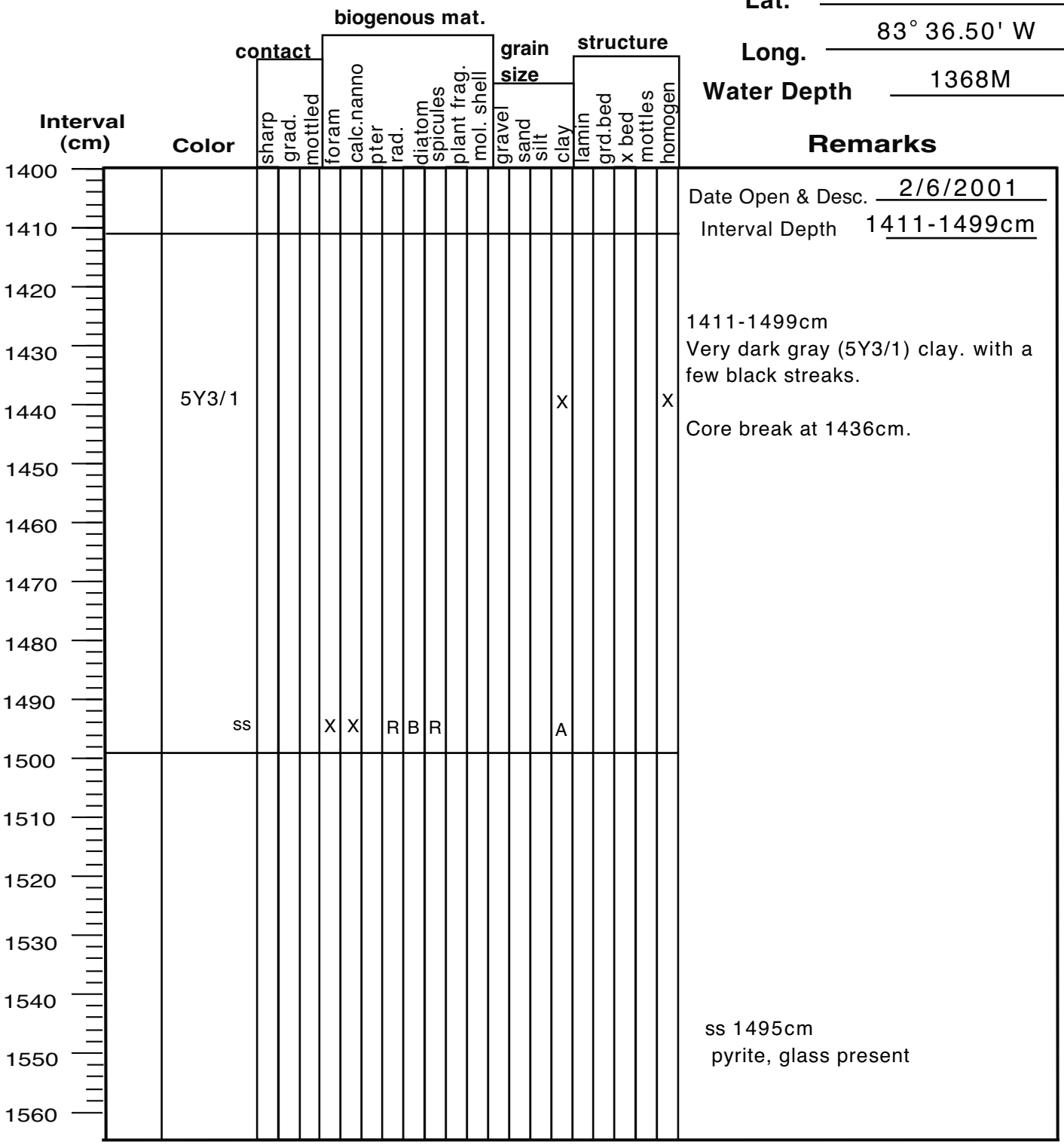
CORE ID ME0005A-43JC

SECTION 12 **of** 12

Lat. 7° 51.35' N

Long. 83° 36.50' W

Water Depth 1368M



Date Open & Desc. 2/6/2001

Interval Depth 1411-1499cm

1411-1499cm
Very dark gray (5Y3/1) clay. with a few black streaks.

Core break at 1436cm.

ss 1495cm
pyrite, glass present

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

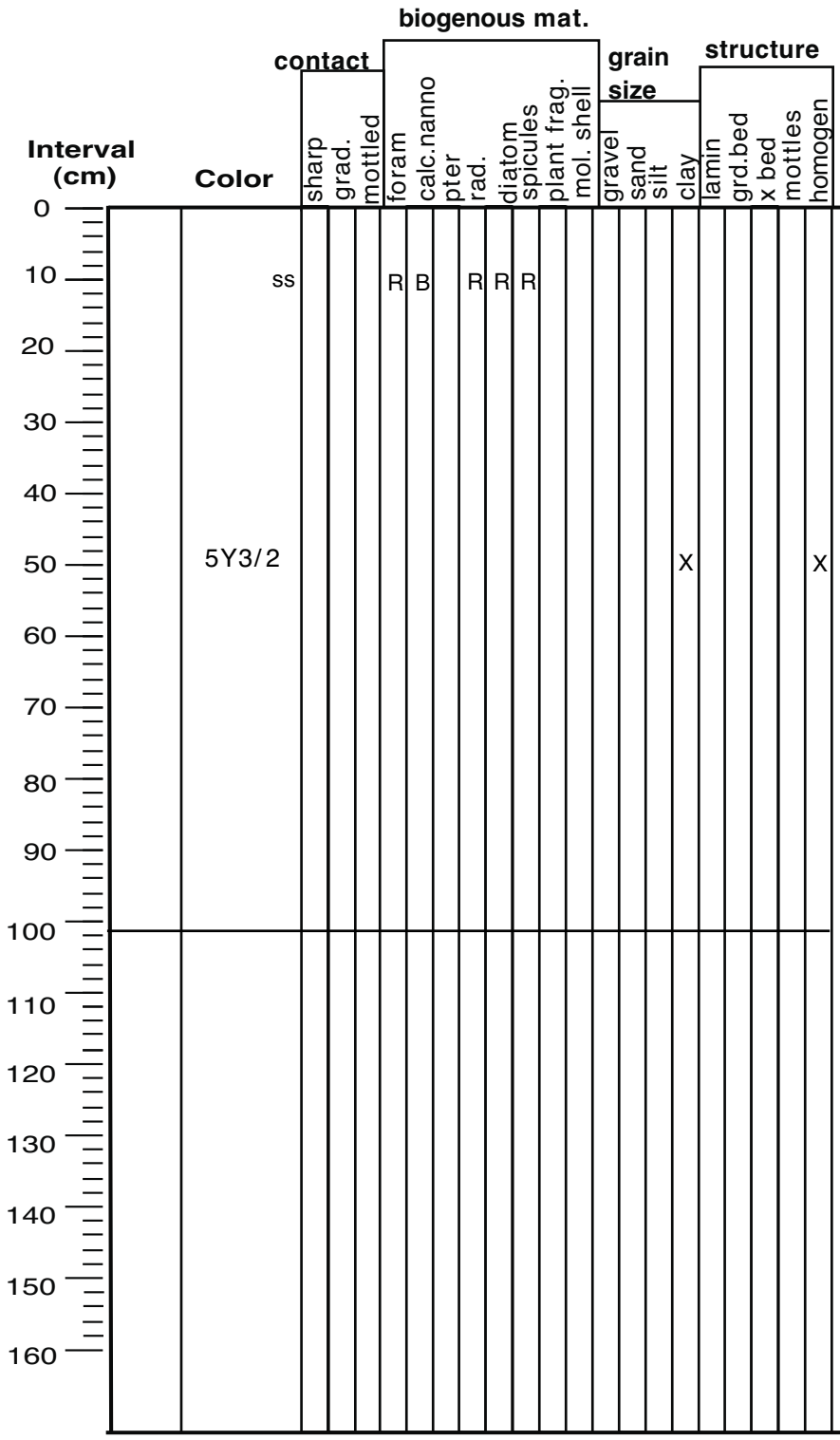
CORE ID ME0005A-44JC

SECTION 1 **of** 5

Lat. 8° 22.8' N

Long. 84° 0.95' W

Water Depth 2134M



Remarks

Date Open & Desc. 4/17/2001

Interval Depth 0-101cm

very soft core at top
some standing water

0-101cm
Dark olive gray (5Y3/2) clay with a few black streaks below 60cm

ss 10cm

Fossils: X-Present A-Abundant C-Common R-rare B-Barren

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

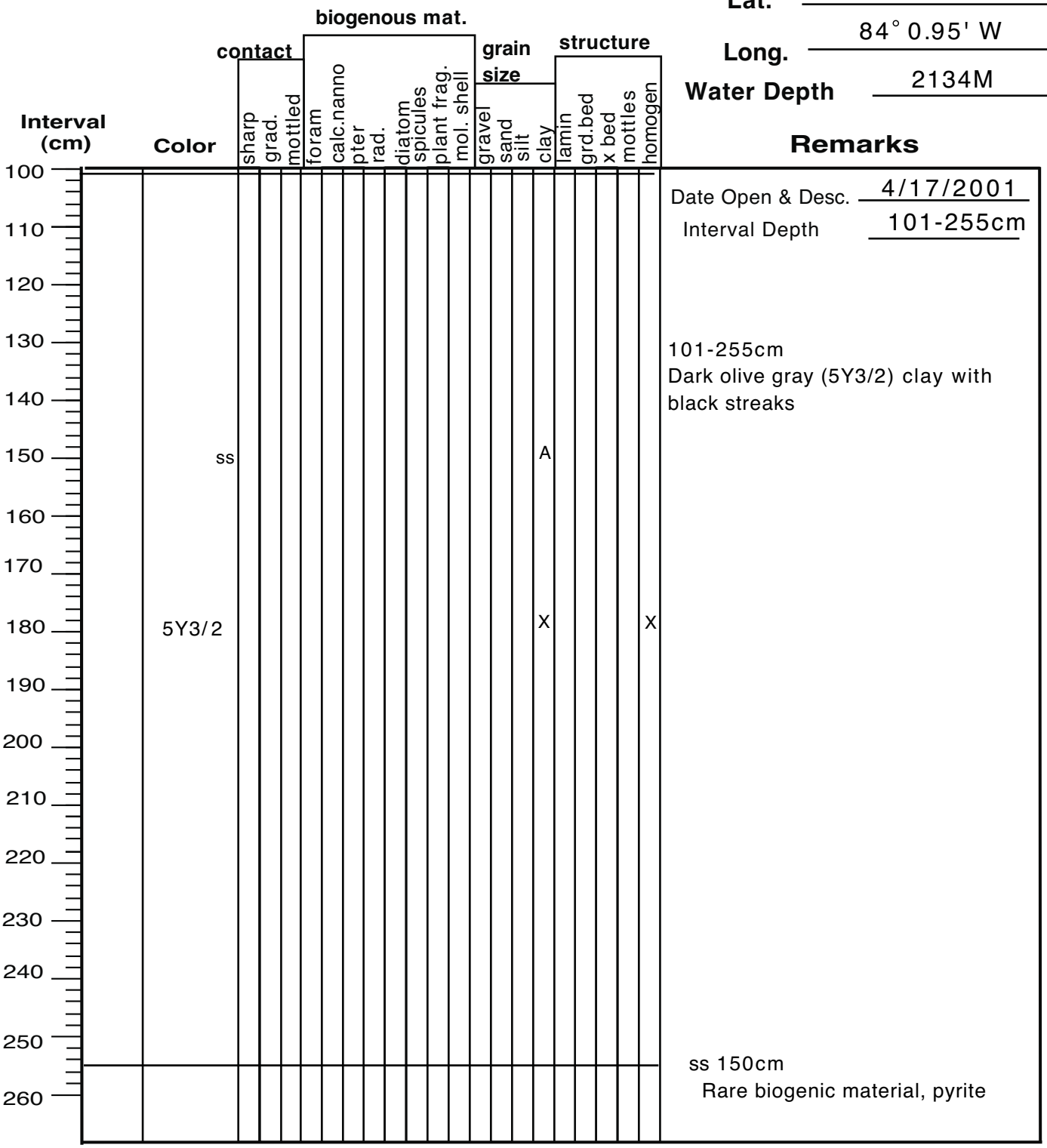
CORE ID ME0005A-44JC

SECTION 2 **of** 5

Lat. 8° 22.8' N

Long. 84° 0.95' W

Water Depth 2134M



Date Open & Desc. 4/17/2001

Interval Depth 101-255cm

101-255cm
Dark olive gray (5Y3/2) clay with black streaks

ss 150cm
Rare biogenic material, pyrite

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

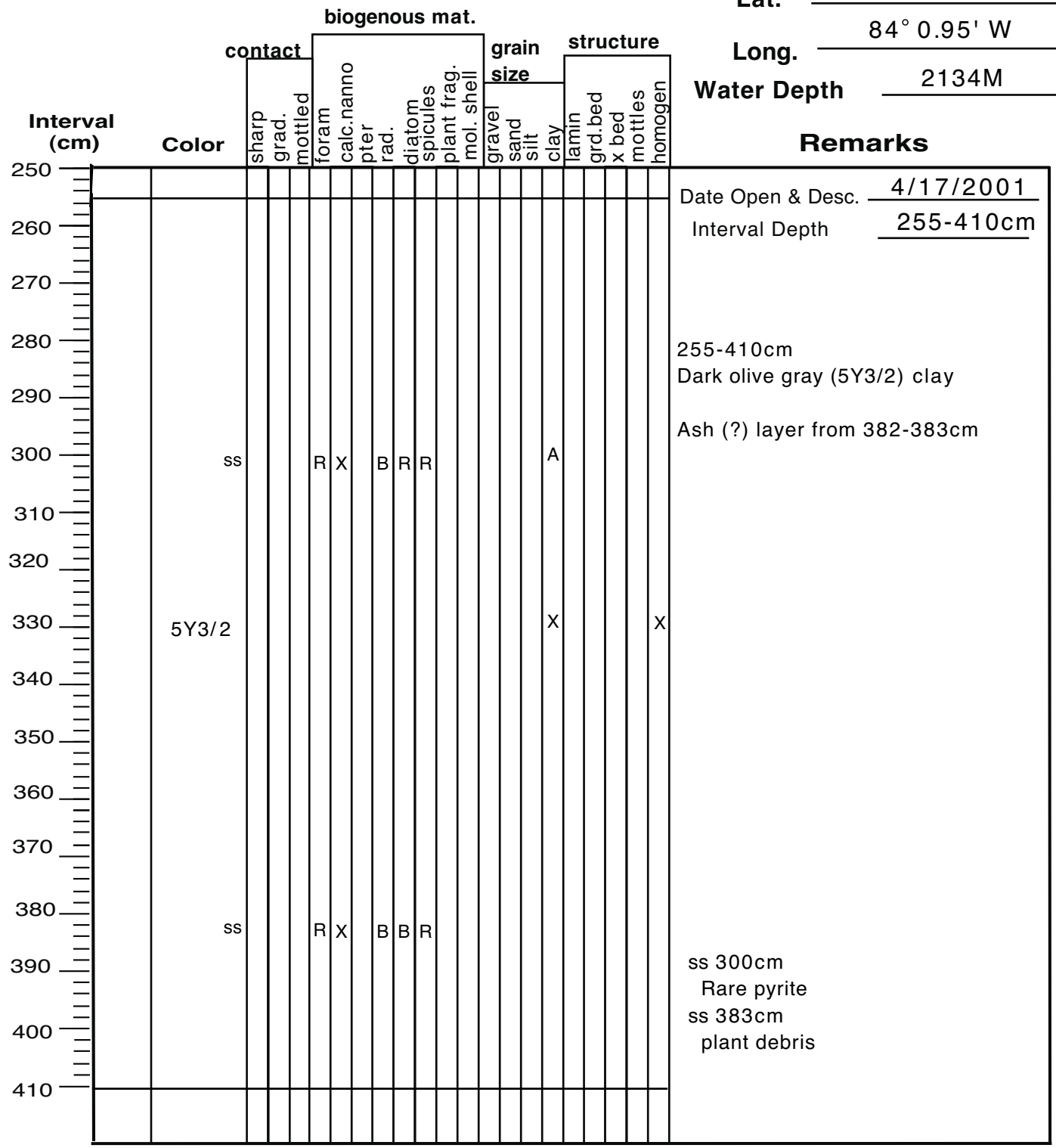
CORE ID ME0005A-44JC

SECTION 3 **of** 5

Lat. 8° 22.8' N

Long. 84° 0.95' W

Water Depth 2134M



Date Open & Desc. 4/17/2001

Interval Depth 255-410cm

255-410cm
Dark olive gray (5Y3/2) clay

Ash (?) layer from 382-383cm

ss 300cm
Rare pyrite
ss 383cm
plant debris

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

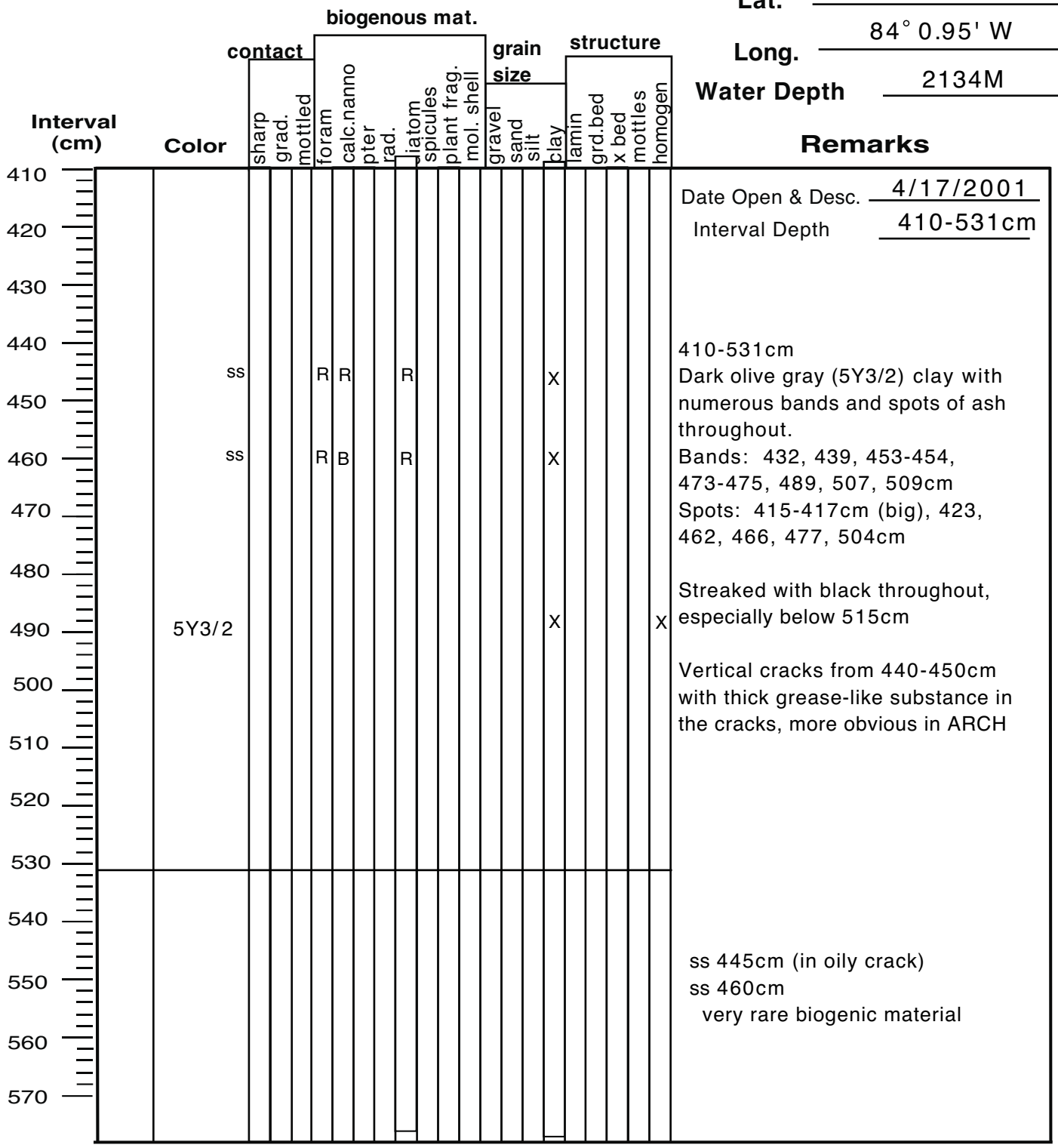
CORE ID ME0005A-44JC

SECTION 4 **of** 5

Lat. 8° 22.8' N

Long. 84° 0.95' W

Water Depth 2134M



Date Open & Desc. 4/17/2001

Interval Depth 410-531cm

410-531cm
Dark olive gray (5Y3/2) clay with numerous bands and spots of ash throughout.
Bands: 432, 439, 453-454, 473-475, 489, 507, 509cm
Spots: 415-417cm (big), 423, 462, 466, 477, 504cm

Streaked with black throughout, especially below 515cm

Vertical cracks from 440-450cm with thick grease-like substance in the cracks, more obvious in ARCH

ss 445cm (in oily crack)
ss 460cm
very rare biogenic material

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

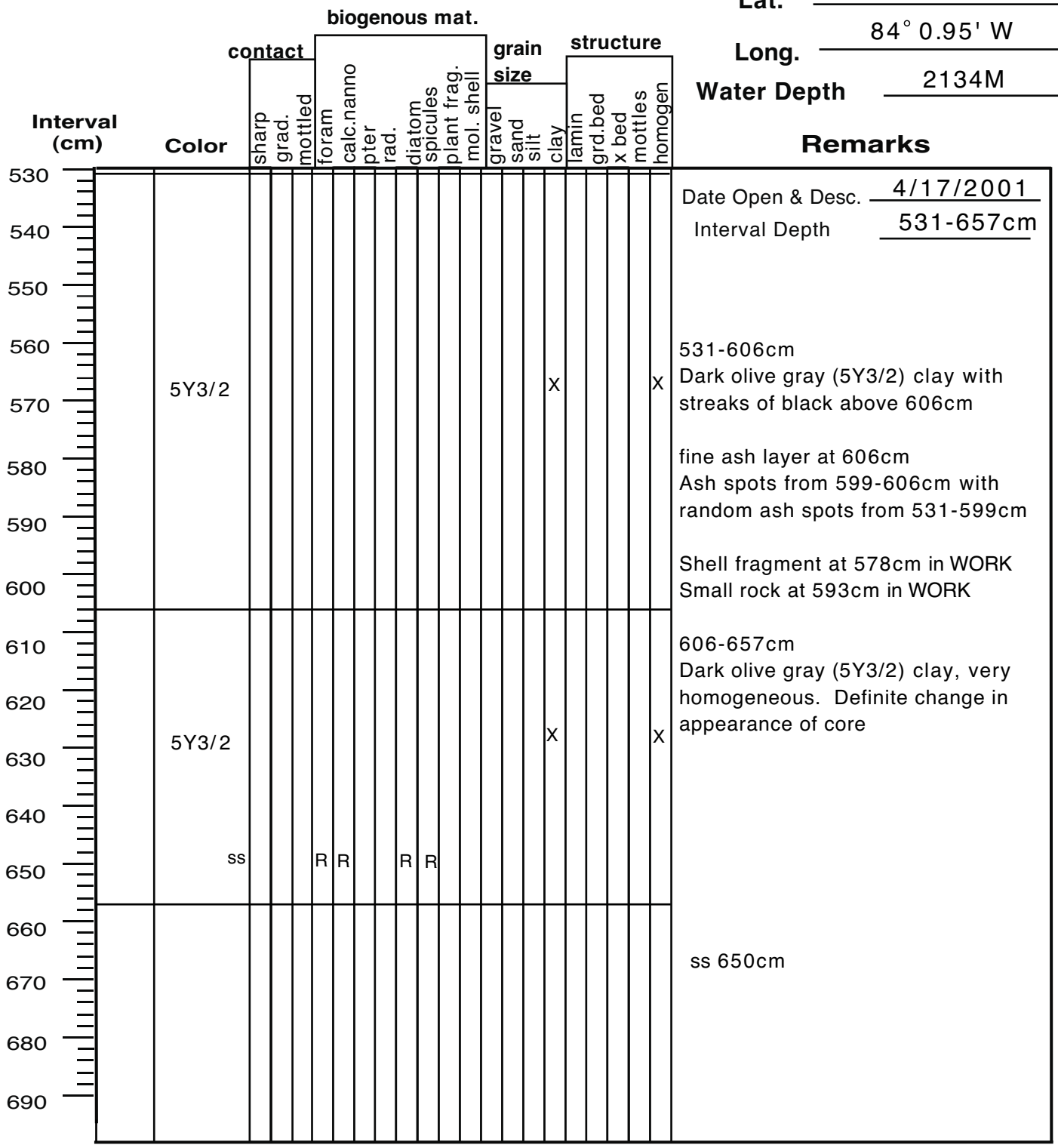
CORE ID ME0005A-44JC

SECTION 5 **of** 5

Lat. 8° 22.8' N

Long. 84° 0.95' W

Water Depth 2134M



Remarks

Date Open & Desc. 4/17/2001

Interval Depth 531-657cm

531-606cm
Dark olive gray (5Y3/2) clay with streaks of black above 606cm

fine ash layer at 606cm
Ash spots from 599-606cm with random ash spots from 531-599cm

Shell fragment at 578cm in WORK
Small rock at 593cm in WORK

606-657cm
Dark olive gray (5Y3/2) clay, very homogeneous. Definite change in appearance of core

ss 650cm

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

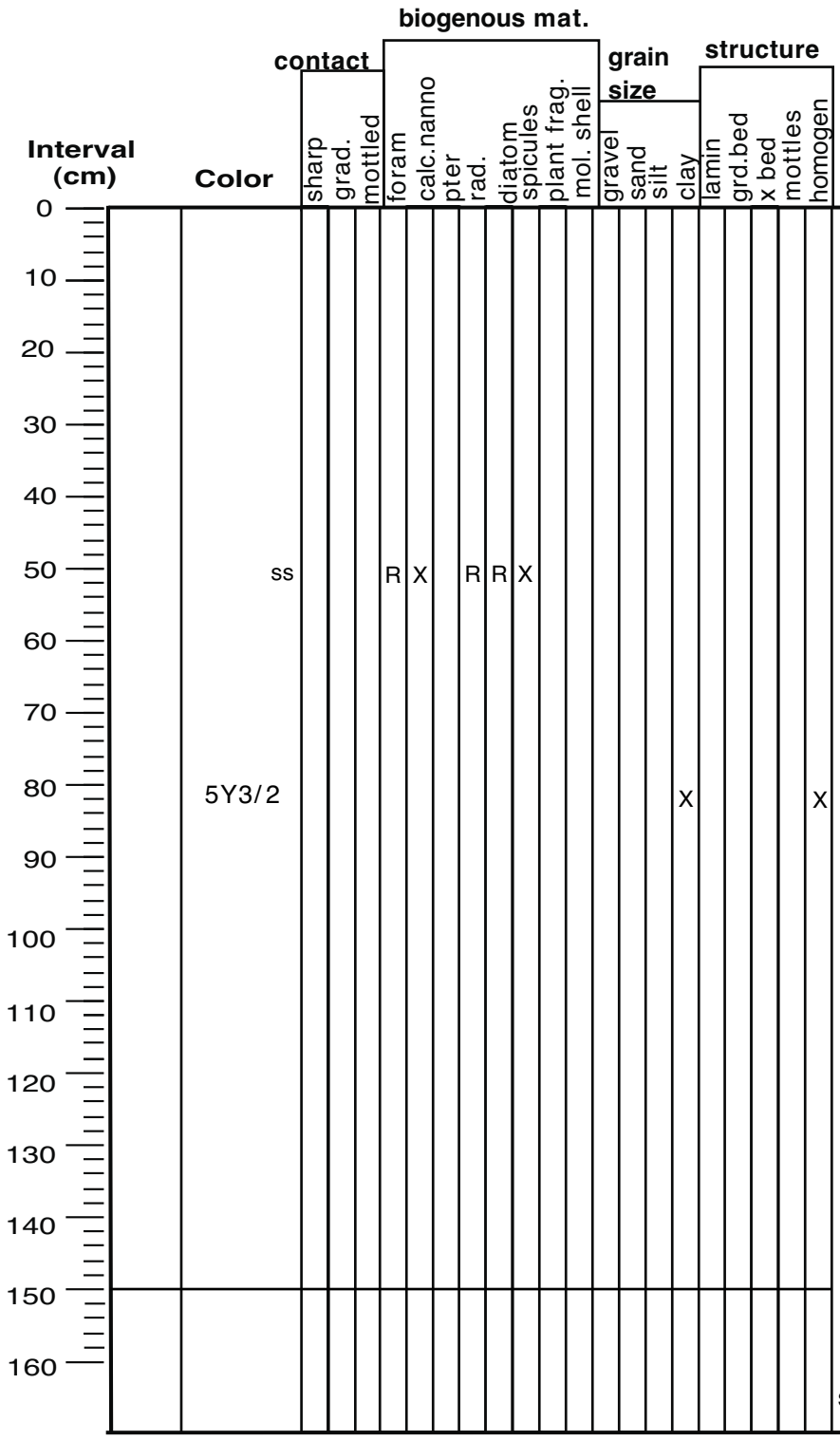
CORE ID ME0005A-44TC

SECTION 1 **of** 2

Lat. 8° 22.8' N

Long. 84° 0.95' W

Water Depth 2134M



Remarks

Date Open & Desc. 4/17/2001

Interval Depth 0-150cm

opened at sea 6/7/2000

very soft core
ARCH: 0-14cm disturbed; core doesn't fill tube. Break at 14cm

0-150cm
Dark olive gray (5Y3/2) clay

Mottles of olive (5Y4/3) from 53-62cm

Water pockets at 34, 51cm

In WORK half
Tiny shell fragments 42, 92, 95cm

Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

CORE LOG

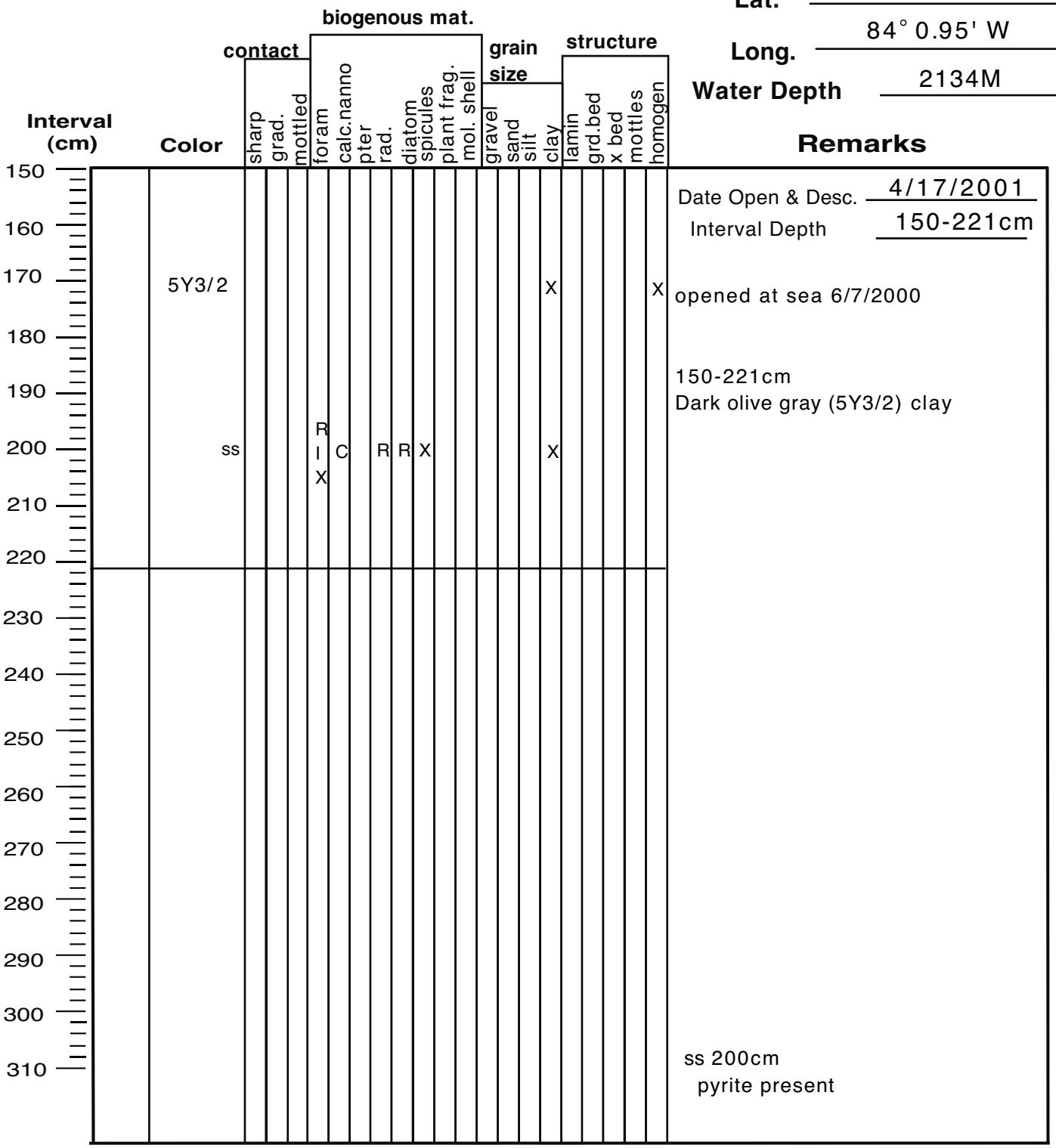
CORE ID ME0005A-44TC

SECTION 2 **of** 2

Lat. 8° 22.8' N

Long. 84° 0.95' W

Water Depth 2134M



Fossils: X-Present C-Common B-Barren
A-Abundant R-rare

Contacts: s-sharp; g-gradational; m-mottled

graded bed (turbidite)

ss-smear slide

Appendix D

NEMO-III
Cruise Prospectus

R/V Melville NEMO EXPEDITION, Leg III

Manzanillo Mexico to Puerto Caldera Costa Rica
15 May 2000 to 8 June 2000

Nicklas G. Pisias, Alan C. Mix, Chris Goldfinger
Oregon State University

Mitch Lyle
Boise State University

R/V MELVILLE NEMO-4 EXPEDITION
Manzanillo, Mexico to Punta Caldera, Costa Rica
SCIENTIFIC PROSPECTUS

Nicklas G. Pisias[1], Alan C. Mix[1], and Mitch Lyle[2]

[1]College of Oceanic and Atmospheric Sciences, Oceanography Administration Building 104, Oregon State University, Corvallis, OR 97331 USA

[2]Center for Geophysical Investigation of the Shallow Subsurface (CGISS), Boise State University, Boise Idaho..

Contact: Nick Pisias (Chief Scientist)
Phone: 503-737-5213, Fax: 503-737-2064,
Email: pisias@oce.orst.edu ,

8 May, 2000

OVERVIEW

This document provides a pre-cruise outline of shipboard operations, equipment, and logistics for the NEMO Expedition, Leg IV, a program to study sedimentary geology of the eastern equatorial Pacific off Mexico, Costa Rica and Ecuador. This cruise is scheduled to be at sea from 15 May (1600 hr) to 9 June 2000 (0800 hr), aboard *R/V Melville*, from Manzanillo Mexico to Punta Caldera Costa Rica. The program is built from a program, funded by NSF. This program (Pisias, Mix, and Lyle,PI's) consists of geophysical survey, piston coring, and multicoring in latitudinal and depth transects of sites off the Gulf of Tehuantepec Mexico, the Carnegie Ridge off Ecuador and on the Cocos Ridge off Costa Rica. The major scientific goals of this program are to obtain site survey information for future ODP drilling, to assess long-term variations in the strength and productivity of the eastern boundary current, and to record changes in the properties of deep and bottom water masses.

OPERATIONS

The primary field operations will be:

1) high-resolution bathymetric mapping using SEABEAM.
2) digital single-channel seismic reflection profiling.
3) high-resolution digital 3.5 kHz profiling.
4) Sediment coring (using piston- and multi-coring systems supplied by Oregon State University).

Most of the sites are located on bathymetric highs to avoid as much as possible terrigenous turbidites and tectonic complexities on the margin, but are close to the continents to maximize sedimentation rates in the zone of high productivity and hemipelagic sediment influx. One set of sites is on the Mexican margin in the Gulf of Tehuantepec.

The basic cruise plan, with 10 detailed survey areas, is outlined in **Table 1**, and illustrated in **Figure 1**. Site names follow current Ocean Drilling Program conventions, with a 3-letter location code (CAR = Carnegie Ridge, COC = Cocos Ridge) a sequential number within each area, and a letter (B here indicates our second iteration on each site, revising the locations noted in earlier documents submitted to the Ocean Drilling Program, C indicates the third iteration, and so on). Most survey areas will contain one station for coring

using both multicore and two piston core (i.e., there will usually be THREE cores in each survey area -- one multicores and two piston cores).

TABLE 1: Basic cruise plan, with 10 survey areas. Precise coring locations will be decided at sea based on detailed geophysical survey. Times allocated for survey and stations are estimates based on preliminary survey plans. The latitude and longitude given for each survey area Table 1 is approximate, for purposes of whole-cruise planning. The bridge staff will be given more detailed location information on way points. NOTE THAT SHORT TERM SCHEDULES AND WAY POINTS MAY CHANGE AT SHORT NOTICE, BASED ON WHAT WE OBSERVE ON THE SEA FLOOR, WEATHER, OR OTHER UNEXPECTED EVENTS. UPDATES WILL BE POSTED ON THE WHITE BOARD ON THE MAIN DECK.

Name	LAT Deg.	LAT Min.	LON Deg.	LON Min.	Water Depth	Speed (knts)	Dist. (nm)	Transit (hours)	Survey (hours)	Station (hours)	Cumul Days
Manzanillo, Mexico	19	12	-104	-12	na	--	0.0	0.0	0.0	0.0	0.00
Gulf of Tehuantepec	15	30.0	-95	0.0	400	11.0	571.6	52.0	40.0	36.0	5.33
Start COC-1	7	36.0	-84	-11.0	1000	11.0	792.6	72.1	0.0	0.0	8.33
COC-1	7	18.0	-84	-6.0	1000	11.0	18.7	1.7	40.0	24.0	11.07
Start CAR-1	0	-21.0	-82	-6.0	1200	11.0	474.3	43.1	0.0	0.0	12.87
CAR-1	0	-33.0	-81	-59.0	1200	11.0	13.9	1.3	40.0	24.0	15.59
Start CAR-2	-1	-33.0	-82	-57.0	2000	11.0	83.4	7.6	0.0	0.0	15.90
CAR-2	-1	-50.0	-82	-50.0	2000	11.0	18.4	1.7	40.0	24.0	18.64
Y69-108P	4	9.0	-85	-2.0	2500	11.0	382.5	34.8	7.0	8.0	20.71
Cocos Island Area	4	55.0	-87	-30.0	1000	11.0	154.5	14.0	6.0	7.0	21.84
Y71-3-4P	5	48.0	-84	-58.0	2500	11.0	160.3	14.6	7.0	8.0	23.07
Punta Caldera, Costa Rica	9	53.0	-84	-45.0	0	11.0	245.3	22.3	0.0	0.0	24.00

11.0	7.5	5.5	24.00
Days Trans.	Days Survey	Days Station	Days Total

The operational plan for most target areas will be to begin the survey with swath map, digital 3.5 kHz profiler, and digital single-channel seismic profiling, on a series of crossing lines. As the survey is progressing, the scientific party will choose coring sites for stations, based on the quality of sediment cover, water depth, and other considerations. Typical survey areas will contain two station locations, and the ship will move to these sites for coring first with multicore, and then at the same site with the piston core. Coring time estimates include time for setup and deployment of the multicore (MC), setup and deploying the piston core (PC), moving the ship to a secondary location in the survey area, and repeating the MC and PC coring operation. Estimated station times vary from area to area, because the calculation includes variable lowering times to the sea floor as a function of water depth.

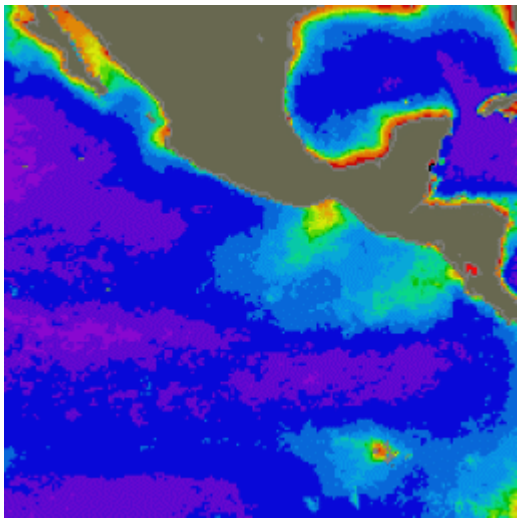


Figure 1

Note that many of the areas we will visit have little existing survey information available. Final survey turning points and coring sites will be determined at sea based on the detailed geophysical survey. This means that the shipboard party should expect schedule changes at sea. This is typical of survey/coring operations. We will plan to keep the SEABEAM system and 3.5 kHz profiler operating on the transit lines between all survey areas. On some transits we will also deploy single channel seismic gear, depending on time available.

SAFETY

The HIGHEST PRIORITY and PRIMARY RESPONSIBILITY of EVERY PERSON at sea will be SAFETY. SIO Res. Techs. will inform the scientific party about special procedures. A few comments here:

1) When working on the fantail, wear floating work vests (provided by the ship), and heavy boots at all times. Wear hard hats if any overhead gear might be used. If you don't have your own boots and hard hat, the OSU group is provided a selection for shared use. Don't work alone on the fantail at night or in heavy seas.

2) Much of the deck gear is heavy and can be dangerous. Don't be a hero - let cranes and hoists lift heavy gear. Don't put your hands or feet under gear that could crush them. Don't try to catch heavy falling objects. Watch your head. Watch your feet.

3) Wire is dangerous. Don't try to hold wire with bare hands - wear work gloves. Don't step in a bight or coil of wire - if it moves it can trap you.

4) Wire under tension is more dangerous. A snapped wire acts like a whip and can kill you. Whenever possible keep away from wire under tension. Especially critical times are during pullout of cores from the sea floor. This is when the large wire is under its greatest tension.

5) Crane and Winch directions and operations. If everyone is trying to direct operations with hand signals, the result is chaos and danger. Bob Wilson will direct deck operations, and will generally operate the cranes. The ONLY non-SIO scientist to give wire and winch direction hand signals will be Pete Kalk. Bob

Wilson and Pete Kalk will work out together the orchestration of winch and wire operations. SIO scientific staff and ship's crew will of course follow their standard practice.

6) Keep all gear secured, whether in the lab or on deck. Gear falling or sliding around on a moving ship is not good either for the gear or for you.

7). There is no such thing as a dumb question. We're all here to learn, and no one knows everything. If you're confused about anything, ask. If the answer contains ship jargon you don't understand, ask again.

SHIPBOARD EQUIPMENT

A) SEABEAM OPERATIONS

The purpose of SeaBeam swath mapping operations is to characterize bathymetry and sediment character in the survey areas, in order to optimize placement of coring sites and future drilling sites. Most of the sites comprise depth transects on bathymetric rises or the continental margin, thus determining regional bathymetry is critical. SeaBeam will be run during all survey operations and transits.

The surveys are designed to provide reasonably complete swath coverage of the survey areas, assuming the SeaBeam system will operate at its listed specifications:

150 degree swath in water depths to 1500 m
120 degree swath in water depths to 6000 m

This means that the SeaBeam system "sees" a swath width of about 3.5 to 7.5 times the water depth. The edges of the swath are less reliable than the center, so for surveying the spacing between lines will be approximately 2.5 times the water depth in deep water, and somewhat wider in shallow water.

Both bathymetry and backscatter imagery will be examined in real time. Recorded raw data will include depth cross track, and amplitude for each beam merged with navigation and sensor information. The scientific party will process the SeaBeam data to obtain cleaned and gridded, navigationally corrected bathymetry (in ASCII x,y,z), contour plots, and geometrically corrected side scan mosaics. The data will be archived on EXABYTE tape, CD-ROM, and in hard copy.

B) DIGITAL SINGLE-CHANNEL SEISMIC PROFILING

The purpose of the SCS program is to place potential drilling targets in a regional structural context, to ensure that the proposed drilling sites are most suitable for meeting the objectives outlined in the drilling proposal (reasonably continuous sedimentation, representative of regional oceanographic processes), and to ensure that the proposed drill sites are free from potential hazards. A secondary objective of the SCS program is to explore the potential of the seismic record as a paleoceanographic tool in its own right.

Resolution within the sedimentary section should be as high as possible, given the constraints of penetration. The system should be adjusted to increase sampling rate (and thus resolution) when deep penetration is not needed. Ideally the system should have a bandwidth on the order of 1 kHz; sampling rate should be variable but the system should certainly be capable of sampling at rates of at least 0.25 msec. Depth of the streamer array should be monitored (*e.g.*, depth transducer on array). The data will be acquired digitally and stored in standard SEG-Y format on EXABYTE tape and CD-ROM. Monitor records will assure data quality and facilitate real-time decision making. The scientific party plans to process seismic data on board using

SIOSEIS software. Calibration of the system will include a far-field recording of the outgoing seismic source characteristics (measured in the configuration used during the survey).

C) HIGH-RESOLUTION, DIGITAL 3.5 kHz PROFILING.

As with the SCS system, the 3.5 kHz system will be used to assure that the uppermost sediments at proposed drill and coring sites (and between drill sites) are suitable for the objectives of the drilling program, to understand the continuity of recent sedimentation between drill sites and to ensure that the proposed drill sites are free from potential hazards. The data will be recorded digitally at rates of at least 10 kHz per channel, and archived on EXABYTE tapes and CD-ROM in standard SEG-Y format. The scientific party plans to process the 35 kHz data on board, using SIOSEIS software.

D) SEDIMENT CORING AND OTHER DECK OPERATIONS

All deck operations will be under the guidance of one of the SIO Resident Technicians. Pete Kalk and Chris Moser will work closely together to guide the coring operations.

The goal of sediment coring on this cruise is to obtain 1) long continuous records of sediments that monitor climatic, oceanographic, and chemical changes in the region (via piston and gravity coring), and 2) high-quality samples of the sediment-water interface for purposes of modern calibration and process studies (via multicoring).

Coring deployment data will be recorded on OSU/NORCOR Repository data sheets. Core locations will be cross-referenced with NEMO Expedition Leg IV station numbers. Core names will be as follows:

ME0005B-xxYYzz,

where ME stands for Melvile, 0005B stands for the second cruise in the fifth month of 2000, xx stands for a sequential core lowering number, YY is the device type (PC=piston core, TC=trigger core, GC=gravity core, MC=multicore, NB=niskin bottle), and zz is the tube number for the multicore or the section number for the piston and gravity cores, or a bottle number for a niskin bottle (if two are deployed).

- A PC and TC lowered together have the same xx number, and all eight tubes on a MC have the same xx number.

- No MC and PC will have the same xx number, as by definition they are different lowerings.

- Core lowerings that come up empty will maintain their xx number, and the number will increment for the next core. This is because the data on the cause of an unsuccessful core are useful for future coring efforts.

Within each survey area, the order of operations, following completion of the survey, will be 1) move ship to primary station, 2) deploy multicore, 3) deploy large diameter piston core, 4) deploy long small diameter piston core, and 5) secure gear and depart area toward next survey area. This generic plan may be modified based on time available, flow of materials through the lab, or special needs for less or more coring in some areas. Details of these operations follow:

1) Multicoring, using 9/16" wire terminated with Fiege fitting. Lift weight of the Multicore system on the deck is about 2000 lb. The OSU multicore system will have one or two Niskin-type bottle**s** mounted on its frame, to obtain a bottom water sample near the sea floor. The bottle will be triggered by the core landing.

Multicore operations will use the aft "A"-frame. The multicore will be launched over the stern. Typical rates of lowering to the sea floor are 50 m/min. Approach to the seafloor is monitored with a pinger system. During recovery the multicore is lifted over the starboard rail and is secured on near the starboard side on the fantail, forward of the crane base and crutch. After the multicore system is secure on deck, the trawl wire will be moved from the multicore, and while the mud-full sections of the multicore are being moved into the lab for processing, final rigging of the piston core will occur.

2) Piston Coring: For operations, piston core gear will be mounted along the starboard rail. The rotating "bucket" cradle for the piston core weightstand is mounted under the starbord "A"-frame. The "A"-frame has been moved to allow at least 70 feet of core pipe mounted horizontally forward of the weightstand. The system will be deployed using the "A"-frame and the OSU Hiab crane to launch the trigger core. Typical lowering speeds will be 60 m/min. Approach to the seafloor is monitored with a pinger system. Triggering and pullout is best monitored with an analog tensiometer. Typical pullout tensions for long piston cores in deep water are 20,000 - 24,000 lb. At this time the wire is most dangerous. Please be award of your location on deck during this operation (better yet, go inside). On recovery of the piston core gear, rotating the core barrel from vertical to horizontal and placement onto outboard core racks will require one or two lift points along the starboard rail, with load limits of less than 1500 lb. each.

3) Trigger/Gravity Core: This core (deployed with the piston core if a trigger core) will be landed on the fantail vertically, after separation from the weightstand. It will be moved vertically to a lashing point near the lab, where water will be siphoned off the mud and the liner will be cut and capped at top and bottom. After capping, the core can be moved to horizontal position, where it is cut into sections if necessary, capped, and moved into the lab for further processing.

4) Piston Core Liner Extrusion: The OSU Piston Core Extruder System an air-driven cylinder to drive rods that push full 20-ft PVC core liners out the catcher end of the piston core. As the core liners are extruded, they are cut and capped at ~150 cm intervals, labeled and then moved to holding barrels in the lab. The top section of piston core liner sometimes has the piston and wire still in place, and thus extra care is taken when cutting the final (top) section. Core sections are numbered sequentially from the bottom (section 1) to the top. This is because the sections from the bottom of the core are extruded first, and the sections are labeled immediately as they are extruded. The process of extracting all the core sections from the piston core typically takes about one hour, and if weather conditions permit we will get underway to the next station while this process is occurring.

5) Surface Water Sampling: An ancillary activity, requested by the UBC group is to sample surface waters using a bucket, to be coordinated with the daily XBT launches by the SeaBeam calibration. A designated member of the scientific party will coordinate this activity with the SeaBeam technician, if necessary will communicate with the bridge to slow the ship briefly for the bucket sampling.

E) LABORATORY OPERATIONS

1) Barrels and Racks for staging into the lab: After recovery, piston, trigger, and gravity core sections will be stored temporarily, resting vertically in a rack aft in the main lab, or in steel barrels near the core splitter (one for labeled, scribed core sections recorded on the repository data sheet and ready to analyze by MSCL, one for cores ready to split). Recovered multicore tubes will be stored temporarily on a rack in the "hanger" lab. When the cores to be split and analyzed first enter the lab, permanent labels are scribed onto the liners. Any trimming of liner ends (rarely but sometimes needed) will be done at this time, and final core lengths assigned and recorded.

2) Core Splitting. Following labeling and recording of core recovery cores will be split for detailed analysis, using the OSU core splitter. This splitter uses vibrating saws for maximum safety (they won't cut your hand), narrow kerf cut, and easy chip cleanup.

3) Split-core analysis track. Archive-halves of split cores will be analyzed in the OSU MSCL van. The primary measurement on split cores will be gamma attenuation (sediment density), magnetic susceptibility and P-wave velocity. Note the gamma attenuation uses a radiation source and only authorized personnel can be in the MSCL van during operations.

4) Visual Core Descriptions: Work-halves of split cores will be described visually, using standard core describing procedures, which will include occasional analysis of smear slides or sieving for microscopic analysis of coarse components.

5) Working Core Halves of piston and gravity cores will go to the sampling table. A sampling plan will be decided prior to each coring site.

6) Multicore processing: The Multicore system will be deployed with eight core tubes and one or two water bottles. On recovery, the eight core tubes will be removed and placed on a rack in the "hangar" lab. Four multicores will go to the cold room as soon as possible, and be processed immediately for analysis of sediment pore waters by the chemistry group. Water samples will be taken from the Niskin bottle and/or the core tubes for chemical analysis as soon as the multicorer is secured on deck. The four remaining multicore tubes will be siphoned to remove water, cut to the length of the mud, capped, labeled, and processed similar to the PC and TC cores (MST/SCAT, split, described, archived, and stored). One of these four, will have the top two cm removed by the geochemistry group and bottled in buffered formalin, for purposes of preserving and later staining live benthic foraminifera.

7) Core Storage: Following splitting, describing, non-intrusive analysis, and, cores will be stored in plastic "D" tubes, temporarily in a metal rack supplied by OSU, and permanently in reinforced cardboard boxes to be stacked in the OSU Refrigerated van. In most cases, archive and working halves of cores will be in different D-tubes, but for short core sections (such as the MC cores and others as needed) both the archive and working halves will be in the same D-tube. Cores will be shipped to the OSU/NORCOR marine geology repository in the OSU refrigerated van, for further study and permanent storage. Refrigeration will be maintained throughout the cruise and during shipping.

G) PORT OPERATIONS - LOADING AND UNLOADING.

Almost all gear was either sent airfreight or shipped to Manaznillo. Most other gear from the scientific party is being brought as luggage. Thus, the first task in Manzanillo will be to load all gear and the two 20'vans (MSCL lab van and refrigeration van). Because R/V Melville is returning to San Diego soon after our cruise, we will plan to leave most gear on the ship in Punta Caldera, packed and ready to remove, stored out of the way of the next scientific party. A representative of the OSU group will meet the ship in San Diego to facilitate shipment of OSU materials to Oregon. Other scientific participants will make their own arrangements. We arrive in Costa Rica on the 9th of June and have two days to secure all equipment before the next scientific party can start loading. We can stay on the ship until the morning of the 12th of June.

PERSONNEL AND RESPONSIBILITIES:

The chief scientist and primary contact person for this cruise will be Dr. Nick Pisias at Oregon State University. Co-chief scientists for this cruise will be Dr. Alan Mix at Oregon State University, and Dr. Mitch Lyle ad Boise State University. Pisias will be responsible for program coordination and detailed

cruise plans, and for archiving and analyzing the sediment cores in the lab. Mix will take primary responsibility for the coring facility, including OSU coring technician Pete Kalk and deployment of coring gear in cooperation with SIO personnel. Lyle will take primary responsibility for all geophysics. Seismic and SeaBeam operations are subcontracted to Scripps Institution of Oceanography. Dr. Chris Goldfinger will be responsible for all SeaBeam processing and interpretation.

Participant List for R/V Melville Cruise to Eastern Equatorial Pacific (Gulf of Tehuantepec, Cocos and Carnegie Ridges)

	Participant Name	Sex	Shift	Deck	Lab	Watch	Room	Position	Institution
1	Nicklas G. Pisias	M	1				02-41-2	co-Chief Scientist	Oregon State Univ.
2	Alan C. Mix	M	2				01-33-1	co-Chief Scientist	OSU
3	Mitchell Lyle	M	B	SEIS	SEIS		01-28-1	co-PI	Boise State Univ.
4	Chris Goldfinger	M	A	SEAB	SEAB		01-28-1	co-PI	OSU
5	Lee Liberty	M	A	SEIS	SEIS		2-79-1	Research Assoc. Tech.	Boise State Univ. (BSU)
6	Aleksandra Janik	F	B	SEIS	SEIS	1	2-55-2	Graduate Student	Univ. Miami
7	Peter Kalk	M	A	CORE	-	-	2-72-1	Research Assoc. Tech.	OSU
8	Chris Moser	M	B	CORE			2-72-1	Research Assoc. Tech.	OSU
9	Maziet Cheseby	F	A	MSCL	DP	2	2-45-4	Research Assoc. Tech	OSU
10	Mysti Weber	F	B	MC	CD	3	01-29-0	Research Assoc. Tech	OSU
11	Adolfo Molina-Cruz	M	A	MC	MC		2-84-2	Professor	UNAM Mexico City
12	Stacy Kish	F	B	MSCL	CD	1	2-45-4	Graduate Student	OSU
13	Nicklas J. Pisias	M	B*	MSCL	DP		2-89-2	MST Technician	OSU/Univ. Puget Sound
14	Melissa Feldberg	F	B	MSCL	CD	2	2-38-2	Graduate Student	OSU
15	Heather Benway	F	A	H2O/MC	CD	4	2-38-2	Graduate Student	OSU
16	Brit Perlet	F	A	MC.	Chem.	3	2-55-2	Graduate Student	Univ. South Carolina
17	Elizabeth Kujawinski	F	B	MC.	Chem	1	2-72-2	Graduate Student	Woods Hole Ocean. Int.
18	Stephanie Kienast	F	A	H2O/MC	CD	4	2-62-2	Graduate Student	Univ. British Columbia
19	Tara Ivanochko	F	B	PC	CD	2	2-62-2	Graduate Student	Univ. British Columbia
20	Peter Eiler	M	1	MC			01-33-1	Professor	Willamette University
21	Anthony Hager	M	A*	MC		2	2-84-3	Undergraduate Student	Willamette Univ.

22	Kenji Wright	M	B*	MC		4	2-84-3	Undergraduate Student	Willamette Univ.
23	Jennifer Taylor	F	A*	PC		1	2-72-2	Undergraduate Student	Willamette Univ.
24	Natalie Speck	F	B*	PC		3	2-79-2	Undergraduate Student	Calif. Lutheran Univ.
25	Ignacio Martinez	M	A	PC	CD		2-89-2	Professor	Univ. EAFIT Columbia.
26	Ligia L. Perez-Cruz	F	A	PC		3	2-79-2	Graduate Student	UNAM
27	Carlos Gutierrez	M	B	SEIS	SEAB		2-84-2	Professor	UNAM
28	Steve Hovan	M	B	PC	CD		2-79-1	Professor	UIP
29	David Hulett	M	A	SEIS	SEIS	4	2-84-3	Student	BSU
30	Gene Pillard	M	C				2-50-2	Res. Tech.	SIO
31	Shad Baiz	M	C				2-50-2	Res. Tech.	SIO
32	Seth Mogk	M	C				2-67-2	Seismic Tech.	SIO
33		M	C				2-67-2	Computer Tech	SIO
34	Cadet	F					1-52-2		
35	Cadet	F	C				1-52-2		

Task Codes: Chem = bottom water sampling and live benthic foram staining and archival, CORE = Coring technicians, DP = core track data processing, MC = multicore (deck,=rigging and deployment, lab = processing), MSCL = multi-sensor core logger operations, PC = piston coring, CD = core descriptions and processing, SEAB=seabeam data processing and visualization, SEIS = siesmic system (deck = deployment, lab = data processing

Shift 1 = 0600 - 1800
Shift 2 = 1800 - 0600
Shift A = 0000 - 1200
Shift B = 1200 - 2400
* Required to take three one hour breaks during each shift.
Under Watches: A1 = 0000 - 0300
A2 = 0300 - 0600
A3 = 0600 - 0900
A4 = 0900 - 1200

B1 = 1200 - 1500
B2 = 1500 - 1800

B3 = 1800 - 2100
B4 = 2100 - 2400

Everyone from the non-SIO shipboard scientific party will stand an underway watch for four hours each day. The only exception is Pete Kalk and Chris Moser, who is responsible for coring on a 24-hr basis. Watch standers monitor the recording instruments, keep track of positions and times to next operations, wake up people as needed, and log scientific operations. Typically three or four people are assigned to each watch, and typically only two people are needed each time. This is done for flexibility, so that if someone is busy with lab work they can trade with their watch partners to make sure the watch is covered. Each watch team can work out among themselves how to manage these assignments fairly. The first person listed on each watch is the watch leader, and will hold primary responsibility for making sure the watch is covered.

OPERATIONAL LOGS -- A program will be available on the SUN workstations for logging events, with time, location, and comments. This is very important to keep track of what happened when, station numbers and locations, core numbers, problems needing attention by future watches, etc. It is better to have too many notes in the log than too few, as it can be very confusing to reconstruct events in the cruise without these notes. Generally the watchstanders will do most of the logging, but the log is available from any workstation, and events in the lab or elsewhere can be logged by anyone at any time. The computer staff will provide instructions on the logging program.

Appendicies:

BENTHIC FORAM SAMPLE PROCESSING

Note that samples should be processed as soon as possible after core comes up.

1. Prepare in advance 125cc Nalgene sample bottles by wrapping yellow tape around middle of each one, ready for labeling. Make sure that the yellow tape overlaps itself.

2. Any standing water should be siphoned from the top of the multicore before it is extruded.

3. Using white plug and gray piping to create a plunger, the sediment should be carefully extruded. Sample at half centimeter intervals from 0-6cm, and then at one centimeter intervals from 6-12cm. The half-centimeter or one-centimeter spacer ring should be placed on top of multicore tube and the sediment slowly extruded until it has reached the top of the spacer ring. Then the plastic plate should be slipped below the spacer ring to separate the sample. Using a spatula, the mud sample can then be scraped off the plate into a prepared sample bottle. A funnel might be useful here since the mouth of the sample bottle is fairly narrow. Don't overfill the sample bottle.

4. Label bottle clearly with core name and depth interval. Label format should be as follows:
   e.g. ME0005-1MC8 0-0.5cm
   (ship = ME year = 00 month = 05 station = 1 device = MC tube = 8 depth = 0-0.5cm)

5. Make sure spacer ring, plate, funnel and spatulas are washed before the next interval of sediment is extruded.

6. When the sampling has been completed , the remainder of the core should be extruded in 4cm intervals and stored in Ziploc bags and labeled accordingly.

7. When the extrusion process has been completed, the bottled samples should be taken to the lab immediately for further processing. There are bottle crates available so that the samples can easily be carried together.

8. Working in the hood and wearing gloves, pour the formalin solution into the carboy. Add enough formalin solution to the sample bottle to cover the sediment. (approx 0.5cm above sediment is adequate). Close lid tightly and shake bottle so that solution mixes with the sediment. Secure tape around cap of bottle and place in Ziploc bag.

9. Samples should then be stored together in black plastic garbage bag and placed in cooler.

Water Sampling
Melville Cruise
May to June 2000

Surface Sea Water

Four 30ml sample bottles are to be filled for each surface sea water Niskin deployment. Two of these will be poisoned with HgCl, and will be analyzed for 13C of the inorganic carbon. One sample bottle is filled for Salinity, and one filled for 18O analysis of the water.

The labels should be labeled as follows:

SSW-(station number) 13C A POISON
SSW-(station number) 13C B POISON
SSW-(station number) 18O
SSW-(station number) SAL

Multicore Bottom Water

Use the same sampling scheme as above. The labels for these samples will be:

MBW-(station number) 13C A POISON
MBW-(station number) 13C B POISON
MBW-(station number) 18O
MBW-(station number) SAL

Collection Procedure

(Same for Multicore and Surface Water Niskins)

A. One hour before Samples are on deck
- Plug in Beeswax pot
- Prepare sample labels

B. ASAP after Samples are on Deck
- Fit collection tube over nipple of Nisksin
- Open vent valve of Niskin
- Push in collection valve and regulate for a steady low-volume flow rate
- Allow 100-200 ml to flush through tube
- Continue the flow, and begin filling each of the four samples bottles. Fill and dump each bottle twice before filling for the final sample.
- Fill from the bottom on the last fill, and withdraw the fill tube slowly, allowing a meniscus to form on the top.
- Cap immediately with the Septa-seal cap

- Order of sample collection:
  - 13C A
  - 13C B
  - Salinity
    - 18O
- Continue until all samples are collected.
- Take samples into the lab for poisoning

C. Mercury Poisoning
- Separate out the two 13C sample bottles
- MAKE SURE YOU ARE POISIONING THE CORRECT BOTTLES
- PUT ON GLOVES!
- Remove the stock solution of HgCl from the Styrofoam container
- Remove a syringe from the box inside the zip-lock bag
- Invert the stock solution of HgCl, insert the syringe into the septa and withdraw 15 units, (150 ul) , then depress plunger back to 10 units while still inside the stock solution. This should clear any air bubbles from the tip of the syringe.
- Inject 5 units (50 ul) into each of the sample bottles through the septa.
- Return the syringe into the box inside the zip-lock bag
- Use a Kimwipe to remove any water drops that form on the top of the sample bottles. Dispose of this Kimwipe in a labeled containment bag.
- Return the stock solution of HgCl to its Styrofoam container
- Use Kimwipes to absorb any drops or spills of HgCl solution, and place them in the containment bag. Rinse area with water and use paper towel to absorb all liquid. Place towel in containment bag.

D. Sealing the Sample Bottles in Beeswax
- Rinse the outside of all sample bottles with fresh water, and wipe dry with a paper towel
- Dip the cap end of each bottle into the hot beeswax to build up a seal around the top and edge of the cap.
- Place sealed sample bottles in the cooler (do not freeze).

E. Post Collection
- Rinse Collection tube with ships fresh water and store in zip-lock bag.
- Unplug Beeswax pot